California Northstate University Medical Center Project Drainage Study

Prepared for:

California Northstate University

&

City of Elk Grove

DRAFT SUBMITTAL

May 18, 2020

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I. PROJECT OVERVIEW

California Northstate University is pursuing redevelopment of a 25.1-acre site as a new Medical Center Campus. The proposed development (Project) is located in the western part of the city of Elk Grove, California (City), just south of Elk Grove Boulevard and between Interstate 5 and West Taron Drive. **Figure 1** (attached) shows the location of the Project. The property is protected by a levee and currently mapped by the Federal Emergency Management Agency (FEMA) under the National Floodplain Insurance Program (NFIP) as 'Zone X', area with reduced risk due to levee during a 100-year event. The City of Elk Grove hired MBK Engineers to perform analysis and mapping of the current 200-year floodplain due to levee failure along the Sacramento River.

Wood Rodgers, Inc. (Wood Rodgers) has been directed to evaluate the impact of the Project to local drainage infrastructure. This drainage study presents a hydrologic analysis of pre-Project and post-Project conditions based on the current conceptual design consistent with the overall submittal dated April 1, 2020. A design level hydraulic analysis was not performed for this conceptual drainage study and will be provided when the Project reaches the design phase. The hydrologic analysis from this drainage study indicates that the current design concept will reduce peak flow leaving the site and will not require additional peak flow drainage mitigation.

II. PRE-PROJECT CONDITIONS

A. Existing Drainage Conditions

Currently the Project site accommodates a number of commercial businesses within various buildings and associated paved parking areas. The site was constructed in three phases. The southern third of the site was constructed between 1999 and 2002 as a single building with parking. It was originally occupied by the American Automobile Association (AAA), and is currently occupied by the California Northstate University Colleges of Pharmacy and Medicine. The northern third of the site was constructed between 2006 and 2007 with various commercial retail facilities and also includes paved parking. The central third of the site was constructed in 2009 as a single building with paved parking, and is currently occupied by an automotive repair software firm (ALLDATA LLC).

The Project site drains to an existing storm drain trunkline along West Taron Drive at 4 locations. The upstream end of this trunkline is adjacent to the project, just southwest of the West Taron Drive and Elk Grove Blvd intersection. The trunkline flows southwest and receives runoff from West Taron Drive and a portion of Riparian Drive to the southeast, in addition to runoff from the Project. The trunkline ultimately outfalls to a detention basin to the south which was evaluated by West Yost Associates under the City's Storm Drainage Master Plan.

B. Hydrologic Analysis

A watershed delineation was prepared by Wood Rodgers. The existing Project site was subdivided into 11 sub-watersheds based on topography and the existing storm drain system configuration. The watersheds representing the existing drainage conditions for the Project site are shown on **Figure 2**. Watershed Parameters were determined from soil, topography, land use, and storm drain data.

Figure 3 shows the soil types within and surrounding the Project area. The entire project is underlain by hydrologic type "D" soils, indicating that the soils have high natural runoff potential. This information was obtained from the Natural Resources Conservation Services website at https://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx.

Figure 4 shows the topographic data used to delineate the existing watersheds within the Project area.

The existing land use is zoned as light industrial and general commercial throughout the Project site and consists of mostly impervious surfaces. The existing impervious areas of the Project area were delineated in detail to make an accurate comparison with post-Project conditions. **Figure 5** shows the existing site imperviousness. The existing imperviousness of the combined Project site is 75.8 percent.

Wood Rodgers prepared a hydrologic model using the SacCalc program to determine the 100-year flows exiting the Project site under existing conditions. Watershed lag was computed within SacCalc using the travel time method with a component for upstream overland flow and a component for pipe flow. The overland flow component is computed within the SacCalc program based on Sacramento County standards. The pipe flow lag component is computed based on pipe size, length, and slope which were estimated from the existing storm drain network.

Table 1 (attached) presents the key hydrologic parameters for each sub-watershed shown in Figure 2.

Watersheds were routed through pipe elements using the Muskingum-Cunge method. The locations of routing elements and junctions are also shown in Figure 2. Runoff was routed through the West Taron Drive trunkline to the junction with the most downstream outfall pipe from the Project site. The 100-year storm event was analyzed in this study. **Table 2** shows the estimated peak flow results for the 100-year storm event.

Table 2 – Existing 100-year Peak Flow Results	
SacCalc Element	**Peak Flow Rate (cfs)**
EX003	15
EX004	16
JNC001	31
C009	31
EX005	14
EX007	8.5
C008	8.5
EX011	4.4
C000	4.3
JNC009	13
C001	12
EX002	8.6
EX008	5.7
EX009	2.6
EX001	7.7
EX010	2.2
EX006	18
C002	18
JNC003	28
C003	27
JNC004	30
C004	29
JNC005	43
C005	41
JNC006	54
C006	52
JNC007	66
C007	64
JNC008	93

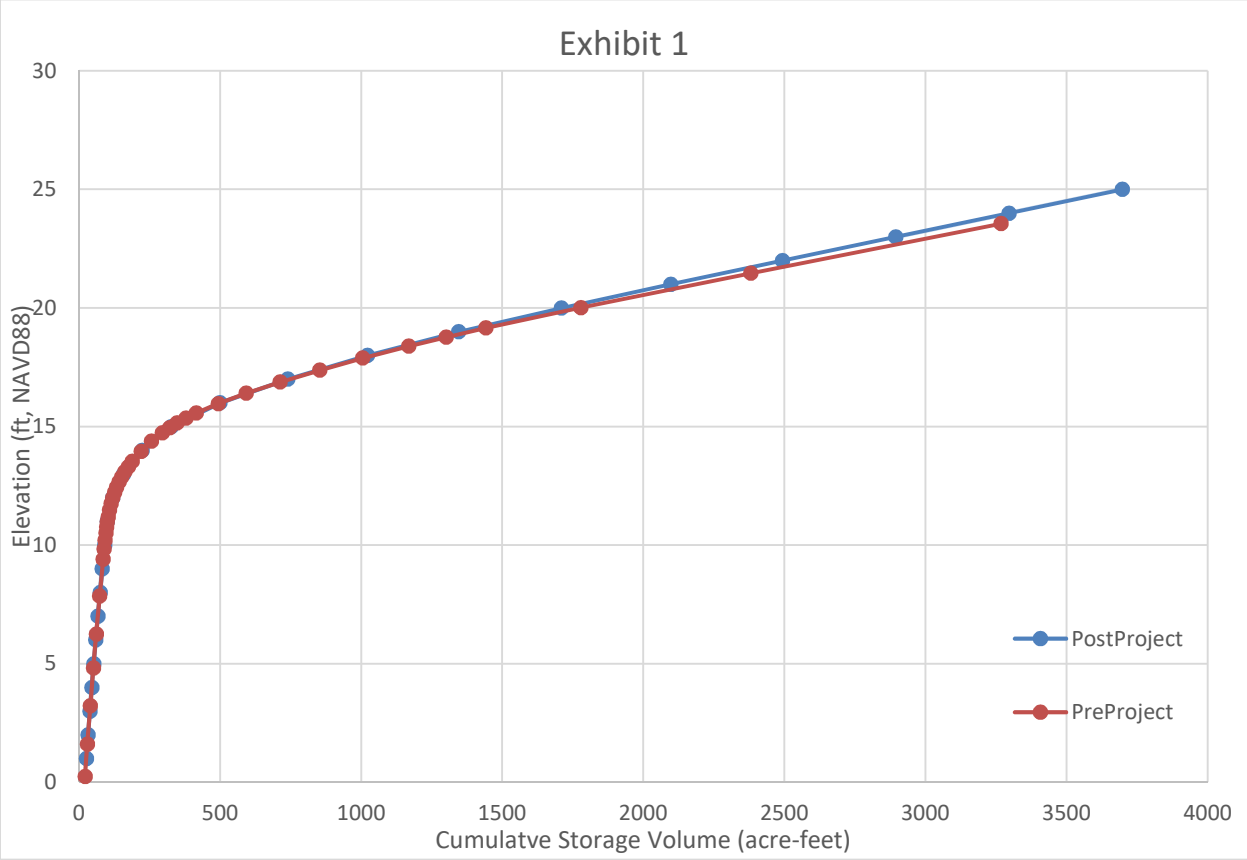
C. Hydraulic Analysis

A design level hydraulic analysis was not performed as part of this Drainage Study. Routing was performed using SacCalc methods to determine peak flow rates from the conceptual design of the Project. Wood Rodgers basis of design will be based on no increase in runoff from the site compared to existing development. Therefore, the focus of this study is the runoff generated within the Project boundary.

D. 200-Year Floodplain

The project site is within a defined 200-year floodplain based on a combination of levee failure scenarios of the Sacramento River levee and the existing levee along the western boundary of the City. A pdf copy of the existing conditions floodplain was obtained from a report developed by MBK Engineers and is shown on **Figure 6**.

Wood Rodgers was provided a copy of the existing conditions HEC-RAS modeling and modified the existing model geometry by reflecting the construction of the project above the 200-year floodplain levels. To define this condition, the storage area labeled "80.1" in the model was modified to redefine the elevation/storage relationship, reducing the volume of effective storage to entirely eliminate storage within the project boundary, as reported on Exhibit 1.



At this time, all ground floor levels are being proposed for parking only, with all habitable spaces floor elevations to be constructed above the 200-year water surface elevations. Furthermore, the conveyance (overland) flow capacity between storage areas was modified in the vicinity of the project by blocking flow over the connecting weir structures between storage areas where the project is located. The segment of overflow over Elk Grove Boulevard immediately north of the project, and the segment of existing levee west of the project were blocked to simulate preventing pass-through flow through the site. The results of the revised modeling show that the maximum water surface elevation increased by 0.01 feet in Scenarios L1 and L2 for storage area "80" and Scenario L3 for storage area "80.1". As the modeling results are reported to the nearest 0.1 feet in the MBK report, and the new values still round to the same values reported in MBK's report, Wood Rodgers proposes that these value changes are negligible. Figure 6A provides a zoomed-in version of the pre-project 200-year floodplain for the project. Figure 6B depicts the worst-case project impact to the 200-year floodplain, using the methodology described above. The updated modeling is provided in **Appendix A**.

III. POST-PROJECT CONDITIONS

A. Overview

The conceptual design of the Project includes elevating all structures to create parking underneath each structure. This will allow the conversion of part of the existing parking area to open space, reducing overall imperviousness. The Project will also re-direct the runoff of some areas based on preliminary site layout.

B. Hydrologic Analysis

In order to evaluate the conceptual drainage design for the Project, a hydrological analysis representing the post-project runoff conditions was performed by Wood Rodgers using the SacCalc program. The proposed development reduces the impervious area within the Project site. Re-orientation of roadways resulted in redirection of some areas to different watersheds. **Figure 7** shows the resulting watersheds based on the conceptual design grading and storm drain layout. The Project site was delineated into 12 watersheds which will eventually drain to the same outfalls at West Taron Drive as pre-Project conditions. Watershed parameters were calculated using the same methods as in the analysis of pre-Project watersheds.

Table 3 (attached) summarizes the key hydrologic parameters for the post-Project condition sub-watersheds.

The underlying soil conditions are assumed to remain relatively unchanged after grading in order to represent infiltrative conditions for pervious portions of development. If there is

any change to soil conditions it is anticipated that infill/import will be more pervious than existing soils, further increasing onsite infiltration and reducing runoff. However, for purposes of this analysis, the conservative estimate is based on existing soils.

The land use is proposed to be rezoned to include designations of Industrial-Office Park and Employment Center. The conceptual design will, however, reduce the total impervious area in the Project site to 70.2 percent. The post-Project site imperviousness is shown on **Figure 8.**

Watershed travel time lag parameters for pipe flow were estimated based on the proposed storm drain network shown in Figure 8.

Watersheds were similarly routed through pipe elements as in the analysis of pre-Project conditions. The locations of routing elements and junctions are shown in Figure 8. **Table 4** shows the estimated peak flow results for the 100-year storm event.

Hydrology was not reevaluated as part of the 200-year analysis. The modeling provided by MBK Engineers assumes that all water contributing to the 200-year floodplain originates from levee failure flow leaving the Sacramento River. No local rainfall is considered coincident or contributing to the floodplain.

Table 4 – Post-Project 100-year Peak Flow Results

SacCalc Element	Peak Flow Rate (cfs)
PR005	3.8
PR001	9.8
C008	9.7
PR006	4.4
C000	4.3
JNC009	14
C001	14
PR002	7
PR007	3.6
PR008	2.5
PR003	2.5
PR011	24
C003	23
JNC004	28
C004	27
JNC005	36
C005	35
JNC006	49
C006	48

JNC007	51
C007	51
PR009	2.6
PR004	13
PR012	14
PR010	12
C009	12
JNC002	37
C010	36
JNC001	39
C011	39
JNC008	87

C. Stormwater Quality and LID Strategy

The Project site's storm runoff quantities will be reduced, however, current stormwater quality treatment requirements will still need to be addressed. Since the original site was constructed (2002-2009), the state, Sacramento County and the City of Elk Grove are required to implement development approval processes referencing the current comprehensive water quality treatment best management practices. It is Wood Rodgers' professional opinion that the new site configuration of open-space and landscape areas will provide sufficient area to implement best management practices that will meet the state and local requirements as based on the National Pollution Discharge Elimination System program. Final sizing and locations of these facilities will be addressed at the time of design. However, the City has directed the project to provide a preliminary layout of Low Impact Development (LID) and water quality treatment facilities to prove that the proposed site building layout can accommodate a workable solution for ultimate buildout, as well as identifying what may be constructed within the Phase 1 footprint.

From an LID implementation standpoint, the target for a major project within the City is to achieve a minimum of 100 points, as calculated under Appendix D of the Sacramento County Storm Water Quality Design Manual (SCSWQDM), which is available online at the website www.beriverfriendly.net. Onsite LID facilities are intended to store and/or infiltrate runoff within the project area. Some types of allowed LID facilities include trees and flow across vegetated surfaces. Preliminary evaluations indicate that these types of facilities will not achieve the required LID minimum levels.

The project will utilize the bio-retention planter design option, which directs runoff through plant growing soil/root complex. With the presence of underlying clay soils on site, as described under the current soil survey from the Natural Resources Conservation Service, the project proposes using the bio-retention planter design with an underdrain. With the

underdrain configuration, this allows for the option of elevated planters to be constructed above existing ground, particularly within some areas adjacent to buildings. Final vertical locations will be determined during final design, and are not specified in this report. All bioretention facilities with underdrains will be appropriately connected to discharge via the storm drain system. With this "flow-through" planter configuration the engineered soil profile, roots, and plants with each planter area will allow for storage/attenuation and enhanced evaporation of runoff.

The use of LID facilities provides some treatment benefits while reducing the volume of runoff that must be treated before being discharged from the site. For the ultimate project site, **Figure 9** shows the potential siting locations of bioretention facilities, within the overall landscaped areas. Coupled with trees and landscaped features, a bio-retention area of 18,300 square feet produces greater than 100 LID points. In support of this configuration, the associated ultimate conditions calculation spreadsheet is attached in Appendix B. For Phase 1, the potential area of stormwater planters required to generate 100 LID points is approximately 9,100 square feet, which can be sited within the available landscaping areas shown on **Figure 10**. The associated Phase 1 conditions calculation spreadsheet is provided in Appendix B. Figure 11 shows the proposed LID facilities for Phase 2, with the associated calculation spreadsheet also provided in Appendix B. It is important to note that reconfiguration of some site areas is required in transitioning from Phase 1 to Phase 2 to ultimate conditions, which necessitates the elimination of some portion of facilities and construction of new facilities at new locations to compensate.

Achieving 100 LID points will not fully address treatment requirements associated with the project. Residual treatment is calculated in the spreadsheets provided in Appendix B. For purposes of this preliminary assessment the solution for treating residual runoff is through end-of-pipe treatment, which involves filtration consistent with the approved proprietary treatment devices referred to in Table 3-3 and 5-1 of the SCSWQDM. All hydraulically operated (passive) filtration devices will be located outside of the City's right-of-way and owned, operated and maintained by the private property owner. Preliminary sizing quotations from Contech (supporting documentation is provided in Appendix A) shows a Stormfilter Unit with the dimensions of 8 feet by 24 feet (with 12-inch cartridges) can accommodate a storm water quality flow (WQF) rate of 1.2 cfs, and can be outfitted to meet the latest trash capture requirements. The calculated peak WQF for each preliminary onsite watershed was calculated with proposed conditions watersheds while accounting for proposed LID features, as summarized on Figure 9. It is anticipated that up to six separate treatment vaults may be required, to be located at each of the six pipe discharge locations identified on Figure 9, to address any residual treatment and trash capture requirements. Two of the six locations can operate with a vault having maximum dimensions of 8 feet by 24 feet, with the other five locations requiring a vault less than half of these dimensions. For

purposes of this preliminary drainage study, Wood Rodgers proposes using a treatment vault with the maximum dimensions of 8 feet by 12 feet (WQF 0.6 cfs) for these smaller flow locations.

Hydromodification requirements are met as the project area is within the "Not Applicable" zone on Figure 5-2 of the SCSWQDM and is therefore exempt.

IV. Results Summary and Conclusions/Recommendations

Peak flow rates were compared at five "Points of Comparison" (POC), shown in **Table 5**. Four POC locations coincide with where runoff exits the project site and one POC is on the West Taron Drive trunkline. Peak flows were unchanged or reduced at the most upstream three outfall pipes. Re-orientation of watersheds caused a slight local increase in flow to the fourth (furthest downstream) outfall. However, the combined flow in the trunkline at this location is reduced by 7 cfs overall. Therefore, no adverse drainage impacts to adjacent properties will result from implementation of the Project.

The final storm water design configurations may be adjusted from that shown once final building layouts and final grading are defined during final design and improvement plan review. The overall approach will be maintained during all phases of design and implementation. Additional hydraulic analysis for the Project area will be conducted later during the design phase of the project to ensure all requirements are met.

Table 5 – 100-year Storm Event Peak Flow Comparison

POC	Existing SacCalc Element	Post-Project SacCalc Element	Existing Peak Flow (cfs)	Proposed Peak Flow (cfs)	Difference (cfs)
1	JNC004	JNC004	30	28	-2
2	JNC005	JNC005	43	36	-7
3	JNC006	JNC006	54	49	-5
4	JNC007	JNC007	66	51	-15
5	JNC008	JNC008	93	86	-7

The analysis performed and documented within this Preliminary Drainage Study verifies that the conceptual design of the Project will provide positive impacts from stormwater quality and flood control perspectives. As the project is a redevelopment site with no drainage work outside of known disturbed/developed areas, no outside agency permits are anticipated.

SacCalc modeling files and GIS mapping files used to determine the existing and Project conditions are provided in **Appendix A**.

PROJECT: **8673 - CALIFORNIA NORTHSTATE UNIVERSITY MEDICAL CAMPUS**
LOCATION: **ELK GROVE, CA**
SUBJECT: **EXISTING HYDROLOGIC PARAMETERS**
METHOD: **SACRAMENTO**

Watershed Name	Node	Watershed Area	Mean Elevation	Impervious	Lag Method	Overland Flow Land Use	Pipe Length	Pipe Diameter	Pipe Slope	Manning's "n"
		(ac)	(in)	%	(ft)	(ft)	(ft)	(ft)	(ft/ft)	
EX001	EX001	2.16	17	82.80	Travel Time	Commercial	233.00	1.50	0.0030	0.0150
EX002	EX002	2.42	17	75.80	Travel Time	Commercial	169.00	1.00	0.0030	0.0150
EX003	EX003	4.49	17	83.90	Travel Time	Commercial	340.00	1.50	0.0030	0.0150
EX004	EX004	4.57	17	84.50	Travel Time	Commercial	425.00	3.00	0.0030	0.0150
EX005	EX005	4.27	17	83.90	Travel Time	Commercial	435.00	1.50	0.0030	0.0150
EX006	EX006	5.21	17	74.70	Travel Time	Commercial	265.00	1.50	0.0030	0.0150
EX007	EX007	2.50	17	76.50	Travel Time	Commercial	327.00	1.50	0.0030	0.0150
EX008	EX008	1.61	17	50.60	Travel Time	Commercial	-	-	-	-
EX009	EX009	0.73	17	80.80	Travel Time	Commercial	-	-	-	-
EX010	EX010	0.61	17	76.50	Travel Time	Commercial	-	-	-	-
EX011	EX011	1.25	17	80.00	Travel Time	Commercial	-	-	-	-

Table 1

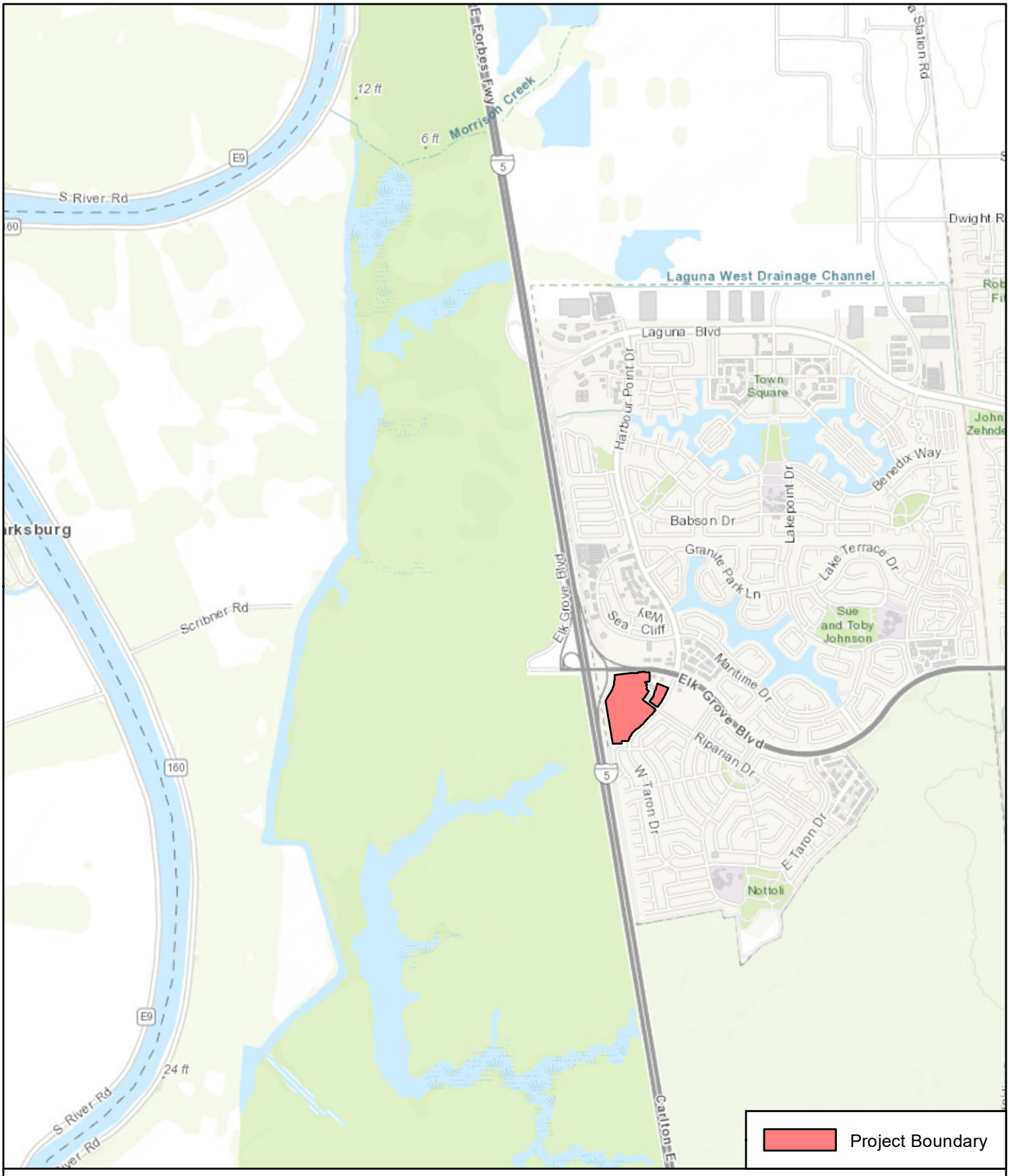
Prepared by:
Wood Rodgers, Inc

PROJECT: **8673 - CALIFORNIA NORTHSTATE UNIVERSITY MEDICAL CAMPUS**
LOCATION: **ELK GROVE, CA**
SUBJECT: **POST-PROJECT HYDROLOGIC PARAMETERS**
METHOD: **SACRAMENTO**

Watershed Name	Node	Watershed Area	Mean Elevation	Impervious	Lag Method	Overland Flow Land Use	Pipe Length	Pipe Diameter	Pipe Slope	Manning's "n"
		(ac)	(in)	%	(ft)	(ft)	(ft)	(ft)	(ft/ft)	
PR001	PR001	2.85	17	80.86	Travel Time	Commercial	327.00	1.50	0.0030	0.0150
PR002	PR002	2.07	17	51.30	Travel Time	Commercial	252.50	1.00	0.0030	0.0150
PR003	PR003	0.71	17	30.90	Travel Time	Commercial	76.00	1.00	0.0030	0.0150
PR004	PR004	3.55	17	77.20	Travel Time	Commercial	270.00	1.50	0.0030	0.0150
PR005	PR005	1.28	17	69.30	Travel Time	Commercial	500.00	3.00	0.0030	0.0150
PR006	PR006	1.25	17	80.00	Travel Time	Commercial	-	-	-	-
PR007	PR007	1.89	17	42.90	Travel Time	Commercial	250.00	3.00	0.0030	0.0350
PR008	PR008	0.72	17	76.80	Travel Time	Commercial	95.00	1.00	0.0030	0.0150
PR009	PR009	0.74	17	76.70	Travel Time	Commercial	75.00	1.00	0.0030	0.0150
PR010	PR010	3.44	17	82.50	Travel Time	Commercial	205.00	1.00	0.0030	0.0150
PR011	PR011	7.24	17	83.40	Travel Time	Commercial	420.00	1.50	0.0030	0.0150
PR012	PR012	3.82	17	45.40	Travel Time	Commercial	180.00	3.00	0.0030	0.0150

Table 3

Prepared by:
Wood Rodgers, Inc



LOCATION MAP

CALIFORNIA NORTHSTATE UNIVERSITY
ELK GROVE, CALIFORNIA
March 2020

NORTH

0 600,200 2,400

FEET

PRELIMINARY

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FIGURE 1

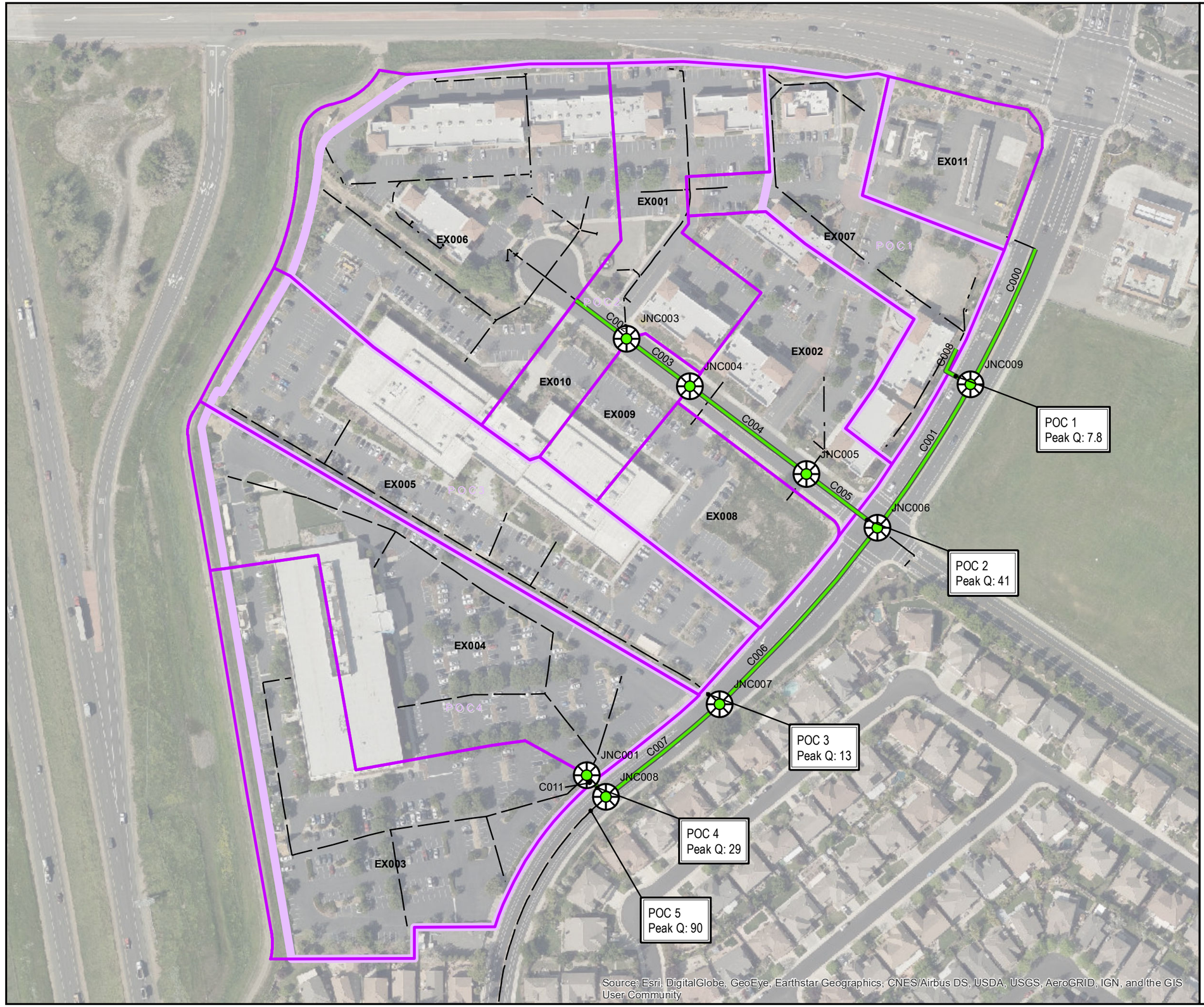
FIGURE 2

EXISTING DRAINAGE CONDITIONS

CALIFORNIA NORTHSTATE UNIVERSITY

ELK GROVE, CA

MARCH 2020



Legend

- Junction
- Routing Reach
- Existing Drainage Pipe
- Area Draining to POC
- Watershed

PRELIMINARY

0 100 200

Feet

NORTH

WOOD RODGERS

BUILDING RELATIONSHIPS ONE PROJECT AT A TIME

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FIGURE 3

SOILS MAP

CALIFORNIA NORTHSTATE UNIVERSITY

ELK GROVE, CA

MARCH 2020

PRELIMINARY

0 100 200

Feet

NORTH

WOOD RODGERS

BUILDING RELATIONSHIPS ONE PROJECT AT A TIME

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FIGURE 4

EXISTING TOPOGRAPHY

CALIFORNIA NORTHSTATE UNIVERSITY

ELK GROVE, CA

MARCH 2020

Legend

1-ft Contour

PRELIMINARY

0 100 200

Feet

NORTH

WOOD RODGERS

BUILDING RELATIONSHIPS ONE PROJECT AT A TIME

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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FIGURE 5

EXISTING SITE IMPERVIOUSNESS

CALIFORNIA NORTHSTATE UNIVERSITY

ELK GROVE, CA

MARCH 2020

Legend

- Site Boundary
- Pervious
- Impervious

Pervious Area: 6.11 Acres
Impervious Area: 19.19 Acres
Impervious Percentage: 75.8%

PRELIMINARY

0 100 200

Feet

NORTH

WOOD RODGERS

BUILDING RELATIONSHIPS ONE PROJECT AT A TIME

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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www.mbkengineers.com

City of Elk Grove Laguna West Area ULOP Determination

1-in-200 Year Floodplain

0 500 1,000
Feet

Exhibit 1

Figure 6

R:_Flood Control\2445 City of Elk Grove\Tasks\2018_ULOP_Determination\GIS\Exhibit 1 - Inundation.mxd

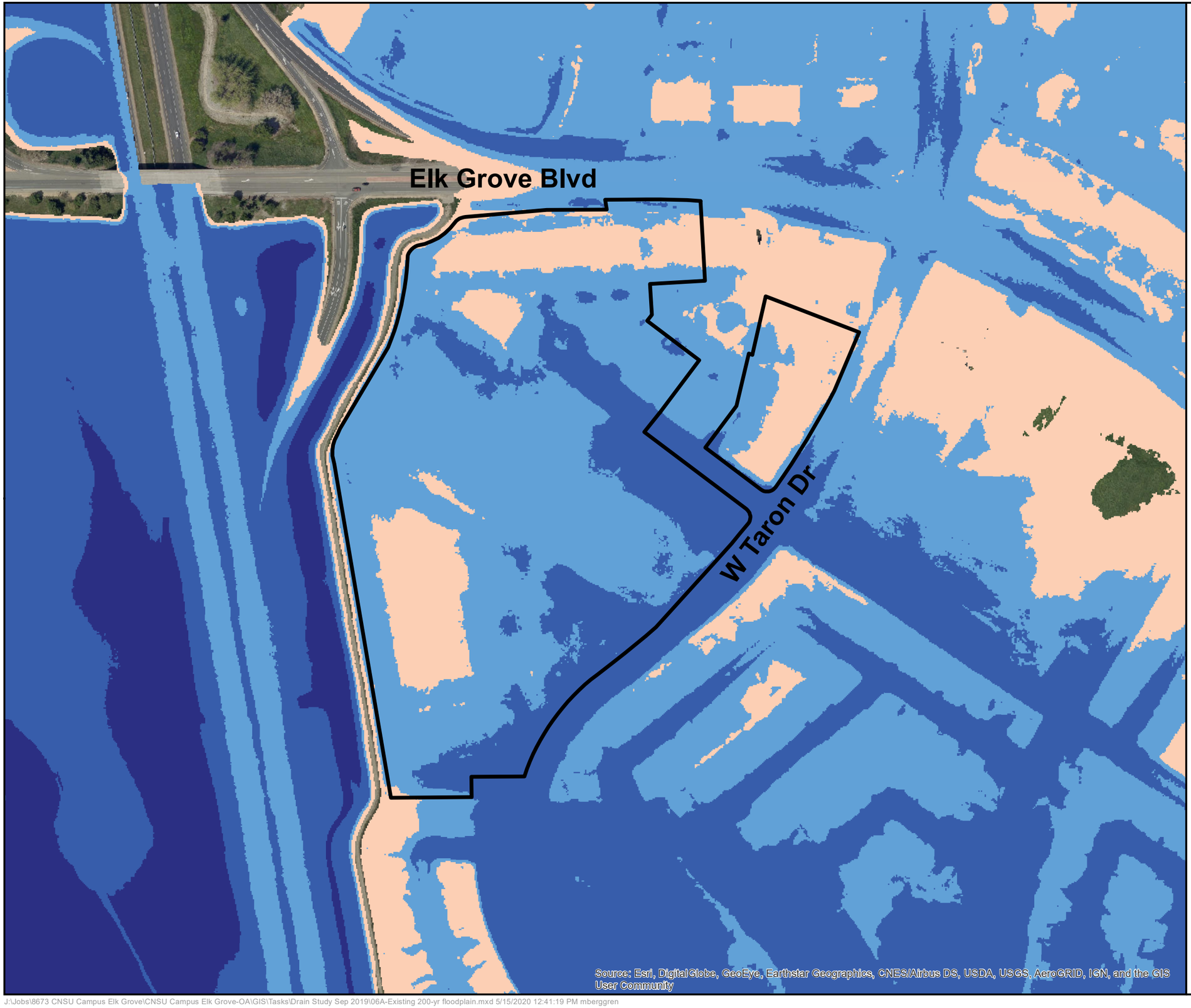

FIGURE 6A

EXISTING 200-YEAR FLOODPLAIN DEPTH

CALIFORNIA NORTHSTATE UNIVERSITY

ELK GROVE, CA

MAY 2020

Legend

Future Project Areas

200-year Flood Depth (ft)

- 0 - 3
- 3 - 5
- 5 - 10
- >10

Notes:

1. Existing building footprints not mapped
2. Source: 200-year floodplain depths provided by MBK Engineers

PRELIMINARY

0 100 200

Feet

NORTH

WOOD RODGERS

BUILDING RELATIONSHIPS ONE PROJECT AT A TIME

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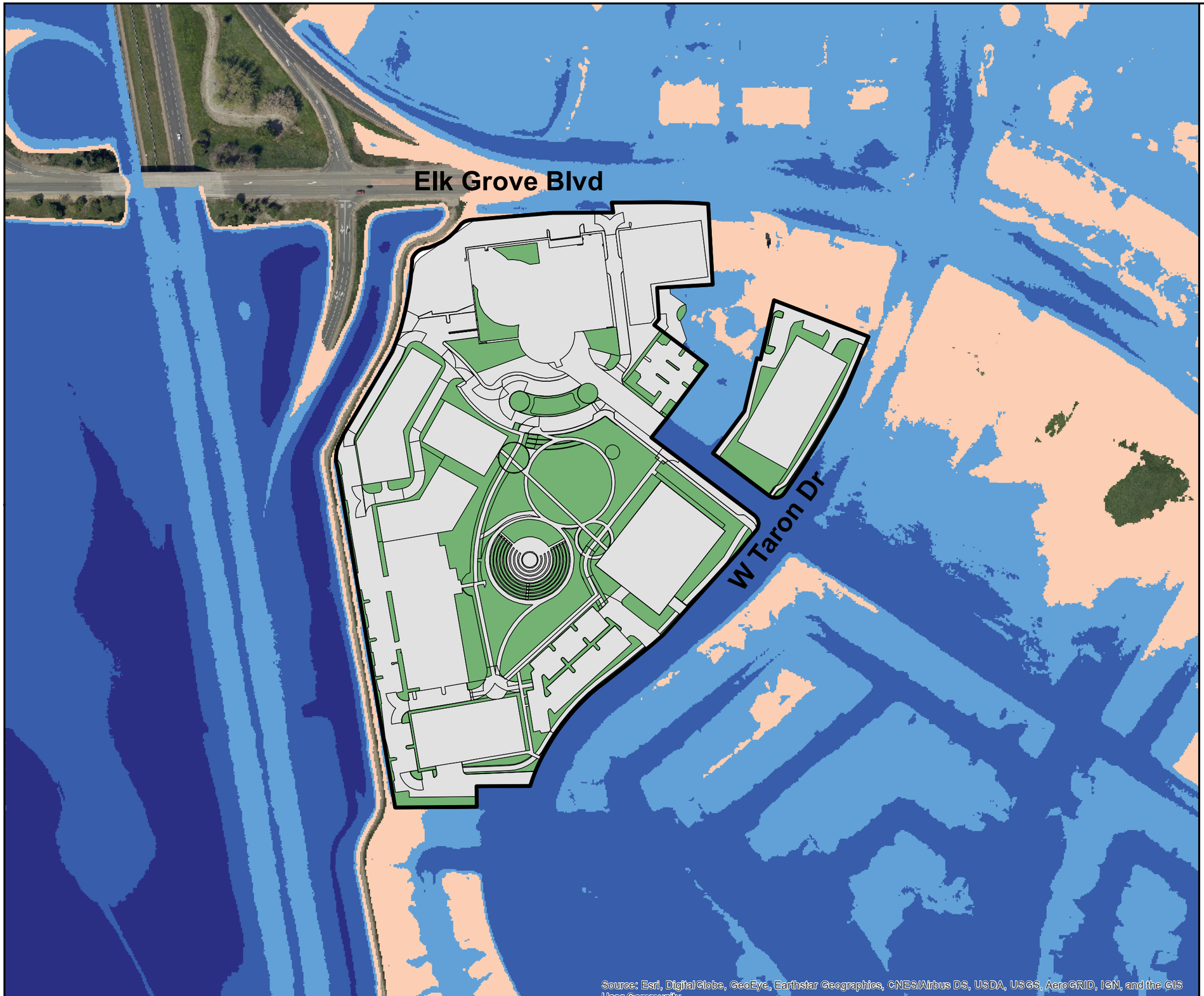

FIGURE 6B

POST-PROJECT 200-YEAR FLOODPLAIN DEPTH

CALIFORNIA NORTHSTATE UNIVERSITY

ELK GROVE, CA

MAY 2020

Legend

Proposed Project

200-year Flood Depth (ft)

- 0 - 3
- 3 - 5
- 5 - 10
- >10

Notes:
1. Proposed project was analyzed as fully removed from the 200-year floodplain with no impacts to flooding outside of the project boundary
2. Source: 200-year floodplain depths provided by MBK Engineers

PRELIMINARY

0 100 200

Feet

NORTH

WOOD RODGERS

BUILDING RELATIONSHIPS ONE PROJECT AT A TIME

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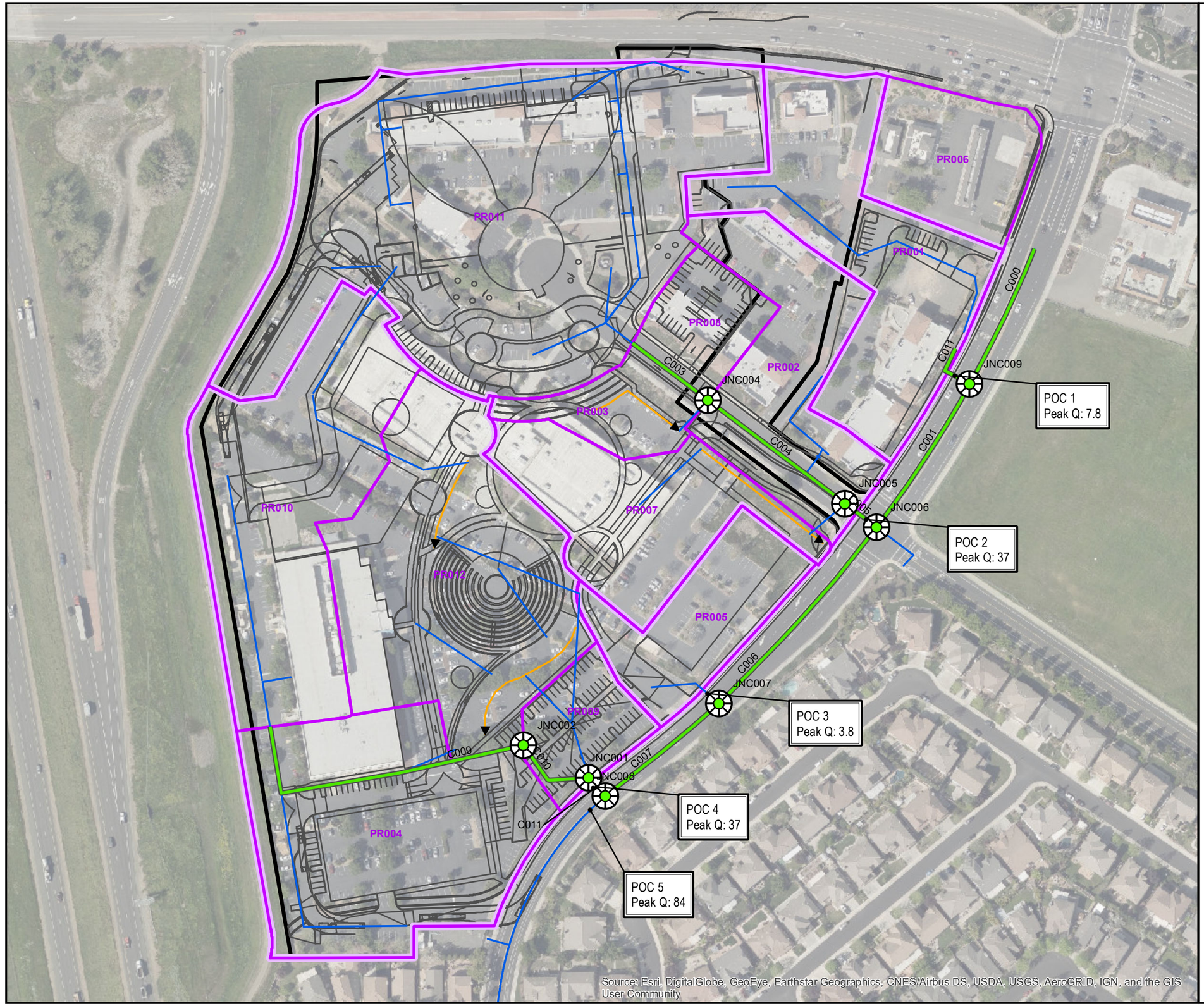
FIGURE 7

POST-PROJECT DRAINAGE CONDITIONS

CALIFORNIA NORTHSTATE UNIVERSITY

ELK GROVE, CA

MARCH 2020



Legend

- Junction
- Routing Reach
- Area Draining to POC
- Watershed
- Pipes
- Swale
- Site Boundary

PRELIMINARY

0 100 200

Feet

NORTH

WOOD RODGERS

BUILDING RELATIONSHIPS ONE PROJECT AT A TIME

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FIGURE 8

POST-PROJECT SITE IMPERVIOUSNESS

CALIFORNIA NORTHSTATE UNIVERSITY

ELK GROVE, CA

MAY 2020

Legend

- Pervious
- Impervious
- Site Boundary

Pervious Area: 7.53 Acres
Impervious Area: 17.77 Acres
Impervious Percentage: 70.2%

PRELIMINARY

0 100 200

Feet

NORTH

WOOD RODGERS

BUILDING RELATIONSHIPS ONE PROJECT AT A TIME

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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FIGURE 9

STORM WATER QUALITY
ULTIMATE CONDITIONS

CALIFORNIA NORTHSTATE UNIVERSITY

ELK GROVE, CA
MAY 2020

Legend

- Mechanical Filtration Point
- Bio Retention Area
- Watershed
- Drainage Pipe
- Drainage Swale

PRELIMINARY

0 100 200
Feet

NORTH

WOOD RODGERS
BUILDING RELATIONSHIPS ONE PROJECT AT A TIME

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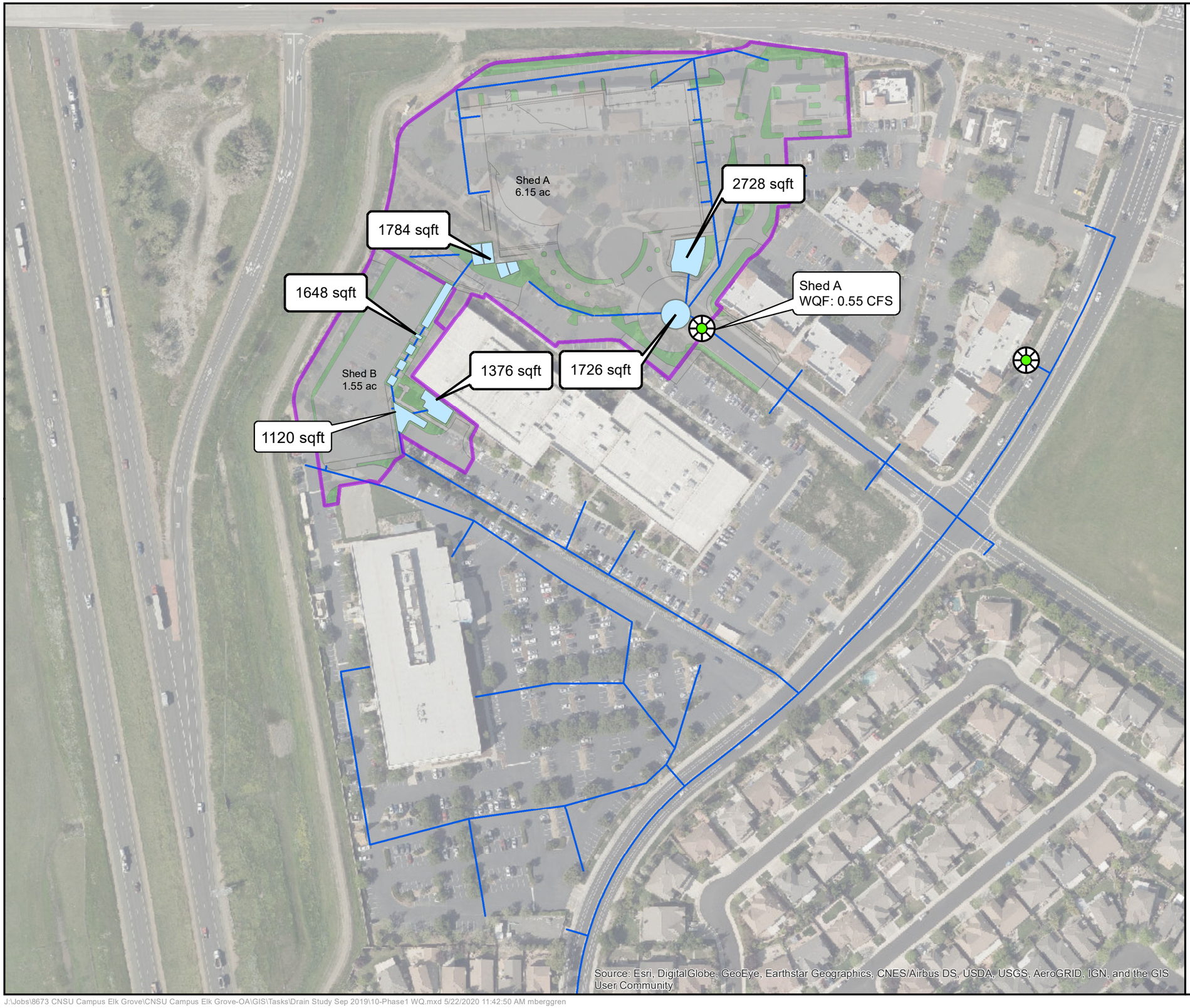

FIGURE 10

STORM WATER QUALITY
PHASE 1

CALIFORNIA NORTHSTATE UNIVERSITY

ELK GROVE, CA
MAY 2020

Legend

- Mechanical Filtration Point
- Water Quality Shed
- Bioretention Area
- Pervious Area
- Impervious Area
- Drainage Pipe

PRELIMINARY

0 100 200
Feet

NORTH

WOOD RODGERS
BUILDING RELATIONSHIPS ONE PROJECT AT A TIME

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FIGURE 11

STORM WATER QUALITY PHASE 2 CONDITIONS

CALIFORNIA NORTHSTATE UNIVERSITY

ELK GROVE, CA

MAY 2020

Shed A
6.85 ac

3174 sqft

Shed A
WQF: 0.45 CFS

1784 sqft

Shed F
1.6 ac

Shed C
WQF: 0.016 CFS

4262 sqft

Shed C
0.51 ac

Shed F
WQF: 0.221 CFS

Shed D
WQF: 0.140 CFS

Shed D
1.9 ac

Shed E
1.29 ac

Shed B
11.01 ac

Shed E
WQF: 0.152 CFS

15752 sqft

Shed B
WQF: 0.35 CFS

Legend

- Mechanical Filtration Point
- Bio Retention Area
- Watershed
- Drainage Pipe
- Drainage Swale

PRELIMINARY

0 100 200
Feet

NORTH

WOOD RODGERS
BUILDING RELATIONSHIPS ONE PROJECT AT A TIME

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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APPENDIX A

APPENDIX B

Appendix D-2: Commercial Sites: Low Impact Development (LID) Credits and Treatment BMP Sizing Calculations

Name of Drainage Shed: Phase 1
Location of project: Sacramento

Fill in Blue Highlighted boxes

Step 1 - Open Space and Pervious Area Credits

Is your project within the drainage area of a common drainage plan that includes open space? If not, skip to 1 b.

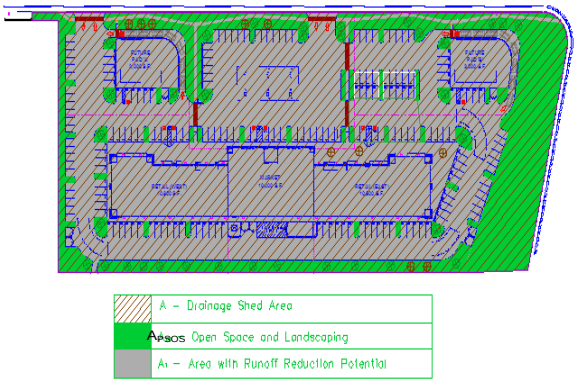
1 a. Common Drainage Plan Area	9	acres	A_{CDP}	
Common Drainage Plan Open Space (Off-project)	0	acres	A_{OS}	**see area example below**
a. Natural storage reservoirs and drainage corridors	0	acres		
b. Buffer zones for natural water bodies	0	acres		
c. Natural areas including existing trees, other vegetation, and soil	0	acres		
d. Common landscape area/park	0	acres		
e. Regional Flood Control/Drainage basins	0	acres		
1 b. Project Drainage Shed Area (Total)	8.88	acres	A	
Project-Specific Open Space (In-project, communal)**	1.40	acres	A_{PSOS}	
a. Natural storage reservoirs and drainage corridors	0.00	acres		
b. Buffer zones for natural water bodies	0.00	acres		
c. Natural areas including existing trees, other vegetation, and soil	0.00	acres		**see area example below**
d. Landscape area/park	1.40	acres		
e. Flood Control/Drainage basins	0.00	acres		

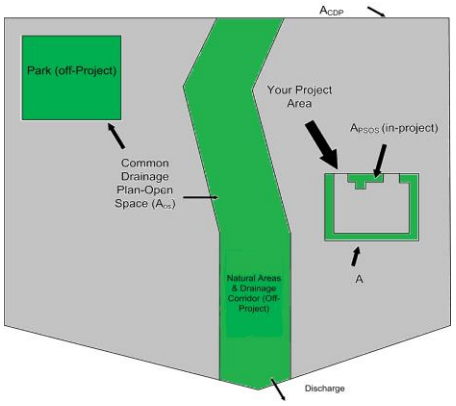
** Doesn't include impervious areas within individual lots and surrounding individual units. That is accounted for below using Form D-1a in Step 2.

Area with Runoff Reduction Potential	$A - A_{PSOS}$ =	7.48	acres	A_T
Assumed Initial Impervious Fraction	A_T / A =	0.84		I

Open Space & Pervious Area LID Credit (Step 1)

$(A_{OS}/A_{CDP}+A_{PSOS}/A)x100$ = 16 pts





Step 2 - Runoff Reduction Credits

Runoff Reduction Treatments	Impervious Area Managed			Efficiency Factor		Effective Area Managed (A_C)	
Porous Pavement:							
Option 1: Porous Pavement (see Fact Sheet, excludes porous pavement used in Option 2)	0	acres	x		=	0.000	acres
Option 2: Disconnected Pavement (see Fact Sheet, excludes porous pavement used in Option 1)	use Form D-2a for credits →					0.00	acres
Landscaping used to Disconnect Pavement (see Fact Sheet)	0	acres			=	0.00	acres
Disconnected Roof Drains (see Fact Sheet and/or Table D-2b for summary of requirements)	0	acres			=	0.00	acres
Ecoroof (see Fact Sheet)	0	acres			=	0.00	acres
Interceptor Trees (see Fact Sheet)	use Form D-2b for credits →					0.02	acres
Total Effective Area Managed by Runoff Reduction Measures				A_C		0.02	acres

Runoff Reduction Credit (Step 2) $(A_C / A_T)*100$ = 0 pts

Table D-2a

Porous Pavement Type	Efficiency Multiplier
Cobblestone Block Pavement	0.40
Pervious Concrete/Asphalt	0.60
Modular Block Pavement &	0.75
Reinforced Grass Pavement	1.00

Table D-2b

Maximum roof size	Minimum travel distance
≤ 3,500 sq ft	21 ft
≤ 5,000 sq ft	24 ft
≤ 7,500 sq ft	28 ft
≤ 10,000 sq ft	32 ft

Form D-2a: Disconnected Pavement Worksheet

See Fact Sheet for more information regarding Disconnected Pavement credit guidelines

Effective Area Managed (A_C)

Pavement Draining to Porous Pavement

2. Enter area draining onto Porous Pavement	0.00	acres	Box K1
3. Enter area of Receiving Porous Pavement (excludes area entered in Step 2 under Porous Pavement)	0.00	acres	Box K2
4. Ratio of Areas (Box K1 / Box K2)	0.00		Box K3

5. Select multiplier using ratio from Box K3 and enter into Box K4

Ratio (Box D)	Multiplier
Ratio is ≤ 0.5	1.00
Ratio is > 0.5 and < 1.0	0.83
Ratio is > 1.0 and < 1.5	0.71
Ratio is > 1.5 and < 2.0	0.55

	1		Box K4
6. Enter Efficiency of Porous Pavement (see table below)			Box K5

Porous Pavement Type	Efficiency Multiplier
Cobblestone Block Pavement	0.40
Pervious Concrete Asphalt Pavement	0.60
Modular Block Pavement Porous Gravel Pavement	0.75
Reinforced Grass Pavement	1.00

7. Multiply Box K2 by Box K5 and enter into Box K6	0.00	acres	Box K6
8. Multiply Boxes K1,K4, and K5 and enter the result in Box K7	0.00	acres	Box K7
9. Add Box K6 to Box K7 and multiply by 60%, and enter the Result in Box K8 This is the amount of area credit to enter into the "Disconnected Pavement" Box of Form D-2			0.00 acres

Form D-2b: Interceptor Tree Worksheet

See Fact Sheet for more information regarding Interceptor Tree credit guidelines

New Evergreen Trees

1. Enter number of new evergreen trees that qualify as Interceptor Trees in Box L1.	0	trees	Box L1
2. Multiply Box L1 by 200 and enter result in Box L2	0	sq. ft.	Box L2

New Deciduous Trees

3. Enter number of new deciduous trees that qualify as Interceptor Trees in Box L3.	50	trees	Box L3
4. Multiply Box L3 by 100 and enter result in Box L4	5000	sq. ft.	Box L4

Existing Tree Canopy

5. Enter square footage of existing tree canopy that qualifies as Existing Tree canopy in Box L5.	0	sq. ft.	Box L5
6. Multiply Box L5 by 0.5 and enter the result in Box L6	0	sq. ft.	Box L6

Total Interceptor Tree EAM Credits

Add Boxes L2, L4, and L6 and enter it into Box L7	5000	sq. ft.	Box L7
Divide Box L7 by 43,560 and multiply by 20% to get effective area managed and enter result in Box L8 This is the amount of area credit to enter into the "Interceptor Trees" Box of Form D-2	0.02	acres	Box L8

Step 3 - Runoff Management Credits

Capture and Use Credits

Impervious Area Managed by Rain barrels, Cisterns, and automatically-emptied systems

(see Fact Sheet) | - | enter gallons, for simple rain barrels | 0.00 | acres

Automated-Control Capture and Use System

(see Fact Sheet, then enter impervious area managed by the system) | 0.00 | acres

Bioretention/Infiltration Credits

Impervious Area Managed by Bioretention BMPs

(see Fact Sheet)

Bioretention Area | 10,382 | sq ft
Subdrain Elevation | 6 | inches
Ponding Depth, inches | 12 | inches | 3.55 | acres

Impervious Area Managed by Infiltration BMPs

(see Fact Sheet)

Drawdown Time, hrs | | drawdown_hrs_inf
Soil Infiltration Rate, in/hr | | soil_inf_rate

Sizing Option 1: Capture Volume, acre-ft | 0.00 | capture_vol_inf | 0.00 | acres

Sizing Option 2: Infiltration BMP surface area, sq ft | 0 | soil_surface_area | 0.00 | acres

Basin or trench? | approximate BMP depth | 0.00 | ft

Impervious Area Managed by Amended Soil or Mulch Beds

(see Fact Sheet) Mulched Infiltration Area, sq ft | - | mulch_area | 0.00 | acres

Total Effective Area Managed by Capture-and-Use/Bioretention/Infiltration BMPs | 3.55 | A_{LIDc}

Runoff Management Credit (Step 3) A_{LIDC}/A_T*200 = | 95.0 | pts

Total LID Credits (Step 1+2+3) LID compliant, check for treatment sizing in Step 4 111.1

Does project require hydromodification management? If yes, proceed to using SacHM.

Adjusted Area for Flow-Based, Non-LID Treatment $A_T - A_C - A_{LIDC}$ = | 3.90 | A_{AT}

Adjusted Impervious Fraction of A for Volume-Based, Non-LID Treatment A_{AT} / A = | 0.44 | I_A

Further treatment is required, see choose flow-based or volume-based sizing in Step 4

Step 4a Treatment - Flow-Based (Rational Method)

Calculate treatment flow (cfs): Flow = Runoff Coefficient x Rainfall Intensity x Area

Look up value for i in Table D-2c (Rainfall Intensity) | 0.18 | i

Obtain A_{AT} from Step 3 | 3.90 | A_{AT}

Use C = 0.95 | 0.95 | C

Flow = 0.95 * i * A_{AT} | 0.67 | cfs

Table D-2c

Rainfall Intensity		
Roseville	i =	0.20 in/hr
Sacramento	i =	0.18 in/hr
Folsom	i =	0.20 in/hr

Step 4b Treatment - Volume-Based (ASCE-WEF)

Calculate water quality volume (Acre-Feet): WQV = Area x Maximized Detention Volume (P_0)

Obtain A from Step 1 | 8.88 | A | 48 | hrs | Specified Draw Down time

Obtain P_0: Maximized Detention Volume from figures E-1 to E-4 in Appendix E of this manual using I_A from Step 2. | 0.32 | P_0

Calculate treatment volume (acre-ft):

Treatment volume = A x (P_0 / 12) | 0.24 | Acre-Feet

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Appendix D-2: Commercial Sites: Low Impact Development (LID) Credits and Treatment BMP Sizing Calculations

Name of Drainage Shed: Phase 1 Shed A
Location of project: Sacramento

Fill in Blue Highlighted boxes

Step 1 - Open Space and Pervious Area Credits

Is your project within the drainage area of a common drainage plan that includes open space? If not, skip to 1 b.

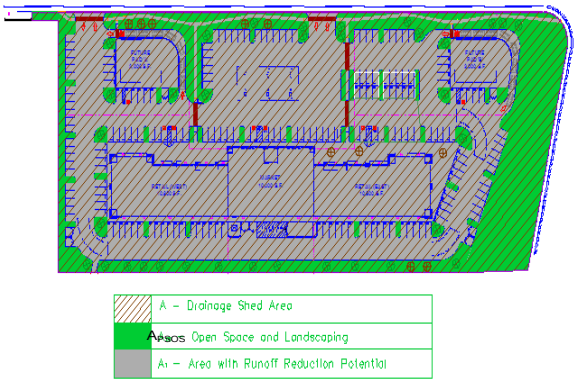
1 a. Common Drainage Plan Area	9	acres	A_{CDP}	
Common Drainage Plan Open Space (Off-project)	0	acres	A_{OS}	see area example below
a. Natural storage reservoirs and drainage corridors	0	acres		
b. Buffer zones for natural water bodies	0	acres		
c. Natural areas including existing trees, other vegetation, and soil	0	acres		
d. Common landscape area/park	0	acres		
e. Regional Flood Control/Drainage basins	0	acres		
1 b. Project Drainage Shed Area (Total)	7.30	acres	A	
Project-Specific Open Space (In-project, communal)**	0.90	acres	A_{PSOS}	
a. Natural storage reservoirs and drainage corridors	0.00	acres		
b. Buffer zones for natural water bodies	0.00	acres		
c. Natural areas including existing trees, other vegetation, and soil	0.00	acres		see area example below
d. Landscape area/park	0.90	acres		
e. Flood Control/Drainage basins	0.00	acres		

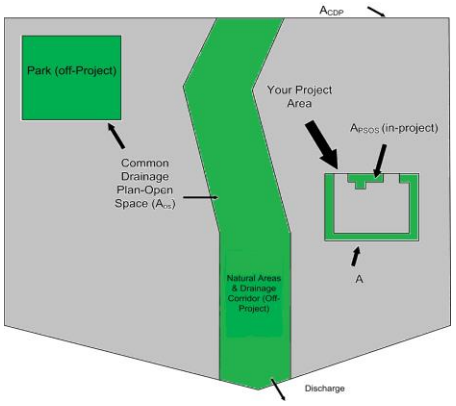
** Doesn't include impervious areas within individual lots and surrounding individual units. That is accounted for below using Form D-1a in Step 2.

Area with Runoff Reduction Potential	$A - A_{PSOS}$ =	6.40	acres	A_T
Assumed Initial Impervious Fraction	A_T / A =	0.88		I

Open Space & Pervious Area LID Credit (Step 1)

$(A_{OS}/A_{CDP}+A_{PSOS}/A)x100$ = 12 pts





Step 2 - Runoff Reduction Credits

Runoff Reduction Treatments	Impervious Area Managed			Efficiency Factor		Effective Area Managed (A_C)	
Porous Pavement:							
Option 1: Porous Pavement (see Fact Sheet, excludes porous pavement used in Option 2)	0	acres	x		=	0.000	acres
Option 2: Disconnected Pavement (see Fact Sheet, excludes porous pavement used in Option 1)	use Form D-2a for credits →					0.00	acres
Landscaping used to Disconnect Pavement (see Fact Sheet)	0	acres			=	0.00	acres
Disconnected Roof Drains (see Fact Sheet and/or Table D-2b for summary of requirements)	0	acres			=	0.00	acres
Ecoroof (see Fact Sheet)	0	acres			=	0.00	acres
Interceptor Trees (see Fact Sheet)	use Form D-2b for credits →					0.02	acres
Total Effective Area Managed by Runoff Reduction Measures				A_C		0.02	acres

Runoff Reduction Credit (Step 2) $(A_C / A_T)*100$ = 0 pts

Table D-2a

Porous Pavement Type	Efficiency Multiplier
Cobblestone Block Pavement	0.40
Pervious Concrete/Asphalt	0.60
Modular Block Pavement &	0.75
Reinforced Grass Pavement	1.00

Table D-2b

Maximum roof size	Minimum travel distance
≤ 3,500 sq ft	21 ft
≤ 5,000 sq ft	24 ft
≤ 7,500 sq ft	28 ft
≤ 10,000 sq ft	32 ft

Form D-2a: Disconnected Pavement Worksheet

See Fact Sheet for more information regarding Disconnected Pavement credit guidelines

Effective Area Managed (A_C)

Pavement Draining to Porous Pavement

2. Enter area draining onto Porous Pavement	0.00	acres	Box K1
3. Enter area of Receiving Porous Pavement (excludes area entered in Step 2 under Porous Pavement)	0.00	acres	Box K2
4. Ratio of Areas (Box K1 / Box K2)	0.00		Box K3

5. Select multiplier using ratio from Box K3 and enter into Box K4

Ratio (Box D)	Multiplier
Ratio is ≤ 0.5	1.00
Ratio is > 0.5 and < 1.0	0.83
Ratio is > 1.0 and < 1.5	0.71
Ratio is > 1.5 and < 2.0	0.55

	1		Box K4
6. Enter Efficiency of Porous Pavement (see table below)			Box K5

Porous Pavement Type	Efficiency Multiplier
Cobblestone Block Pavement	0.40
Pervious Concrete Asphalt Pavement	0.60
Modular Block Pavement Porous Gravel Pavement	0.75
Reinforced Grass Pavement	1.00

7. Multiply Box K2 by Box K5 and enter into Box K6	0.00	acres	Box K6
8. Multiply Boxes K1,K4, and K5 and enter the result in Box K7	0.00	acres	Box K7
9. Add Box K6 to Box K7 and multiply by 60%, and enter the Result in Box K8 This is the amount of area credit to enter into the "Disconnected Pavement" Box of Form D-2			0.00 acres

Form D-2b: Interceptor Tree Worksheet

See Fact Sheet for more information regarding Interceptor Tree credit guidelines

New Evergreen Trees

1. Enter number of new evergreen trees that qualify as Interceptor Trees in Box L1.	0	trees	Box L1
2. Multiply Box L1 by 200 and enter result in Box L2	0	sq. ft.	Box L2

New Deciduous Trees

3. Enter number of new deciduous trees that qualify as Interceptor Trees in Box L3.	50	trees	Box L3
4. Multiply Box L3 by 100 and enter result in Box L4	5000	sq. ft.	Box L4

Existing Tree Canopy

5. Enter square footage of existing tree canopy that qualifies as Existing Tree canopy in Box L5.	0	sq. ft.	Box L5
6. Multiply Box L5 by 0.5 and enter the result in Box L6	0	sq. ft.	Box L6

Total Interceptor Tree EAM Credits

Add Boxes L2, L4, and L6 and enter it into Box L7	5000	sq. ft.	Box L7
Divide Box L7 by 43,560 and multiply by 20% to get effective area managed and enter result in Box L8 This is the amount of area credit to enter into the "Interceptor Trees" Box of Form D-2	0.02	acres	Box L8

Step 3 - Runoff Management Credits

Capture and Use Credits

Impervious Area Managed by Rain barrels, Cisterns, and automatically-emptied systems

(see Fact Sheet) | - | enter gallons, for simple rain barrels | 0.00 | acres

Automated-Control Capture and Use System

(see Fact Sheet, then enter impervious area managed by the system) | 0.00 | acres

Bioretention/Infiltration Credits

Impervious Area Managed by Bioretention BMPs

(see Fact Sheet)

Bioretention Area | 6,238 | sq ft
Subdrain Elevation | 6 | inches
Ponding Depth, inches | 12 | inches
2.14 | acres

Impervious Area Managed by Infiltration BMPs

(see Fact Sheet)

Drawdown Time, hrs | | drawdown_hrs_inf
Soil Infiltration Rate, in/hr | | soil_inf_rate

Sizing Option 1: Capture Volume, acre-ft | 0.00 | capture_vol_inf | 0.00 | acres

Sizing Option 2: Infiltration BMP surface area, sq ft | 0 | soil_surface_area | 0.00 | acres

Basin or trench? | approximate BMP depth | 0.00 | ft

Impervious Area Managed by Amended Soil or Mulch Beds

(see Fact Sheet) Mulched Infiltration Area, sq ft | - | mulch_area | 0.00 | acres

Total Effective Area Managed by Capture-and-Use/Bioretention/Infiltration BMPs | 2.14 | A_{LIDc}

Runoff Management Credit (Step 3) A_{LIDC}/A_T*200 = | 66.7 | pts

Total LID Credits (Step 1+2+3) Warning: More LID Is Required 79.4

Does project require hydromodification management? If yes, proceed to using SacHM.

Adjusted Area for Flow-Based, Non-LID Treatment $A_T - A_C - A_{LIDC}$ = | 4.24 | A_{AT}

Adjusted Impervious Fraction of A for Volume-Based, Non-LID Treatment A_{AT} / A = | 0.58 | I_A

Further treatment is required, see choose flow-based or volume-based sizing in Step 4

Step 4a Treatment - Flow-Based (Rational Method)

Calculate treatment flow (cfs): Flow = Runoff Coefficient x Rainfall Intensity x Area

Look up value for i in Table D-2c (Rainfall Intensity) | 0.18 | i

Obtain A_{AT} from Step 3 | 4.24 | A_{AT}

Use C = 0.95 | 0.95 | C

Flow = 0.95 * i * A_{AT} | 0.73 | cfs

Table D-2c

Rainfall Intensity		
Roseville	i =	0.20 in/hr
Sacramento	i =	0.18 in/hr
Folsom	i =	0.20 in/hr

Step 4b Treatment - Volume-Based (ASCE-WEF)

Calculate water quality volume (Acre-Feet): WQV = Area x Maximized Detention Volume (P_0)

Obtain A from Step 1 | 7.30 | A | 48 | hrs | Specified Draw Down time

Obtain P_0: Maximized Detention Volume from figures E-1 to E-4 in Appendix E of this manual using I_A from Step 2. | 0.43 | P_0

Calculate treatment volume (acre-ft):

Treatment volume = A x (P_0 / 12) | 0.26 | Acre-Feet

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Appendix D-2: Commercial Sites: Low Impact Development (LID) Credits and Treatment BMP Sizing Calculations

Name of Drainage Shed: Phase 1 Shed B
Location of project: Sacramento

Fill in Blue Highlighted boxes

Step 1 - Open Space and Pervious Area Credits

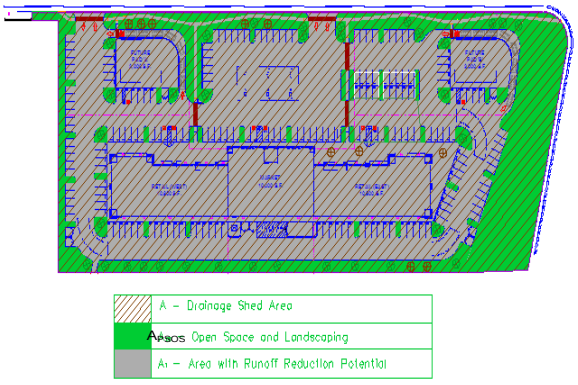
Is your project within the drainage area of a common drainage plan that includes open space? If not, skip to 1 b.

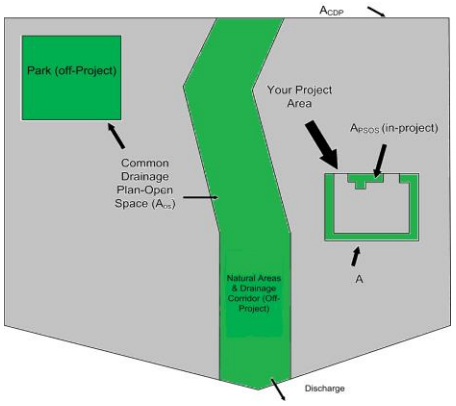
1 a. Common Drainage Plan Area	9	acres	A_{CDP}	
Common Drainage Plan Open Space (Off-project)	0	acres	A_{OS}	see area example below
a. Natural storage reservoirs and drainage corridors	0	acres		
b. Buffer zones for natural water bodies	0	acres		
c. Natural areas including existing trees, other vegetation, and soil	0	acres		
d. Common landscape area/park	0	acres		
e. Regional Flood Control/Drainage basins	0	acres		
1 b. Project Drainage Shed Area (Total)	2.10	acres	A	
Project-Specific Open Space (In-project, communal)**	0.50	acres	A_{PSOS}	
a. Natural storage reservoirs and drainage corridors	0.00	acres		
b. Buffer zones for natural water bodies	0.00	acres		
c. Natural areas including existing trees, other vegetation, and soil	0.00	acres		see area example below
d. Landscape area/park	0.50	acres		
e. Flood Control/Drainage basins	0.00	acres		

** Doesn't include impervious areas within individual lots and surrounding individual units. That is accounted for below using Form D-1a in Step 2.

Area with Runoff Reduction Potential	$A - A_{PSOS}$ =	1.60	acres	A_T
Assumed Initial Impervious Fraction	A_T / A =	0.76		I

Open Space & Pervious Area LID Credit (Step 1)
$(A_{OS}/A_{CDP}+A_{PSOS}/A)x100$ = 24 pts





Step 2 - Runoff Reduction Credits

Runoff Reduction Treatments	Impervious Area Managed			Efficiency Factor		Effective Area Managed (A_C)	
Porous Pavement:							
Option 1: Porous Pavement (see Fact Sheet, excludes porous pavement used in Option 2)	0	acres	x		=	0.000	acres
Option 2: Disconnected Pavement (see Fact Sheet, excludes porous pavement used in Option 1)	use Form D-2a for credits →					0.00	acres
Landscaping used to Disconnect Pavement (see Fact Sheet)	0	acres			=	0.00	acres
Disconnected Roof Drains (see Fact Sheet and/or Table D-2b for summary of requirements)	0	acres			=	0.00	acres
Ecoroof (see Fact Sheet)	0	acres			=	0.00	acres
Interceptor Trees (see Fact Sheet)	use Form D-2b for credits →					0.02	acres
Total Effective Area Managed by Runoff Reduction Measures				A_C		0.02	acres

Runoff Reduction Credit (Step 2) $(A_C / A_T)*100$ = 1 pts

Table D-2a

Porous Pavement Type	Efficiency Multiplier
Cobblestone Block Pavement	0.40
Pervious Concrete/Asphalt	0.60
Modular Block Pavement &	0.75
Reinforced Grass Pavement	1.00

Table D-2b

Maximum roof size	Minimum travel distance
≤ 3,500 sq ft	21 ft
≤ 5,000 sq ft	24 ft
≤ 7,500 sq ft	28 ft
≤ 10,000 sq ft	32 ft

Form D-2a: Disconnected Pavement Worksheet

See Fact Sheet for more information regarding Disconnected Pavement credit guidelines

Effective Area Managed (A_C)

Pavement Draining to Porous Pavement

2. Enter area draining onto Porous Pavement	0.00	acres	Box K1
3. Enter area of Receiving Porous Pavement (excludes area entered in Step 2 under Porous Pavement)	0.00	acres	Box K2
4. Ratio of Areas (Box K1 / Box K2)	0.00		Box K3

5. Select multiplier using ratio from Box K3 and enter into Box K4

Ratio (Box D)	Multiplier
Ratio is ≤ 0.5	1.00
Ratio is > 0.5 and < 1.0	0.83
Ratio is > 1.0 and < 1.5	0.71
Ratio is > 1.5 and < 2.0	0.55

	1		Box K4
6. Enter Efficiency of Porous Pavement (see table below)			Box K5

Porous Pavement Type	Efficiency Multiplier
Cobblestone Block Pavement	0.40
Pervious Concrete Asphalt Pavement	0.60
Modular Block Pavement Porous Gravel Pavement	0.75
Reinforced Grass Pavement	1.00

7. Multiply Box K2 by Box K5 and enter into Box K6	0.00	acres	Box K6
8. Multiply Boxes K1,K4, and K5 and enter the result in Box K7	0.00	acres	Box K7
9. Add Box K6 to Box K7 and multiply by 60%, and enter the Result in Box K8 This is the amount of area credit to enter into the "Disconnected Pavement" Box of Form D-2			0.00 acres

Form D-2b: Interceptor Tree Worksheet

See Fact Sheet for more information regarding Interceptor Tree credit guidelines

New Evergreen Trees

1. Enter number of new evergreen trees that qualify as Interceptor Trees in Box L1.	0	trees	Box L1
2. Multiply Box L1 by 200 and enter result in Box L2	0	sq. ft.	Box L2

New Deciduous Trees

3. Enter number of new deciduous trees that qualify as Interceptor Trees in Box L3.	50	trees	Box L3
4. Multiply Box L3 by 100 and enter result in Box L4	5000	sq. ft.	Box L4

Existing Tree Canopy

5. Enter square footage of existing tree canopy that qualifies as Existing Tree canopy in Box L5.	0	sq. ft.	Box L5
6. Multiply Box L5 by 0.5 and enter the result in Box L6	0	sq. ft.	Box L6

Total Interceptor Tree EAM Credits

Add Boxes L2, L4, and L6 and enter it into Box L7	5000	sq. ft.	Box L7
Divide Box L7 by 43,560 and multiply by 20% to get effective area managed and enter result in Box L8 This is the amount of area credit to enter into the "Interceptor Trees" Box of Form D-2	0.02	acres	Box L8

Step 3 - Runoff Management Credits

Capture and Use Credits

Impervious Area Managed by Rain barrels, Cisterns, and automatically-emptied systems

(see Fact Sheet) | - | enter gallons, for simple rain barrels | 0.00 | acres

Automated-Control Capture and Use System

(see Fact Sheet, then enter impervious area managed by the system) | 0.00 | acres

Bioretention/Infiltration Credits

Impervious Area Managed by Bioretention BMPs

(see Fact Sheet)

Bioretention Area | 4,144 | sq ft
Subdrain Elevation | 6 | inches
Ponding Depth, inches | 12 | inches | 1.42 | acres

Impervious Area Managed by Infiltration BMPs

(see Fact Sheet)

Drawdown Time, hrs | | drawdown_hrs_inf
Soil Infiltration Rate, in/hr | | soil_inf_rate

Sizing Option 1: Capture Volume, acre-ft | 0.00 | capture_vol_inf | 0.00 | acres

Sizing Option 2: Infiltration BMP surface area, sq ft | 0 | soil_surface_area | 0.00 | acres

Basin or trench? | approximate BMP depth | 0.00 | ft

Impervious Area Managed by Amended Soil or Mulch Beds

(see Fact Sheet) Mulched Infiltration Area, sq ft | - | mulch_area | 0.00 | acres

Total Effective Area Managed by Capture-and-Use/Bioretention/Infiltration BMPs | 1.42 | A_{LIDc}

Runoff Management Credit (Step 3) A_{LIDC}/A_T*200 = | 177.4 | pts

Total LID Credits (Step 1+2+3) LID compliant, check for treatment sizing in Step 4 202.6

Does project require hydromodification management? If yes, proceed to using SacHM.

Adjusted Area for Flow-Based, Non-LID Treatment $A_T - A_C - A_{LIDC}$ = | 0.16 | A_{AT}

Adjusted Impervious Fraction of A for Volume-Based, Non-LID Treatment A_{AT} / A = | 0.08 | I_A

Further treatment is required, see choose flow-based or volume-based sizing in Step 4

Step 4a Treatment - Flow-Based (Rational Method)

Calculate treatment flow (cfs): Flow = Runoff Coefficient x Rainfall Intensity x Area

Look up value for i in Table D-2c (Rainfall Intensity) | 0.18 | i

Obtain A_{AT} from Step 3 | 0.16 | A_{AT}

Use C = 0.95 | 0.95 | C

Flow = 0.95 * i * A_{AT} | 0.03 | cfs

Table D-2c

Rainfall Intensity		
Roseville	i =	0.20 in/hr
Sacramento	i =	0.18 in/hr
Folsom	i =	0.20 in/hr

Step 4b Treatment - Volume-Based (ASCE-WEF)

Calculate water quality volume (Acre-Feet): WQV = Area x Maximized Detention Volume (P_0)

Obtain A from Step 1 | 2.10 | A | 48 | hrs | Specified Draw Down time

Obtain P_0: Maximized Detention Volume from figures E-1 to E-4 in Appendix E of this manual using I_A from Step 2. | 0.10 | P_0

Calculate treatment volume (acre-ft):

Treatment volume = A x (P_0 / 12) | 0.02 | Acre-Feet

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Appendix D-2: Commercial Sites: Low Impact Development (LID) Credits and Treatment BMP Sizing Calculations

Name of Drainage Shed: Area A
Location of project: Sacramento

Fill in Blue Highlighted boxes

Step 1 - Open Space and Pervious Area Credits

Is your project within the drainage area of a common drainage plan that includes open space? If not, skip to 1 b.

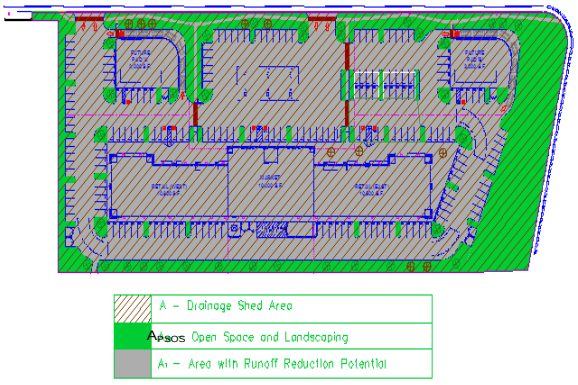
1 a. Common Drainage Plan Area	25	acres	A_{CDP}	
Common Drainage Plan Open Space (Off-project)	0	acres	A_{OS}	**see area example below**
a. Natural storage reservoirs and drainage corridors	0	acres		
b. Buffer zones for natural water bodies	0	acres		
c. Natural areas including existing trees, other vegetation, and soil	0	acres		
d. Common landscape area/park	0	acres		
e. Regional Flood Control/Drainage basins	0	acres		
1 b. Project Drainage Shed Area (Total)	6.85	acres	A	
Project-Specific Open Space (In-project, communal)**	0.75	acres	A_{PSOS}	
a. Natural storage reservoirs and drainage corridors	0.00	acres		
b. Buffer zones for natural water bodies	0.00	acres		
c. Natural areas including existing trees, other vegetation, and soil	0.00	acres		**see area example below**
d. Landscape area/park	0.75	acres		
e. Flood Control/Drainage basins	0.00	acres		

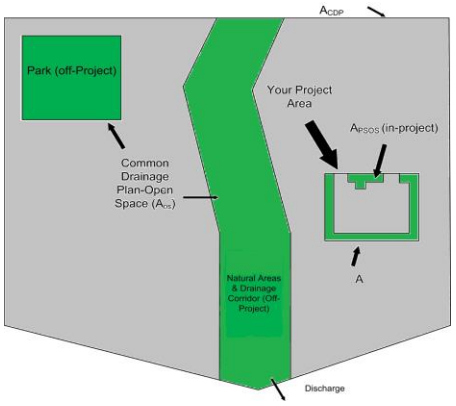
** Doesn't include impervious areas within individual lots and surrounding individual units. That is accounted for below using Form D-1a in Step 2.

Area with Runoff Reduction Potential	$A - A_{PSOS}$ =	6.10	acres	A_T
Assumed Initial Impervious Fraction	A_T / A =	0.89		I

Open Space & Pervious Area LID Credit (Step 1)

$(A_{OS}/A_{CDP}+A_{PSOS}/A)x100$ = 11 pts





Step 2 - Runoff Reduction Credits

Runoff Reduction Treatments	Impervious Area Managed			Efficiency Factor		Effective Area Managed (A_C)	
Porous Pavement:							
Option 1: Porous Pavement (see Fact Sheet, excludes porous pavement used in Option 2)	0	acres	x		=	0.000	acres
Option 2: Disconnected Pavement (see Fact Sheet, excludes porous pavement used in Option 1)	use Form D-2a for credits →					0.00	acres
Landscaping used to Disconnect Pavement (see Fact Sheet)	0.0000	acres			=	0.00	acres
Disconnected Roof Drains (see Fact Sheet and/or Table D-2b for summary of requirements)	0	acres			=	0.00	acres
Ecoroof (see Fact Sheet)	0	acres			=	0.00	acres
Interceptor Trees (see Fact Sheet)	use Form D-2b for credits →					0.00	acres
Total Effective Area Managed by Runoff Reduction Measures				A_C		0.00	acres

Runoff Reduction Credit (Step 2) $(A_C / A_T)*100$ = 0 pts

Table D-2a

Porous Pavement Type	Efficiency Multiplier
Cobblestone Block Pavement	0.40
Pervious Concrete/Asphalt	0.60
Modular Block Pavement &	0.75
Reinforced Grass Pavement	1.00

Table D-2b

Maximum roof size	Minimum travel distance
≤ 3,500 sq ft	21 ft
≤ 5,000 sq ft	24 ft
≤ 7,500 sq ft	28 ft
≤ 10,000 sq ft	32 ft

Form D-2a: Disconnected Pavement Worksheet

See Fact Sheet for more information regarding Disconnected Pavement credit guidelines

Effective Area Managed (A_C)

Pavement Draining to Porous Pavement

2. Enter area draining onto Porous Pavement	0.00	acres	Box K1
3. Enter area of Receiving Porous Pavement (excludes area entered in Step 2 under Porous Pavement)	0.00	acres	Box K2
4. Ratio of Areas (Box K1 / Box K2)	0.00		Box K3

5. Select multiplier using ratio from Box K3 and enter into Box K4

Ratio (Box D)	Multiplier
Ratio is ≤ 0.5	1.00
Ratio is > 0.5 and < 1.0	0.83
Ratio is > 1.0 and < 1.5	0.71
Ratio is > 1.5 and < 2.0	0.55

	1		Box K4
6. Enter Efficiency of Porous Pavement (see table below)			Box K5

Porous Pavement Type	Efficiency Multiplier
Cobblestone Block Pavement	0.40
Pervious Concrete Asphalt Pavement	0.60
Modular Block Pavement Porous Gravel Pavement	0.75
Reinforced Grass Pavement	1.00

7. Multiply Box K2 by Box K5 and enter into Box K6	0.00	acres	Box K6
8. Multiply Boxes K1,K4, and K5 and enter the result in Box K7	0.00	acres	Box K7
9. Add Box K6 to Box K7 and multiply by 60%, and enter the Result in Box K8 This is the amount of area credit to enter into the "Disconnected Pavement" Box of Form D-2			0.00 acres

Form D-2b: Interceptor Tree Worksheet

See Fact Sheet for more information regarding Interceptor Tree credit guidelines

New Evergreen Trees

1. Enter number of new evergreen trees that qualify as Interceptor Trees in Box L1.		trees	Box L1
2. Multiply Box L1 by 200 and enter result in Box L2	0	sq. ft.	Box L2

New Deciduous Trees

3. Enter number of new deciduous trees that qualify as Interceptor Trees in Box L3.		trees	Box L3
4. Multiply Box L3 by 100 and enter result in Box L4	0	sq. ft.	Box L4

Existing Tree Canopy

5. Enter square footage of existing tree canopy that qualifies as Existing Tree canopy in Box L5.	0	sq. ft.	Box L5
6. Multiply Box L5 by 0.5 and enter the result in Box L6	0	sq. ft.	Box L6

Total Interceptor Tree EAM Credits

Add Boxes L2, L4, and L6 and enter it into Box L7	0	sq. ft.	Box L7
Divide Box L7 by 43,560 and multiply by 20% to get effective area managed and enter result in Box L8 This is the amount of area credit to enter into the "Interceptor Trees" Box of Form D-2	0.00	acres	Box L8

Step 3 - Runoff Management Credits

Capture and Use Credits

Impervious Area Managed by Rain barrels, Cisterns, and automatically-emptied systems

(see Fact Sheet) | - | enter gallons, for simple rain barrels | 0.00 | acres

Automated-Control Capture and Use System

(see Fact Sheet, then enter impervious area managed by the system) | 0.00 | acres

Bioretention/Infiltration Credits

Impervious Area Managed by Bioretention BMPs

(see Fact Sheet)

Bioretention Area | 9,210 | sq ft
Subdrain Elevation | 6 | inches
Ponding Depth, inches | 12 | inches
3.15 | acres

Impervious Area Managed by Infiltration BMPs

(see Fact Sheet)

Drawdown Time, hrs | | drawdown_hrs_inf
Soil Infiltration Rate, in/hr | | soil_inf_rate

Sizing Option 1: Capture Volume, acre-ft | 0.00 | capture_vol_inf | 0.00 | acres

Sizing Option 2: Infiltration BMP surface area, sq ft | 0 | soil_surface_area | 0.00 | acres

Basin or trench? | approximate BMP depth | 0.00 | ft

Impervious Area Managed by Amended Soil or Mulch Beds

(see Fact Sheet) Mulched Infiltration Area, sq ft | | mulch_area | 0.00 | acres

Total Effective Area Managed by Capture-and-Use/Bioretention/Infiltration BMPs | 3.15 | A_{LIDc}

Runoff Management Credit (Step 3) A_{LIDC}/A_T*200 = | 103.3 | pts

Total LID Credits (Step 1+2+3) LID compliant, check for treatment sizing in Step 4 | 114.2

Does project require hydromodification management? If yes, proceed to using SacHM.

Adjusted Area for Flow-Based, Non-LID Treatment $A_T - A_C - A_{LIDC}$ = | 2.95 | A_{AT}

Adjusted Impervious Fraction of A for Volume-Based, Non-LID Treatment A_{AT} / A = | 0.43 | I_A

Further treatment is required, see choose flow-based or volume-based sizing in Step 4

Step 4a Treatment - Flow-Based (Rational Method)

Calculate treatment flow (cfs): Flow = Runoff Coefficient x Rainfall Intensity x Area

Look up value for i in Table D-2c (Rainfall Intensity) | 0.18 | i

Obtain A_{AT} from Step 3 | 2.95 | A_{AT}

Use C = 0.95 | 0.95 | C

Flow = 0.95 * i * A_{AT} | 0.50 | cfs

Table D-2c

Rainfall Intensity		
Roseville	i =	0.20 in/hr
Sacramento	i =	0.18 in/hr
Folsom	i =	0.20 in/hr

Step 4b Treatment - Volume-Based (ASCE-WEF)

Calculate water quality volume (Acre-Feet): WQV = Area x Maximized Detention Volume (P_0)

Obtain A from Step 1 | 6.85 | A | 48 | hrs | Specified Draw Down time

Obtain P_0: Maximized Detention Volume from figures E-1 to E-4 in Appendix E of this manual using I_A from Step 2. | 0.32 | P_0

Calculate treatment volume (acre-ft):

Treatment volume = A x (P_0 / 12) | 0.18 | Acre-Feet

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Appendix D-2: Commercial Sites: Low Impact Development (LID) Credits and Treatment BMP Sizing Calculations

Name of Drainage Shed: Shed B
Location of project: Sacramento

Fill in Blue Highlighted boxes

Step 1 - Open Space and Pervious Area Credits

Is your project within the drainage area of a common drainage plan that includes open space? If not, skip to 1 b.

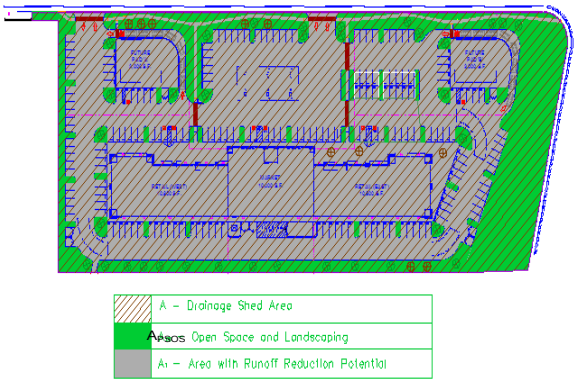
1 a. Common Drainage Plan Area	25	acres	A_{CDP}	
Common Drainage Plan Open Space (Off-project)	0	acres	A_{OS}	see area example below
a. Natural storage reservoirs and drainage corridors	0	acres		
b. Buffer zones for natural water bodies	0	acres		
c. Natural areas including existing trees, other vegetation, and soil	0	acres		
d. Common landscape area/park	0	acres		
e. Regional Flood Control/Drainage basins	0	acres		
1 b. Project Drainage Shed Area (Total)	11.01	acres	A	
Project-Specific Open Space (In-project, communal)**	3.75	acres	A_{PSOS}	
a. Natural storage reservoirs and drainage corridors	0.00	acres		
b. Buffer zones for natural water bodies	0.00	acres		
c. Natural areas including existing trees, other vegetation, and soil	0.00	acres		see area example below
d. Landscape area/park	3.75	acres		
e. Flood Control/Drainage basins	0.00	acres		

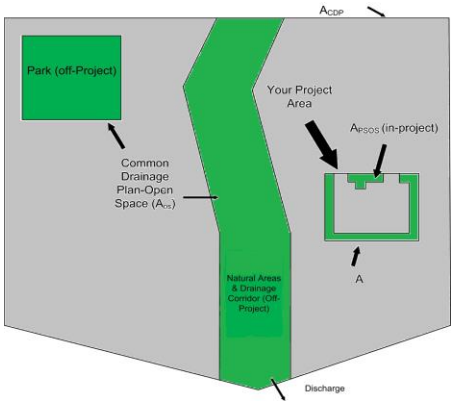
** Doesn't include impervious areas within individual lots and surrounding individual units. That is accounted for below using Form D-1a in Step 2.

Area with Runoff Reduction Potential	$A - A_{PSOS}$ =	7.26	acres	A_T
Assumed Initial Impervious Fraction	A_T / A =	0.66		I

Open Space & Pervious Area LID Credit (Step 1)

$(A_{OS}/A_{CDP}+A_{PSOS}/A)x100$ = 34 pts





Step 2 - Runoff Reduction Credits

Runoff Reduction Treatments	Impervious Area Managed			Efficiency Factor		Effective Area Managed (A_C)	
Porous Pavement:							
Option 1: Porous Pavement (see Fact Sheet, excludes porous pavement used in Option 2)	0	acres	x		=	0.000	acres
Option 2: Disconnected Pavement (see Fact Sheet, excludes porous pavement used in Option 1)	use Form D-2a for credits →					0.00	acres
Landscaping used to Disconnect Pavement (see Fact Sheet)	0.0000	acres			=	0.00	acres
Disconnected Roof Drains (see Fact Sheet and/or Table D-2b for summary of requirements)	0	acres			=	0.00	acres
Ecoroof (see Fact Sheet)	0	acres			=	0.00	acres
Interceptor Trees (see Fact Sheet)	use Form D-2b for credits →					0.00	acres
Total Effective Area Managed by Runoff Reduction Measures				A_C		0.00	acres

Runoff Reduction Credit (Step 2) $(A_C / A_T)*100$ = 0 pts

Table D-2a

Porous Pavement Type	Efficiency Multiplier
Cobblestone Block Pavement	0.40
Pervious Concrete/Asphalt	0.60
Modular Block Pavement &	0.75
Reinforced Grass Pavement	1.00

Table D-2b

Maximum roof size	Minimum travel distance
≤ 3,500 sq ft	21 ft
≤ 5,000 sq ft	24 ft
≤ 7,500 sq ft	28 ft
≤ 10,000 sq ft	32 ft

Form D-2a: Disconnected Pavement Worksheet

See Fact Sheet for more information regarding Disconnected Pavement credit guidelines

Effective Area Managed (A_C)

Pavement Draining to Porous Pavement

2. Enter area draining onto Porous Pavement	0.00	acres	Box K1
3. Enter area of Receiving Porous Pavement (excludes area entered in Step 2 under Porous Pavement)	0.00	acres	Box K2
4. Ratio of Areas (Box K1 / Box K2)	0.00		Box K3

5. Select multiplier using ratio from Box K3 and enter into Box K4

Ratio (Box D)	Multiplier
Ratio is ≤ 0.5	1.00
Ratio is > 0.5 and < 1.0	0.83
Ratio is > 1.0 and < 1.5	0.71
Ratio is > 1.5 and < 2.0	0.55

	1		Box K4
6. Enter Efficiency of Porous Pavement (see table below)			Box K5

Porous Pavement Type	Efficiency Multiplier
Cobblestone Block Pavement	0.40
Pervious Concrete Asphalt Pavement	0.60
Modular Block Pavement Porous Gravel Pavement	0.75
Reinforced Grass Pavement	1.00

7. Multiply Box K2 by Box K5 and enter into Box K6	0.00	acres	Box K6
8. Multiply Boxes K1,K4, and K5 and enter the result in Box K7	0.00	acres	Box K7
9. Add Box K6 to Box K7 and multiply by 60%, and enter the Result in Box K8 This is the amount of area credit to enter into the "Disconnected Pavement" Box of Form D-2			0.00 acres

Form D-2b: Interceptor Tree Worksheet

See Fact Sheet for more information regarding Interceptor Tree credit guidelines

New Evergreen Trees

1. Enter number of new evergreen trees that qualify as Interceptor Trees in Box L1.		trees	Box L1
2. Multiply Box L1 by 200 and enter result in Box L2	0	sq. ft.	Box L2

New Deciduous Trees

3. Enter number of new deciduous trees that qualify as Interceptor Trees in Box L3.		trees	Box L3
4. Multiply Box L3 by 100 and enter result in Box L4	0	sq. ft.	Box L4

Existing Tree Canopy

5. Enter square footage of existing tree canopy that qualifies as Existing Tree canopy in Box L5.	0	sq. ft.	Box L5
6. Multiply Box L5 by 0.5 and enter the result in Box L6	0	sq. ft.	Box L6

Total Interceptor Tree EAM Credits

Add Boxes L2, L4, and L6 and enter it into Box L7	0	sq. ft.	Box L7
Divide Box L7 by 43,560 and multiply by 20% to get effective area managed and enter result in Box L8 This is the amount of area credit to enter into the "Interceptor Trees" Box of Form D-2	0.00	acres	Box L8

Step 3 - Runoff Management Credits

Capture and Use Credits

Impervious Area Managed by Rain barrels, Cisterns, and automatically-emptied systems

(see Fact Sheet) | - | enter gallons, for simple rain barrels | 0.00 | acres

Automated-Control Capture and Use System

(see Fact Sheet, then enter impervious area managed by the system) | 0.00 | acres

Bioretention/Infiltration Credits

Impervious Area Managed by Bioretention BMPs

(see Fact Sheet)

Bioretention Area | 15,750 | sq ft
Subdrain Elevation | 6 | inches
Ponding Depth, inches | 12 | inches
5.39 | acres

Impervious Area Managed by Infiltration BMPs

(see Fact Sheet)

Drawdown Time, hrs | | drawdown_hrs_inf
Soil Infiltration Rate, in/hr | | soil_inf_rate

Sizing Option 1: Capture Volume, acre-ft | 0.00 | capture_vol_inf | 0.00 | acres

Sizing Option 2: Infiltration BMP surface area, sq ft | 0 | soil_surface_area | 0.00 | acres

Basin or trench? | approximate BMP depth | 0.00 | ft

Impervious Area Managed by Amended Soil or Mulch Beds

(see Fact Sheet) Mulched Infiltration Area, sq ft | | mulch_area | 0.00 | acres

Total Effective Area Managed by Capture-and-Use/Bioretention/Infiltration BMPs | 5.39 | A_{LIDc}

Runoff Management Credit (Step 3) A_{LIDC}/A_T*200 = | 148.6 | pts

Total LID Credits (Step 1+2+3) LID compliant, check for treatment sizing in Step 4 182.6

Does project require hydromodification management? If yes, proceed to using SacHM.

Adjusted Area for Flow-Based, Non-LID Treatment $A_T - A_C - A_{LIDC}$ = | 1.87 | A_{AT}

Adjusted Impervious Fraction of A for Volume-Based, Non-LID Treatment A_{AT} / A = | 0.17 | I_A

Further treatment is required, see choose flow-based or volume-based sizing in Step 4

Step 4a Treatment - Flow-Based (Rational Method)

Calculate treatment flow (cfs): Flow = Runoff Coefficient x Rainfall Intensity x Area

Look up value for i in Table D-2c (Rainfall Intensity) | 0.18 | i

Obtain A_{AT} from Step 3 | 1.87 | A_{AT}

Use C = 0.95 | 0.95 | C

Flow = 0.95 * i * A_{AT} | 0.32 | cfs

Table D-2c

Rainfall Intensity		
Roseville	i =	0.20 in/hr
Sacramento	i =	0.18 in/hr
Folsom	i =	0.20 in/hr

Step 4b Treatment - Volume-Based (ASCE-WEF)

Calculate water quality volume (Acre-Feet): WQV = Area x Maximized Detention Volume (P_0)

Obtain A from Step 1 | 11.01 | A | 48 | hrs | Specified Draw Down time

Obtain P_0: Maximized Detention Volume from figures E-1 to E-4 in Appendix E of this manual using I_A from Step 2. | 0.16 | P_0

Calculate treatment volume (acre-ft):

Treatment volume = A x (P_0 / 12) | 0.15 | Acre-Feet

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Appendix D-2: Commercial Sites: Low Impact Development (LID) Credits and Treatment BMP Sizing Calculations

Name of Drainage Shed: Shed C
Location of project: Sacramento

Fill in Blue Highlighted boxes

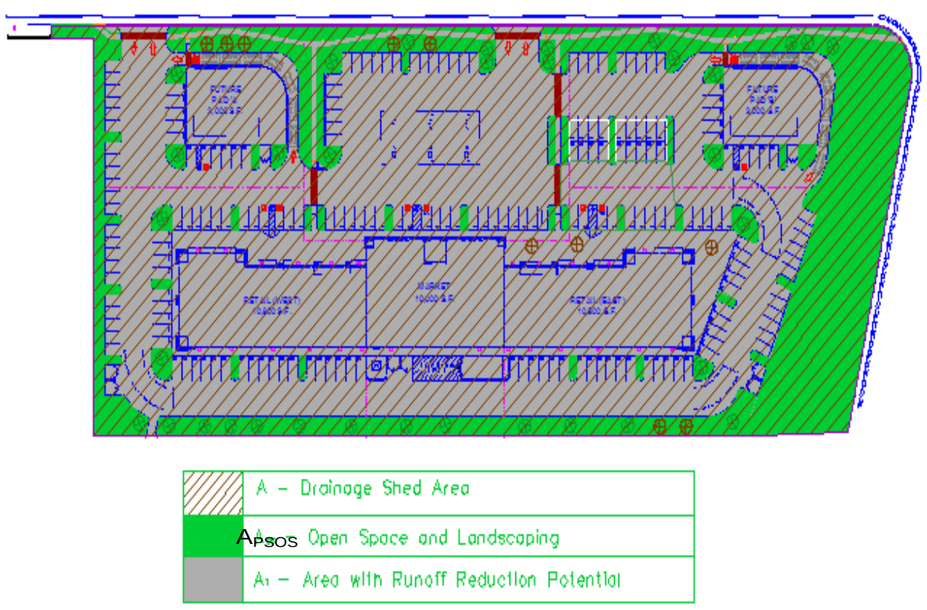
Step 1 - Open Space and Pervious Area Credits

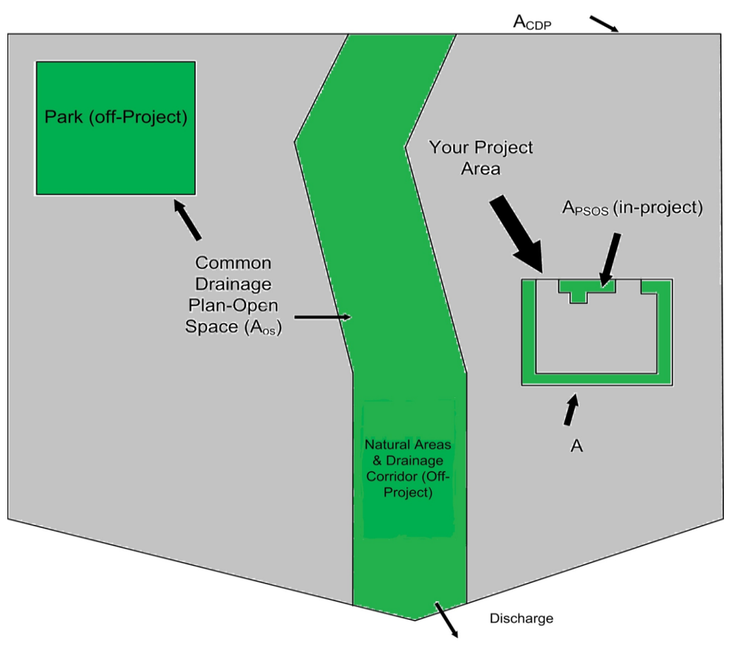
Is your project within the drainage area of a common drainage plan that includes open space? If not, skip to 1 b.

1 a. Common Drainage Plan Area	25	acres	A_{CDP}	
Common Drainage Plan Open Space (Off-project)	0	acres	A_{OS}	**see area example below**
a. Natural storage reservoirs and drainage corridors	0	acres		
b. Buffer zones for natural water bodies	0	acres		
c. Natural areas including existing trees, other vegetation, and soil	0	acres		
d. Common landscape area/park	0	acres		
e. Regional Flood Control/Drainage basins	0	acres		
1 b. Project Drainage Shed Area (Total)	0.51	acres	A	
Project-Specific Open Space (In-project, communal)**	0.42	acres	A_{PSOS}	
a. Natural storage reservoirs and drainage corridors	0.00	acres		
b. Buffer zones for natural water bodies	0.00	acres		**see area example below**
c. Natural areas including existing trees, other vegetation, and soil	0.00	acres		
d. Landscape area/park	0.42	acres		
e. Flood Control/Drainage basins	0.00	acres		

** Doesn't include impervious areas within individual lots and surrounding individual units. That is accounted for below using Form D-1a in Step 2.

Area with Runoff Reduction Potential	$A - A_{PSOS}$ =	0.09	acres	A_T
Assumed Initial Impervious Fraction	A_T / A =	0.18		I
Open Space & Pervious Area LID Credit (Step 1)	$(A_{OS}/A_{CDP}+A_{PSOS}/A)x100$ =	82	pts	





Step 2 - Runoff Reduction Credits

Runoff Reduction Treatments	Impervious Area Managed			Efficiency Factor		Effective Area Managed (A_C)	
Porous Pavement:							
Option 1: Porous Pavement (see Fact Sheet, excludes porous pavement used in Option 2)	0	acres	x		=	0.000	acres
Option 2: Disconnected Pavement (see Fact Sheet, excludes porous pavement used in Option 1)	use Form D-2a for credits →					0.00	acres
Landscaping used to Disconnect Pavement (see Fact Sheet)	0.0000	acres			=	0.00	acres
Disconnected Roof Drains (see Fact Sheet and/or Table D-2b for summary of requirements)	0	acres			=	0.00	acres
Ecoroof (see Fact Sheet)	0	acres			=	0.00	acres
Interceptor Trees (see Fact Sheet)	use Form D-2b for credits →					0.00	acres
Total Effective Area Managed by Runoff Reduction Measures				A_C		0.00	acres
Runoff Reduction Credit (Step 2)					$(A_C / A_T)*100$ =	0	pts

Table D-2a

Porous Pavement Type	Efficiency Multiplier
Cobblestone Block Pavement	0.40
Pervious Concrete/Asphalt	0.60
Modular Block Pavement &	0.75
Reinforced Grass Pavement	1.00

Table D-2b

Maximum roof size	Minimum travel distance
≤ 3,500 sq ft	21 ft
≤ 5,000 sq ft	24 ft
≤ 7,500 sq ft	28 ft
≤ 10,000 sq ft	32 ft

Form D-2a: Disconnected Pavement Worksheet

See Fact Sheet for more information regarding Disconnected Pavement credit guidelines

Effective Area Managed (A_C)

Pavement Draining to Porous Pavement

2. Enter area draining onto Porous Pavement	0.00	acres	Box K1
3. Enter area of Receiving Porous Pavement (excludes area entered in Step 2 under Porous Pavement)	0.00	acres	Box K2
4. Ratio of Areas (Box K1 / Box K2)	0.00		Box K3

5. Select multiplier using ratio from Box K3 and enter into Box K4

Ratio (Box D)	Multiplier
Ratio is ≤ 0.5	1.00
Ratio is > 0.5 and < 1.0	0.83
Ratio is > 1.0 and < 1.5	0.71
Ratio is > 1.5 and < 2.0	0.55

	1		Box K4
6. Enter Efficiency of Porous Pavement (see table below)			Box K5

Porous Pavement Type	Efficiency Multiplier
Cobblestone Block Pavement	0.40
Pervious Concrete Asphalt Pavement	0.60
Modular Block Pavement Porous Gravel Pavement	0.75
Reinforced Grass Pavement	1.00

7. Multiply Box K2 by Box K5 and enter into Box K6	0.00	acres	Box K6
8. Multiply Boxes K1,K4, and K5 and enter the result in Box K7	0.00	acres	Box K7
9. Add Box K6 to Box K7 and multiply by 60%, and enter the Result in Box K8			0.00 acres

This is the amount of area credit to enter into the "Disconnected Pavement" Box of Form D-2

Form D-2b: Interceptor Tree Worksheet

See Fact Sheet for more information regarding Interceptor Tree credit guidelines

New Evergreen Trees

1. Enter number of new evergreen trees that qualify as Interceptor Trees in Box L1.		trees	Box L1
2. Multiply Box L1 by 200 and enter result in Box L2	0	sq. ft.	Box L2

New Deciduous Trees

3. Enter number of new deciduous trees that qualify as Interceptor Trees in Box L3.		trees	Box L3
4. Multiply Box L3 by 100 and enter result in Box L4	0	sq. ft.	Box L4

Existing Tree Canopy

5. Enter square footage of existing tree canopy that qualifies as Existing Tree canopy in Box L5.	0	sq. ft.	Box L5
6. Multiply Box L5 by 0.5 and enter the result in Box L6	0	sq. ft.	Box L6

Total Interceptor Tree EAM Credits

Add Boxes L2, L4, and L6 and enter it into Box L7	0	sq. ft.	Box L7
Divide Box L7 by 43,560 and multiply by 20% to get effective area managed and enter result in Box L8	0.00	acres	Box L8

This is the amount of area credit to enter into the "Interceptor Trees" Box of Form D-2

Step 3 - Runoff Management Credits

Capture and Use Credits

Impervious Area Managed by Rain barrels, Cisterns, and automatically-emptied systems

(see Fact Sheet) - enter gallons, for simple rain barrels: 0.00 acres

Automated-Control Capture and Use System

(see Fact Sheet, then enter impervious area managed by the system): 0.00 acres

Bioretention/Infiltration Credits

Impervious Area Managed by Bioretention BMPs

(see Fact Sheet)

Bioretention Area _____ sq ft
Subdrain Elevation _____ inches
Ponding Depth, inches _____ inches: 0.00 acres

Impervious Area Managed by Infiltration BMPs

(see Fact Sheet)

Drawdown Time, hrs _____ drawdown_hrs_inf
Soil Infiltration Rate, in/hr _____ soil_inf_rate

Sizing Option 1: Capture Volume, acre-ft 0.00 capture_vol_inf: 0.00 acres

Sizing Option 2: Infiltration BMP surface area, sq ft 0 soil_surface_area: 0.00 acres

Basin or trench? _____ approximate BMP depth 0.00 ft

Impervious Area Managed by Amended Soil or Mulch Beds

(see Fact Sheet) Mulched Infiltration Area, sq ft _____ mulch_area: 0.00 acres

Total Effective Area Managed by Capture-and-Use/Bioretention/Infiltration BMPs: 0.00 A_{LIDc}

Runoff Management Credit (Step 3) A_{LIDC}/A_T*200 = 0.0 pts

Total LID Credits (Step 1+2+3) Warning: More LID Is Required 82.2

Does project require hydromodification management? If yes, proceed to using SacHM.

Adjusted Area for Flow-Based, Non-LID Treatment $A_T - A_C - A_{LIDC}$ = 0.09 A_{AT}

Adjusted Impervious Fraction of A for Volume-Based, Non-LID Treatment A_{AT} / A = 0.18 I_A

Further treatment is required, see choose flow-based or volume-based sizing in Step 4

Step 4a Treatment - Flow-Based (Rational Method)

Calculate treatment flow (cfs): Flow = Runoff Coefficient x Rainfall Intensity x Area

Look up value for i in Table D-2c (Rainfall Intensity): 0.18 i

Obtain A_{AT} from Step 3: 0.09 A_{AT}

Use C = 0.95: 0.95 C

Flow = 0.95 * i * A_{AT}: 0.0156 cfs

Table D-2c

Rainfall Intensity			
Roseville	i =	0.20	in/hr
Sacramento	i =	0.18	in/hr
Folsom	i =	0.20	in/hr

Step 4b Treatment - Volume-Based (ASCE-WEF)

Calculate water quality volume (Acre-Feet): WQV = Area x Maximized Detention Volume (P_0)

Obtain A from Step 1: 0.51 A; 48 hrs Specified Draw Down time

Obtain P_0: Maximized Detention Volume from figures E-1 to E-4 in Appendix E of this manual using I_A from Step 2.: 0.17 P_0

Calculate treatment volume (acre-ft):

Treatment volume = A x (P_0 / 12): 0.01 Acre-Feet

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Appendix D-2: Commercial Sites: Low Impact Development (LID) Credits and Treatment BMP Sizing Calculations

Name of Drainage Shed: Shed D
Location of project: Sacramento

Fill in Blue Highlighted boxes

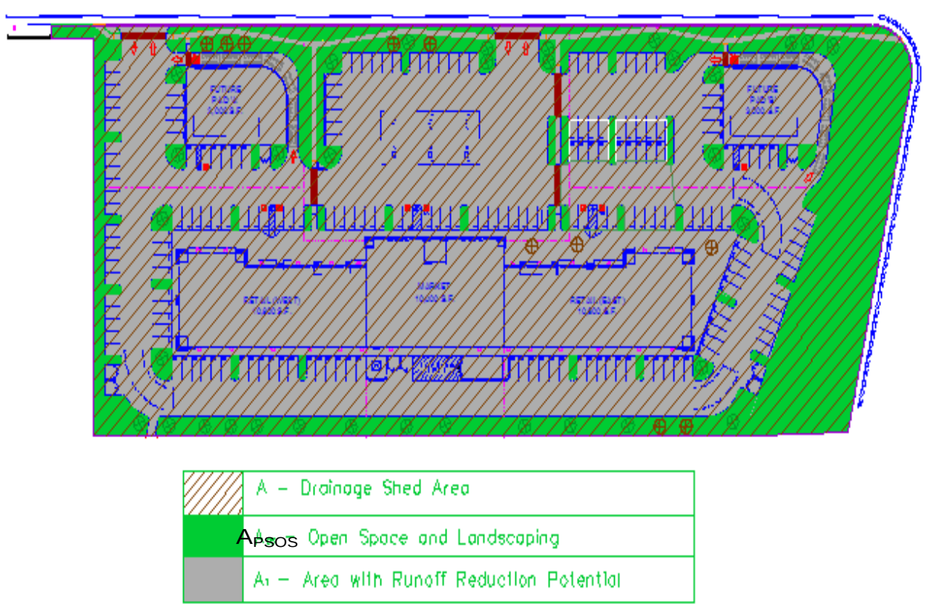
Step 1 - Open Space and Pervious Area Credits

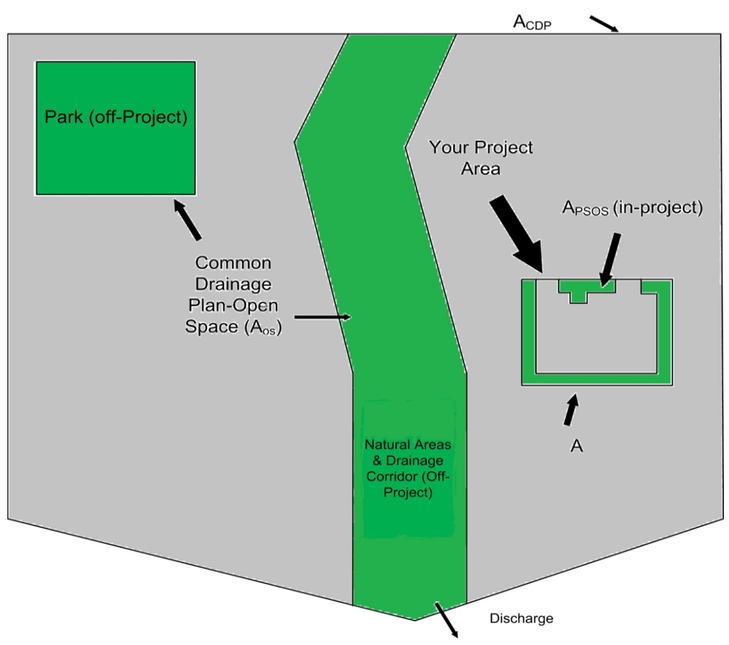
Is your project within the drainage area of a common drainage plan that includes open space? If not, skip to 1 b.

1 a. Common Drainage Plan Area	25	acres	A_{CDP}	
Common Drainage Plan Open Space (Off-project)	0	acres	A_{OS}	**see area example below**
a. Natural storage reservoirs and drainage corridors	0	acres		
b. Buffer zones for natural water bodies	0	acres		
c. Natural areas including existing trees, other vegetation, and soil	0	acres		
d. Common landscape area/park	0	acres		
e. Regional Flood Control/Drainage basins	0	acres		
1 b. Project Drainage Shed Area (Total)	1.90	acres	A	
Project-Specific Open Space (In-project, communal)**	1.09	acres	A_{PSOS}	
a. Natural storage reservoirs and drainage corridors	0.00	acres		
b. Buffer zones for natural water bodies	0.00	acres		
c. Natural areas including existing trees, other vegetation, and soil	0.00	acres		**see area example below**
d. Landscape area/park	1.09	acres		
e. Flood Control/Drainage basins	0.00	acres		

** Doesn't include impervious areas within individual lots and surrounding individual units. That is accounted for below using Form D-1a in Step 2.

Area with Runoff Reduction Potential	$A - A_{PSOS}$ =	0.80	acres	A_T
Assumed Initial Impervious Fraction	A_T / A =	0.42		I
Open Space & Pervious Area LID Credit (Step 1)	$(A_{OS}/A_{CDP}+A_{PSOS}/A)x100$ =	58	pts	





Step 2 - Runoff Reduction Credits

Runoff Reduction Treatments	Impervious Area Managed			Efficiency Factor		Effective Area Managed (A_C)	
Porous Pavement:							
Option 1: Porous Pavement (see Fact Sheet, excludes porous pavement used in Option 2)	0	acres	x		=	0.000	acres
Option 2: Disconnected Pavement (see Fact Sheet, excludes porous pavement used in Option 1)	use Form D-2a for credits →					0.00	acres
Landscaping used to Disconnect Pavement (see Fact Sheet)	0.0000	acres			=	0.00	acres
Disconnected Roof Drains (see Fact Sheet and/or Table D-2b for summary of requirements)	0	acres			=	0.00	acres
Ecoroof (see Fact Sheet)	0	acres			=	0.00	acres
Interceptor Trees (see Fact Sheet)	use Form D-2b for credits →					0.00	acres
Total Effective Area Managed by Runoff Reduction Measures				A_C		0.00	acres
Runoff Reduction Credit (Step 2)					$(A_C / A_T)*100$ =	0	pts

Table D-2a

Porous Pavement Type	Efficiency Multiplier
Cobblestone Block Pavement	0.40
Pervious Concrete/Asphalt	0.60
Modular Block Pavement &	0.75
Reinforced Grass Pavement	1.00

Table D-2b

Maximum roof size	Minimum travel distance
≤ 3,500 sq ft	21 ft
≤ 5,000 sq ft	24 ft
≤ 7,500 sq ft	28 ft
≤ 10,000 sq ft	32 ft

Form D-2a: Disconnected Pavement Worksheet

See Fact Sheet for more information regarding Disconnected Pavement credit guidelines

Effective Area Managed (A_C)

Pavement Draining to Porous Pavement

2. Enter area draining onto Porous Pavement	0.00	acres	Box K1
3. Enter area of Receiving Porous Pavement (excludes area entered in Step 2 under Porous Pavement)	0.00	acres	Box K2
4. Ratio of Areas (Box K1 / Box K2)	0.00		Box K3

5. Select multiplier using ratio from Box K3 and enter into Box K4

Ratio (Box D)	Multiplier
Ratio is ≤ 0.5	1.00
Ratio is > 0.5 and < 1.0	0.83
Ratio is > 1.0 and < 1.5	0.71
Ratio is > 1.5 and < 2.0	0.55

	1		Box K4
6. Enter Efficiency of Porous Pavement (see table below)			Box K5

Porous Pavement Type	Efficiency Multiplier
Cobblestone Block Pavement	0.40
Pervious Concrete Asphalt Pavement	0.60
Modular Block Pavement Porous Gravel Pavement	0.75
Reinforced Grass Pavement	1.00

7. Multiply Box K2 by Box K5 and enter into Box K6	0.00	acres	Box K6
8. Multiply Boxes K1,K4, and K5 and enter the result in Box K7	0.00	acres	Box K7
9. Add Box K6 to Box K7 and multiply by 60%, and enter the Result in Box K8			0.00 acres

This is the amount of area credit to enter into the "Disconnected Pavement" Box of Form D-2

Form D-2b: Interceptor Tree Worksheet

See Fact Sheet for more information regarding Interceptor Tree credit guidelines

New Evergreen Trees

1. Enter number of new evergreen trees that qualify as Interceptor Trees in Box L1.		trees	Box L1
2. Multiply Box L1 by 200 and enter result in Box L2	0	sq. ft.	Box L2

New Deciduous Trees

3. Enter number of new deciduous trees that qualify as Interceptor Trees in Box L3.		trees	Box L3
4. Multiply Box L3 by 100 and enter result in Box L4	0	sq. ft.	Box L4

Existing Tree Canopy

5. Enter square footage of existing tree canopy that qualifies as Existing Tree canopy in Box L5.	0	sq. ft.	Box L5
6. Multiply Box L5 by 0.5 and enter the result in Box L6	0	sq. ft.	Box L6

Total Interceptor Tree EAM Credits

Add Boxes L2, L4, and L6 and enter it into Box L7	0	sq. ft.	Box L7
Divide Box L7 by 43,560 and multiply by 20% to get effective area managed and enter result in Box L8	0.00	acres	Box L8

This is the amount of area credit to enter into the "Interceptor Trees" Box of Form D-2

Step 3 - Runoff Management Credits

Capture and Use Credits

Impervious Area Managed by Rain barrels, Cisterns, and automatically-emptied systems

(see Fact Sheet) - enter gallons, for simple rain barrels: 0.00 acres

Automated-Control Capture and Use System

(see Fact Sheet, then enter impervious area managed by the system): 0.00 acres

Bioretention/Infiltration Credits

Impervious Area Managed by Bioretention BMPs

(see Fact Sheet)

Bioretention Area _____ sq ft
Subdrain Elevation _____ inches
Ponding Depth, inches _____ inches: 0.00 acres

Impervious Area Managed by Infiltration BMPs

(see Fact Sheet)

Drawdown Time, hrs _____ drawdown_hrs_inf
Soil Infiltration Rate, in/hr _____ soil_inf_rate

Sizing Option 1: Capture Volume, acre-ft 0.00 capture_vol_inf: 0.00 acres

Sizing Option 2: Infiltration BMP surface area, sq ft 0 soil_surface_area: 0.00 acres

Basin or trench? _____ approximate BMP depth 0.00 ft

Impervious Area Managed by Amended Soil or Mulch Beds

(see Fact Sheet) Mulched Infiltration Area, sq ft _____ mulch_area: 0.00 acres

Total Effective Area Managed by Capture-and-Use/Bioretention/Infiltration BMPs: 0.00 A_{LIDc}

Runoff Management Credit (Step 3) A_{LIDC}/A_T*200 = 0.0 pts

Total LID Credits (Step 1+2+3)

Warning: More LID Is Required 57.6

Does project require hydromodification management? If yes, proceed to using SacHM.

Adjusted Area for Flow-Based, Non-LID Treatment $A_T - A_C - A_{LIDC}$ = 0.80 A_{AT}

Adjusted Impervious Fraction of A for Volume-Based, Non-LID Treatment A_{AT} / A = 0.42 I_A

Further treatment is required, see choose flow-based or volume-based sizing in Step 4

Step 4a Treatment - Flow-Based (Rational Method)

Calculate treatment flow (cfs): Flow = Runoff Coefficient x Rainfall Intensity x Area

Look up value for i in Table D-2c (Rainfall Intensity): 0.18 i

Obtain A_{AT} from Step 3: 0.80 A_{AT}

Use C = 0.95: 0.95 C

Flow = 0.95 * i * A_{AT}: 0.137 cfs

Table D-2c

Rainfall Intensity			
Roseville	i =	0.20	in/hr
Sacramento	i =	0.18	in/hr
Folsom	i =	0.20	in/hr

Step 4b Treatment - Volume-Based (ASCE-WEF)

Calculate water quality volume (Acre-Feet): WQV = Area x Maximized Detention Volume (P_0)

Obtain A from Step 1: 1.90 A — 48 hrs — Specified Draw Down time

Obtain P_0: Maximized Detention Volume from figures E-1 to E-4 in Appendix E of this manual using I_A from Step 2.: 0.31 P_0

Calculate treatment volume (acre-ft):

Treatment volume = A x (P_0 / 12): 0.05 Acre-Feet

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Appendix D-2: Commercial Sites: Low Impact Development (LID) Credits and Treatment BMP Sizing Calculations

Name of Drainage Shed: Shed E
Location of project: Sacramento

Fill in Blue Highlighted boxes

Step 1 - Open Space and Pervious Area Credits

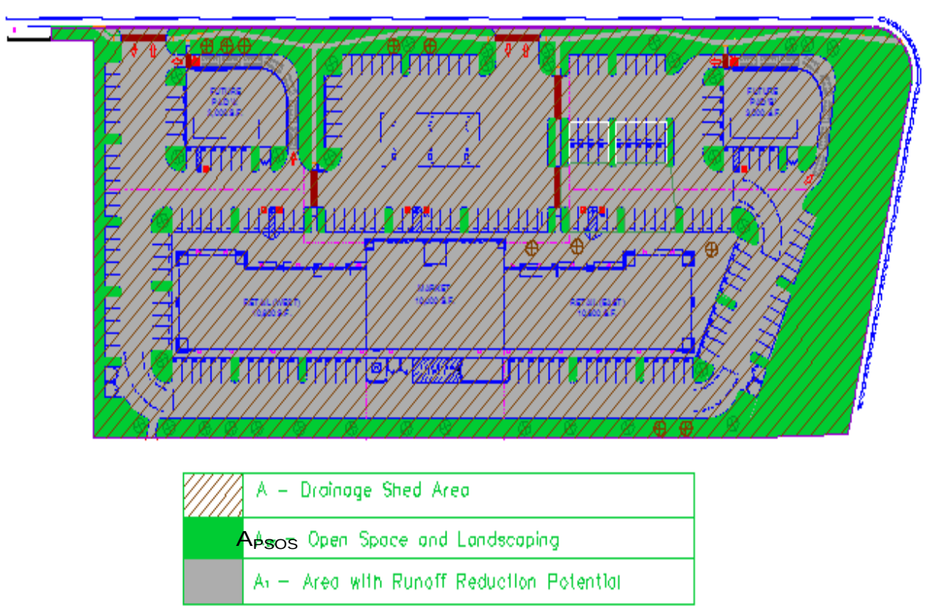
Is your project within the drainage area of a common drainage plan that includes open space? If not, skip to 1 b.

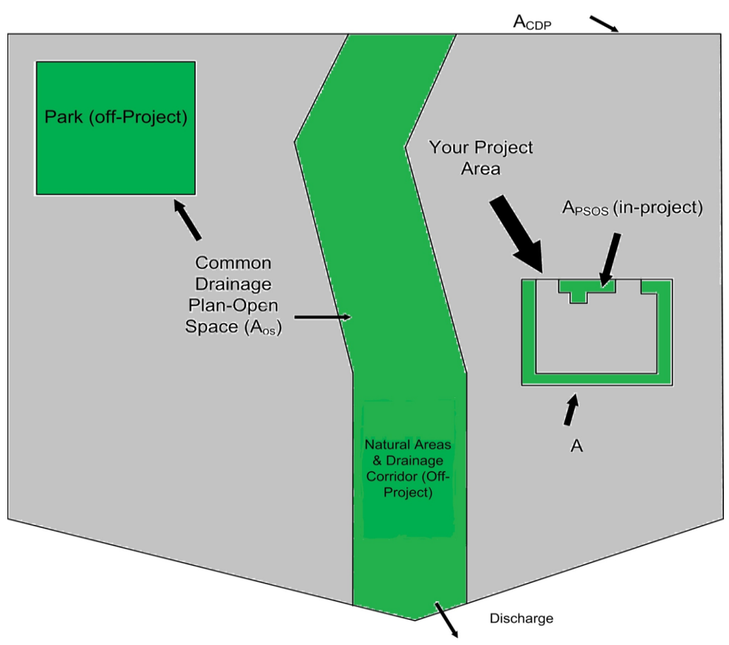
1 a. Common Drainage Plan Area	25	acres	A_{CDP}	
Common Drainage Plan Open Space (Off-project)	0	acres	A_{OS}	**see area example below**
a. Natural storage reservoirs and drainage corridors	0	acres		
b. Buffer zones for natural water bodies	0	acres		
c. Natural areas including existing trees, other vegetation, and soil	0	acres		
d. Common landscape area/park	0	acres		
e. Regional Flood Control/Drainage basins	0	acres		
1 b. Project Drainage Shed Area (Total)	1.28	acres	A	
Project-Specific Open Space (In-project, communal)**	0.50	acres	A_{PSOS}	
a. Natural storage reservoirs and drainage corridors	0.00	acres		
b. Buffer zones for natural water bodies	0.00	acres		**see area example below**
c. Natural areas including existing trees, other vegetation, and soil	0.00	acres		
d. Landscape area/park	0.50	acres		
e. Flood Control/Drainage basins	0.00	acres		

** Doesn't include impervious areas within individual lots and surrounding individual units. That is accounted for below using Form D-1a in Step 2.

Area with Runoff Reduction Potential	$A - A_{PSOS}$ =	0.78	acres	A_T
Assumed Initial Impervious Fraction	A_T / A =	0.61		I

Open Space & Pervious Area LID Credit (Step 1)
$(A_{OS}/A_{CDP}+A_{PSOS}/A)x100$ = 39 pts





Step 2 - Runoff Reduction Credits

Runoff Reduction Treatments	Impervious Area Managed			Efficiency Factor		Effective Area Managed (A_C)	
Porous Pavement:							
Option 1: Porous Pavement (see Fact Sheet, excludes porous pavement used in Option 2)	0	acres	x		=	0.000	acres
Option 2: Disconnected Pavement (see Fact Sheet, excludes porous pavement used in Option 1)	use Form D-2a for credits →					0.00	acres
Landscaping used to Disconnect Pavement (see Fact Sheet)	0.0000	acres			=	0.00	acres
Disconnected Roof Drains (see Fact Sheet and/or Table D-2b for summary of requirements)	0	acres			=	0.00	acres
Ecoroof (see Fact Sheet)	0	acres			=	0.00	acres
Interceptor Trees (see Fact Sheet)	use Form D-2b for credits →					0.00	acres
Total Effective Area Managed by Runoff Reduction Measures				A_C		0.00	acres
Runoff Reduction Credit (Step 2)					$(A_C / A_T)*100$ =	0	pts

Table D-2a

Porous Pavement Type	Efficiency Multiplier
Cobblestone Block Pavement	0.40
Pervious Concrete/Asphalt	0.60
Modular Block Pavement &	0.75
Reinforced Grass Pavement	1.00

Table D-2b

Maximum roof size	Minimum travel distance
≤ 3,500 sq ft	21 ft
≤ 5,000 sq ft	24 ft
≤ 7,500 sq ft	28 ft
≤ 10,000 sq ft	32 ft

Form D-2a: Disconnected Pavement Worksheet

See Fact Sheet for more information regarding Disconnected Pavement credit guidelines

Effective Area Managed (A_C)

Pavement Draining to Porous Pavement

2. Enter area draining onto Porous Pavement	0.00	acres	Box K1
3. Enter area of Receiving Porous Pavement (excludes area entered in Step 2 under Porous Pavement)	0.00	acres	Box K2
4. Ratio of Areas (Box K1 / Box K2)	0.00		Box K3

5. Select multiplier using ratio from Box K3 and enter into Box K4

Ratio (Box D)	Multiplier
Ratio is ≤ 0.5	1.00
Ratio is > 0.5 and < 1.0	0.83
Ratio is > 1.0 and < 1.5	0.71
Ratio is > 1.5 and < 2.0	0.55

	1		Box K4
6. Enter Efficiency of Porous Pavement (see table below)			Box K5

Porous Pavement Type	Efficiency Multiplier
Cobblestone Block Pavement	0.40
Pervious Concrete Asphalt Pavement	0.60
Modular Block Pavement Porous Gravel Pavement	0.75
Reinforced Grass Pavement	1.00

7. Multiply Box K2 by Box K5 and enter into Box K6	0.00	acres	Box K6
8. Multiply Boxes K1,K4, and K5 and enter the result in Box K7	0.00	acres	Box K7
9. Add Box K6 to Box K7 and multiply by 60%, and enter the Result in Box K8			0.00 acres

This is the amount of area credit to enter into the "Disconnected Pavement" Box of Form D-2

Form D-2b: Interceptor Tree Worksheet

See Fact Sheet for more information regarding Interceptor Tree credit guidelines

New Evergreen Trees

1. Enter number of new evergreen trees that qualify as Interceptor Trees in Box L1.		trees	Box L1
2. Multiply Box L1 by 200 and enter result in Box L2	0	sq. ft.	Box L2

New Deciduous Trees

3. Enter number of new deciduous trees that qualify as Interceptor Trees in Box L3.		trees	Box L3
4. Multiply Box L3 by 100 and enter result in Box L4	0	sq. ft.	Box L4

Existing Tree Canopy

5. Enter square footage of existing tree canopy that qualifies as Existing Tree canopy in Box L5.	0	sq. ft.	Box L5
6. Multiply Box L5 by 0.5 and enter the result in Box L6	0	sq. ft.	Box L6

Total Interceptor Tree EAM Credits

Add Boxes L2, L4, and L6 and enter it into Box L7	0	sq. ft.	Box L7
Divide Box L7 by 43,560 and multiply by 20% to get effective area managed and enter result in Box L8	0.00	acres	Box L8

This is the amount of area credit to enter into the "Interceptor Trees" Box of Form D-2

Step 3 - Runoff Management Credits

Capture and Use Credits

Impervious Area Managed by Rain barrels, Cisterns, and automatically-emptied systems

(see Fact Sheet) - enter gallons, for simple rain barrels: 0.00 acres

Automated-Control Capture and Use System

(see Fact Sheet, then enter impervious area managed by the system): 0.00 acres

Bioretention/Infiltration Credits

Impervious Area Managed by Bioretention BMPs

(see Fact Sheet)

Bioretention Area _____ sq ft
Subdrain Elevation _____ inches
Ponding Depth, inches _____ inches: 0.00 acres

Impervious Area Managed by Infiltration BMPs

(see Fact Sheet)

Drawdown Time, hrs _____ drawdown_hrs_inf
Soil Infiltration Rate, in/hr _____ soil_inf_rate

Sizing Option 1: Capture Volume, acre-ft 0.00 capture_vol_inf: 0.00 acres

Sizing Option 2: Infiltration BMP surface area, sq ft 0 soil_surface_area: 0.00 acres

Basin or trench? _____ approximate BMP depth 0.00 ft

Impervious Area Managed by Amended Soil or Mulch Beds

(see Fact Sheet) Mulched Infiltration Area, sq ft _____ mulch_area: 0.00 acres

Total Effective Area Managed by Capture-and-Use/Bioretention/Infiltration BMPs: 0.00 A_{LIDc}

Runoff Management Credit (Step 3) A_{LIDC}/A_T*200 = 0.0 pts

Total LID Credits (Step 1+2+3)

Warning: More LID Is Required 38.9

Does project require hydromodification management? If yes, proceed to using SacHM.

Adjusted Area for Flow-Based, Non-LID Treatment $A_T - A_C - A_{LIDC}$ = 0.78 A_{AT}

Adjusted Impervious Fraction of A for Volume-Based, Non-LID Treatment A_{AT} / A = 0.61 I_A

Further treatment is required, see choose flow-based or volume-based sizing in Step 4

Step 4a Treatment - Flow-Based (Rational Method)

Calculate treatment flow (cfs): Flow = Runoff Coefficient x Rainfall Intensity x Area

Look up value for i in Table D-2c (Rainfall Intensity): 0.18 i

Obtain A_{AT} from Step 3: 0.78 A_{AT}

Use C = 0.95: 0.95 C

Flow = 0.95 * i * A_{AT}: 0.134 cfs

Table D-2c

Rainfall Intensity			
Roseville	i =	0.20	in/hr
Sacramento	i =	0.18	in/hr
Folsom	i =	0.20	in/hr

Step 4b Treatment - Volume-Based (ASCE-WEF)

Calculate water quality volume (Acre-Feet): WQV = Area x Maximized Detention Volume (P_0)

Obtain A from Step 1: 1.28 A — 48 hrs — Specified Draw Down time

Obtain P_0: Maximized Detention Volume from figures E-1 to E-4 in Appendix E of this manual using I_A from Step 2.: 0.45 P_0

Calculate treatment volume (acre-ft):

Treatment volume = A x (P_0 / 12): 0.05 Acre-Feet

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Appendix D-2: Commercial Sites: Low Impact Development (LID) Credits and Treatment BMP Sizing Calculations

Name of Drainage Shed: Shed F
Location of project: Sacramento

Fill in Blue Highlighted boxes

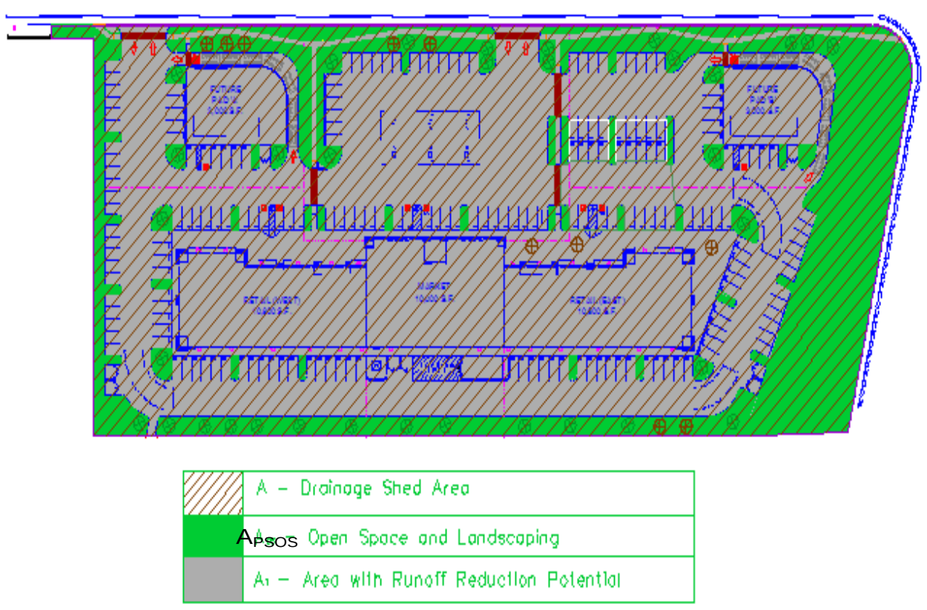
Step 1 - Open Space and Pervious Area Credits

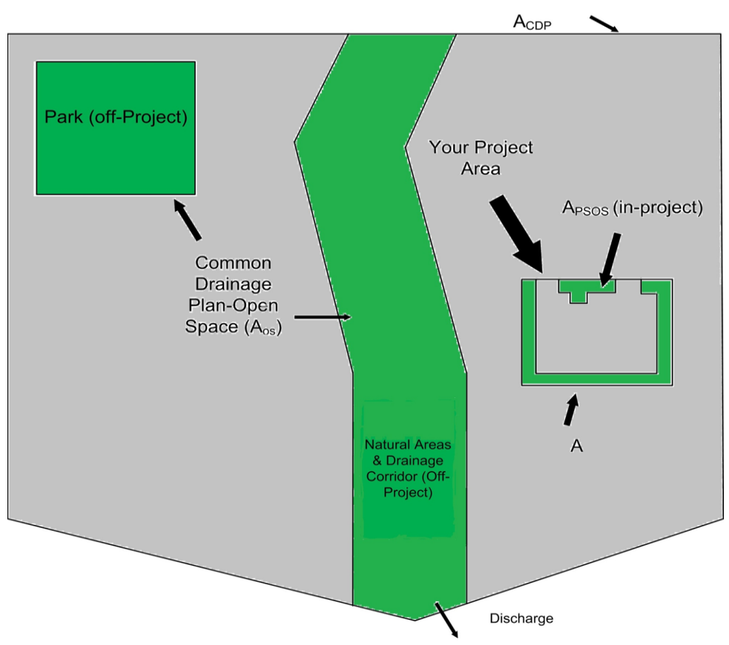
Is your project within the drainage area of a common drainage plan that includes open space? If not, skip to 1 b.

1 a. Common Drainage Plan Area	25	acres	A_{CDP}	
Common Drainage Plan Open Space (Off-project)	0	acres	A_{OS}	**see area example below**
a. Natural storage reservoirs and drainage corridors	0	acres		
b. Buffer zones for natural water bodies	0	acres		
c. Natural areas including existing trees, other vegetation, and soil	0	acres		
d. Common landscape area/park	0	acres		
e. Regional Flood Control/Drainage basins	0	acres		
1 b. Project Drainage Shed Area (Total)	1.53	acres	A	
Project-Specific Open Space (In-project, communal)**	0.20	acres	A_{PSOS}	
a. Natural storage reservoirs and drainage corridors	0.00	acres		
b. Buffer zones for natural water bodies	0.00	acres		
c. Natural areas including existing trees, other vegetation, and soil	0.00	acres		**see area example below**
d. Landscape area/park	0.20	acres		
e. Flood Control/Drainage basins	0.00	acres		

** Doesn't include impervious areas within individual lots and surrounding individual units. That is accounted for below using Form D-1a in Step 2.

Area with Runoff Reduction Potential	$A - A_{PSOS}$ =	1.33	acres	A_T
Assumed Initial Impervious Fraction	A_T / A =	0.87		I
Open Space & Pervious Area LID Credit (Step 1)	$(A_{OS}/A_{CDP}+A_{PSOS}/A)x100$ =	13	pts	





Step 2 - Runoff Reduction Credits

Runoff Reduction Treatments	Impervious Area Managed			Efficiency Factor		Effective Area Managed (A_C)	
Porous Pavement:							
Option 1: Porous Pavement (see Fact Sheet, excludes porous pavement used in Option 2)	0	acres	x		=	0.000	acres
Option 2: Disconnected Pavement (see Fact Sheet, excludes porous pavement used in Option 1)	use Form D-2a for credits →					0.00	acres
Landscaping used to Disconnect Pavement (see Fact Sheet)	0.0000	acres			=	0.00	acres
Disconnected Roof Drains (see Fact Sheet and/or Table D-2b for summary of requirements)	0	acres			=	0.00	acres
Ecoroof (see Fact Sheet)	0	acres			=	0.00	acres
Interceptor Trees (see Fact Sheet)	use Form D-2b for credits →					0.00	acres
Total Effective Area Managed by Runoff Reduction Measures				A_C		0.00	acres
Runoff Reduction Credit (Step 2)					$(A_C / A_T)*100$ =	0	pts

Table D-2a

Porous Pavement Type	Efficiency Multiplier
Cobblestone Block Pavement	0.40
Pervious Concrete/Asphalt	0.60
Modular Block Pavement &	0.75
Reinforced Grass Pavement	1.00

Table D-2b

Maximum roof size	Minimum travel distance
≤ 3,500 sq ft	21 ft
≤ 5,000 sq ft	24 ft
≤ 7,500 sq ft	28 ft
≤ 10,000 sq ft	32 ft

Form D-2a: Disconnected Pavement Worksheet

See Fact Sheet for more information regarding Disconnected Pavement credit guidelines

Effective Area Managed (A_C)

Pavement Draining to Porous Pavement

2. Enter area draining onto Porous Pavement	0.00	acres	Box K1
3. Enter area of Receiving Porous Pavement (excludes area entered in Step 2 under Porous Pavement)	0.00	acres	Box K2
4. Ratio of Areas (Box K1 / Box K2)	0.00		Box K3

5. Select multiplier using ratio from Box K3 and enter into Box K4

Ratio (Box D)	Multiplier
Ratio is ≤ 0.5	1.00
Ratio is > 0.5 and < 1.0	0.83
Ratio is > 1.0 and < 1.5	0.71
Ratio is > 1.5 and < 2.0	0.55

	1		Box K4
6. Enter Efficiency of Porous Pavement (see table below)			Box K5

Porous Pavement Type	Efficiency Multiplier
Cobblestone Block Pavement	0.40
Pervious Concrete Asphalt Pavement	0.60
Modular Block Pavement Porous Gravel Pavement	0.75
Reinforced Grass Pavement	1.00

7. Multiply Box K2 by Box K5 and enter into Box K6	0.00	acres	Box K6
8. Multiply Boxes K1,K4, and K5 and enter the result in Box K7	0.00	acres	Box K7
9. Add Box K6 to Box K7 and multiply by 60%, and enter the Result in Box K8			0.00 acres

This is the amount of area credit to enter into the "Disconnected Pavement" Box of Form D-2

Form D-2b: Interceptor Tree Worksheet

See Fact Sheet for more information regarding Interceptor Tree credit guidelines

New Evergreen Trees

1. Enter number of new evergreen trees that qualify as Interceptor Trees in Box L1.		trees	Box L1
2. Multiply Box L1 by 200 and enter result in Box L2	0	sq. ft.	Box L2

New Deciduous Trees

3. Enter number of new deciduous trees that qualify as Interceptor Trees in Box L3.		trees	Box L3
4. Multiply Box L3 by 100 and enter result in Box L4	0	sq. ft.	Box L4

Existing Tree Canopy

5. Enter square footage of existing tree canopy that qualifies as Existing Tree canopy in Box L5.	0	sq. ft.	Box L5
6. Multiply Box L5 by 0.5 and enter the result in Box L6	0	sq. ft.	Box L6

Total Interceptor Tree EAM Credits

Add Boxes L2, L4, and L6 and enter it into Box L7	0	sq. ft.	Box L7
Divide Box L7 by 43,560 and multiply by 20% to get effective area managed and enter result in Box L8	0.00	acres	Box L8

This is the amount of area credit to enter into the "Interceptor Trees" Box of Form D-2

Step 3 - Runoff Management Credits

Capture and Use Credits

Impervious Area Managed by Rain barrels, Cisterns, and automatically-emptied systems

(see Fact Sheet) - enter gallons, for simple rain barrels — 0.00 acres

Automated-Control Capture and Use System

(see Fact Sheet, then enter impervious area managed by the system) — 0.00 acres

Bioretention/Infiltration Credits

Impervious Area Managed by Bioretention BMPs

(see Fact Sheet)

Bioretention Area _____ sq ft
Subdrain Elevation _____ inches
Ponding Depth, inches _____ inches — 0.00 acres

Impervious Area Managed by Infiltration BMPs

(see Fact Sheet)

Drawdown Time, hrs _____ drawdown_hrs_inf
Soil Infiltration Rate, in/hr _____ soil_inf_rate

Sizing Option 1: Capture Volume, acre-ft 0.00 capture_vol_inf — 0.00 acres

Sizing Option 2: Infiltration BMP surface area, sq ft 0 soil_surface_area — 0.00 acres

Basin or trench? _____ approximate BMP depth 0.00 ft

Impervious Area Managed by Amended Soil or Mulch Beds

(see Fact Sheet) Mulched Infiltration Area, sq ft _____ mulch_area — 0.00 acres

Total Effective Area Managed by Capture-and-Use/Bioretention/Infiltration BMPs	0.00	A_{LIDc}
Runoff Management Credit (Step 3)	A_{LIDC}/A_T*200 = 0.0	pts

Total LID Credits (Step 1+2+3) Warning: More LID Is Required 13.1

Does project require hydromodification management? If yes, proceed to using SacHM.

Adjusted Area for Flow-Based, Non-LID Treatment	$A_T - A_C - A_{LIDC}$ = 1.33	A_{AT}
Adjusted Impervious Fraction of A for Volume-Based, Non-LID Treatment	A_{AT} / A = 0.87	I_A

Further treatment is required, see choose flow-based or volume-based sizing in Step 4

Step 4a Treatment - Flow-Based (Rational Method)

Calculate treatment flow (cfs): Flow = Runoff Coefficient x Rainfall Intensity x Area

Look up value for i in Table D-2c (Rainfall Intensity)	0.18	i
Obtain A_{AT} from Step 3	1.33	A_{AT}
Use C = 0.95	0.95	C
Flow = 0.95 * i * A_{AT}	0.227	cfs

Table D-2c

Rainfall Intensity			
Roseville	i =	0.20	in/hr
Sacramento	i =	0.18	in/hr
Folsom	i =	0.20	in/hr

Step 4b Treatment - Volume-Based (ASCE-WEF)

Calculate water quality volume (Acre-Feet): WQV = Area x Maximized Detention Volume (P_0)

Obtain A from Step 1	1.53	A	48 hrs	Specified Draw Down time
Obtain P_0: Maximized Detention Volume from figures E-1 to E-4 in Appendix E of this manual using I_A from Step 2.	0.73	P_0		
Calculate treatment volume (acre-ft): **Treatment volume = A x (P_0 / 12)**	0.09	Acre-Feet		

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Appendix D-2: Commercial Sites: Low Impact Development (LID) Credits and Treatment BMP Sizing Calculations

Name of Drainage Shed: Shed G
Location of project: Sacramento

Fill in Blue Highlighted boxes

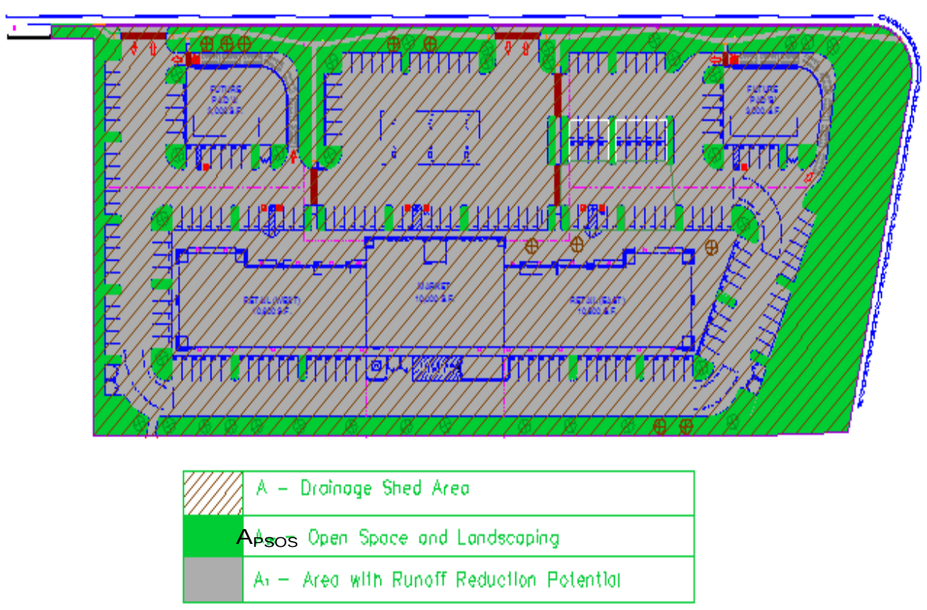
Step 1 - Open Space and Pervious Area Credits

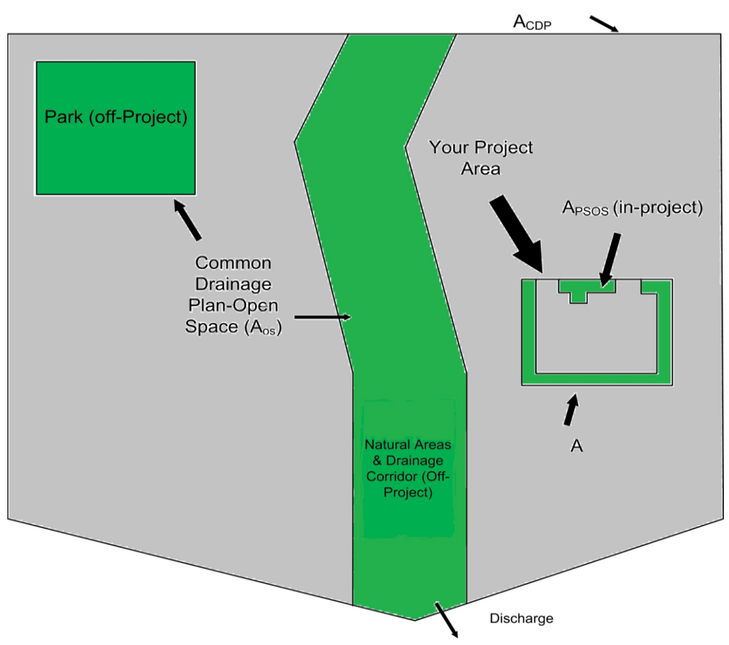
Is your project within the drainage area of a common drainage plan that includes open space? If not, skip to 1 b.

1 a. Common Drainage Plan Area	25	acres	A_{CDP}	
Common Drainage Plan Open Space (Off-project)	0	acres	A_{OS}	**see area example below**
a. Natural storage reservoirs and drainage corridors	0	acres		
b. Buffer zones for natural water bodies	0	acres		
c. Natural areas including existing trees, other vegetation, and soil	0	acres		
d. Common landscape area/park	0	acres		
e. Regional Flood Control/Drainage basins	0	acres		
1 b. Project Drainage Shed Area (Total)	2.53	acres	A	
Project-Specific Open Space (In-project, communal)**	0.63	acres	A_{PSOS}	
a. Natural storage reservoirs and drainage corridors	0.00	acres		
b. Buffer zones for natural water bodies	0.00	acres		
c. Natural areas including existing trees, other vegetation, and soil	0.00	acres		**see area example below**
d. Landscape area/park	0.63	acres		
e. Flood Control/Drainage basins	0.00	acres		

** Doesn't include impervious areas within individual lots and surrounding individual units. That is accounted for below using Form D-1a in Step 2.

Area with Runoff Reduction Potential	$A - A_{PSOS}$ =	1.89	acres	A_T
Assumed Initial Impervious Fraction	A_T / A =	0.75		I
Open Space & Pervious Area LID Credit (Step 1)	$(A_{OS}/A_{CDP}+A_{PSOS}/A)x100$ =	25	pts	





Step 2 - Runoff Reduction Credits

Runoff Reduction Treatments	Impervious Area Managed			Efficiency Factor		Effective Area Managed (A_C)	
Porous Pavement:							
Option 1: Porous Pavement (see Fact Sheet, excludes porous pavement used in Option 2)	0	acres	x		=	0.000	acres
Option 2: Disconnected Pavement (see Fact Sheet, excludes porous pavement used in Option 1)	use Form D-2a for credits →					0.00	acres
Landscaping used to Disconnect Pavement (see Fact Sheet)	0.0000	acres			=	0.00	acres
Disconnected Roof Drains (see Fact Sheet and/or Table D-2b for summary of requirements)	0	acres			=	0.00	acres
Ecoroof (see Fact Sheet)	0	acres			=	0.00	acres
Interceptor Trees (see Fact Sheet)	use Form D-2b for credits →					0.00	acres
Total Effective Area Managed by Runoff Reduction Measures				A_C		0.00	acres
Runoff Reduction Credit (Step 2)					$(A_C / A_T)*100$ =	0	pts

Table D-2a

Porous Pavement Type	Efficiency Multiplier
Cobblestone Block Pavement	0.40
Pervious Concrete/Asphalt	0.60
Modular Block Pavement &	0.75
Reinforced Grass Pavement	1.00

Table D-2b

Maximum roof size	Minimum travel distance
≤ 3,500 sq ft	21 ft
≤ 5,000 sq ft	24 ft
≤ 7,500 sq ft	28 ft
≤ 10,000 sq ft	32 ft

Form D-2a: Disconnected Pavement Worksheet

See Fact Sheet for more information regarding Disconnected Pavement credit guidelines

Effective Area Managed (A_C)

Pavement Draining to Porous Pavement

2. Enter area draining onto Porous Pavement	0.00	acres	Box K1
3. Enter area of Receiving Porous Pavement (excludes area entered in Step 2 under Porous Pavement)	0.00	acres	Box K2
4. Ratio of Areas (Box K1 / Box K2)	0.00		Box K3

5. Select multiplier using ratio from Box K3 and enter into Box K4

Ratio (Box D)	Multiplier
Ratio is ≤ 0.5	1.00
Ratio is > 0.5 and < 1.0	0.83
Ratio is > 1.0 and < 1.5	0.71
Ratio is > 1.5 and < 2.0	0.55

	1		Box K4
6. Enter Efficiency of Porous Pavement (see table below)			Box K5

Porous Pavement Type	Efficiency Multiplier
Cobblestone Block Pavement	0.40
Pervious Concrete Asphalt Pavement	0.60
Modular Block Pavement Porous Gravel Pavement	0.75
Reinforced Grass Pavement	1.00

7. Multiply Box K2 by Box K5 and enter into Box K6	0.00	acres	Box K6
8. Multiply Boxes K1,K4, and K5 and enter the result in Box K7	0.00	acres	Box K7
9. Add Box K6 to Box K7 and multiply by 60%, and enter the Result in Box K8			0.00 acres

This is the amount of area credit to enter into the "Disconnected Pavement" Box of Form D-2

Form D-2b: Interceptor Tree Worksheet

See Fact Sheet for more information regarding Interceptor Tree credit guidelines

New Evergreen Trees

1. Enter number of new evergreen trees that qualify as Interceptor Trees in Box L1.		trees	Box L1
2. Multiply Box L1 by 200 and enter result in Box L2	0	sq. ft.	Box L2

New Deciduous Trees

3. Enter number of new deciduous trees that qualify as Interceptor Trees in Box L3.		trees	Box L3
4. Multiply Box L3 by 100 and enter result in Box L4	0	sq. ft.	Box L4

Existing Tree Canopy

5. Enter square footage of existing tree canopy that qualifies as Existing Tree canopy in Box L5.	0	sq. ft.	Box L5
6. Multiply Box L5 by 0.5 and enter the result in Box L6	0	sq. ft.	Box L6

Total Interceptor Tree EAM Credits

Add Boxes L2, L4, and L6 and enter it into Box L7	0	sq. ft.	Box L7
Divide Box L7 by 43,560 and multiply by 20% to get effective area managed and enter result in Box L8	0.00	acres	Box L8

This is the amount of area credit to enter into the "Interceptor Trees" Box of Form D-2

Step 3 - Runoff Management Credits

Capture and Use Credits

Impervious Area Managed by Rain barrels, Cisterns, and automatically-emptied systems

(see Fact Sheet) - enter gallons, for simple rain barrels — 0.00 acres

Automated-Control Capture and Use System

(see Fact Sheet, then enter impervious area managed by the system) — 0.00 acres

Bioretention/Infiltration Credits

Impervious Area Managed by Bioretention BMPs

(see Fact Sheet)

Bioretention Area ____ sq ft
Subdrain Elevation ____ inches
Ponding Depth, inches ____ inches — 0.00 acres

Impervious Area Managed by Infiltration BMPs

(see Fact Sheet)

Drawdown Time, hrs ____ drawdown_hrs_inf
Soil Infiltration Rate, in/hr ____ soil_inf_rate

Sizing Option 1: Capture Volume, acre-ft 0.00 capture_vol_inf — 0.00 acres

Sizing Option 2: Infiltration BMP surface area, sq ft 0 soil_surface_area — 0.00 acres

Basin or trench? ____ approximate BMP depth 0.00 ft

Impervious Area Managed by Amended Soil or Mulch Beds

(see Fact Sheet) Mulched Infiltration Area, sq ft ____ mulch_area — 0.00 acres

Total Effective Area Managed by Capture-and-Use/Bioretention/Infiltration BMPs	0.00	A_{LIDc}
Runoff Management Credit (Step 3)	A_{LIDC}/A_T*200 = 0.0	pts

Total LID Credits (Step 1+2+3) Warning: More LID Is Required 25.0

Does project require hydromodification management? If yes, proceed to using SacHM.

Adjusted Area for Flow-Based, Non-LID Treatment	$A_T - A_C - A_{LIDC}$ = 1.89	A_{AT}
Adjusted Impervious Fraction of A for Volume-Based, Non-LID Treatment	A_{AT} / A = 0.75	I_A

Further treatment is required, see choose flow-based or volume-based sizing in Step 4

Step 4a Treatment - Flow-Based (Rational Method)

Calculate treatment flow (cfs): Flow = Runoff Coefficient x Rainfall Intensity x Area

Look up value for i in Table D-2c (Rainfall Intensity)	0.18	i
Obtain A_{AT} from Step 3	1.89	A_{AT}
Use C = 0.95	0.95	C
Flow = 0.95 * i * A_{AT}	0.32	cfs

Table D-2c

Rainfall Intensity		
Roseville	i =	0.20 in/hr
Sacramento	i =	0.18 in/hr
Folsom	i =	0.20 in/hr

Step 4b Treatment - Volume-Based (ASCE-WEF)

Calculate water quality volume (Acre-Feet): WQV = Area x Maximized Detention Volume (P_0)

Obtain A from Step 1	2.53	A	48 hrs	Specified Draw Down time
Obtain P_0: Maximized Detention Volume from figures E-1 to E-4 in Appendix E of this manual using I_A from Step 2.	0.59	P_0		
Calculate treatment volume (acre-ft): **Treatment volume = A x (P_0 / 12)**	0.12	Acre-Feet		

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Appendix D-2: Commercial Sites: Low Impact Development (LID) Credits and Treatment BMP Sizing Calculations

Name of Drainage Shed: Overall
Location of project: Sacramento

Fill in Blue Highlighted boxes

Step 1 - Open Space and Pervious Area Credits

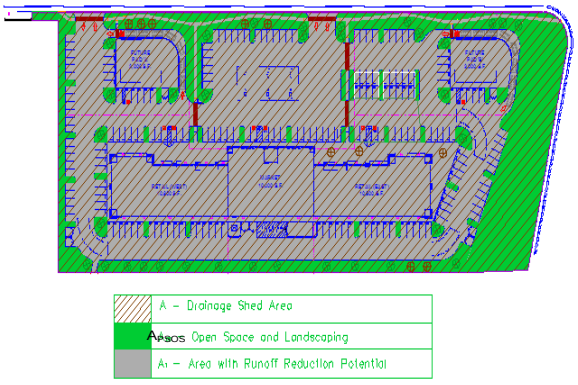
Is your project within the drainage area of a common drainage plan that includes open space? If not, skip to 1 b.

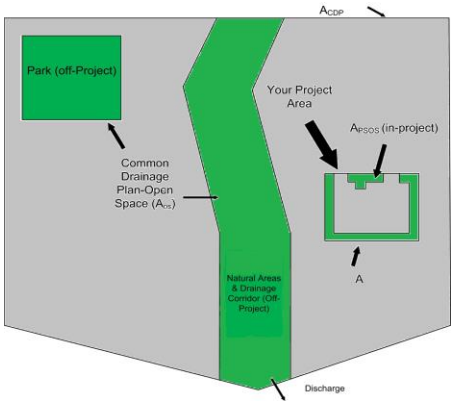
1 a. Common Drainage Plan Area	25	acres	A_{CDP}	
Common Drainage Plan Open Space (Off-project)	0	acres	A_{OS}	**see area example below**
a. Natural storage reservoirs and drainage corridors	0	acres		
b. Buffer zones for natural water bodies	0	acres		
c. Natural areas including existing trees, other vegetation, and soil	0	acres		
d. Common landscape area/park	0	acres		
e. Regional Flood Control/Drainage basins	0	acres		
1 b. Project Drainage Shed Area (Total)	25.14	acres	A	
Project-Specific Open Space (In-project, communal)**	7.20	acres	A_{PSOS}	
a. Natural storage reservoirs and drainage corridors	0.00	acres		
b. Buffer zones for natural water bodies	0.00	acres		
c. Natural areas including existing trees, other vegetation, and soil	0.00	acres		**see area example below**
d. Landscape area/park	7.20	acres		
e. Flood Control/Drainage basins	0.00	acres		

** Doesn't include impervious areas within individual lots and surrounding individual units. That is accounted for below using Form D-1a in Step 2.

Area with Runoff Reduction Potential	$A - A_{PSOS}$ =	17.94	acres	A_T
Assumed Initial Impervious Fraction	A_T / A =	0.71		I

Open Space & Pervious Area LID Credit (Step 1)
$(A_{OS}/A_{CDP}+A_{PSOS}/A)x100$ = 29 pts





Step 2 - Runoff Reduction Credits

Runoff Reduction Treatments	Impervious Area Managed			Efficiency Factor		Effective Area Managed (A_C)	
Porous Pavement:							
Option 1: Porous Pavement (see Fact Sheet, excludes porous pavement used in Option 2)	0	acres	x		=	0.000	acres
Option 2: Disconnected Pavement (see Fact Sheet, excludes porous pavement used in Option 1)	use Form D-2a for credits →					0.00	acres
Landscaping used to Disconnect Pavement (see Fact Sheet)	0	acres			=	0.00	acres
Disconnected Roof Drains (see Fact Sheet and/or Table D-2b for summary of requirements)	0	acres			=	0.00	acres
Ecoroof (see Fact Sheet)	0	acres			=	0.00	acres
Interceptor Trees (see Fact Sheet)	use Form D-2b for credits →					0.10	acres
Total Effective Area Managed by Runoff Reduction Measures				A_C		0.10	acres

Runoff Reduction Credit (Step 2) $(A_C / A_T)*100$ = 1 pts

Table D-2a

Porous Pavement Type	Efficiency Multiplier
Cobblestone Block Pavement	0.40
Pervious Concrete/Asphalt	0.60
Modular Block Pavement &	0.75
Reinforced Grass Pavement	1.00

Table D-2b

Maximum roof size	Minimum travel distance
≤ 3,500 sq ft	21 ft
≤ 5,000 sq ft	24 ft
≤ 7,500 sq ft	28 ft
≤ 10,000 sq ft	32 ft

Form D-2a: Disconnected Pavement Worksheet

See Fact Sheet for more information regarding Disconnected Pavement credit guidelines

Effective Area Managed (A_C)

Pavement Draining to Porous Pavement

2. Enter area draining onto Porous Pavement	0.00	acres	Box K1
3. Enter area of Receiving Porous Pavement (excludes area entered in Step 2 under Porous Pavement)	0.00	acres	Box K2
4. Ratio of Areas (Box K1 / Box K2)	0.00		Box K3

5. Select multiplier using ratio from Box K3 and enter into Box K4

Ratio (Box D)	Multiplier
Ratio is ≤ 0.5	1.00
Ratio is > 0.5 and < 1.0	0.83
Ratio is > 1.0 and < 1.5	0.71
Ratio is > 1.5 and < 2.0	0.55

	1		Box K4
6. Enter Efficiency of Porous Pavement (see table below)			Box K5

Porous Pavement Type	Efficiency Multiplier
Cobblestone Block Pavement	0.40
Pervious Concrete Asphalt Pavement	0.60
Modular Block Pavement Porous Gravel Pavement	0.75
Reinforced Grass Pavement	1.00

7. Multiply Box K2 by Box K5 and enter into Box K6	0.00	acres	Box K6
8. Multiply Boxes K1,K4, and K5 and enter the result in Box K7	0.00	acres	Box K7
9. Add Box K6 to Box K7 and multiply by 60%, and enter the Result in Box K8 This is the amount of area credit to enter into the "Disconnected Pavement" Box of Form D-2			0.00 acres

Form D-2b: Interceptor Tree Worksheet

See Fact Sheet for more information regarding Interceptor Tree credit guidelines

New Evergreen Trees

1. Enter number of new evergreen trees that qualify as Interceptor Trees in Box L1.	57	trees	Box L1
2. Multiply Box L1 by 200 and enter result in Box L2	11400	sq. ft.	Box L2

New Deciduous Trees

3. Enter number of new deciduous trees that qualify as Interceptor Trees in Box L3.	100	trees	Box L3
4. Multiply Box L3 by 100 and enter result in Box L4	10000	sq. ft.	Box L4

Existing Tree Canopy

5. Enter square footage of existing tree canopy that qualifies as Existing Tree canopy in Box L5.	0	sq. ft.	Box L5
6. Multiply Box L5 by 0.5 and enter the result in Box L6	0	sq. ft.	Box L6

Total Interceptor Tree EAM Credits

Add Boxes L2, L4, and L6 and enter it into Box L7	21400	sq. ft.	Box L7
Divide Box L7 by 43,560 and multiply by 20% to get effective area managed and enter result in Box L8 This is the amount of area credit to enter into the "Interceptor Trees" Box of Form D-2	0.10	acres	Box L8

Step 3 - Runoff Management Credits

Capture and Use Credits

Impervious Area Managed by Rain barrels, Cisterns, and automatically-emptied systems

(see Fact Sheet) | - | enter gallons, for simple rain barrels | 0.00 | acres

Automated-Control Capture and Use System

(see Fact Sheet, then enter impervious area managed by the system) | 0.00 | acres

Bioretention/Infiltration Credits

Impervious Area Managed by Bioretention BMPs

(see Fact Sheet)

Bioretention Area | 24,960 | sq ft
Subdrain Elevation | 6 | inches
Ponding Depth, inches | 12 | inches
8.55 acres

Impervious Area Managed by Infiltration BMPs

(see Fact Sheet)

Drawdown Time, hrs | | drawdown_hrs_inf
Soil Infiltration Rate, in/hr | | soil_inf_rate

Sizing Option 1: Capture Volume, acre-ft | 0.00 | capture_vol_inf | 0.00 acres

Sizing Option 2: Infiltration BMP surface area, sq ft | 0 | soil_surface_area | 0.00 acres

Basin or trench? | approximate BMP depth | 0.00 ft

Impervious Area Managed by Amended Soil or Mulch Beds

(see Fact Sheet) Mulched Infiltration Area, sq ft | | mulch_area | 0.00 acres

Total Effective Area Managed by Capture-and-Use/Bioretention/Infiltration BMPs | 8.55 | A_{LIDc}

Runoff Management Credit (Step 3) A_{LIDC}/A_T*200 = | 95.3 | pts

Total LID Credits (Step 1+2+3) LID compliant, check for treatment sizing in Step 4 | 124.5

Does project require hydromodification management? If yes, proceed to using SacHM.

Adjusted Area for Flow-Based, Non-LID Treatment $A_T - A_C - A_{LIDC}$ = | 9.30 | A_{AT}

Adjusted Impervious Fraction of A for Volume-Based, Non-LID Treatment A_{AT} / A = | 0.37 | I_A

Further treatment is required, see choose flow-based or volume-based sizing in Step 4

Step 4a Treatment - Flow-Based (Rational Method)

Calculate treatment flow (cfs): Flow = Runoff Coefficient x Rainfall Intensity x Area

Look up value for i in Table D-2c (Rainfall Intensity) | 0.18 | i

Obtain A_{AT} from Step 3 | 9.30 | A_{AT}

Use C = 0.95 | 0.95 | C

Flow = 0.95 * i * A_{AT} | 1.59 | cfs

Table D-2c

Rainfall Intensity		
Roseville	i =	0.20 in/hr
Sacramento	i =	0.18 in/hr
Folsom	i =	0.20 in/hr

Step 4b Treatment - Volume-Based (ASCE-WEF)

Calculate water quality volume (Acre-Feet): WQV = Area x Maximized Detention Volume (P_0)

Obtain A from Step 1 | 25.14 | A | 48 | hrs | Specified Draw Down time

Obtain P_0: Maximized Detention Volume from figures E-1 to E-4 in Appendix E of this manual using I_A from Step 2. | 0.28 | P_0

Calculate treatment volume (acre-ft):

Treatment volume = A x (P_0 / 12) | 0.58 | Acre-Feet

v06232012

Mike Nowlan

From: Erickson, Neil <NErickson@conteches.com>
Sent: Thursday, April 2, 2020 2:21 PM
To: Mike Nowlan
Subject: Contech: City of Elk Grove Project

Hello Mike,

The following is being provided for preliminary estimating only.

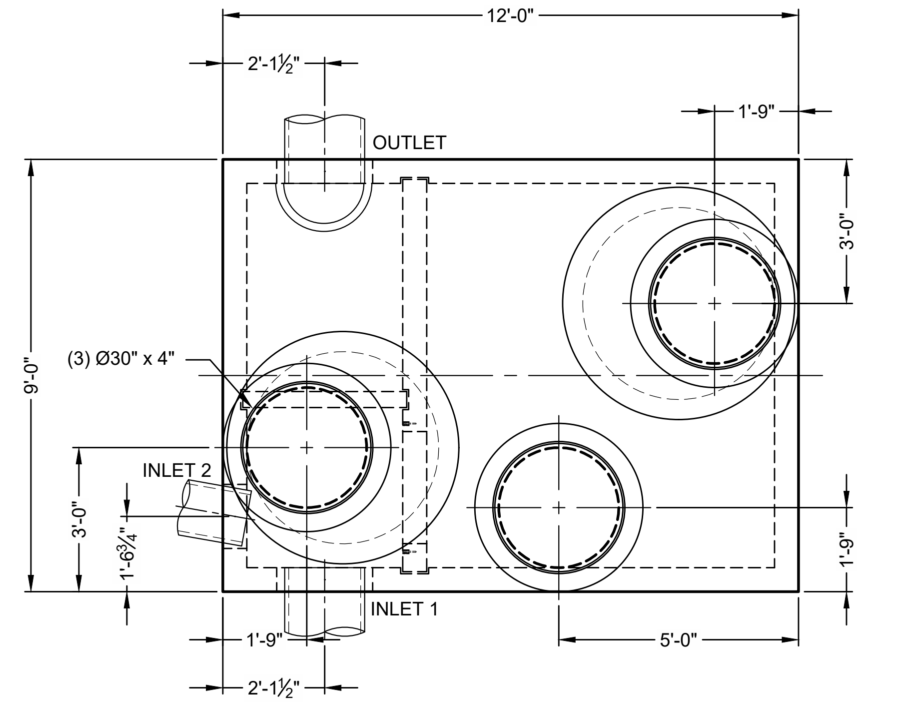
Note:
1. An online and offline option are provided for WQ areas C, D, E and F.
2. An offline option would require an upstream bypass structure.
    a. The smaller bypass flows a 48" manhole should be sufficient.
    b. The larger bypass flows may need a 6'x6' vault for bypass.
3. Minimum finished grade to flow line out heights are provided.
    a. Vaults can be manufactured as deep as needed.
    b. Shallow and custom systems can be designed when needed.

WQ Area	WQF	SacCalc Element	Q10	Q100	Bypass10	Bypass100	StormFilter	Maximum Treatment Flow	Minimum FG to FL Out	Online	Peak In
A	0.76	PR011	15	25	14.2	24.2	8'x11' Peak Diversion	0.902 cfs	5.17'	Y	H.O.W.
B	0.32	JNC001	23	39	22.7	38.7	6'x8' Peak Diversion	0.401 cfs	5.17'	Y	H.O.W.
C	0.02	PR003	1.4	2.5	1.4	2.5	CatchBasin, Deep 18"	0.134 cfs	3.3' - 4.25'	Y	1.8 cfs
C	0.02	PR003	1.4	2.5	1.4	2.5	48" Manhole	0.150 cfs	5.17'	N	Require
D	0.14	PR007	1.9	3.6	1.8	3.5	6'x6' Vault	0.301 cfs	5.17'	Y	1.8 cfs
D	0.14	PR007	1.9	3.6	1.8	3.5	48" Manhole	0.150 cfs	5.17'	N	Require
E	0.13	PR005	2.3	3.8	2.2	3.7	6'x8' Peak Diversion	0.401 cfs	5.17'	Y	H.O.W.
E	0.13	PR005	2.3	3.8	2.2	3.7	48" Manhole	0.150 cfs	5.17'	N	Require
F	0.23	PR001	5.9	9.8	5.7	9.6	6'x8' Peak Diversion	0.401 cfs	5.17'	Y	H.O.W.
F	0.23	PR001	5.9	9.8	5.7	9.6	72" Manhole	0.351 cfs	5.17'	N	Require
1. Peak flow is only limited by the water surface elevation over bypass wier (H.O.W. = height over wier)											

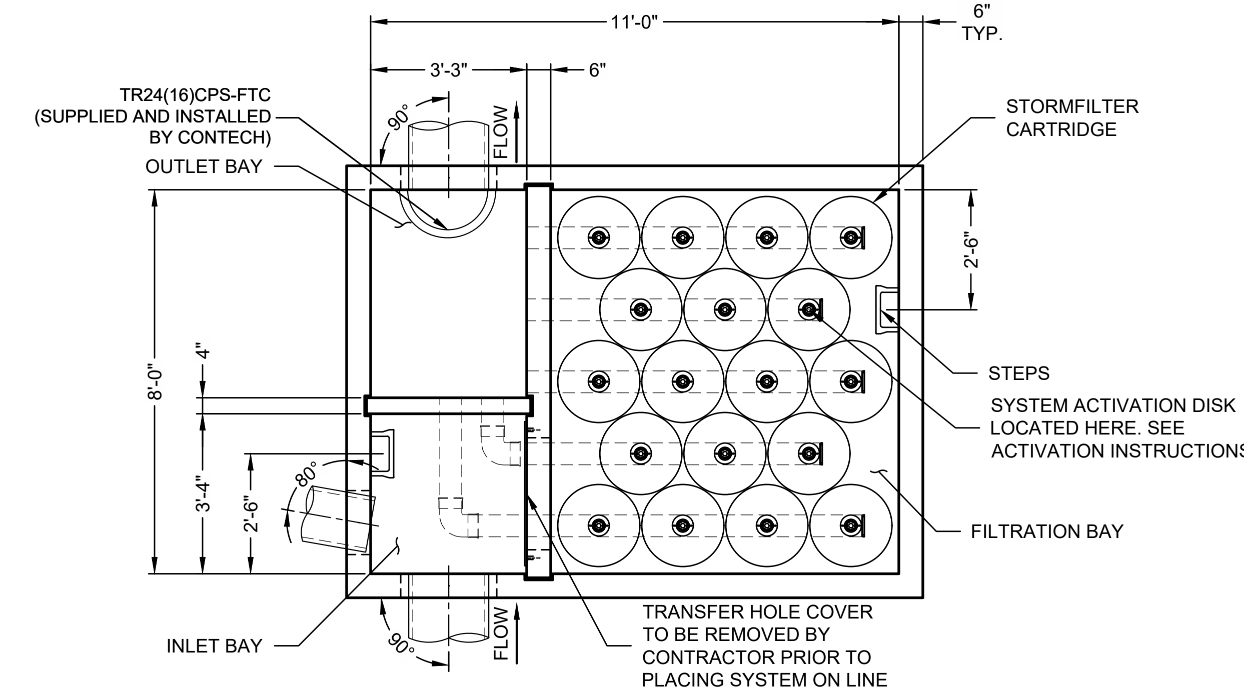
Best regards,

Neil Erickson
Sr. Stormwater Consultant

Contech Engineered Solutions LLC
5 Sierra Gates Plaza, Suite 390 | Roseville, CA 95678
Mob: 916-635-0760
nerickson@conteches.com
www.ContechES.com



PLAN VIEW



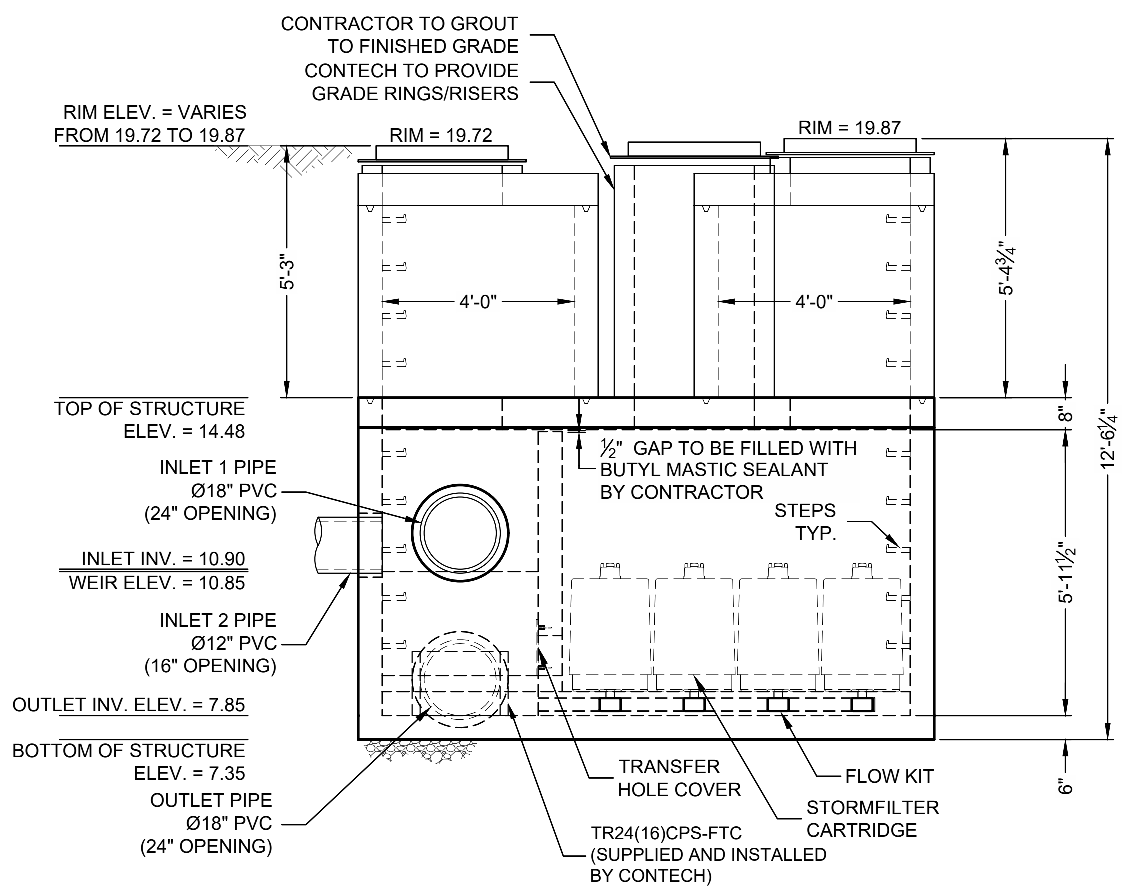
PLAN VIEW (TOP SLAB NOT SHOWN)

MATERIAL LIST - PROVIDED BY CONTECH

COUNT	DESCRIPTION	INSTALLED BY
18	27", ZPG CARTRIDGE	CONTECH
18	RESTRICTOR DISK (GLD), 22.5 GPM	CONTECH
0	2"Ø PVC SLIP PLUG	CONTECH
1	FLOW KIT (80R)	CONTECH
1	36" x 14" TRANSFER HOLE COVER	CONTECH
1	JOINT SEALANT	CONTRACTOR
1	TR24(16)CPS-FTC	CONTECH
3 PLCS	GRADE RINGS/RISERS	CONTRACTOR
3	Ø30" x 4" EJ #001810119A01, OR EQUIVALENT FRAME AND COVER	CONTRACTOR
18	STEPS, P10CTS LANE LADDER, OR EQUIVALENT	CONTECH
1	STORMFILTER ACTIVATION DISK	CONTECH

SITE DESIGN DATA

WATER QUALITY FLOW RATE	0.85 CFS
PEAK FLOW RATE	5.51 CFS
RETURN PERIOD OF PEAK FLOW	10 YRS
FILTER MEDIA TYPE	ZPG



ELEVATION VIEW

PERFORMANCE SPECIFICATION

FILTER CARTRIDGES SHALL BE MEDIA-FILLED, PASSIVE, SIPHON ACTUATED, RADIAL FLOW, AND SELF CLEANING. **RADIAL MEDIA DEPTH SHALL BE 7-INCHES**. FILTER MEDIA CONTACT TIME SHALL BE AT LEAST **38 SECONDS**.
SPECIFIC FLOW RATE SHALL BE **2 GPM/SF (MAXIMUM)**. SPECIFIC FLOW RATE IS THE MEASURE OF THE FLOW (GPM) DIVIDED BY THE MEDIA SURFACE CONTACT AREA (SF). MEDIA VOLUMETRIC FLOW RATE SHALL BE **6 GPM/CF OF MEDIA (MAXIMUM).**

GENERAL NOTES

1. CONTECH TO PROVIDE ALL MATERIALS UNLESS NOTED OTHERWISE.
2. FOR FABRICATION DRAWINGS WITH DETAILED STRUCTURE DIMENSIONS AND WEIGHTS, PLEASE CONTACT YOUR CONTECH ENGINEERED SOLUTIONS LLC REPRESENTATIVE. www.ContechES.com
3. STORMFILTER WATER QUALITY STRUCTURE SHALL BE IN ACCORDANCE WITH ALL DESIGN DATA AND INFORMATION CONTAINED IN THIS DRAWING. CONTRACTOR TO CONFIRM STRUCTURE MEETS REQUIREMENTS OF PROJECT.
4. STRUCTURE SHALL MEET AASHTO HS-20 LOAD RATING, ASSUMING EARTH COVER OF 0' - 6' AND GROUNDWATER ELEVATION AT, OR BELOW, THE OUTLET PIPE INVERT ELEVATION. ENGINEER OF RECORD TO CONFIRM ACTUAL GROUNDWATER ELEVATION. CASTINGS SHALL MEET AASHTO M306 AND BE CAST WITH THE CONTECH LOGO.
5. STORMFILTER STRUCTURE SHALL BE PRECAST CONCRETE CONFORMING WITH ASTM C-857 AND AASHTO LOAD FACTOR DESIGN METHOD.

INSTALLATION NOTES

A. ANY SUB-BASE, BACKFILL DEPTH, AND/OR ANTI-FLOTATION PROVISIONS ARE SITE-SPECIFIC DESIGN CONSIDERATIONS AND SHALL
B. BE SPECIFIED BY ENGINEER OF RECORD.
C. CONTRACTOR TO PROVIDE EQUIPMENT WITH SUFFICIENT LIFTING AND REACH CAPACITY TO LIFT AND SET THE STORMFILTER STRUCTURE.
D. CONTRACTOR TO INSTALL JOINT SEALANT BETWEEN ALL SECTIONS AND ASSEMBLE STRUCTURE.
E. CONTRACTOR TO PROVIDE, INSTALL, AND GROUT PIPES. MATCH OUTLET PIPE INVERT WITH OUTLET BAY FLOOR.
F. CONTRACTOR TO TAKE APPROPRIATE MEASURES TO PROTECT CARTRIDGES FROM CONSTRUCTION-RELATED EROSION RUNOFF.
G. CONTRACTOR TO REMOVE THE TRANSFER HOLE COVER WHEN THE SYSTEM IS BROUGHT ONLINE.

STRUCTURE WEIGHT

APPROXIMATE HEAVIEST PICK = 40,000 LBS OF 2 PIECES
BASE SECTION SHIPPED WITH CARTRIDGES INSTALLED
MAX FOOTPRINT = 9' x 12'

CONTECH
PROPOSAL
DRAWING

PRECN
LAYOUT 6
CLASS 600
5851 / PR80127

MARK	DATE	REVISION DESCRIPTION	BY

STORMFILTER PEAK DIVERSION W/ CPS - SFPD0811

CONTECH ENGINEERED SOLUTIONS LLC
www.ContechES.com
9025 Centre Pointe Dr., Suite 400, West Chester, OH 45069
800-338-1122 513-645-7000 513-645-7993 FAX

The Stormwater Management StormFilter®

DATE: ----	
DESIGNED: ----	DRAWN: ----
CHECKED: ----	APPROVED: ----
PROJECT No.: ----	SEQUENCE No.: ----
SHEET: C1 OF 1	

Revel Environmental Manufacturing Inc.
sales@remfilters.com (888) 526-4736 Lic. No. 857410

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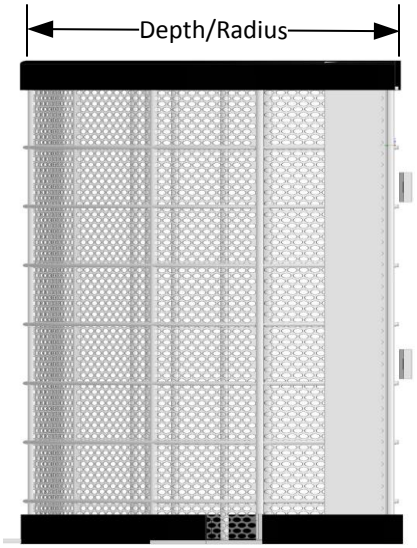
Southern California
2110 South Grand Avenue
Santa Ana, California 92705
P: (714) 557-2676
F: (714) 557-2679

www.remfilters.com

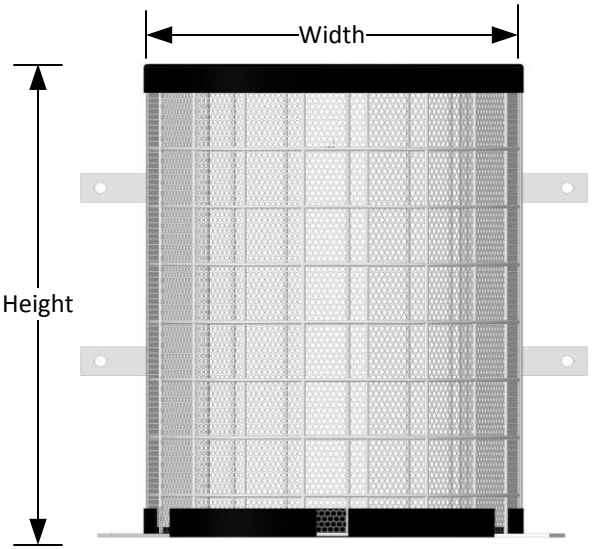
REM TRITON CPS - FTC

Standard size dimensions

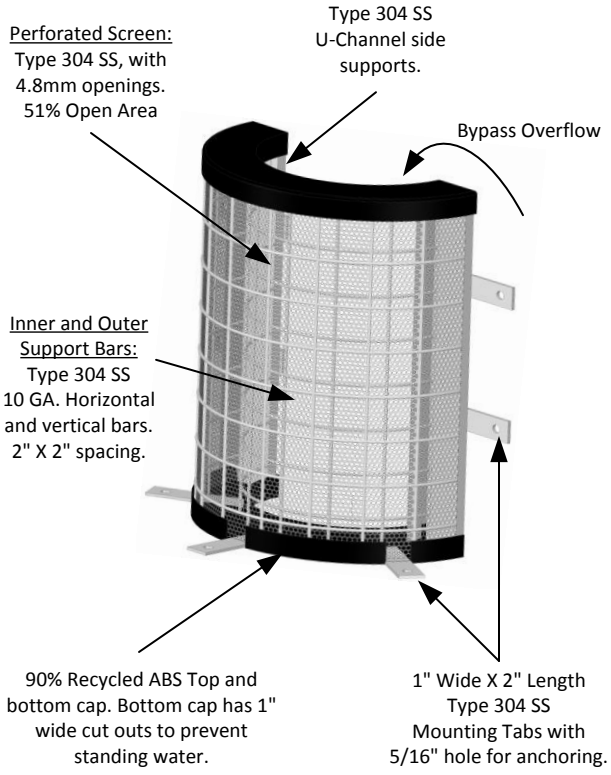
Model:	TR20(12)CPS-FTC	TR24(16)CPS-FTC	TR40(18)CPS-FTC
Width:	20"	24"	40"
Height:	12"	16"	18"
Depth/Radius:	8"	12"	20"
Filtered Flow Rate:	*5.56 (CFS)*	*9.89 (CFS)*	*18.54 (CFS)*
Bypass Radius:	*6"*	*10"*	*18"*
Bypass Flow:	*19.24 (CFS)*	*25.65 (CFS)*	*42.55 (CFS)*



Side View



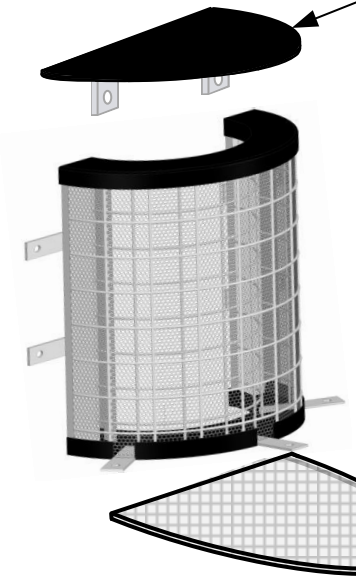
Front View



***APPROVED** Full Trash Capture Device through the California State Water Resource Control Board

Notes:

- **Units are constructed using a 10 GA. Stainless Steel inner and outer housing support for added structural integrity.**
- **Perforated Stainless Steel is configured with a 51% Open Area for excellent flow rates comparative to its size.**
- **CPS Stainless Steel housing and additional attached SS parts are welded.**
- **Custom sizes and configurations are available.**
- **Multiple units can be mounted vertically to increase capture capacity.**
- **CPS unit is capable of housing an absorbent media if ever required, with no retrofitting or modifications needed.**
- **CPS unit can also be elevated off the basin floor in "Sump" type basins.**
- **MADE IN THE USA.**



Optional Deflector Plate
Simply anchor above CPS unit at the desired height.

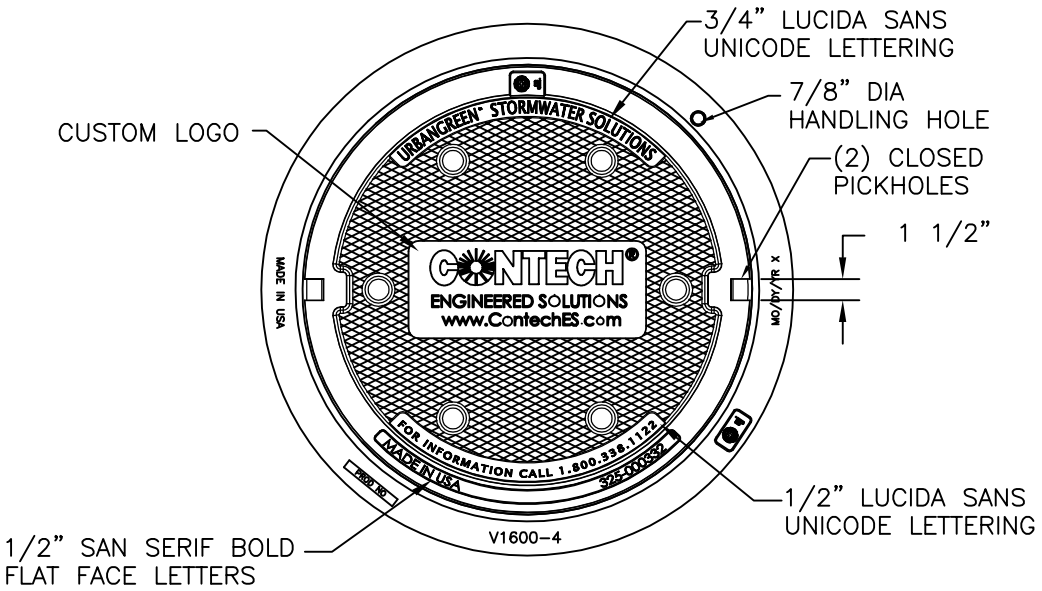
Deflector plate can be configured using a Type 304 SS perforated sheet or .5" thick HDPE

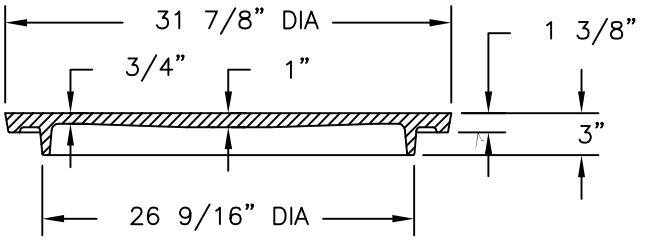
Optional Contour Apron
Simply attach to the bottom of CPS unit with (3) bolts, before installation.

Contour Apron is configured using a Type 304 SS perforated sheet with 4.8mm openings.

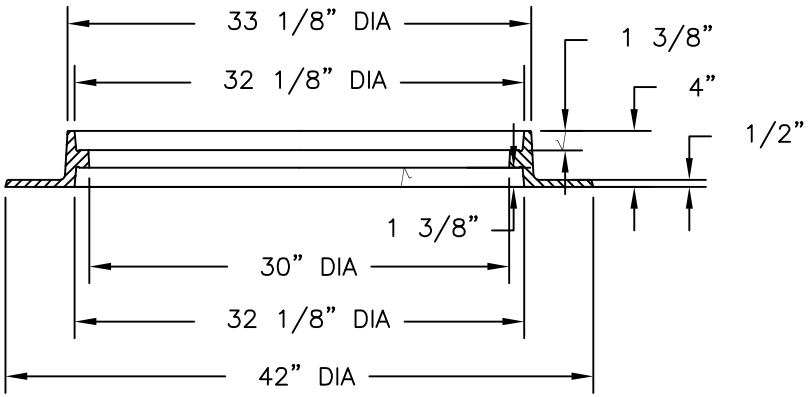
**Anchor to floor where needed.*

V1600-4 1810A4 Assembly Solid, Sediment Tight





COVER SECTION



FRAME SECTION

Product Number

001810119A01

Design Features

-Materials
Cover
Gray Iron (CL35B)
Frame
Gray Iron (CL35B)

-Design Load
Heavy Duty
-Open Area
n/a
-Coating
Undipped
-√Designates Machined Surface

Certification

- ASTM A48
-
-
-Country of Origin: USA

Major Components

001810119
41600419

Drawing Revision

2/1/2016 Designer: MAH
7/14/2016 Revised By: SBO

Disclaimer

Weights (lbs./kg) dimensions (inches/mm) and drawings provided for your guidance. We reserve the right to modify specifications without prior notice.

Contact

800 626 4653
ejco.com