INNOVATIVE DESIGN. **CLASSIC RESULTS.**

MASTER DEVELOPMENT DRAINAGE PLAN AMENDMENT AND PRELIMINARY DRAINAGE REPORT FOR FOREST LAKES (FILINGS 5, 6, & 7) EL PASO COUNTY, COLORADO

November 2018

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Job no. 1175.21

PCD File No. PUDSP181

MASTER DEVELOPMENT DRAINAGE PLAN AMENDMENT AND PRELIMINARY DRAINAGE REPORT FOR FOREST LAKES (FIL. 5, 6, & 7)

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 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.

_____ _____

Kyle R Campbell, Colorado P.E. #29794 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: Forest Lakes Residential Development, LLC

By: _____

Title: _____

Address: 6385 Corporate Drive, Suite 200

Colorado Springs, CO 80919

EL PASO COUNTY ONLY:

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

_____ _____

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

CLASSIC CONSULTING ENGINEERS & SURVEYORS

MASTER DEVELOPMENT DRAINAGE PLAN AMENDMENT AND PRELIMINARY DRAINAGE REPORT FOR FOREST LAKES (FIL. 5, 6, & 7)

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MASTER DEVELOPMENT DRAINAGE PLAN AMENDMENT AND PRELIMINARY DRAINAGE REPORT FOR FOREST LAKES (FIL. 5, 6, & 7)

PURPOSE

This document is the Master Development Drainage Plan Amendment and Preliminary Drainage Report for Forest Lakes (Filings 5, 6, & 7). The purpose of this report is to identify general onsite and offsite drainage patterns, storm sewer corridors and areas tributary to the site, and to safely route developed storm water runoff to adequate treatment and outfall facilities. Based upon the revisions to the Filings 5, 6, & 7 site layout. The proposed Filings 5, 6, & 7 development shall be in adherence to the El Paso County approved Master Development Drainage Plan for Forest Lakes as well as current County Drainage Criteria.

PROJECT DESCRIPTION

The Forest Lakes development is a phased master planned community located in northern El Paso County, Colorado. The master planned land includes areas of open space, residential, trails, drainage, preservation and two water supply reservoirs. The property lies to the east of Pike National Forest, north of the United States Air Force Academy, west of Interstate 25 and south of the Town of Monument. The Forest Lakes property is located in portions of Sections 27, 28, 29 and 33 of Township 11 South, Range 67 West of the Sixth Principal Meridian and covers approximately 900 acres. The proposed amendment area (Filings 5, 6, & 7) is the far westerly area east of Filing 1 and is comprised of 287 acres. Watersheds that impact the Filings 5, 6, & 7 property include Beaver Creek, Hell Creek and North Beaver Creek. These watersheds are tributary to Monument Creek. Monument Creek itself passes along the eastern boundary of the overall Forest Lakes property in a north to south direction. The purpose of the amended Master Development Drainage Plan analysis is to provide existing and updated developed peak flow data for the 5-year and 100-year recurrence intervals within the Filings 5, 6, & 7 portion of the property. This information has been used to develop overall drainage design information and to identify the required storm drainage and flood control facilities within the Filings 5, 6, & 7 property. The vicinity map for the Filings 5, 6, & 7 Amendment area is presented in the Appendix of this report.

The initial approved Master Development Drainage Plan titled, "Forest Lakes Master Development Drainage Plan", was approved by Kiowa Engineering Corporation and dated April 11, 2002. The following is an excerpt from that report:

> "The hydrology analysis for the initially approved Forest Lakes Master Development Drainage Plan was completed in three phases. The first phase is a regional hydrologic analysis. The regional hydrology model uses an elliptical rainfall distribution patterns based upon Hydromet 52. The regional analysis was conducted in order to assess the development's overall impact upon peak

discharges within Monument Creek as it passes in Forest Lakes development. The hydrology development in the Monument Creek Drainage Basin Planning Study (DBPS) was utilized as a basis for the regional analysis. The existing and developed basin hydrologic conditions were analyzed. The second phase was a localized hydrologic analysis that focused upon determining the peak discharges along the major drainageways within the property. For this phase, a Type II storm pattern was assumed over the drainage basins associated with the Forest Lakes development. This analysis was developed in order to provide information in use in modeling floodplains and sizing of major drainageway facilities. The third phase was an on-site developed condition hydrologic analysis, using the Rational Method to determine the peak flows within the property to size and locate on site hydraulic structures."

For this Filings 5, 6, & 7 Amendment, detailed analysis of initial/local systems will be deferred to the future final drainage reports when platting is proposed.

Presented on Exhibit A (map from initial MDDP in appendix) is information for the major sub-watershed information that impact the Forest Lakes property, including Hell Creek, Beaver Creek and North Beaver Creek. The sub-watersheds shown on Exhibit A were used in the hydrologic analysis for the regional and localized hydrologic analysis described above. Beaver Creek courses through the center of the Forest Lakes Development from west to east. The most significant feature within the Beaver Creek watershed is Bristlecone Lake and Pinon Lake which are not affected by this Filings 5, 6, & 7 Amendment. These lakes and their embankments were constructed in 1986 as water supply reservoirs.

The site is located within the Beaver Creek Drainage Basin.

PREVIOUS REPORTS

Several studies were reviewed in the preparation of the initial Master Development Drainage Plan and this Filings 5, 6, & 7 Amendment. These studies include:

1. Master Plan Level Geologic Hazards Evaluation and Preliminary Geotechnical Investigation, Forest Lakes Master Development Plan, prepared by CTL/Thompson, Inc. dated July 31, 2001.
2. Forest Lakes Master Development Drainage Plan, prepared by Kiowa Engineering Corporation dated April 11, 2002.
3. City of Colorado Springs and El Paso County Flood Insurance Study, prepared by Federal Emergency Management Agency, dated Marcy 1997.

4. City of Colorado Springs Drainage Criteria Manual Volume 1, May 2014.
5. Drainage Criteria Manual (Volume 3) latest revision April 2008, Urban Drainage and Flood Criteria District.
6. Baseline Hydrology Study, Monument Creek Drainage Basin Planning Study, prepared by CH2M Hill, Inc. and Kiowa Engineering Corporation dated May 1992.
7. Forest Lakes Master Drainage Plan and Phase 1 Drainage Report, prepared by KKBNA, Inc. dated November 1986.
8. Procedures for Determining Peak Flows in Colorado, Incorporates and Supplements Technical Release No. 55, prepared by Soil Conservation Service, dated March 1980.

The Forest Lakes Master Development Drainage Plan (MDDP) dated November 1986, was prepared as a part of the planning for the property which originally began in 1986. This MDDP (1986) was prepared using the City/County drainage criteria that were in affect at the time. Peak flow data was developed for the watersheds that pass through the property. Drainageway improvements, detention basin plans and roadway crossing sizes were developed for the proposed development condition for the initially developed areas.

SOILS AND GEOLOGY

Soils within the watersheds that are tributary to the Forest Lakes property vary between soil types A through D, as identified by the U.S. Department of Agriculture, Soil Conservation Service. Soils are classified in hydrologic groups A, B, C, and D according to their infiltration capacity. Type D soils are dominant in the forested areas west of Monument Creek. These soils are generally associated with the Pikes Peak Granite found in the region. This is particularly true for the forested portion of the Beaver Creek watershed. The decomposed granite soils exhibit extremely high rates of runoff and are very susceptible to erosion and sedimentation. Hydrologic Soils Group A soils consist chiefly of well-drained sand and gravel and have a low runoff potential. The soils within the Forest Lakes property are predominantly soil type B. See Appendix for additional information.

DRAINAGE CRITERIA

The hydrology for the major sub-watersheds (i.e., Beaver Creek), were estimated using the methods outlined in the initial Master Development Drainage Plan. Exhibit A presents the major sub-watersheds that impact the Forest Lakes property. All updated calculations for the Filings 5, 6, & 7 Amendment area were performed using the following:

Hydrologic calculations were performed using the City of Colorado Springs/El Paso County Drainage Criteria Manual, as revised in November 1991 and October 1994. Stormwater quality analysis and Extended Detention Basin (EDB) design are per the Urban Drainage and Flood Control District Manual and UD-BMP Version 3.01 spreadsheet. The Preliminary drainage calculations within this report use the Rational Method to estimate stormwater runoff to the three pond locations. Future Final Drainage Report(s) will provide a more detailed basin breakdown and utilize this runoff method to calculate the runoff to each inlets and storm sewer pipes. Also, the future Final Drainage Reports will provide the final design for each of the three full spectrum detention and water quality facilities and detailed IRF calculations/exhibits to support the tributary impervious values used.

FLOODPLAIN STATEMENT

A portion of this site is located within a floodplain as determined by the Flood Insurance Rate Maps (F.I.R.M.) Map Numbers 08041 C0267G, CO266G, CO258G, & CO259G effective date, December 7, 2018 (See Appendix for overlay exhibit). No proposed development is anticipated to take place within the floodplain other than one proposed roadway crossing as reflected on the drainage maps.

EXISTING MAJOR DRAINAGEWAYS

Three major drainageways flow onto the Forest Lakes site, including North Beaver Creek, South Beaver Creek and Hell Creek. Hell Creek, North and South Beaver Creek converge in the western portion of the site to form Beaver Creek. Beaver Creek continues through the site on an easterly course through Bristle Cone Lake over the reservoir spillway. The drainageways are well defined and heavily vegetated. The bottom width of the drainageways range from 5-feet in the smaller Hell Creek to 10-feet in the larger Beaver Creek.

The intent of the Filings 5, 6, & 7 site development is to leave the major drainageways in their existing form to the greatest practical extent possible. Developed runoff is routed to the three full spectrum detention and water quality facilities prior to releasing into these downstream channels. The original MDDP provided channel hydraulic analysis and determined with the use of full spectrum detention for the developed runoff, there are no channel improvements required. Therefore, there is no need for any additional hydraulic studies within these channels. Minimal disturbance only to the fringe of the wetland areas is proposed, no mouse area disturbance is anticipated. Proper permitting for the wetlands disturbance will be in place prior to any construction.

One road crossing of the existing drainageway is planned with Filings 5, 6, & 7. This crossing will be along North Beaver Creek upstream of the confluence between North and South Beaver Creek. The proposed culverts under the road crossings along North Beaver Creek have been designed to convey the 100-year Bulked Stream Flow (debris flow rate) from the CTL Thompson study of 4,130 cfs. A full hydraulic analysis will be completed with the Final Drainage Report and will meet the allowable bridge clearance criteria of at least 2 feet of freeboard between the box culvert ceiling and 100-yr water surface elevation. Per the CTL Thompson 'Debris Flow Report', we will work with the original HEC-RAS model to properly design this culvert to pass the entire debris flow rate.

PROPOSED DRAINAGE CONDITIONS

As reflected in the approved Kiowa MDDP, the site is influenced by off-site tributary flows from the west and north. Also, as reflected in the MDDP, on-site full spectrum detention and water quality facilities will detain and treat the developed runoff from the proposed site prior to releasing at or below historic rates to the downstream channels. As previously mentioned, the rational method was used to estimate developed runoff values. Appropriate peak runoff calculations have been used and will be verified with the future final drainage reports.

DESIGN POINT 1 (Q_5 = 54.8 cfs and Q_{100} = 132.2 cfs) is the developed runoff from the proposed single family development, Basin A, 37.55 acres. This runoff is collected in a public storm sewer system and routed to the proposed Full Spectrum Detention and Storm Water Quality Facility – Pond A. This facility in an extended detention basin (EDB) per the current drainage criteria and UDFCD (Urban Drainage Flood Control District) standards. A composite impervious value was determined using the Site-Level Low Impact Development (LID) Design Effective Impervious Calculator (IRF Form) located in the Appendix of this report. With the tributary area of 37.55 acres and a calculated 41.4% imperviousness, the total required Excess Urban Runoff Volume (EURV) is 1.642 Ac.-ft. A future Final Drainage Report will provide the detailed breakdown used on the IRF form and exact tributary imperviousness value for each pond.

Impact structures or other means or energy dissipation will be provided at all pipe daylight point into and out of the proposed ponds and bypass storm systems. Final pond design, outlet structure sizing, trickle channel and forebay details will be included with final construction drawings for review and approval by El Paso County prior to construction approval. The EURV design of this pond ensures that all discharges (2, 5, 10, 25, 50 and 100 year) will be released at or below historic release rates. Two preliminary pond sizing forms (UD-Detention v.3.07 & EDB Design Procedure Form) are included in the Appendix of this report and show the following outlet box features in order to maintain release rates at or below historic levels:

4' wide by 4' deep outlet box

4" initial surcharge volume, 350 square feet, 2.5' deep micropool (bottom = 7105.50)

Bottom of pond/top of Micropool = 7108.00

EURV = Top of Box = 7114.00 Required EURV = 1.642 ac.-ft. Provided EURV = 1.83 ac.-ft.

(3) orifice holes - 3 square inch bottom hole (1" x 3")

- 4 square inch middle hole (2" x 2")

- 4 square inch top hole (2" x 2")

30" RCP outlet pipe at invert out = 7107.80

45' length emergency spillway at 7117.00, Top of pond berm elevation = 7120.00, 12' wide minimum width.

Using an equivalent undeveloped area of land, Basin EX-A of 37.55 acres, a historic release rate and thus an allowable release rate for Pond A is Q_5 = 12.1 cfs and Q_{100} = 80.9 cfs. Per the UD-Detention form, the restricted release rate from the facility is Q_5 = 0.67 cfs and Q_{100} = 52.1 cfs with a 100-year water surface elevation in the pond of 7116.46. Final pond design and release rates will be finalized with the final drainage report for the proposed subdivision.

DESIGN POINT 2 (Q_5 = 22.0 cfs and Q_{100} = 147.5 cfs) is the historic undeveloped runoff from the off-site Basin OS-1, 77.01 acres of adjacent national forest. This runoff sheet flows east directly toward the proposed lots and cul-de-sac roadways. A series of CDOT Type C grate inlets will be installed along the eastern edge of Basin OS-1, behind the lots to intercept this historic runoff prior to draining into the proposed development. A bypass or diversion pipe system will be installed from these grated inlets to the south and into the proposed development but this pipe will not connect with the proposed development runoff and Pond A tributary storm pipe. Swales and berming will be installed to route this historic runoff to the grated inlets. In the event of inlet clogging the overflow path will be down the shared lot line swales of the adjacent home lots. Riprap or concrete 'V'-notched swales will be installed along these shared lot lines when the proposed home lots back up to the significant hill side throughout the property. Maintenance of these grated inlets and diversion storm pipe system is by the Forest Lakes Metro District. Energy dissipation of this historic runoff will be provided at the exit point of this bypass main into the South Beaver Creek corridor. Future final drainage reports will discuss erosion protection and adequate downstream corridors from all pipe release points to the existing channels.

DESIGN POINT 3 (Q_5 = 23.7 cfs and Q_{100} = 186.5 cfs) is the combined runoff from the historic bypass of Design Point 2 and the release rate of Pond A into the South Beaver Creek mouse limits. The historic release rate into South

Beaver Creek from this portion of the development is Q_5 = 32.7 cfs and Q_{100} = 219.5 cfs. Therefore, the proposed development will not hinder the downstream corridor as the flow rates are less than in the existing conditions.

DESIGN POINT 4 (Q_5 = 64.1 cfs and Q_{100} = 176.0 cfs) is the developed runoff from the proposed single family development and existing open space area, Basin B, 59.94 acres. This runoff is collected in a public storm sewer system and routed to the proposed Full Spectrum Detention and Storm Water Quality Facility – Pond B. This facility in an extended detention basin (EDB) per the current drainage criteria and UDFCD (Urban Drainage Flood Control District) standards. A Preliminary composite impervious value was determined using the Site-Level Low Impact Development (LID) Design Effective Impervious Calculator (IRF Form) located in the Appendix of this report. With the tributary area of 59.94 acres and a calculated 28.8% imperviousness, the total required Excess Urban Runoff Volume (EURV) is 1.771 Ac.-ft. A future Final Drainage Report will provide the detailed breakdown used on the IRF form and exact tributary imperviousness value for each pond.

Impact structures or other means or energy dissipation will be provided at all pipe daylight point into and out of the proposed ponds and bypass storm systems. Final pond design, outlet structure sizing, trickle channel and forebay details will be included with final construction drawings for review and approval by El Paso County prior to construction approval. The EURV design of this pond ensures that all discharges (2, 5, 10, 25, 50 and 100 year) will be released at or below historic release. Two preliminary pond sizing forms (UD-Detention v.3.07 & EDB Design Procedure Form) are included in the Appendix of this report and show the following outlet box features in order to maintain release rates at or below historic levels:

6' wide by 4' deep outlet box
5" initial surcharge volume, 350 square feet, 2.5' deep micropool (bottom = 7049.50)
Bottom of pond/top of Micropool = 7054.00
EURV = Top of Box = 7059.80 Required EURV = 1.771 ac.-ft. Provided EURV = 1.92 ac.-ft.
(3) orifice holes - 4 square inch bottom hole (2" x 2")
- **8 square inch middle hole (4" x 2")**
- **12 square inch top hole (4" x 3")**

30" RCP outlet pipe at invert out = 7051.80
50' length emergency spillway at 7063.00, Top of pond berm elevation = 7066.00, 12' wide minimum width.

Using an equivalent undeveloped area of land, Basin EX-B of 37.55 acres, a historic release rate and thus an allowable release rate for Pond B is Q_5 = 18.7 cfs and Q_{100} = 125.6 cfs. Per the UD-Detention form, the restricted release rate

from the facility is Q_5 = 1.3 cfs and Q_{100} = 84.2 cfs with a 100-year water surface elevation in the pond of 7062.75. Final pond design and release rates will be finalized with the final drainage report for the proposed subdivision.

DESIGN POINT 5 (Q_5 = 1441 cfs and Q_{100} = 4130 cfs) is the interpolated historic flow rate within North Beaver Creek channel from the referenced CTL Thompson Debris Flow report. This runoff rate is much higher than the MDDP 100-year rate of 2,950 cfs. The purpose of including this design point and basin in this analysis is to show that the runoff rate in South Beaver Creek is less with the installation of the proposed three detention facilities for the developed runoff. This historic runoff stays within the established North Beaver Creek corridor and continues south-east into the proposed development toward Design Point 6.

DESIGN POINT 6 (Q_5 = 1433 cfs and Q_{100} = 4116 cfs) is the flow rate within North Beaver Creek channel from DP-5 and Basin D, 24.98 acres of onsite property mostly comprised of open space/undeveloped area. At this location is a proposed roadway crossing (Mesa Top Drive) and (3) single cell box culverts (8' high x 15' wide @ 0.50% grade) to convey this runoff to the south and Design Point 9. A UD-Culvert v.3.04 from UDFCD (located in the Appendix) was used to preliminarily estimate the headwater depth and provide riprap energy dissipation calculations; Type M riprap, 80' length of protection and 63' wide. Preliminary box culvert sizing was also completed using the Bentley FlowMaster program, results included in the Appendix and include a velocity less than 20 ft/sec and normal depth less of 4.63'. The inside of the box culvert is 8' high, therefore there is 3.37' of freeboard over the debris flow rate within the box culvert. As previously mentioned, a full hydraulic analysis will be completed with the Final Drainage Report and in conjunction with CTL Thompson and the HEC-RAS channel model. This runoff continues south to Design Point 9.

DESIGN POINT 7 (Q_5 = 9.8 cfs and Q_{100} = 66.1 cfs) is the runoff generated from off-site Basin OS-3, 10.31 acres of existing large lot single family homes and undeveloped land to the north, and onsite Basin F, 16.61 acres of 2 large home lots (over 5 acre lots). The majority of these lots will remain undeveloped except for the driveway and actual home footprint, and as these lots are over 5 acres in size, detention and water quality is not required. Therefore, multiple grated inlets will intercept this runoff and a diversion/bypass pipe will route the runoff to the south-west along Mesa Top Drive and directly discharging into North Beaver Creek. Design Point 8 also contains bypass runoff and connects to this system prior to discharging into the creek. As with all proposed storm sewer, these grated inlets and diversion pipe will be owned and maintained by the Forest Lakes Metro District.

DESIGN POINT 8 (Q_5 = 8.7 cfs and Q_{100} = 58.2 cfs) is the runoff generated from off-site Basin OS-2, 19.91 acres of existing large lot single family homes and undeveloped land to the north, and onsite Basin E, 8.96 acres of 2 large home lots (over 5 acre lots). The majority of these lots will remain undeveloped except for the driveway and actual home footprint, and as these lots are over 5 acres in size, detention and water quality is not required. Therefore, multiple grated inlets will intercept this runoff and a diversion/bypass pipe will route the runoff to the south, connecting with the bypass main from Design Point 7. Energy dissipation of this historic runoff will be provided at the exit point of this bypass main into the North Beaver Creek corridor, downstream of the box culvert crossing at Design Point 6.

DESIGN POINT 9 (Q_5 = 1440 cfs and Q_{100} = 4164 cfs) is the combined flow rate within North Beaver Creek channel downstream of the proposed box culverts and discharge point from Design Points 7 & 8. This runoff continues south-east in the natural North Beaver Creek corridor where it combines with the release from Pond B at Design Point 10.

DESIGN POINT 10 (Q_5 = 1441 cfs and Q_{100} = 4192 cfs) is the runoff within North Beaver Creek channel downstream of Design Point 9 and including the restricted release rate from Pond B. The historic release rate into North Beaver Creek in the undeveloped conditions is Q_5 = 1448 cfs and Q_{100} = 4216 cfs. Therefore, the proposed development will not hinder the downstream corridor as the flow rates are less than in the existing conditions.

DESIGN POINT 11 (Q_5 = 46.9 cfs and Q_{100} = 117.2 cfs) is the developed runoff from the proposed single family development and existing open space area, Basin C, 30.28 acres. This runoff is collected in a public storm sewer system and routed to the proposed Full Spectrum Detention and Storm Water Quality Facility – Pond C. This facility in an extended detention basin (EDB) per the current drainage criteria and UDFCD (Urban Drainage Flood Control District) standards. A composite impervious value was determined using the Site-Level Low Impact Development (LID) Design Effective Impervious Calculator (IRF Form) located in the Appendix of this report. With the tributary area of 30.28 acres and a calculated 35.5% imperviousness, the total required Excess Urban Runoff Volume (EURV) is 1.121 Ac.-ft. A future Final Drainage Report will provide the detailed breakdown used on the IRF form and exact tributary imperviousness value for each pond. The emergency spillway for this facility will drain onto the proposed Forest Lakes Drive and south through the open space between Lots 27 & 28 and into Beaver Creek.

Impact structures or other means or energy dissipation will be provided at all pipe daylight point into and out of the proposed ponds and bypass storm systems. Final pond design, outlet structure sizing, trickle channel and forebay details will be included with final construction drawings for review and approval by El Paso County prior to construction

approval. The EURV design of this pond ensures that all discharges (2, 5, 10, 25, 50 and 100 year) will be released at or below historic release. Two preliminary pond sizing forms (UD-Detention v.3.07 & EDB Design Procedure Form) are included in the Appendix of this report and show the following outlet box features in order to maintain release rates at or below historic levels:

6' wide by 4' deep outlet box
4" initial surcharge volume, 350 square feet, 2.5' deep micropool (bottom = 7027.50)
Bottom of pond/top of Micropool = 7030.00
EURV = Top of Box = 7034.00 Required EURV = 1.121 ac.-ft. Provided EURV = 1.18 ac.-ft.
(3) orifice holes - 3 square inch bottom hole (1" x 3")
- 3 square inch middle hole (1" x 3")
- 6 square inch top hole (2" x 3")
30" RCP outlet pipe at invert out = 7029.80
38' length emergency spillway at 7039.00, Top of pond berm elevation = 7042.00, 12' wide minimum width.

Using an equivalent undeveloped area of land, Basin EX-C of 37.55 acres, a historic release rate and thus an allowable release rate for Pond C is Q_5 = 10.2 cfs and Q_{100} = 68.6 cfs. Per the UD-Detention form, the restricted release rate from the facility is Q_5 = 0.55 cfs and Q_{100} = 33.5 cfs with a 100-year water surface elevation in the pond of 7035.70. Final pond design and release rates will be finalized with the final drainage report for the proposed subdivision.

DESIGN POINT 12 (Q_5 = 1442 cfs and Q_{100} = 4200 cfs) is the runoff within North Beaver Creek channel downstream of Design Point 10 and including the restricted release rate from Pond C. The historic release rate into North Beaver Creek in the undeveloped conditions is Q_5 = 1452 cfs and Q_{100} = 4242 cfs. Therefore, the proposed development will not hinder the downstream corridor as the flow rates are less than in the existing conditions.

EURV and Stormwater Quality Capture Volume: The standard Extended Detention Basin spreadsheet has been provided in the Appendix of this report to provide sizing based upon UDFCD requirements for EURV, with a minimum drain time of 72 hours.

Detention Maintenance, Ownership and Access: The Metro District for Forest Lakes will own and maintain Detention Facility A, B and C. Access to the pond will be provided per the current El Paso County Criteria and UDFCD

criteria. An El Paso County Detention Pond Maintenance Agreement will be required indicating these Facilities to be ultimately owned and maintained by the Metro District.

DRAINAGE AND BRIDGE FEES

Forest Lakes Filings 5, 6, & 7 is to be platted in the future and is within the Beaver Creek Miscellaneous Drainage Basin. The fees in place at the time of platting will be calculated within future Final Drainage Reports.

If available, existing Drainage Fee credits will be utilized to offset portions of the required fees due for this development, as to be defined in future Final Drainage Reports. Multiple plats are anticipated for this Filings 5, 6, & 7 area.

SUMMARY

Developed runoff from the proposed Forest Lakes Filings 5, 6, & 7 are proposed to outfall to three proposed public storm systems serving three separate Full Spectrum Detention and Storm Water Quality facilities (owned and maintained by the Forest Lakes Metropolitan District) prior to discharging to downstream facilities. The proposed Full Spectrum detention/water quality ponds were sized using the current and applicable drainage criteria and provide release rates below existing allowable release rates and therefore the proposed development does not overburden downstream facilities. Future Final Drainage Reports will further define and provide additional analysis for all on-site storm facilities as the project moves forward.

PREPARED BY:

Matthew Larson
Project Manager

REFERENCES

1. City of Colorado Springs and El Paso County Drainage Criteria Manual Volume 1, May 2014.

2. Drainage Criteria Manual (Volume 3) latest revision April 2008, Urban Drainage and Flood Criteria District.

3. "Forest Lakes Master Development Drainage Plan," by Kiowa Engineering Corporation, revised April 11, 2002.

4. "Preliminary and Final Drainage Report Forest Lakes Subdivision Filing No. 1," by Kiowa Engineering Corporation, filed September 8, 2004.

5. "Drainage Report Amendment for Preliminary and Final Drainage Report Forest Lakes Subdivision Filing No. 1," by Classic Consulting Engineers & Surveyors, LLC, dated August 2015.

6. "Debris Flow/Mudflow Analysis Forest Lakes Subdivision (Phase 2) Lindbergh Road and W. Baptist Road El Paso County, Colorado," by CTL Thompson Inc., dated August 6, 2018.

VICINITY MAP

CLASSIC
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ENGINEERS & SURVEYORS

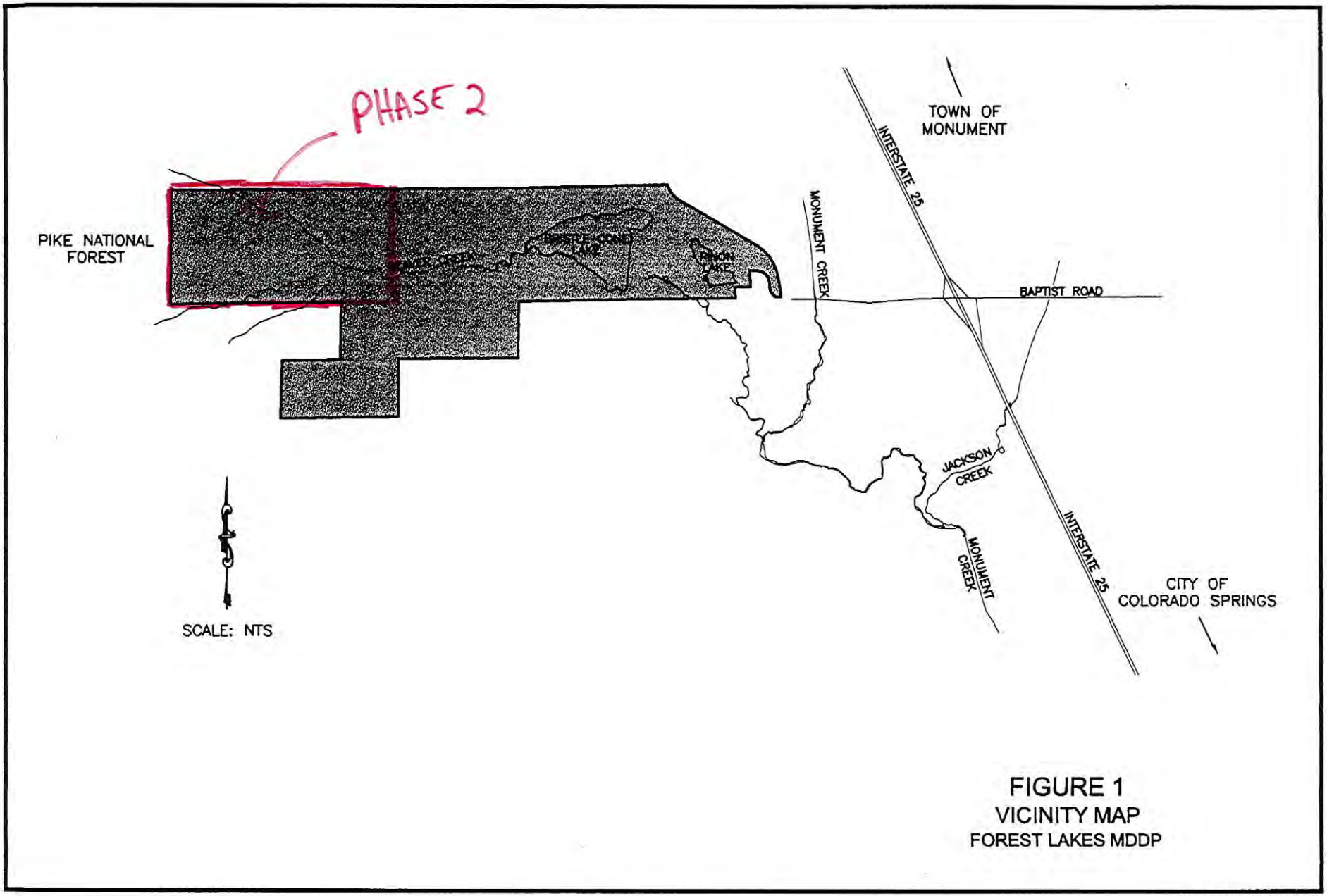

FIGURE 1
VICINITY MAP
FOREST LAKES MDDP

00013Figure(P)[8.5x11][01/08/02]

SOILS MAP (S.C.S. SURVEY)

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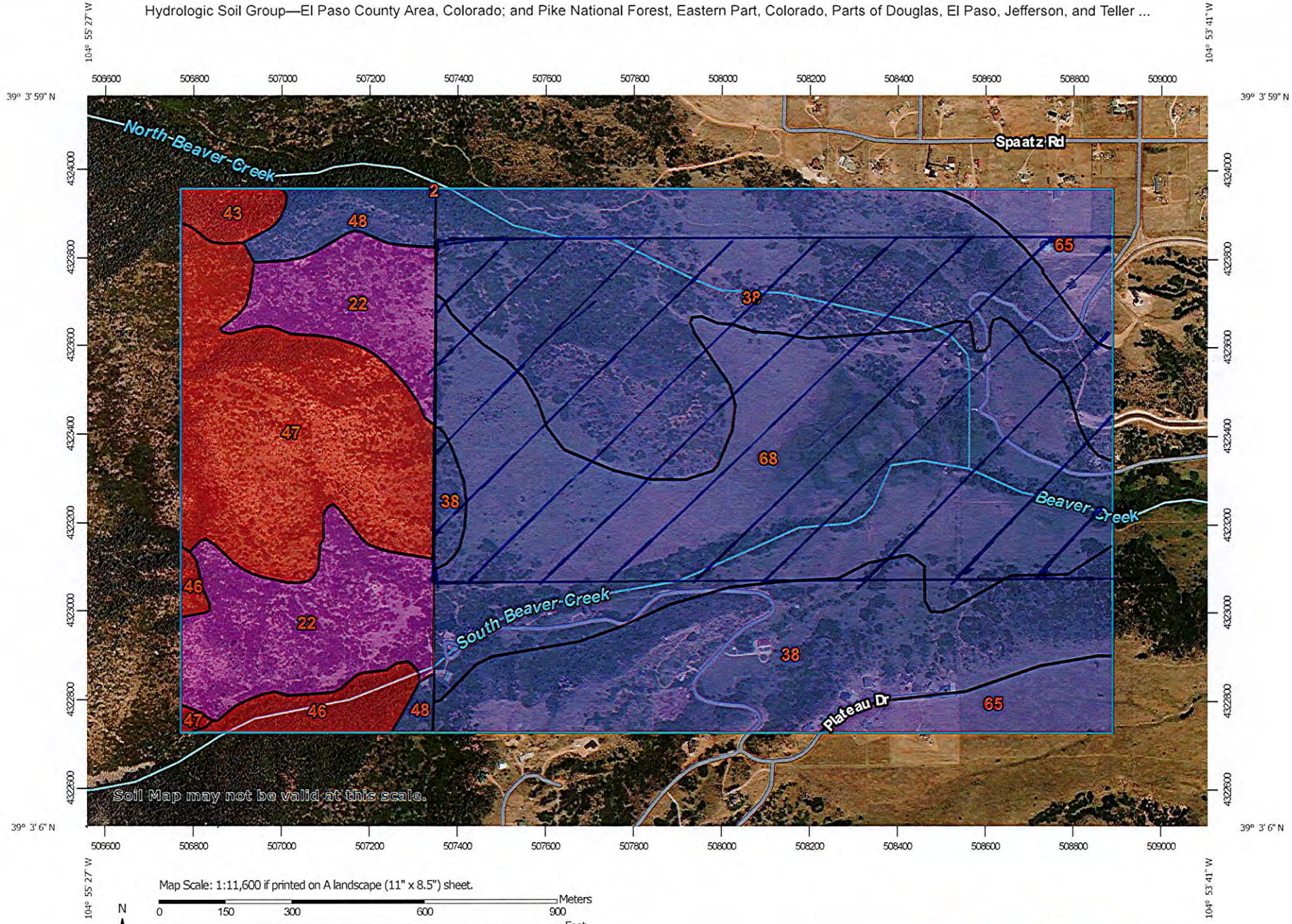


Map Scale: 1:11,600 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 150 300 600 900

Feet: 0 500 1000 2000 3000

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

Fil. S-7 SITE

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 Survey Area: Pike National Forest, Eastern Part, Colorado, Parts of Douglas, El Paso, Jefferson, and Teller Counties
Survey Area Data: Version 5, Sep 10, 2018

Your area of interest (AOI) includes more than one soil survey area. These survey areas may have been mapped at different scales, with a different land use in mind, at different times, or at different levels of detail. This may result in map unit symbols, soil properties, and interpretations that do not completely agree across soil survey area boundaries.

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

MAP LEGEND

MAP INFORMATION

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
38	Jarre-Tecolote complex, 8 to 65 percent slopes	B	247.0	38.2%
65	Perrypark gravelly sandy loam, 3 to 9 percent slopes	B	33.1	5.1%
68	Peyton-Pring complex, 3 to 8 percent slopes	B	190.3	29.4%
Subtotals for Soil Survey Area			**470.3**	**72.8%**
Totals for Area of Interest			**646.2**	**100.0%**

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
2	Aquolls, 1 to 10 percent slopes	A/D	0.0	0.0%
22	Kassler very gravelly coarse sandy loam, 5 to 35 percent slopes	A	68.0	10.5%
43	Sphinx gravelly coarse sandy loam, 40 to 70 percent slopes	D	6.0	0.9%
46	Sphinx-Rock outcrop complex, 15 to 80 percent slopes	D	12.5	1.9%
47	Sphinx, warm-Rock outcrop complex, 15 to 80 percent slopes	D	75.2	11.6%
48	Tecolote very gravelly sandy loam, 15 to 40 percent slopes, very stony	B	14.1	2.2%
Subtotals for Soil Survey Area			**175.8**	**27.2%**
Totals for Area of Interest			**646.2**	**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

F.E.M.A. MAP

CLASSIC
CONSULTING
ENGINEERS & SURVEYORS

29

29

28

PIKE NATIONAL FOREST
EL PASO COUNTY

SPAATZ RD

MAP NO. 08041 C0258G

LIMIT OF STUDY

Unnamed Road

ZONE AE

EL PASO COUNTY
UNINCORPORATED AREAS
080059

MAP NO. 08041 C0259G

ZONE AE

FLOODING EFFECTS FROM
NORTH BEAVER CREEK

North Beaver Creek

EL PASO COUNTY
UNINCORPORATED AREAS
080059

North Beaver Creek

ZONE AE

ZONE AE

EL PASO COUNTY
UNINCORPORATED AREAS
080059

MAP NO. 08041 C0266G

North Beaver Creek

29

28

FOREST LAKES DR

Beaver Creek

ZONE AE

ZONE AE

Beaver Creek

MAP NO. 08041 C0267G

ZONE AE

LIMIT OF STUDY

DIAMONDBACK DR

DIAMONDBACK RD

DIAMONDBACK RD

32

N

1" = 500'

N:\11752 DRAWINGS\EXHIBITS\FEMA MAP OVERLAY.dwg, 2/19/2019 9:49:56 AM, 1:500

EXISTING CONDITIONS CALCULATIONS

(FROM PREVIOUSLY APPROVED KIOWA MDDP)

CLASSIC
CONSULTING
ENGINEERS & SURVEYORS

Forest Lakes MDDP
Time of Concentration Calculation

Basin / Design Pt	Contributing Basins	Slope			Length			Runoff Coef.	Velocity			T			Total T	Basin / Design Pt
		O'land	Channel	Road	O'land	Channel	Road	(10-year)	O'land	Channel	Road	O'land	Channel	Road		
OS1		20.0 %	20.0 %		1000 lf	900 lf		0.25	0.9 ft/sec	5.0 ft/sec		1112 sec.	180 sec.		21.5 min.	OS1
OS2		20.0 %			700 lf			0.25	0.8 ft/sec			931 sec.			15.5 min.	OS2
OS3		20.0 %			750 lf			0.25	0.8 ft/sec			963 sec.			16.1 min.	OS3
OS4		20.0 %			400 lf			0.25	0.6 ft/sec			703 sec.			11.7 min.	OS4
OS5		5.0 %	5.0 %		500 lf	2200 lf		0.25	0.4 ft/sec	4.0 ft/sec		1248 sec.	550 sec.		30.0 min.	OS5
OS5A		5.0 %	5.0 %		400 lf	100 lf		0.25	0.4 ft/sec	5.0 ft/sec		1116 sec.	20 sec.		18.9 min.	OS5A
OS5B		4.0 %	4.0 %		400 lf	900 lf		0.25	0.3 ft/sec	4.0 ft/sec		1202 sec.	225 sec.		23.8 min.	OS5B
OS7		4.0 %			900 lf			0.25	0.5 ft/sec			1803 sec.			30.1 min.	OS7
DP A1	A, OS1	20.0 %	14.0 %	8.4 %	1000 lf	1370 lf	550 lf	0.26	0.9 ft/sec	4.5 ft/sec	5.8 ft/sec	1099 sec.	304 sec.	95 sec.	25.0 min.	DP A1
DP C1	B, C, OS2	20.0 %	8.0 %	4.8 %	700 lf	100 lf	900 lf	0.30	0.8 ft/sec	4.0 ft/sec	4.4 ft/sec	876 sec.	25 sec.	206 sec.	18.4 min.	DP C1
DP D1	A, D, OS1	20.0 %	14.0 %	7.5 %	1000 lf	1370 lf	2000 lf	0.27	0.9 ft/sec	4.5 ft/sec	5.5 ft/sec	1086 sec.	304 sec.	366 sec.	29.3 min.	DP D1
DP G1	G, OS3	20.0 %		3.2 %	750 lf		400 lf	0.26	0.8 ft/sec		3.6 ft/sec	952 sec.		112 sec.	17.7 min.	DP G1
DP H1	H,K,L	5.0 %	5.0 %	1.6 %	500 lf	330 lf	500 lf	0.35	0.5 ft/sec	3.5 ft/sec	2.5 ft/sec	1101 sec.	94 sec.	198 sec.	23.2 min.	DP H1
DP H2	H,K,L,I OS4	5.0 %	5.0 %	1.6 %	500 lf	330 lf	500 lf	0.32	0.4 ft/sec	3.5 ft/sec	2.5 ft/sec	1145 sec.	94 sec.	198 sec.	24.0 min.	DP H2
DP I1	I, OS4	18.0 %		1.1 %	450 lf		270 lf	0.29	0.6 ft/sec		2.1 ft/sec	736 sec.		128 sec.	14.4 min.	DP I1
DP M1	M2, O	20.0 %	17.9 %	2.3 %	300 lf	420 lf	300 lf	0.30	0.5 ft/sec	5.5 ft/sec	3.0 ft/sec	573 sec.	76 sec.	98 sec.	12.5 min.	DP M1
DP M2	M,M1,M2, O	9.0 %	10.9 %		300 lf	1370 lf		0.30	0.4 ft/sec	5.0 ft/sec		748 sec.	274 sec.		17.0 min.	DP M2
DP Q1	N, S5,OS5B	4.0 %	5.0 %		400 lf	2700 lf		0.25	0.3 ft/sec	4.0 ft/sec		1202 sec.	675 sec.		31.3 min.	DP Q1
DP Q2	Q, OS5,OS5A-B	5.0 %	5.0 %		750 lf	3100 lf		0.27	0.5 ft/sec	4.0 ft/sec		1492 sec.	775 sec.		37.8 min.	DP Q2
DP T1	N,Q,R,S,T,U,OS5,OS5AB	13.5 %	5.3 %		480 lf	4500 lf		0.31	0.6 ft/sec	3.0 ft/sec		815 sec.	1500 sec.		38.6 min.	DP T1
DP Z1	W,X,Y,Z	2.6 %		1.1 %	190 lf		1330 lf	0.60	0.3 ft/sec		2.1 ft/sec	563 sec.		636 sec.	20.0 min.	DP Z1
DP GG1	OS7,DD,EE,FF,GG	4.0 %		3.0 %	500 lf		2800 lf	0.30	0.4 ft/sec		3.5 ft/sec	1265 sec.		810 sec.	34.6 min.	DP GG1

Equations:

Time of Concentration (Overland) = $1.87(1.1-C_5)L^{0.5}S^{-0.333}$

C_5 = Runoff coefficient for five-year flow

L = Length of overland flow in feet

S = Slope of flow path in percent

Velocity (Road) = $10(10^{(0.5\log S+0.3)})$

S = Slope of flow path in percent

Forest Lakes MDDP
Time of Concentration Calculation

Basin / Design Pt.	Contributing Basins	Slope			Length			Runoff Coef. (10-year)	Velocity			T_c			T_c	Basin / Design Pt.
		O'land	Channel	Road	O'land	Channel	Road		O'land	Channel	Road	O'land	Channel	Road		
A		13.3 %	8.8 %	8.4 %	300 lf	170 lf	550 lf	0.30	0.5 ft/sec	4.5 ft/sec	5.8 ft/sec	656 sec.	38 sec.	95 sec.	13.2 min.	A
B		13.3 %	8.0 %	8.0 %	300 lf	100 lf	660 lf	0.30	0.5 ft/sec	4.0 ft/sec	5.7 ft/sec	656 sec.	25 sec.	117 sec.	13.3 min.	B
C		8.3 %	6.7 %	4.8 %	300 lf	60 lf	770 lf	0.35	0.4 ft/sec	3.5 ft/sec	4.4 ft/sec	719 sec.	17 sec.	176 sec.	15.2 min.	C
D		33.3 %	7.4 %	4.3 %	540 lf	340 lf	800 lf	0.30	0.8 ft/sec	4.5 ft/sec	4.1 ft/sec	649 sec.	76 sec.	194 sec.	15.3 min.	D
E		22.7 %	14.8 %	1.6 %	440 lf	270 lf	500 lf	0.30	0.7 ft/sec	5.5 ft/sec	2.5 ft/sec	665 sec.	49 sec.	198 sec.	15.2 min.	E
EI		25.0 %		9.0 %	400 lf		500 lf	0.30	0.7 ft/sec		6.0 ft/sec	615 sec.		84 sec.	11.6 min.	EI
F		5.8 %	5.8 %		800 lf	600 lf		0.30	0.6 ft/sec	3.0 ft/sec		1414 sec.	200 sec.		26.9 min.	F
G		5.0 %		4.2 %	70 lf		710 lf	0.30	0.2 ft/sec		4.1 ft/sec	439 sec.		173 sec.	10.2 min.	G
H		5.0 %	5.0 %	1.6 %	500 lf	330 lf	500 lf	0.30	0.4 ft/sec	3.5 ft/sec	2.5 ft/sec	1174 sec.	94 sec.	198 sec.	24.4 min.	H
I		24.3 %		1.1 %	370 lf		270 lf	0.30	0.6 ft/sec		2.1 ft/sec	597 sec.		128 sec.	12.1 min.	I
J		15.0 %	10.0 %		300 lf	150 lf		0.38	0.5 ft/sec	5.0 ft/sec		568 sec.	30 sec.		10.0 min.	J
K		23.3 %	13.3 %	3.2 %	300 lf	150 lf	470 lf	0.47	0.7 ft/sec	5.5 ft/sec	3.6 ft/sec	429 sec.	27 sec.	132 sec.	9.8 min.	K
L		13.3 %	18.6 %	4.4 %	300 lf	430 lf	90 lf	0.35	0.5 ft/sec	5.5 ft/sec	4.2 ft/sec	615 sec.	78 sec.	21 sec.	11.9 min.	L
M		9.0 %	10.9 %		300 lf	1370 lf		0.30	0.4 ft/sec	5.0 ft/sec		748 sec.	274 sec.		17.0 min.	M
M1		18.3 %	20.0 %	5.2 %	300 lf	280 lf	970 lf	0.30	0.5 ft/sec	5.5 ft/sec	4.5 ft/sec	590 sec.	51 sec.	214 sec.	14.3 min.	M1
M2		25.0 %	15.1 %	2.1 %	300 lf	430 lf	140 lf	0.30	0.6 ft/sec	5.0 ft/sec	2.9 ft/sec	532 sec.	86 sec.	48 sec.	11.1 min.	M2
N		5.0 %	6.5 %		300 lf	860 lf		0.30	0.3 ft/sec	3.5 ft/sec		910 sec.	246 sec.		19.3 min.	N
O		20.0 %	17.9 %		300 lf	420 lf		0.30	0.5 ft/sec	5.5 ft/sec		573 sec.	76 sec.		10.8 min.	O
P		21.7 %	14.0 %	5.6 %	300 lf	430 lf	250 lf	0.35	0.6 ft/sec	5.0 ft/sec	4.7 ft/sec	523 sec.	86 sec.	53 sec.	11.0 min.	P
Q		14.7 %		3.8 %	340 lf		1580 lf	0.35	0.5 ft/sec		3.9 ft/sec	634 sec.		406 sec.	17.3 min.	Q
R		8.0 %		2.7 %	200 lf		1460 lf	0.50	0.4 ft/sec		3.3 ft/sec	476 sec.		442 sec.	15.3 min.	R
S		8.3 %		2.7 %	120 lf		1700 lf	0.50	0.3 ft/sec		3.3 ft/sec	364 sec.		518 sec.	14.7 min.	S
T		18.0 %		3.6 %	500 lf		220 lf	0.30	0.7 ft/sec		3.8 ft/sec	767 sec.		58 sec.	13.7 min.	T
U		13.5 %	5.3 %	2.0 %	480 lf	320 lf	660 lf	0.40	0.7 ft/sec	3.0 ft/sec	2.8 ft/sec	723 sec.	107 sec.	236 sec.	17.7 min.	U
V		4.5 %		3.0 %	430 lf		750 lf	0.30	0.4 ft/sec	3.0 ft/sec	3.5 ft/sec	1128 sec.	0 sec.	217 sec.	22.4 min.	V
W		2.6 %		1.9 %	190 lf		800 lf	0.60	0.3 ft/sec		2.7 ft/sec	560 sec.		293 sec.	14.2 min.	W
X		2.2 %		1.1 %	90 lf		1330 lf	0.60	0.2 ft/sec		2.1 ft/sec	408 sec.		628 sec.	17.3 min.	X
Y		2.9 %		1.4 %	140 lf		630 lf	0.60	0.3 ft/sec		2.4 ft/sec	468 sec.		264 sec.	12.2 min.	Y
Z		2.0 %	2.0 %		300 lf	70 lf		0.60	0.4 ft/sec	2.0 ft/sec		771 sec.	35 sec.		13.4 min.	Z
AA		1.9 %		1.9 %	160 lf		640 lf	0.60	0.3 ft/sec		2.7 ft/sec	576 sec.		234 sec.	13.5 min.	AA
BB		3.3 %		0.8 %	60 lf		360 lf	0.60	0.2 ft/sec		1.8 ft/sec	291 sec.		198 sec.	8.1 min.	BB
CC		20.0 %		4.7 %	760 lf		1270 lf	0.30	0.8 ft/sec		4.3 ft/sec	913 sec.		293 sec.	20.1 min.	CC
DD		4.0 %		2.0 %	500 lf		300 lf	0.30	0.4 ft/sec		2.8 ft/sec	1265 sec.		106 sec.	22.9 min.	DD
EE		2.3 %	3.0 %	2.1 %	300 lf	460 lf	290 lf	0.30	0.3 ft/sec	2.5 ft/sec	2.9 ft/sec	1172 sec.	184 sec.	101 sec.	24.3 min.	EE
FF		2.2 %	2.2 %	2.8 %	300 lf	160 lf	860 lf	0.30	0.3 ft/sec	4.0 ft/sec	3.3 ft/sec	1196 sec.	40 sec.	258 sec.	24.9 min.	FF
GG		4.0 %	4.0 %	2.9 %	500 lf	160 lf		0.30	0.4 ft/sec	2.5 ft/sec		1265 sec.	64 sec.		22.1 min.	GG
HH		1.3 %		2.4 %	300 lf		1600 lf	0.30	0.2 ft/sec		3.1 ft/sec	1413 sec.		514 sec.	32.1 min.	HH
II		16.0 %	16.0 %	4.1 %	300 lf	550 lf	1460 lf	0.30	0.5 ft/sec	5.5 ft/sec		618 sec.	100 sec.		12.0 min.	II
JJ		8.0 %	8.0 %		500 lf	2390 lf		0.30	0.5 ft/sec	4.0 ft/sec		1006 sec.	598 sec.		26.7 min.	JJ

Equations:

Time of Concentration (Overland) = $1.87(1.1-C_5)L^{0.5} S^{-0.333}$

C_5 = Runoff coefficient for five-year flow

L = Length of overland flow in feet

S = Slope of flow path in percent

Velocity (Road) = $10(10^{(0.5\log S + 0.3)})$

S = Slope of flow path in percent

Forest Lakes MDDP
Runoff Coefficient Calculation

Basin	Area 1 (8 Lot/Acre) % Area	C_{10}	C_{100}	Area 2 (Lawn) % Area	C_{10}	C_{100}	Basin C_{10}	Basin C_{100}	Basin
J	37 %	0.60	0.70	63 %	0.25	0.35	0.38	0.48	J
K	63 %	0.60	0.70	38 %	0.25	0.35	0.47	0.57	K

Design Point	Basin	Area	% Area	C_{10}	C_{100}		
DP A1	A	13.60 ac	19.80 %	0.30	0.40	0.06	0.08
	OS1	55.10 ac	80.20 %	0.25	0.35	0.20	0.28
		68.70 ac	100.0 %			0.26	0.36

Design Point	Basin	Area	% Area	C_{10}	C_{100}		
DP C1	B	3.74 ac	17.58 %	0.30	0.40	0.05	0.07
	C	9.27 ac	43.58 %	0.35	0.45	0.15	0.20
	OS2	8.26 ac	38.83 %	0.25	0.35	0.10	0.14
		21.27 ac	100.0 %			0.30	0.40

Design Point	Basin	Area	% Area	C_{10}	C_{100}		
DP D1	A	13.60 ac	15.05 %	0.30	0.40	0.05	0.06
	D	21.66 ac	23.97 %	0.30	0.40	0.07	0.10
	OS1	55.10 ac	60.98 %	0.25	0.35	0.15	0.21
		90.36 ac	100.0 %			0.27	0.37

Design Point	Basin	Area	% Area	C_{10}	C_{100}		
DP G1	G	3.63 ac	18.01 %	0.30	0.40	0.05	0.07
	OS3	16.53 ac	81.99 %	0.25	0.35	0.20	0.29
		20.16 ac	100.0 %			0.26	0.36

Design Point	Basin	Area	% Area	C_{10}	C_{100}		
DP H1	H	15.90 ac	58.61 %	0.30	0.40	0.18	0.23
	K	5.60 ac	20.64 %	0.47	0.57	0.10	0.12
	L	5.63 ac	20.75 %	0.35	0.45	0.07	0.09
		27.13 ac	100.0 %			0.35	0.45

Design Point	Basin	Area	% Area	C_{10}	C_{100}		
DP H2	H	15.90 ac	35.36 %	0.30	0.40	0.11	0.14
	K	5.60 ac	12.46 %	0.47	0.57	0.06	0.07
	L	5.63 ac	12.52 %	0.35	0.45	0.04	0.06
	I	15.59 ac	34.68 %	0.30	0.40	0.10	0.14
	OS4	2.24 ac	4.98 %	0.25	0.35	0.01	0.02
		44.96 ac	100.0 %			0.32	0.42

Design Point	Basin	Area	% Area	C_{10}	C_{100}		
DP I1	I	15.59 ac	87.44 %	0.30	0.40	0.26	0.35
	OS4	2.24 ac	12.56 %	0.25	0.35	0.03	0.04
		17.83 ac	100.0 %			0.29	0.39

Forest Lakes MDDP
Runoff Coefficient Calculation

Design Point	Basin	Area	% Area	C10	C100		
DP Q2	N	8.09 ac	8.96 %	0.30	0.40	0.03	0.04
	Q	14.45 ac	16.00 %	0.35	0.45	0.06	0.07
	OS5,OS5A-B	67.77 ac	75.04 %	0.25	0.35	0.19	0.26
		90.31 ac	100.0 %			0.27	0.37

Design Point	Basin	Area	% Area	C10	C100		
DP T1	N	8.09 ac	6.59 %	0.30	0.40	0.02	0.03
	Q	14.45 ac	11.77 %	0.35	0.45	0.04	0.05
	R	10.87 ac	8.85 %	0.50	0.60	0.04	0.05
	S	6.67 ac	5.43 %	0.50	0.60	0.03	0.03
	T	5.01 ac	4.08 %	0.30	0.40	0.01	0.02
	U	9.96 ac	8.11 %	0.40	0.50	0.03	0.04
	OS5,OS5A-B	67.77 ac	55.18 %	0.25	0.35	0.14	0.19
		122.82 ac	100.0 %			0.31	0.41

DEVELOPED CONDITIONS CALCULATIONS

CLASSIC℠
CONSULTING
ENGINEERS & SURVEYORS

JOB NAME: *FOREST LAKES - FILINGS 5, 6, 7*
JOB NUMBER: *1175.21*
DATE: *11/20/18*
CALCULATED BY: *MAL*

PRELIMINARY DRAINAGE REPORT ~ BASIN RUNOFF COEFFICIENT SUMMARY

BASIN	TOTAL AREA (AC)	IMPERVIOUS AREA / STREETS			LOTS/LANDSCAPE/UNDEV. AREAS (NOT PAVEMENT)			WEIGHTED		WEIGHTED CA					
		AREA (AC)	C(5)	C(100)	AREA (AC)	C(5)	C(100)	C(5)	C(100)	CA(2)	CA(5)	CA(10)	CA(25)	CA(50)	CA(100)
A	37.55	4.90	0.90	0.96	32.65	0.32	0.51	0.40	0.57	13.18	14.86	16.59	18.97	20.00	21.36
B	59.94	7.55	0.90	0.96	52.39	0.23	0.45	0.31	0.51	15.63	18.84	22.14	26.48	28.65	30.82
C	30.28	5.73	0.90	0.96	24.55	0.25	0.46	0.37	0.55	10.01	11.29	12.88	14.72	15.75	16.79
D	24.98	0.00	0.90	0.96	24.98	0.11	0.37	0.11	0.37	1.00	2.75	4.75	6.74	7.99	9.24
E	8.96	0.00	0.90	0.96	8.96	0.09	0.36	0.09	0.36	0.27	0.81	1.52	2.33	2.78	3.23
F	16.61	0.00	0.90	0.96	16.61	0.09	0.36	0.09	0.36	0.50	1.49	2.82	4.32	5.15	5.98
OS-1	77.01	0.00	0.90	0.96	77.01	0.09	0.36	0.09	0.36	2.31	6.93	13.09	20.02	23.87	27.72
OS-2	19.91	0.00	0.90	0.96	19.91	0.09	0.36	0.09	0.36	0.60	1.79	3.38	5.18	6.17	7.17
OS-3	10.31	0.00	0.90	0.96	10.31	0.09	0.36	0.09	0.36	0.31	0.93	1.75	2.68	3.20	3.71
EX. A	37.55	0.00	0.90	0.96	37.55	0.09	0.36	0.09	0.36	1.13	3.38	6.38	9.76	11.64	13.52
EX. B	59.94	0.00	0.90	0.96	59.94	0.09	0.36	0.09	0.36	1.80	5.39	10.19	15.58	18.58	21.58
EX. C	30.28	0.00	0.90	0.96	30.28	0.09	0.36	0.09	0.36	0.91	2.73	5.15	7.87	9.39	10.90

JOB NAME: FOREST LAKES - FILINGS 5, 6, 7
JOB NUMBER: 1175.21
DATE: 11/20/2018
CALC'D BY: MAL

PRELIMINARY DRAINAGE REPORT ~ BASIN RUNOFF SUMMARY

	WEIGHTED						OVERLAND				STREET / CHANNEL FLOW				Tc	INTENSITY						TOTAL FLOWS	
BASIN	CA(2)	CA(5)	CA(10)	CA(25)	CA(50)	CA(100)	C(5)	Length (ft)	Height (ft)	Tc (min)	Length (ft)	Slope (%)	Velocity (fps)	Tc (min)	TOTAL (min)	I(2) (in/hr)	I(5) (in/hr)	I(10) (in/hr)	I(25) (in/hr)	I(50) (in/hr)	I(100) (in/hr)	Q(5) (cfs)	Q(100) (cfs)
A	13.18	14.86	16.59	18.97	20.00	21.36	0.09	330	120	10.1	1580	5.2%	8.0	3.3	13.4	2.94	3.69	4.30	4.92	5.53	6.19	**54.8**	**132.2**
B	15.63	18.84	22.14	26.48	28.65	30.82	0.09	500	170	12.7	1800	6.0%	8.6	3.5	16.2	2.72	3.40	3.97	4.54	5.10	5.71	**64.1**	**176.0**
C	10.01	11.29	12.88	14.72	15.75	16.79	0.09	60	8	6.0	2040	6.5%	8.9	3.8	9.8	3.32	4.16	4.85	5.54	6.24	6.98	**46.9**	**117.2**
D	1.00	2.75	4.75	6.74	7.99	9.24	0.09	100	20	6.8	2040	6.0%	8.6	4.0	10.8	3.21	4.02	4.69	5.36	6.03	6.75	**11.0**	**62.4**
E	0.27	0.81	1.52	2.33	2.78	3.23	0.09	150	20	9.5	720	5.3%	8.1	1.5	11.0	3.18	3.99	4.65	5.32	5.98	6.69	**3.2**	**21.6**
F	0.50	1.49	2.82	4.32	5.15	5.98	0.09	90	20	6.2	1030	6.8%	9.1	1.9	8.1	3.55	4.45	5.19	5.93	6.67	7.46	**6.6**	**44.6**
OS-1	2.31	6.93	13.09	20.02	23.87	27.72	0.09	460	64	16.4	2000	14.0%	13.1	2.5	19.0	2.53	3.17	3.70	4.23	4.76	5.32	**22.0**	**147.5**
OS-2	0.60	1.79	3.38	5.18	6.17	7.17	0.09	400	60	14.9	450	15.0%	13.6	0.6	15.5	2.78	3.47	4.05	4.63	5.21	5.83	**6.2**	**41.8**
OS-3	0.31	0.93	1.75	2.68	3.20	3.71	0.09	200	60	8.4	210	30.0%	19.2	0.2	8.6	3.48	4.36	5.09	5.81	6.54	7.32	**4.0**	**27.2**

JOB NAME: FOREST LAKES - FILINGS 5, 6, 7
JOB NUMBER: 1175.21
DATE: 11/20/2018
CALC'D BY: MAL

PRELIMINARY DRAINAGE REPORT ~ BASIN RUNOFF SUMMARY

BASIN	WEIGHTED						OVERLAND				STREET / CHANNEL FLOW				Tc	INTENSITY						TOTAL FLOWS	
	CA(2)	CA(5)	CA(10)	CA(25)	CA(50)	CA(100)	C(5)	Length (ft)	Height (ft)	Tc (min)	Length (ft)	Slope (%)	Velocity (fps)	Tc (min)	TOTAL (min)	I(2) (in/hr)	I(5) (in/hr)	I(10) (in/hr)	I(25) (in/hr)	I(50) (in/hr)	I(100) (in/hr)	Q(5) (cfs)	Q(100) (cfs)
THE FOLLOWING BASINS ARE INCLUDED TO CALCULATE ALLOWABLE RELEASE RATES FROM THE PONDS																							
EX. A	1.13	3.38	6.38	9.76	11.64	13.52	0.09	420	120	12.4	1300	8.0%	9.9	2.2	14.6	2.85	3.57	4.16	4.76	5.35	5.99	**12.1**	**80.9**
EX. B	1.80	5.39	10.19	15.58	18.58	21.58	0.09	500	170	12.7	1500	6.4%	8.9	2.8	15.6	2.77	3.47	4.04	4.62	5.20	5.82	**18.7**	**125.6**
EX. C	0.91	2.73	5.15	7.87	9.39	10.90	0.09	260	46	11.4	600	3.6%	6.6	1.5	12.9	2.99	3.75	4.37	5.00	5.62	6.29	**10.2**	**68.6**
THESE BASINS MATCH THE AREAS TRIBUTARY TO EACH FACILITY AND THEREFORE A MAP IS NOT NEEDED																							

JOB NAME: *FOREST LAKES - FILINGS 5, 6, 7*
JOB NUMBER: *1175.21*
DATE: *11/20/18*
CALCULATED BY: *MAL*

PRELIMINARY DRAINAGE REPORT ~ SURFACE ROUTING SUMMARY

Design Point(s)	Contributing Basins	Equivalent CA(5)	Equivalent CA(100)	Maximum Tc	Intensity		Flow		FEATURE
					I(5)	I(100)	Q(5)	Q(100)	
1	BASIN A	14.86	21.36	13.4	3.69	6.19	54.8	132.2	POND A
2	BASIN OS-1	6.93	27.72	19.0	3.17	5.32	22.0	147.5	GRATED INLETS & BYPASS STORM
	POND A RELEASE	0.55	7.32	13.4	3.69	6.19	2.0	45.3	30" OUTLET PIPE
3	DP-2 + POND A RELEASE	7.48	35.04	19.0	3.17	5.32	23.7	186.5	EXISTING CHANNEL
4	BASIN B	18.84	30.82	16.2	3.40	5.71	64.1	176.0	POND B
5	BASIN OS-4	1000.00	1708.50	60.0	1.44	2.42	1441.5	4129.9	FROM CTL REPORT - NORTH BEAVER CREEK DEBRIS FLOW RATE
6	DP-5 + BASIN D	1002.75	1717.74	60.5	1.43	2.40	1433.0	4116.3	Proposed Box Culvert - Triple 15' x 8'
7	BASIN F + BASIN OS-3	2.42	9.69	10.5	4.06	6.82	9.8	66.1	GRATED INLETS & BYPASS STORM
8	BASIN E + BASIN OS-2	2.60	10.39	17.0	3.34	5.60	8.7	58.2	GRATED INLETS & BYPASS STORM
9	DP-6 + DP-7 + DP-8	1007.77	1737.83	60.5	1.43	2.40	1440.1	4164.4	EXISTING CHANNEL
	POND B RELEASE	0.65	11.31	16.2	3.40	5.71	2.2	64.6	30" OUTLET PIPE
10	DP-9 + POND B RELEASE	1008.42	1749.14	60.5	1.43	2.40	1441.1	4191.5	EXISTING CHANNEL
11	BASIN C	11.29	16.79	9.8	4.16	6.98	46.9	117.2	POND C
	POND C RELEASE	0.29	3.51	9.8	4.16	6.98	1.2	24.5	30" OUTLET PIPE
12	DP-10 + POND C RELEASE	1008.71	1752.65	60.5	1.43	2.40	1441.5	4199.9	EXISTING CHANNEL

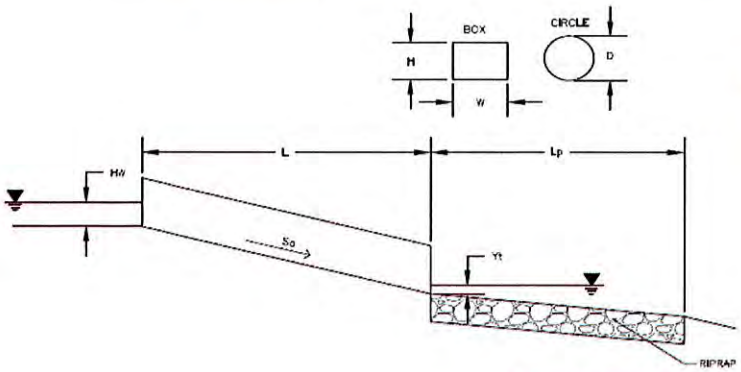
JOB NAME: *FOREST LAKES - FILINGS 5, 6, 7*
JOB NUMBER: *1175.21*
DATE: *11/20/18*
CALCULATED BY: *MAL*

PRELIMINARY DRAINAGE REPORT ~ SURFACE ROUTING SUMMARY

Design Point(s)	Contributing Basins	Equivalent CA(5)	Equivalent CA(100)	Maximum Tc	Intensity		Flow		FEATURE
					I(5)	I(100)	Q(5)	Q(100)	
THE FOLLOWING ARE TO COMPARE THE HISTORIC FLOW RATES WITHIN THE CHANNEL (UNDEVELOPED CONDITIONS)									
EX-DP-3	BASIN OS-1 + BASIN EX-A	10.31	41.24	19.0	3.17	5.32	32.7	219.5	EXISTING CHANNEL
EX-DP-10	DP-9 + BASIN EX-B	1013.16	1759.41	60.5	1.43	2.40	1447.8	4216.1	EXISTING CHANNEL
EX-DP-12	EX-DP-10 + BASIN EX-C	1015.89	1770.31	60.5	1.43	2.40	1451.7	4242.3	EXISTING CHANNEL

Determination of Culvert Headwater and Outlet Protection

Project: FOREST LAKES PHASE 2
Basin ID: DP-6 - MESA TOP ROAD CROSSING OF NORTH BEAVER CREEK



Preliminary Rock Protection Calculation

Soil Type:
Choose One:
(●) Sandy
( ) Non-Sandy

Supercritical Flow! Using Ha to calculate protection type.

Design Information (Input):

	Design Discharge	Q =	4130	cfs
Circular Culvert:				
	Barrel Diameter in Inches	D =		inches
	Inlet Edge Type (Choose from pull-down list)			
Box Culvert:		OR		
	Barrel Height (Rise) in Feet	Height (Rise) =	8	ft
	Barrel Width (Span) in Feet	Width (Span) =	45	ft
	Inlet Edge Type (Choose from pull-down list)		1.5 : 1 Bevel w/ 90 Deg. Headwall	
	Number of Barrels	No =	1	
	Inlet Elevation	Elev IN =	7050	ft
	Outlet Elevation OR Slope	Elev OUT =	7049	ft
	Culvert Length	L =	120	ft
	Manning's Roughness	n =	0.013	
	Bend Loss Coefficient	k_b =	0	
	Exit Loss Coefficient	k_x =	1	
	Tailwater Surface Elevation	Elev Y_t =		ft
	Max Allowable Channel Velocity	V =	5	ft/s

Required Protection (Output):

Tailwater Surface Height	Y_t =	3.20	ft
Flow Area at Max Channel Velocity	A_t =	826.00	ft^2
Culvert Cross Sectional Area Available	A =	360.00	ft^2
Entrance Loss Coefficient	k_e =	0.20	
Friction Loss Coefficient	k_f =	0.23	
Sum of All Losses Coefficients	k_s =	1.43	ft
Culvert Normal Depth	Y_n =	3.92	ft
Culvert Critical Depth	Y_c =	6.40	ft
Tailwater Depth for Design	d =	7.20	ft
Adjusted Diameter OR Adjusted Rise	H_a =	5.96	ft
Expansion Factor	1/(2*tan(Θ)) =	4.67	
Flow/Diameter$^{2.5}$ OR Flow/(Span * Rise$^{1.5}$)	Q/WH^1.5 =	4.06	$ft^{0.5}/s$
Froude Number	Fr =	2.08	Supercritical!
Tailwater/Adjusted Diameter OR Tailwater/Adjusted Rise	Yt/H =	0.54	
Inlet Control Headwater	HW_I =	9.96	ft
Outlet Control Headwater	HW_O =	9.13	ft
Design Headwater Elevation	**HW =**	**7,059.96**	ft
Headwater/Diameter OR Headwater/Rise Ratio	**HW/H =**	**1.25**	
Minimum Theoretical Riprap Size	d_{50} =	12	in
Nominal Riprap Size	d_{50} =	12	in
UDFCD Riprap Type	**Type =**	M	
Length of Protection	L_p =	80	ft
Width of Protection	T =	63	ft

DP-6 - MESA TOP CROSSING

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00500	ft/ft
Height	8.00	ft
Bottom Width	45.00	ft
Discharge	4130.00	ft^3/s

Results

Normal Depth	4.63	ft
Flow Area	208.37	ft^2
Wetted Perimeter	54.26	ft
Hydraulic Radius	3.84	ft
Top Width	45.00	ft
Critical Depth	6.40	ft
Percent Full	57.9	%
Critical Slope	0.00185	ft/ft
Velocity	19.82	ft/s
Velocity Head	6.10	ft
Specific Energy	10.74	ft
Froude Number	1.62	
Discharge Full	6574.11	ft^3/s
Slope Full	0.01267	ft/ft
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	57.88	%
Downstream Velocity	Infinity	ft/s

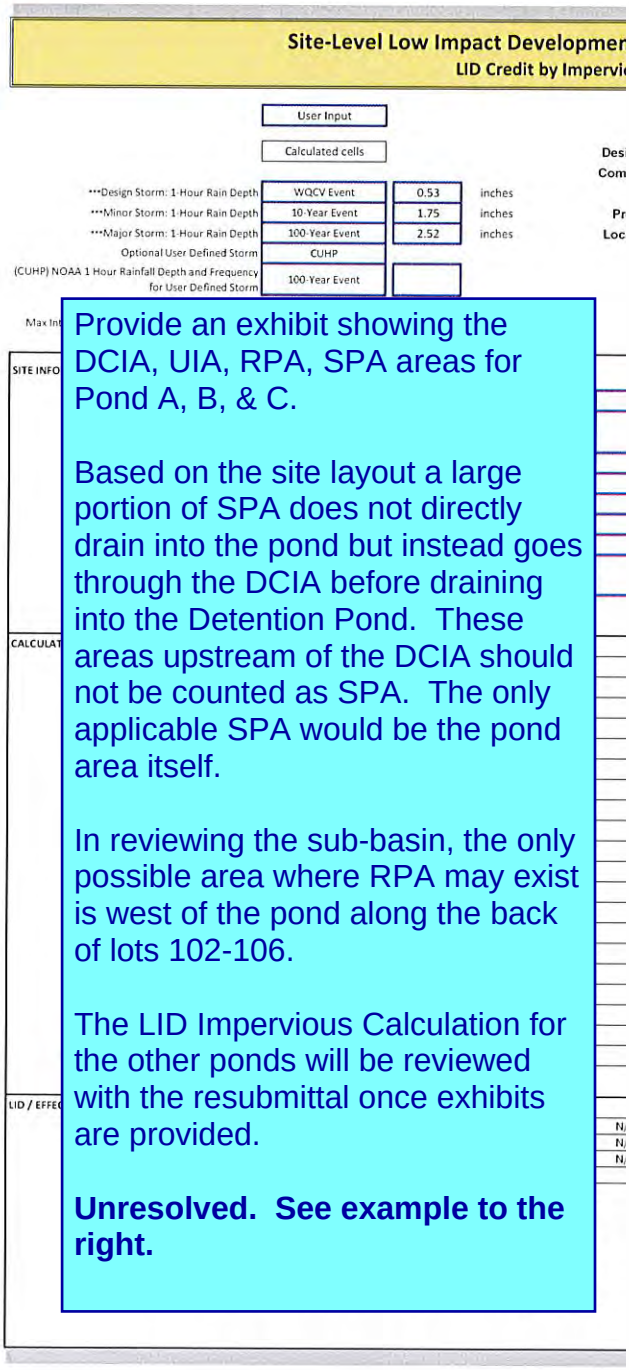
DP-6 - MESA TOP CROSSING

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	4.63	ft
Critical Depth	6.40	ft
Channel Slope	0.00500	ft/ft
Critical Slope	0.00185	ft/ft

DETENTION POND "A"

CLASSIC
CONSULTING
ENGINEERS & SURVEYORS



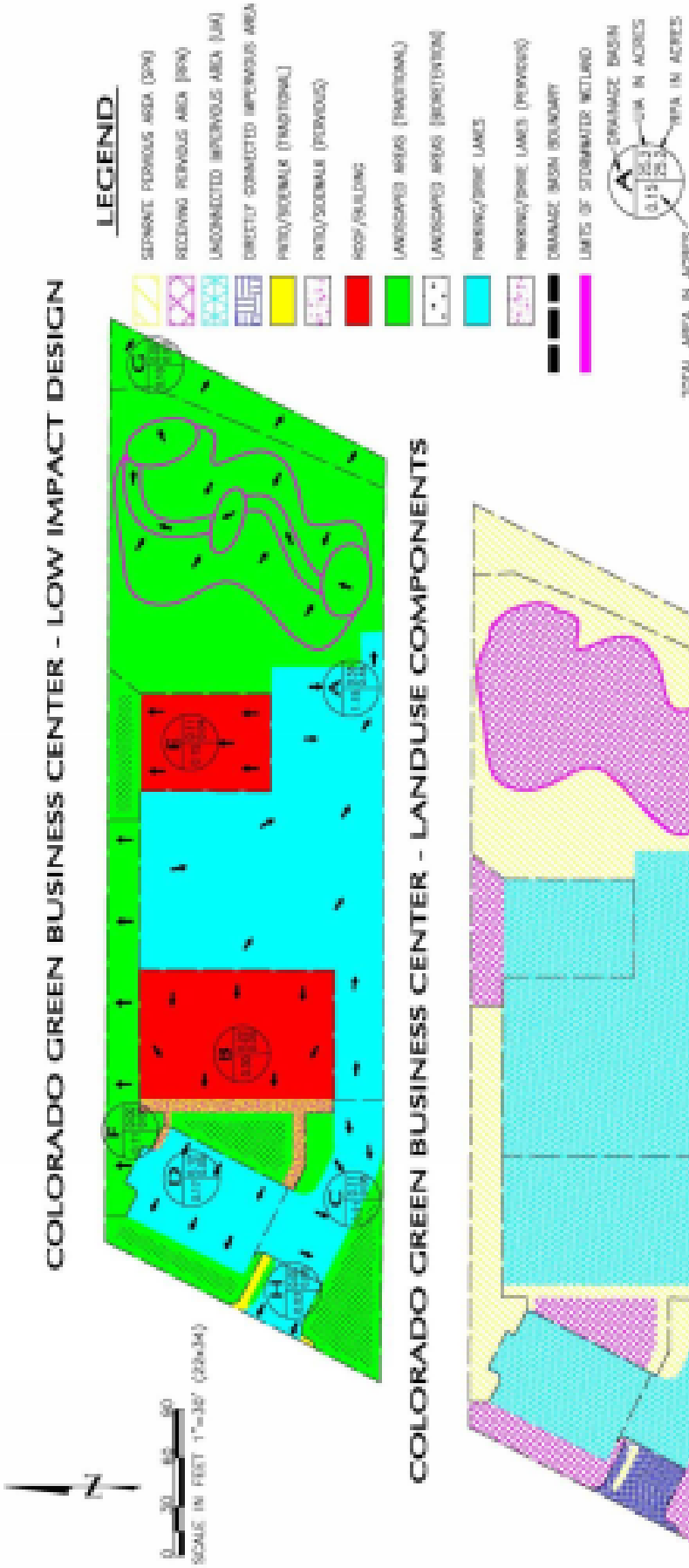
Provide an exhibit showing the DCIA, UIA, RPA, SPA areas for Pond A, B, & C.

Based on the site layout a large portion of SPA does not directly drain into the pond but instead goes through the DCIA before draining into the Detention Pond. These areas upstream of the DCIA should not be counted as SPA. The only applicable SPA would be the pond area itself.

In reviewing the sub-basin, the only possible area where RPA may exist is west of the pond along the back of lots 102-106.

The LID Impervious Calculation for the other ponds will be reviewed with the resubmittal once exhibits are provided.

Unresolved. See example to the right.



Design Procedure Form: Extended Detention Basin (EDB)

Designer:	Matt Larson
Company:	Classic Consulting Engineers & Surveyors, LLC
Date:	February 18, 2019
Project:	FOREST LAKES - PHASE 2
Location:	POND A - PRELIMINARY DESIGN

1. Basin Storage Volume	
A) Effective Imperviousness of Tributary Area, I_a	I_a = 41.4 %
B) Tributary Area's Imperviousness Ratio ($i = I_a / 100$)	i = 0.414
C) Contributing Watershed Area	Area = 37.550 ac
D) For Watersheds Outside of the Denver Region, Depth of Average Runoff Producing Storm	d_6 = 0.42 in
E) Design Concept (Select EURV when also designing for flood control)	Choose One: ○ Water Quality Capture Volume (WQCV) ◉ Excess Urban Runoff Volume (EURV)
F) Design Volume (WQCV) Based on 40-hour Drain Time ($V_{DESIGN} = (1.0 * (0.91 * i^3 - 1.19 * i^2 + 0.78 * i) / 12 * Area$)	V_{DESIGN}= 0.574 ac-ft
G) For Watersheds Outside of the Denver Region, Water Quality Capture Volume (WQCV) Design Volume ($V_{WQCV\ OTHER} = (d_6 * (V_{DESIGN}/0.43))$	$V_{DESIGN\ OTHER}$= 0.561 ac-ft
H) User Input of Water Quality Capture Volume (WQCV) Design Volume (Only if a different WQCV Design Volume is desired)	$V_{DESIGN\ USER}$= ac-ft
I) Predominant Watershed NRCS Soil Group	Choose One: ○ A ◉ B ○ C / D
J) Excess Urban Runoff Volume (EURV) Design Volume For HSG A: $EURV_A = 1.68 * i^{1.28}$ For HSG B: $EURV_B = 1.36 * i^{1.08}$ For HSG C/D: $EURV_{C/D} = 1.20 * i^{1.08}$	EURV = 1.642 ac-ft
2. Basin Shape: Length to Width Ratio (A basin length to width ratio of at least 2:1 will improve TSS reduction.)	L : W = 2.0 : 1
3. Basin Side Slopes	
A) Basin Maximum Side Slopes (Horizontal distance per unit vertical, 4:1 or flatter preferred)	Z = 4.00 ft / ft
4. Inlet	
A) Describe means of providing energy dissipation at concentrated inflow locations:	

Design Procedure Form: Extended Detention Basin (EDB)

Designer:	Matt Larson
Company:	Classic Consulting Engineers & Surveyors, LLC
Date:	November 19, 2018
Project:	FOREST LAKES - PHASE 2
Location:	POND A

5. Forebay	
A) Minimum Forebay Volume (V_{FMIN} = 3% of the WQCV)	V_{FMIN} = 0.017 ac-ft
B) Actual Forebay Volume	V_F = 0.020 ac-ft
C) Forebay Depth (D_F = 18 inch maximum)	D_F = 12.0 in
D) Forebay Discharge	
i) Undetained 100-year Peak Discharge	Q_{100} = 132.20 cfs
ii) Forebay Discharge Design Flow ($Q_F = 0.02 * Q_{100}$)	Q_F = 2.64 cfs
E) Forebay Discharge Design	Choose One: ○Berm With Pipe ◉Wall with Rect. Notch ○Wall with V-Notch Weir (flow too small for berm w/ pipe)
F) Discharge Pipe Size (minimum 8-inches)	Calculated D_P = in
G) Rectangular Notch Width	Calculated W_N = 11.9 in
6. Trickle Channel	
A) Type of Trickle Channel	Choose One: ◉Concrete ○Soft Bottom
F) Slope of Trickle Channel	S = 0.0050 ft / ft
7. Micropool and Outlet Structure	
A) Depth of Micropool (2.5-feet minimum)	D_M = 2.5 ft
B) Surface Area of Micropool (10 ft^2 minimum)	A_M = 350 sq ft
C) Outlet Type	Choose One: ◉Orifice Plate ○Other (Describe):
D) Smallest Dimension of Orifice Opening Based on Hydrograph Routing (Use UD-Detention)	$D_{orifice}$ = 1.00 inches
E) Total Outlet Area	A_{ot} = 6.00 square inches

Design Procedure Form: Extended Detention Basin (EDB)

Designer: Matt Larson
Company: Classic Consulting Engineers & Surveyors, LLC
Date: November 19, 2018
Project: FOREST LAKES - PHASE 2
Location: POND A

8. Initial Surcharge Volume	
A) Depth of Initial Surcharge Volume (Minimum recommended depth is 4 inches)	D_{IS} = 4 in
B) Minimum Initial Surcharge Volume (Minimum volume of 0.3% of the WQCV)	V_{IS} = 73.3 cu ft
C) Initial Surcharge Provided Above Micropool	V_s = 116.7 cu ft
9. Trash Rack	
A) Water Quality Screen Open Area: $A_t = A_{ot} * 38.5*(e^{-0.095D})$	A_t = 210 square inches
B) Type of Screen (If specifying an alternative to the materials recommended in the USDCM, indicate "other" and enter the ratio of the total open are to the total screen are for the material specified.)	*S.S. Well Screen with 60% Open Area*
Other (Y/N): N	
C) Ratio of Total Open Area to Total Area (only for type 'Other')	User Ratio =
D) Total Water Quality Screen Area (based on screen type)	A_{total} = 350 sq. in.
E) Depth of Design Volume (EURV or WQCV) (Based on design concept chosen under 1E)	H= 5 feet
F) Height of Water Quality Screen (H_{TR})	H_{TR}= 88 inches
G) Width of Water Quality Screen Opening ($W_{opening}$) (Minimum of 12 inches is recommended)	$W_{opening}$ = 12.0 inches

Design Procedure Form: Extended Detention Basin (EDB)

Designer: Matt Larson
Company: Classic Consulting Engineers & Surveyors, LLC
Date: November 19, 2018
Project: FOREST LAKES - PHASE 2
Location: POND A

10. Overflow Embankment	
A) Describe embankment protection for 100-year and greater overtopping:	45' WIDE SPILLWAY AT ELEV. 7117.00
B) Slope of Overflow Embankment (Horizontal distance per unit vertical, 4:1 or flatter preferred)	10.00
11. Vegetation	Choose One: ○ Irrigated ◉ Not Irrigated
12. Access	
A) Describe Sediment Removal Procedures	12' WIDE ACCESS ROAD W/ MIN. 30' CL RADIUS TO POND BOTTOM

Notes:

JOB NAME: FOREST LAKES PHASE 2
JOB NUMBER: 1175.21
DATE: 02/19/19
CALCULATED BY: MAL

POND A EURV

POND SIZING WITH PONDPACK EQUATION:
INSERT POND DESIGN SIZE INFO: (RED)

POND ELEVATION : (from lowest to highest)
7108.00
7108.00
7110.00
7112.00
7113.00
7114.00

AREA (BTM to TOP):		
	-	acres
123	0.00	acres
11,955	0.27	acres
17,846	0.41	acres
21,004	0.48	acres
23,897	0.55	acres
	-	acres
	-	acres
	-	acres
	-	acres
	-	acres
	-	acres

PRELIMINARY SIZE:

VOLUME = 1/3{(EL2-EL1)*(A1+A2+((A1*A2)^.5))}

							CUMMULATIVE VOLUME:
-	AC-FT	from	7,108	to	7,108		
0.20	AC-FT	from	7,108	to	7,110		0.20
0.67	AC-FT	from	7,110	to	7,112		0.87
0.44	AC-FT	from	7,112	to	7,113		1.32
0.51	AC-FT	from	7,113	to	7,114		1.83
-	AC-FT	from	7,114	to	-		1.83
-	AC-FT	from	-	to	-		1.83
-	AC-FT	from	-	to	-		1.83
-	AC-FT	from	-	to	-		1.83
-	AC-FT	from	-	to	-		1.83
-	AC-FT	from	-	to	-		1.83

*SIZING IS FOR PRELIMINARY PURPOSES ONLY.

VOLUME = 1.83 AC-FT

APPROXIMATE SURFACE AREA REQUIREMENT

POND DEPTH (FT)	POND VOLUME AC-FT		CF	SURFACE AREA (SF)
4	1.83	=	79,501	19,875
6	1.83	=	79,501	13,250
8	1.83	=	79,501	9,938
10	1.83	=	79,501	7,950

JOB NAME: FOREST LAKES PHASE 2
JOB NUMBER: 1175.21
DATE: 02/19/19
CALCULATED BY: MAL

POND A SPILLWAY

POND SIZING WITH PONDPACK EQUATION:
INSERT POND DESIGN SIZE INFO: (RED)

POND ELEVATION : (from lowest to highest)
7108.00
7108.00
7110.00
7112.00
7114.00
7116.00
7117.00

AREA (BTM to TOP):		
	-	acres
123	0.00	acres
11,955	0.27	acres
17,846	0.41	acres
23,897	0.55	acres
30,889	0.71	acres
34,317	0.79	acres
	-	acres
	-	acres
	-	acres
	-	acres
	-	acres

PRELIMINARY SIZE:

VOLUME = 1/3{(EL2-EL1)*(A1+A2+((A1*A2)^.5))}

							CUMMULATIVE VOLUME:
-	AC-FT	from	7,108	to	7,108		
0.20	AC-FT	from	7,108	to	7,110		0.20
0.67	AC-FT	from	7,110	to	7,112		0.87
0.95	AC-FT	from	7,112	to	7,114		1.82
1.24	AC-FT	from	7,114	to	7,116		3.06
0.74	AC-FT	from	7,116	to	7,117		3.80
-	AC-FT	from	7,117	to	-		3.80
-	AC-FT	from	-	to	-		3.80
-	AC-FT	from	-	to	-		3.80
-	AC-FT	from	-	to	-		3.80
-	AC-FT	from	-	to	-		3.80

*SIZING IS FOR PRELIMINARY PURPOSES ONLY.

VOLUME = 3.80 AC-FT

APPROXIMATE SURFACE AREA REQUIREMENT

POND DEPTH (FT)	POND VOLUME AC-FT		CF	SURFACE AREA (SF)
4	3.80	=	######	41,403
6	3.80	=	######	27,602
8	3.80	=	######	20,702
10	3.80	=	######	16,561

JOB NAME: FOREST LAKES PHASE 2
JOB NUMBER: 1175.21
DATE: 02/19/19
CALCULATED BY: MAL

POND A - TOP OF BERM

POND SIZING WITH PONDPACK EQUATION:
INSERT POND DESIGN SIZE INFO: (RED)

POND ELEVATION : (from lowest to highest)	AREA (BTM to TOP):		
7108.00		-	acres
7108.00	123	0.00	acres
7110.00	11,955	0.27	acres
7112.00	17,846	0.41	acres
7114.00	23,897	0.55	acres
7116.00	30,889	0.71	acres
7118.00	38,385	0.88	acres
7120.00	46,144	1.06	acres
		-	acres
		-	acres
		-	acres
		-	acres

PRELIMINARY SIZE:

VOLUME = 1/3{(EL2-EL1)*(A1+A2+((A1*A2)^.5))}

							CUMMULATIVE VOLUME:
-	AC-FT	from	7,108	to	7,108		
0.20	AC-FT	from	7,108	to	7,110		0.20
0.67	AC-FT	from	7,110	to	7,112		0.87
0.95	AC-FT	from	7,112	to	7,114		1.82
1.24	AC-FT	from	7,114	to	7,116		3.06
1.57	AC-FT	from	7,116	to	7,118		4.63
1.92	AC-FT	from	7,118	to	7,120		6.55
-	AC-FT	from	7,120	to	-		6.55
-	AC-FT	from	-	to	-		6.55
-	AC-FT	from	-	to	-		6.55
-	AC-FT	from	-	to	-		6.55

*SIZING IS FOR PRELIMINARY PURPOSES ONLY.

VOLUME = 6.55 AC-FT

APPROXIMATE SURFACE AREA REQUIREMENT

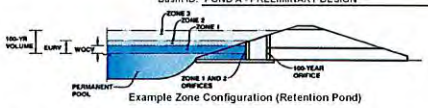
POND DEPTH (FT)	POND VOLUME AC-FT		CF	SURFACE AREA (SF)
4	6.55	=	######	71,341
6	6.55	=	######	47,560
8	6.55	=	######	35,670
10	6.55	=	######	28,536

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Project: FOREST LAKES PHASE 2

Basin ID: POND A - PRELIMINARY DESIGN



Example Zone Configuration (Retention Pond)

Required Volume Calculation

Selected BMP Type =	EDB		
Watershed Area =	37.55	acres	
Watershed Length =	1,300	ft	
Watershed Slope =	0.080	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) =	0.574	acre-feet	
Excess Urban Runoff Volume (EURV) =	1.637	acre-feet	
2-yr Runoff Volume (P1 = 1.19 in.) =	1.295	acre-feet	
5-yr Runoff Volume (P1 = 1.5 in.) =	1.797	acre-feet	
10-yr Runoff Volume (P1 = 1.75 in.) =	2.532	acre-feet	
25-yr Runoff Volume (P1 = 2 in.) =	3.761	acre-feet	
50-yr Runoff Volume (P1 = 2.25 in.) =	4.592	acre-feet	
100-yr Runoff Volume (P1 = 2.52 in.) =	5.682	acre-feet	
500-yr Runoff Volume (P1 = 3.1 in.) =	7.788	acre-feet	
Approximate 2-yr Detention Volume =	1.211	acre-feet	
Approximate 5-yr Detention Volume =	1.687	acre-feet	
Approximate 10-yr Detention Volume =	2.307	acre-feet	
Approximate 25-yr Detention Volume =	2.569	acre-feet	
Approximate 50-yr Detention Volume =	2.695	acre-feet	
Approximate 100-yr Detention Volume =	3.075	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
3.10	inches

Stage-Storage Calculation

Zone 1 Volume (WQCV) =	0.574	acre-feet
Zone 2 Volume (EURV - Zone 1) =	1.063	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	1.438	acre-feet
Total Detention Basin Volume =	3.075	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	

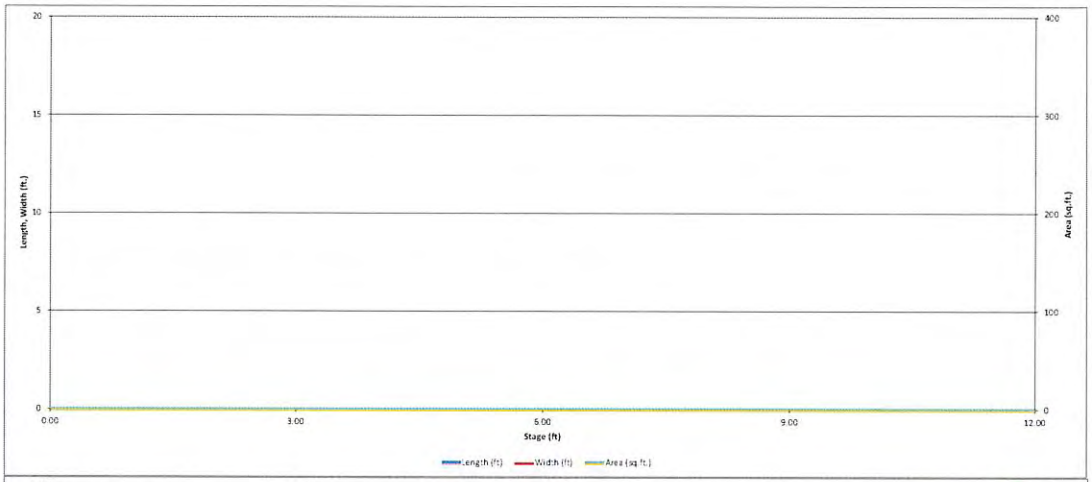
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	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

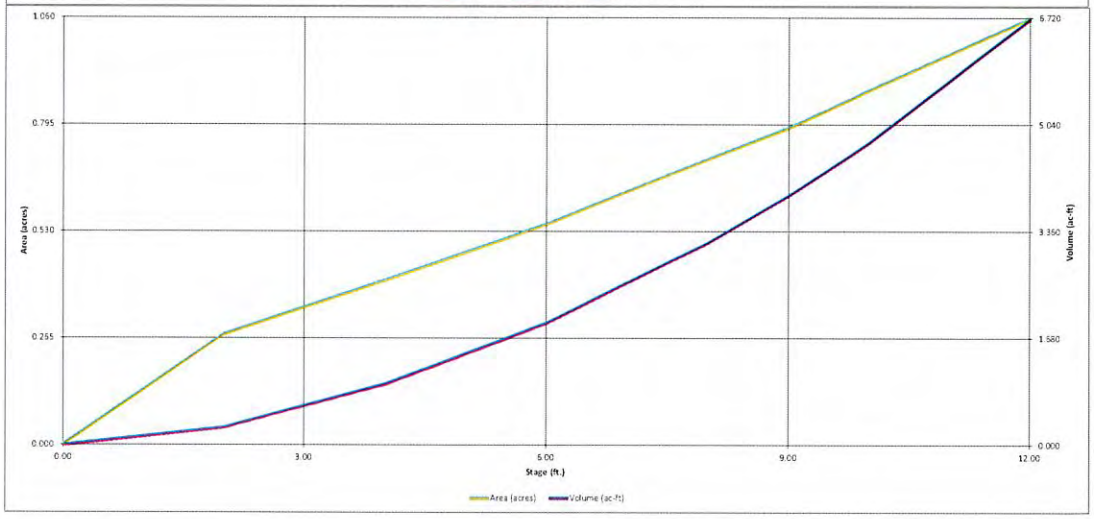
Depth Increment = 0.25 ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	123	0.003		
	--	2.00	--	--	--	11,955	0.274	11,959	0.275
	--	4.00	--	--	--	17,846	0.410	41,879	0.961
	--	6.00	--	--	--	23,897	0.549	83,622	1.920
	--	8.00	--	--	--	30,889	0.709	138,408	3.177
	--	9.00	--	--	--	34,317	0.788	171,011	3.926
	--	10.00	--	--	--	38,385	0.881	207,362	4.760
	--	12.00	--	--	--	46,144	1.059	291,891	6.701

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)



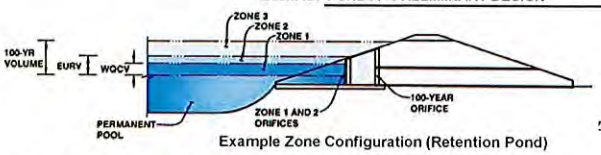


Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project: FOREST LAKES PHASE 2

Basin ID: POND A - PRELIMINARY DESIGN



Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	2.97	0.574	Orifice Plate
Zone 2 (EURV)	5.47	1.063	Orifice Plate
Zone 3 (100-year)	7.86	1.438	Weir&Pipe (Restrict)
		3.075	Total

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

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

Calculated Parameters for Underdrain

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

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

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =	6.00	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	2.00	4.00					
Orifice Area (sq. inches)	3.00	4.00	4.00					

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

User Input: Vertical Orifice (Circular or Rectangular)

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

Calculated Parameters for Vertical Orifice

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

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

	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	6.00	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	4.00	N/A	feet
Overflow Weir Slope =	4.00	N/A	H:V (enter zero for flat grate)
Horiz. Length of Weir Sides =	4.00	N/A	feet
Overflow Grate Open Area % =	85%	N/A	%, grate open area/total area
Debris Clogging % =	50%	N/A	%

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected	
Height of Grate Upper Edge, H_t =	7.00	N/A	feet
Over Flow Weir Slope Length =	4.12	N/A	feet
Grate Open Area / 100-yr Orifice Area =	2.86	N/A	should be ≥ 4
Overflow Grate Open Area w/o Debris =	14.02	N/A	ft^2
Overflow Grate Open Area w/ Debris =	7.01	N/A	ft^2

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

	Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	0.20	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	30.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	30.00		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	4.91	N/A	ft^2
Outlet Orifice Centroid =	1.25	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	3.14	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	9.00	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	45.00	feet
Spillway End Slopes =	10.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Calculated Parameters for Spillway

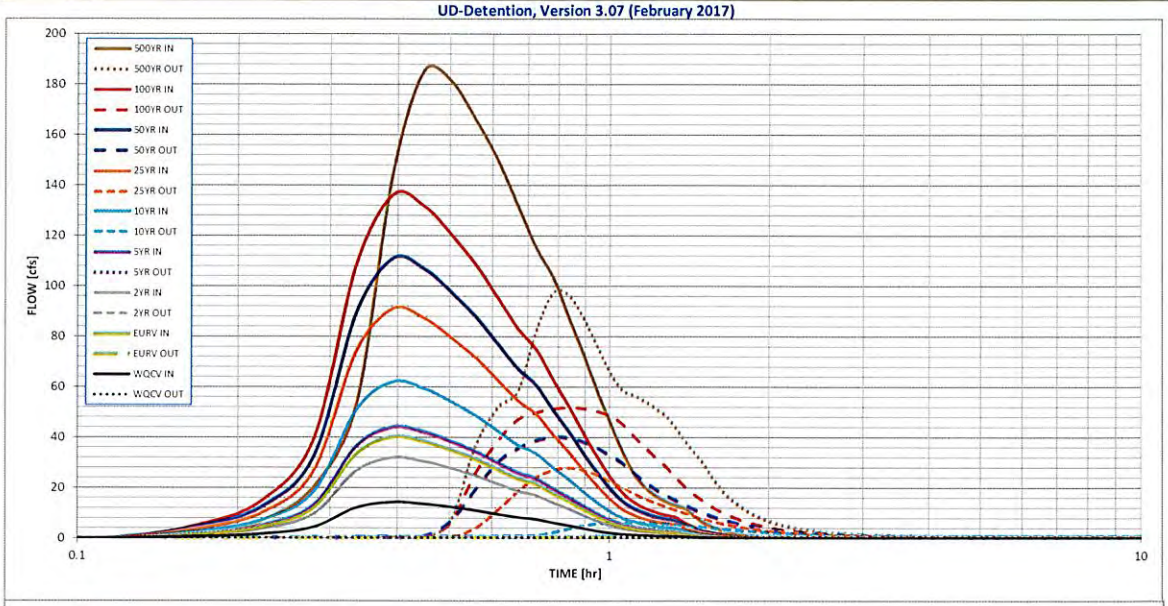
Spillway Design Flow Depth=	0.75	feet
Stage at Top of Freeboard =	10.75	feet
Basin Area at Top of Freeboard =	0.95	acres

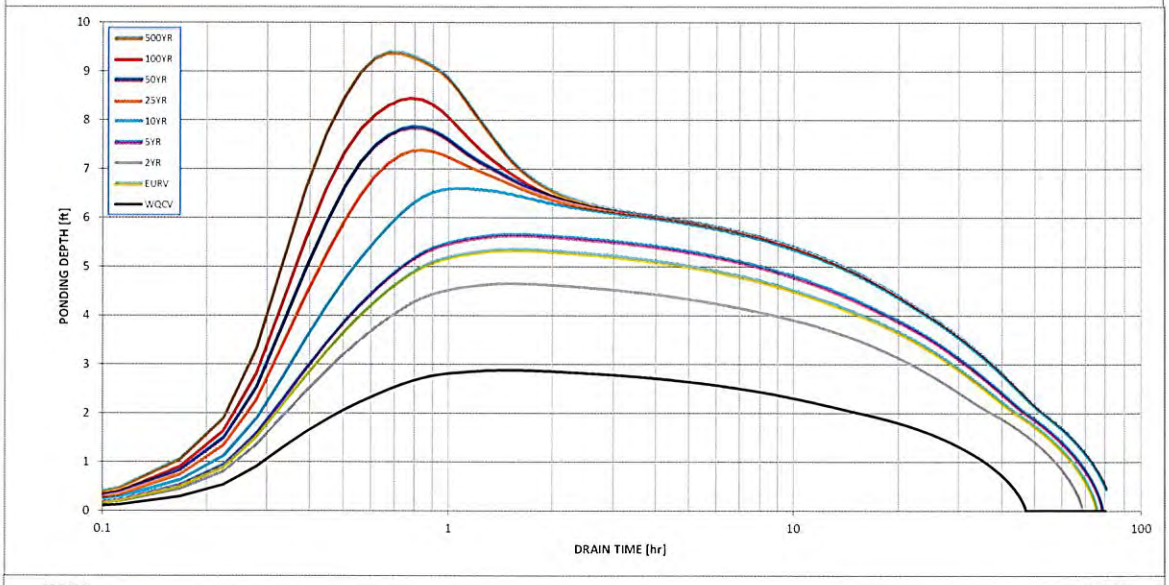
Routed Hydrograph Results

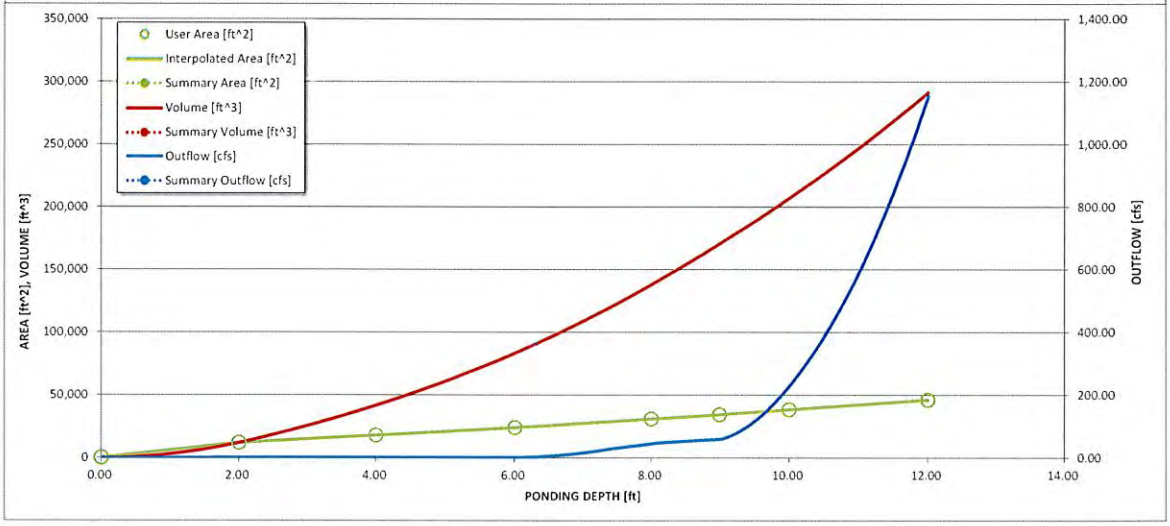
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	3.10
Calculated Runoff Volume (acre-ft) =	0.574	1.637	1.295	1.797	2.532	3.761	4.592	5.682	7.788
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	0.574	1.638	1.296	1.799	2.534	3.766	4.598	5.679	7.789
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.02	0.03	0.31	0.96	1.32	1.76	2.54
Predevelopment Peak Q (cfs) =	0.0	0.0	0.7	1.154	11.7	36.1	49.7	65.9	95.5
Peak Inflow Q (cfs) =	14.2	40.2	31.9	44.0	61.8	91.2	111.0	136.4	185.6
Peak Outflow Q (cfs) =	0.3	0.6	0.5	0.666	6.1	28.1	40.0	52.1	97.5
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.6	0.5	0.8	0.8	0.8	1.0
Structure Controlling Flow =	Plate	Plate	Plate	Plate	Overflow Grate 1	Overflow Grate 1	Overflow Grate 1	Overflow Grate 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	0.4	1.9	2.8	3.6	4.4
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) =	43	67	62	69	72	68	65	62	57
Time to Drain 99% of Inflow Volume (hours) =	45	72	66	75	79	77	76	75	72
Maximum Ponding Depth (ft) =	2.88	5.34	4.65	5.65	6.59	7.40	7.86	8.46	9.38
Area at Maximum Ponding Depth (acres) =	0.33	0.50	0.45	0.52	0.60	0.66	0.70	0.75	0.82
Maximum Volume Stored (acre-ft) =	0.545	1.573	1.242	1.727	2.251	2.766	3.072	3.512	4.232

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)







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

Detention Basin Outlet Structure Design

Outflow Hydrograph Workbook Filename: _____

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

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

	SOURCE	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
3.35 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:03:21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hydrograph	0:06:42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Constant	0:10:03	0.63	1.74	1.39	1.90	2.63	3.82	4.56	5.48	7.13
1.494	0:13:24	1.70	4.73	3.77	5.18	7.22	10.57	12.74	15.47	20.56
	0:16:45	4.37	12.15	9.68	13.31	18.55	27.13	32.70	39.72	52.81
	0:20:06	12.02	33.36	26.57	36.53	50.90	74.38	89.64	108.82	144.51
	0:23:27	14.25	40.16	31.86	44.05	61.77	91.24	110.96	136.40	185.57
	0:26:48	13.59	38.43	30.47	42.17	59.20	87.67	106.93	131.97	180.98
	0:30:09	12.37	34.98	27.74	38.38	53.88	79.79	97.46	120.50	165.75
	0:33:30	11.04	31.38	24.86	34.44	48.43	71.87	87.81	108.61	149.50
	0:36:51	9.53	27.25	21.55	29.92	42.20	62.83	76.87	95.23	131.39
	0:40:12	8.31	23.67	18.74	25.99	36.73	54.82	67.14	83.25	114.99
	0:43:33	7.52	21.47	16.99	23.57	33.25	49.52	60.56	74.97	103.27
	0:46:54	6.20	17.87	14.12	19.64	27.77	41.47	50.81	63.06	87.28
	0:50:15	5.06	14.72	11.60	16.18	22.94	34.34	42.13	52.34	72.54
	0:53:36	3.89	11.50	9.03	12.67	18.05	27.17	33.43	41.67	58.05
	0:56:57	2.89	8.73	6.82	9.63	13.82	20.95	25.86	32.33	45.20
	1:00:18	2.10	6.39	4.97	7.07	10.22	15.62	19.35	24.28	34.12
	1:03:39	1.63	4.87	3.80	5.38	7.72	11.73	14.49	18.11	25.32
	1:07:00	1.34	3.97	3.11	4.38	6.26	9.45	11.63	14.49	20.16
	1:10:21	1.14	3.36	2.63	3.70	5.28	7.96	9.78	12.18	16.91
	1:13:42	1.00	2.94	2.31	3.24	4.61	6.93	8.51	10.58	14.65
	1:17:03	0.90	2.64	2.07	2.90	4.13	6.20	7.60	9.44	13.06
	1:20:24	0.83	2.42	1.91	2.67	3.79	5.68	6.96	8.64	11.93
	1:23:45	0.61	1.78	1.40	1.97	2.80	4.22	5.20	6.50	9.08
	1:27:06	0.45	1.30	1.02	1.43	2.04	3.06	3.76	4.69	6.55
	1:30:27	0.33	0.96	0.75	1.05	1.50	2.26	2.78	3.48	4.86
	1:33:48	0.24	0.71	0.56	0.78	1.11	1.68	2.07	2.59	3.61
	1:37:09	0.17	0.51	0.40	0.57	0.81	1.23	1.52	1.90	2.66
	1:40:30	0.12	0.36	0.29	0.40	0.58	0.88	1.09	1.37	1.92
	1:43:51	0.09	0.26	0.21	0.29	0.42	0.64	0.79	0.99	1.39
	1:47:12	0.06	0.18	0.14	0.20	0.29	0.45	0.55	0.70	0.99
	1:50:33	0.03	0.11	0.09	0.12	0.18	0.29	0.36	0.46	0.65
	1:53:54	0.02	0.06	0.04	0.07	0.10	0.16	0.21	0.26	0.38
	1:57:15	0.01	0.02	0.02	0.03	0.04	0.07	0.10	0.12	0.19
	2:00:36	0.00	0.00	0.00	0.00	0.01	0.02	0.03	0.04	0.06
	2:03:57	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:07:18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:10:39	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:14:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:17:21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:20:42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:24:03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:27:24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:30:45	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:34:06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:37:27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:40:48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:44:09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:47:30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:50:51	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:54:12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:57:33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:00:54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:04:15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:07:36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:10:57	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:14:18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:17:39	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:21:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:24:21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:27:42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:31:03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:34:24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:37:45	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:41:06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:44:27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:47:48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:51:09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:54:30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:57:51	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:01:12	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]

DETENTION POND "B"

CLASSIC
CONSULTING
ENGINEERS & SURVEYORS

Site-Level Low Impact Development (LID) Design Effective Impervious Calculator

LID Credit by Impervious Reduction Factor (IRF) Method

User Input

Calculated cells

***Design Storm: 1-Hour Rain Depth	WQCV Event	0.53	inches
***Minor Storm: 1-Hour Rain Depth	10-Year Event	1.75	inches
***Major Storm: 1-Hour Rain Depth	100-Year Event	2.52	inches
Optional User Defined Storm	CUHP		
(CUHP) NOAA 1 Hour Rainfall Depth and Frequency for User Defined Storm	100-Year Event		
Max Intensity for Optional User Defined Storm	0		

Designer:	Matt Larson
Company:	Classic Consulting Engineers & Surveyors, LLC
Date:	February 18, 2019
Project:	FOREST LAKES - PHASE 2
Location:	POND B - PRELIMINARY DESIGN

SITE INFORMATION (USER-INPUT)

Sub-basin Identifier	TRIB BASIN
Receiving Pervious Area Soil Type	Sandy Loam
Total Area (ac., Sum of DCIA, UIA, RPA, & SPA)	59.940
Directly Connected Impervious Area (DCIA, acres)	15.110
Unconnected Impervious Area (UIA, acres)	2.170
Receiving Pervious Area (RPA, acres)	0.890
Separate Pervious Area (SPA, acres)	41.770
RPA Treatment Type: Conveyance (C), Volume (V), or Permeable Pavement (PP)	C

CALCULATED RESULTS (OUTPUT)

Total Calculated Area (ac, check against input)	59.940
Directly Connected Impervious Area (DCIA, %)	25.2%
Unconnected Impervious Area (UIA, %)	3.6%
Receiving Pervious Area (RPA, %)	1.5%
Separate Pervious Area (SPA, %)	69.7%
A_R (RPA / UIA)	0.410
I_a Check	0.710
f / I for WQCV Event:	2.0
f / I for 10-Year Event:	0.5
f / I for 100-Year Event:	0.3
f / I for Optional User Defined Storm CUHP:	
IRF for WQCV Event:	0.73
IRF for 10-Year Event:	0.93
IRF for 100-Year Event:	0.96
IRF for Optional User Defined Storm CUHP:	
Total Site Imperviousness: I_{total}	28.8%
Effective Imperviousness for WQCV Event:	27.9%
Effective Imperviousness for 10-Year Event:	28.6%
Effective Imperviousness for 100-Year Event:	28.7%
Effective Imperviousness for Optional User Defined Storm CUHP:	

LID / EFFECTIVE IMPERVIOUSNESS CREDITS

WQCV Event CREDIT: Reduce Detention By:	2.2%	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
10-Year Event CREDIT**: Reduce Detention By:	0.9%	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
100-Year Event CREDIT**: Reduce Detention By:	0.5%	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
User Defined CUHP CREDIT: Reduce Detention By:														

Total Site Imperviousness:	28.8%
Total Site Effective Imperviousness for WQCV Event:	27.9%
Total Site Effective Imperviousness for 10-Year Event:	28.6%
Total Site Effective Imperviousness for 100-Year Event:	28.7%
Total Site Effective Imperviousness for Optional User Defined Storm CUHP:	

Notes:

* Use Green-Ampt average infiltration rate values from Table 3-3.

** Flood control detention volume credits based on empirical equations from Storage Chapter of USDCM.

*** Method assumes that 1-hour rainfall depth is equivalent to 1-hour intensity for calculation purposed

Design Procedure Form: Extended Detention Basin (EDB)

Designer:	Matt Larson
Company:	Classic Consulting Engineers & Surveyors, LLC
Date:	February 18, 2019
Project:	FOREST LAKES - PHASE 2
Location:	POND B - PRELIMINARY DESIGN

1. Basin Storage Volume	
A) Effective Imperviousness of Tributary Area, I_a	I_a = 28.8 %
B) Tributary Area's Imperviousness Ratio ($i = I_a / 100$)	i = 0.288
C) Contributing Watershed Area	Area = 59.940 ac
D) For Watersheds Outside of the Denver Region, Depth of Average Runoff Producing Storm	d_6 = 0.42 in
E) Design Concept (Select EURV when also designing for flood control)	Choose One: ○ Water Quality Capture Volume (WQCV) ◉ Excess Urban Runoff Volume (EURV)
F) Design Volume (WQCV) Based on 40-hour Drain Time ($V_{DESIGN} = (1.0 * (0.91 * i^3 - 1.19 * i^2 + 0.78 * i) / 12 * Area$)	V_{DESIGN}= 0.738 ac-ft
G) For Watersheds Outside of the Denver Region, Water Quality Capture Volume (WQCV) Design Volume ($V_{WQCV\ OTHER} = (d_6 * (V_{DESIGN}/0.43))$	$V_{DESIGN\ OTHER}$= 0.720 ac-ft
H) User Input of Water Quality Capture Volume (WQCV) Design Volume (Only if a different WQCV Design Volume is desired)	$V_{DESIGN\ USER}$= ac-ft
I) Predominant Watershed NRCS Soil Group	Choose One: ○ A ◉ B ○ C / D
J) Excess Urban Runoff Volume (EURV) Design Volume For HSG A: $EURV_A = 1.68 * i^{1.28}$ For HSG B: $EURV_B = 1.36 * i^{1.08}$ For HSG C/D: $EURV_{C/D} = 1.20 * i^{1.08}$	EURV = 1.771 ac-ft
2. Basin Shape: Length to Width Ratio (A basin length to width ratio of at least 2:1 will improve TSS reduction.)	L : W = 2.0 : 1
3. Basin Side Slopes	
A) Basin Maximum Side Slopes (Horizontal distance per unit vertical, 4:1 or flatter preferred)	Z = 4.00 ft / ft
4. Inlet	
A) Describe means of providing energy dissipation at concentrated inflow locations:	

Design Procedure Form: Extended Detention Basin (EDB)

Designer:	Matt Larson
Company:	Classic Consulting Engineers & Surveyors, LLC
Date:	November 20, 2018
Project:	FOREST LAKES - PHASE 2
Location:	POND B

5. Forebay	
A) Minimum Forebay Volume (V_{FMIN} = 3% of the WQCV)	V_{FMIN} = 0.022 ac-ft
B) Actual Forebay Volume	V_F = 0.025 ac-ft
C) Forebay Depth (D_F = 18 inch maximum)	D_F = 12.0 in
D) Forebay Discharge	
i) Undetained 100-year Peak Discharge	Q_{100} = 176.00 cfs
ii) Forebay Discharge Design Flow ($Q_F = 0.02 * Q_{100}$)	Q_F = 3.52 cfs
E) Forebay Discharge Design	Choose One: ○Berm With Pipe ◉Wall with Rect. Notch ○Wall with V-Notch Weir (flow too small for berm w/ pipe)
F) Discharge Pipe Size (minimum 8-inches)	Calculated D_P = in
G) Rectangular Notch Width	Calculated W_N = 15.1 in
6. Trickle Channel	
A) Type of Trickle Channel	Choose One: ◉Concrete ○Soft Bottom
F) Slope of Trickle Channel	S = 0.0050 ft / ft
7. Micropool and Outlet Structure	
A) Depth of Micropool (2.5-feet minimum)	D_M = 2.5 ft
B) Surface Area of Microoool (10 ft^2 minimum)	A_M = 250 sq ft
C) Outlet Type	Choose One: ◉Orifice Plate ○Other (Describe):
D) Smallest Dimension of Orifice Opening Based on Hydrograph Routing (Use UD-Detention)	$D_{orifice}$ = 1.00 inches
E) Total Outlet Area	A_{ot} = 6.00 square inches

Design Procedure Form: Extended Detention Basin (EDB)

Designer:	**Matt Larson**
Company:	**Classic Consulting Engineers & Surveyors, LLC**
Date:	**November 20, 2018**
Project:	**FOREST LAKES - PHASE 2**
Location:	**POND B**

8. Initial Surcharge Volume	
A) Depth of Initial Surcharge Volume (Minimum recommended depth is 4 inches)	D_{IS} = 5 in
B) Minimum Initial Surcharge Volume (Minimum volume of 0.3% of the WQCV)	V_{IS} = 94.2 cu ft
C) Initial Surcharge Provided Above Micropool	V_s = 104.2 cu ft
9. Trash Rack	
A) Water Quality Screen Open Area: $A_t = A_{ot} * 38.5*(e^{-0.095D})$	A_t = 210 square inches
B) Type of Screen (If specifying an alternative to the materials recommended in the USDCM, indicate "other" and enter the ratio of the total open are to the total screen are for the material specified.)	*S.S. Well Screen with 60% Open Area*
Other (Y/N): N	
C) Ratio of Total Open Area to Total Area (only for type 'Other')	User Ratio =
D) Total Water Quality Screen Area (based on screen type)	A_{total} = 350 sq. in.
E) Depth of Design Volume (EURV or WQCV) (Based on design concept chosen under 1E)	H= 5.3 feet
F) Height of Water Quality Screen (H_{TR})	H_{TR} = 91.6 inches
G) Width of Water Quality Screen Opening ($W_{opening}$) (Minimum of 12 inches is recommended)	$W_{opening}$ = 12.0 inches

Design Procedure Form: Extended Detention Basin (EDB)

Designer: Matt Larson
Company: Classic Consulting Engineers & Surveyors, LLC
Date: November 20, 2018
Project: FOREST LAKES - PHASE 2
Location: POND B

10. Overflow Embankment	
A) Describe embankment protection for 100-year and greater overtopping:	50' WIDE CONCRETE SPILLWAY AT ELEV. 7061.00
B) Slope of Overflow Embankment (Horizontal distance per unit vertical, 4:1 or flatter preferred)	10.00
11. Vegetation	Choose One: ○ Irrigated ◉ Not Irrigated
12. Access	
A) Describe Sediment Removal Procedures	12' WIDE ACCESS ROAD W/ MIN. 30' CL RADIUS TO POND BOTTOM

Notes:

JOB NAME: FOREST LAKES PHASE 2
JOB NUMBER: 1175.21
DATE: 02/19/19
CALCULATED BY: MAL

POND B EURV

POND SIZING WITH PONDPACK EQUATION:
INSERT POND DESIGN SIZE INFO: (RED)

POND ELEVATION : (from lowest to highest)	AREA (BTM to TOP):		
7054.00		-	acres
7054.00	100	0.00	acres
7056.00	15,020	0.34	acres
7058.00	19,411	0.45	acres
7059.80	24,125	0.55	acres
		-	acres
		-	acres
		-	acres
		-	acres
		-	acres
		-	acres
		-	acres

PRELIMINARY SIZE:

VOLUME = 1/3{(EL2-EL1)*(A1+A2+((A1*A2)^.5))}

						CUMMULATIVE VOLUME:
-	AC-FT	from	7,054	to	7,054	
0.25	AC-FT	from	7,054	to	7,056	0.25
0.78	AC-FT	from	7,056	to	7,058	1.03
0.89	AC-FT	from	7,058	to	7,060	1.92
-	AC-FT	from	7,060	to	-	1.92
-	AC-FT	from	-	to	-	1.92
-	AC-FT	from	-	to	-	1.92
-	AC-FT	from	-	to	-	1.92
-	AC-FT	from	-	to	-	1.92
-	AC-FT	from	-	to	-	1.92
-	AC-FT	from	-	to	-	1.92

*SIZING IS FOR PRELIMINARY PURPOSES ONLY.

VOLUME = 1.92 AC-FT

APPROXIMATE SURFACE AREA REQUIREMENT

POND DEPTH (FT)	POND VOLUME AC-FT		CF	SURFACE AREA (SF)
4	1.92	=	83,497	20,874
6	1.92	=	83,497	13,916
8	1.92	=	83,497	10,437
10	1.92	=	83,497	8,350

JOB NAME: FOREST LAKES PHASE 2
JOB NUMBER: 1175.21
DATE: 02/19/19
CALCULATED BY: MAL

POND B - SPILLWAY

POND SIZING WITH PONDPACK EQUATION:
INSERT POND DESIGN SIZE INFO: (RED)

POND ELEVATION : (from lowest to highest)
7054.00
7054.00
7056.00
7058.00
7060.00
7062.00
7063.00

AREA (BTM to TOP):		
	-	acres
100	0.00	acres
15,020	0.34	acres
19,411	0.45	acres
24,125	0.55	acres
29,262	0.67	acres
31,943	0.73	acres
	-	acres
	-	acres
	-	acres
	-	acres
	-	acres

PRELIMINARY SIZE:

VOLUME = 1/3{(EL2-EL1)*(A1+A2+((A1*A2)^.5))}

						CUMMULATIVE VOLUME:
-	AC-FT	from	7,054	to	7,054	
0.25	AC-FT	from	7,054	to	7,056	0.25
0.78	AC-FT	from	7,056	to	7,058	1.03
0.99	AC-FT	from	7,058	to	7,060	2.02
1.21	AC-FT	from	7,060	to	7,062	3.23
0.70	AC-FT	from	7,062	to	7,063	3.92
-	AC-FT	from	7,063	to	-	3.92
-	AC-FT	from	-	to	-	3.92
-	AC-FT	from	-	to	-	3.92
-	AC-FT	from	-	to	-	3.92
-	AC-FT	from	-	to	-	3.92

*SIZING IS FOR PRELIMINARY PURPOSES ONLY.

VOLUME = 3.92 AC-FT

APPROXIMATE SURFACE AREA REQUIREMENT

POND DEPTH (FT)	POND VOLUME AC-FT		CF	SURFACE AREA (SF)
4	3.92	=	######	42,714
6	3.92	=	######	28,476
8	3.92	=	######	21,357
10	3.92	=	######	17,086

JOB NAME: FOREST LAKES PHASE 2
JOB NUMBER: 1175.21
DATE: 02/19/19
CALCULATED BY: MAL

POND B - TOP OF BERM

POND SIZING WITH PONDPACK EQUATION:
INSERT POND DESIGN SIZE INFO: (RED)

POND ELEVATION : (from lowest to highest)
7054.00
7054.00
7056.00
7058.00
7060.00
7062.00
7064.00
7066.00

AREA (BTM to TOP):		
	-	acres
100	0.00	acres
15,020	0.34	acres
19,411	0.45	acres
24,125	0.55	acres
29,262	0.67	acres
34,880	0.80	acres
40,925	0.94	acres
	-	acres
	-	acres
	-	acres
	-	acres

PRELIMINARY SIZE:

VOLUME = 1/3{(EL2-EL1)*(A1+A2+((A1*A2)^.5))}

						CUMMULATIVE VOLUME:
-	AC-FT	from	7,054	to	7,054	
0.25	AC-FT	from	7,054	to	7,056	0.25
0.78	AC-FT	from	7,056	to	7,058	1.03
0.99	AC-FT	from	7,058	to	7,060	2.02
1.21	AC-FT	from	7,060	to	7,062	3.23
1.46	AC-FT	from	7,062	to	7,064	4.68
1.72	AC-FT	from	7,064	to	7,066	6.40
-	AC-FT	from	7,066	to	-	6.40
-	AC-FT	from	-	to	-	6.40
-	AC-FT	from	-	to	-	6.40
-	AC-FT	from	-	to	-	6.40

*SIZING IS FOR PRELIMINARY PURPOSES ONLY.

VOLUME = 6.40 AC-FT

APPROXIMATE SURFACE AREA REQUIREMENT

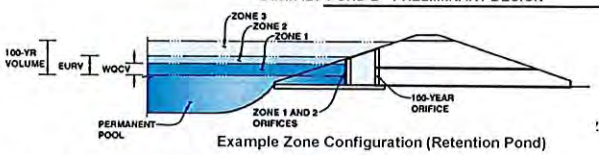
POND DEPTH (FT)	POND VOLUME AC-FT		CF	SURFACE AREA (SF)
4	6.40	=	######	69,739
6	6.40	=	######	46,492
8	6.40	=	######	34,869
10	6.40	=	######	27,895

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project: FOREST LAKES PHASE 2

Basin ID: POND B - PRELIMINARY DESIGN



Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	3.06	0.738	Orifice Plate
Zone 2 (EURV)	5.31	1.028	Orifice Plate
Zone 3 (100-year)	8.75	2.117	Weir&Pipe (Restrict)
		3.883	Total

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

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

Calculated Parameters for Underdrain

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

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

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =	6.00	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	2.00	4.00					
Orifice Area (sq. inches)	4.00	8.00	12.00					

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

User Input: Vertical Orifice (Circular or Rectangular)

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

Calculated Parameters for Vertical Orifice

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

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

	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	6.00	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	6.00	N/A	feet
Overflow Weir Slope =	4.00	N/A	H:V (enter zero for flat grate)
Horiz. Length of Weir Sides =	4.00	N/A	feet
Overflow Grate Open Area % =	85%	N/A	%, grate open area/total area
Debris Clogging % =	50%	N/A	%

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected	
Height of Grate Upper Edge, H_t =	7.00	N/A	feet
Over Flow Weir Slope Length =	4.12	N/A	feet
Grate Open Area / 100-yr Orifice Area =	2.97	N/A	should be ≥ 4
Overflow Grate Open Area w/o Debris =	21.03	N/A	ft^2
Overflow Grate Open Area w/ Debris =	10.51	N/A	ft^2

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

	Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	0.20	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	36.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	36.00		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	7.07	N/A	ft^2
Outlet Orifice Centroid =	1.50	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	3.14	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	9.00	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	50.00	feet
Spillway End Slopes =	10.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Calculated Parameters for Spillway

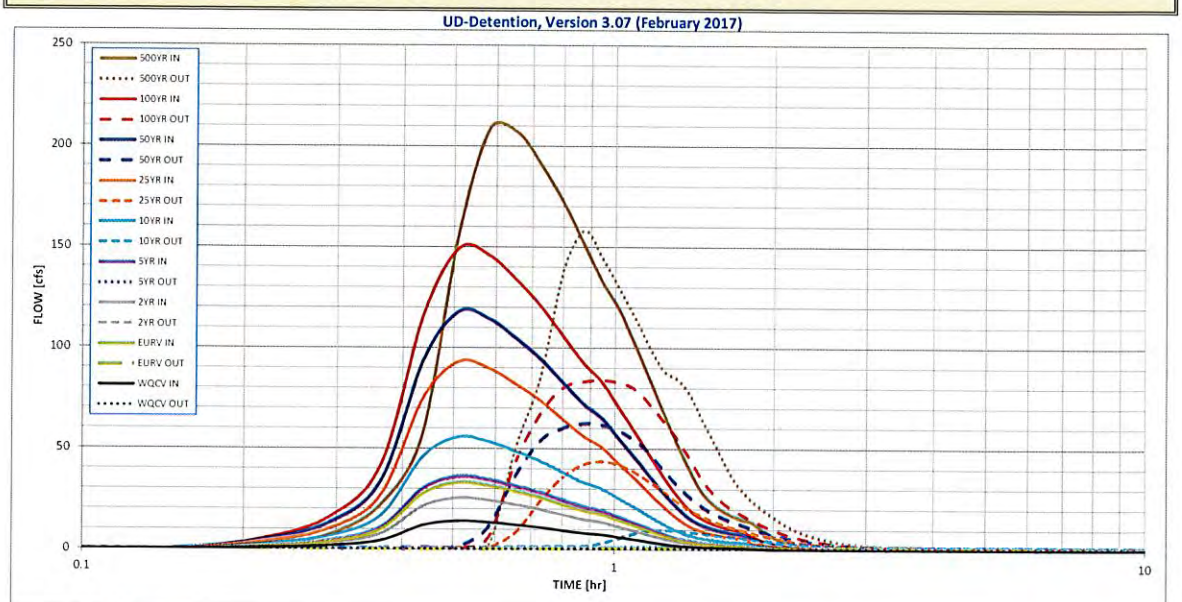
Spillway Design Flow Depth=	0.75	feet
Stage at Top of Freeboard =	10.75	feet
Basin Area at Top of Freeboard =	0.85	acres

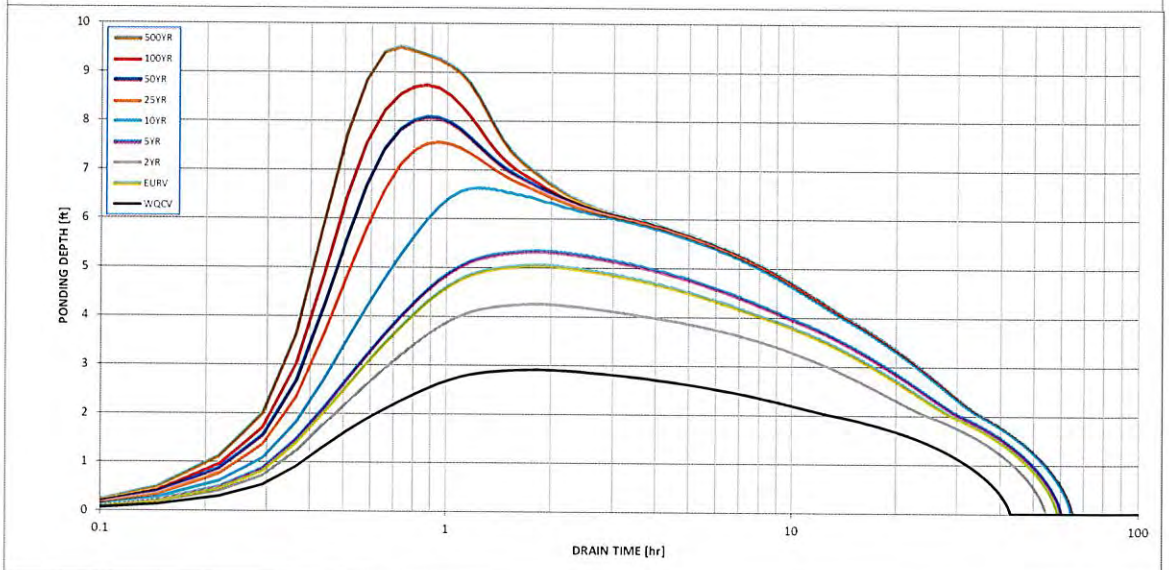
Routed Hydrograph Results

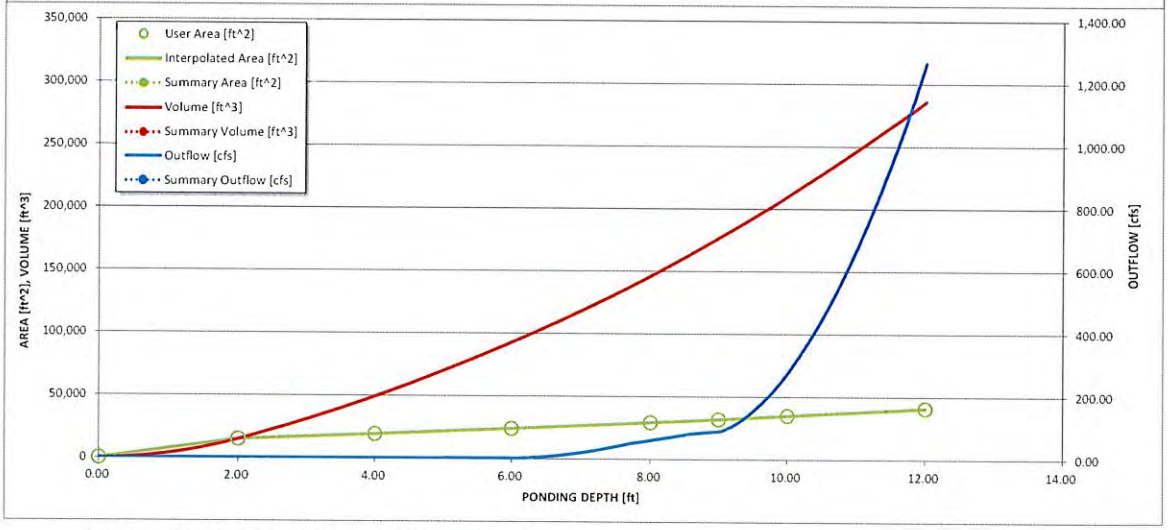
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	3.10
Calculated Runoff Volume (acre-ft) =	0.738	1.766	1.348	1.925	2.971	5.052	6.413	8.194	11.589
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	0.738	1.766	1.349	1.926	2.973	5.054	6.417	8.195	11.597
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.01	0.02	0.23	0.75	1.03	1.38	2.01
Predevelopment Peak Q (cfs) =	0.0	0.0	0.8	1.412	13.8	44.8	61.9	82.9	120.6
Peak Inflow Q (cfs) =	14.0	33.2	25.4	36.1	55.4	93.3	117.8	149.4	209.2
Peak Outflow Q (cfs) =	0.5	1.2	0.9	1.263	9.5	44.0	62.4	84.2	158.2
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.9	0.7	1.0	1.0	1.0	1.3
Structure Controlling Flow =	Plate	Plate	Plate	Plate	Overflow Grate 1	Overflow Grate 1	Overflow Grate 1	Overflow Grate 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	0.4	2.0	2.9	3.9	4.5
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	52	48	52	54	49	46	42	35
Time to Drain 99% of Inflow Volume (hours) =	41	56	52	57	60	58	56	55	52
Maximum Ponding Depth (ft) =	2.91	5.05	4.26	5.34	6.62	7.58	8.08	8.75	9.52
Area at Maximum Ponding Depth (acres) =	0.39	0.50	0.46	0.52	0.59	0.65	0.68	0.72	0.77
Maximum Volume Stored (acre-ft) =	0.678	1.635	1.251	1.783	2.492	3.086	3.410	3.877	4.448

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)







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

Detention Basin Outlet Structure Design

Outflow Hydrograph Workbook Filename: _____

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

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

	SOURCE	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
4.37 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:04:22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hydrograph	0:08:44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Constant	0:13:07	0.62	1.43	1.10	1.55	2.35	3.80	4.66	5.70	7.45
1.145	0:17:29	1.67	3.90	3.00	4.25	6.46	10.66	13.25	16.49	22.31
	0:21:51	4.29	10.02	7.71	10.90	16.59	27.36	34.03	42.35	57.34
	0:26:13	11.77	27.51	21.17	29.93	45.52	74.99	93.18	115.85	156.57
	0:30:35	14.00	33.16	25.41	36.13	55.43	93.32	117.80	149.45	209.20
	0:34:58	13.37	31.74	24.30	34.59	53.16	90.08	114.30	145.97	206.77
	0:39:20	12.17	28.89	22.12	31.49	48.38	82.17	104.48	133.76	190.25
	0:43:42	10.88	25.93	19.83	28.26	43.53	74.05	94.20	120.66	171.74
	0:48:04	9.40	22.52	17.19	24.57	37.97	64.86	82.67	106.09	151.41
	0:52:26	8.19	19.56	14.95	21.34	33.09	56.68	72.30	92.86	132.65
	0:56:49	7.42	17.74	13.56	19.35	29.93	51.09	65.04	83.35	118.66
	1:01:11	6.13	14.78	11.26	16.13	25.02	42.91	54.81	70.50	100.99
	1:05:33	5.01	12.18	9.26	13.30	20.69	35.60	45.52	58.61	84.07
	1:09:55	3.87	9.53	7.22	10.42	16.31	28.29	36.31	46.94	67.69
	1:14:17	2.89	7.25	5.45	7.94	12.53	21.91	28.21	36.57	52.94
	1:18:40	2.09	5.31	3.98	5.83	9.30	16.42	21.23	27.63	40.18
	1:23:02	1.61	4.04	3.04	4.43	7.01	12.28	15.81	20.49	29.63
	1:27:24	1.33	3.30	2.49	3.61	5.67	9.84	12.62	16.30	23.44
	1:31:46	1.13	2.78	2.10	3.05	4.78	8.27	10.60	13.67	19.61
	1:36:08	0.99	2.43	1.84	2.66	4.16	7.19	9.20	11.84	16.94
	1:40:31	0.89	2.18	1.65	2.39	3.73	6.42	8.21	10.55	15.07
	1:44:53	0.82	2.01	1.52	2.19	3.42	5.88	7.50	9.64	13.74
	1:49:15	0.60	1.48	1.12	1.62	2.53	4.41	5.67	7.34	10.64
	1:53:37	0.44	1.08	0.82	1.18	1.84	3.19	4.09	5.30	7.66
	1:57:59	0.32	0.79	0.60	0.87	1.36	2.36	3.03	3.93	5.69
	2:02:22	0.24	0.59	0.44	0.64	1.01	1.75	2.25	2.92	4.22
	2:06:44	0.17	0.43	0.32	0.47	0.74	1.29	1.66	2.15	3.13
	2:11:06	0.12	0.30	0.23	0.33	0.53	0.93	1.20	1.56	2.26
	2:15:28	0.09	0.22	0.16	0.24	0.38	0.67	0.87	1.13	1.64
	2:19:50	0.06	0.15	0.11	0.16	0.26	0.47	0.61	0.80	1.17
	2:24:13	0.03	0.09	0.07	0.10	0.17	0.31	0.40	0.53	0.78
	2:28:35	0.02	0.05	0.04	0.06	0.09	0.18	0.23	0.31	0.47
	2:32:57	0.01	0.02	0.01	0.02	0.04	0.08	0.11	0.15	0.23
	2:37:19	0.00	0.00	0.00	0.00	0.01	0.02	0.03	0.05	0.08
	2:41:41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:46:04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:50:26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:54:48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:59:10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:03:32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:07:55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:12:17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:16:39	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:21:01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:25:23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:29:46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:34:08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:38:30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:42:52	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:47:14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:51:37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:55:59	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:00:21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:04:43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:09:05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:13:28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:17:50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:22:12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:26:34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:56	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:39:41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:44:03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:48:25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:52:47	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:57:10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:01:32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:05:54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:14:38	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.

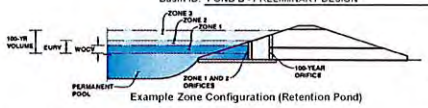
Stage - Storage Description	Stage [ft]	Area [ft^2]	Area [acres]	Volume [ft^3]	Volume [ac-ft]	Total Outflow [cfs]

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Project: FOREST LAKES PHASE 2

Basin ID: POND B - PRELIMINARY DESIGN



Example Zone Configuration (Retention Pond)

Required Volume Calculation

Selected BMP Type =	EDB		
Watershed Area =	59.94	acres	
Watershed Length =	2,300	ft	
Watershed Slope =	0.060	ft/ft	
Watershed Imperviousness =	28.80%	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) =	0.738	acre-feet	
Excess Urban Runoff Volume (EURV) =	1.766	acre-feet	
2-yr Runoff Volume (P1 = 1.19 in.) =	1.348	acre-feet	
5-yr Runoff Volume (P1 = 1.5 in.) =	1.925	acre-feet	
10-yr Runoff Volume (P1 = 1.75 in.) =	2.971	acre-feet	
25-yr Runoff Volume (P1 = 2 in.) =	5.052	acre-feet	
50-yr Runoff Volume (P1 = 2.25 in.) =	6.413	acre-feet	
100-yr Runoff Volume (P1 = 2.52 in.) =	8.194	acre-feet	
500-yr Runoff Volume (P1 = 3.1 in.) =	11.589	acre-feet	
Approximate 2-yr Detention Volume =	1.258	acre-feet	
Approximate 5-yr Detention Volume =	1.806	acre-feet	
Approximate 10-yr Detention Volume =	2.659	acre-feet	
Approximate 25-yr Detention Volume =	3.102	acre-feet	
Approximate 50-yr Detention Volume =	3.270	acre-feet	
Approximate 100-yr Detention Volume =	3.883	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
3.10	inches

Stage-Storage Calculation

Zone 1 Volume (WQCV) =	0.738	acre-feet
Zone 2 Volume (EURV - Zone 1) =	1.028	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	2.117	acre-feet
Total Detention Basin Volume =	3.883	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	

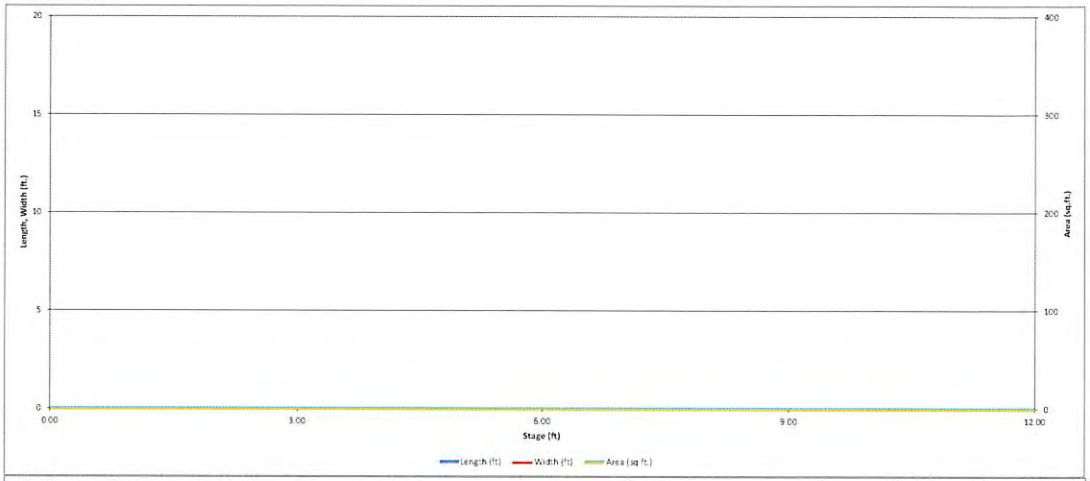
Initial Surcharge Area (A_{SV}) =	user	ft^2
Surcharge Volume Length (L_{SV}) =	user	ft
Surcharge Volume Width (W_{SV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	ft^2
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

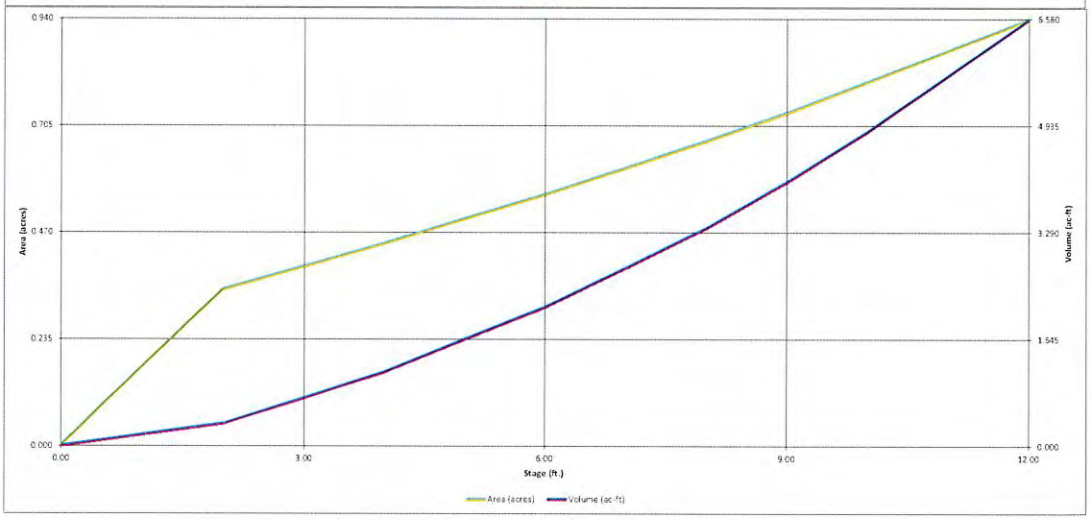
Depth Increment = 0.25 ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	100	0.002		
	--	2.00	--	--	--	15,020	0.345	14,970	0.344
	--	4.00	--	--	--	19,411	0.446	49,551	1.138
	--	6.00	--	--	--	24,125	0.554	93,087	2.137
	--	8.00	--	--	--	29,262	0.672	146,474	3.363
	--	9.00	--	--	--	31,943	0.733	177,076	4.065
	--	10.00	--	--	--	34,880	0.801	210,488	4.832
	--	12.00	--	--	--	40,925	0.940	286,293	6.572

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)





DETENTION POND "C"

CLASSIC
CONSULTING
ENGINEERS & SURVEYORS

Worksheet Protected

Site-Level Low Impact Development (LID) Design Effective Impervious Calculator

LID Credit by Impervious Reduction Factor (IRF) Method

User Input

Calculated cells

***Design Storm: 1-Hour Rain Depth	WQCV Event	0.53	inches
***Minor Storm: 1-Hour Rain Depth	10-Year Event	1.75	inches
***Major Storm: 1-Hour Rain Depth	100-Year Event	2.52	inches
Optional User Defined Storm	CUHP		
(CUHP) NOAA 1 Hour Rainfall Depth and Frequency for User Defined Storm	100-Year Event		
Max Intensity for Optional User Defined Storm	0		

Designer:	Matt Larson
Company:	Classic Consulting Engineers & Surveyors, LLC
Date:	February 18, 2019
Project:	FOREST LAKES - PHASE 2
Location:	POND C - PRELIMINARY DESIGN

SITE INFORMATION (USER-INPUT)

Sub-basin Identifier	TRIB BASIN
Receiving Pervious Area Soil Type	Sandy Loam
Total Area (ac., Sum of DCIA, UIA, RPA, & SPA)	30.280
Directly Connected Impervious Area (DCIA, acres)	9.570
Unconnected Impervious Area (UIA, acres)	1.170
Receiving Pervious Area (RPA, acres)	0.480
Separate Pervious Area (SPA, acres)	19.060
RPA Treatment Type: Conveyance (C), Volume (V), or Permeable Pavement (PP)	C

CALCULATED RESULTS (OUTPUT)

Total Calculated Area (ac, check against input)	30.280
Directly Connected Impervious Area (DCIA, %)	31.6%
Unconnected Impervious Area (UIA, %)	3.9%
Receiving Pervious Area (RPA, %)	1.6%
Separate Pervious Area (SPA, %)	62.9%
A_R (RPA / UIA)	0.410
I_a Check	0.710
f / I for WQCV Event:	2.0
f / I for 10-Year Event:	0.5
f / I for 100-Year Event:	0.3
f / I for Optional User Defined Storm CUHP:	
IRF for WQCV Event:	0.73
IRF for 10-Year Event:	0.93
IRF for 100-Year Event:	0.96
IRF for Optional User Defined Storm CUHP:	
Total Site Imperviousness: I_{total}	35.5%
Effective Imperviousness for WQCV Event:	34.4%
Effective Imperviousness for 10-Year Event:	35.2%
Effective Imperviousness for 100-Year Event:	35.3%
Effective Imperviousness for Optional User Defined Storm CUHP:	

LID / EFFECTIVE IMPERVIOUSNESS CREDITS

WQCV Event CREDIT: Reduce Detention By:	1.8%	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
10-Year Event CREDIT**: Reduce Detention By:	0.8%	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
100-Year Event CREDIT**: Reduce Detention By:	0.4%	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
User Defined CUHP CREDIT: Reduce Detention By:														

Total Site Imperviousness:	35.5%
Total Site Effective Imperviousness for WQCV Event:	34.4%
Total Site Effective Imperviousness for 10-Year Event:	35.2%
Total Site Effective Imperviousness for 100-Year Event:	35.3%
Total Site Effective Imperviousness for Optional User Defined Storm CUHP:	

Notes:

* Use Green-Ampt average infiltration rate values from Table 3-3.

** Flood control detention volume credits based on empirical equations from Storage Chapter of USDCM.

*** Method assumes that 1-hour rainfall depth is equivalent to 1-hour intensity for calculation purposed

Design Procedure Form: Extended Detention Basin (EDB)

Designer:	**Matt Larson**
Company:	**Classic Consulting Engineers & Surveyors, LLC**
Date:	**February 18, 2019**
Project:	**FOREST LAKES - PHASE 2**
Location:	**POND C - PRELIMINARY DESIGN**

1. Basin Storage Volume	
A) Effective Imperviousness of Tributary Area, I_a	I_a = 35.5 %
B) Tributary Area's Imperviousness Ratio ($i = I_a / 100$)	i = 0.355
C) Contributing Watershed Area	Area = 30.280 ac
D) For Watersheds Outside of the Denver Region, Depth of Average Runoff Producing Storm	d_6 = 0.42 in
E) Design Concept (Select EURV when also designing for flood control)	Choose One: ○ Water Quality Capture Volume (WQCV) ◉ Excess Urban Runoff Volume (EURV)
F) Design Volume (WQCV) Based on 40-hour Drain Time ($V_{DESIGN} = (1.0 * (0.91 * i^3 - 1.19 * i^2 + 0.78 * i) / 12 * Area$)	V_{DESIGN}= 0.423 ac-ft
G) For Watersheds Outside of the Denver Region, Water Quality Capture Volume (WQCV) Design Volume ($V_{WQCV\ OTHER} = (d_6 * (V_{DESIGN}/0.43))$	$V_{DESIGN\ OTHER}$= 0.413 ac-ft
H) User Input of Water Quality Capture Volume (WQCV) Design Volume (Only if a different WQCV Design Volume is desired)	$V_{DESIGN\ USER}$= ac-ft
I) Predominant Watershed NRCS Soil Group	Choose One: ○ A ◉ B ○ C / D
J) Excess Urban Runoff Volume (EURV) Design Volume For HSG A: $EURV_A = 1.68 * i^{1.28}$ For HSG B: $EURV_B = 1.36 * i^{1.08}$ For HSG C/D: $EURV_{C/D} = 1.20 * i^{1.08}$	EURV = 1.121 ac-ft
2. Basin Shape: Length to Width Ratio (A basin length to width ratio of at least 2:1 will improve TSS reduction.)	L : W = 2.0 : 1
3. Basin Side Slopes	
A) Basin Maximum Side Slopes (Horizontal distance per unit vertical, 4:1 or flatter preferred)	Z = 4.00 ft / ft
4. Inlet	
A) Describe means of providing energy dissipation at concentrated inflow locations:	

Design Procedure Form: Extended Detention Basin (EDB)

Designer:	Matt Larson
Company:	Classic Consulting Engineers & Surveyors, LLC
Date:	November 20, 2018
Project:	FOREST LAKES - PHASE 2
Location:	POND C

5. Forebay	
A) Minimum Forebay Volume (V_{FMIN} = 3% of the WQCV)	V_{FMIN} = 0.012 ac-ft
B) Actual Forebay Volume	V_F = 0.015 ac-ft
C) Forebay Depth (D_F = 18 inch maximum)	D_F = 12.0 in
D) Forebay Discharge	
i) Undetained 100-year Peak Discharge	Q_{100} = 117.20 cfs
ii) Forebay Discharge Design Flow ($Q_F = 0.02 * Q_{100}$)	Q_F = 2.34 cfs
E) Forebay Discharge Design	Choose One: ○Berm With Pipe ◉Wall with Rect. Notch ○Wall with V-Notch Weir (flow too small for berm w/ pipe)
F) Discharge Pipe Size (minimum 8-inches)	Calculated D_L = in
G) Rectangular Notch Width	Calculated W_N = 10.8 in
6. Trickle Channel	
A) Type of Trickle Channel	Choose One: ◉Concrete ○Soft Bottom
F) Slope of Trickle Channel	S = 0.0050 ft / ft
7. Micropool and Outlet Structure	
A) Depth of Micropool (2.5-feet minimum)	D_M = 2.5 ft
B) Surface Area of Micropool (10 ft^2 minimum)	A_M = 250 sq ft
C) Outlet Type	Choose One: ◉Orifice Plate ○Other (Describe):
D) Smallest Dimension of Orifice Opening Based on Hydrograph Routing (Use UD-Detention)	$D_{orifice}$ = 1.00 inches
E) Total Outlet Area	A_{ot} = 6.00 square inches

Design Procedure Form: Extended Detention Basin (EDB)

Designer:	**Matt Larson**
Company:	**Classic Consulting Engineers & Surveyors, LLC**
Date:	**November 20, 2018**
Project:	**FOREST LAKES - PHASE 2**
Location:	**POND C**

8. Initial Surcharge Volume	
A) Depth of Initial Surcharge Volume (Minimum recommended depth is 4 inches)	D_{IS} = 4 in
B) Minimum Initial Surcharge Volume (Minimum volume of 0.3% of the WQCV)	V_{IS} = 54.0 cu ft
C) Initial Surcharge Provided Above Micropool	V_s = 83.3 cu ft
9. Trash Rack	
A) Water Quality Screen Open Area: $A_t = A_{ot} * 38.5*(e^{-0.095D})$	A_t = 210 square inches
B) Type of Screen (If specifying an alternative to the materials recommended in the USDCM, indicate "other" and enter the ratio of the total open are to the total screen are for the material specified.)	*S.S. Well Screen with 60% Open Area*
Other (Y/N): N	
C) Ratio of Total Open Area to Total Area (only for type 'Other')	User Ratio =
D) Total Water Quality Screen Area (based on screen type)	A_{total} = 350 sq. in.
E) Depth of Design Volume (EURV or WQCV) (Based on design concept chosen under 1E)	H= 5 feet
F) Height of Water Quality Screen (H_{TR})	H_{TR} = 88 inches
G) Width of Water Quality Screen Opening ($W_{opening}$) (Minimum of 12 inches is recommended)	$W_{opening}$ = 12.0 inches

Design Procedure Form: Extended Detention Basin (EDB)

Designer: Matt Larson
Company: Classic Consulting Engineers & Surveyors, LLC
Date: November 20, 2018
Project: FOREST LAKES - PHASE 2
Location: POND C

10. Overflow Embankment	
A) Describe embankment protection for 100-year and greater overtopping:	38' WIDE SPILLWAY AT ELEV. 7039.00
B) Slope of Overflow Embankment (Horizontal distance per unit vertical, 4:1 or flatter preferred)	10.00
11. Vegetation	Choose One: ○ Irrigated ◉ Not Irrigated
12. Access	
A) Describe Sediment Removal Procedures	12' WIDE ACCESS ROAD W/ MIN. 30' CL RADIUS TO POND BOTTOM

Notes:

JOB NAME: FOREST LAKES PHASE 2
JOB NUMBER: 1175.21
DATE: 02/19/19
CALCULATED BY: MAL

POND C EURV

POND SIZING WITH PONDPACK EQUATION:
INSERT POND DESIGN SIZE INFO: (RED)

POND ELEVATION : (from lowest to highest)	AREA (BTM to TOP):		
7030.00		-	acres
7030.00	390	0.01	acres
7032.00	16,854	0.39	acres
7034.00	22,197	0.51	acres
		-	acres
		-	acres
		-	acres
		-	acres
		-	acres
		-	acres
		-	acres
		-	acres

PRELIMINARY SIZE:

VOLUME = 1/3{(EL2-EL1)*(A1+A2+((A1*A2)^.5))}

						CUMMULATIVE VOLUME:
-	AC-FT	from	7,030	to	7,030	
0.30	AC-FT	from	7,030	to	7,032	0.30
0.88	AC-FT	from	7,032	to	7,034	1.18
-	AC-FT	from	7,034	to	-	1.18
-	AC-FT	from	-	to	-	1.18
-	AC-FT	from	-	to	-	1.18
-	AC-FT	from	-	to	-	1.18
-	AC-FT	from	-	to	-	1.18
-	AC-FT	from	-	to	-	1.18
-	AC-FT	from	-	to	-	1.18
-	AC-FT	from	-	to	-	1.18

*SIZING IS FOR PRELIMINARY PURPOSES ONLY.

VOLUME = 1.18 AC-FT

APPROXIMATE SURFACE AREA REQUIREMENT

POND DEPTH (FT)	POND VOLUME AC-FT		CF	SURFACE AREA (SF)
4	1.18	=	51,612	12,903
6	1.18	=	51,612	8,602
8	1.18	=	51,612	6,452
10	1.18	=	51,612	5,161

JOB NAME: FOREST LAKES PHASE 2
JOB NUMBER: 1175.21
DATE: 02/19/19
CALCULATED BY: MAL

POND C - SPILLWAY

POND SIZING WITH PONDPACK EQUATION:
INSERT POND DESIGN SIZE INFO: (RED)

POND ELEVATION : (from lowest to highest)
7030.00
7030.00
7032.00
7034.00
7036.00
7038.00
7039.00

AREA (BTM to TOP):		
	-	acres
390	0.01	acres
16,854	0.39	acres
22,197	0.51	acres
28,151	0.65	acres
34,588	0.79	acres
37,856	0.87	acres
	-	acres
	-	acres
	-	acres
	-	acres
	-	acres

PRELIMINARY SIZE:

VOLUME = 1/3{(EL2-EL1)*(A1+A2+((A1*A2)^.5))}

						CUMMULATIVE VOLUME:
-	AC-FT	from	7,030	to	7,030	
0.30	AC-FT	from	7,030	to	7,032	0.30
0.88	AC-FT	from	7,032	to	7,034	1.18
1.14	AC-FT	from	7,034	to	7,036	2.33
1.42	AC-FT	from	7,036	to	7,038	3.75
0.82	AC-FT	from	7,038	to	7,039	4.57
-	AC-FT	from	7,039	to	-	4.57
-	AC-FT	from	-	to	-	4.57
-	AC-FT	from	-	to	-	4.57
-	AC-FT	from	-	to	-	4.57
-	AC-FT	from	-	to	-	4.57

*SIZING IS FOR PRELIMINARY PURPOSES ONLY.

VOLUME = 4.57 AC-FT

APPROXIMATE SURFACE AREA REQUIREMENT

POND DEPTH (FT)	POND VOLUME AC-FT		CF	SURFACE AREA (SF)
4	4.57	=	######	49,797
6	4.57	=	######	33,198
8	4.57	=	######	24,899
10	4.57	=	######	19,919

JOB NAME: FOREST LAKES PHASE 2
JOB NUMBER: 1175.21
DATE: 02/19/19
CALCULATED BY: MAL

POND C - TOP OF BERM

POND SIZING WITH PONDPACK EQUATION:
INSERT POND DESIGN SIZE INFO: (RED)

POND ELEVATION : (from lowest to highest)
7030.00
7030.00
7032.00
7034.00
7036.00
7038.00
7040.00
7042.00

AREA (BTM to TOP):		
	-	acres
390	0.01	acres
16,854	0.39	acres
22,197	0.51	acres
28,151	0.65	acres
34,588	0.79	acres
41,409	0.95	acres
48,674	1.12	acres
	-	acres
	-	acres
	-	acres
	-	acres

PRELIMINARY SIZE:

VOLUME = 1/3{(EL2-EL1)*(A1+A2+((A1*A2)^.5))}

						CUMMULATIVE VOLUME:
-	AC-FT	from	7,030	to	7,030	
0.30	AC-FT	from	7,030	to	7,032	0.30
0.88	AC-FT	from	7,032	to	7,034	1.18
1.14	AC-FT	from	7,034	to	7,036	2.33
1.42	AC-FT	from	7,036	to	7,038	3.75
1.72	AC-FT	from	7,038	to	7,040	5.47
2.05	AC-FT	from	7,040	to	7,042	7.52
-	AC-FT	from	7,042	to	-	7.52
-	AC-FT	from	-	to	-	7.52
-	AC-FT	from	-	to	-	7.52
-	AC-FT	from	-	to	-	7.52

*SIZING IS FOR PRELIMINARY PURPOSES ONLY.

VOLUME = 7.52 AC-FT

APPROXIMATE SURFACE AREA REQUIREMENT

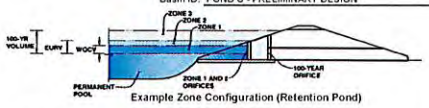
POND DEPTH (FT)	POND VOLUME AC-FT		CF	SURFACE AREA (SF)
4	7.52	=	######	81,891
6	7.52	=	######	54,594
8	7.52	=	######	40,945
10	7.52	=	######	32,756

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Project: FOREST LAKES PHASE 2

Basin ID: POND C - PRELIMINARY DESIGN



Example Zone Configuration (Retention Pond)

Required Volume Calculation

Selected BMP Type =	EDB	
Watershed Area =	30.28	acres
Watershed Length =	2,100	ft
Watershed Slope =	0.065	ft/ft
Watershed Imperviousness =	35.50%	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) =	0.423	acre-feet
Excess Urban Runoff Volume (EURV) =	1.118	acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.871	acre-feet
5-yr Runoff Volume (P1 = 1.5 in.) =	1.224	acre-feet
10-yr Runoff Volume (P1 = 1.75 in.) =	1.789	acre-feet
25-yr Runoff Volume (P1 = 2 in.) =	2.808	acre-feet
50-yr Runoff Volume (P1 = 2.25 in.) =	3.486	acre-feet
100-yr Runoff Volume (P1 = 2.52 in.) =	4.375	acre-feet
500-yr Runoff Volume (P1 = 3.1 in.) =	6.081	acre-feet
Approximate 2-yr Detention Volume =	0.814	acre-feet
Approximate 5-yr Detention Volume =	1.148	acre-feet
Approximate 10-yr Detention Volume =	1.617	acre-feet
Approximate 25-yr Detention Volume =	1.833	acre-feet
Approximate 50-yr Detention Volume =	1.927	acre-feet
Approximate 100-yr Detention Volume =	2.238	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
3.10	inches

Stage-Storage Calculation

Zone 1 Volume (WQCV) =	0.423	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.695	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	1.120	acre-feet
Total Detention Basin Volume =	2.238	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	

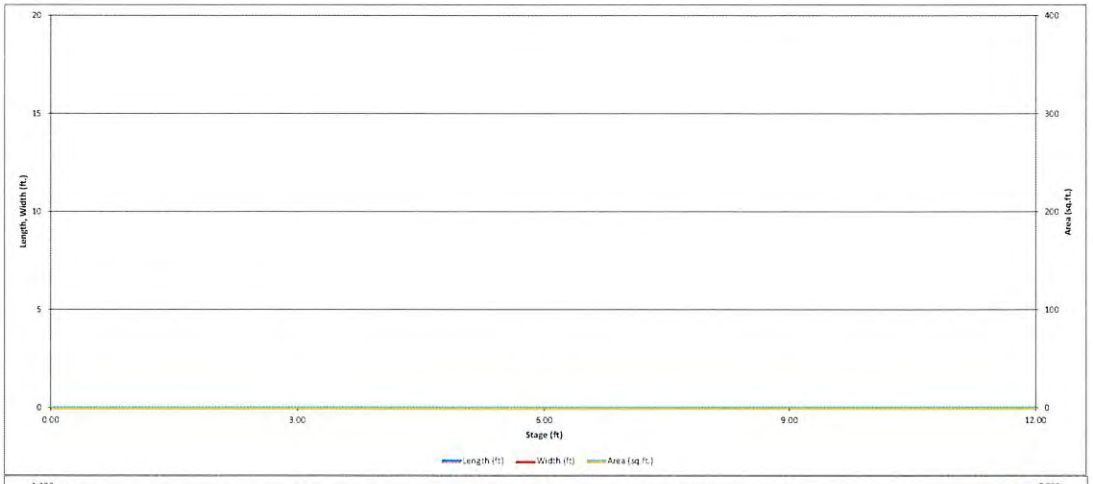
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	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

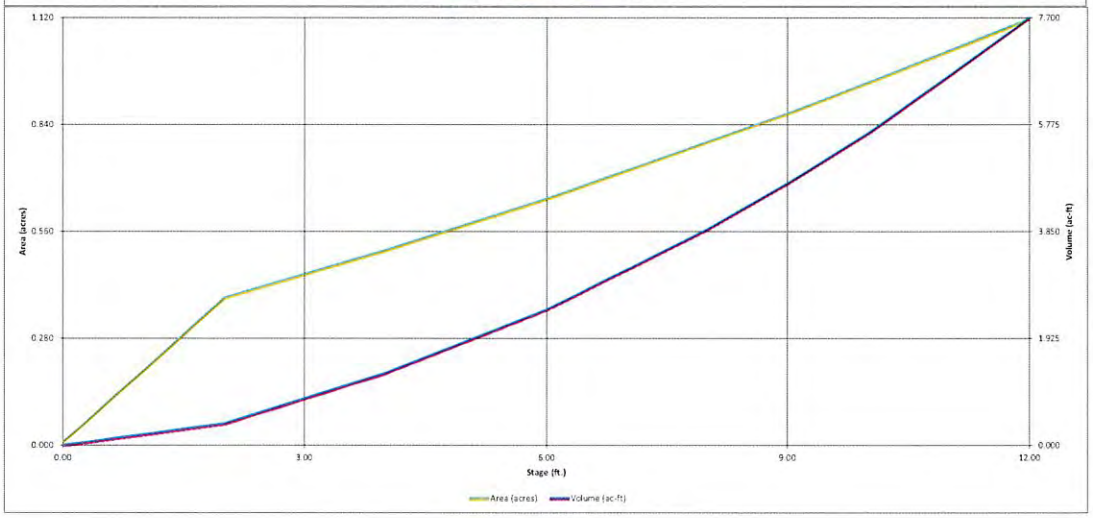
Depth Increment = 0.25 ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	390	0.009		
	--	2.00	--	--	--	16,854	0.387	17,076	0.392
	--	4.00	--	--	--	22,197	0.510	56,295	1.292
	--	6.00	--	--	--	28,151	0.646	106,643	2.448
	--	8.00	--	--	--	34,588	0.794	169,382	3.888
	--	9.00	--	--	--	37,856	0.869	205,604	4.720
	--	10.00	--	--	--	41,409	0.951	245,236	5.630
	--	12.00	--	--	--	48,674	1.117	335,319	7.698

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)



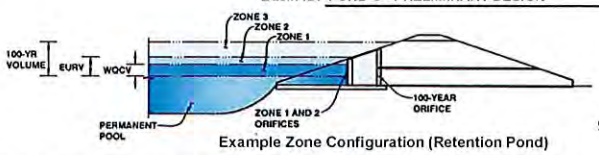


Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project: FOREST LAKES PHASE 2

Basin ID: POND C - PRELIMINARY DESIGN



Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	2.07	0.423	Orifice Plate
Zone 2 (EURV)	3.66	0.695	Orifice Plate
Zone 3 (100-year)	5.67	1.120	Weir&Pipe (Restrict)
		2.238	Total

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

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

Calculated Parameters for Underdrain

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

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

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =	4.00	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	1.33	2.66					
Orifice Area (sq. inches)	3.00	3.00	6.00					

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

User Input: Vertical Orifice (Circular or Rectangular)

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

Calculated Parameters for Vertical Orifice

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

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

	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	4.00	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	6.00	N/A	feet
Overflow Weir Slope =	4.00	N/A	H:V (enter zero for flat grate)
Horiz. Length of Weir Sides =	4.00	N/A	feet
Overflow Grate Open Area % =	85%	N/A	%, grate open area/total area
Debris Clogging % =	50%	N/A	%

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected	
Height of Grate Upper Edge, H_t =	5.00	N/A	feet
Over Flow Weir Slope Length =	4.12	N/A	feet
Grate Open Area / 100-yr Orifice Area =	6.69	N/A	should be ≥ 4
Overflow Grate Open Area w/o Debris =	21.03	N/A	ft^2
Overflow Grate Open Area w/ Debris =	10.51	N/A	ft^2

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

	Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	0.20	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	24.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	24.00		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	3.14	N/A	ft^2
Outlet Orifice Centroid =	1.00	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	3.14	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	9.00	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	38.00	feet
Spillway End Slopes =	10.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Calculated Parameters for Spillway

Spillway Design Flow Depth=	0.65	feet
Stage at Top of Freeboard =	10.65	feet
Basin Area at Top of Freeboard =	1.00	acres

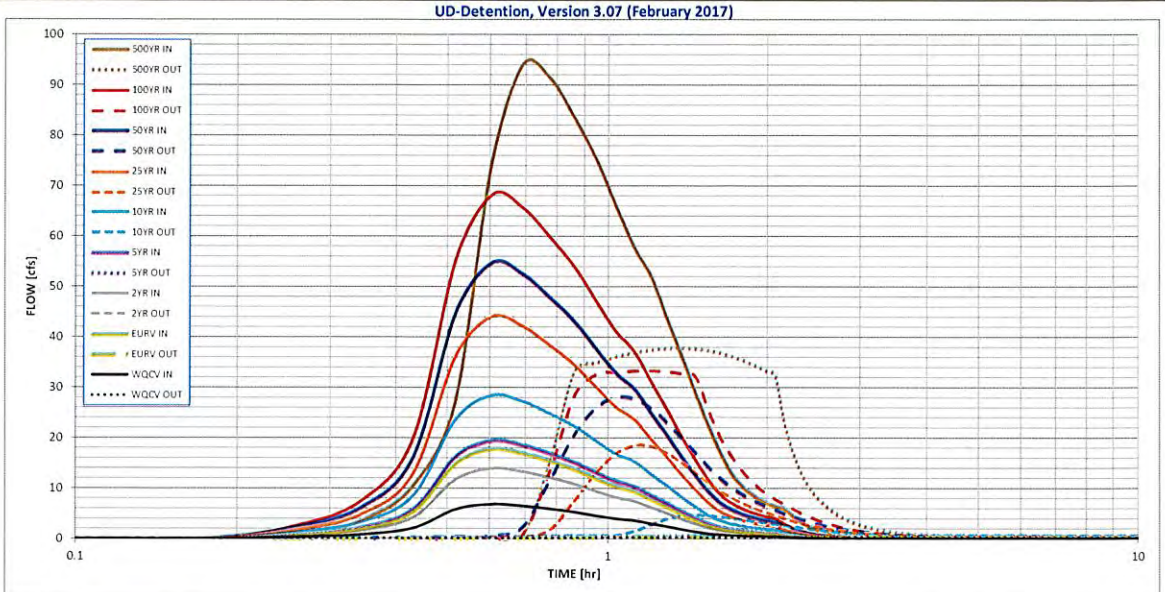
Routed Hydrograph Results

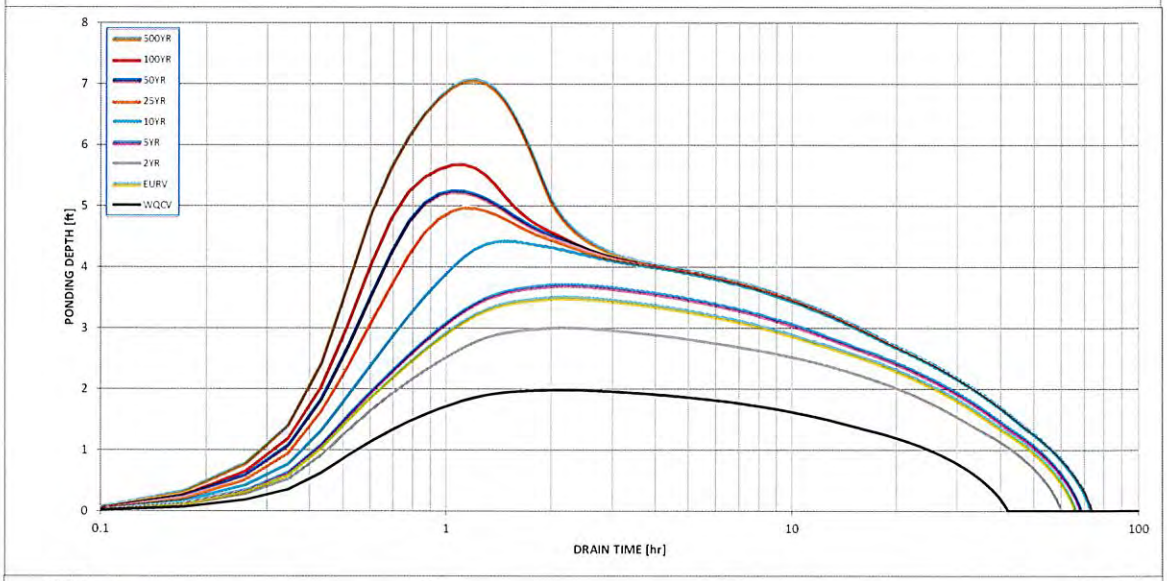
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	3.10
Calculated Runoff Volume (acre-ft) =	0.423	1.118	0.871	1.224	1.789	2.808	3.486	4.375	6.081
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	0.423	1.118	0.871	1.223	1.790	2.809	3.487	4.377	6.075
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.01	0.02	0.18	0.62	0.86	1.16	1.69
Predevelopment Peak Q (cfs) =	0.0	0.0	0.3	0.585	5.6	18.8	26.0	35.1	51.2
Peak Inflow Q (cfs) =	6.8	17.8	13.9	19.5	28.3	44.2	54.[illegible]	68.4	94.2
Peak Outflow Q (cfs) =	0.2	0.5	0.4	0.553	4.6	18.7	28.0	33.5	37.9
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.9	0.8	1.0	1.1	1.0	0.7
Structure Controlling Flow =	Plate	Plate	Plate	Plate	Overflow Grate 1	Overflow Grate 1	Overflow Grate 1	Outlet Plate 1	Outlet Plate 1
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	0.2	0.8	1.3	1.6	1.8
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	38	59	54	60	62	58	56	53	48
Time to Drain 99% of Inflow Volume (hours) =	40	63	57	65	68	66	65	64	62
Maximum Ponding Depth (ft) =	1.99	3.50	3.00	3.71	4.42	4.98	5.24	5.70	7.07
Area at Maximum Ponding Depth (acres) =	0.38	0.48	0.45	0.49	0.54	0.58	0.59	0.63	0.73
Maximum Volume Stored (acre-ft) =	0.388	1.045	0.813	1.142	1.507	1.825	1.977	2.251	3.182

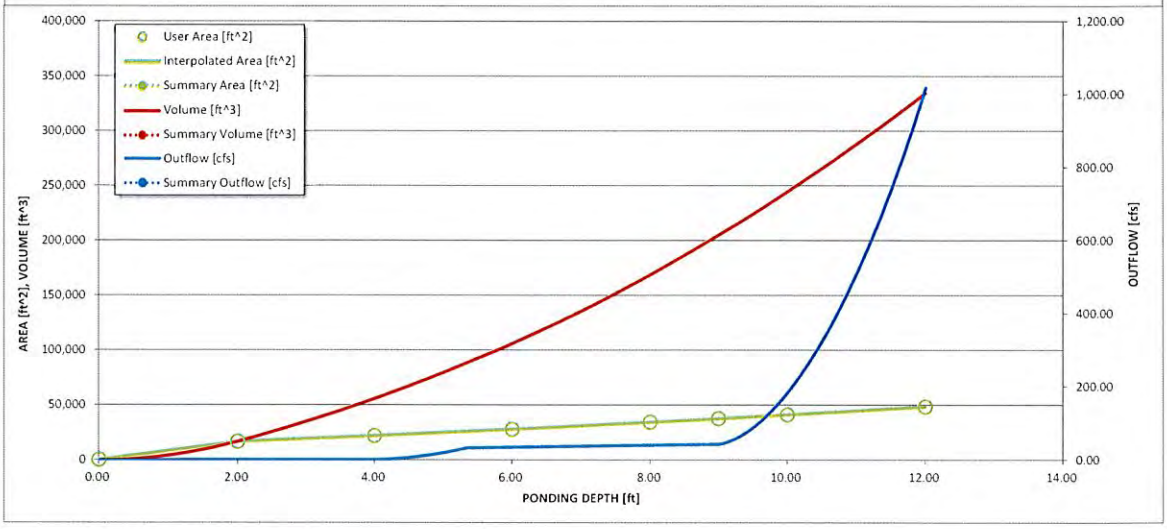
Release at or below historic rate

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]
5.18 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hydrograph Constant	0:10:22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:15:32	0.30	0.78	0.61	0.85	1.22	1.88	2.30	2.83	3.76
0.966	0:20:43	0.82	2.11	1.65	2.30	3.33	5.16	6.35	7.87	10.64
	0:25:54	2.10	5.42	4.25	5.92	8.56	13.25	16.31	20.20	27.32
	0:31:05	5.77	14.89	11.68	16.25	23.51	36.35	44.73	55.37	74.82
	0:36:16	6.81	17.81	13.92	19.46	28.34	44.21	54.71	68.37	94.22
	0:41:26	6.49	17.02	13.30	18.61	27.13	42.39	52.53	65.84	91.30
	0:46:37	5.91	15.50	12.10	16.94	24.70	38.58	47.81	59.99	83.41
	0:51:48	5.26	13.88	10.83	15.18	22.16	34.70	43.04	54.04	75.20
	0:56:59	4.53	12.02	9.37	13.16	19.25	30.25	37.60	47.29	65.96
	1:02:10	3.95	10.46	8.15	11.44	16.72	26.35	32.80	41.30	57.68
	1:07:20	3.58	9.48	7.39	10.37	15.17	23.85	29.64	37.27	51.91
	1:12:31	2.94	7.87	6.12	8.61	12.64	19.92	24.80	31.25	43.71
	1:17:42	2.39	6.46	5.01	7.07	10.41	16.47	20.53	25.90	36.29
	1:22:53	1.83	5.02	3.87	5.50	8.15	12.98	16.23	20.54	28.92
	1:28:04	1.35	3.77	2.90	4.15	6.20	9.96	12.50	15.88	22.46
	1:33:14	0.98	2.74	2.09	3.02	4.55	7.38	9.30	11.87	16.89
	1:38:25	0.77	2.10	1.62	2.31	3.46	5.57	7.00	8.89	12.58
	1:43:36	0.63	1.73	1.33	1.90	2.82	4.51	5.64	7.15	10.06
	1:48:47	0.54	1.46	1.13	1.60	2.38	3.80	4.75	6.01	8.45
	1:53:58	0.47	1.28	0.99	1.40	2.08	3.31	4.14	5.23	7.33
	1:59:08	0.43	1.15	0.89	1.26	1.87	2.97	3.70	4.68	6.55
	2:04:19	0.39	1.06	0.82	1.16	1.72	2.72	3.39	4.28	5.99
	2:09:30	0.29	0.78	0.60	0.85	1.26	2.01	2.52	3.20	4.51
	2:14:41	0.21	0.57	0.44	0.62	0.92	1.46	1.83	2.31	3.26
	2:19:52	0.15	0.42	0.32	0.46	0.68	1.08	1.35	1.71	2.41
	2:25:02	0.11	0.31	0.24	0.34	0.50	0.80	1.00	1.27	1.80
	2:30:13	0.08	0.22	0.17	0.24	0.36	0.58	0.73	0.93	1.32
	2:35:24	0.06	0.16	0.12	0.17	0.26	0.42	0.53	0.67	0.95
	2:40:35	0.04	0.11	0.09	0.12	0.19	0.30	0.38	0.49	0.69
	2:45:46	0.03	0.08	0.06	0.08	0.13	0.21	0.27	0.34	0.49
	2:50:56	0.02	0.05	0.03	0.05	0.08	0.13	0.17	0.22	0.32
	2:56:07	0.01	0.02	0.02	0.03	0.04	0.07	0.10	0.13	0.18
	3:01:18	0.00	0.01	0.01	0.01	0.02	0.03	0.04	0.06	0.09
	3:06:29	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.02	0.03
	3:11:40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:16:50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:22:01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:27:12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:32:23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:37:34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:42:44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:47:55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:53:06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:58:17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:03:28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:08:38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:13:49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:19:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:24:11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:29:22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:34:32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:39:43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:44:54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:50:05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:00:26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:05:37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:59	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:21:10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:26:20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:31:31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:36:42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:41:53	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:47:04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:52:14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:57:25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:02:36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:07:47	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:12:58	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

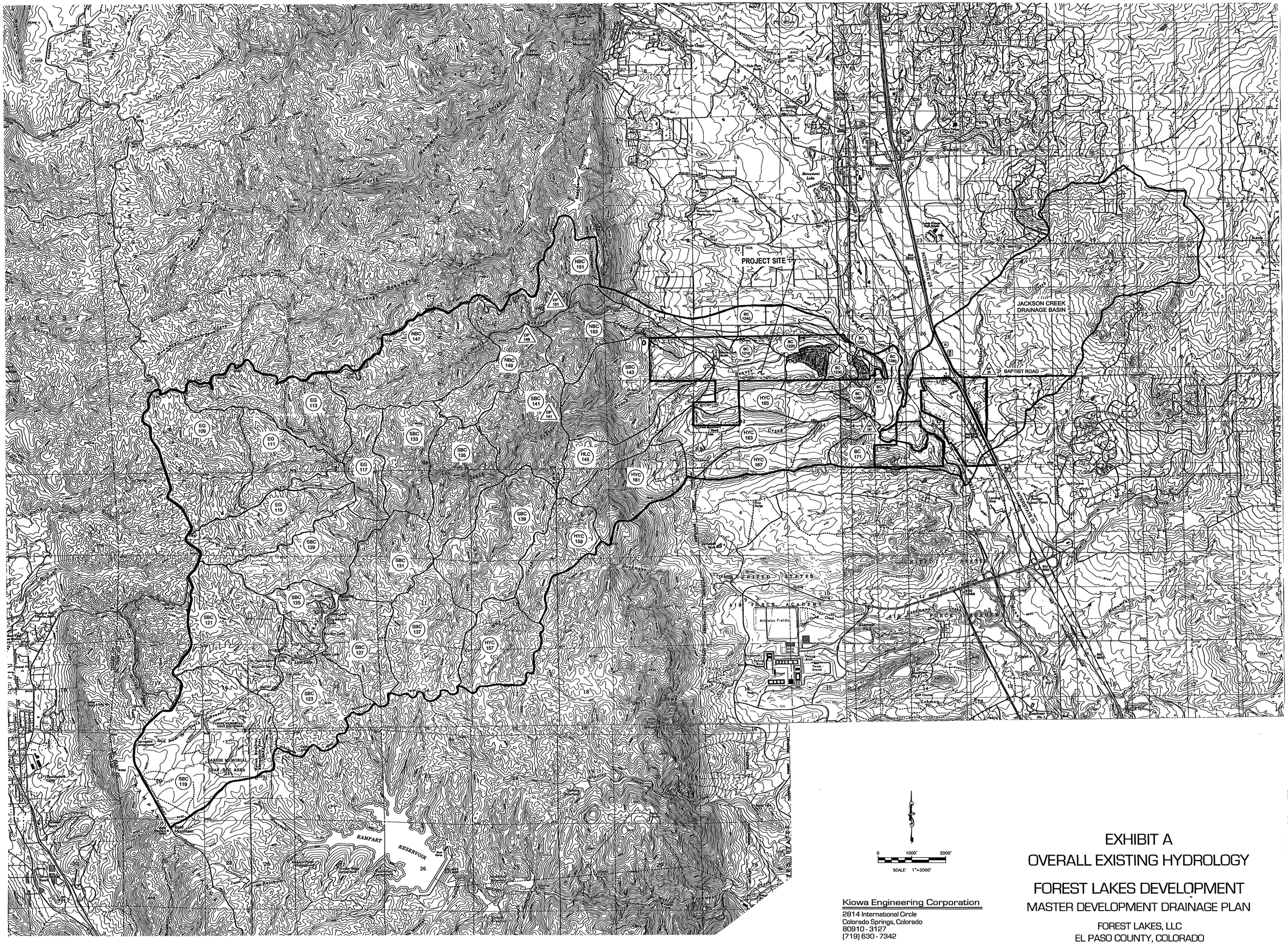
The user can create a summary S-A-V-D by entering the desired stage increments and the remainder of the table will populate automatically.

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]

DRAINAGE MAPS

CLASSIC
CONSULTING
ENGINEERS & SURVEYORS

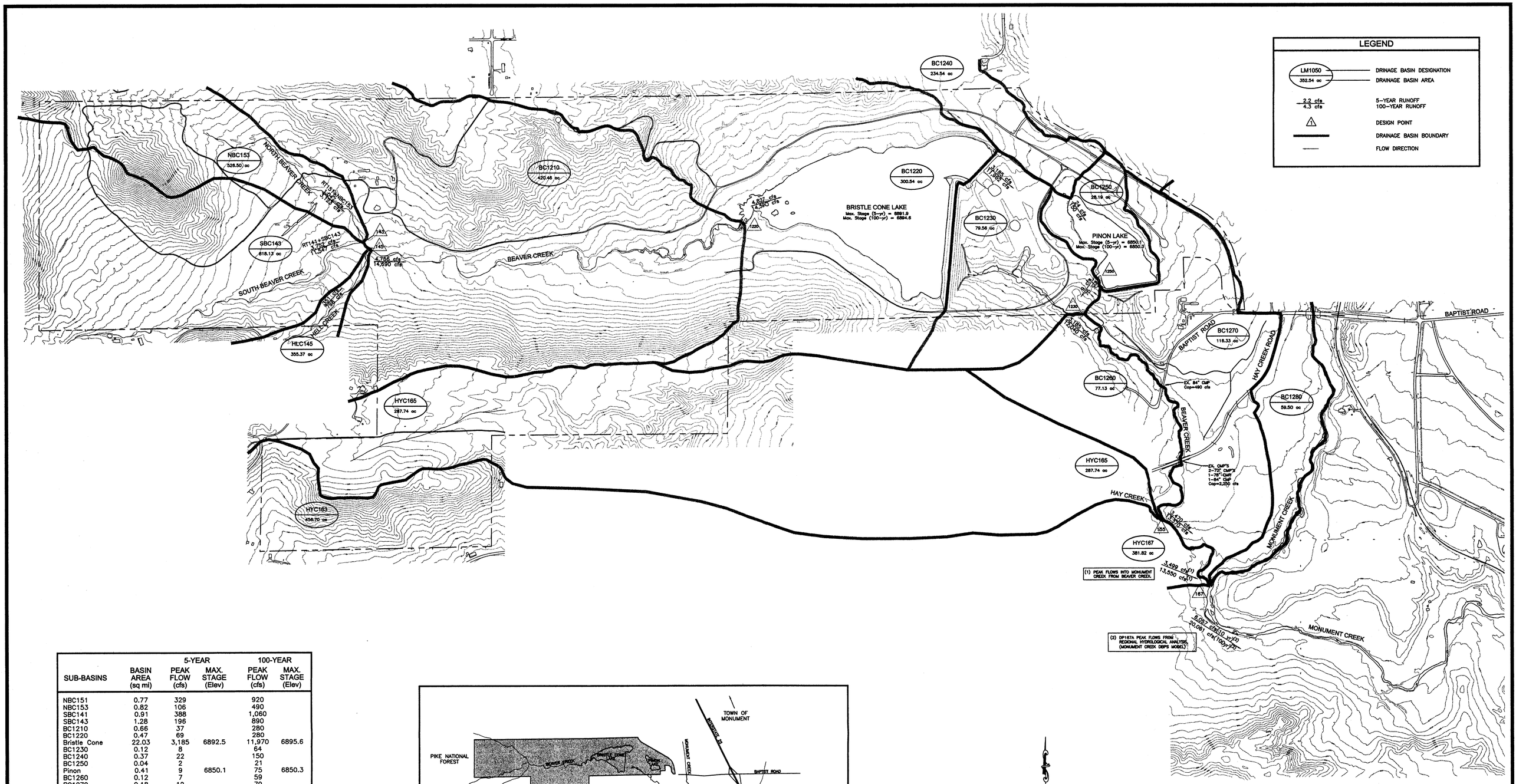


Kiowa Engineering Corporation
2814 International Circle
Colorado Springs, Colorado
80910 - 3127
(719) 630 - 7342

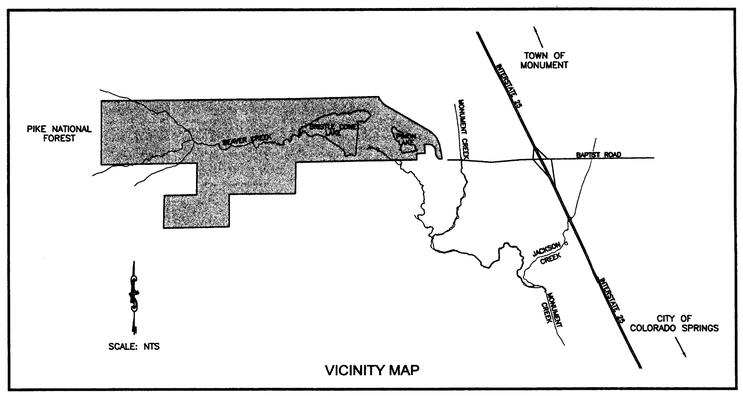
EXHIBIT A
OVERALL EXISTING HYDROLOGY

FOREST LAKES DEVELOPMENT
MASTER DEVELOPMENT DRAINAGE PLAN

FOREST LAKES, LLC
EL PASO COUNTY, COLORADO



SUB-BASINS	BASIN AREA (sq mi)	5-YEAR PEAK FLOW (cfs)	5-YEAR MAX. STAGE (Elev)	100-YEAR PEAK FLOW (cfs)	100-YEAR MAX. STAGE (Elev)
NBC151	0.77	329		920	
NBC153	0.82	106		490	
SBC141	0.91	388		1,060	
SBC143	1.28	196		890	
BC1210	0.66	37		280	
BC1220	0.47	69		280	
Bristle Cone	22.03	3,185	6892.5	11,970	6895.6
BC1230	0.12	8		64	
BC1240	0.37	22		150	
BC1250	0.04	2		21	
Pinon	0.41	9	6850.1	75	6850.3
BC1260	0.12	7		59	
BC1270	0.18	12		79	
BC1280	0.09	6		42	
HLC145	0.56	351		770	
HYC161	0.73	266		780	
HYC163	0.71	40		320	
HYC165	0.45	21		160	
HYC167	0.6	64		330	
DESIGN POINTS					
DP143	20.35	4,524		14,080	
DP145	20.9	4,756		14,690	
DP155	25.93	3,470		13,370	
DP167	26.8	3,499		13,550	
DP1220	22.03	4,827		15,120	
DP1230	22.57	3,185		12,040	
DP1250	0.41	24		170	



VICINITY MAP

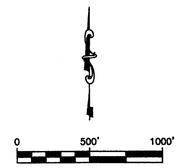


EXHIBIT B

LOCALIZED EXISTING HYDROLOGY

24-HOUR TYPE II STORM

FOREST LAKES DEVELOPMENT

MASTER DEVELOPMENT DRAINAGE PLAN

FOREST LAKES, LLC

EL PASO COUNTY, COLORADO

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Colorado Springs, Colorado
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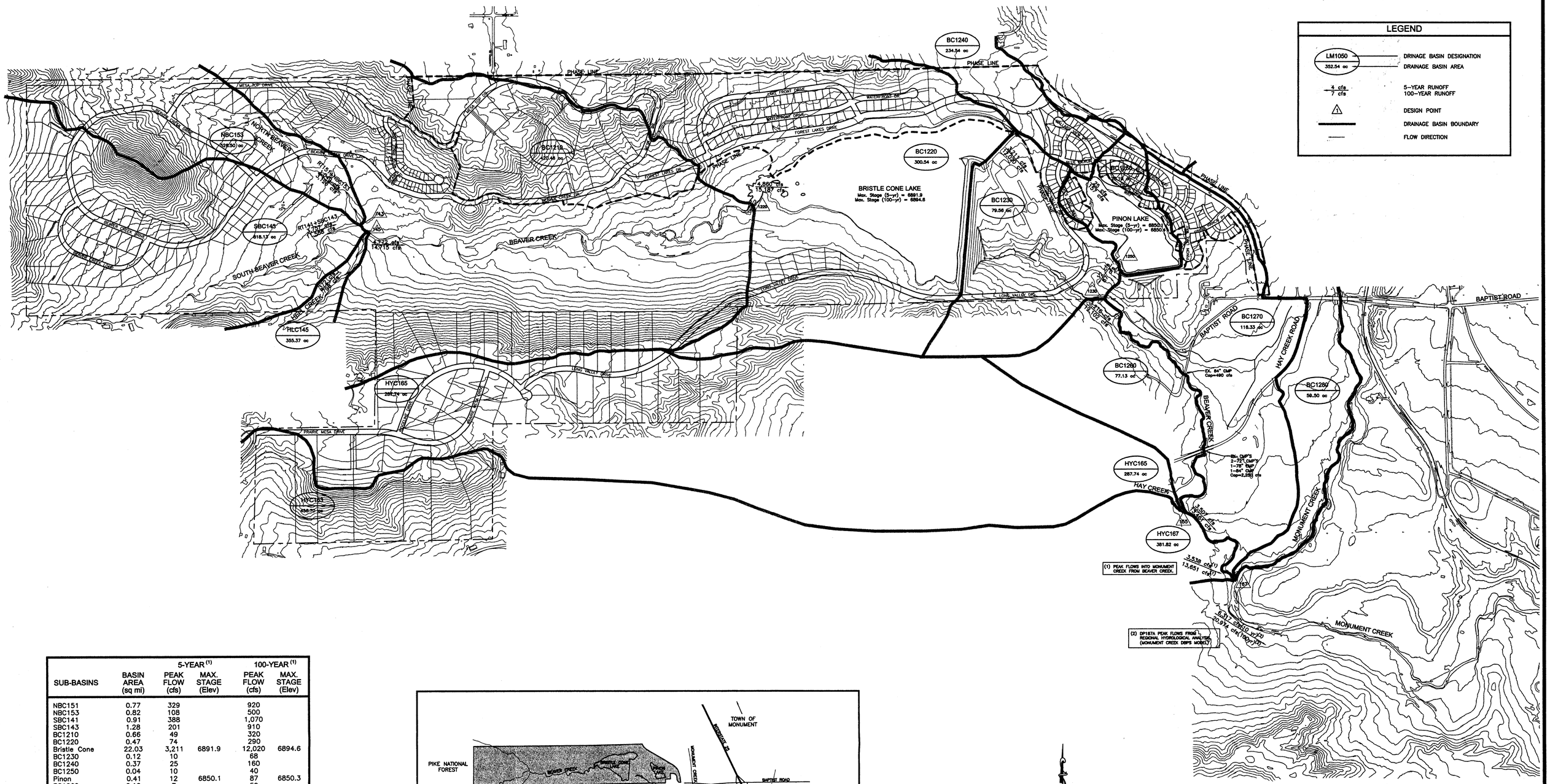
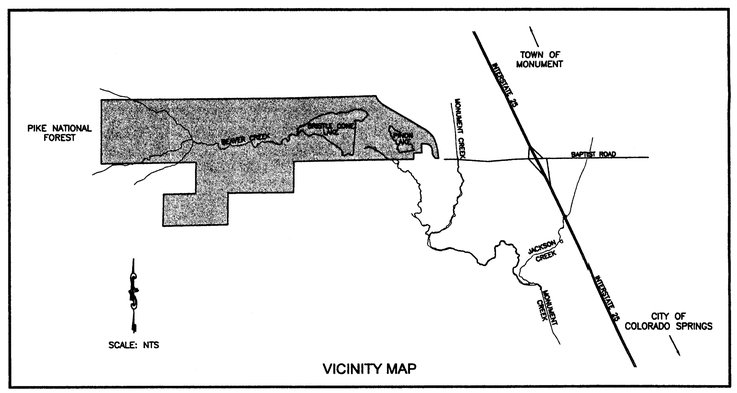
00013EX--BEX(P)[24x36][04/11/02]



SUB-BASINS	BASIN AREA (sq mi)	5-YEAR (1) PEAK FLOW (cfs)	5-YEAR (1) MAX. STAGE (Elev)	100-YEAR (1) PEAK FLOW (cfs)	100-YEAR (1) MAX. STAGE (Elev)
NBC151	0.77	329		920	
NBC153	0.82	108		500	
SBC141	0.91	388		1,070	
SBC143	1.28	201		910	
BC1210	0.66	49		320	
BC1220	0.47	74		290	
Bristle Cone	22.03	3,211	6891.9	12,020	6894.6
BC1230	0.12	10		68	
BC1240	0.37	25		160	
BC1250	0.04	10		40	
Pinon	0.41	12	6850.1	87	6850.3
BC1260	0.12	7		59	
BC1270	0.18	16		90	
BC1280	0.09	6		42	
HLC145	0.56	372		800	
HYC161	0.73	266		780	
HYC163	0.71	44		330	
HYC165	0.45	30		190	
HYC167	0.6	64		320	
DESIGN POINTS					
DP143	20.35	4,528		14,090	
DP145	20.9	4,772		14,720	
DP155	25.93	3,507		13,460	
DP167	26.8	3,538		13,650	
DP1220	22.03	4,860		15,190	
DP1230	22.57	3,216		12,100	
DP1250	0.41	31		190	

(1) THE DISCHARGES LISTED BELOW REPRESENT THE BASINS AS FULLY DEVELOPED WITHOUT DETENTION.



VICINITY MAP

EXHIBIT C

LOCALIZED FUTURE HYDROLOGY

24-HOUR TYPE II STORM

FOREST LAKES DEVELOPMENT

MASTER DEVELOPMENT DRAINAGE PLAN

FOREST LAKES, LLC

EL PASO COUNTY, COLORADO

Kiowa Engineering Corporation

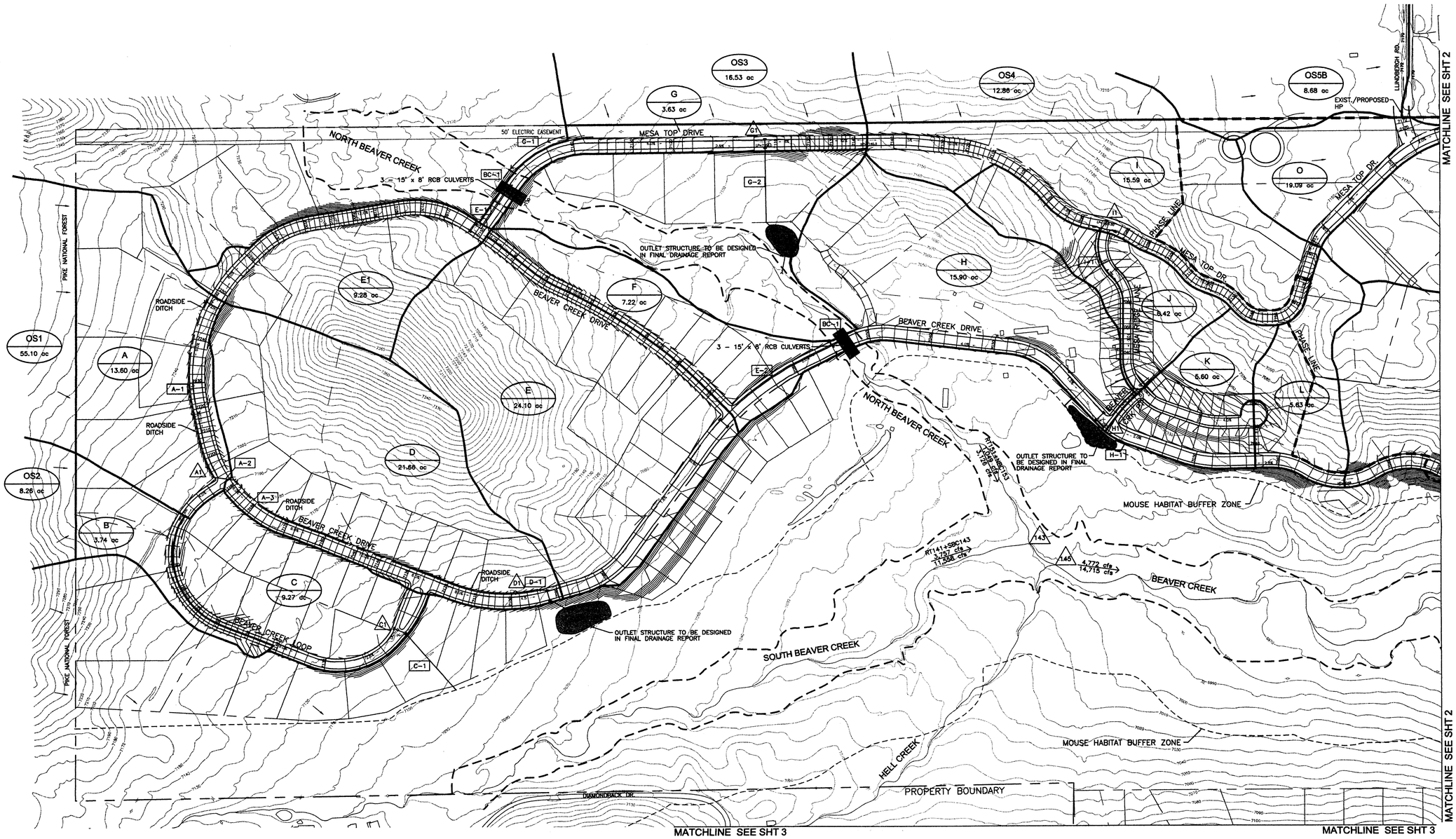
2814 International Circle

Colorado Springs, Colorado

80910 - 3127

(719) 630 - 7342

0001EX-CFT(P)[24x36][04/11/02]



0 200' 400'

SCALE: 1"=200'

LEGEND

- LM1050 / 352.54 ac — DRAINAGE BASIN DESIGNATION / DRAINAGE BASIN AREA
- 2.2 cfs / 4.3 cfs — 5-YEAR RUNOFF / 100-YEAR RUNOFF
- DESIGN POINT
- DRAINAGE BASIN BOUNDARY
- C-13 — CONVEYANCE ELEMENT/ HYDRAULIC STRUCTURE
- TIME OF CONCENTRATION FLOW PATH
- DETENTION BASIN LOCATION
- 100-YEAR FLOODPLAIN LIMITS

SUMMARY OF DRAINAGE BASINS AND DESIGN POINTS

BASIN / DP	DEVELOPED CONDITION 5 Year	100 Year	BASIN / DP	DEVELOPED CONDITION 5 Year	100 Year	BASIN / DP	DEVELOPED CONDITION 5 Year	100 Year
A	15 cfs	35 cfs	T	5 cfs	13 cfs	OS5	22 cfs	54 cfs
B	4 cfs	10 cfs	U	12 cfs	27 cfs	OS5A	17 cfs	41 cfs
C	11 cfs	25 cfs	V	5 cfs	17 cfs	OS5B	6 cfs	14 cfs
D	22 cfs	51 cfs	W	11 cfs	22 cfs	OS7	6 cfs	16 cfs
E	24 cfs	57 cfs	X	13 cfs	26 cfs	DP A1	46 cfs	114 cfs
E1	11 cfs	25 cfs	Y	9 cfs	18 cfs	DP C1	19 cfs	46 cfs
F	5 cfs	13 cfs	Z	9 cfs	18 cfs	DP D1	57 cfs	140 cfs
G	4 cfs	10 cfs	AA	12 cfs	24 cfs	DP G1	16 cfs	40 cfs
H	13 cfs	30 cfs	BB	3 cfs	6 cfs	DP H1	26 cfs	58 cfs
I	18 cfs	41 cfs	CC	21 cfs	49 cfs	DP H2	47 cfs	110 cfs
J	10 cfs	22 cfs	DD	12 cfs	28 cfs	DP I1	28 cfs	68 cfs
K	11 cfs	23 cfs	EE	15 cfs	35 cfs	DP M1	29 cfs	68 cfs
L	7 cfs	17 cfs	FF	9 cfs	21 cfs	DP M2	57 cfs	135 cfs
M	20 cfs	48 cfs	GG	6 cfs	13 cfs	DP Q1	30 cfs	76 cfs
M1	13 cfs	31 cfs	HH	7 cfs	17 cfs	DP Q2	49 cfs	120 cfs
M2	8 cfs	19 cfs	II	26 cfs	62 cfs	DP T1	76 cfs	178 cfs
N	7 cfs	17 cfs	JJ	21 cfs	50 cfs	DP Z1	35 cfs	71 cfs
O	22 cfs	53 cfs	BC1240	48 cfs	160 cfs	DP GG1	40 cfs	95 cfs
P	18 cfs	40 cfs	OS1	39 cfs	96 cfs	DP 143	4,528 cfs	14,090 cfs
Q	16 cfs	36 cfs	OS2	7 cfs	17 cfs	DP 145	4,772 cfs	14,720 cfs
R	18 cfs	39 cfs	OS3	14 cfs	34 cfs	DP 1220	4,860 cfs	15,190 cfs
S	11 cfs	24 cfs	OS4	12 cfs	30 cfs	DP 1230	3,216 cfs	12,100 cfs

SUMMARY OF DRAINAGE CONVEYANCES

CONVEYANCE NUMBER	SIZE / TYPE	CONVEYANCE NUMBER	SIZE / TYPE
A-1	ROADSIDE SWALE	V-1	54-INCH RCP
A-2	48-INCH RCP CULVERT	X-1	24-INCH RCP
A-3	ROADSIDE SWALE	X-2	36-INCH RCP
C-1	30-INCH RCP	BB-1	ROADSIDE SWALE
D-1	48-INCH RCP CULVERT	DD-1	24-INCH RCP
E-1	24-INCH RCP	DD-2	36-INCH RCP
E-2	30-INCH RCP	DD-3	36-INCH RCP
G-1	ROADSIDE SWALE	HH-1	24-INCH RCP
G-2	30-INCH RCP	HH-2	30-INCH RCP
H-1	42-INCH RCP	JJ-1	36-INCH RCP CULVERT
I-1	36-INCH RCP		
M-1	36-INCH RCP CULVERT	BC-1	3 - 15' x 8' RCB CULVERT
M-2	36-INCH RCP	BC-2	70-FT CLEAR SPAN BRIDGE
M-3	36-INCH RCP	BC-5	54-INCH RCP CULVERT
P-1	ROADSIDE SWALE		
P-2	30-INCH RCP CULVERT		
Q-1	ROADSIDE SWALE		
Q-2	48-INCH RCP CULVERT		
Q-3	42-INCH RCP		
Q-4	42-INCH RCP		

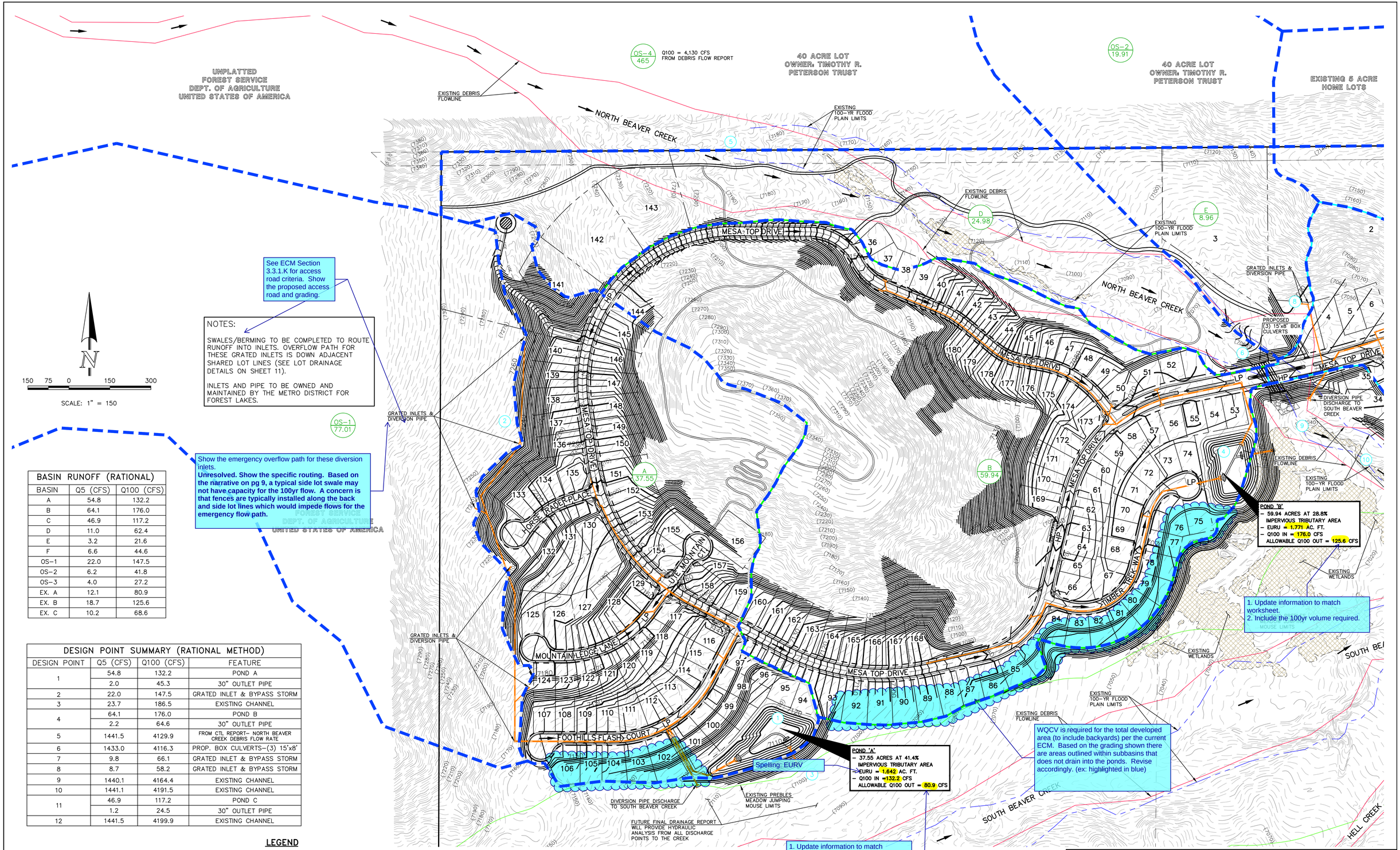
Kiowa Engineering Corporation
2814 International Circle
Colorado Springs, Colorado
80910-3127
[719] 630-7342

FOREST LAKES
MASTER DEVELOPMENT DRAINAGE PLAN
PROPOSED HYDROLOGIC SUBBASINS & DRAINAGE STRUCTURES
EL PASO COUNTY, COLORADO

Project No.:	00013
Date:	April 11, 2002
Design:	RNW/MWE
Drawn:	MWE
Check:	RNW
Revisions:	

SHEET 1 OF 4 SHEETS

0001301DPP[24x36][04/11/02]



See ECM Section 3.3.1.K for access road criteria. Show the proposed access road and grading.

NOTES:

SWALES/BERMING TO BE COMPLETED TO ROUTE RUNOFF INTO INLETS. OVERFLOW PATH FOR THESE GRATED INLETS IS DOWN ADJACENT SHARED LOT LINES (SEE LOT DRAINAGE DETAILS ON SHEET 11).

INLETS AND PIPE TO BE OWNED AND MAINTAINED BY THE METRO DISTRICT FOR FOREST LAKES.

Show the emergency overflow path for these diversion inlets.
Unresolved. Show the specific routing. Based on the narrative on pg 9, a typical side lot swale may not have capacity for the 100yr flow. A concern is that fences are typically installed along the back and side lot lines which would impede flows for the emergency flow path.

N

150 75 0 150 300

SCALE: 1" = 150

BASIN RUNOFF (RATIONAL)		
BASIN	Q5 (CFS)	Q100 (CFS)
A	54.8	132.2
B	64.1	176.0
C	46.9	117.2
D	11.0	62.4
E	3.2	21.6
F	6.6	44.6
OS-1	22.0	147.5
OS-2	6.2	41.8
OS-3	4.0	27.2
EX. A	12.1	80.9
EX. B	18.7	125.6
EX. C	10.2	68.6

DESIGN POINT SUMMARY (RATIONAL METHOD)			
DESIGN POINT	Q5 (CFS)	Q100 (CFS)	FEATURE
1	54.8	132.2	POND A
	2.0	45.3	30" OUTLET PIPE
2	22.0	147.5	GRATED INLET & BYPASS STORM
3	23.7	186.5	EXISTING CHANNEL
4	64.1	176.0	POND B
	2.2	64.6	30" OUTLET PIPE
5	1441.5	4129.9	FROM CTL REPORT– NORTH BEAVER CREEK DEBRIS FLOW RATE
6	1433.0	4116.3	PROP. BOX CULVERTS–(3) 15'x8'
7	9.8	66.1	GRATED INLET & BYPASS STORM
8	8.7	58.2	GRATED INLET & BYPASS STORM
9	1440.1	4164.4	EXISTING CHANNEL
10	1441.1	4191.5	EXISTING CHANNEL
11	46.9	117.2	POND C
	1.2	24.5	30" OUTLET PIPE
12	1441.5	4199.9	EXISTING CHANNEL

LEGEND

EXISTING GROUND CONTOUR (7000)
PROPOSED FINISHED CONTOUR 7000
SUBDIVISION BOUNDARY
LOT LINE
PREBLES MOUSE LIMITS
100-YR FLOODPLAIN LIMITS
DEBRIS FLOWLINE

PROPOSED BASIN BOUNDARY
DIRECTION OF DRAINAGE
EXISTING STORM SEWER
EXISTING STORM INLET
PROPOSED STORM SEWER
PROPOSED STORM INLET
LOW POINT/HIGH POINT LP/HP

BASIN IDENTIFIER D
AREA IN ACRES 1.41
DESIGN POINT 1
EXISTING WETLANDS

CLASSIC CONSULTING ENGINEERS & SURVEYORS SM
619 N. Cascade Avenue, Suite 200 (719)785-0790
Colorado Springs, Colorado 80903 (719)785-0799(Fax)

FOREST LAKES – FILINGS 5, 6, & 7
MDDP AMENDMENT &
PRELIMINARY DRAINAGE REPORT
DEVELOPED CONDITIONS

CLASSIC CONSULTING ENGINEERS & SURVEYORS

DESIGNED BY	MAL	SCALE		DATE	11/18/18
DRAWN BY	MAL	(H) 1"= 150'		SHEET	1 OF 2
CHECKED BY		(V) 1"= N/A		JOB NO.	1175.21

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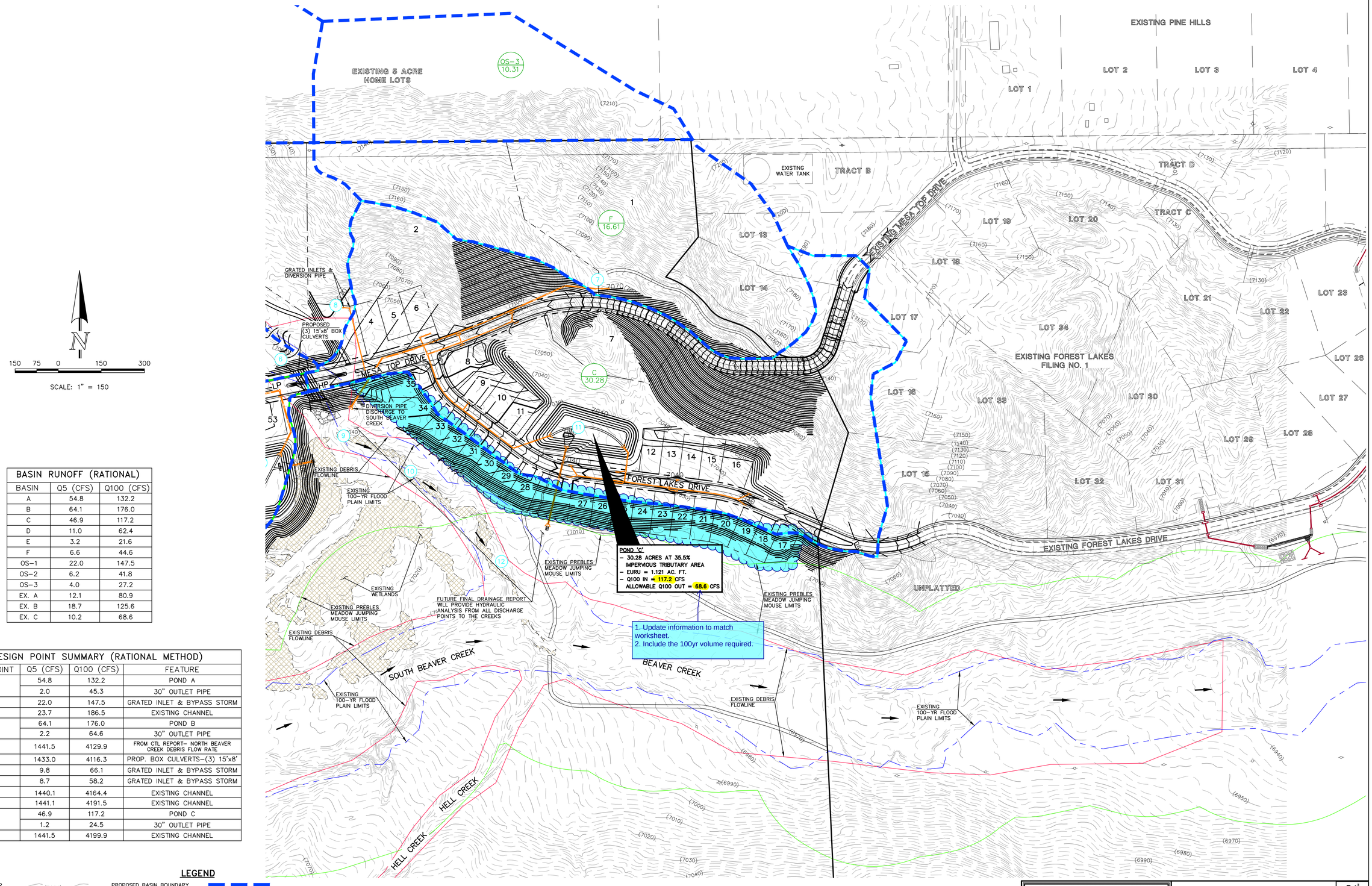

N

150 75 0 150 300

SCALE: 1" = 150

BASIN RUNOFF (RATIONAL)		
BASIN	Q5 (CFS)	Q100 (CFS)
A	54.8	132.2
B	64.1	176.0
C	46.9	117.2
D	11.0	62.4
E	3.2	21.6
F	6.6	44.6
OS–1	22.0	147.5
OS–2	6.2	41.8
OS–3	4.0	27.2
EX. A	12.1	80.9
EX. B	18.7	125.6
EX. C	10.2	68.6

DESIGN POINT SUMMARY (RATIONAL METHOD)			
DESIGN POINT	Q5 (CFS)	Q100 (CFS)	FEATURE
1	54.8	132.2	POND A
	2.0	45.3	30" OUTLET PIPE
2	22.0	147.5	GRATED INLET & BYPASS STORM
3	23.7	186.5	EXISTING CHANNEL
4	64.1	176.0	POND B
	2.2	64.6	30" OUTLET PIPE
5	1441.5	4129.9	FROM CTL REPORT– NORTH BEAVER CREEK DEBRIS FLOW RATE
6	1433.0	4116.3	PROP. BOX CULVERTS–(3) 15'x8'
7	9.8	66.1	GRATED INLET & BYPASS STORM
8	8.7	58.2	GRATED INLET & BYPASS STORM
9	1440.1	4164.4	EXISTING CHANNEL
10	1441.1	4191.5	EXISTING CHANNEL
11	46.9	117.2	POND C
	1.2	24.5	30" OUTLET PIPE
12	1441.5	4199.9	EXISTING CHANNEL

LEGEND

- EXISTING GROUND CONTOUR (7000)
- PROPOSED FINISHED CONTOUR 7000
- SUBDIVISION BOUNDARY
- LOT LINE
- PREBLES MOUSE LIMITS
- 100–YR FLOODPLAIN LIMITS
- DEBRIS FLOWLINE
- PROPOSED BASIN BOUNDARY
- DIRECTION OF DRAINAGE
- EXISTING STORM SEWER
- EXISTING STORM INLET
- PROPOSED STORM SEWER
- PROPOSED STORM INLET
- LOW POINT/HIGH POINT LP/HP
- BASIN IDENTIFIER D
- AREA IN ACRES 1.41
- DESIGN POINT 1
- EXISTING WETLANDS

CLASSIC SM CONSULTING ENGINEERS & SURVEYORS
619 N. Cascade Avenue, Suite 200 (719)785-0790
Colorado Springs, Colorado 80903 (719)785-0799(Fax)

FOREST LAKES – FILINGS 5, 6, & 7
MDDP AMENDMENT &
PRELIMINARY DRAINAGE REPORT
DEVELOPED CONDITIONS

DESIGNED BY	MAL	SCALE		DATE	11/18/18
DRAWN BY	MAL	(H) 1"= 150'		SHEET	2 OF 2
CHECKED BY		(V) 1"= N/A		JOB NO.	1175.21

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Markup Summary

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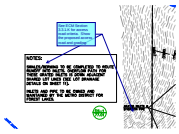

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Page Label: 90
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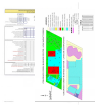
Date: 2/28/2019 2:48:12 PM
Color:

See ECM Section 3.3.1.K for access road criteria. Show the proposed access road and grading.

3/4/2019 2:41:04 PM (1)



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3/4/2019 2:41:20 PM (1)

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Page Label: 41
Author: dsdlaforce
Date: 3/4/2019 2:41:20 PM
Color:

Provide an exhibit showing the DCIA, UIA, RPA, SPA areas for Pond A, B, & C.

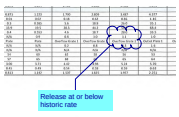
Based on the site layout a large portion of SPA does not directly drain into the pond but instead goes through the DCIA before draining into the Detention Pond. These areas upstream of the DCIA should not be counted as SPA. The only applicable SPA would be the pond area itself.

In reviewing the sub-basin, the only possible area where RPA may exist is west of the pond along the back of lots 102-106.

The LID Impervious Calculation for the other ponds will be reviewed with the resubmittal once exhibits are provided.

Unresolved. See example to the right.

3/4/2019 2:55:48 PM (1)



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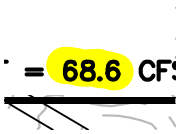
Release at or below historic rate

3/4/2019 2:57:50 PM (1)



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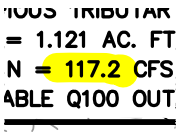

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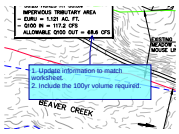

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Author: dsdlaforce
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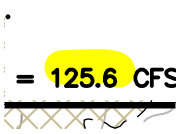
1. Update information to match worksheet.
2. Include the 100yr volume required.

3/4/2019 3:28:19 PM (1)



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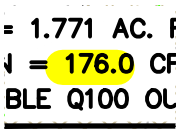

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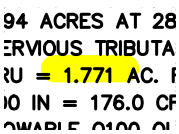

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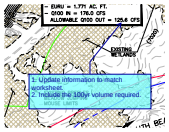

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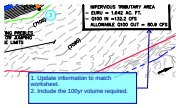

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Date: 3/4/2019 3:29:46 PM
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2. Include the 100yr volume required.

3/4/2019 3:29:56 PM (1)

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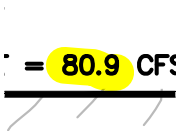
Date: 3/4/2019 3:29:56 PM
Color:

Spelling: EURV

3/4/2019 3:30:14 PM (1)



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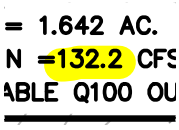

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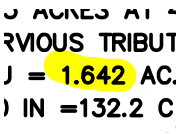

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Show the emergency overflow path for these diversion inlets.
Unresolved. Show the specific routing. Based on the narrative on pg 9, a typical side lot swale may not have capacity for the 100yr flow. A concern is that fences are typically installed along the back and side lot lines which would impede flows for the emergency flow path.

3/4/2019 4:26:50 PM (1)

Subject: Callout
Page Label: 90
Author: dsdlaforce
Date: 3/4/2019 4:26:50 PM
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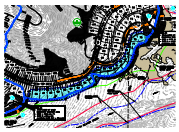
WQCV is required for the total developed area (to include backyards) per the current ECM. Based on the grading shown there are areas outlined within subbasins that does not drain into the ponds. Revise accordingly. (ex: highlighted in blue)

3/4/2019 4:28:32 PM (1)



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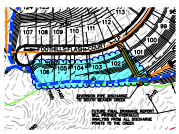

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