MASTER DEVELOPMENT DRAINAGE PLAN AMENDMENT FOR FOREST LAKES (FOREST LAKES PHASE 2) EL PASO COUNTY, COLORADO

December 2017

With the application being a PUDSP (combined PUD & Preliminary Plan), this drainage report title and content should be a combined amendment to the MDDP and Preliminary Drainage Report For Forest Lakes Ph 2.

Prepared for:
FOREST LAKES RESIDENTIAL DEVELOPMENT, LLC
6385 CORPORATE DRIVE, SUITE 200
COLORADO SPRINGS CO 80919
(719) 592-9333

Prepared by:
CLASSIC CONSULTING ENGINEERS & SURVEYORS
619 N. CASCADE AVENUE, SUITE 200
COLORADO SPRINGS CO 80903
(719) 785-0790

Job no. 1175.20

Add "PCD File No. PUDSP181"

CLASSIC CONSULTING ENGINEERS & SURVEYORS

MASTER DEVELOPMENT DRAINAGE PLAN AMENDMENT FOR FOREST LAKES (FOREST LAKES PHASE 2)

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 FOR FOREST LAKES (FOREST LAKES PHASE 2)

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DETENTION POND "B"

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MASTER DEVELOPMENT DRAINAGE PLAN AMENDMENT FOR FOREST LAKES (FOREST LAKES PHASE 2)

PURPOSE

This document is the Master Development Drainage Plan Amendment for Forest Lakes (Forest Lakes Phase 2). 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 Phase 2 site layout. The proposed Phase 2 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 (Phase 2) is the far westerly area east of Filing 1 and is comprised of 287 acres. Watersheds that impact the Phase 2 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 Phase 2 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 Phase 2 property. The vicinity map for the Phase 2 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 Phase 2 Amendment, detailed analysis of initial/local systems will be deferred to the future final drainage reports when platting is proposed.

Presented on Exhibit A (reduced scale 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 Phase 2 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 Phase 2 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 Phase 2 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 Rational Method was used to estimate stormwater runoff to the proposed inlets and storm sewer pipes and for comparison purposes to the runoff rates found within the previous reports.

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 Number 08041C 0270F effective date, March 17, 1997 (See Appendix). No proposed development is anticipated to take place within the floodplain other than two proposed roadway crossings as reflected on the drainage maps. At the time of the Final Drainage Report submittal, FEMA coordination will be initiated for this section of North Beaver Creek where the floodplain as reflected on the maps does not correspond to the site topography.

EXISTING MAJOR DRAINAGEWAYS

Four 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 Phase 2 site development is to leave the major drainageways in their existing form to the greatest practical extent possible. There may be the need for localized drainageway improvements should long-term degradation of the drainageway banks or inverts occur as South Beaver Creek, Beaver Creek and Hell Creek include both wetlands and Preble's Jumping Mouse habitat. Minimal disturbance only to the fringe to wetland areas is proposed, no mouse area disturbance is anticipated.

Two road crossings of the existing drainageways are planned with Phase 2. These two crossings 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 flow using the bulking factor recommended in the prior analysis. .

PR

Expand on the narrative. What it the diversion catchment area shown on the map and is the conveyance anticipated to be a drainage channel or pipe?

As … by off-site tributary flows from the west and north.

Westerly off-site Basin OS-1 (Q_5 = 22 cfs and Q_{100} = 158 cfs) generated flows from the adjacent national forest. With final design, these flows will be routed south away from the proposed development area directly into South Beaver Creek. Additional details within future final drainage reports will detail the design of these diversions.

Basin A (Q_5 = 21 cfs and Q_{100} = 67 cfs) are single-family lots and public street flows from the area west of Forest Lakes Drive. These flows will be intercepted by proposed public storm inlets and piped and routed to proposed Bond B, described later in this section.

Basin C (Q_5 = 19 cfs and Q_{100} = 61 cfs) and **Basin B** (Q_5 = 6 cfs and Q_{100} = 43 cfs) are comprised of the large knoll and adjacent proposed single-family lots that will be intercepted by proposed public storm inlets and piped and routed to proposed Bond B, described later in this section.

Basin D (Q_5 = 5 cfs and Q_{100} = 35 cfs), **Basin E** (Q_5 = 6 cfs and Q_{100} = 19 cfs), **Basin OS-2** (Q_5 = 6 cfs and Q_{100} = 46 cfs), **Basin OS-3** (Q_5 = 7 cfs and Q_{100} = 49 cfs), **Basin J** (Q_5 = 14 cfs and Q_{100} = 25 cfs), **Basin K** (Q_5 = 1.4 cfs and Q_{100} = 10 cfs), **Basin F** (Q_5 = 28 cfs and Q_{100} = 88 cfs), **Basin H** (Q_5 = 1.1 cfs and Q_{100} = 8 cfs), and **Basin I** (Q_5 = 3 cfs and Q_{100} = 24 cfs). Developed lot and street flows are collected within proposed street curb inlets and routed via public storm pipes to Pond C. See description below for Pond C.

Basin G (Q_5 = 1.3 cfs and Q_{100} = 10 cfs) are open space flows tributary to North Beaver Creek that are routed south into the South Beaver Creek confluence and not routed into Pond C.

Full Spectrum Detention.

EURV and Stormwater Quality Capture Vol … spreadsheet has been provided in the Appendix of this report to p… …s for EURV, with a minimum drain time of 72 hours.

requirements for Full Spectrum detention (WQCV, EURV, and 100-yr storm).

Drain time is 40hrs for WQCV, 97% of all of the runoff from rainfall event less than 5-yr storm within 72 hrs, and 99% of all of the runoff from rainfall event greater than 5-yr storm within 120 hrs.

Detention Summary:

Proposed Detention Facility A is a 1.522 ac-ft EURV facility. A storm pipe will outlet the stormwater from the pond and will convey flows to the designated outfall location at along South Beaver Creek. Total inflow to this facility is Q_{100}= 68.4 cfs. This pond will store and treat developed stormwater from Forest Lakes Phase 2 and the off-site tributary portions of the adjacent park as described in this report. A vast majority of Basin OS-1 (80.30 acres) drains historically to South Beaver Creek, however it is anticipated with future development that this area will be routed south away from

Revise to Full Spectrum detention facility. (typical comment for all detention facilities)

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the development area. Historic release for the area tributary to Facility A pond is Q_{100}= 43.2 cfs. 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. Appropriate energy dissipation measures will be included in the construction drawings at the outlet pipe connection to existing South Beaver Creek to provide for permanent erosion protection. The proposed outlet structure will include the UDFCD required 3' hole perforated orifice plate. Reference worksheets in Appendix for details. This facility and outlet structure will be designed and constructed with future filing drainage improvements. 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 constru

Is this a typo?

Proposed Detention Facility B is a 24.13 ac-ft pond. This pond treats 39.54 acres of upstream tributary development area. As described in this report, offsite historic flows have been routed to bypass this facility along North Beaver Creek. Historic release for the 39.54 acres tributary to Facility C pond is Q_{100}= 67 cfs. 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. Appropriate energy dissipation measures will be included in the construction drawings at the outlet pipe connection to existing Black Squirrel Creek to provide for permanent erosion protection. The proposed outlet structure will include the UDFCD required 3' hole perforated orifice plate. Reference worksheets in Appendix for details. This facility and outlet structure will be constructed with future filing drainage impro

Is pond C the combination of the two ponds bisected by Forest Lakes Drive? Elaborate the narrative and revise the drainage design calculation to be a pond in a series.

ckle channel and forebay details will be included with final cons

County prior to construction approval in conjunction with future

Proposed Detention Facility C is a 5.275 ac-ft pond. This pond treats 75.42 acres of upstream tributary development area. As described in this report, offsite historic flows have been routed to bypass this facility along Beaver Creek. Historic release for the 75.42 acres tributary to Facility C pond is Q_{100}= 103 cfs. 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. Appropriate energy dissipation measures will be included in the construction drawings at the outlet pipe connection to existing Black Squirrel Creek to provide for permanent erosion protection. The proposed outlet structure will include the UDFCD required 3' hole perforated orifice plate. Reference worksheets in Appendix for details. This facility and outlet structure will be constructed with future filing drainage improvements. 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 in conjunction with future Final Plat submittals.

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 Phase 2 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.

Existing Drainage Fee credits will be utilized to offset portions of the required fees due for these two filings, as to be defined in future Final Drainage Reports. Multiple plats are anticipated for this Phase 2 area.

SUMMARY

Developed runoff from the proposed Forest Lakes Phase 2 are proposed to outfall to three proposed public storm systems serving three separate detention/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:

Kyle R. Campbell, P.E.
Division Manager

Sm/117520/MDDP Amendment.doc

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.

VICINITY MAP

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SOILS MAP (S.C.S. SURVEY)

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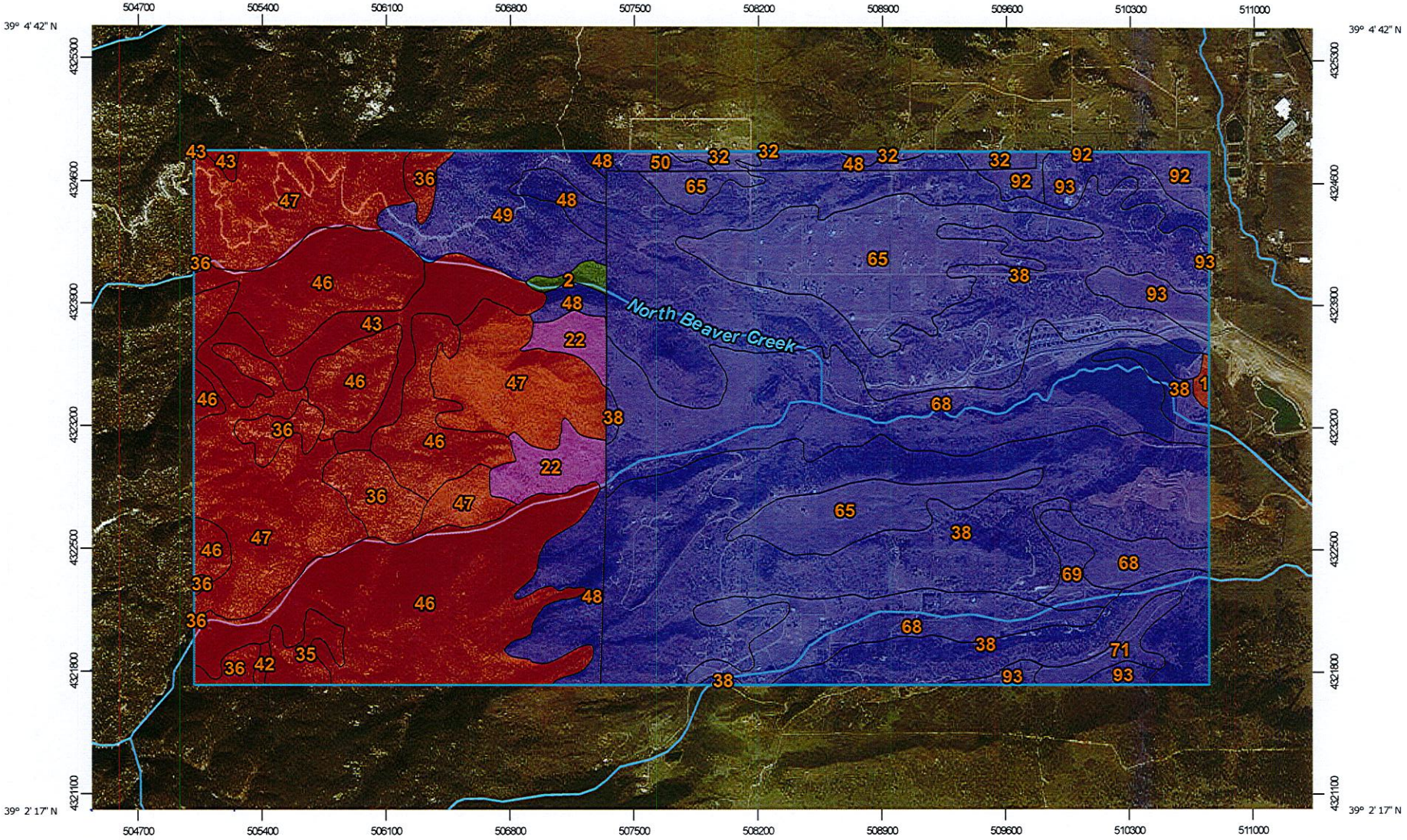
Hydrologic Soil Group—El Paso County Area, Colorado; and Pike National Forest, Eastern Part, Colorado, Parts of Douglas, El Paso, Jefferson, and Teller ...
(Forest Lakes)



Map Scale: 1:31,500 if printed on A landscape (11" x 8.5") sheet.

N

Meters
0 450 900 1800 2700

Feet
0 1500 3000 6000 9000

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

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

Soil Rating Polygons

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Water Features

- Streams and Canals

Transportation

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

Background

- Aerial Photography

MAP INFORMATION

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

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 15, Oct 10, 2017

Soil Survey Area: Pike National Forest, Eastern Part, Colorado, Parts of Douglas, El Paso, Jefferson, and Teller Counties
Survey Area Data: Version 4, Oct 12, 2017

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: Feb 22, 2014—Mar 9, 2017

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

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
1	Alamosa loam, 1 to 3 percent slopes	D	4.9	0.1%
38	Jarre-Tecolote complex, 8 to 65 percent slopes	B	1,396.0	32.2%
65	Perrypark gravelly sandy loam, 3 to 9 percent slopes	B	353.9	8.2%
68	Peyton-Pring complex, 3 to 8 percent slopes	B	565.0	13.0%
69	Peyton-Pring complex, 8 to 15 percent slopes	B	28.5	0.7%
71	Pring coarse sandy loam, 3 to 8 percent slopes	B	29.4	0.7%
92	Tomah-Crowfoot loamy sands, 3 to 8 percent slopes	B	39.9	0.9%
93	Tomah-Crowfoot complex, 8 to 15 percent slopes	B	100.4	2.3%
Subtotals for Soil Survey Area			**2,518.0**	**58.0%**
Totals for Area of Interest			**4,341.0**	**100.0%**

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
2	Aquolls, 1 to 10 percent slopes	A/D	11.0	0.3%
22	Kassler very gravelly coarse sandy loam, 5 to 35 percent slopes	A	71.5	1.6%
32	Perrypark coarse sandy loam, 1 to 15 percent slopes	B	25.3	0.6%
35	Rock outcrop-Sphinx complex, 15 to 80 percent slopes	D	29.2	0.7%
36	Rock outcrop-Sphinx, warm complex, 15 to 80 percent slopes	D	100.6	2.3%
42	Sphinx gravelly coarse sandy loam, 15 to 40 percent slopes	D	3.8	0.1%
43	Sphinx gravelly coarse sandy loam, 40 to 70 percent slopes	D	126.1	2.9%

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
46	Sphinx-Rock outcrop complex, 15 to 80 percent slopes	D	620.4	14.3%
47	Sphinx, warm-Rock outcrop complex, 15 to 80 percent slopes	D	526.7	12.1%
48	Tecolote very gravelly sandy loam, 15 to 40 percent slopes, very stony	B	147.4	3.4%
49	Tecolote very gravelly sandy loam, 40 to 70 percent slopes, very stony	B	148.3	3.4%
50	Tomah sandy loam, 2 to 15 percent slopes	B	12.5	0.3%
Subtotals for Soil Survey Area			**1,823.0**	**42.0%**
Totals for Area of Interest			**4,341.0**	**100.0%**

Description

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

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

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

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

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

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

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

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

F.E.M.A. MAP

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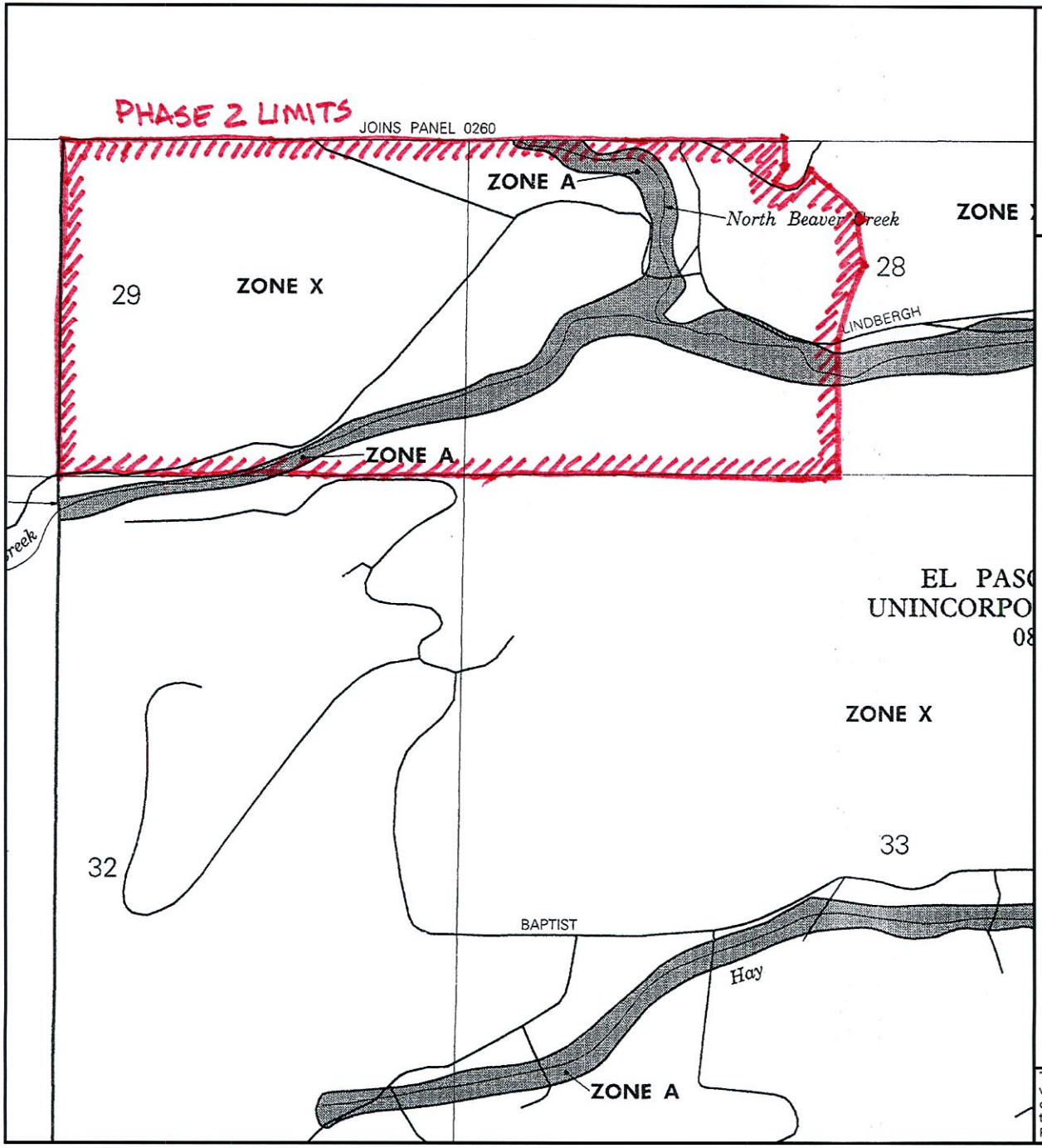

APPROXIMATE SCALE IN FEET

1000 0 1000

NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP

EL PASO COUNTY, COLORADO AND INCORPORATED AREAS

PANEL 270 OF 1300

(SEE MAP INDEX FOR PANELS NOT PRINTED)

CONTAINS: COMMUNITY	NUMBER	PANEL	SUFFIX
EL PASO COUNTY, UNINCORPORATED AREAS	080059	0270	F

MAP NUMBER 08041C0270 F

EFFECTIVE DATE: MARCH 17, 1997

Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov

EXISTING CONDITIONS CALCULATIONS

(FROM PREVIOUSLY APPROVED KIOWA MDDP)

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Forest Lakes MDDP
Time of Concentration Calculation

Basin / Design Pt	Contributing Basins	Slope O'land	Slope Channel	Slope Road	Length O'land	Length Channel	Length Road	Runoff Coef. (10-year)	Velocity O'land	Velocity Channel	Velocity Road	T_i O'land	T_t Channel	T_t Road	T_c	Basin / Design Pt
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 O'land	Slope Channel	Slope Road	Length O'land	Length Channel	Length Road	Runoff Coef (10-year)	Velocity O'land	Velocity Channel	Velocity Road	T_c O'land	T_c Channel	T_c Road	T_c	Basin / Design Pt
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
E1		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.	E1
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 Lots/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	C_{10}	C_{100}		
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	C_{10}	C_{100}		
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 PHASE 2*
JOB NUMBER: *1161.00*
DATE: *01/16/17*
CALCULATED BY: *DLG*

FINAL DRAINAGE REPORT ~ BASIN RUNOFF COEFFICIENT SUMMARY

		IMPERVIOUS AREA / STREETS							LANDSCAPE/UNDEVELOPED AREAS							WEIGHTED			WEIGHTED CA		
BASIN	TOTAL AREA (AC)	AREA (AC)	C(2)	C(5)	C(10)	C(25)	C(50)	C(100)	AREA (AC)	C(2)	C(5)	C(10)	C(25)	C(50)	C(100)	C(2)	C(5)	C(100)	CA(2)	CA(5)	CA(100)
A	22.89	22.89	0.22	0.30	0.38	0.47	0.52	0.57	0.00	0.02	0.08	0.15	0.25	0.30	0.35	0.22	0.30	0.57	**5.03**	**6.87**	**13.04**
B	19.13	0.00	0.89	0.90	0.92	0.94	0.95	0.96	19.13	0.02	0.08	0.15	0.25	0.30	0.35	0.02	0.08	0.35	**0.38**	**1.53**	**6.69**
C	20.41	20.41	0.22	0.30	0.38	0.47	0.52	0.57	0.00	0.02	0.08	0.15	0.25	0.30	0.35	0.22	0.30	0.57	**4.49**	**6.12**	**11.63**
D	15.74	0.00	0.89	0.90	0.92	0.94	0.95	0.96	15.74	0.02	0.08	0.15	0.25	0.30	0.35	0.02	0.08	0.35	**0.31**	**1.26**	**5.51**
E	6.41	6.41	0.22	0.30	0.38	0.47	0.52	0.57	0.00	0.02	0.08	0.15	0.25	0.30	0.35	0.22	0.30	0.57	**1.41**	**1.92**	**3.66**
F	29.28	29.28	0.22	0.30	0.38	0.47	0.52	0.57	0.00	0.02	0.08	0.15	0.25	0.30	0.35	0.22	0.30	0.57	**6.44**	**8.79**	**16.69**
G	8.39	0.00	0.89	0.90	0.92	0.94	0.95	0.96	8.39	0.02	0.08	0.15	0.25	0.30	0.35	0.02	0.08	0.35	**0.17**	**0.67**	**2.94**
H	3.22	0.00	0.89	0.90	0.92	0.94	0.95	0.96	3.22	0.02	0.08	0.15	0.25	0.30	0.35	0.02	0.08	0.35	**0.06**	**0.26**	**1.13**
I	12.50	0.00	0.89	0.90	0.92	0.94	0.95	0.96	12.50	0.02	0.08	0.15	0.25	0.30	0.35	0.02	0.08	0.35	**0.25**	**1.00**	**4.37**
J	3.70	3.70	0.89	0.90	0.92	0.94	0.95	0.96	0.00	0.02	0.08	0.15	0.25	0.30	0.35	0.89	0.90	0.96	**3.29**	**3.33**	**3.55**
K	4.57	0.00	0.89	0.90	0.92	0.94	0.95	0.96	4.57	0.02	0.08	0.15	0.25	0.30	0.35	0.02	0.08	0.35	**0.09**	**0.37**	**1.60**
OS-1	80.30	0.00	0.89	0.90	0.92	0.94	0.95	0.96	80.30	0.02	0.08	0.15	0.25	0.30	0.35	0.02	0.08	0.35	**1.61**	**6.42**	**28.11**
OS-2	21.37	0.00	0.89	0.90	0.92	0.94	0.95	0.96	21.37	0.02	0.08	0.15	0.25	0.30	0.35	0.02	0.08	0.35	**0.43**	**1.71**	**7.48**
OS-3	21.07	0.00	0.89	0.90	0.92	0.94	0.95	0.96	21.07	0.02	0.08	0.15	0.25	0.30	0.35	0.02	0.08	0.35	**0.42**	**1.69**	**7.37**

JOB NAME: *FOREST LAKES PHASE 2*
JOB NUMBER: *1161.00*
DATE: *03/06/03*
CALC'D BY: *DLG*

$$t_i = \frac{0.395(1.1 - C_5)\sqrt{L}}{S^{0.33}} \qquad V = C_v S_w^{0.5} \qquad \text{Tc=L/V}$$

$$t_c = \frac{L}{180} + 10$$

Table 6-7. Conveyance Coefficient, C_v

Type of Land Surface	C_v
Heavy meadow	2.5
Tillage/field	5
Riprap (not buried)*	6.5
Short pasture and lawns	7
Nearly bare ground	10
Grassed waterway	15
Paved areas and shallow paved swales	20

*For buried riprap, select C_v value based on type of vegetative cover.

FINAL DRAINAGE REPORT ~ BASIN RUNOFF SUMMARY

BASIN	WEIGHTED			OVERLAND				STREET / CHANNEL FLOW				Tc	INTENSITY						TOTAL FLOWS		
	CA(2)	CA(5)	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(2) (cfs)	Q(5) (cfs)	Q(100) (cfs)
A	5.03	6.87	13.04	0.08	170	3.4	19.1	400	6.0%	4.9	1.4	20.5	2.44	3.06	3.56	4.07	4.58	5.13	12	21	67
B	0.38	1.53	6.69	0.08	300	60	11.9	200	20.0%	8.9	0.4	12.2	3.05	3.83	4.46	5.10	5.74	6.42	1	6	43
C	4.49	6.12	11.63	0.08	120	2.5	15.8	1000	6.0%	4.9	3.4	19.2	2.52	3.15	3.67	4.20	4.72	5.28	11	19	61
D	0.31	1.26	5.51	0.08	300	60	11.9	200	20.0%	8.9	0.4	12.2	3.05	3.83	4.46	5.10	5.74	6.42	1	5	35
E	1.41	1.92	3.66	0.08	120	2.4	16.0	1000	6.0%	4.9	3.4	19.5	2.50	3.13	3.65	4.18	4.70	5.26	4	6	19
F	6.44	8.79	16.69	0.08	120	2.4	16.0	1000	6.0%	4.9	3.4	19.5	2.50	3.13	3.65	4.18	4.70	5.26	16	28	88
G	0.17	0.67	2.94	0.08	300	1.8	37.8	1000	6.0%	4.9	3.4	41.2	1.61	2.01	2.34	2.68	3.01	3.37	0.3	1.3	10
H	0.06	0.26	1.13	0.08	224	76	8.6	0	0.0%	0.0	0.0	8.6	3.47	4.35	5.08	5.80	6.53	7.31	0.2	1.1	8
I	0.25	1.00	4.37	0.08	120	2.4	16.0	500	6.0%	4.9	1.7	17.8	2.61	3.27	3.81	4.36	4.90	5.49	1	3	24
J	3.29	3.33	3.55	0.08	15	0.3	5.7	1000	6.0%	4.9	3.4	9.1	3.41	4.27	4.99	5.70	6.41	7.18	11	14	25
K	0.09	0.37	1.60	0.08	300	60	11.9	300	6.0%	4.9	1.0	12.9	2.99	3.75	4.37	5.00	5.62	6.29	0.3	1.4	10
OS-1	1.61	6.42	28.11	0.08	300	30	14.9	1000	20.0%	8.9	1.9	16.8	2.68	3.35	3.91	4.47	5.03	5.63	4	22	158
OS-2	0.43	1.71	7.48	0.08	300	60	11.9	1000	20.0%	8.9	1.9	13.7	2.92	3.65	4.26	4.87	5.48	6.13	1	6	46
OS-3	0.42	1.69	7.37	0.08	300	75	11.0	200	25.0%	10.0	0.3	11.4	3.14	3.94	4.59	5.25	5.91	6.61	1	7	49

JOB NAME:	*FOREST LAKES PHASE 2*
JOB NUMBER:	*1161.00*
DATE:	*01/16/17*
CALCULATED BY:	*DLG*

FINAL DRAINAGE REPORT ~ SURFACE ROUTING SUMMARY

Design Point(s)	Contributing Basins	Equivalent CA(5)	Equivalent CA(100)	Maximum Tc	Intensity		Flow		
					I(5)	I(100)	Q(5)	Q(100)	Inlet Size
1	BASIN A	6.87	13.04	20.5	3.06	5.13	21	67	POND A
2	BASINS B +C	7.65	18.33	19.2	3.15	5.28	24	97	POND B
3	BASINS D, E, F, H, I, J, K	16.92	36.51	19.5	3.13	5.26	53	192	POND C

DETENTION POND "A"

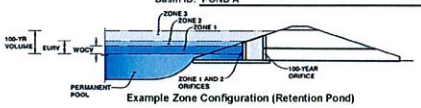
CLASSIC
CONSULTING
ENGINEERS & SURVEYORS

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Project: FOREST LAKES PHASE 2

Basin ID: POND A



Example Zone Configuration (Retention Pond)

Required Volume Calculation

Selected BMP Type =	EDB	
Watershed Area =	22.89	acres
Watershed Length =	1,000	ft
Watershed Slope =	0.020	ft/ft
Watershed Imperviousness =	30.00%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	0.0%	percent
Percentage Hydrologic Soil Groups C/D =	100.0%	percent
Desired WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	
Water Quality Capture Volume (WQCV) =	0.289	acre-feet
Excess Urban Runoff Volume (EURV) =	0.624	acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.572	acre-feet
5-yr Runoff Volume (P1 = 1.5 in.) =	0.948	acre-feet
10-yr Runoff Volume (P1 = 1.75 in.) =	1.358	acre-feet
25-yr Runoff Volume (P1 = 2 in.) =	2.143	acre-feet
50-yr Runoff Volume (P1 = 2.25 in.) =	2.699	acre-feet
100-yr Runoff Volume (P1 = 2.52 in.) =	3.403	acre-feet
500-yr Runoff Volume (P1 = 3.1 in.) =	4.705	acre-feet
Approximate 2-yr Detention Volume =	0.535	acre-feet
Approximate 5-yr Detention Volume =	0.895	acre-feet
Approximate 10-yr Detention Volume =	1.039	acre-feet
Approximate 25-yr Detention Volume =	1.168	acre-feet
Approximate 50-yr Detention Volume =	1.221	acre-feet
Approximate 100-yr Detention Volume =	1.495	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

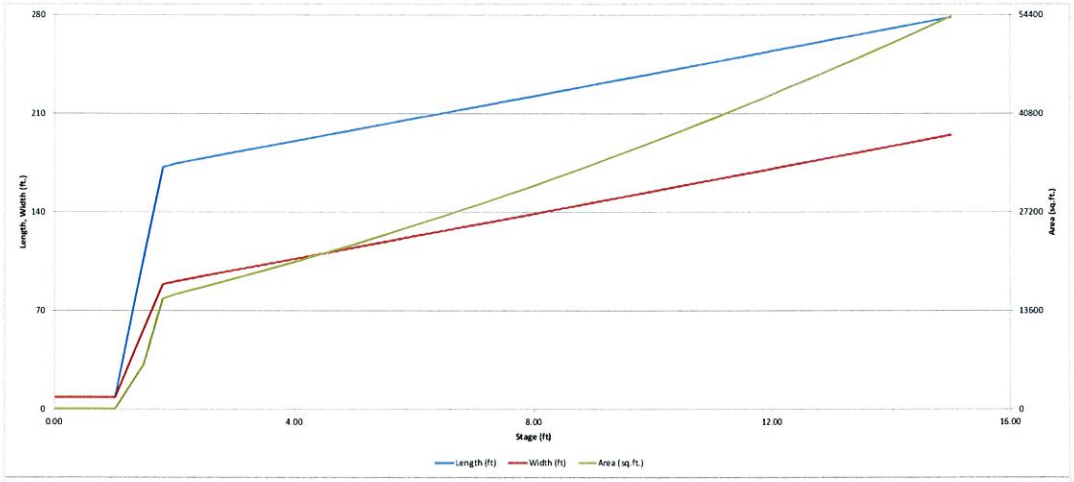
Zone 1 Volume (WQCV) =	0.289	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.335	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.871	acre-feet
Total Detention Basin Volume =	1.495	acre-feet
Initial Surcharge Volume (ISV) =	38	ft^3
Initial Surcharge Depth (ISD) =	0.50	ft
Total Available Detention Depth (H_{tota}) =	5.00	ft
Depth of Trickle Channel (H_{TC}) =	0.50	ft
Slope of Trickle Channel (S_{TC}) =	0.005	ft/ft
Slopes of Main Basin Sides (S_{main}) =	4	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	2	
Initial Surcharge Area (A_{ISV}) =	76	ft^2
Surcharge Volume Length (L_{ISV}) =	8.7	ft
Surcharge Volume Width (W_{ISV}) =	8.7	ft
Depth of Basin Floor (H_{FLOOR}) =	0.80	ft
Length of Basin Floor (L_{FLOOR}) =	172.8	ft
Width of Basin Floor (W_{FLOOR}) =	89.2	ft
Area of Basin Floor (A_{FLOOR}) =	15,411	ft^2
Volume of Basin Floor (V_{FLOOR}) =	4,443	ft^3
Depth of Main Basin (H_{MAIN}) =	3.20	ft
Length of Main Basin (L_{MAIN}) =	198.4	ft
Width of Main Basin (W_{MAIN}) =	114.7	ft
Area of Main Basin (A_{MAIN}) =	22,762	ft^2
Volume of Main Basin (V_{MAIN}) =	60,607	ft^3
Calculated Total Basin Volume (V_{total}) =	1.495	acre-feet

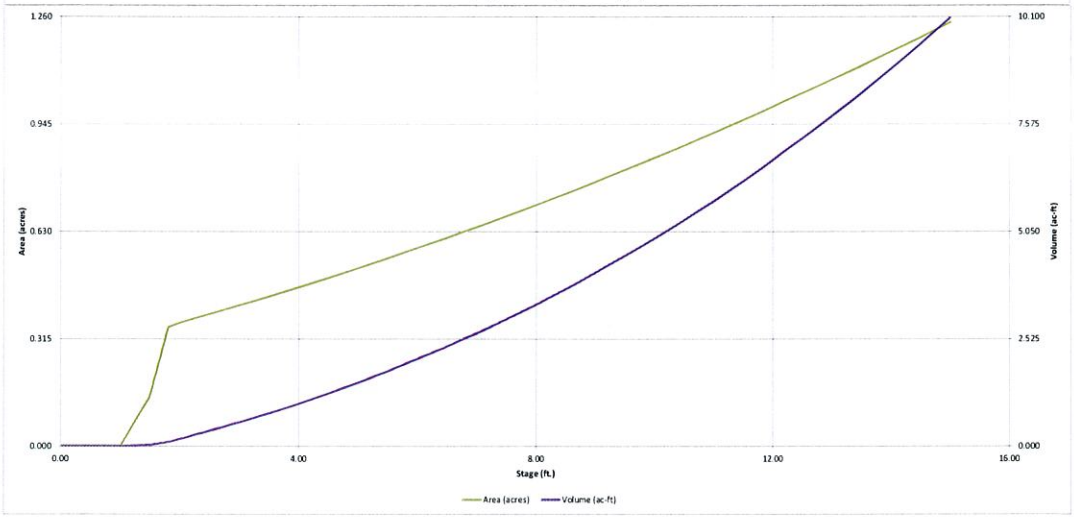
Depth Increment = 0.5 ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	0.00		8.7	8.7	76		0.002		
ISV	0.50		8.7	8.7	76		0.002	37	0.001
	1.00		8.7	8.7	76		0.002	75	0.002
	1.50		108.6	57.7	6,268		0.144	1,230	0.028
Floor	1.80		171.9	88.7	15,245		0.350	4,463	0.102
	2.00		174.3	90.6	15,802		0.363	7,426	0.170
Zone 1 (WQCV)	2.31		176.9	93.2	16,487		0.378	12,592	0.289
	2.50		178.4	94.7	16,900		0.388	15,764	0.362
	3.00		182.4	98.7	18,008		0.413	24,489	0.562
Zone 2 (EURV)	3.15		183.6	99.9	18,347		0.421	27,216	0.625
	3.50		186.4	102.7	19,149		0.440	33,777	0.775
	4.00		190.4	106.7	20,321		0.467	43,643	1.002
	4.50		194.4	110.7	21,526		0.494	54,104	1.242
Zone 3 (100-year)	5.00		198.4	114.7	22,762		0.523	65,174	1.496
	5.50		202.4	118.7	24,031		0.552	76,871	1.765
	6.00		206.4	122.7	25,331		0.582	89,210	2.048
	6.50		210.4	126.7	26,664		0.612	102,208	2.346
	7.00		214.4	130.7	28,028		0.643	115,879	2.660
	7.50		218.4	134.7	29,425		0.676	130,241	2.990
	8.00		222.4	138.7	30,853		0.708	145,310	3.336
	8.50		226.4	142.7	32,314		0.742	161,100	3.698
	9.00		230.4	146.7	33,806		0.776	177,629	4.078
	9.50		234.4	150.7	35,331		0.811	194,912	4.475
	10.00		238.4	154.7	36,888		0.847	212,965	4.889
	10.50		242.4	158.7	38,476		0.883	231,805	5.322
	11.00		246.4	162.7	40,097		0.920	251,446	5.772
	11.50		250.4	166.7	41,749		0.958	271,907	6.242
	12.00		254.4	170.7	43,434		0.997	293,201	6.731
	12.50		258.4	174.7	45,150		1.037	315,346	7.239
	13.00		262.4	178.7	46,899		1.077	338,356	7.768
	13.50		266.4	182.7	48,679		1.118	362,250	8.316
	14.00		270.4	186.7	50,492		1.159	387,041	8.885
	14.50		274.4	190.7	52,336		1.201	412,747	9.475
	15.00		278.4	194.7	54,213		1.245	439,383	10.087

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)



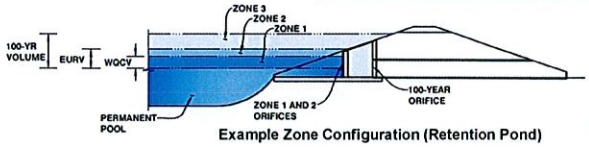


Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project: _____

Basin ID: _____



Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	2.31	0.289	Orifice Plate
Zone 2 (EURV)	3.15	0.335	Orifice Plate
Zone 3 (100-year)	5.00	0.871	Weir&Pipe (Restrict)
		1.495	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 =	12.00	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
=	N/A	feet
=	N/A	ft^2

Revise. UDFCD recommends three orifices to maximize the diameter.
Comment applies to all proposed ponds.

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 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	1.00	2.00		
Orifice Area (sq. inches)	0.88	1.25	2.25		

	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 =	0.00	N/A	H:V (enter zero for flat grate)
Horiz. Length of Weir Sides =	4.00	N/A	feet
Overflow Grate Open Area % =	70%	N/A	%, grate open area/total area
Debris Clogging % =	50%	N/A	%

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected	
Height of Grate Upper Edge, H_t =	4.00	N/A	feet
Over Flow Weir Slope Length =	4.00	N/A	feet
Grate Open Area / 100-yr Orifice Area =	3.42	N/A	should be ≥ 4
Overflow Grate Open Area w/o Debris =	16.80	N/A	ft^2
Overflow Grate Open Area w/ Debris =	8.40	N/A	ft^2

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

	Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	2.50	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 Trap

Spillway Invert Stage=	5.50	feet
Spillway Crest Length =	75.0	feet
Spillway End Slopes =	4.00	acres
Freeboard above Max Water Surface =	1.00	

rs for Spillway

Per UDFCD "The maximum allowable 100-yr release rate for a full spectrum detention facility is equal to 90 percent of the predevelopment discharge for the upstream watershed." (Ch 12, Section 4.1.2)
Comment applies to all proposed ponds.

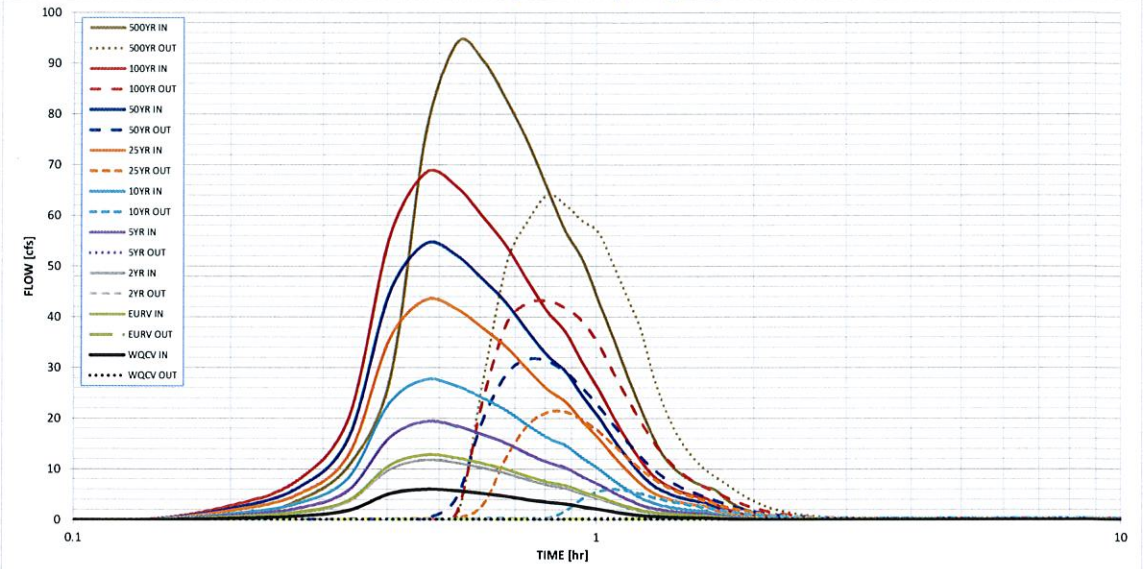
Routed Hydrograph Results

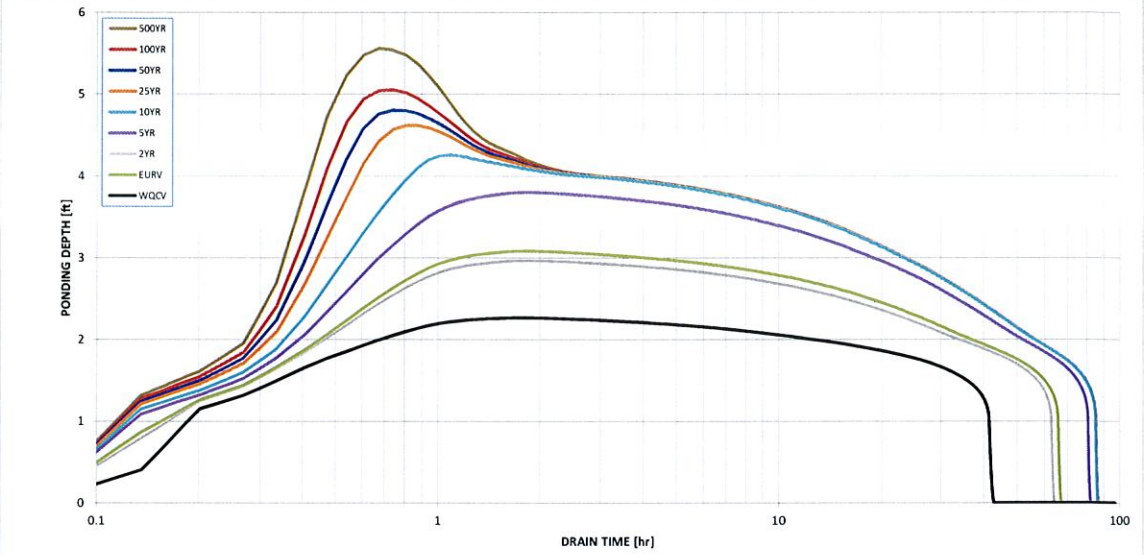
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	3.10
Calculated Runoff Volume (acre-ft) =	0.289	0.624	0.572	0.948	1.358	2.143	2.699	3.403	4.705
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	0.289	0.622	0.571	0.946	1.357	2.141	2.696	3.401	4.702
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.02	0.17	0.45	1.01	1.33	1.72	2.45
Predevelopment Peak Q (cfs) =	0.0	0.0	0.4	3.8	10.2	23.1	30.5	39.4	56.2
Peak Inflow Q (cfs) =	6.0	12.8	11.8	19.4	27.6	43.4	54.4	68.4	94.0
Peak Outflow Q (cfs) =	0.1	0.2	0.2	0.3	6.0	21.3	31.6	43.2	64.1
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.1	0.6	0.9	1.0	1.1	1.1
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	0.3	1.3	1.9	2.5	3.6
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	40	62	59	75	77	73	71	67	61
Time to Drain 99% of Inflow Volume (hours) =	41	65	62	79	82	81	80	79	76
Maximum Ponding Depth (ft) =	2.27	3.08	2.97	3.80	4.26	4.62	4.81	5.05	5.56
Area at Maximum Ponding Depth (acres) =	0.38	0.42	0.41	0.46	0.48	0.50	0.51	0.53	0.56
Maximum Volume Stored (acre-ft) =	0.270	0.595	0.546	0.910	1.120	1.297	1.393	1.522	1.798

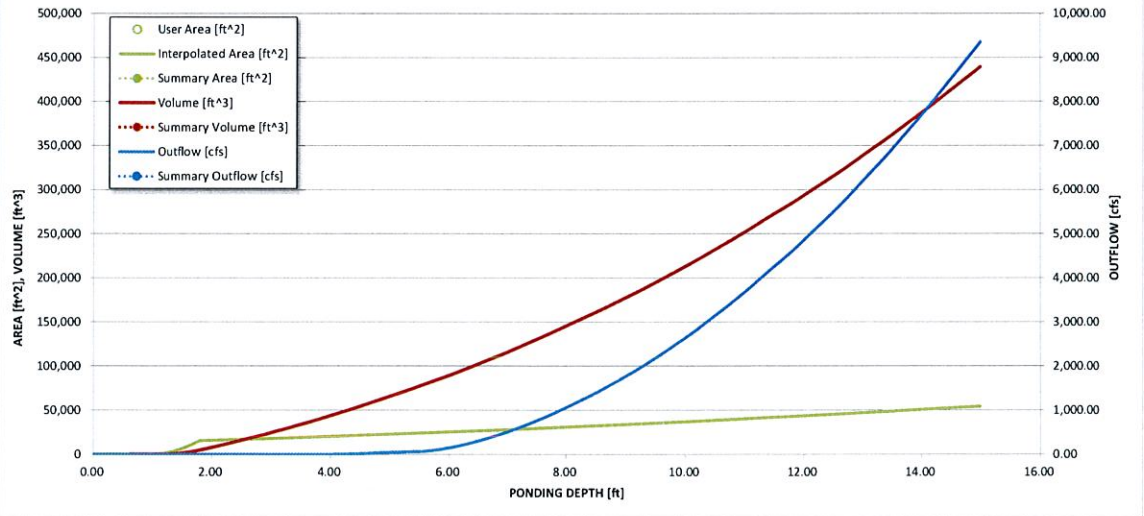
Must be within 72hrs per Senate Bill 15-212

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)







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

Detention Basin Outlet Structure Design

Outflow Hydrograph Workbook Filename:

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

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

Time Interval	SOURCE	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK
	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
4.04 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:04:02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hydrograph	0:08:05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Constant	0:12:07	0.27	0.57	0.52	0.85	1.20	1.86	2.32	2.88	3.86
1.237	0:16:10	0.72	1.53	1.40	2.30	3.27	5.09	6.36	7.95	10.78
	0:20:12	1.85	3.93	3.61	5.91	8.39	13.06	16.33	20.41	27.68
	0:24:14	5.10	10.79	9.92	16.23	23.03	35.85	44.80	55.99	75.87
	0:28:17	5.99	12.80	11.75	19.37	27.64	43.36	54.44	68.44	94.04
	0:32:19	5.70	12.21	11.21	18.50	26.44	41.54	52.19	65.70	90.66
	0:36:22	5.19	11.12	10.21	16.85	24.07	37.81	47.50	59.79	82.65
	0:40:24	4.61	9.93	9.11	15.08	21.57	33.96	42.71	53.83	74.47
	0:44:26	3.96	8.57	7.86	13.05	18.71	29.54	37.23	47.01	65.20
	0:48:29	3.46	7.47	6.85	11.35	16.26	25.68	32.42	41.00	56.95
	0:52:31	3.13	6.76	6.21	10.29	14.75	23.28	29.34	37.06	51.36
	0:56:34	2.56	5.58	5.11	8.52	12.26	19.42	24.51	31.00	43.11
	1:00:36	2.08	4.56	4.17	6.99	10.08	16.02	20.26	25.66	35.75
	1:04:38	1.58	3.51	3.21	5.41	7.85	12.57	15.95	20.27	28.38
	1:08:41	1.16	2.61	2.38	4.06	5.94	9.60	12.23	15.61	21.96
	1:12:43	0.85	1.89	1.73	2.93	4.33	7.07	9.06	11.61	16.44
	1:16:46	0.66	1.47	1.34	2.26	3.31	5.36	6.84	8.74	12.30
	1:20:48	0.55	1.21	1.10	1.86	2.71	4.36	5.54	7.05	9.87
	1:24:50	0.46	1.02	0.94	1.57	2.29	3.68	4.67	5.94	8.30
	1:28:53	0.41	0.90	0.82	1.38	2.00	3.21	4.07	5.17	7.22
	1:32:55	0.37	0.81	0.74	1.24	1.80	2.88	3.65	4.63	6.45
	1:36:58	0.34	0.75	0.68	1.14	1.66	2.64	3.35	4.24	5.91
	1:41:00	0.25	0.55	0.50	0.84	1.22	1.95	2.48	3.15	4.42
	1:45:02	0.18	0.40	0.37	0.62	0.89	1.42	1.80	2.28	3.20
	1:49:05	0.13	0.29	0.27	0.45	0.65	1.05	1.33	1.69	2.36
	1:53:07	0.10	0.22	0.20	0.33	0.48	0.78	0.99	1.25	1.76
	1:57:10	0.07	0.15	0.14	0.24	0.35	0.56	0.72	0.92	1.29
	2:01:12	0.05	0.11	0.10	0.17	0.25	0.40	0.51	0.66	0.93
	2:05:14	0.03	0.08	0.07	0.12	0.18	0.29	0.37	0.48	0.67
	2:09:17	0.02	0.05	0.05	0.08	0.12	0.20	0.26	0.33	0.47
	2:13:19	0.01	0.03	0.03	0.05	0.07	0.13	0.16	0.21	0.31
	2:17:22	0.01	0.01	0.01	0.02	0.04	0.07	0.09	0.12	0.18
	2:21:24	0.00	0.00	0.00	0.01	0.01	0.03	0.04	0.05	0.08
	2:25:26	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.02
	2:29:29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:33:31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:37:34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:41:36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:45:38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:49:41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:53:43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:57:46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:01:48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:05:50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:09:53	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:13:55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:17:58	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:22:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:26:02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:30:05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:34:07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:38:10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:42:12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:46:14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:50:17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:54:19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:58:22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:02:24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:06:26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:14:31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:18:34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:22:36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:26:38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:34:43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:38:46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:42:48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:46:50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:50:53	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Summary Stage-Area-Volume-Discharge Relationships

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

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

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

DETENTION POND "B"

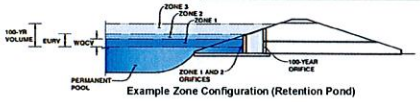
CLASSIC℠
CONSULTING
ENGINEERS & SURVEYORS

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Project: FOREST LAKES PHASE 2

Basin ID: POND B



Example Zone Configuration (Retention Pond)

Required Volume Calculation

Selected BMP Type =	EDB	
Watershed Area =	39.54	acres
Watershed Length =	2,000	ft
Watershed Slope =	0.040	ft/ft
Watershed Imperviousness =	30.00%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	0.0%	percent
Percentage Hydrologic Soil Groups C/D =	100.0%	percent
Desired WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	
Water Quality Capture Volume (WQCV) =	0.499	acre-feet
Excess Urban Runoff Volume (EURV) =	1.077	acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.987	acre-feet
5-yr Runoff Volume (P1 = 1.5 in.) =	1.637	acre-feet
10-yr Runoff Volume (P1 = 1.75 in.) =	2.346	acre-feet
25-yr Runoff Volume (P1 = 2 in.) =	3.701	acre-feet
50-yr Runoff Volume (P1 = 2.25 in.) =	4.662	acre-feet
100-yr Runoff Volume (P1 = 2.52 in.) =	5.879	acre-feet
500-yr Runoff Volume (P1 = 3.1 in.) =	8.127	acre-feet
Approximate 2-yr Detention Volume =	0.925	acre-feet
Approximate 5-yr Detention Volume =	1.546	acre-feet
Approximate 10-yr Detention Volume =	1.794	acre-feet
Approximate 25-yr Detention Volume =	2.017	acre-feet
Approximate 50-yr Detention Volume =	2.109	acre-feet
Approximate 100-yr Detention Volume =	2.582	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) =	0.499	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.578	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	1.505	acre-feet
Total Detention Basin Volume =	2.582	acre-feet
Initial Surcharge Volume (ISV) =	65	ft^3
Initial Surcharge Depth (ISD) =	0.50	ft
Total Available Detention Depth (H_{tot}) =	5.00	ft
Depth of Trickle Channel (H_{TC}) =	0.50	ft
Slope of Trickle Channel (S_{TC}) =	0.005	ft/ft
Slopes of Main Basin Sides (S_{main}) =	4	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	2	

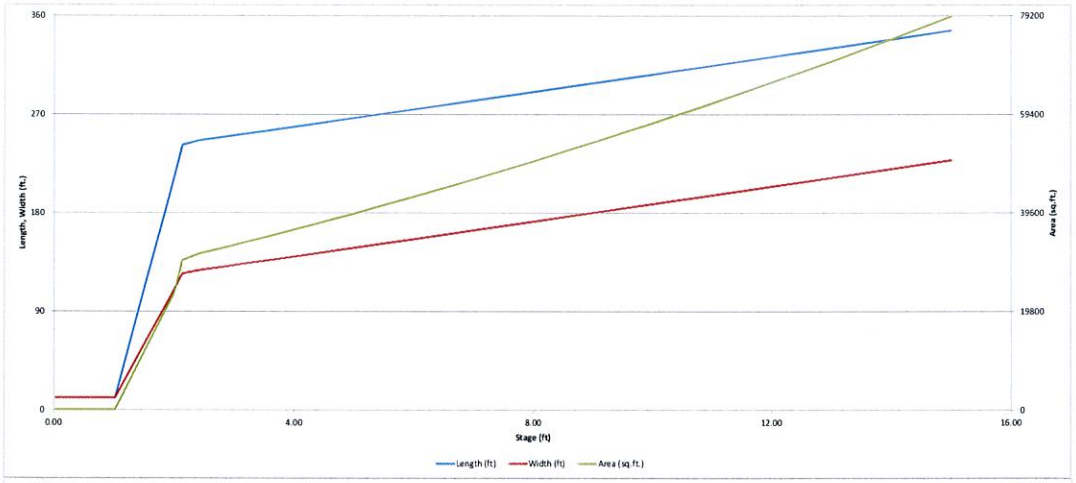
Initial Surcharge Area (A_{ISV}) =	130	ft^2
Surcharge Volume Length (L_{ISV}) =	11.4	ft
Surcharge Volume Width (W_{ISV}) =	11.4	ft
Depth of Basin Floor (H_{FLOOR}) =	1.14	ft
Length of Basin Floor (L_{FLOOR}) =	243.8	ft
Width of Basin Floor (W_{FLOOR}) =	125.3	ft
Area of Basin Floor (A_{FLOOR}) =	30,550	ft^2
Volume of Basin Floor (V_{FLOOR}) =	12,406	ft^3
Depth of Main Basin (H_{MAIN}) =	2.86	ft
Length of Main Basin (L_{MAIN}) =	266.7	ft
Width of Main Basin (W_{MAIN}) =	148.2	ft
Area of Main Basin (A_{MAIN}) =	39,522	ft^2
Volume of Main Basin (V_{MAIN}) =	99,964	ft^3
Calculated Total Basin Volume (V_{tot}) =	2.583	acre-feet

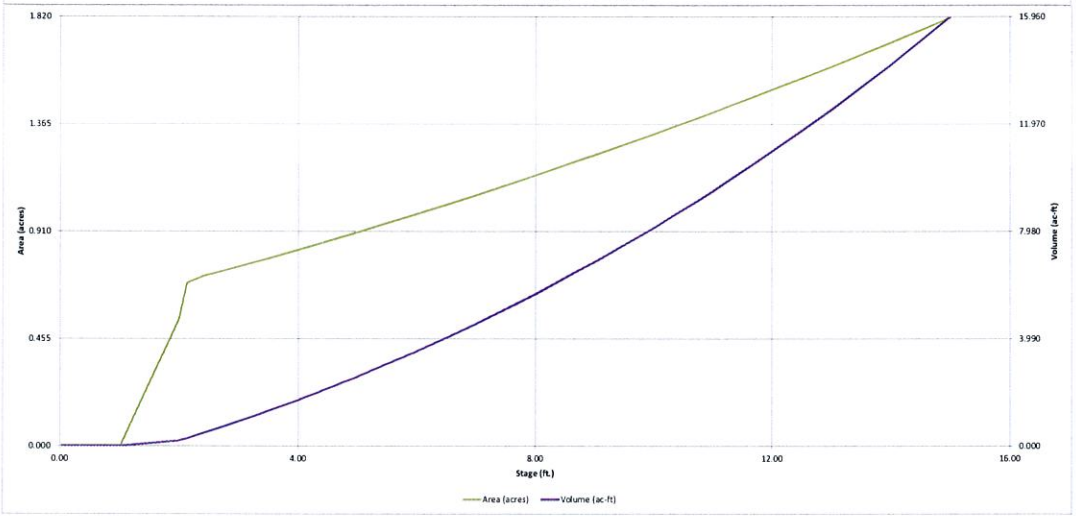
Depth Increment = 1 ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	0.00		11.4	11.4	130		0.003		
ISV	0.50		11.4	11.4	130		0.003	64	0.001
	1.00		11.4	11.4	130		0.003	129	0.003
	2.00		213.4	110.4	23,562		0.541	8,559	0.196
Floor	2.14		241.9	124.4	30,103		0.691	12,306	0.283
Zone 1 (WQCV)	2.44		246.2	127.7	31,445		0.722	21,909	0.503
	3.00		250.7	132.2	33,140		0.761	39,991	0.918
Zone 2 (EURV)	3.21		252.3	133.9	33,786		0.776	47,018	1.079
	4.00		258.7	140.2	36,267		0.833	74,684	1.715
Zone 3 (100-year)	5.00		266.7	148.2	39,522		0.907	112,568	2.584
	6.00		274.7	156.2	42,905		0.985	153,771	3.530
	7.00		282.7	164.2	46,416		1.066	198,421	4.555
	8.00		290.7	172.2	50,055		1.149	246,846	5.662
	9.00		298.7	180.2	53,822		1.236	298,574	6.854
	10.00		306.7	188.2	57,717		1.325	354,333	8.134
	11.00		314.7	196.2	61,740		1.417	414,051	9.505
	12.00		322.7	204.2	65,891		1.513	477,856	10.970
	13.00		330.7	212.2	70,170		1.611	545,876	12.532
	14.00		338.7	220.2	74,577		1.712	618,239	14.193
	15.00		346.7	228.2	79,112		1.816	695,073	15.957

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)



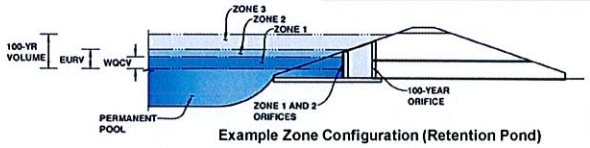


Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project: FOREST LAKES PHASE 2

Basin ID: POND B



Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	2.44	0.499	Orifice Plate
Zone 2 (EURV)	3.21	0.578	Orifice Plate
Zone 3 (100-year)	5.00	1.505	Weir&Pipe (Restrict)
		2.582	Total

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

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

Calculated Parameters for Underdrain

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

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

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =	3.75	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	11.25	inches
Orifice Plate: Orifice Area per Row =	N/A	inches

Calculated Parameters for Plate

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

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	0.90	1.80	2.70	3.60			
Orifice Area (sq. inches)	0.69	2.25	3.00	3.00				

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

User Input: Vertical Orifice (Circular or Rectangular)

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

Calculated Parameters for Vertical Orifice

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

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

	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	3.75	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	8.00	N/A	feet
Overflow Weir Slope =	0.00	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 =	3.75	N/A	feet
Over Flow Weir Slope Length =	4.00	N/A	feet
Grate Open Area / 100-yr Orifice Area =	3.85	N/A	should be ≥ 4
Overflow Grate Open Area w/o Debris =	27.20	N/A	ft^2
Overflow Grate Open Area w/ Debris =	13.60	N/A	ft^2

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

	Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	2.50	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	36.00	N/A	inc
Restrictor Plate Height Above Pipe Invert =	36.00		inc

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
Angle of Restrictor Plate on Pipe =	3.14	N/A	radians

Provide emergency spillway

User Input: Emergency Spillway (Rectangular or Trapezoidal)

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

Calculated Parameters for Spillway

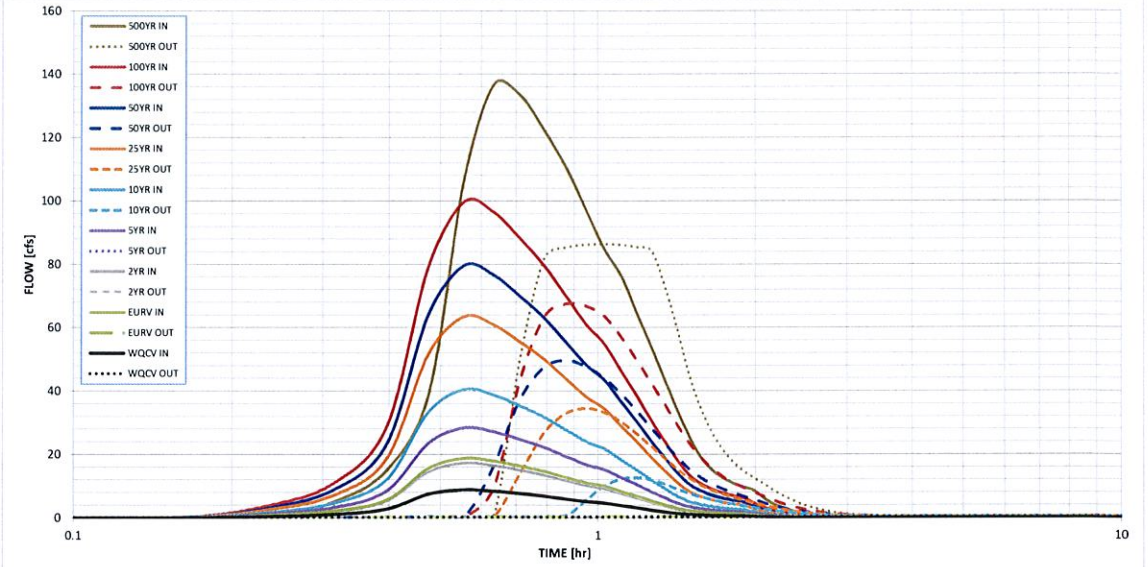
Spillway Design Flow Depth=		feet
Stage at Top of Freeboard =		feet
Basin Area at Top of Freeboard =		acres

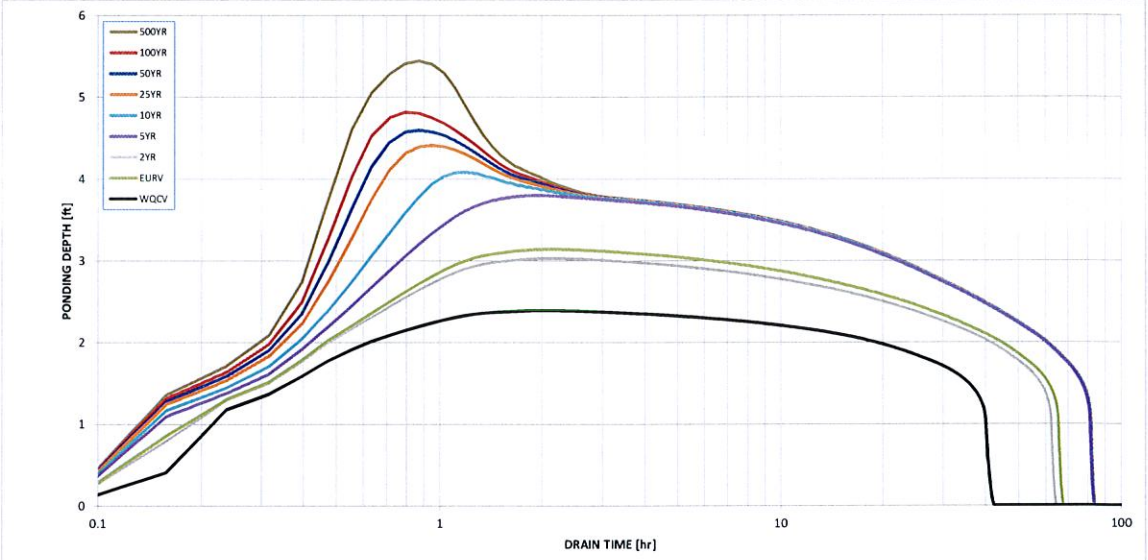
Routed Hydrograph Results

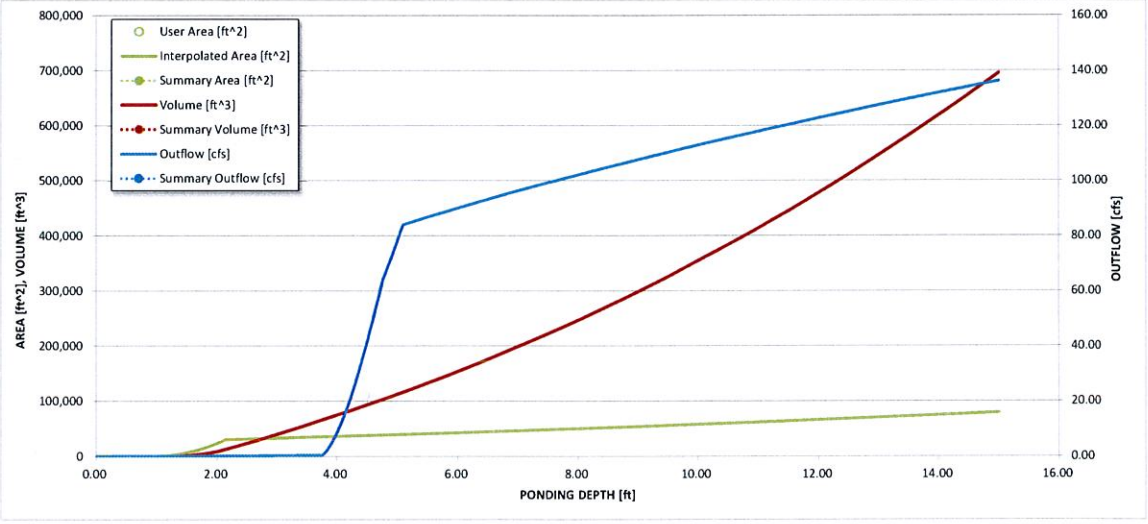
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	3.10
Calculated Runoff Volume (acre-ft) =	0.499	1.077	0.987	1.637	2.346	3.701	4.662	5.879	8.127
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	0.499	1.077	0.988	1.637	2.347	3.703	4.664	5.876	8.124
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.02	0.13	0.36	0.84	1.11	1.44	2.06
Predevelopment Peak Q (cfs) =	0.0	0.0	0.6	5.2	14.3	33.2	43.8	57.0	81.3
Peak Inflow Q (cfs) =	8.8	18.8	17.2	28.4	40.5	63.4	79.5	99.7	136.6
Peak Outflow Q (cfs) =	0.2	0.3	0.3	1.2	12.7	34.5	49.6	67.5	86.4
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.2	0.9	1.0	1.1	1.2	1.1
Structure Controlling Flow =	Plate	Plate	Plate	Overflow Grate 1	Overflow Grate 1	Overflow Grate 1	Overflow Grate 1	Overflow Grate 1	Outlet Plate 1
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	0.0	0.5	1.2	1.8	2.5	3.2
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	38	61	58	75	72	68	65	63	58
Time to Drain 99% of Inflow Volume (hours) =	40	64	61	79	78	77	75	74	72
Maximum Ponding Depth (ft) =	2.39	3.14	3.03	3.80	4.09	4.41	4.60	4.82	5.44
Area at Maximum Ponding Depth (acres) =	0.72	0.77	0.76	0.82	0.84	0.86	0.88	0.89	0.94
Maximum Volume Stored (acre-ft) =	0.467	1.025	0.933	1.549	1.781	2.062	2.219	2.413	2.991

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]
4.74 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:04:44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hydrograph Constant	0:09:29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:14:13	0.39	0.82	0.76	1.23	1.73	2.66	3.27	3.99	5.22
1.056	0:18:58	1.05	2.22	2.04	3.34	4.74	7.35	9.12	11.28	15.09
	0:23:42	2.70	5.71	5.25	8.58	12.17	18.87	23.42	28.96	38.75
	0:28:26	7.41	15.69	14.42	23.57	33.39	51.75	64.20	79.33	106.00
	0:33:11	8.77	18.76	17.22	28.37	40.46	63.43	79.53	99.66	136.63
	0:37:55	8.36	17.93	16.46	27.15	38.77	60.94	76.66	96.51	133.42
	0:42:40	7.61	16.32	14.98	24.71	35.29	55.46	69.88	88.14	122.24
	0:47:24	6.79	14.61	13.41	22.17	31.71	49.95	62.97	79.46	110.27
	0:52:08	5.85	12.66	11.61	19.25	27.61	43.66	55.13	69.68	96.94
	0:56:53	5.10	11.01	10.10	16.72	24.02	38.09	48.15	60.92	84.85
	1:01:37	4.62	9.98	9.16	15.16	21.75	34.42	43.43	54.85	76.17
	1:06:22	3.80	8.28	7.59	12.62	18.16	28.81	36.45	46.16	64.42
	1:11:06	3.10	6.79	6.22	10.39	14.99	23.86	30.22	38.32	53.56
	1:15:50	2.38	5.27	4.82	8.13	11.78	18.87	23.99	30.53	42.88
	1:20:35	1.76	3.97	3.62	6.17	9.01	14.55	18.56	23.69	33.41
	1:25:19	1.28	2.88	2.62	4.52	6.65	10.84	13.89	17.80	25.23
	1:30:04	0.99	2.21	2.02	3.44	5.03	8.15	10.40	13.27	18.71
	1:34:48	0.82	1.81	1.66	2.81	4.08	6.56	8.35	10.62	14.89
	1:39:32	0.70	1.54	1.40	2.37	3.45	5.53	7.02	8.92	12.49
	1:44:17	0.61	1.35	1.23	2.08	3.01	4.81	6.10	7.74	10.82
	1:49:01	0.55	1.21	1.11	1.86	2.70	4.31	5.45	6.91	9.64
	1:53:46	0.51	1.11	1.02	1.71	2.47	3.94	4.99	6.32	8.81
	1:58:30	0.37	0.82	0.75	1.26	1.83	2.93	3.73	4.76	6.71
	2:03:14	0.27	0.60	0.55	0.92	1.33	2.13	2.70	3.44	4.84
	2:07:59	0.20	0.44	0.40	0.68	0.98	1.57	2.00	2.55	3.59
	2:12:43	0.15	0.33	0.30	0.50	0.73	1.17	1.49	1.89	2.67
	2:17:28	0.10	0.23	0.21	0.36	0.53	0.85	1.09	1.39	1.97
	2:22:12	0.07	0.17	0.15	0.26	0.38	0.61	0.78	1.00	1.42
	2:26:56	0.05	0.12	0.11	0.19	0.27	0.44	0.57	0.73	1.03
	2:31:41	0.03	0.08	0.07	0.13	0.19	0.31	0.40	0.51	0.73
	2:36:25	0.02	0.05	0.04	0.08	0.12	0.20	0.26	0.33	0.48
	2:41:10	0.01	0.02	0.02	0.04	0.07	0.11	0.15	0.19	0.28
	2:45:54	0.00	0.01	0.01	0.02	0.03	0.05	0.07	0.09	0.14
	2:50:38	0.00	0.00	0.00	0.00	0.01	0.01	0.02	0.03	0.04
	2:55:23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:00:07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:04:52	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:09:36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:14:20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:19:05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:23:49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:28:34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:33:18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:38:02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:42:47	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:47:31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:52:16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:57:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:01:44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:06:29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:11:13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:58	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:34:55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:39:40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:44:24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:49:08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:53:53	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:58:37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:03:22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:08:06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:12:50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:17:35	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:22:19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:27:04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:31:48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:36:32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:41:17	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 "C"

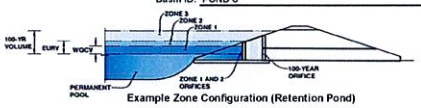
CLASSIC SM
CONSULTING
ENGINEERS & SURVEYORS

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Project: FOREST LAKES PHASE 2

Basin ID: POND C



Example Zone Configuration (Retention Pond)

Required Volume Calculation

Selected BMP Type =	EDB	
Watershed Area =	75.42	acres
Watershed Length =	1,800	ft
Watershed Slope =	0.010	ft/ft
Watershed Imperviousness =	30.00%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	0.0%	percent
Percentage Hydrologic Soil Groups C/D =	100.0%	percent
Desired WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	
Water Quality Capture Volume (WQCV) =	0.952	acre-feet
Excess Urban Runoff Volume (EURV) =	2.055	acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	1.883	acre-feet
5-yr Runoff Volume (P1 = 1.5 in.) =	3.122	acre-feet
10-yr Runoff Volume (P1 = 1.75 in.) =	4.474	acre-feet
25-yr Runoff Volume (P1 = 2 in.) =	7.059	acre-feet
50-yr Runoff Volume (P1 = 2.25 in.) =	8.892	acre-feet
100-yr Runoff Volume (P1 = 2.52 in.) =	11.213	acre-feet
500-yr Runoff Volume (P1 = 3.1 in.) =	15.501	acre-feet
Approximate 2-yr Detention Volume =	1.764	acre-feet
Approximate 5-yr Detention Volume =	2.949	acre-feet
Approximate 10-yr Detention Volume =	3.422	acre-feet
Approximate 25-yr Detention Volume =	3.847	acre-feet
Approximate 50-yr Detention Volume =	4.023	acre-feet
Approximate 100-yr Detention Volume =	4.926	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

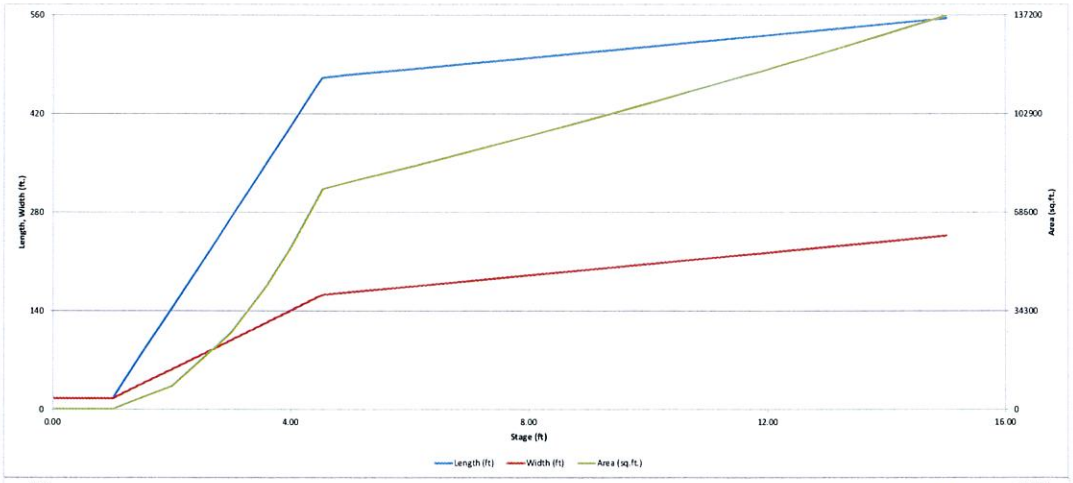
Zone 1 Volume (WQCV) =	0.952	acre-feet
Zone 2 Volume (EURV - Zone 1) =	1.103	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	2.871	acre-feet
Total Detention Basin Volume =	4.926	acre-feet
Initial Surcharge Volume (ISV) =	124	ft^3
Initial Surcharge Depth (ISD) =	0.50	ft
Total Available Detention Depth (H_{TOTAL}) =	6.00	ft
Depth of Trickle Channel (H_{TC}) =	0.50	ft
Slope of Trickle Channel (S_{TC}) =	0.008	ft/ft
Slopes of Main Basin Sides (S_{MAIN}) =	4	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	3	
Initial Surcharge Area (A_{ISV}) =	249	ft^2
Surcharge Volume Length (L_{ISV}) =	15.8	ft
Surcharge Volume Width (W_{ISV}) =	15.8	ft
Depth of Basin Floor (H_{FLOOR}) =	3.54	ft
Length of Basin Floor (L_{FLOOR}) =	471.8	ft
Width of Basin Floor (W_{FLOOR}) =	163.1	ft
Area of Basin Floor (A_{FLOOR}) =	76,941	ft^2
Volume of Basin Floor (V_{FLOOR}) =	96,116	ft^3
Depth of Main Basin (H_{MAIN}) =	1.46	ft
Length of Main Basin (L_{MAIN}) =	483.5	ft
Width of Main Basin (W_{MAIN}) =	174.8	ft
Area of Main Basin (A_{MAIN}) =	84,518	ft^2
Volume of Main Basin (V_{MAIN}) =	118,209	ft^3
Calculated Total Basin Volume (V_{TOTAL}) =	4.926	acre-feet

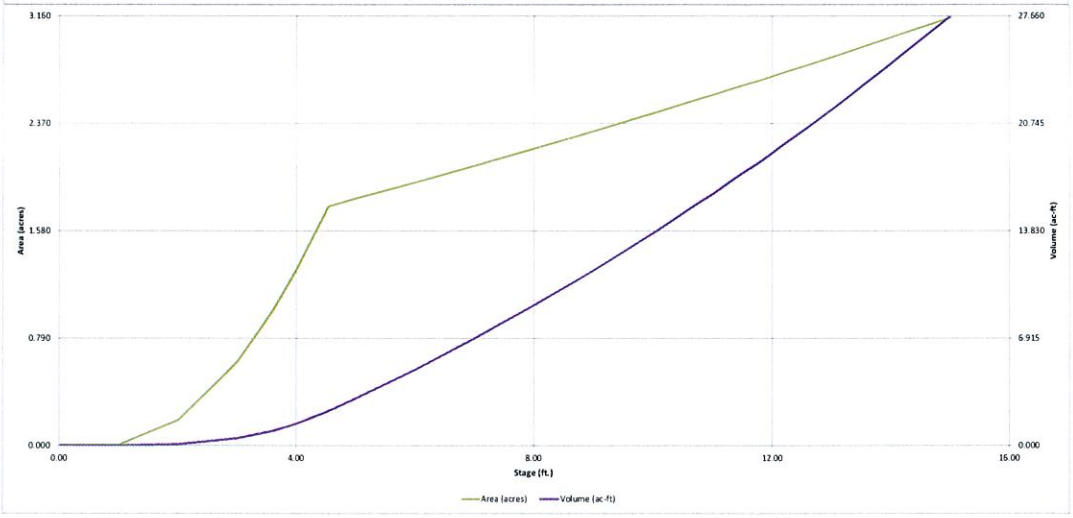
Depth Increment = 1 ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	0.00		15.8	15.8	249		0.006		
ISV	0.50		15.8	15.8	249		0.006	122	0.003
	1.00		15.8	15.8	249		0.006	246	0.006
	2.00		143.5	57.0	8,182		0.188	3,553	0.082
	3.00		273.8	99.1	27,133		0.623	20,464	0.470
Zone 1 (WQCV)	3.60		351.2	124.1	43,583		1.001	41,485	0.952
	4.00		402.8	140.8	56,700		1.302	61,484	1.411
Zone 2 (EURV)	4.44		459.5	159.1	73,115		1.678	89,968	2.065
Floor	4.54		471.1	162.9	76,729		1.761	96,710	2.220
	5.00		475.5	166.8	79,315		1.821	133,422	3.063
Zone 3 (100-year)	6.00		483.5	174.8	84,518		1.940	215,328	4.943
	7.00		491.5	182.8	89,848		2.063	302,500	6.944
	8.00		499.5	190.8	95,307		2.188	395,067	9.069
	9.00		507.5	198.8	100,894		2.316	493,157	11.321
	10.00		515.5	206.8	106,608		2.447	596,897	13.703
	11.00		523.5	214.8	112,451		2.582	706,416	16.217
	12.00		531.5	222.8	118,421		2.719	821,841	18.867
	13.00		539.5	230.8	124,520		2.859	943,301	21.655
	14.00		547.5	238.8	130,747		3.002	1,070,924	24.585
	15.00		555.5	246.8	137,101		3.147	1,204,837	27.659

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)



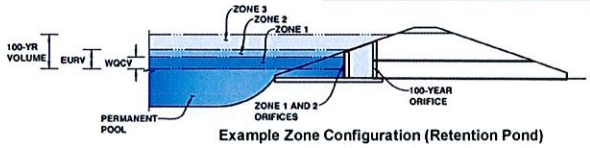


Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project: FOREST LAKES PHASE 2

Basin ID: POND C



Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	3.60	0.952	Orifice Plate
Zone 2 (EURV)	4.44	1.103	Orifice Plate
Zone 3 (100-year)	6.00	2.871	Weir&Pipe (Restrict)
		4.926	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 =	4.44	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	17.80	inches
Orifice Plate: Orifice Area per Row =	2.92	sq. inches (diameter = 1-15/16 inches)

Calculated Parameters for Plate

WQ Orifice Area per Row =	2.028E-02	ft^2
Elliptical Half-Width =	N/A	feet
Elliptical Slot Centroid =	N/A	feet
Elliptical Slot Area =	N/A	ft^2

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	1.48	2.96					
Orifice Area (sq. inches)	2.92	2.92	2.92					

	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 =	4.44	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	8.00	N/A	feet
Overflow Weir Slope =	0.00	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 =	4.44	N/A	feet
Over Flow Weir Slope Length =	4.00	N/A	feet
Grate Open Area / 100-yr Orifice Area =	2.83	N/A	should be ≥ 4
Overflow Grate Open Area w/o Debris =	27.20	N/A	ft^2
Overflow Grate Open Area w/ Debris =	13.60	N/A	ft^2

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

	Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	2.50	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	42.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	42.00		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	9.62	N/A	ft^2
Outlet Orifice Centroid =	1.75	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=	6.50	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	150.00	feet
Spillway End Slopes =	6.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Calculated Parameters for Spillway

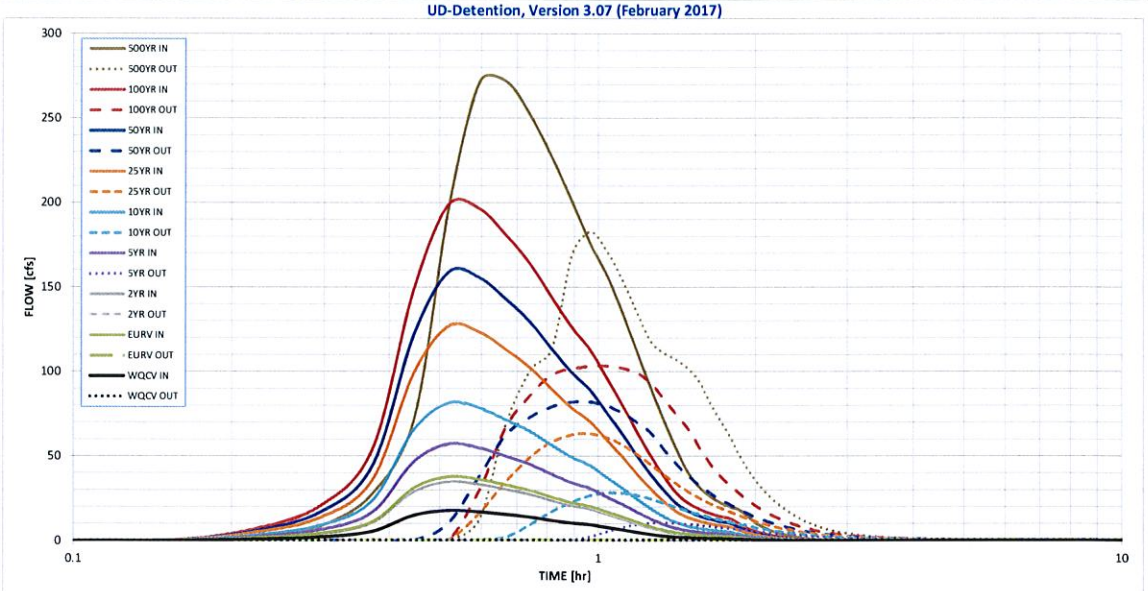
Spillway Design Flow Depth=	0.57	feet
Stage at Top of Freeboard =	8.07	feet
Basin Area at Top of Freeboard =	2.20	acres

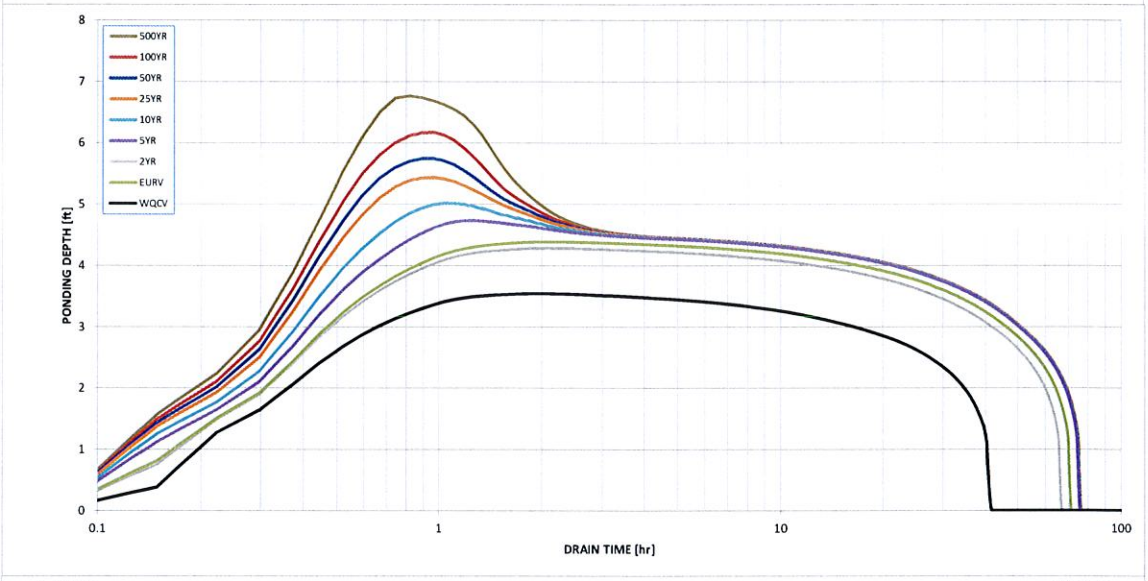
Routed Hydrograph Results

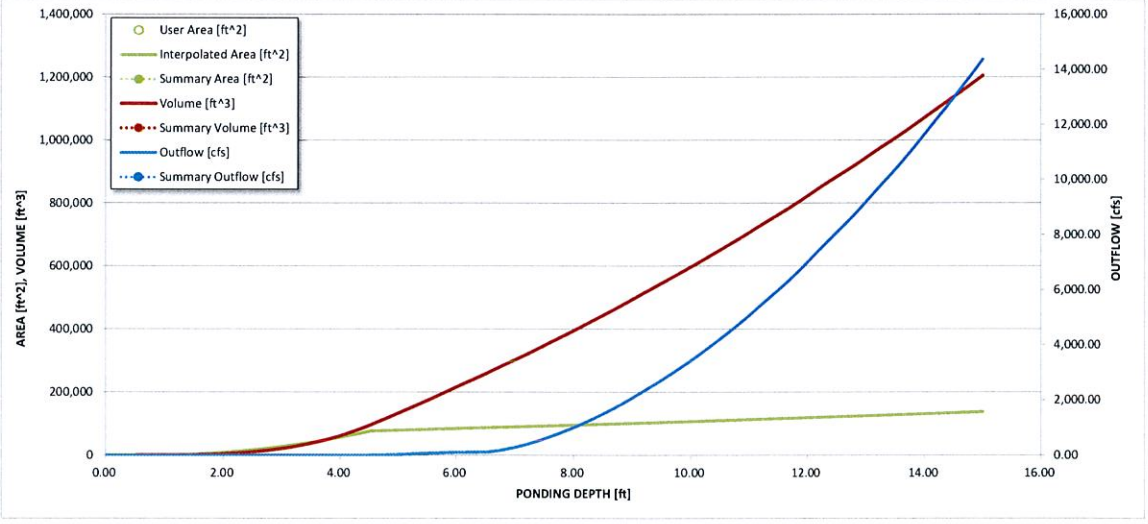
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	3.10
Calculated Runoff Volume (acre-ft) =	0.952	2.055	1.883	3.122	4.474	7.059	8.892	11.213	15.501
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	0.953	2.056	1.884	3.124	4.477	7.057	8.893	11.220	15.513
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.02	0.14	0.39	0.90	1.19	1.54	2.19
Predevelopment Peak Q (cfs) =	0.0	0.0	1.3	10.9	29.6	67.8	89.5	116.0	165.5
Peak Inflow Q (cfs) =	17.7	37.8	34.7	57.2	81.4	126.9	158.9	199.0	271.8
Peak Outflow Q (cfs) =	0.4	0.5	0.5	10.6	28.3	63.3	82.0	103.3	182.8
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	1.0	1.0	0.9	0.9	0.9	1.1
Structure Controlling Flow =	Plate	Plate	Plate	Overflow Grate 1	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	0.4	1.0	2.3	3.0	3.8	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) =	38	65	61	68	66	62	60	57	51
Time to Drain 99% of Inflow Volume (hours) =	40	68	64	72	71	70	69	67	65
Maximum Ponding Depth (ft) =	3.54	4.39	4.28	4.73	5.02	5.44	5.75	6.17	6.77
Area at Maximum Ponding Depth (acres) =	0.96	1.62	1.54	1.79	1.82	1.87	1.91	1.96	2.03
Maximum Volume Stored (acre-ft) =	0.894	1.966	1.808	2.576	3.081	3.857	4.443	5.275	6.453

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]
4.45 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:04:27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hydrograph	0:08:54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Constant	0:13:21	0.78	1.62	1.49	2.42	3.36	4.95	5.97	7.14	9.03
1.125	0:17:48	2.10	4.44	4.08	6.66	9.35	14.18	17.40	21.30	28.00
	0:22:15	5.40	11.40	10.48	17.09	24.02	36.40	44.70	54.73	72.03
	0:26:42	14.83	31.30	28.77	46.88	65.84	99.65	122.24	149.48	196.32
	0:31:09	17.70	37.83	34.72	57.16	81.39	126.91	158.89	199.00	271.66
	0:35:36	16.91	36.23	33.24	54.84	78.40	123.44	155.58	196.44	271.84
	0:40:03	15.40	32.98	30.26	49.90	71.44	112.94	142.70	180.67	251.14
	0:44:30	13.78	29.62	27.16	44.91	64.37	101.85	128.74	163.08	226.83
	0:48:57	11.92	25.75	23.60	39.19	56.34	89.44	113.26	143.74	200.45
	0:53:24	10.38	22.38	20.50	34.16	49.20	78.25	99.16	125.91	175.70
	0:57:51	9.41	20.29	18.59	30.89	44.39	70.34	88.94	112.67	156.67
	1:02:18	7.79	16.92	15.50	25.83	37.23	59.35	75.34	95.83	134.08
	1:06:45	6.38	13.96	12.77	21.37	30.86	49.31	62.65	79.77	111.75
	1:11:12	4.95	10.95	10.01	16.86	24.48	39.40	50.24	64.20	90.43
	1:15:39	3.71	8.35	7.62	12.96	18.93	30.64	39.18	50.19	70.95
	1:20:06	2.68	6.15	5.60	9.63	14.16	23.10	29.63	38.08	54.17
	1:24:33	2.07	4.66	4.25	7.25	10.61	17.17	21.94	28.09	40.11
	1:29:00	1.70	3.79	3.46	5.86	8.52	13.69	17.43	22.23	31.46
	1:33:27	1.44	3.20	2.92	4.94	7.17	11.49	14.61	18.61	26.20
	1:37:54	1.26	2.80	2.56	4.30	6.23	9.96	12.65	16.08	22.56
	1:42:21	1.14	2.51	2.29	3.85	5.57	8.89	11.27	14.31	20.03
	1:46:48	1.05	2.30	2.11	3.53	5.10	8.12	10.29	13.05	18.22
	1:51:15	0.77	1.70	1.55	2.62	3.81	6.15	7.87	10.08	14.32
	1:55:42	0.56	1.24	1.13	1.90	2.76	4.44	5.67	7.26	10.32
	2:00:09	0.41	0.91	0.83	1.40	2.04	3.29	4.21	5.39	7.65
	2:04:36	0.30	0.68	0.62	1.04	1.52	2.45	3.13	4.00	5.67
	2:09:03	0.22	0.49	0.45	0.76	1.11	1.80	2.31	2.96	4.21
	2:13:30	0.16	0.35	0.32	0.54	0.80	1.30	1.67	2.14	3.05
	2:17:57	0.11	0.25	0.23	0.40	0.58	0.94	1.21	1.55	2.21
	2:22:24	0.07	0.17	0.16	0.27	0.41	0.67	0.86	1.11	1.59
	2:26:51	0.04	0.11	0.10	0.18	0.26	0.44	0.57	0.74	1.07
	2:31:18	0.02	0.06	0.05	0.10	0.15	0.26	0.34	0.44	0.65
	2:35:45	0.01	0.02	0.02	0.04	0.07	0.12	0.16	0.22	0.34
	2:40:12	0.00	0.00	0.00	0.01	0.02	0.04	0.05	0.07	0.12
	2:44:39	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
	2:49:06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:53:33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:58:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:02:27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:06:54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:11:21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:15:48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
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	3:29:09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:33:36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:38:03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:42:30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:46:57	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
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	4:04:45	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:09:12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:13:39	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:18:06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:22:33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:27:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:31:27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:40:21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:44:48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:49:15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:53:42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:58:09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:02:36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:07:03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:11:30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:57	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:24	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

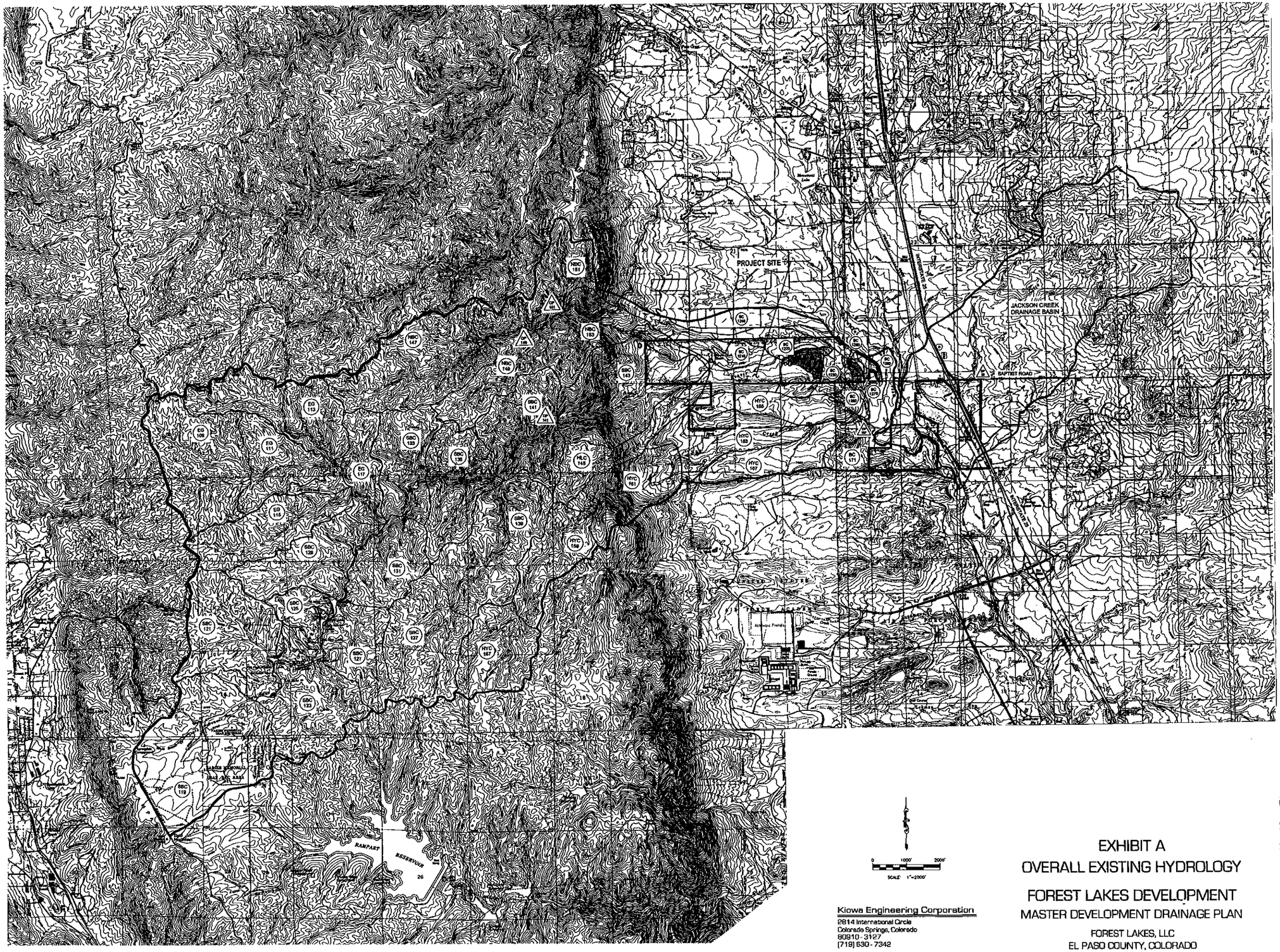
The user can create a summary S-A-V-D by entering the desired stage increments and the remainder of the table will populate automatically.

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

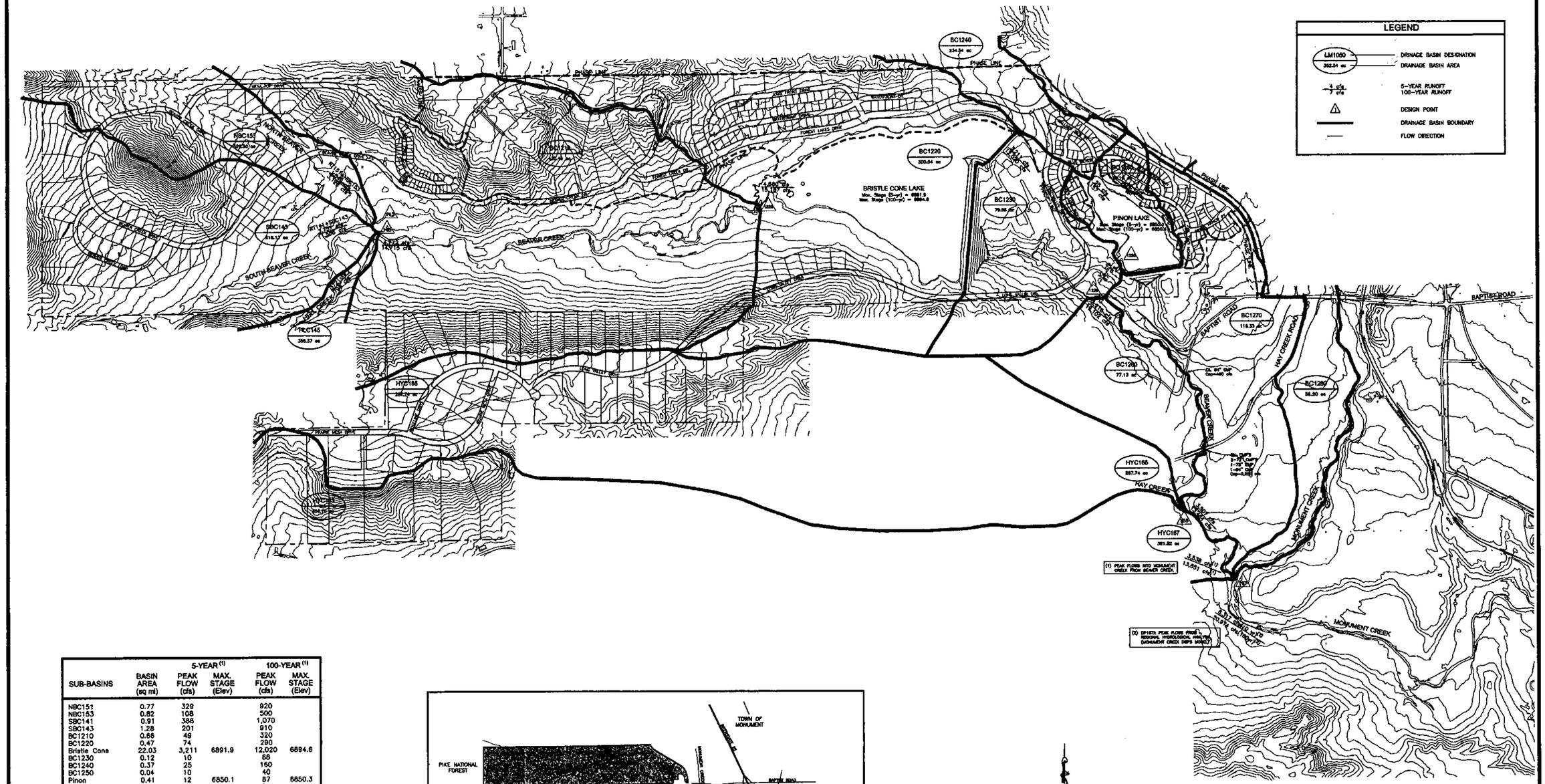
CLASSIC
CONSULTING
ENGINEERS & SURVEYORS



Kiowa Engineering Corporation
2614 International Circle
Colorado Springs, Colorado
80910 - 3127
(719) 630 - 7342

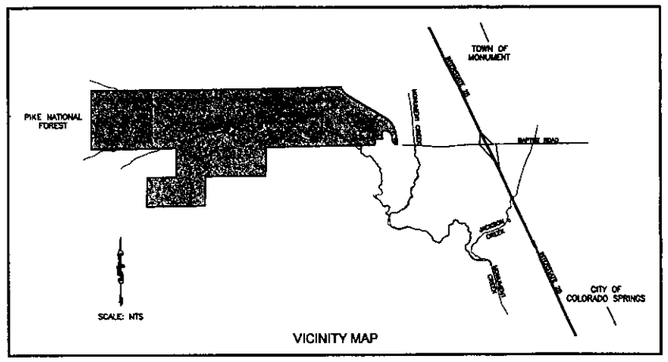
EXHIBIT A
OVERALL EXISTING HYDROLOGY
FOREST LAKES DEVELOPMENT
MASTER DEVELOPMENT DRAINAGE PLAN

FOREST LAKES, LLC
EL PASO COUNTY, COLORADO

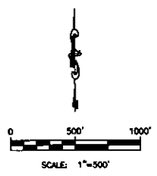


SUB-BASINS	BASIN AREA (sq mi)	5-YEAR (1) PEAK FLOW (cfs)	5-YEAR (1) MAX. STAGE (Elev)	100-YEAR (1) PEAK FLOW (cfs)	100-YEAR (1) MAX. STAGE (Elev)
NBC151	0.77	329		920	
NBC153	0.82	108		500	
SBC141	0.91	388		1,070	
SBC143	1.28	201		910	
BC1210	0.66	49		320	
BC1220	0.47	74		290	
Bristle Cone	22.03	3,211	6891.9	12,020	6894.6
BC1230	0.12	10		65	
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	0.58	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



Kiowa Engineering Corporation
2814 International Circle
Colorado Springs, Colorado
80910 - 3127
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EXHIBIT C

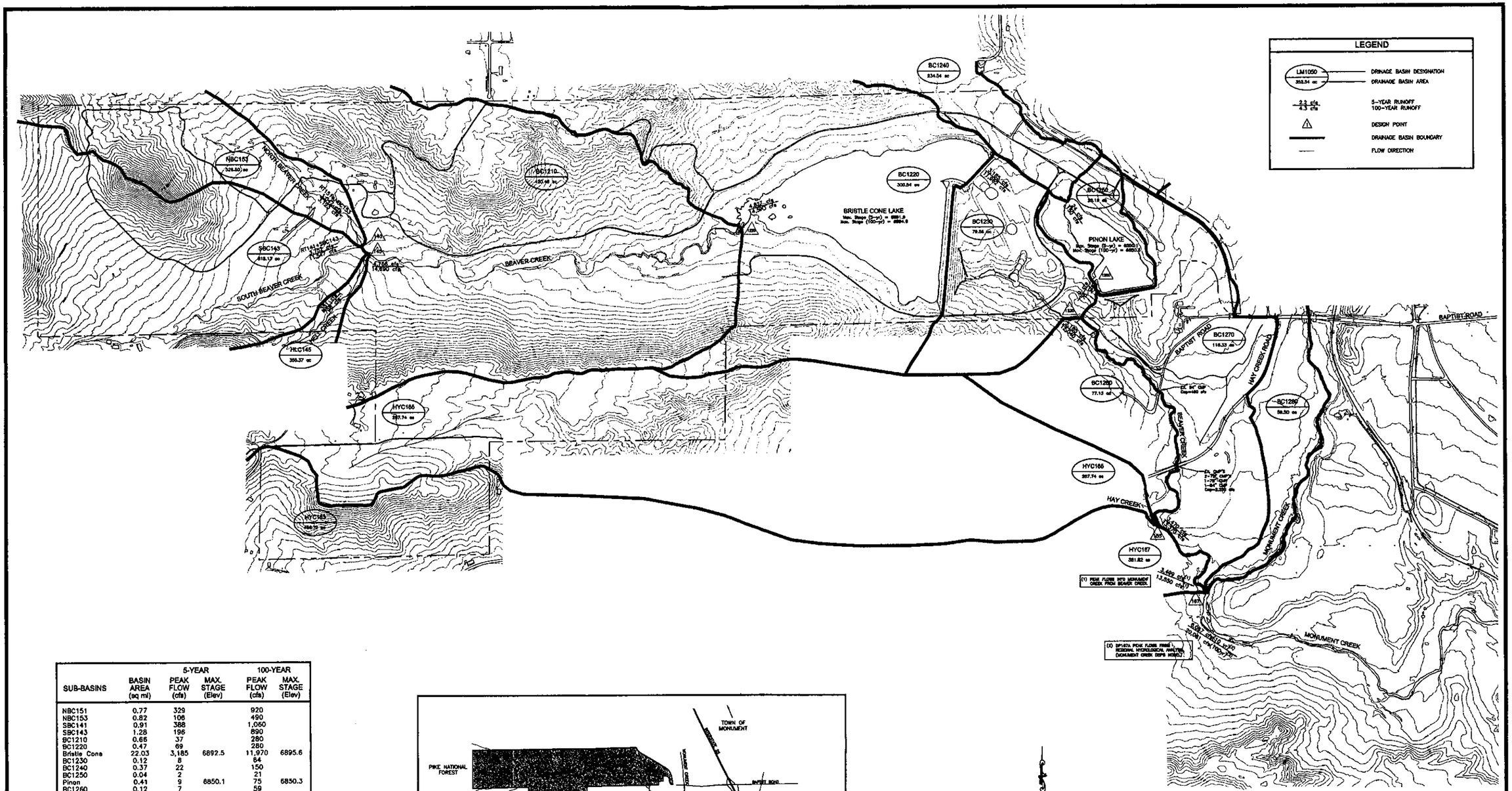
LOCALIZED FUTURE HYDROLOGY

24-HOUR TYPE II STORM

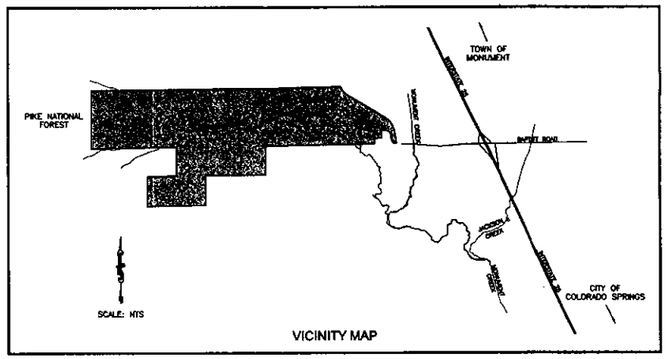
FOREST LAKES DEVELOPMENT

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	0.65	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

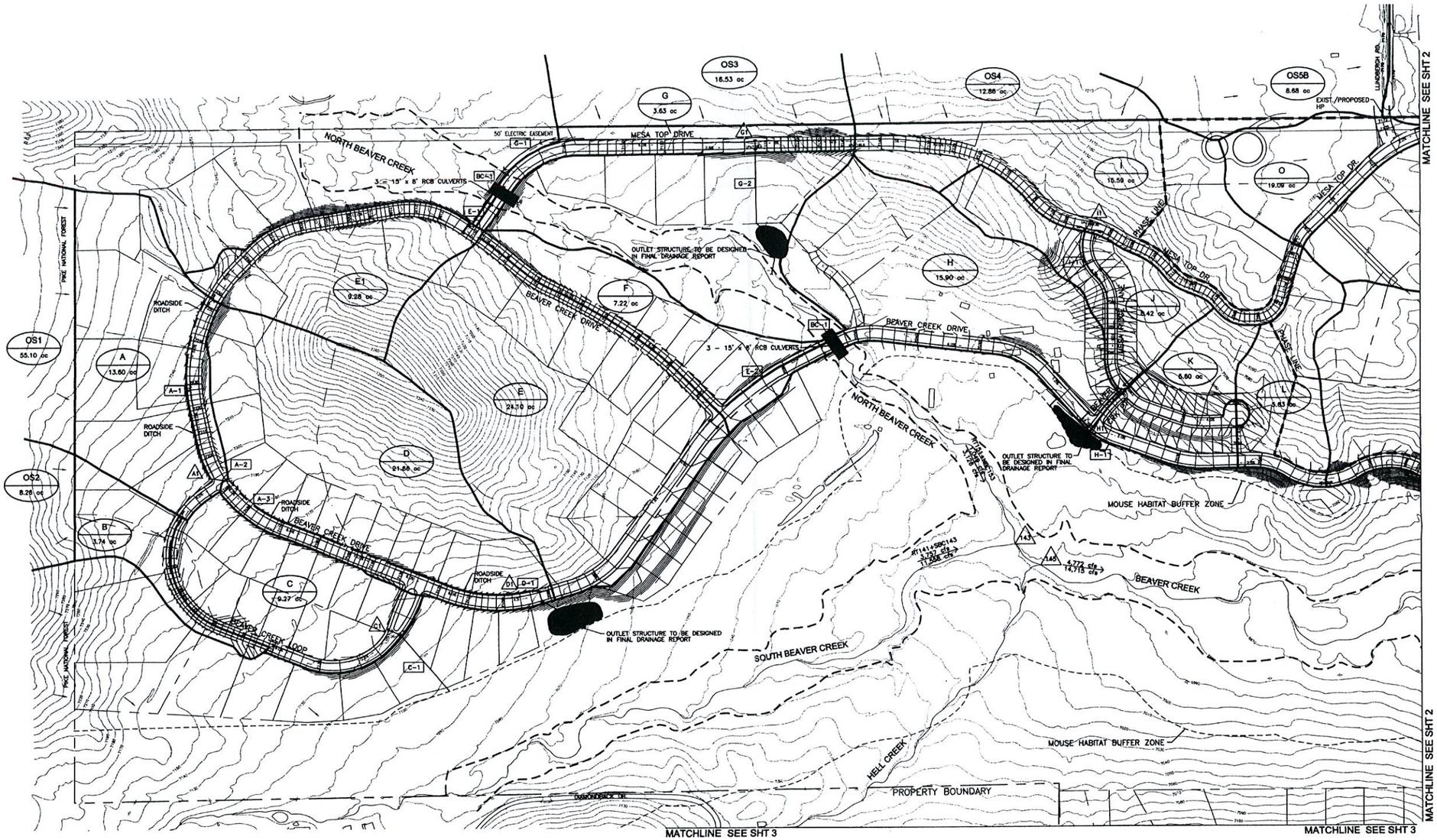
Kiowa Engineering Corporation

2814 International Circle

Colorado Springs, Colorado

80910 - 3127

(719) 630 - 7342



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

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

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	OS3	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	28 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	78 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	18 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	4,880 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		

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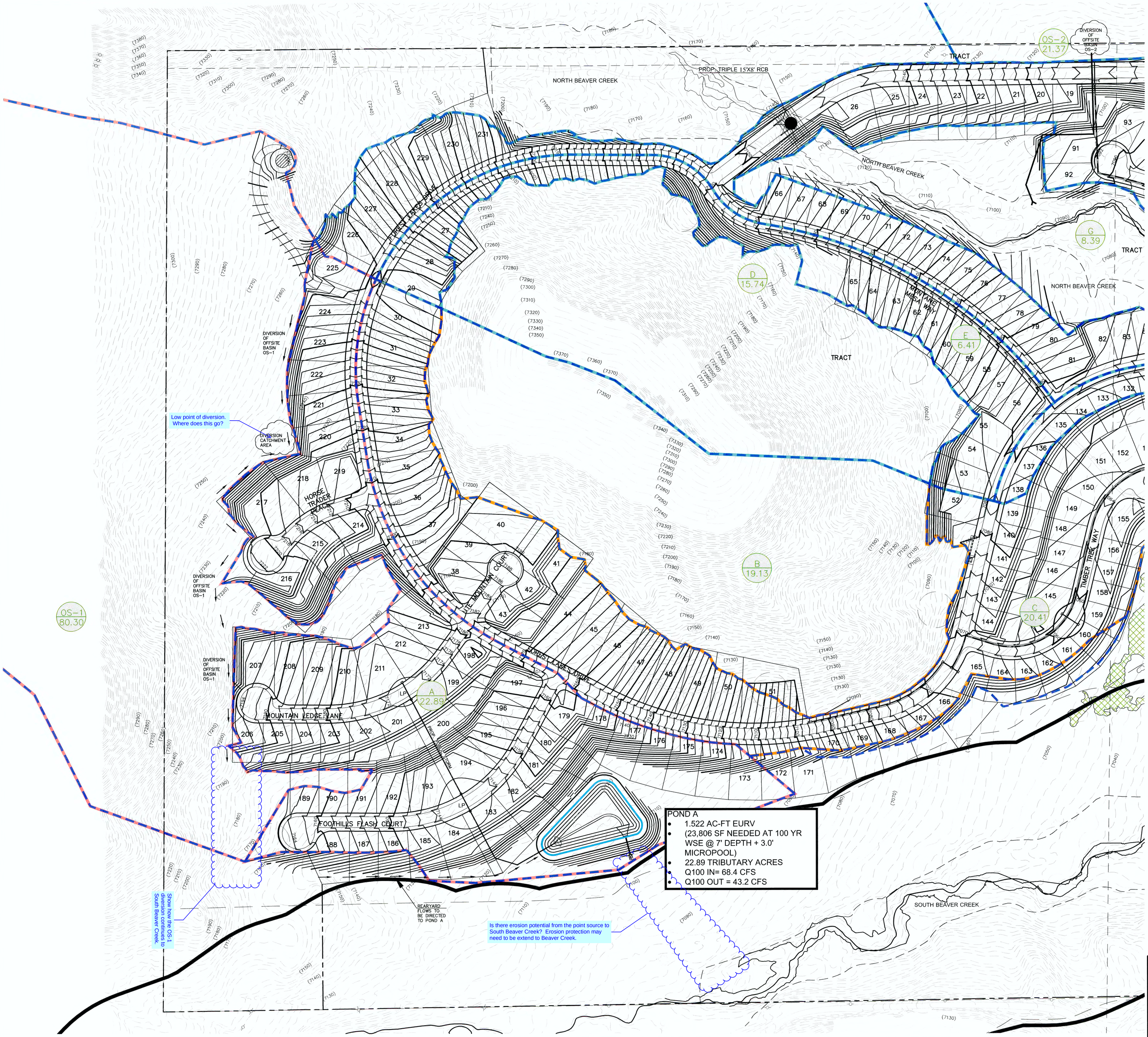
FOREST LAKES
MASTER DEVELOPMENT DRAINAGE PLAN
PROPOSED HYDROLOGIC SUBBASINS & DRAINAGE STRUCTURES
EL PASO COUNTY, COLORADO

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

SHEET 1 OF 4 SHEETS

0001301SPOP[Feb3d]04/11/02



NOTES:
1) ALL STORM SEWER TO BE PUBLIC UNLESS OTHERWISE NOTED.
2) TYPICAL 47' ROW STREET SECTIONS TO HAVE TYPE 5 C&G WITH TYPE 1 C&G AT INTERSECTIONS AND TRACTS.

LEGEND

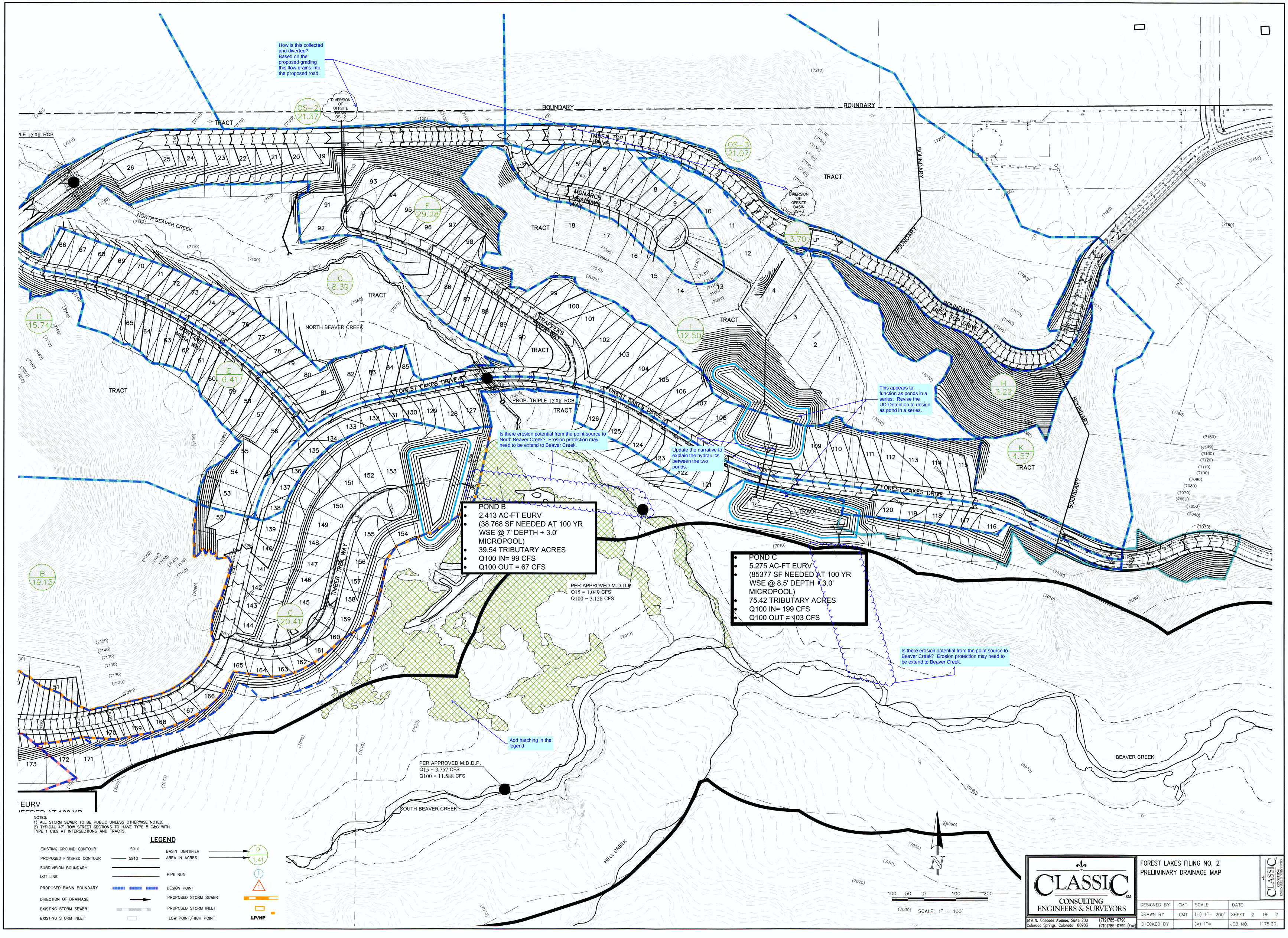
EXISTING GROUND CONTOUR	5910	BASIN IDENTIFIER	D 1.41
PROPOSED FINISHED CONTOUR	5910	AREA IN ACRES	
SUBDIVISION BOUNDARY			
LOT LINE		PIPE RUN	1
PROPOSED BASIN BOUNDARY		DESIGN POINT	1
DIRECTION OF DRAINAGE		PROPOSED STORM SEWER	
EXISTING STORM SEWER		PROPOSED STORM INLET	
EXISTING STORM INLET		LOW POINT/HIGH POINT	LP/HP

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

FOREST LAKES FILING NO. 2
PRELIIMINARY DRAINAGE MAP

CLASSIC CONSULTING ENGINEERS & SURVEYORS

DESIGNED BY	CMT	SCALE	DATE
DRAWN BY	CMT	(H) 1"=	SHEET 1 OF 2
CHECKED BY		(V) 1"=	JOB NO. 1175.20


How is this collected and diverted? Based on the proposed grading this flow drains into the proposed road.
DIVERSION OF OFFSITE BASIN OS-2
DIVERSION OF OFFSITE BASIN OS-3
OS-2 21.37
OS-3 21.07
F 29.28
G 8.39
D 15.74
E 6.41
B 19.13
C 20.41
I 12.50
J 3.70
H 3.22
K 4.57
TRACT
BOUNDARY
MESA TOP DRIVE
MONARCH MEADOWS WAY
TRAPPERS TREK WAY
MONTANE MESA WAY
NORTH BEAVER CREEK
FOREST LAKES DRIVE
PROP. TRIPLE 15'X8' RCB
TIMBER TREK WAY
This appears to function as ponds in a series. Revise the UD-Detention to design as pond in a series.
Is there erosion potential from the point source to North Beaver Creek? Erosion protection may need to be extend to Beaver Creek.
Update the narrative to explain the hydraulics between the two ponds.
POND B
2.413 AC-FT EURV
(38,768 SF NEEDED AT 100 YR WSE @ 7' DEPTH + 3.0' MICROPOOL)
39.54 TRIBUTARY ACRES
Q100 IN= 99 CFS
Q100 OUT = 67 CFS
POND C
5.275 AC-FT EURV
(85377 SF NEEDED AT 100 YR WSE @ 8.5' DEPTH + 3.0' MICROPOOL)
75.42 TRIBUTARY ACRES
Q100 IN= 199 CFS
Q100 OUT = 103 CFS
PER APPROVED M.D.D.P.
Q15 = 1.049 CFS
Q100 = 3.128 CFS
Is there erosion potential from the point source to Beaver Creek? Erosion protection may need to be extend to Beaver Creek.
Add hatching in the legend.
PER APPROVED M.D.D.P.
Q15 = 3.757 CFS
Q100 = 11.588 CFS
SOUTH BEAVER CREEK
HELL CREEK
BEAVER CREEK
EURV
NOTES:
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LEGEND
EXISTING GROUND CONTOUR 5910
PROPOSED FINISHED CONTOUR 5910
SUBDIVISION BOUNDARY
LOT LINE
PROPOSED BASIN BOUNDARY
DIRECTION OF DRAINAGE
EXISTING STORM SEWER
EXISTING STORM INLET
BASIN IDENTIFIER
AREA IN ACRES
PIPE RUN
DESIGN POINT
PROPOSED STORM SEWER
PROPOSED STORM INLET
LOW POINT/HIGH POINT
LP/HP
SCALE: 1" = 100'
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FOREST LAKES FILING NO. 2
PRELIIMINARY DRAINAGE MAP
DESIGNED BY CMT
DRAWN BY CMT
CHECKED BY
SCALE (H) 1"= 200' (V) 1"=
DATE
SHEET 2 OF 2
JOB NO. 1175.20