

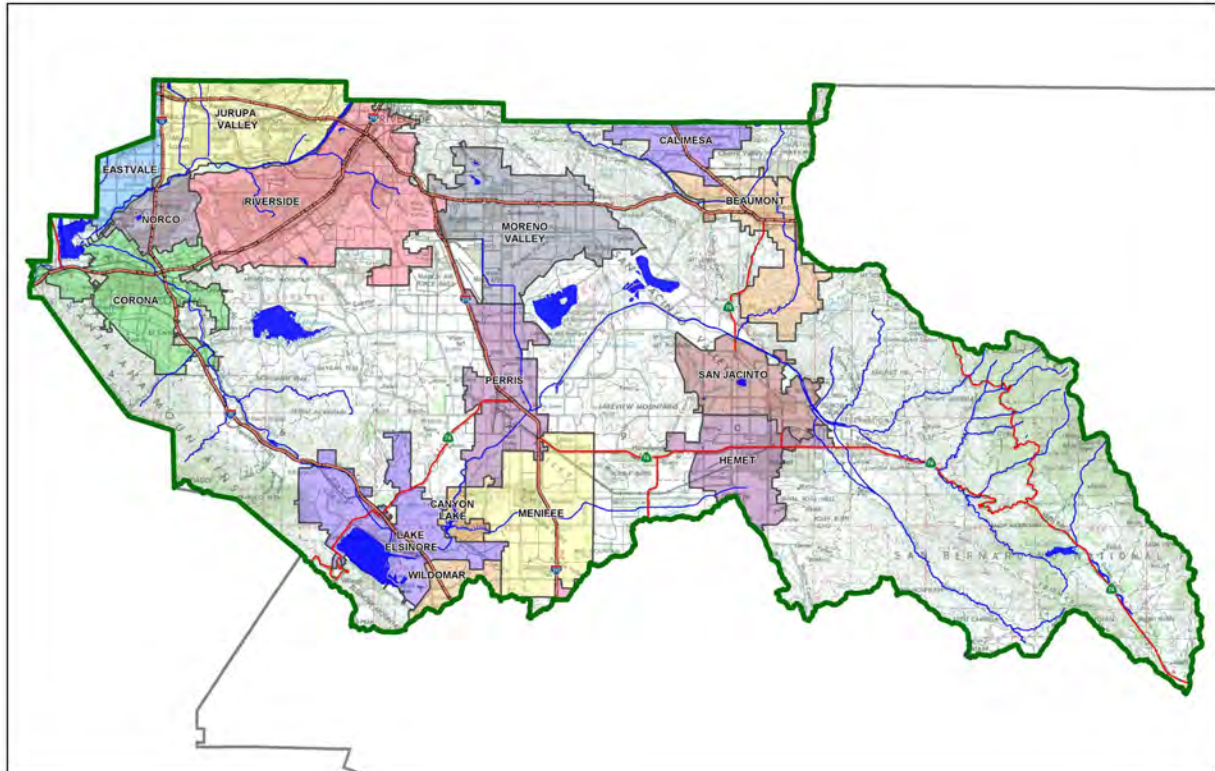
Project Specific Water Quality Management Plan

A Template for Projects located within the **Santa Ana Watershed** Region of Riverside County

Project Title: Skyline Heights

Development No: TTM 36544

Design Review/Case No: DPR 13-002, TTM 36544



Contact Information:

Prepared for:

Richland Developers, Inc.
3161 Michelson Drive, Suite 425
Irvine, CA 92612
Mike Byer
(949) 261-7010

Prepared by:

KWC Engineers
1880 Compton Ave., Suite 100
Corona, CA 92881
Mike Taing, P.E.
(951) 734-2130 x235

☒ Preliminary
☐ Final

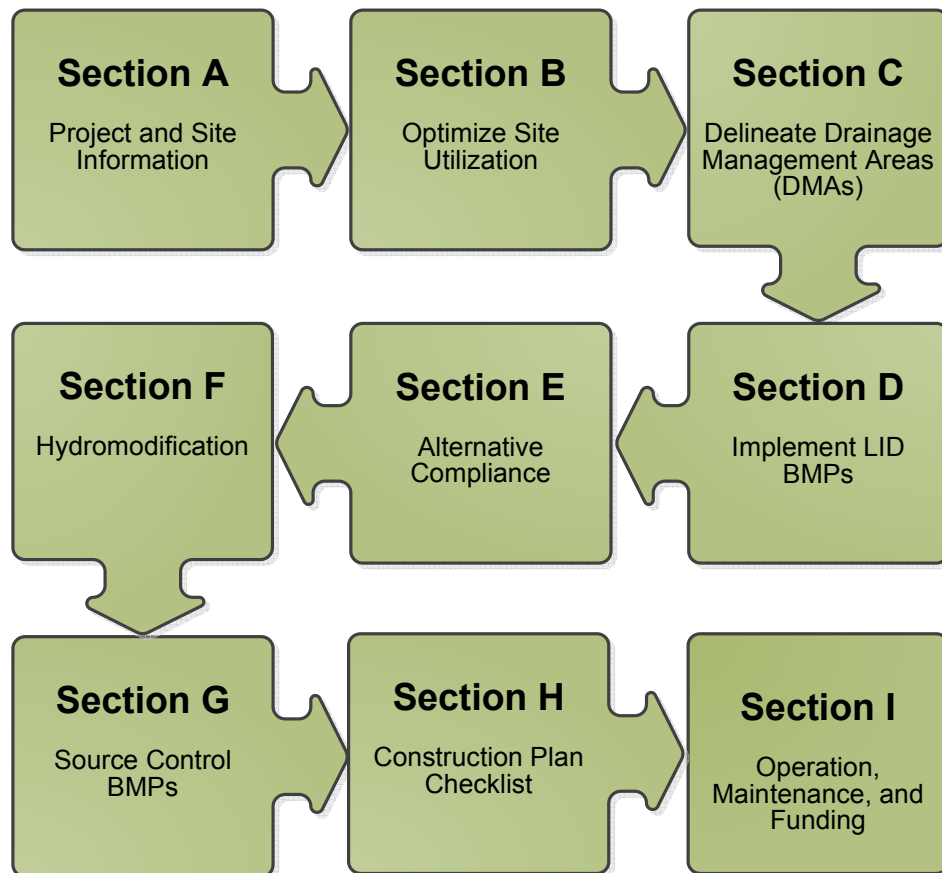
Original Date Prepared: 05-06-2013

Revision Date(s): 01-10-2014

*Prepared for Compliance with
Regional Board Order No. **R8-2010-0033***

A Brief Introduction

This Project-Specific WQMP Template for the **Santa Ana Region** has been prepared to help guide you in documenting compliance for your project. Because this document has been designed to specifically document compliance, you will need to utilize the WQMP Guidance Document as your “how-to” manual to help guide you through this process. Both the Template and Guidance Document go hand-in-hand, and will help facilitate a well prepared Project-Specific WQMP. Below is a flowchart for the layout of this Template that will provide the steps required to document compliance.



OWNER'S CERTIFICATION

This Project-Specific Water Quality Management Plan (WQMP) has been prepared for Richland Communities, Inc. by KWC Engineers for the Skyline Heights project.

This WQMP is intended to comply with the requirements of City of Corona for Storm Water Quality Ordinance (Corona Municipal Code Section 15.36, Title 13 Chapter 13.27 and City Council Ordinance No. 2291 and 2828) which includes the requirement for the preparation and implementation of a Project-Specific WQMP.

The undersigned, while owning the property/project described in the preceding paragraph, shall be responsible for the implementation and funding of this WQMP and will ensure that this WQMP is amended as appropriate to reflect up-to-date conditions on the site. In addition, the property owner accepts responsibility for interim operation and maintenance of Stormwater BMPs until such time as this responsibility is formally transferred to a subsequent owner. This WQMP will be reviewed with the facility operator, facility supervisors, employees, tenants, maintenance and service contractors, or any other party (or parties) having responsibility for implementing portions of this WQMP. At least one copy of this WQMP will be maintained at the project site or project office in perpetuity. The undersigned is authorized to certify and to approve implementation of this WQMP. The undersigned is aware that implementation of this WQMP is enforceable under City of Corona Water Quality Ordinance (Corona Municipal Code Section 15.36, Title 13 Chapter 13.27 and City Council Ordinance No. 2291 and 2828).

"I, the undersigned, certify under penalty of law that the provisions of this WQMP have been reviewed and accepted and that the WQMP will be transferred to future successors in interest."


Owner's Signature

5/6/13
Date

Mike Byer
Owner's Printed Name

Mike Byer
Owner's Title/Position

PREPARER'S CERTIFICATION

"The selection, sizing and design of stormwater treatment and other stormwater quality and quantity control measures in this plan meet the requirements of Regional Water Quality Control Board Order No. R8-2010-0033 and any subsequent amendments thereto."


Preparer's Signature

5/6/13
Date

Mike C. Taing
Preparer's Printed Name

Sr. Project Engineer
Preparer's Title/Position

Preparer's Licensure:



Table of Contents

Section A: Project and Site Information.....	6
A.1 Maps and Site Plans.....	7
A.2 Identify Receiving Waters.....	7
A.3 Additional Permits/Approvals required for the Project:	8
Section B: Optimize Site Utilization (LID Principles)	9
Section C: Delineate Drainage Management Areas (DMAs).....	11
Section D: Implement LID BMPs	13
D.1 Infiltration Applicability	13
D.2 Harvest and Use Assessment.....	14
D.3 Bioretention and Biotreatment Assessment	16
D.4 Feasibility Assessment Summaries	17
D.5 LID BMP Sizing	18
Section E: Alternative Compliance (LID Waiver Program)	19
E.1 Identify Pollutants of Concern	20
E.2 Stormwater Credits	21
E.3 Sizing Criteria.....	21
E.4 Treatment Control BMP Selection	22
Section F: Hydromodification	23
F.1 Hydrologic Conditions of Concern (HCOC) Analysis.....	23
F.2 HCOC Mitigation.....	24
Section G: Source Control BMPs	25
Section H: Construction Plan Checklist	27
Section I: Operation, Maintenance and Funding.....	28

List of Tables

Table A.1 Identification of Receiving Waters.....	8
Table A.2 Other Applicable Permits.....	8
Table C.1 DMA Classifications.....	11
Table C.2 Type 'A', Self-Treating Areas.....	11
Table C.3 Type 'B', Self-Retaining Areas.....	12
Table C.4 Type 'C', Areas that Drain to Self-Retaining Areas.....	12
Table C.5 Type 'D', Areas Draining to BMPs.....	12
Table D.1 Infiltration Feasibility.....	13
Table D.2 LID Prioritization Summary Matrix.....	17
Table D.3 DCV Calculations for LID BMPs.....	18
Table E.1 Potential Pollutants by Land Use Type.....	20
Table E.2 Water Quality Credits.....	21
Table E.3 Treatment Control BMP Sizing.....	21
Table E.4 Treatment Control BMP Selection.....	22
Table F.1 Hydrologic Conditions of Concern Summary.....	23
Table G.1 Permanent and Operational Source Control Measures.....	25
Table H.1 Construction Plan Cross-reference.....	27

List of Appendices

Appendix 1: Maps and Site Plans.....	29
Appendix 2: Construction Plans.....	30
Appendix 3: Soils Information.....	31
Appendix 4: Historical Site Conditions.....	32
Appendix 5: LID Infeasibility.....	33
Appendix 6: BMP Design Details.....	34
Appendix 7: Hydromodification.....	35
Appendix 8: Source Control.....	36
Appendix 9: O&M.....	37
Appendix 10: Educational Materials.....	- 6 -

Section A: Project and Site Information

PROJECT INFORMATION	
Type of Project:	Single Family Residential (R1-7.2)
Planning Area:	Temescal Canyon Area Plan
Community Name:	City of Corona
Development Name:	Skyline Heights
PROJECT LOCATION	
Latitude & Longitude (DMS): 33°50'44"N, 117°36'26"W	
Project Watershed and Sub-Watershed: Santa Ana River Reach 3, Temescal Creek, Mabey Canyon, Kroonen Channel, and Oak Street Channel.	
APN(s): 275-040-012, 275-040-015, 275-050-004, 275-080-010, 275-070-003, 275-040-006, and 275-040-011	
Map Book and Page No.: N/A	
PROJECT CHARACTERISTICS	
Proposed or Potential Land Use(s)	Single Family Residential
Proposed or Potential SIC Code(s)	N/A
Area of Impervious Project Footprint (SF)	1,741,356 sf
Total Area of <u>proposed</u> Impervious Surfaces within the Project Limits (SF)/or Replacement	1,741,356 sf
Does the project consist of offsite road improvements?	☒ Y ☐ N
Does the project propose to construct unpaved roads?	☐ Y ☒ N
Is the project part of a larger common plan of development (phased project)?	☐ Y ☒ N
EXISTING SITE CHARACTERISTICS	
Total area of <u>existing</u> Impervious Surfaces within the project limits (SF)	0 sf
Is the project located within any MSHCP Criteria Cell?	☐ Y ☒ N
If so, identify the Cell number:	Insert text here.
Are there any natural hydrologic features on the project site?	☒ Y ☐ N
Is a Geotechnical Report attached?	☒ Y ☐ N
If no Geotech. Report, list the NRCS soils type(s) present on the site (A, B, C and/or D)	Insert text here.
What is the Water Quality Design Storm Depth for the project?	0.95
Project Description: The Skyline heights project is comprised of 270.9 acres of vacant land situated in the hills to the southwest of the City of Corona in Western Riverside County, California adjacent to Foothill Parkway. The project area includes the area (a pproximately 17.16 acres) to be acquired for the construction of the future Foothill Parkway westerly extension and Mabey Canyon Debris basin. The site is located approximately 3 miles south of the 71 and 91 Freeways and approximately 4 miles west of Interstate 15 (I-15). Figure 1 in Appendix 1 shows a location map of the general area. The site is within the City of ACorona's Sphere of Influence and is proposed to be annexed to the City during the entitlement process. The City of Corona is currently processing the Capital Improvement Project for the Fotthill Parkway Westerly Extension between Green River Road and Trudy Way. Construction is planned to be completed in the next few years. Foothill Parkway will border the eastern portion of the project and will be the primary access to the site. The Skyline Heights project is generally bounded to the north and east by single-family	

residences and on the south and west by the Cleveland National Forest and large privately owned parcels. Within the general boundaries of the project is an undeveloped 10.0 acre parcel which is considered “Not a Part” and is owned by the U.S. Forest Service. Adjacent to the southeast portion of the project site is a single-family residential community which is currently graded and under construction (Tract Map 31955). The immediate surrounding area consists of Low Density Residential (2-6 du/ac) as well as undeveloped open space within the City of Corona. Skyline Drive, a graded forest service access road, is located just to the south of the project. This road provides recreational hiking and mountain biking opportunities to residents on a local and regional level.

The project site consists of sparsely vegetated and otherwise undeveloped land with the exception of dirt roads. The site is characterized by steep topography, generally increasing in elevation from the northeast to the southwest. Several canyons and ravines are present which will convey natural drainage across the project site.

As proposed by the Skyline Heights project, the site consists of 292 single family residential lots with 7,200 sf minimum lots within the proposed low density residential land use designation. The project site is comprised of approximately 270.9 acres of undeveloped vacant land. However, of the 270.9 acres, approximately 17.16 acres will be acquired by the RCTC/City of Corona for the construction of the Westerly Extension of Foothill parkway and Mabey Canyon Debris Basin. It is proposed that approximately 170.9 acres will be graded based on the conceptual grading plan. Figure 2 in Appendix 1 shows a vicinity map of the area illustrating the location of the project and the developments in the area.

A.1 Maps and Site Plans

When completing your Project-Specific WQMP, include a map of the local vicinity and existing site. In addition, include all grading, drainage, landscape/plant palette and other pertinent construction plans in Appendix 2. At a **minimum**, your WQMP Site Plan should include the following:

- Drainage Management Areas
- Proposed Structural BMPs
- Drainage Path
- Drainage Infrastructure, Inlets, Overflows
- Source Control BMPs
- Buildings, Roof Lines, Downspouts
- Impervious Surfaces
- Standard Labeling

Use your discretion on whether or not you may need to create multiple sheets or can appropriately accommodate these features on one or two sheets. Keep in mind that the Co-Permittee plan reviewer must be able to easily analyze your project utilizing this template and its associated site plans and maps.

A.2 Identify Receiving Waters

Using Table A.1 below, list in order of upstream to downstream, the receiving waters that the project site is tributary to. Continue to fill each row with the Receiving Water’s 303(d) listed impairments (if any), designated beneficial uses, and proximity, if any, to a RARE beneficial use. Include a map of the receiving waters in Appendix 1.

Table A.1 Identification of Receiving Waters

Receiving Waters	EPA Approved 303(d) List Impairments	Designated Beneficial Uses	Proximity to RARE Beneficial Use
Temescal Creek Reach 1	pH	REC 1, REC 2, WARM, WILD	-
Santa Ana River Reach 3	Bacteria & Viruses (Pathogens), Copper (wet season) and Lead	AGR, GWR, REC 1, REC 2, WARM, WILD, RARE	-

A.3 Additional Permits/Approvals required for the Project:

Table A.2 Other Applicable Permits

Agency	Permit Required	
State Department of Fish and Game, 1602 Streambed Alteration Agreement	☒ Y	☐ N
State Water Resources Control Board, Clean Water Act (CWA) Section 401 Water Quality Cert.	☒ Y	☐ N
US Army Corps of Engineers, CWA Section 404 Permit	☒ Y	☐ N
US Fish and Wildlife, Endangered Species Act Section 7 Biological Opinion	☒ Y	☐ N
Statewide Construction General Permit Coverage	☒ Y	☐ N
Statewide Industrial General Permit Coverage	☐ Y	☒ N
Western Riverside MSHCP Consistency Approval (e.g., JPR, DBESP)	☐ Y	☒ N
Other (please list in the space below as required) City of Corona Grading, Improvement, and Building Permits.	☒ Y	☐ N

If yes is answered to any of the questions above, the Co-Permittee may require proof of approval/coverage from those agencies as applicable including documentation of any associated requirements that may affect this Project-Specific WQMP.

Section B: Optimize Site Utilization (LID Principles)

Review of the information collected in Section 'A' will aid in identifying the principal constraints on site design and selection of LID BMPs as well as opportunities to reduce imperviousness and incorporate LID Principles into the site and landscape design. For example, **constraints** might include impermeable soils, high groundwater, groundwater pollution or contaminated soils, steep slopes, geotechnical instability, high-intensity land use, heavy pedestrian or vehicular traffic, utility locations or safety concerns. **Opportunities** might include existing natural areas, low areas, oddly configured or otherwise unbuildable parcels, easements and landscape amenities including open space and buffers (which can double as locations for bioretention BMPs), and differences in elevation (which can provide hydraulic head). Prepare a brief narrative for each of the site optimization strategies described below. This narrative will help you as you proceed with your LID design and explain your design decisions to others.

The 2010 Santa Ana MS4 Permit further requires that LID Retention BMPs (Infiltration Only or Harvest and Use) be used unless it can be shown that those BMPs are infeasible. Therefore, it is important that your narrative identify and justify if there are any constraints that would prevent the use of those categories of LID BMPs. Similarly, you should also note opportunities that exist which will be utilized during project design. Upon completion of identifying Constraints and Opportunities, include these on your WQMP Site plan in Appendix 1.

Site Optimization

The following questions are based upon Section 3.2 of the WQMP Guidance Document. Review of the WQMP Guidance Document will help you determine how best to optimize your site and subsequently identify opportunities and/or constraints, and document compliance.

Did you identify and preserve existing drainage patterns? If so, how? If not, why?

The existing drainage pattern of the site were identified and preserved. In the existing condition the site drains easterly across the site along several valleys and stream channels. There are two major drainage channels that bisect the site, Mabey Canyon on the north and Kroonen Channel to the south. The existing and proposed drainage patterns are identified on the WQMP Site Plan (as well as identified in the project Preliminary Hydrology Report). Using a system of flow-by basins, detention basin, and storm drain piping, offsite flow will by-pass the site and will not be co-mingled with development runoff which needs to be treated at the proposed designated BMP treatment areas.

Did you identify and protect existing vegetation? If so, how? If not, why?

The project site borders the Cleveland National Forest. The site consists of sparsely vegetated and otherwise undeveloped land with the exception of dirt roads. The site is characterized by steep topography, generally increasing in elevation from the northeast to the southwest. Several canyons and ravines are present which will convey natural drainage across the project site. As a result, portions of the property are left as open space undisturbed areas. The natural open space areas comprises of approximately 100.0 acres. The existing vegetation and drainage patterns will be protected and are identified in the WQMP Site Plan.

Did you identify and preserve natural infiltration capacity? If so, how? If not, why?

As proposed by the development, the site will be subject to fill of up to 140 feet in some of the canyon bottoms and cuts of up to 155 feet along some of the ridgelines. The site consists of alluvium and colluvium deposits, artificial fill, and Silverado and Ladd formations. The large depths of proposed fill

material expected within the site may reduce the infiltration capabilities of the soil. The infiltration rate after the grading of the site cannot be determined at this time. Infiltration tests may be conducted prior to grading to determine the percolation rate of the soil and its suitability for infiltration type BMPs.

Did you identify and minimize impervious area? If so, how? If not, why?

The impervious area has been minimized in relation to the size of the site and the relative density of the development. The site design proposes public roadways, residential lots, landscaped slopes, and natural open space. The proposed roadway widths are designed to meet City of Corona Standards.

Did you identify and disperse runoff to adjacent pervious areas? If so, how? If not, why?

Yes, roof runoff has been designed to drain into pervious landscape areas with each residential lot prior to discharge onto streets or connection to proposed on-site storm drain systems. The 2-yr storm runoff from development will be collected and conveyed to proposed WQMP treatment areas for treatment prior to discharge or connection to proposed on-site storm drain system.

Section C: Delineate Drainage Management Areas (DMAs)

Utilizing the procedure in Section 3.3 of the WQMP Guidance Document which discusses the methods of delineating and mapping your project site into individual DMAs, complete Table C.1 below to appropriately categorize the types of classification (e.g., Type A, Type B, etc.) per DMA for your project site. Upon completion of this table, this information will then be used to populate and tabulate the corresponding tables for their respective DMA classifications.

Table C.1 DMA Classifications

DMA Name or ID	Surface Type(s) ¹	Area (Sq. Ft.)	DMA Type
DMA Basin A	Roofs, concrete/asphalt, landscaping	105,750 sf	Type D
DMA Basin B	Roofs, concrete/asphalt, landscaping	152,882 sf	Type D
DMA Basin C	Roofs, concrete/asphalt, landscaping	680,801 sf	Type D
DMA Basin D1	Roofs, concrete/asphalt, landscaping	312,746 sf	Type D
DMA Basin D2	Roofs, concrete/asphalt, landscaping	115,269 sf	Type D
DMA Basin D3	Roofs, concrete/asphalt, landscaping	39,896 sf	Type D
DMA Basin E	Roofs, concrete/asphalt, landscaping	334,009 sf	Type D

¹Reference Table 2-1 in the WQMP Guidance Document to populate this column

Table C.2 Type 'A', Self-Treating Areas

DMA Name or ID	Area (Sq. Ft.)	Stabilization Type	Irrigation Type (if any)
Natural Open Space	4,357,800	Existing	N/A

Table C.3 Type 'B', Self-Retaining Areas

Self-Retaining Area				Type 'C' DMAs that are draining to the Self-Retaining Area		
DMA Name/ ID	Post-project surface type	Area (square feet) [A]	Storm Depth (inches) [B]	DMA Name / ID	[C] from Table C.4 = [C]	Required Retention Depth (inches) [D]

$$[D] = [B] + \frac{[B] \cdot [C]}{[A]}$$

Table C.4 Type 'C', Areas that Drain to Self-Retaining Areas

DMA					Receiving Self-Retaining DMA		
DMA Name/ ID	Area (square feet)	Post-project surface type	Runoff factor	Product	DMA name /ID	Area (square feet)	Ratio
	[A]		[B]	[C] = [A] x [B]		[D]	[C]/[D]

Table C.5 Type 'D', Areas Draining to BMPs

DMA Name or ID	BMP Name or ID
DMA Basin A	Extended Detention Basin
DMA Basin B	Extended Detention Basin
DMA Basin C	Extended Detention Basin
DMA Basin D1	Extended Detention Basin
DMA Basin D2	Extended Detention Basin
DMA Basin D3	Extended Detention Basin
DMA Basin E	Extended Detention Basin

Note: More than one drainage management area can drain to a single LID BMP, however, one drainage management area may not drain to more than one BMP.

Section D: Implement LID BMPs

D.1 Infiltration Applicability

Is there an approved downstream 'Highest and Best Use' for stormwater runoff (see discussion in Chapter 2.4.4 of the WQMP Guidance Document for further details)? ☐ Y ☒ N

If yes has been checked, Infiltration BMPs shall not be used for the site. If no, continue working through this section to implement your LID BMPs. It is recommended that you contact your Co-Permittee to verify whether or not your project discharges to an approved downstream 'Highest and Best Use' feature.

Geotechnical Report

A Geotechnical Report or Phase I Environmental Site Assessment may be required by the Copermittee to confirm present and past site characteristics that may affect the use of Infiltration BMPs. In addition, the Co-Permittee, at their discretion, may not require a geotechnical report for small projects as described in Chapter 2 of the WQMP Guidance Document. If a geotechnical report has been prepared, include it in Appendix 3. In addition, if a Phase I Environmental Site Assessment has been prepared, include it in Appendix 4.

Is this project classified as a small project consistent with the requirements of Chapter 2 of the WQMP Guidance Document? ☐ Y ☒ N

Infiltration Feasibility

Table D.1 below is meant to provide a simple means of assessing which DMAs on your site support Infiltration BMPs and is discussed in the WQMP Guidance Document in Chapter 2.4.5. Check the appropriate box for each question and then list affected DMAs as applicable. If additional space is needed, add a row below the corresponding answer.

Table D.1 Infiltration Feasibility

Does the project site...	YES	NO
...have any DMAs with a seasonal high groundwater mark shallower than 10 feet?		X
If Yes, list affected DMAs:		
...have any DMAs located within 100 feet of a water supply well?		X
If Yes, list affected DMAs:		
...have any areas identified by the geotechnical report as posing a public safety risk where infiltration of stormwater could have a negative impact?		X
If Yes, list affected DMAs:		
...have measured in-situ infiltration rates of less than 1.6 inches / hour?		X
If Yes, list affected DMAs:		
...have significant cut and/or fill conditions that would preclude in-situ testing of infiltration rates at the final infiltration surface?		X
If Yes, list affected DMAs:		
...geotechnical report identify other site-specific factors that would preclude effective and safe infiltration?	X	
Describe here: Underlying soil material is bedrock does not infiltrate very well. A geotechnical report will be attached to Appendix 3 of the Preliminary Project Specific WQMP Report for reference.		

If you answered "Yes" to any of the questions above for any DMA, Infiltration BMPs should not be used for those DMAs and you should proceed to the assessment for Harvest and Use below.

D.2 Harvest and Use Assessment

Please check what applies:

- ☒ Reclaimed water will be used for the non-potable water demands for the project.
- ☐ Downstream water rights may be impacted by Harvest and Use as approved by the Regional Board (verify with the Copermitttee).
- ☐ The Design Capture Volume will be addressed using Infiltration Only BMPs. In such a case, Harvest and Use BMPs are still encouraged, but it would not be required if the Design Capture Volume will be infiltrated or evapotranspired.

If any of the above boxes have been checked, Harvest and Use BMPs need not be assessed for the site. If neither of the above criteria applies, follow the steps below to assess the feasibility of irrigation use, toilet use and other non-potable uses (e.g., industrial use).

Irrigation Use Feasibility

Complete the following steps to determine the feasibility of harvesting stormwater runoff for Irrigation Use BMPs on your site:

Step 1: Identify the total area of irrigated landscape on the site, and the type of landscaping used.

Total Area of Irrigated Landscape:

Type of Landscaping (Conservation Design or Active Turf):

Step 2: Identify the planned total of all impervious areas on the proposed project from which runoff might be feasibly captured and stored for irrigation use. Depending on the configuration of buildings and other impervious areas on the site, you may consider the site as a whole, or parts of the site, to evaluate reasonable scenarios for capturing and storing runoff and directing the stored runoff to the potential use(s) identified in Step 1 above.

Total Area of Impervious Surfaces:

Step 3: Cross reference the Design Storm depth for the project site (see Exhibit A of the WQMP Guidance Document) with the left column of Table 2-3 in Chapter 2 to determine the minimum area of Effective Irrigated Area per Tributary Impervious Area (EIATIA).

Enter your EIATIA factor:

Step 4: Multiply the unit value obtained from Step 3 by the total of impervious areas from Step 2 to develop the minimum irrigated area that would be required.

Minimum required irrigated area:

Step 5: Determine if harvesting stormwater runoff for irrigation use is feasible for the project by comparing the total area of irrigated landscape (Step 1) to the minimum required irrigated area (Step 4).

Minimum required irrigated area (Step 4)	Available Irrigated Landscape (Step 1)

Toilet Use Feasibility

Complete the following steps to determine the feasibility of harvesting stormwater runoff for toilet flushing uses on your site:

- Step 1: Identify the projected total number of daily toilet users during the wet season, and account for any periodic shut downs or other lapses in occupancy:

Projected Number of Daily Toilet Users:

Project Type:

- Step 2: Identify the planned total of all impervious areas on the proposed project from which runoff might be feasibly captured and stored for toilet use. Depending on the configuration of buildings and other impervious areas on the site, you may consider the site as a whole, or parts of the site, to evaluate reasonable scenarios for capturing and storing runoff and directing the stored runoff to the potential use(s) identified in Step 1 above.

Total Area of Impervious Surfaces:

- Step 3: Enter the Design Storm depth for the project site (see Exhibit A) into the left column of Table 2-1 in Chapter 2 to determine the minimum number of toilet users per tributary impervious acre (TUTIA).

Enter your TUTIA factor:

- Step 4: Multiply the unit value obtained from Step 3 by the total of impervious areas from Step 2 to develop the minimum number of toilet users that would be required.

Minimum number of toilet users:

- Step 5: Determine if harvesting stormwater runoff for toilet flushing use is feasible for the project by comparing the Number of Daily Toilet Users (Step 1) to the minimum required number of toilet users (Step 4).

<u>Minimum required Toilet Users (Step 4)</u>	<u>Projected number of toilet users (Step 1)</u>

Other Non-Potable Use Feasibility

Are there other non-potable uses for stormwater runoff on the site (e.g. industrial use)? See Chapter 2 of the Guidance for further information. If yes, describe below. If no, write N/A.

N/A

- Step 1: Identify the projected average daily non-potable demand, in gallons per day, during the wet season and accounting for any periodic shut downs or other lapses in occupancy or operation.

Average Daily Demand:

- Step 2: Identify the planned total of all impervious areas on the proposed project from which runoff might be feasibly captured and stored for the identified non-potable use. Depending on the configuration of buildings and other impervious areas on the site, you may consider the site as a whole, or parts of the site, to evaluate reasonable scenarios for capturing and storing runoff and directing the stored runoff to the potential use(s) identified in Step 1 above.

Total Area of Impervious Surfaces:

Step 3: Enter the Design Storm depth for the project site (see Exhibit A) into the left column of Table 2-3 in Chapter 2 to determine the minimum demand for non-potable uses per tributary impervious acre.

Enter the factor from Table 2-3:

Step 4: Multiply the unit value obtained from Step 4 by the total of impervious areas from Step 3 to develop the minimum number of gallons per day of non-potable use that would be required.

Minimum required use:

Step 5: Determine if harvesting stormwater runoff for other non-potable use is feasible for the project by comparing the Number of Daily Toilet Users (Step 1) to the minimum required number of toilet users (Step 4).

Minimum required non-potable use (Step 4)	Projected average daily use (Step 1)

If Irrigation, Toilet and Other Use feasibility anticipated demands are less than the applicable minimum values, Harvest and Use BMPs are not required and you should proceed to utilize LID Bioretention and Biotreatment, unless a site-specific analysis has been completed that demonstrates technical infeasibility as noted in D.3 below.

D.3 Bioretention and Biotreatment Assessment

Other LID Bioretention and Biotreatment BMPs as described in Chapter 2.4.7 of the WQMP Guidance Document are feasible on nearly all development sites with sufficient advance planning.

Select one of the following:

- ☒ LID Bioretention/Biotreatment BMPs will be used for some or all DMAs of the project as noted below in Section D.4 (note the requirements of Section 3.4.2 in the WQMP Guidance Document).
- ☐ A site-specific analysis demonstrating the technical infeasibility of all LID BMPs has been performed and is included in Appendix 5. If you plan to submit an analysis demonstrating the technical infeasibility of LID BMPs, request a pre-submittal meeting with the Copermittee to discuss this option. Proceed to Section E to document your alternative compliance measures.

D.4 Feasibility Assessment Summaries

From the Infiltration, Harvest and Use, Bioretention and Biotreatment Sections above, complete Table D.2 below to summarize which LID BMPs are technically feasible, and which are not, based upon the established hierarchy.

Table D.2 LID Prioritization Summary Matrix

DMA Name/ID	LID BMP Hierarchy				No LID (Alternative Compliance)
	1. Infiltration	2. Harvest and use	3. Bioretention	4. Biotreatment	
DMA Basin A	☐	☐	☐	☒	☐
DMA Basin B	☐	☐	☐	☒	☐
DMA Basin C	☐	☐	☐	☒	☐
DMA Basin D1	☐	☐	☐	☒	☐
DMA Basin D2	☐	☐	☐	☒	☐
DMA Basin D3	☐	☐	☐	☒	☐
DMA Basin D3	☐	☐	☐	☒	☐

For those DMAs where LID BMPs are not feasible, provide a brief narrative below summarizing why they are not feasible, include your technical infeasibility criteria in Appendix 5, and proceed to Section E below to document Alternative Compliance measures for those DMAs. Recall that each proposed DMA must pass through the LID BMP hierarchy before alternative compliance measures may be considered.

No alternative compliance measures were studied or used for this project.

D.5 LID BMP Sizing

Each LID BMP must be designed to ensure that the Design Capture Volume will be addressed by the selected BMPs. First, calculate the Design Capture Volume for each LID BMP using the V_{BMP} worksheet in Appendix F of the LID BMP Design Handbook. Second, design the LID BMP to meet the required V_{BMP} using a method approved by the Copermittee. Utilize the worksheets found in the LID BMP Design Handbook or consult with your Copermittee to assist you in correctly sizing your LID BMPs. Complete Table D.3 below to document the Design Capture Volume and the Proposed Volume for each LID BMP. Provide the completed design procedure sheets for each LID BMP in Appendix 6. You may add additional rows to the table below as needed.

Refer to Appendix 6 for DCV calculations sheets corresponding to the proposed LID BMPs. All proposed BMPs are designed to handle and treat the minimum design capture volumes as identified on the DCV calculations.

Table D.3 DCV Calculations for LID BMPs

DMA Type/ID	DMA Area (square feet)	Post-Project Surface Type	Effective Impervious Fraction, I_f	DMA Runoff Factor	DMA Areas x Runoff Factor	Enter BMP Name / Identifier Here		
	[A]		[B]	[C]	[A] x [C]			
						Design Storm Depth (in)	Design Capture Volume, V_{BMP} (cubic feet)	Proposed Volume on Plans (cubic feet)
	$A_T = \Sigma[A]$				$\Sigma = [D]$	[E]	$[F] = \frac{[D] \times [E]}{12}$	[G]

[B], [C] is obtained as described in Section 2.3.1 of the WQMP Guidance Document

[E] is obtained from Exhibit A in the WQMP Guidance Document

[G] is obtained from a design procedure sheet, such as in LID BMP Design Handbook and placed in Appendix 6

Section E: Alternative Compliance (LID Waiver Program)

LID BMPs are expected to be feasible on virtually all projects. Where LID BMPs have been demonstrated to be infeasible as documented in Section D, other Treatment Control BMPs must be used (subject to LID waiver approval by the Copermittee). Check one of the following Boxes:

- ☒ LID Principles and LID BMPs have been incorporated into the site design to fully address all Drainage Management Areas. No alternative compliance measures are required for this project and thus this Section is not required to be completed.

- Or -

- ☒ The following Drainage Management Areas are unable to be addressed using LID BMPs. A site-specific analysis demonstrating technical infeasibility of LID BMPs has been approved by the Co-Permittee and included in Appendix 5. Additionally, no downstream regional and/or sub-regional LID BMPs exist or are available for use by the project. The following alternative compliance measures on the following pages are being implemented to ensure that any pollutant loads expected to be discharged by not incorporating LID BMPs, are fully mitigated.

E.1 Identify Pollutants of Concern

Utilizing Table A.1 from Section A above which noted your project's receiving waters and their associated EPA approved 303(d) listed impairments, cross reference this information with that of your selected Priority Development Project Category in Table E.1 below. If the identified General Pollutant Categories are the same as those listed for your receiving waters, then these will be your Pollutants of Concern and the appropriate box or boxes will be checked on the last row. The purpose of this is to document compliance and to help you appropriately plan for mitigating your Pollutants of Concern in lieu of implementing LID BMPs.

Table E.1 Potential Pollutants by Land Use Type

Priority Development Project Categories and/or Project Features (check those that apply)	General Pollutant Categories							
	Bacterial Indicators	Metals	Nutrients	Pesticides	Toxic Organic Compounds	Sediments	Trash & Debris	Oil & Grease
☒ Detached Residential Development	P	N	P	P	N	P	P	P
☐ Attached Residential Development	P	N	P	P	N	P	P	P ⁽²⁾
☐ Commercial/Industrial Development	P ⁽³⁾	P	P ⁽¹⁾	P ⁽¹⁾	P ⁽⁵⁾	P ⁽¹⁾	P	P
☐ Automotive Repair Shops	N	P	N	N	P ^(4, 5)	N	P	P
☐ Restaurants (>5,000 ft ²)	P	N	N	N	N	N	P	P
☒ Hillside Development (>5,000 ft ²)	P	N	P	P	N	P	P	P
☒ Parking Lots (>5,000 ft ²)	P ⁽⁶⁾	P	P ⁽¹⁾	P ⁽¹⁾	P ⁽⁴⁾	P ⁽¹⁾	P	P
☐ Retail Gasoline Outlets	N	P	N	N	P	N	P	P
Project Priority Pollutant(s) of Concern	☒	☒	☐	☐	☐	☐	☐	☐

P = Potential

N = Not Potential

⁽¹⁾ A potential Pollutant if non-native landscaping exists or is proposed onsite; otherwise not expected

⁽²⁾ A potential Pollutant if the project includes uncovered parking areas; otherwise not expected

⁽³⁾ A potential Pollutant is land use involving animal waste

⁽⁴⁾ Specifically petroleum hydrocarbons

⁽⁵⁾ Specifically solvents

⁽⁶⁾ Bacterial indicators are routinely detected in pavement runoff

E.2 Stormwater Credits

Projects that cannot implement LID BMPs but nevertheless implement smart growth principles are potentially eligible for Stormwater Credits. Utilize Table 3-8 within the WQMP Guidance Document to identify your Project Category and its associated Water Quality Credit. If not applicable, write N/A.

Table E.2 Water Quality Credits

Qualifying Project Categories	Credit Percentage ²
N/A	
<i>Total Credit Percentage¹</i>	

¹ Cannot Exceed 50%

²Obtain corresponding data from Table 3-8 in the WQMP Guidance Document

E.3 Sizing Criteria

After you appropriately considered Stormwater Credits for your project, utilize Table E.3 below to appropriately size them to the DCV, or Design Flow Rate, as applicable. Please reference Chapter 3.5.2 of the WQMP Guidance Document for further information.

Table E.3 Treatment Control BMP Sizing

DMA Type/ID	DMA Area (square feet)	Post-Project Surface Type	Effective Impervious Fraction, I _f	DMA Runoff Factor	DMA Area x Runoff Factor	Enter BMP Name / Identifier Here			
	[A]		[B]	[C]	[A] x [C]				
N/A						Design Storm Depth (in)	Minimum Design Capture Volume or Design Flow Rate (cubic feet or cfs)	Total Storm Water Credit % Reduction	Proposed Volume or Flow on Plans (cubic feet or cfs)
	A _T = Σ[A]				Σ= [D]	[E]	[F] = $\frac{[D] \times [E]}{[G]}$	[F] X (1-[H])	[I]

[B], [C] is obtained as described in Section 2.3.1 from the WQMP Guidance Document

[E] is obtained from Exhibit A in the WQMP Guidance Document

[G] is for Flow-Based Treatment Control BMPs [G] = 43,560, for Volume-Based Control Treatment BMPs, [G] = 12

[H] is from the Total Credit Percentage as Calculated from Table E.2 above

[I] as obtained from a design procedure sheet from the BMP manufacturer and should be included in Appendix 6

E.4 Treatment Control BMP Selection

Treatment Control BMPs typically provide proprietary treatment mechanisms to treat potential pollutants in runoff, but do not sustain significant biological processes. Treatment Control BMPs must have a removal efficiency of a medium or high effectiveness as quantified below:

- **High:** equal to or greater than 80% removal efficiency
- **Medium:** between 40% and 80% removal efficiency

Such removal efficiency documentation (e.g., studies, reports, etc.) as further discussed in Chapter 3.5.2 of the WQMP Guidance Document, must be included in Appendix 6. In addition, ensure that proposed Treatment Control BMPs are properly identified on the WQMP Site Plan in Appendix 1.

Table E.4 Treatment Control BMP Selection

Selected Treatment Control BMP Name or ID ¹	Priority Pollutant(s) of Concern to Mitigate ²	Removal Efficiency Percentage ³
DMA Basin A (extended det. basin)	Bacteria, Metals	Medium
DMA Basin B (extended det. basin)	Bacteria, Metals	Medium
DMA Basin C (extended det. basin)	Bacteria, Metals	Medium
DMA Basin D1 (extended det. basin)	Bacteria, Metals	Medium
DMA Basin D2 (extended det. basin)	Bacteria, Metals	Medium
DMA Basin D3 (extended det. basin)	Bacteria, Metals	Medium
DMA Basin E (extended det. basin)	Bacteria, Metals	Medium

¹ Treatment Control BMPs must not be constructed within Receiving Waters. In addition, a proposed Treatment Control BMP may be listed more than once if they possess more than one qualifying pollutant removal efficiency.

² Cross Reference Table E.1 above to populate this column.

³ As documented in a Co-Permittee Approved Study and provided in Appendix 6.

Section F: Hydromodification

F.1 Hydrologic Conditions of Concern (HCOC) Analysis

Once you have determined that the LID design is adequate to address water quality requirements, you will need to assess if the proposed LID Design may still create a HCOC. Review Chapters 2 and 3 (including Figure 3-7) of the WQMP Guidance Document to determine if your project must mitigate for Hydromodification impacts. If your project meets one of the following criteria which will be indicated by the check boxes below, you do not need to address Hydromodification at this time. However, if the project does not qualify for Exemptions 1, 2 or 3, then additional measures must be added to the design to comply with HCOC criteria. This is discussed in further detail below in Section F.2.

HCOC EXEMPTION 1: The Priority Development Project disturbs less than one acre. The Copermittee has the discretion to require a Project-Specific WQMP to address HCOCs on projects less than one acre on a case by case basis. The disturbed area calculation should include all disturbances associated with larger common plans of development.

Does the project qualify for this HCOC Exemption? ☐ Y ☒ N

If Yes, HCOC criteria do not apply.

HCOC EXEMPTION 2: The volume and time of concentration¹ of storm water runoff for the post-development condition is not significantly different from the pre-development condition for a 2-year return frequency storm (a difference of 5% or less is considered insignificant) using one of the following methods to calculate:

- Riverside County Hydrology Manual
- Technical Release 55 (TR-55): Urban Hydrology for Small Watersheds (NRCS 1986), or derivatives thereof, such as the Santa Barbara Urban Hydrograph Method
- Other methods acceptable to the Co-Permittee

Does the project qualify for this HCOC Exemption? ☐ Y ☒ N

If Yes, report results in Table F.1 below and provide your substantiated hydrologic analysis in Appendix 7.

Table F.1 Hydrologic Conditions of Concern Summary

	2 year – 24 hour		
	Pre-condition	Post-condition	% Difference
Time of Concentration			
Volume (Cubic Feet)			

¹ Time of concentration is defined as the time after the beginning of the rainfall when all portions of the drainage basin are contributing to flow at the outlet.

HCOC EXEMPTION 3: All downstream conveyance channels to an adequate sump (for example, Prado Dam, Lake Elsinore, Canyon Lake, Santa Ana River, or other lake, reservoir or naturally erosion resistant feature) that will receive runoff from the project are engineered and regularly maintained to ensure design flow capacity; no sensitive stream habitat areas will be adversely affected; or are not identified on the Co-Permittees Hydromodification Sensitivity Maps.

Does the project qualify for this HCOC Exemption? ☒ Y ☐ N

If Yes, HCOC criteria do not apply and note below which adequate sump applies to this HCOC qualifier:

The runoff from the proposed project site (WQMP Areas A, B, C, and E) discharges directly to City/County maintained MS4 Storm Drain System and the Mabey Canyon Debris Basin which drains to the Santa Ana River Reach 3. These facilities have been identified by Riverside County Flood Control and Water Conservation District to be within a watershed not susceptible to HCOC according to the HCOC Applicability Map. This map is included in Appendix 7.

However, the runoff from proposed WQMP drainage area D1, D2, and D3 does not fall into HCOC Exemption 3 criteria and is required to mitigate the HCOC. The project site is proposing a series of privately maintained Detention Basins within the project site to mitigate not only the HCOC requirements but also the increased runoff mitigation requirements for the site. For WQMP Area D1, D2, and D3, the project hydrology report will show that the HCOC runoff and velocity is mitigated for this drainage area with the proposed onsite Detention Basins located upstream of the discharge point. The project hydrology report and Detention Basin sizing calculations is referenced and made part of this document, however, due to the complexity of the analysis only sections of the analysis is included in Appendix 7 of this report.

F.2 HCOC Mitigation

If none of the above HCOC Exemption Criteria are applicable, HCOC criteria is considered mitigated if they meet one of the following conditions:

- a. Additional LID BMPs are implemented onsite or offsite to mitigate potential erosion or habitat impacts as a result of HCOCs. This can be conducted by an evaluation of site-specific conditions utilizing accepted professional methodologies published by entities such as the California Stormwater Quality Association (CASQA), the Southern California Coastal Water Research Project (SCCRWP), or other Co-Permittee approved methodologies for site-specific HCOC analysis.
- b. The project is developed consistent with an approved Watershed Action Plan that addresses HCOC in Receiving Waters.
- c. Mimicking the pre-development hydrograph with the post-development hydrograph, for a 2-year return frequency storm. Generally, the hydrologic conditions of concern are not significant, if the post-development hydrograph is no more than 10% greater than pre-development hydrograph. In cases where excess volume cannot be infiltrated or captured and reused, discharge from the site must be limited to a flow rate no greater than 110% of the pre-development 2-year peak flow.

Be sure to include all pertinent documentation used in your analysis of the items a, b or c in Appendix 7.

Section G: Source Control BMPs

Source control BMPs include permanent, structural features that may be required in your project plans — such as roofs over and berms around trash and recycling areas — and Operational BMPs, such as regular sweeping and “housekeeping”, that must be implemented by the site’s occupant or user. The MEP standard typically requires both types of BMPs. In general, Operational BMPs cannot be substituted for a feasible and effective permanent BMP. Using the Pollutant Sources/Source Control Checklist in Appendix 8, review the following procedure to specify Source Control BMPs for your site:

1. **Identify Pollutant Sources:** Review Column 1 in the Pollutant Sources/Source Control Checklist. Check off the potential sources of Pollutants that apply to your site.
2. **Note Locations on Project-Specific WQMP Exhibit:** Note the corresponding requirements listed in Column 2 of the Pollutant Sources/Source Control Checklist. Show the location of each Pollutant source and each permanent Source Control BMP in your Project-Specific WQMP Exhibit located in Appendix 1.
3. **Prepare a Table and Narrative:** Check off the corresponding requirements listed in Column 3 in the Pollutant Sources/Source Control Checklist. In the left column of Table G.1 below, list each potential source of runoff Pollutants on your site (from those that you checked in the Pollutant Sources/Source Control Checklist). In the middle column, list the corresponding permanent, Structural Source Control BMPs (from Columns 2 and 3 of the Pollutant Sources/Source Control Checklist) used to prevent Pollutants from entering runoff. **Add additional narrative** in this column that explains any special features, materials or methods of construction that will be used to implement these permanent, Structural Source Control BMPs.
4. **Identify Operational Source Control BMPs:** To complete your table, refer once again to the Pollutant Sources/Source Control Checklist. List in the right column of your table the Operational BMPs that should be implemented as long as the anticipated activities continue at the site. Copermittee stormwater ordinances require that applicable Source Control BMPs be implemented; the same BMPs may also be required as a condition of a use permit or other revocable Discretionary Approval for use of the site.

Table G.1 Permanent and Operational Source Control Measures

Potential Sources of Runoff pollutants	Permanent Structural Source Control BMPs	Operational Source Control BMPs
On-site Storm Drain Inlets	Mark all inlets with the words “Only Rain Down the Storm Drain” or similar. Catch Basin Markers shall be per local agency requirements	- Maintain and periodically repaint or replace inlet markings. - Provide Stormwater pollution prevention informations to new site owners, lessees, or operators. - See applicable operational BMPs in Fact Sheet SC-44, “Drainage System Maintenance,” in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com

		• Include the following in lease agreements: "Tenant shall not allow anyone to discharge anything to storm drains or to store or deposit materials so as to create a potential discharge to storm drains."
Landscape/ Outdoor Pesticide Use	Final landscape plans will accomplish all of the following: • Preserve existing native trees, shrubs, and ground cover to the maximum extent possible. • Design landscaping to minimize irrigation and runoff, to promote surface infiltration where appropriate, and to minimize the use of fertilizers and pesticides that can contribute to stormwater pollution. • Where landscaped areas are used to retain or detain stormwater, specify plants that are tolerant of saturated soil conditions. • Consider using pest-resistant plants, especially adjacent to hardscape. • To insure successful establishment, select plants appropriate to site soils, slopes, climate, sun, wind, rain, land use, air movement, ecological consistency, and plant interactions.	• Maintain landscaping using minimum or no pesticides. • See applicable operational BMPs in "What you should know for.....landscape and Gardening" at http://rcflood.org/stormwater/ • Provide IPM information to new owners, lessees and operators.

Section H: Construction Plan Checklist

Populate Table H.1 below to assist the plan checker in an expeditious review of your project. The first two columns will contain information that was prepared in previous steps, while the last column will be populated with the corresponding plan sheets. This table is to be completed with the submittal of your final Project-Specific WQMP.

Table H.1 Construction Plan Cross-reference

BMP No. or ID	BMP Identifier and Description	Corresponding Plan Sheet(s)
DMA Basin A	Extended Detention Basin	
DMA Basin B	Extended Detention Basin	
DMA Basin C	Extended Detention Basin	
DMA Basin D1	Extended Detention Basin	
DMA Basin D2	Extended Detention Basin	
DMA Basin D3	Extended Detention Basin	
DMA Basin E	Extended Detention Basin	

Note that the updated table — or Construction Plan WQMP Checklist — is **only a reference tool** to facilitate an easy comparison of the construction plans to your Project-Specific WQMP. Co-Permittee staff can advise you regarding the process required to propose changes to the approved Project-Specific WQMP.

Section I: Operation, Maintenance and Funding

The Copermittee will periodically verify that Stormwater BMPs on your site are maintained and continue to operate as designed. To make this possible, your Copermittee will require that you include in Appendix 9 of this Project-Specific WQMP:

1. A means to finance and implement facility maintenance in perpetuity, including replacement cost.
2. Acceptance of responsibility for maintenance from the time the BMPs are constructed until responsibility for operation and maintenance is legally transferred. A warranty covering a period following construction may also be required.
3. An outline of general maintenance requirements for the Stormwater BMPs you have selected.
4. Figures delineating and designating pervious and impervious areas, location, and type of Stormwater BMP, and tables of pervious and impervious areas served by each facility. Geo-locating the BMPs using a coordinate system of latitude and longitude is recommended to help facilitate a future statewide database system.
5. A separate list and location of self-retaining areas or areas addressed by LID Principles that do not require specialized O&M or inspections but will require typical landscape maintenance as noted in Chapter 5, pages 85-86, in the WQMP Guidance. Include a brief description of typical landscape maintenance for these areas.

Your local Co-Permittee will also require that you prepare and submit a detailed Stormwater BMP Operation and Maintenance Plan that sets forth a maintenance schedule for each of the Stormwater BMPs built on your site. An agreement assigning responsibility for maintenance and providing for inspections and certification may also be required.

Details of these requirements and instructions for preparing a Stormwater BMP Operation and Maintenance Plan are in Chapter 5 of the WQMP Guidance Document.

Maintenance Mechanism: Privately maintained and funded by development HOA, approved CC&Rs

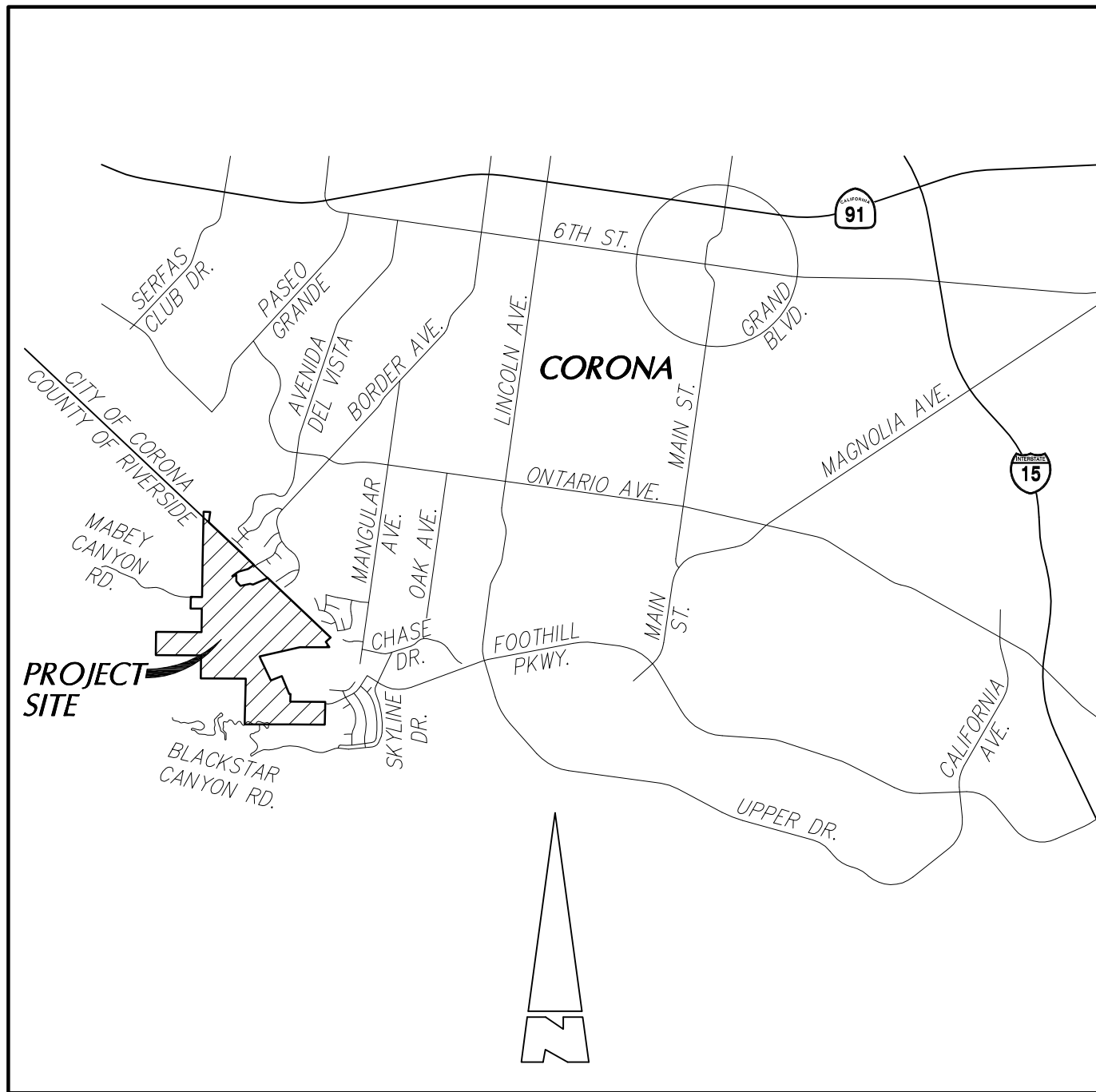
Will the proposed BMPs be maintained by a Home Owners' Association (HOA) or Property Owners Association (POA)?

☒ Y ☐ N

Include your Operation and Maintenance Plan and Maintenance Mechanism in Appendix 9. Additionally, include all pertinent forms of educational materials for those personnel that will be maintaining the proposed BMPs within this Project-Specific WQMP in Appendix 10.

Appendix 1: Maps and Site Plans

Location Map, WQMP Site Plan and Receiving Waters Map



LOCATION MAP

NOT TO SCALE



CIVIL ENGINEERS • PLANNERS • SURVEYORS
1880 COMPTON AVENUE, SUITE 100 • CORONA, CA. 92881-3370 • 951-734-2130

FIGURE 1

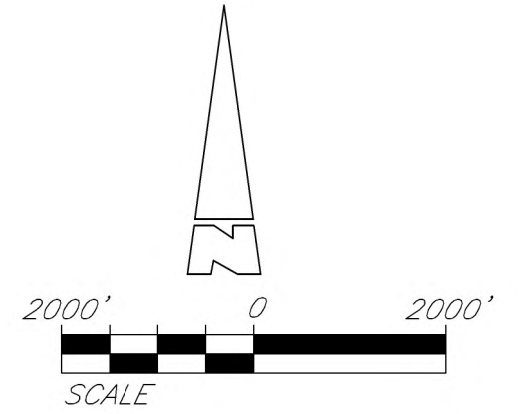
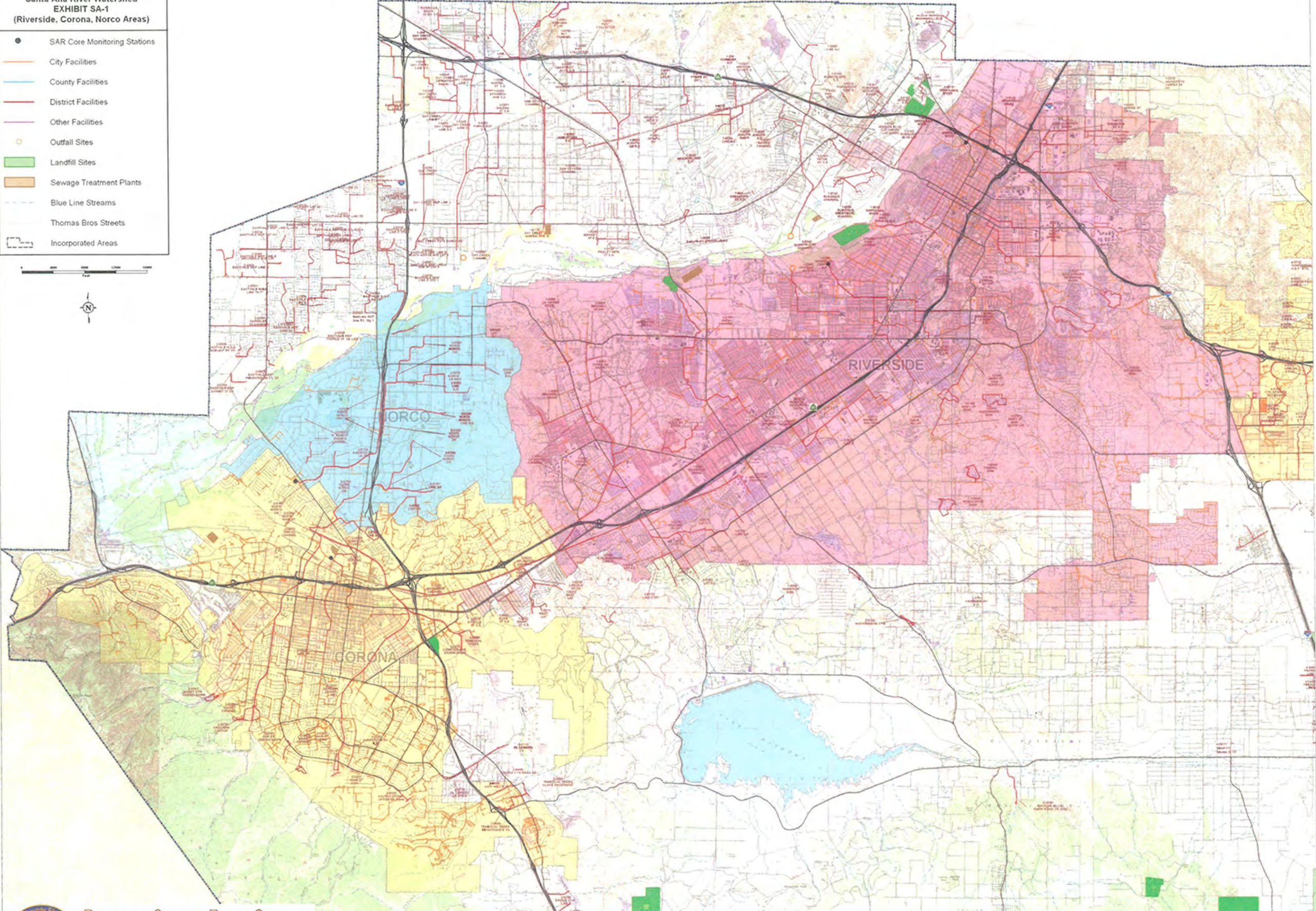
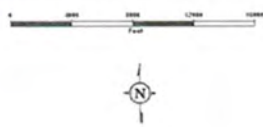


FIGURE 2
VICINITY MAP
KWC ENGINEERS
1800 CANTON AVENUE, SUITE 100 • CORONA, CA 92626 • (951) 234-2100
J.N. 12.1344.1.17

NPDES MUNICIPAL PERMIT
Santa Ana River Watershed
EXHIBIT SA-1
(Riverside, Corona, Norco Areas)

- SAR Core Monitoring Stations
- City Facilities
- County Facilities
- District Facilities
- Other Facilities
- Outfall Sites
- Landfill Sites
- Sewage Treatment Plants
- Blue Line Streams
- Thomas Bros Streets
- Incorporated Areas




**RIVERSIDE COUNTY FLOOD CONTROL
AND WATER CONSERVATION DISTRICT
GEOGRAPHIC INFORMATION SYSTEM**

© NPDES Facility Maps Santa Ana 2009 SAR2009AR.qxd 11/25/2008

The graphical and tabular information shown on this document may be derived from a variety of public agency and/or private commercial sources such as Riverside County Transportation and Land Management Agency, Thomas Brothers Mapping, the Stephen P. Teale Data Center, GIS Technology Center, State of California, the United States Geological Survey and the United States National Atlas. These sources may possess varying levels of accuracy and precision and this product is meant only as a guide to the relative position and scale of the depicted features. This GIS document is in no case to be interpreted as fundamental or decisive for purposes of land surveying, field engineering, plan drafting, code enforcement, land boundary determination and/or land acquisition.

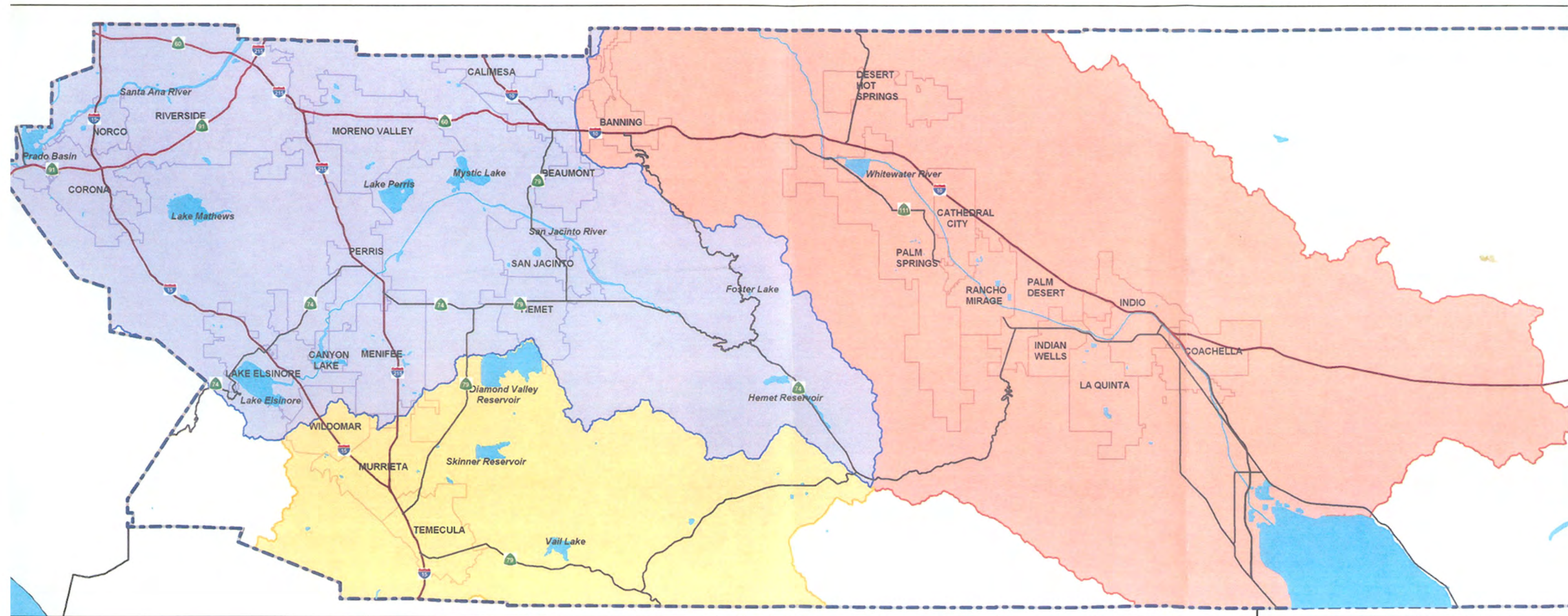
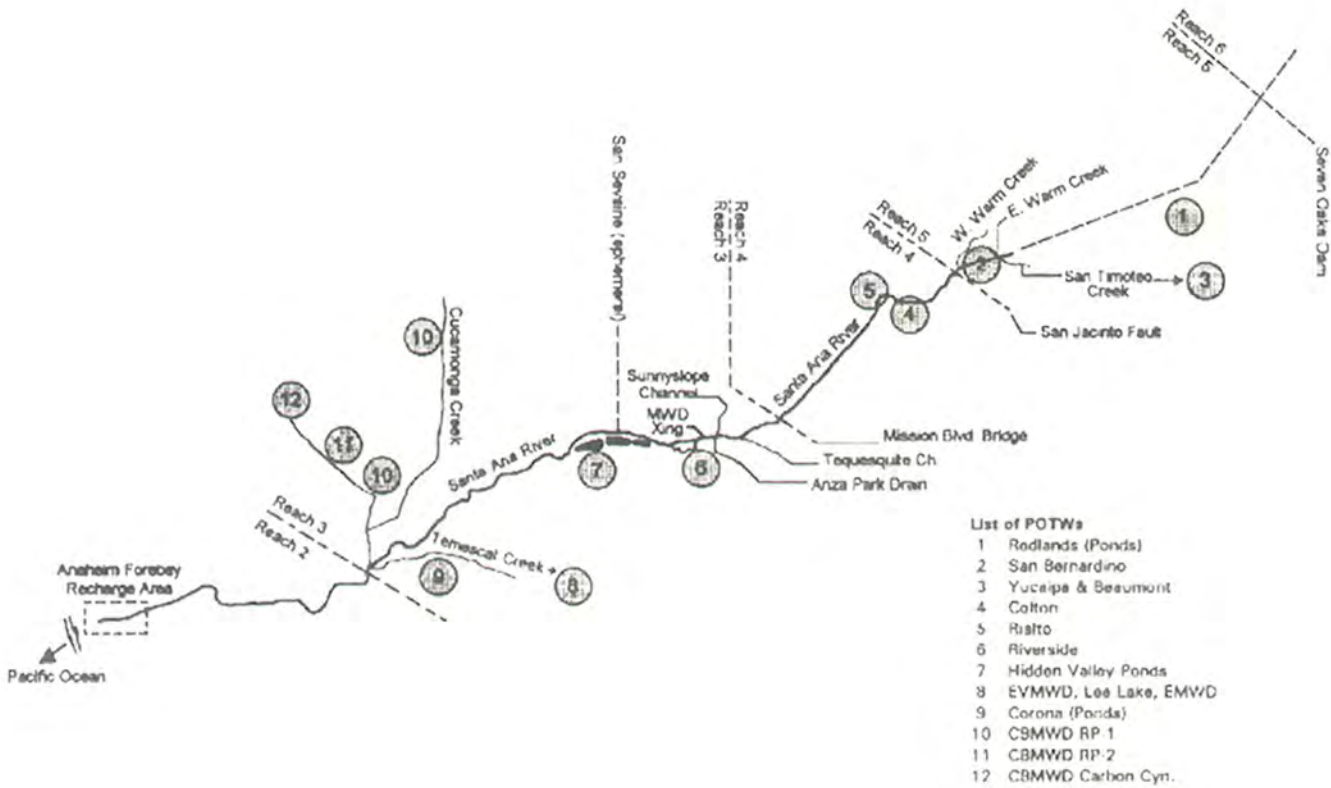


FIGURE 1-2
SANTA ANA RIVER AND TRIBUTARIES

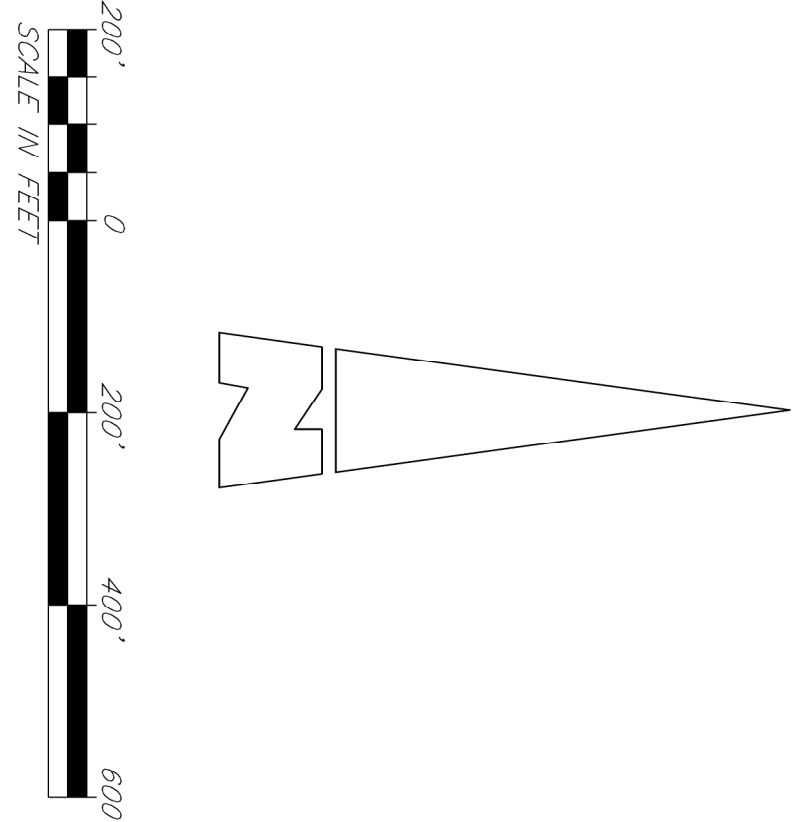


Appendix 3: Soils Information

Geotechnical Study and Other Infiltration Testing Data

Infiltration Opportunities, Constraints, and Recommendations for WQMP Report

See CD in Appendix 4 for pdf of Report



PROJECT BOUNDARY

PROPOSED DETENTION BASINS

NOTE:
1. AERIAL TOPOGRAPHY PREPARED BY
ARROWHEAD MAPPING COMPANY DATED
AUGUST 2012.

DATED: 01-10-14

KWIC ENGINEERS
CIVIL ENGINEERS • PLANNERS • SURVEYORS
1880 COVENTRY AVENUE, SUITE 100 • CORONA, CA 92681-1370 • 951-734-2130

Appendix 4: Historical Site Conditions

Phase I Environmental Site Assessment or Other Information on Past Site Use

See CD in Appendix 4 for pdf of Report

Appendix 5: LID Infeasibility

LID Technical Infeasibility Analysis

Not applicable

Appendix 6: BMP Design Details

BMP Sizing, Design Details and other Supporting Documentation

SKYLINE HEIGHTS
WQMP BMP SIZING -2011 METHOD
BY: KWC ENGINEERS

BASIN	Tributary Area (A)	Tributary Area (A)	Number of 6,000 sf Pads	Number of 5,000 sf Pads	Total Dwelling Units	Area of Roofs	Area of Driveway	Area of Street	Total Impervious Area	Area of Open Space	Area of Landscaping	Required Volume	Required Volume
	(s.f.)	(ac.)				(s.f.)	(s.f.)	(s.f.)	(s.f.)	(s.f.)	(s.f.)	(cu.-ft.)	(ac.-ft.)
A	319,886	7.3	-	21	21	50,400	6,720	48,633	105,753	-	214,133	9,340	0.21
B	357,363	8.2	-	24	24	57,600	7,680	87,602	152,882	-	204,481	12,584	0.29
C	2,391,851	54.9	-	118	118	283,200	37,760	359,841	680,801	344,110	1,366,940	67,649	1.55
D1	806,448	18.5	-	56	56	134,400	17,920	160,426	312,746	20,384	473,318	26,675	0.61
D2	290,662	6.7	8	10	18	48,000	5,760	61,509	115,269	-	175,393	9,674	0.22
D3	76,686	1.8	-	5	5	12,000	1,600	26,296	39,896	-	36,790	3,139	0.07
E	1,260,953	28.9	50	0	50	150,000	16,000	168,009	334,009	254,736	672,208	35,105	0.81
Total	5,503,849	126.4	58	234	292	735,600	93,440	912,316	1,741,356	619,230	3,143,263	164,166	3.77

BASIN	Total Basin Area	Total Basin Area	Average Water Surface Area	Basin Depth to Inlet Elev.	Basin Depth to Top of Basin		Basin Volume (to Inlet Elev.) Provided	Basin Volume (to Inlet Elev.) Provided
	(s.f.)	(ac.)	(s.f.)	(ft.)	(ft.)		(cu.-ft.)	(acre-ft.)
A	6,307	0.14	4,051	3.00	5.00		12,152	0.28
B	9,307	0.21	6,412	3.00	5.00		19,237	0.44
C	15,448	0.35	11,510	6.00	7.00		69,060	1.59
D1	9,119	0.21	6,749	4.00	5.00		26,996	0.62
D2	2,735	0.06	1,808	5.50	6.00		9,944	0.23
D3	3,124	0.07	2,102	1.50	2.00		3,153	0.07
E	7,914	0.18	5,271	6.40	7.00		33,734	0.77
Total	53,954	1.24	37,903				174,276	4.00

NOTE:

1) AREA OF STREET EXCLUDES LANDSCAPED PARKWAY, PARKWAY LANDSCAPING INCLUDED IN AREA OF LANDSCAPING QUANTITY

Calculated Cells

Notes:

Notes:

Notes:

Notes:

Santa Ana Watershed - BMP Design Volume, V_{BMP}

Legend:

Required Entries

Calculated Cells

(Note this worksheet shall only be used in conjunction with BMP designs from the LID BMP Design Handbook)

Company Name **KWC Engineers**

Date **3/5/2013**

Designed by **Victor Elia**

Case No

Company Project Number/Name

2012.1344.1 Skyline Heights

BMP Identification

BMP NAME / ID **Basin D2**

Must match Name/ID used on BMP Design Calculation Sheet

Design Rainfall Depth

85th Percentile, 24-hour Rainfall Depth,
from the Isohyetal Map in Handbook Appendix E

D_{85} = **0.95** inches

Drainage Management Area Tabulation

Insert additional rows if needed to accommodate all DMAs draining to the BMP

DMA Type/ID	DMA Area (square feet)	Post-Project Surface Type	Effective ImperVIOUS Fraction, I_f	DMA Runoff Factor	DMA Areas x Runoff Factor	Design Storm Depth (in)	Design Capture Volume, V_{BMP} (cubic feet)	Proposed Volume on Plans (cubic feet)
Roofs	48000	Roofs	1	0.89	42816			
Dwy	5760	Concrete or Asphalt	1	0.892	5137.9			
Street	61509	Concrete or Asphalt	1	0.892	54866			
Open	0	Natural (D Soil)	0.4	0.279712	0			
Landscape	175393	Ornamental Landscaping	0.1	0.110458	19373.6			
	290662	Total			122193.5	0.95	9673.7	

Proposed Volume must be greater than the Design Capture Volume

Notes:

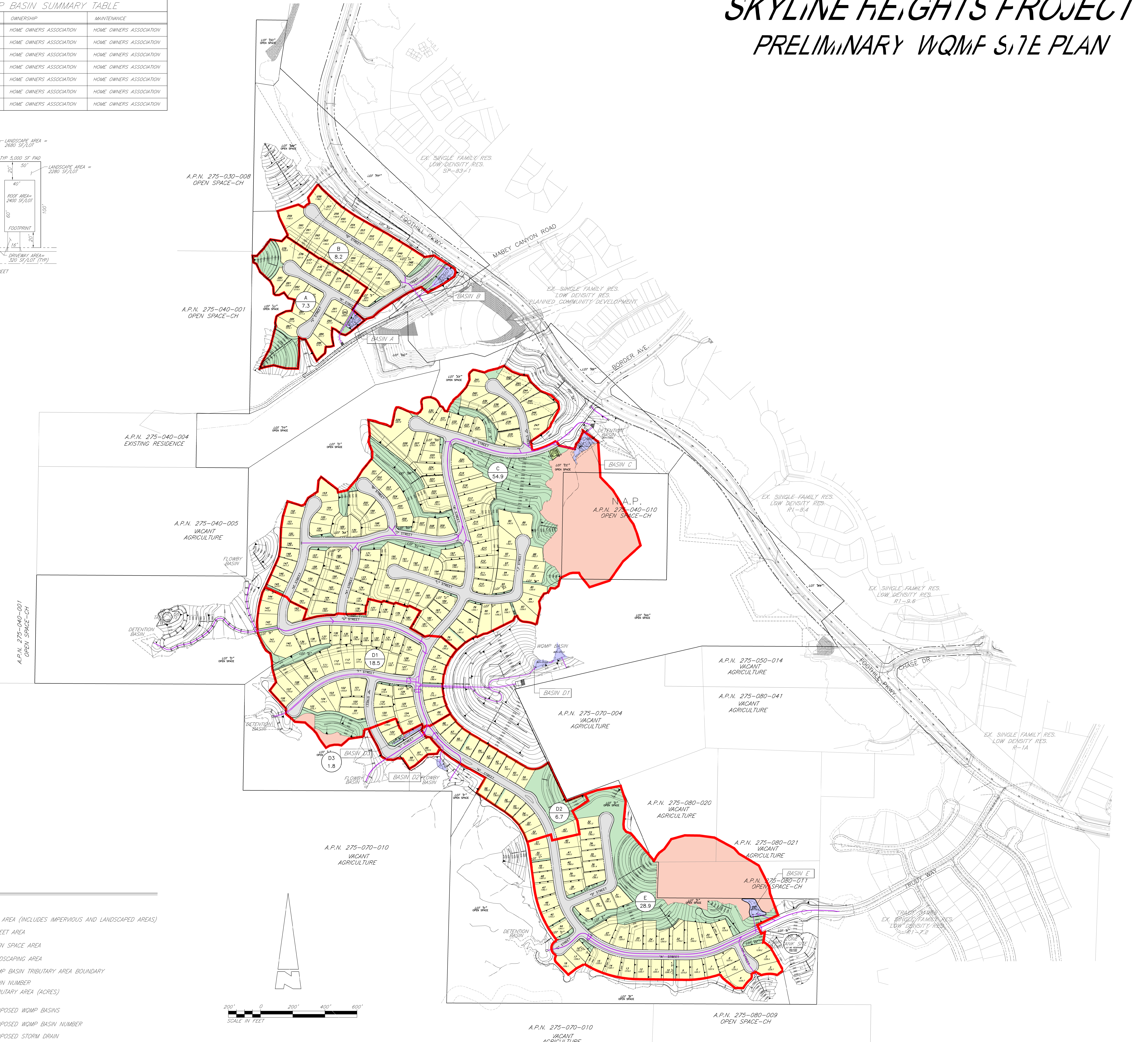
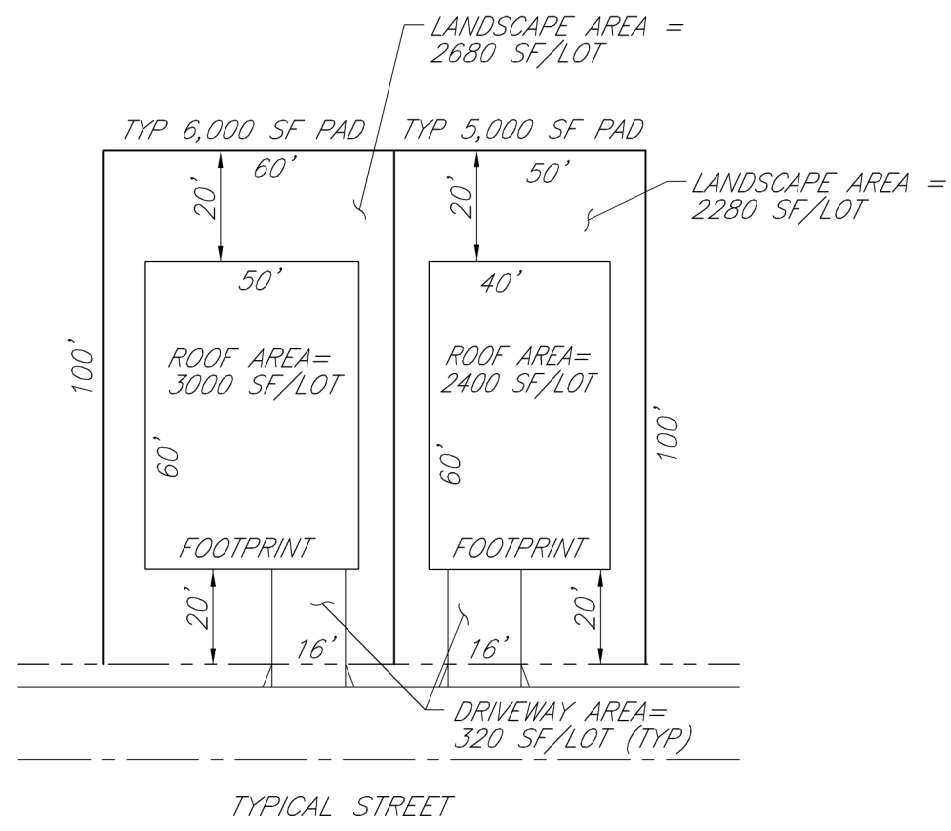
Notes:

<u>Santa Ana Watershed</u> - BMP Design Volume, V_{BMP}						Legend: 		Required Entries	
								Calculated Cells	
<i>(Note this worksheet shall only be used in conjunction with BMP designs from the LID BMP Design Handbook)</i>									
Company Name		KWC Engineers				Date		1/10/2014	
Designed by		Victor Elia				Case No			
Company Project Number/Name		2012.1344.1 Skyline Heights							
BMP Identification									
BMP NAME / ID		Basin E							
<i>Must match Name/ID used on BMP Design Calculation Sheet</i>									
Design Rainfall Depth									
85th Percentile, 24-hour Rainfall Depth, from the Isohyetal Map in Handbook Appendix E						$D_{85} =$		0.95 inches	
Drainage Management Area Tabulation									
<i>Insert additional rows if needed to accommodate all DMAs draining to the BMP</i>									
DMA Type/ID	DMA Area (square feet)	Post-Project Surface Type	Effective Imperivous Fraction, I_f	DMA Runoff Factor	DMA Areas x Runoff Factor	Design Storm Depth (in)	Design Capture Volume, V_{BMP} (cubic feet)	Proposed Volume on Plans (cubic feet)	
Roofs	150000	Roofs	1	0.89	133800				
Dwy	16000	Concrete or Asphalt	1	0.892	14272				
Street	168009	Concrete or Asphalt	1	0.892	149864				
Open	254736	Natural (D Soil)	0.4	0.279712	71252.7				
Landscape	672208	Ornamental Landscaping	0.1	0.110458	74250.8				
	1260953	Total			443439.5				
Proposed Volume must be greater than the Design Capture Volume									
Notes:									

SKYLINE HEIGHTS PROJECT

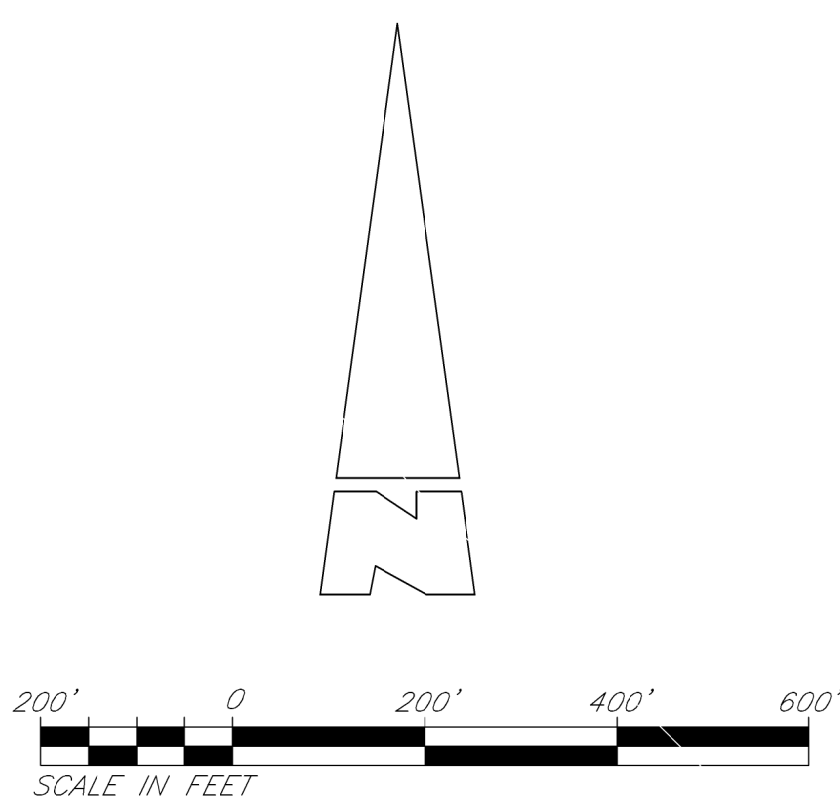
PRELIMINARY WQMF SITE PLAN

WQMP BASIN SUMMARY TABLE			
BASIN	AREA (AC)	OWNERSHIP	MAINTENANCE
A	0.14	HOME OWNERS ASSOCIATION	HOME OWNERS ASSOCIATION
B	0.21	HOME OWNERS ASSOCIATION	HOME OWNERS ASSOCIATION
C	0.35	HOME OWNERS ASSOCIATION	HOME OWNERS ASSOCIATION
D1	0.20	HOME OWNERS ASSOCIATION	HOME OWNERS ASSOCIATION
D2	0.06	HOME OWNERS ASSOCIATION	HOME OWNERS ASSOCIATION
D3	0.07	HOME OWNERS ASSOCIATION	HOME OWNERS ASSOCIATION
E	0.18	HOME OWNERS ASSOCIATION	HOME OWNERS ASSOCIATION



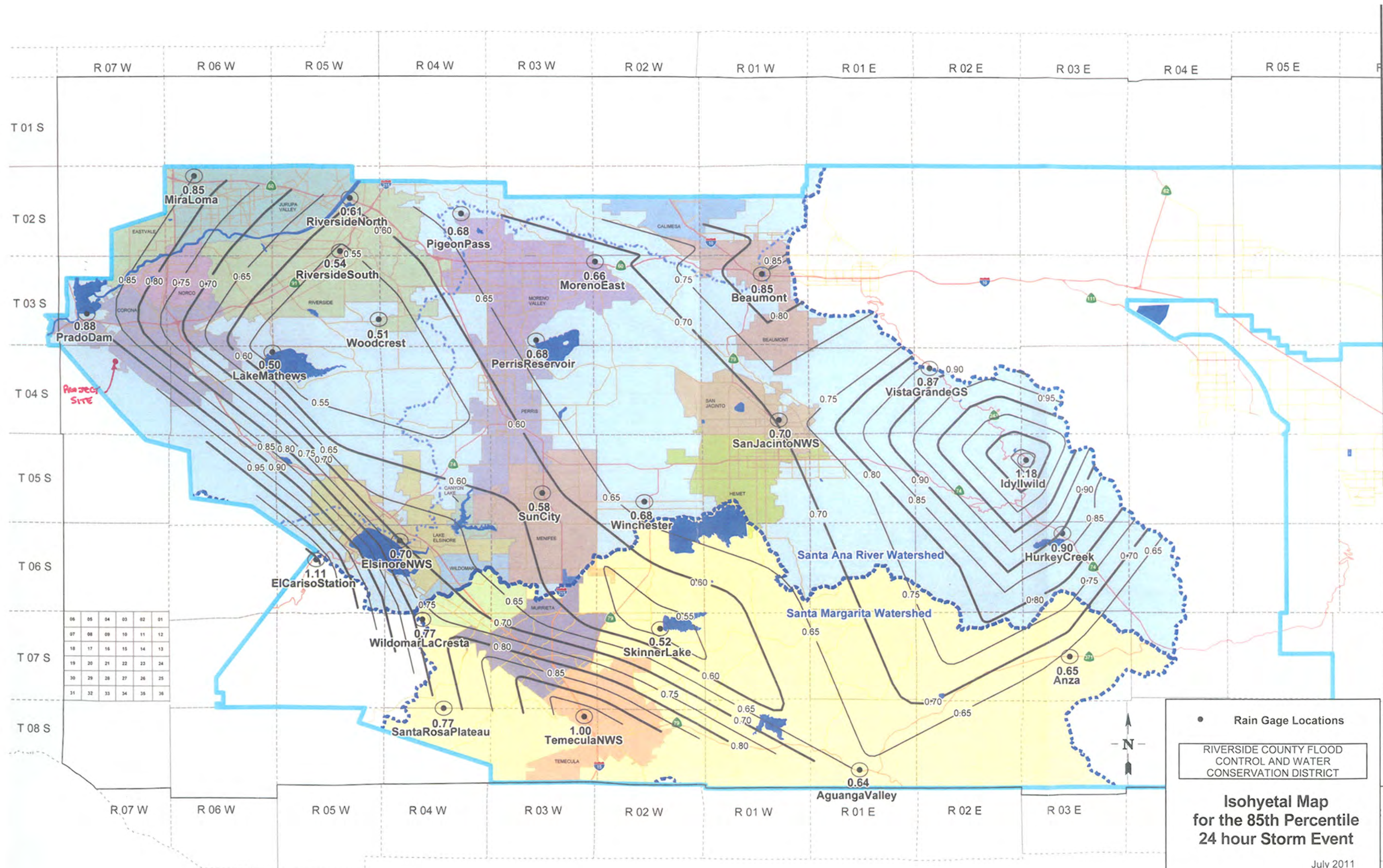
LEGEND

- LOT AREA (INCLUDES IMPERVIOUS AND LANDSCAPED AREAS)
- STREET AREA
- OPEN SPACE AREA
- LANDSCAPING AREA
- WQMP BASIN TRIBUTARY AREA BOUNDARY
- BASIN NUMBER
- TRIBUTARY AREA (ACRES)
- PROPOSED WQMP BASINS
- PROPOSED WQMP BASIN NUMBER
- PROPOSED STORM DRAIN



Appendix 2: Construction Plans

Grading and Drainage Plans



06	05	04	03	02	01
07	06	09	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

APPENDIX E

BMP POLLUTANT REMOVAL EFFECTIVENESS

BMP Pollutant Removal Effectiveness ⁽¹⁾

Pollutant of Concern	Harvest and Use ⁽⁸⁾	Infiltration BMPs ⁽³⁾	Bioretention	Extended Detention Basins ⁽²⁾	Sand Filter Basin ⁽⁷⁾
Sediment	H	H	H	M	H
Nutrient	H	H	⁽⁵⁾	M ⁽⁴⁾	L ⁽⁶⁾
Trash	H	H	H	H	H
Metal	H	H	H	M	M
Bacteria	H	H	H	M	M
Oil & Grease	H	H	H	M	H
Organic Compounds	H	H	H	M	H
Pesticides	H	H	H	U	U

Abbreviations:

L: Low removal efficiency M: Medium removal efficiency H: High removal efficiency U: Unknown

Notes:

- (1) Periodic performance assessment and updating of this table may be performed based on updated information from studies from the District, CASQA, Caltrans or others. These effectiveness ratings are based on the specific BMP designs incorporated into this manual.
- (2) Effectiveness based upon total 72-hour drawdown time.
- (3) Includes infiltration basins, infiltration trenches, and permeable pavements.
- (4) Medium for soil types A & B only. Low for soil types C & D.
- (5) Removal rating is dependent on the soil media depth. L=Min. 18" deep, M= Min. 24" deep, H=Max. 30"-36" deep.
- (6) Medium where sand filter layer is increased to 36".
- (7) Considered to be a Treatment Control BMP. See the WQMP to determine if this BMP can be used.
- (8) Cisterns, when associated with an adequate and reliable (year-round) demand for non-potable use of captured storm water (see the applicable WQMP for any specific requirements), have a High effectiveness at removing all pollutants from stormwater runoff. If there is inadequate demand to reliably drain the cistern through a non-potable use throughout the year, pollutant removal effectiveness will be Low.

EXTENDED DETENTION BASIN BMP FACT SHEET

Maintenance Guidelines

Schedule	Inspection and Maintenance Activity
During every scheduled maintenance check (per below), and <i>as needed</i> at other times	• Maintain vegetation as needed. Use of fertilizers, pesticides and herbicides should be strongly avoided to ensure they don't contribute to water pollution. If appropriate native plant selections and other IPM methods are used, such products shouldn't be needed. If such projects are used: ○ Care should be taken to avoid contact with the low-flow or other trenches, and the media filter in the bottom stage. ○ Products shall be applied in accordance with their labeling, especially in relation to application to water, and in areas subjected to flooding. ○ Fertilizers should not be applied within 15 days before, after, or during the rainy season. • No ponded water should be present for more than 72 hours to avoid nuisance or vector problems. No algae formation should be visible. Correct problems as needed.
Annually. If possible, schedule these inspections before the beginning of the rain season to allow for any repairs to occur before rains occur.	• Remove debris and litter from the entire basin • Inspect hydraulic and structural facilities. Examine the outlet for clogging, the embankment and spillway integrity, as well as damage to any structural element. • Check for erosion, slumping and overgrowth. Repair as needed. • Inspect sand media at the filter drain to verify it is allowing acceptable infiltration. Scarify top 3 inches by raking the filter drain's sand surface annually. • Check the media filter underdrains (via the cleanout) for damage or clogging. Repair as needed. • Remove accumulated sediment and debris from the forebay, and ensure that the notch weir is clear and will allow proper drainage. • Check gravel filled low flow and collector trenches for sediment buildup and repair as needed.
Every 5 years or sooner (depending on whether observed drain times to empty the basin are less than 72 hours).	• Remove the top 3 inches of sand from the filter drain and backfill with 3 inches of new sand to return the sand layer to its original depth. When scarification or removal of the top 3 inches of sand is no longer effective, remove and replace sand filter layer.
Whenever substantial sediment accumulation has occurred.	• Remove accumulated sediment from the bottom of the basin. Removal should extend to original basin depth.

EXTENDED DETENTION BASIN BMP FACT SHEET

Design Summary

Design Parameter	Extended Detention Basin
Drawdown time (total)	72 hours ^{2,3}
Minimum drawdown time for 50% V_{BMP}	24 hours ²
Minimum tributary area	5 acres ²
Outlet erosion control	Energy dissipaters to reduce velocities ¹
Forebay volume	3 to 5 % of V_{BMP} ³
Basin Invert Longitudinal Slope (min.)	1%
Basin Invert Transverse (cross) Slope (min)	1%
Low-flow trench width (min.)	48 inches
Low-flow trench depth (min.)	24 inches
Slope of low-flow trench along bottom excavated Surface (max.)	1%
Slope of gravel collector trenches along bottom excavated surface (max.)	1 %
Length to width ratio (min.)	1.5:1
Basin depth (min.)	1 foot ³
Bottom stage volume	0.5 % of V_{BMP} ³
Bottom stage depth (min)	0.33 feet ³
Filter drain depth (min)	2.33 feet ³
^{1.} Ventura County's Technical Guidance Manual for Stormwater Quality Control Measures ^{2.} CA Stormwater BMP Handbook for New Development and Significant Redevelopment ^{3.} Denver, Colorado's UDFCD Drainage Criteria Manual, Volume 3	

Note: The information contained in this BMP Factsheet is intended to be a summary of design considerations and requirements. Additional information which applies to all detention basins may be found in the "Basin Guidelines" (Appendix C). In addition, information herein may be superseded by other guidelines issued by the Engineering Authority.

Design Procedure

These steps correspond to and provide a description of the information required in the EDB Design Worksheet.

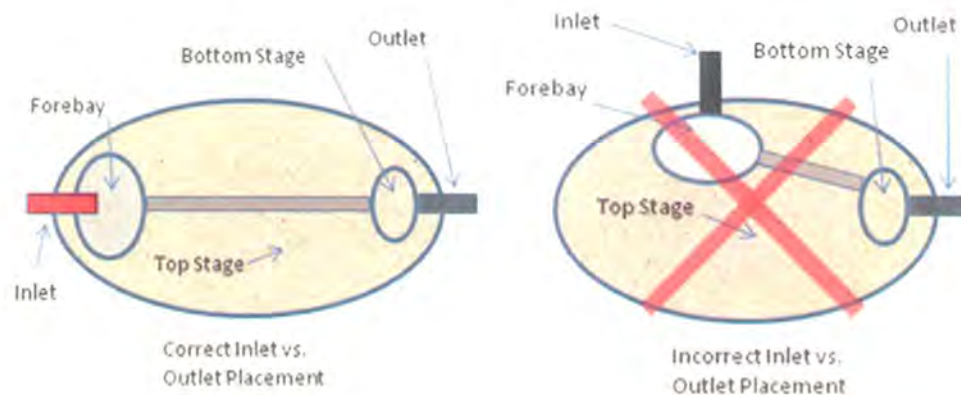
1. Find the Design Volume, V_{BMP} .

- a) Enter the tributary area, A_T to the BMP. The minimum tributary area is 5 acres.
- b) Enter the Design Volume, V_{BMP} , determined from Section 2.1 of this Handbook.

EXTENDED DETENTION BASIN BMP FACT SHEET

2. Basin Footprint

- a) Enter the length and width of the EDB. The length shall be measured between the inlet to the basin and the outlet structure; and the width shall be measured at the widest point of the basin invert. The length to width ratio should be 1.5:1 or longer to prevent short-circuiting and increase the overall effectiveness of the BMP.



- b) Enter the internal basin side slopes. See the "Basin Guidelines" (Appendix C) for side slope requirements. If variable internal side-slopes are used, enter the steepest slope that will be used.
- c) Using Figure 1 as a guide, enter the proposed basin depth, D_B , and the freeboard depth, D_{FB} . Based on the information provided, the spreadsheet will calculate the minimum total depth required, D_{REQ} , for this BMP. D_{REQ} is the depth from the bottom of the underdrain layer in the bottom stage (see step 5c), to the top of the freeboard. This calculated minimum required depth can be used to determine if enough elevation difference is available within the design topography to allow for use of this BMP.
- d) Additionally, the basin depth D_B is equal to D_O , which is the depth from the design pond water surface elevation to the lowest orifice in the outlet structure. D_O is confirmed by the spreadsheet and is used in the Basin Outlet Design described in step 6 below. It should be noted that this lowest orifice is a critical elevation in the design of this BMP. The Volume of the Basin V_{Basin} described in step 3d) is the volume of water above this lowest orifice. This lowest-orifice also represents the dry weather ponded water surface discussed in step 5c below. Below this elevation there must be a minimum of a 4-inch drop down to the surface of the Sand Filter in the bottom stage.

EXTENDED DETENTION BASIN BMP FACT SHEET

3. Basin Design

- a) The Total Basin Depth, D_{TOT} , is calculated automatically, and is the sum of the basin depth D_B plus the freeboard depth D_{FB} .
- b) Enter the longitudinal slope of the basin invert. This slope must be at least 1% and is measured along the low flow trench between the forebay and the bottom stage. Note that the surface of the sand layer in the bottom stage must be level (see Figure 1).
- c) Enter the transverse slope of the basin invert. This transverse (cross sectional) slope must be at least 1% sloped toward the low flow trench.
- d) Enter the Volume of the Basin, V_{Basin} . This volume must be the actual volume of water held within the basin as substantiated by modeling or appropriate volumetric calculations, and must be equal to or greater than V_{BMP} . This volume must be held above the lowest orifice in the Basin Outlet Design described in step 6 below.

4. Forebay Design

All flows must enter the basin through the forebay. The forebay provides a location for the settlement and collection of larger particles, and any other trash or debris. A relatively smooth and level concrete bottom surface should be provided to facilitate mechanical removal of any accumulated sediment, trash and debris.



Figure 2: Forebay filled with storm water

- a) Enter the Forebay Volume V_{FB} . This volume must be from 3 to 5 percent of V_{BMP} .
- b) A rock or concrete berm must be constructed to detain water before it drains into the basin. The top of the berm shall be set no higher than the invert of the inlet conveyance. Enter the Forebay Depth, D_{FBY} .
- c) The spreadsheet will calculate the minimum surface area of the forebay, A_{FB} , based on the provided Forebay Volume and Depth. Ensure that the plans provide for a forebay area at least this large.
- d) Although the forebay will be well submerged in the design event, a full height rectangular notch-type weir shall be constructed through the berm to prevent permanent ponding in the forebay, and allow water to slowly and fully drain to the main body of the basin. This notch should be offset from the inflow streamline to prevent low-flows from short circuiting. Enter the width, W , of this rectangular notch weir. The width shall not be less than 1.5 inches to prevent clogging. Additionally,

EXTENDED DETENTION BASIN BMP FACT SHEET

immediately outside the notch construct a minimum 1-foot by 1-foot gravel pad to prevent vegetative growth within the basin invert from blocking the notch.

5. Dry Weather and Low-Flow Management

The basin shall have both a low-flow gravel trench and a network of gravel collector trenches across the invert of the basin, as well as a bottom stage sand filter to treat low flows and dry weather flows (see Figure 1).

- a) Low Flow Trench: The low-flow gravel trench conveys flow from the forebay to the bottom stage, while allowing for maximum incidental infiltration and volume loss. The trench shall be a minimum of 48 inches wide by 24 inches deep. This trench shall be unlined and backfilled with AASHTO No. 2 gravel (or similar) to the finished surface of the basin invert, and shall not use underdrains. The bottom excavated surface of the low-flow trench shall be 1 percent or flatter to promote infiltration.



Figure 3: Gravel filled low-flow trench

- b) Collector Trenches: Gravel collector trenches beneath the top stage shall be arranged as illustrated in Figure 1 of Appendix C with minimal slope (1% maximum) along their bottom excavated surface to promote infiltration, and must extend from the low-flow trench to the toe of the basin side slopes. They shall be a minimum of 18-inches wide by 24-inches deep, unlined and backfilled with AASHTO No. 2 gravel (or similar) to the finished basin invert surface. The gravel collector trenches shall not use underdrains and shall be constructed with a maximum spacing of 25 feet, center to center. See Figure 1 of Appendix C.
- c) Bottom Stage: A depressed sand filter drain area, referred to as the bottom stage, must be constructed adjacent to the outlet structure to treat any dry weather flows. To ensure that dry weather flows are treated through the sand filter and not discharged through the orifice plate, the top surface of the sand filter must be depressed at least 4 inches below the lowest orifice in the outlet structure. This depressed area will create a micro pool of water that is then filtered down through the sand filter and out through underdrains. Based on the minimum dimensions described below, the minimum depth of excavation below the lowest orifice in the outlet structure is 2.33 feet.
- Enter the Depth of the bottom stage, D_{BS} . As mentioned above, this depth must be at least 4 inches, and extend down below the lowest orifice in the outlet structure.
 - Enter the area of the bottom stage, A_{BS} .

EXTENDED DETENTION BASIN BMP FACT SHEET

- iii. Based on the D_{BS} and A_{BS} entered, the spreadsheet will calculate V_{BS} . This volume is the volume of ponded water that will be held below the lowest orifice in the outlet structure, and above the surface of the sand filter. This volume must be at least 0.5% of V_{BMP} .
- iv. Enter the thickness of the ASTM C-33 sand layer that will be provided, D_s . A minimum thickness of 18 inches is required.
- v. Below the sand layer, a minimum 10-inch thick layer of gravel shall be installed with underdrains to drain the water that has been treated through the sand filter. The underdrains shall connect into the outlet structure. See Appendix B for standard underdrain construction. Enter the diameter of the underdrain pipe (minimum 6" dia.), and the spacing of the underdrains. The maximum spacing of the underdrains is 20 feet on center, however where the area of the bottom stage is particularly small (less than 500 square feet), the underdrain pipes shall be placed at no more than a 10-foot separation on center.

6. Basin Outlet Design

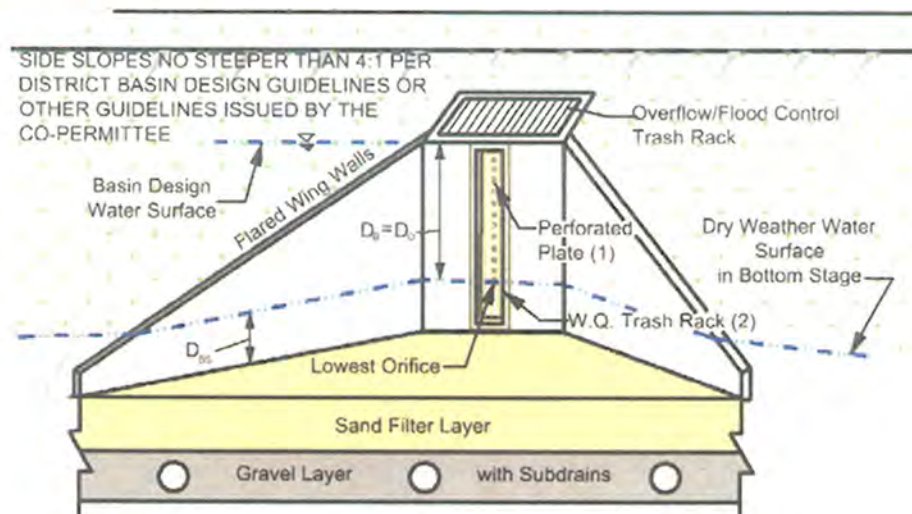


Figure 4: Basin Outlet Structure with Bottom Stage Shown

Outlet structures for publicly maintained basins shall conform to District Standard Drawings WQ501 unless approved in advance by the local Engineering Authority (EA). This standardization is to provide for efficient maintenance. The basin outlet should be sized to release the design volume, V_{BMP} , within a 72-hour period but 50 percent of V_{BMP} within 24 hours. This is an iterative design process where an appropriate control orifice can be selected using the following steps:

- a. Develop a Stage vs. Discharge Curve for the Outlet Structure

EXTENDED DETENTION BASIN BMP FACT SHEET

Estimate the orifice size and outlet plate configuration (number per row, etc.). Based on D_o provided in the Basin Footprint section, the spreadsheet will automatically generate the stage vs. discharge relationship for this outlet:

$$Q = C \cdot A \cdot [2 \cdot g \cdot (H - H_o)]^{0.5}$$

Where:

Q = discharge (ft^3/s)

g = gravitational constant ($32.2 \text{ ft}/\text{s}^2$)

C = orifice coefficient

H = water surface elevation (ft)

A = area of the orifice (ft^2)

H_o = orifice elevation (ft)

The lowest orifice shall be located with its centerline at the top of the bottom stage; at least 4 inches above the surface of the sand filter drain. To help avoid clogging, the minimum orifice diameter is limited to 3/8 inch. Since the 1/4 inch thickness of the orifice plate will be less than the orifice diameter, a value for C of 0.66 may be used. If another value for C is used, justification may be required.

b. Develop a Discharge/Volume vs. Stage Table for the Basin

Based on the shape and size of the basin, develop a relationship between the stage and the volume of water in the basin. Since the orifice spacing is 4 inches on center for the standard orifice plate, the stage intervals must also be 4 inches. Enter the basin volume at each interval starting at the centerline of the lowest orifice.

c. Route the Design Volume through the Basin

The spreadsheet assumes that the Design Volume, V_{BMP} , enters the basin instantaneously and as such, no inflow/outflow hydrograph is necessary. The drawdown time for each stage becomes:

$$\Delta t = V_i / Q$$

Where:

Δt = drawdown time for each stage

V_i = the volume at each stage

Q = the flow rate corresponding to the headwater elevation at each stage.

The spreadsheet automatically determines the drawdown time from the sum of the Δt values for each stage. If the orifice size and plate configuration estimate meets the

EXTENDED DETENTION BASIN BMP FACT SHEET

hydraulic retention time requirements (50% of the volume empties in not less than 24 hours, 100% of the volume empties in no more than 72 hours), the outlet is correctly sized. If these requirements are not met, select a new orifice size or configuration and repeat the process starting at Step 6a.

7. Outlet Protection

To prevent the orifices from clogging, trash racks are required where perforated vertical outlet control plates are used. This allows for easier access to outlet orifices for inspection and cleaning. Trash racks shall be sized to prevent clogging of the primary water quality outlet without restricting the hydraulic capacity of the outlet control orifices. The orifice plate shall be protected with a trash rack conforming to Standard Drawing WQ501 (at end of this section) with at least six square feet of open surface area or 25 times the total orifice area, whichever is greater. The rack shall be adequately secured to prevent it from being removed or opened when maintenance is not occurring.

[Overflow Structure Similar to Standard Drawing Number WQ 501](#)

(Photo courtesy of Colorado Association of Stormwater Floodplain Managers)

Trash rack with screen



EXTENDED DETENTION BASIN BMP FACT SHEET

8. **Overflow Outlet**

Overflow outlets for publicly maintained basins shall conform to Standard Drawing WQ501 (at end of this section) unless approved in advance by the Engineering Authority (EA).

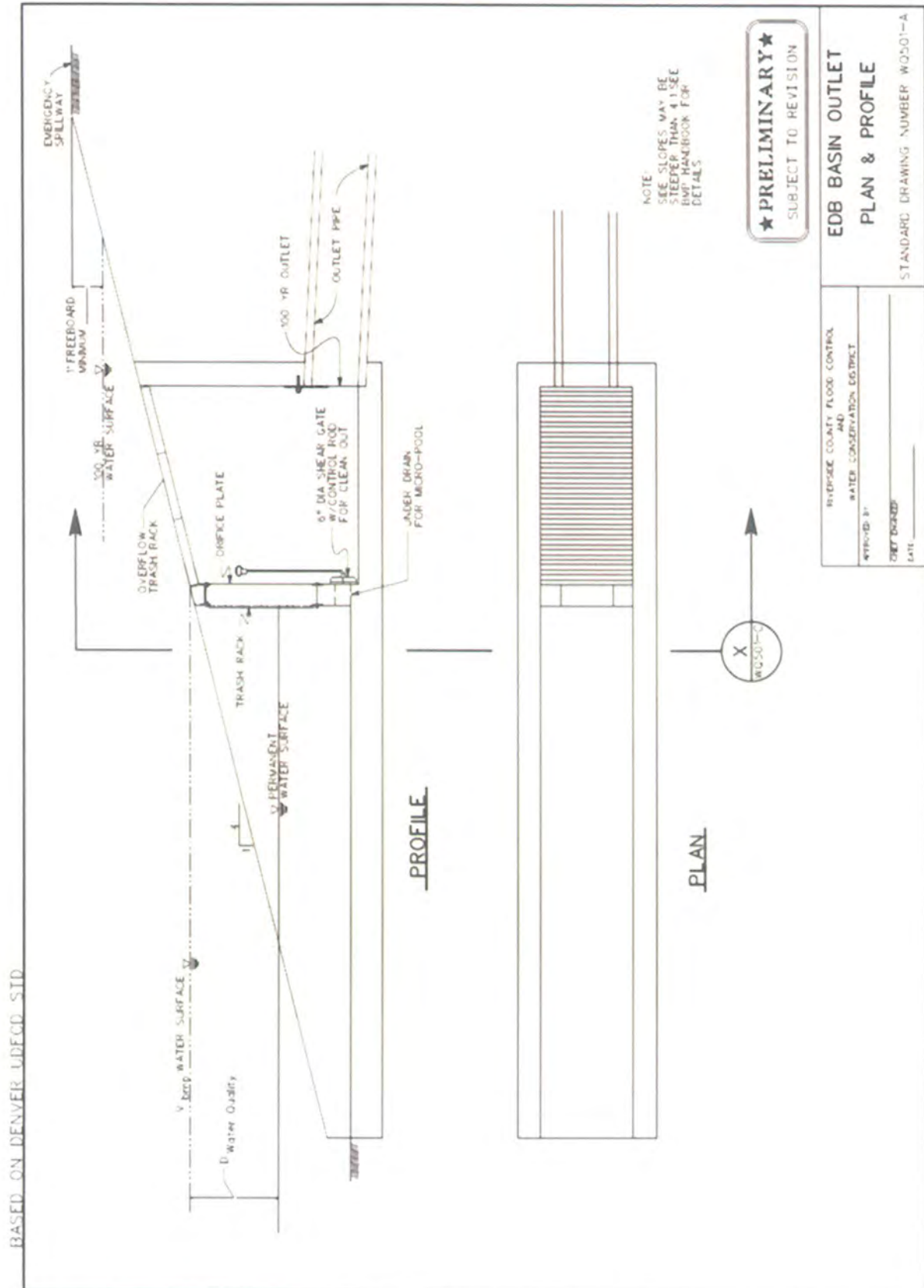
9. **Embankment**

Embankments shall be designed in accordance with applicable standards of Riverside County Flood Control District's "Basin Guidelines" (Appendix C) or other guidelines issued by the Engineering Authority (EA). Where applicable, embankment designs must additionally conform to the requirements of the State of California Division of Safety of Dams.

10. **Spillway and Overflow Structures**

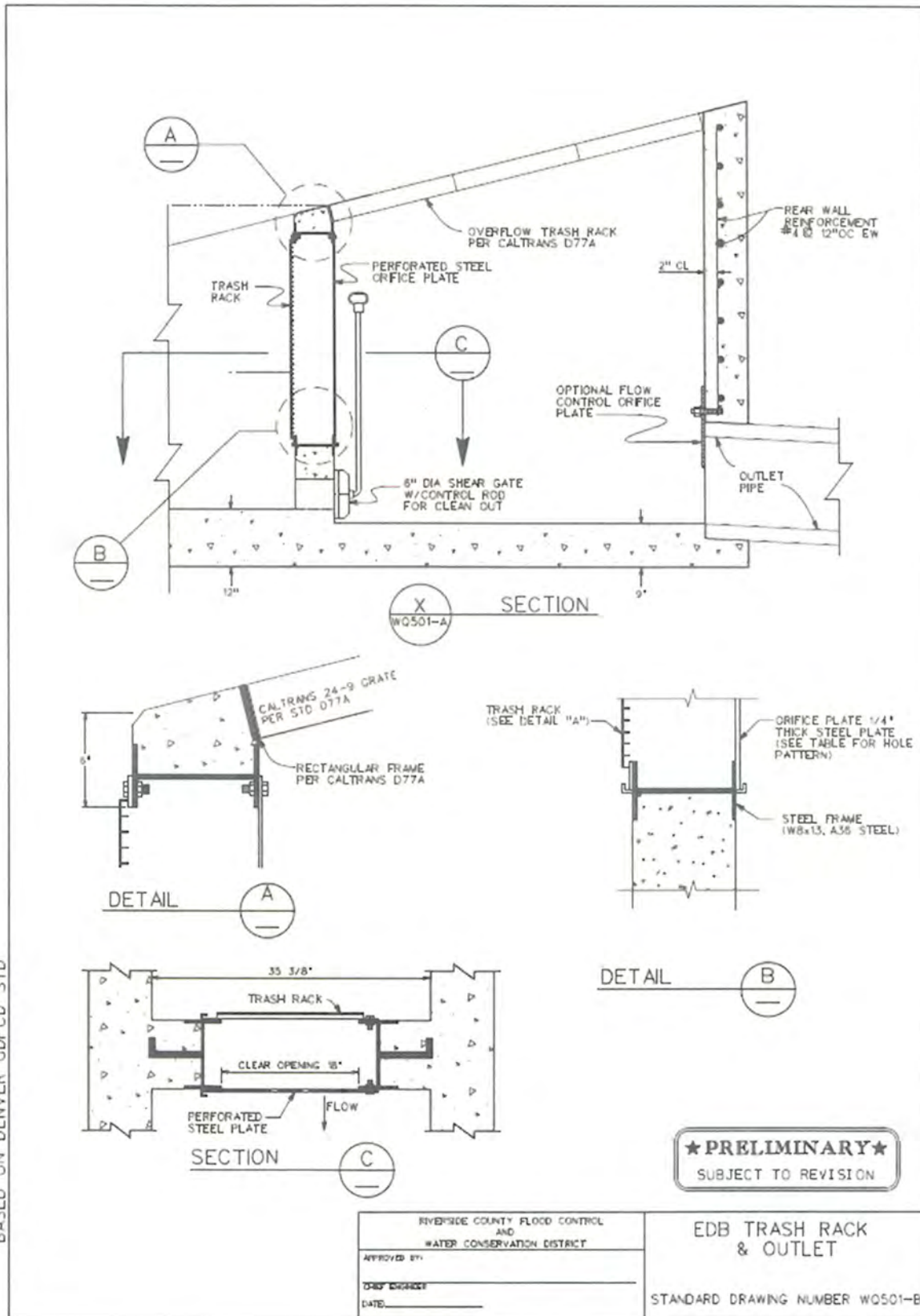
Spillway and overflow structures should be designed in accordance with applicable standards of the "Basin Guidelines" (Appendix C) or other guidelines issued by the Engineering Authority (EA).

EXTENDED DETENTION BASIN BMP FACT SHEET

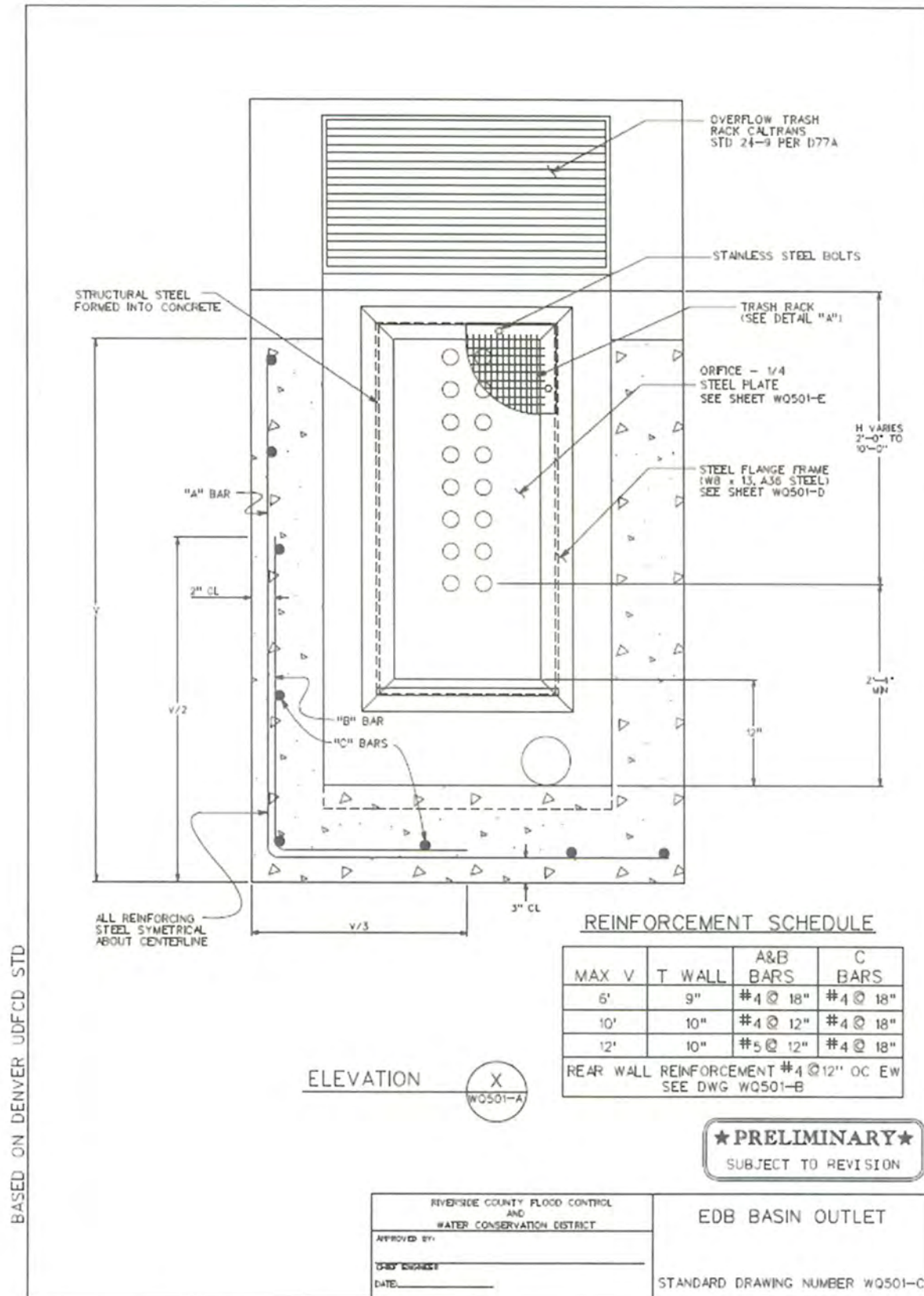


EXTENDED DETENTION BASIN BMP FACT SHEET

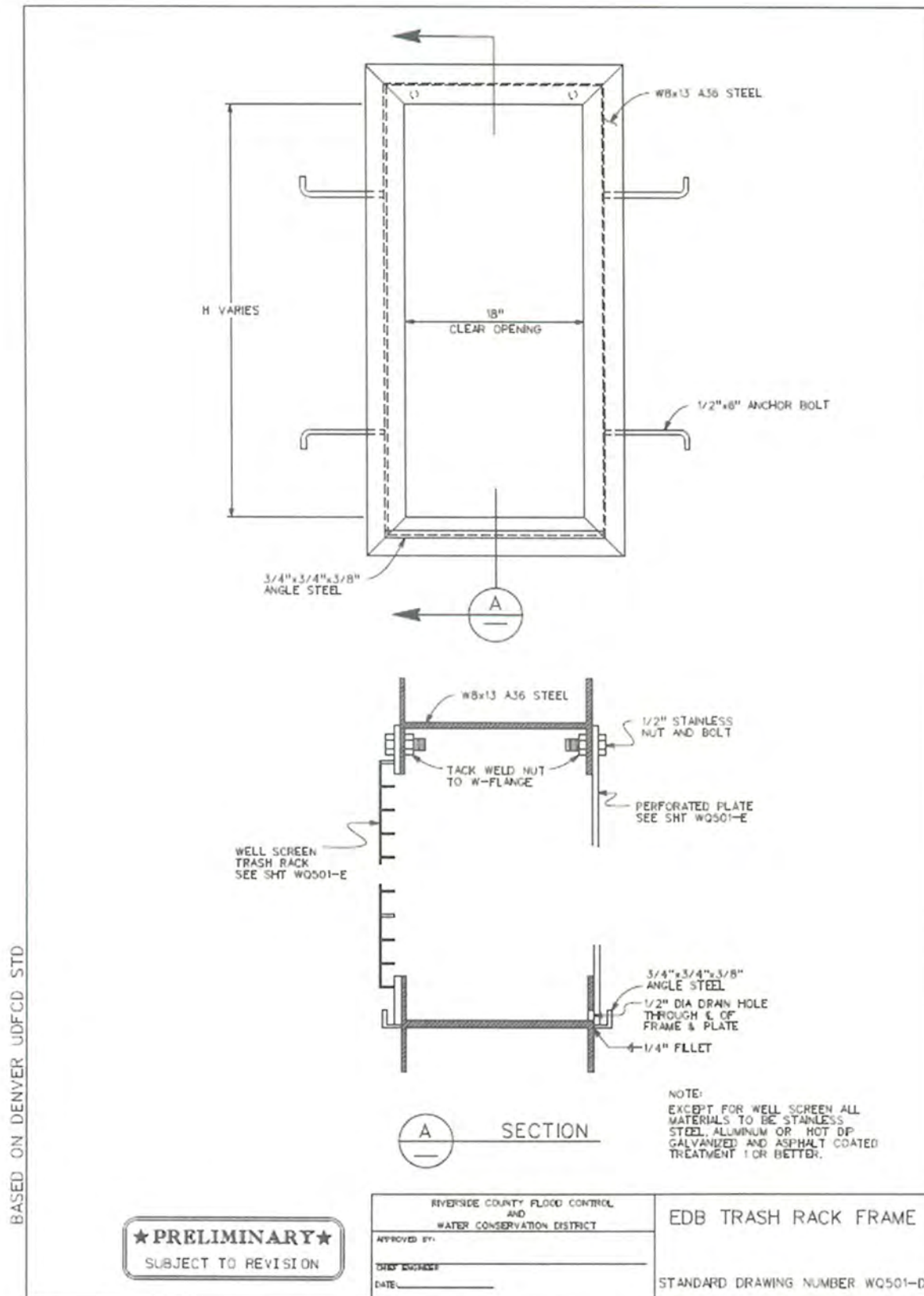
BASED ON DENVER UDFCD STD



EXTENDED DETENTION BASIN BMP FACT SHEET

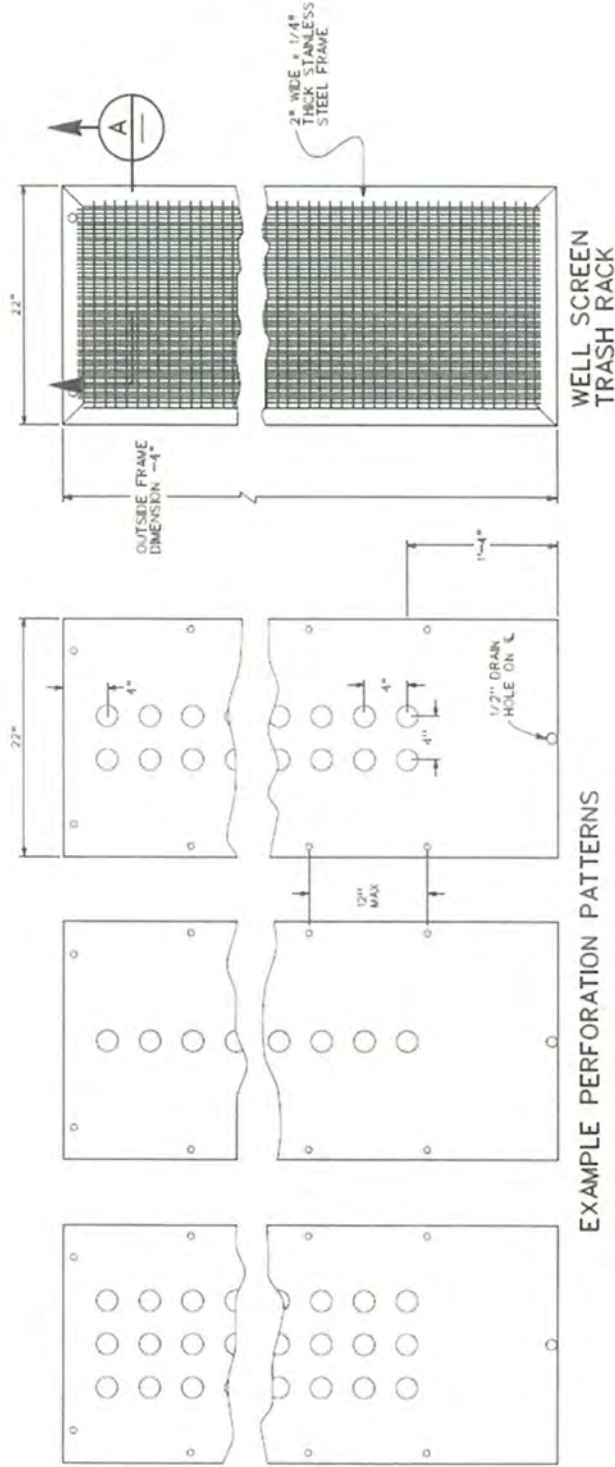


EXTENDED DETENTION BASIN BMP FACT SHEET



EXTENDED DETENTION BASIN BMP FACT SHEET

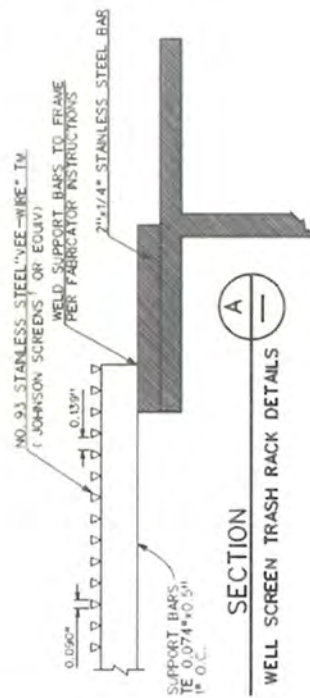
BASED ON DENVER UDFCD STD



EXAMPLE PERFORATION PATTERNS

WELL SCREEN TRASH RACK

- NOTE:
1. THE GOAL IN DESIGNING THE OUTLET IS TO MINIMIZE THE NUMBER OF COLUMNS OF PERFORATIONS THAT WILL DRAIN THE VOLUME IN THE DESIRED TIME DO NOT, HOWEVER, INCREASE THE DIAMETER OF CIRCULAR PERFORATIONS BEYOND 2 INCHES. USE THE ALLOWED PERFORATION SHAPES AND CONFIGURATIONS SHOWN ABOVE. ALLOW WITH FRAME EDB-2 1/2\"/>
 - 2. PERFORATED PLATE TO BE 1/4\"/>



SECTION

WELL SCREEN TRASH RACK DETAILS

★ PRELIMINARY ★
SUBJECT TO REVISION

EDB BASIN OUTLET
PERFORATED PLATE &
WELL SCREEN TRASH RACK

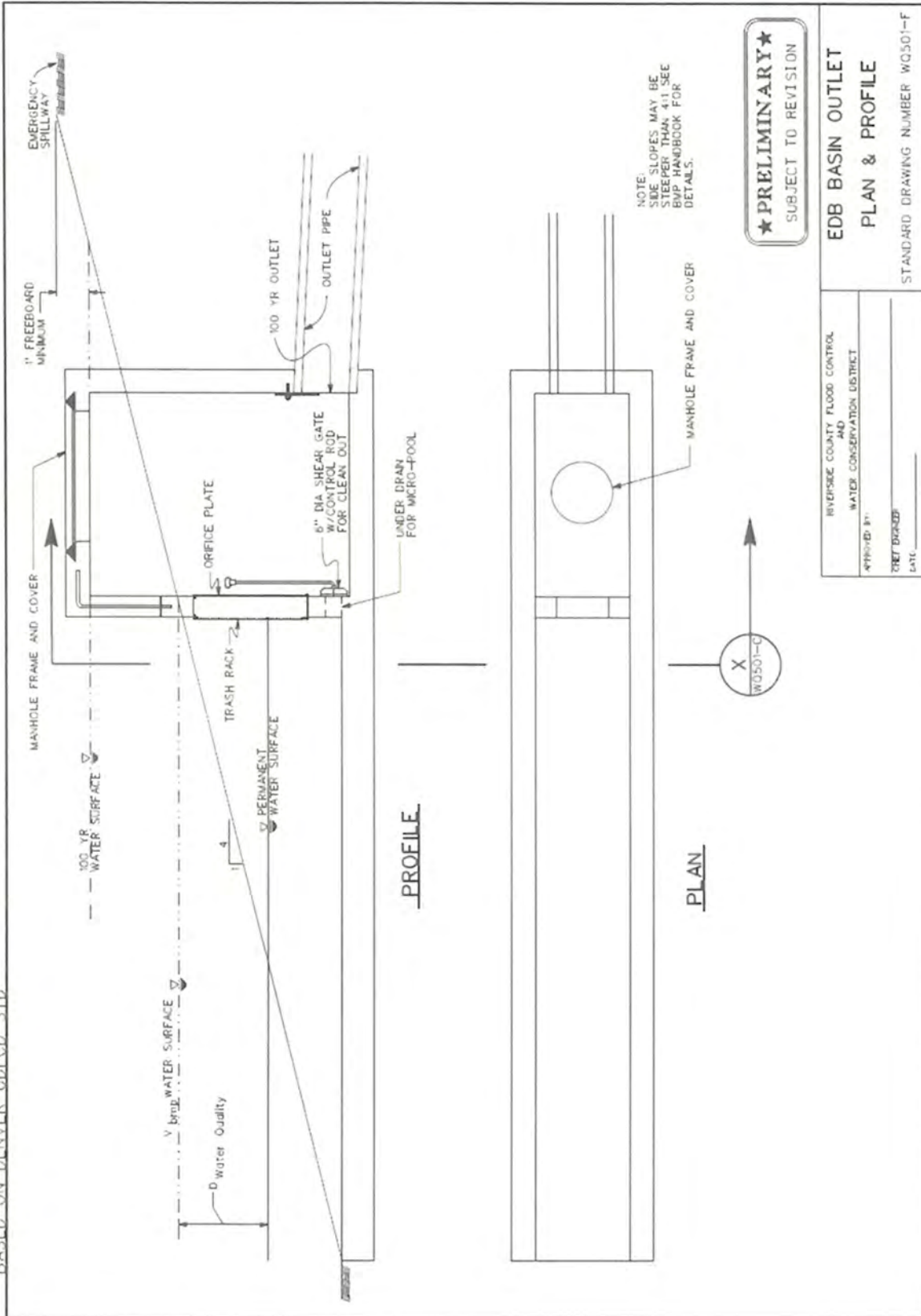
STANDARD DRAWING NUMBER W0501-E

RIVERSIDE COUNTY FLOOD CONTROL
AND
WATER CONSERVATION DISTRICT
APPROVED BY: _____
DATE: _____
DRAWN BY: _____
DATE: _____

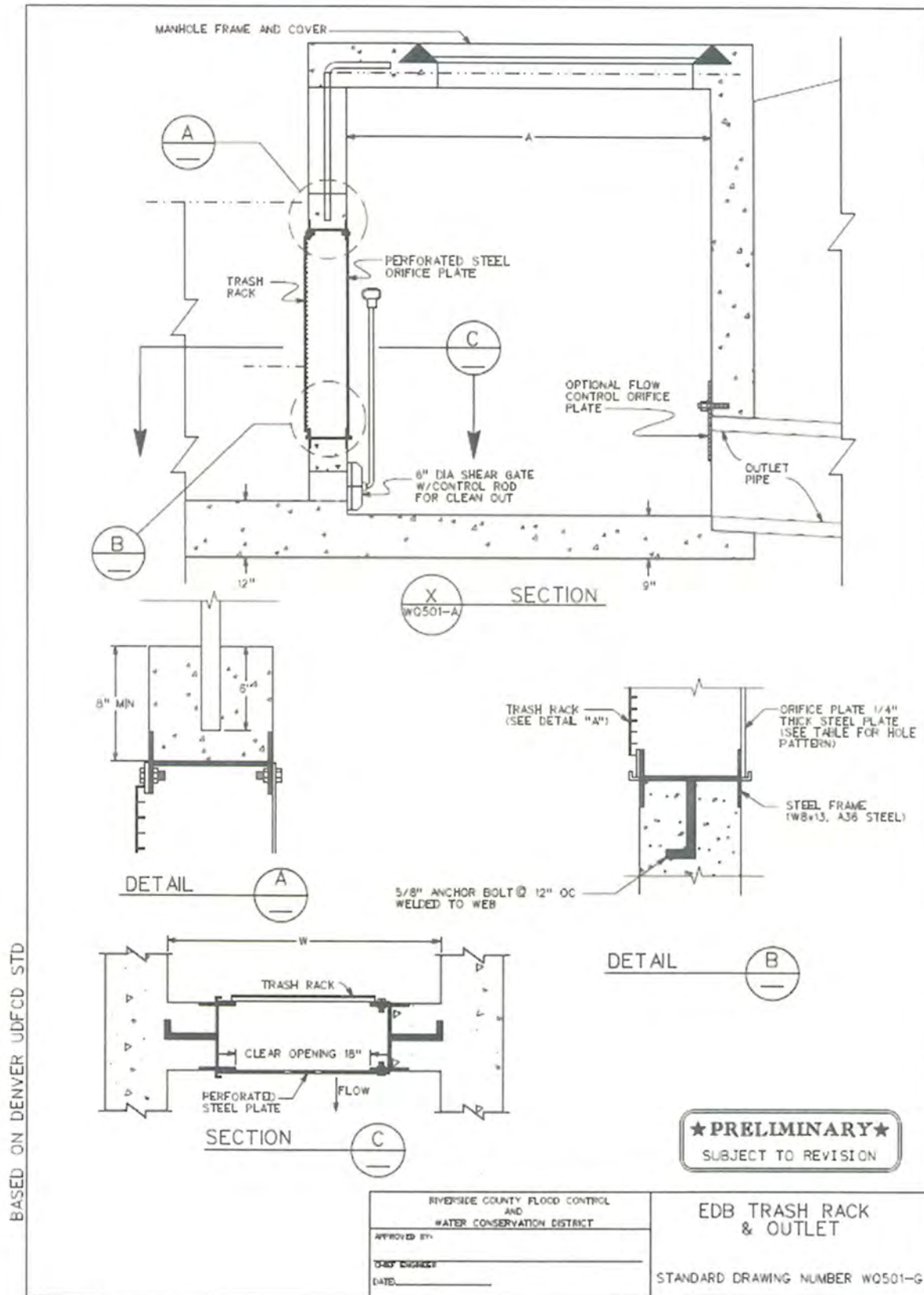
1 JOHNSON SCREENS, ST PAUL, MN USA 1-800-833-9473

EXTENDED DETENTION BASIN BMP FACT SHEET

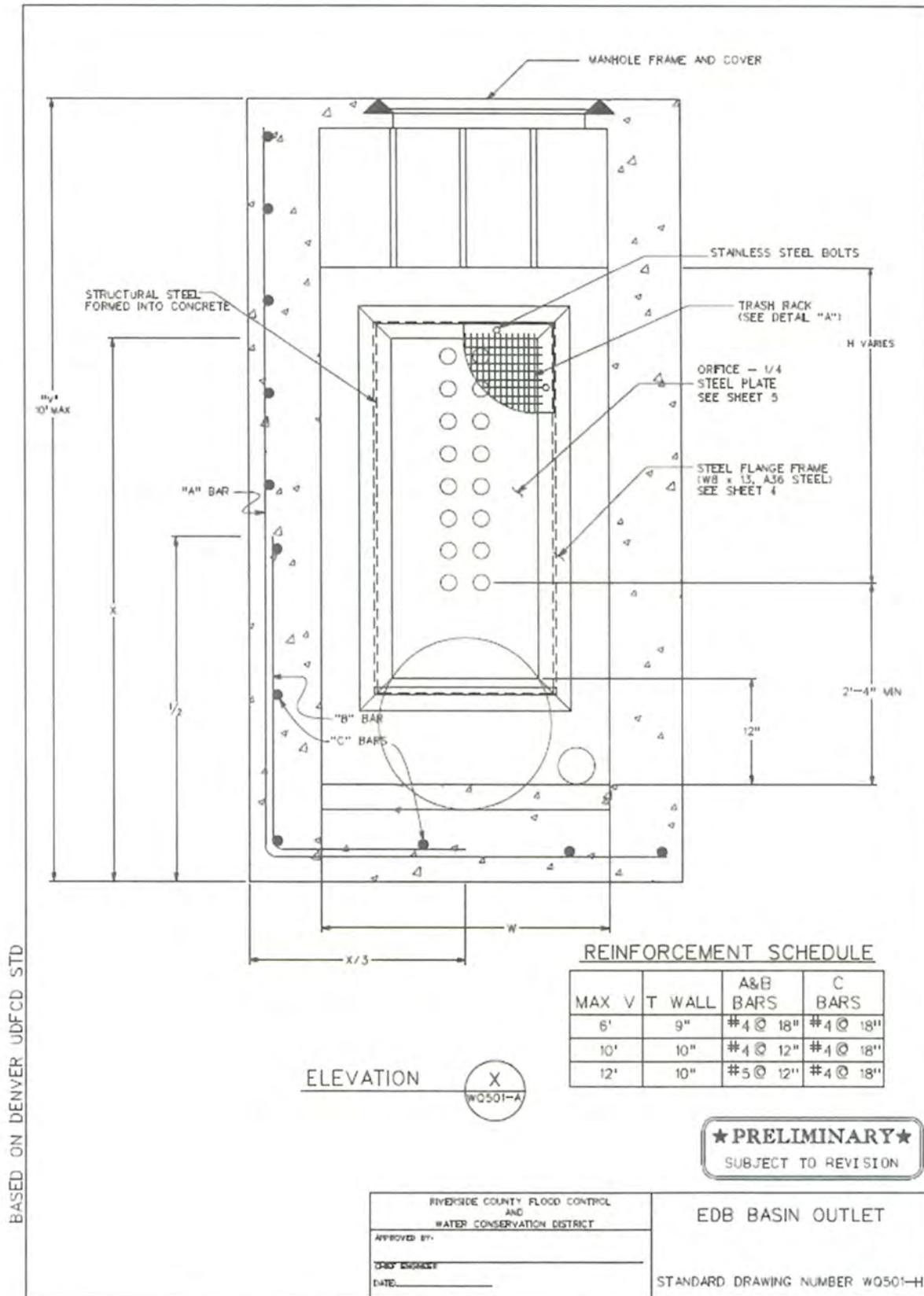
BASED ON DENVER UDFCD STD



EXTENDED DETENTION BASIN BMP FACT SHEET



EXTENDED DETENTION BASIN BMP FACT SHEET



Extended Detention Basin Design Procedure	BMP Subarea No.	Legend:	Required Entries
			Calculated Cells

Company Name: _____ Date: _____
 Designed by: _____ County/City Case No.: _____

Design Volume

Tributary Area (BMP Subarea) $A_T =$ _____ acres

Enter V_{BMP} , determined from Section 2.1 of this Handbook $V_{BMP} =$ _____ ft^3

Basin Footprint

Overall Geometry

Length at Basin Bottom Surface Length = _____ ft

Width at Basin Bottom Surface Width = _____ ft

Meets 1.5 : 1 requirement? ☐

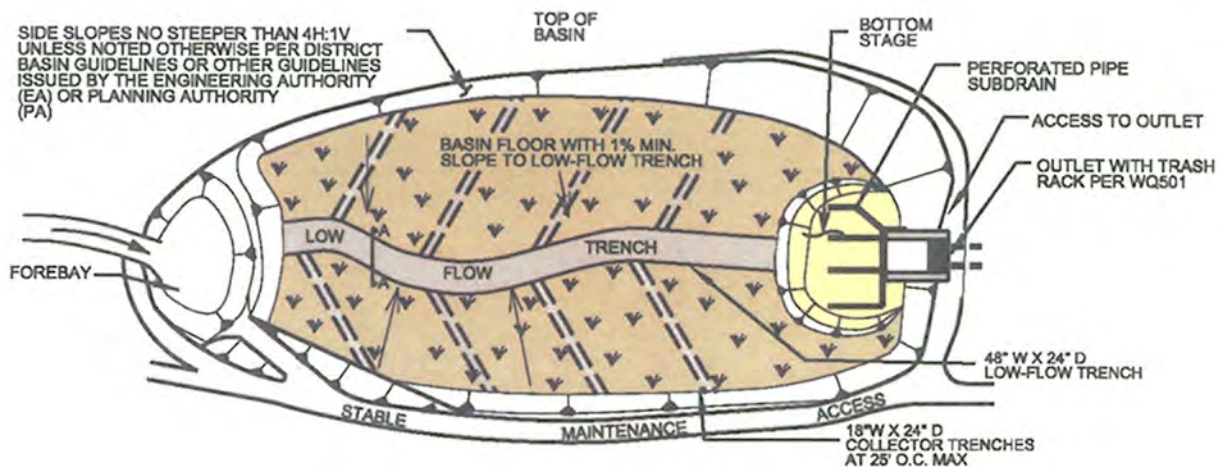
Side Slopes per "Basin Guidelines", Sect. 1.2 $z =$ _____ : 1

Proposed Basin Depth (with no freeboard) $D_B =$ _____ ft

Depth of freeboard (if used) $D_{FB} =$ _____ ft

Minimum Required Allowance for Total Depth (including proposed basin depth, freeboard, minimum depth of bottom stage ($D_{BS}=0.33'$) and minimum filter depth ($D_{FD}=2.33'$)) $D_{REQ} =$ _____ ft

Depth from design water surface elevation to lowest orifice $D_O =$ _____ ft



Basin Design

Basin Design

Proposed Total Basin Depth (proposed depth plus freeboard)

$D_{TOT} =$ ft

Basin Invert Longitudinal Slope

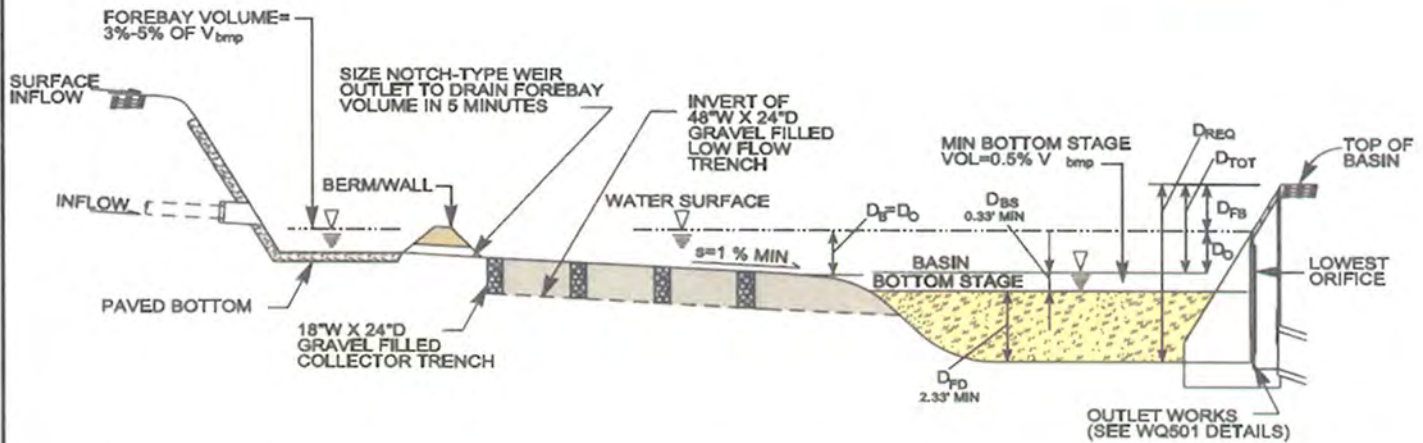
Slope = %

Basin Invert Transverse Slope (1% min)

Slope = %

Basin Volume

$V_{Basin} =$ ft³



Forebay Design

Forebay Volume (3 - 5% V_{BMP})

$V_{FB} =$ ft³

Forebay Depth (height of berm)

$D_{FBY} =$ ft

Minimum Forebay Surface Area

$A_{FB} =$ ft²

Rectangular weir (notch)

$W =$ in

Low-Flow Trench (see graphic below)

Depth (24 inches minimum, gravel filled)

Depth = inches

Width (48 inches minimum)

Width = inches

Trench Invert Longitudinal Slope

Slope = %

Collector Trenches (see graphic below)

Depth (24 inches minimum)

Depth = inches

Width (18 inches minimum)

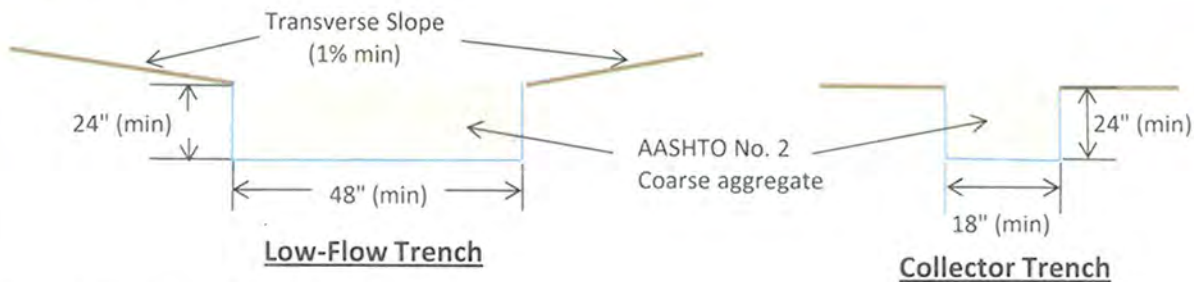
Width = inches

Trench Invert Longitudinal Slope

Slope = %

Spacing (25 feet on center maximum)

S = feet



Bottom Stage (Sand Filter) Design

Depth of the Bottom Stage (4" minimum ponding)

D_{BS} = in

Surface Area of Bottom Stage

A_{BS} = ft^2

Dry Weather Poned Volume (above sand layer)

V_{BS} = ft^3

Is V_{BS} no less than 0.5% V_{BMP} ? Enter Depth and Surface Area

Depth of ASTM-C33 sand (18 inch minimum)

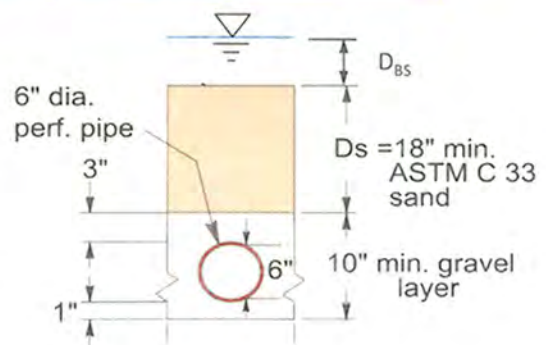
D_s = inches

Diameter of Subdrains

ϕ = in

Subdrain Spacing

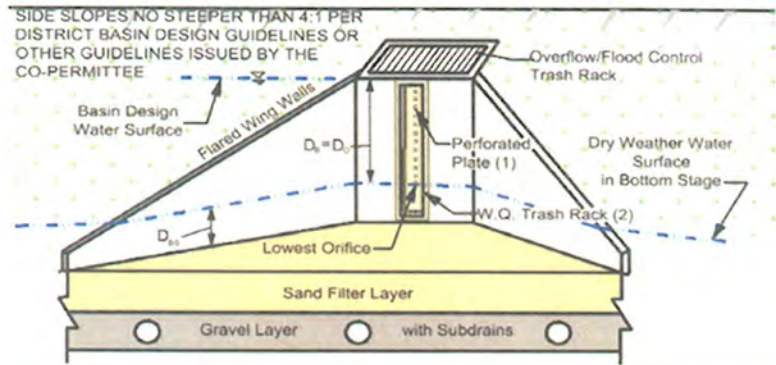
s = ft. on center



Basin Outlet Design

Outlet Design

Assume an orifice area. Based on the information provided above, the spreadsheet provides discharge vs. stage data. Enter the volume vs. stage data for each interval. This information is used to route the volume through the basin. The size of the orifice is acceptable when the data shows that less than 50% of V_{BMP} has drained in 24 hours, and that 100% drawdown occurs within 72 hours.



All values on this worksheet must be filled out to use this calculator

Flow Rate, Q (cfs)

$$Q = CA[2g(H-H_o)]^{0.5}$$

Discharge Coefficient,

Default, C =

Other, C =

Orifice Area (ft²)

Orifice Diameter, d; number of orifices per row, n; and number of orifice rows, N (from the bottom up).

d = inches

n = per row

N = rows

A_{eff} = ft² per row

or

A_{eff} = in² per row

From outflow hydrograph, the time where 50% of V_{BMP} has drained from the basin (24 hour minimum):

Time (50%) = Error * hrs

From outflow hydrograph, the time where 100% V_{BMP} has drained from the basin (within 72 hours):

Time (100 %) = Error * hrs

Headwater Elev. / Stage (ft)	Discharge (cfs)	Volume (acre-ft)	Δt (hrs.)
0	0.0000	0.0000	
0.33			
0.67			
1.00			
1.33			
1.67			
2.00			
2.33			
2.67			
3.00			
3.33			
3.67			
4.00			
4.33			
4.67			
5.00			
5.33			
5.67			
6.00			
6.33			
6.67			
7.00			
7.33			
7.67			
8.00			
8.33			
8.67			
9.00			
9.33			
9.67			
10.00			
		Σ =	0.00

Notes:

Appendix 7: Hydromodification

Supporting Detail Relating to Hydrologic Conditions of Concern

HCOC Mitigation

BASIN C	EXISTING VOLUME (AC-FT)	PROPOSED VOLUME (AC- FT)	DIFFERENCE IN VOLUME (AC-FT)
2Y1H	6.26	5.72	-0.54
2Y3H	7.51	7.40	-0.11
2Y6H	8.98	9.26	0.28
2Y24H	7.58	9.64	2.06
5Y1H	11.20	9.93	-1.27
5Y3H	13.09	12.19	-0.90
5Y6H	16.34	15.74	-0.59
5Y24H	25.10	25.39	0.29
10Y1H	19.97	17.62	-2.35
10Y3H	29.26	26.06	-3.20
10Y6H	36.32	32.76	-3.56
10Y24H	76.75	70.20	-6.54
100Y1H	33.69	29.42	-4.27
100Y3H	52.03	45.41	-6.62
100Y6H	70.65	61.60	-9.05
100Y24H	169.77	149.45	-20.32

EXISTING TRIBUTARY AREA = 311.59 AC

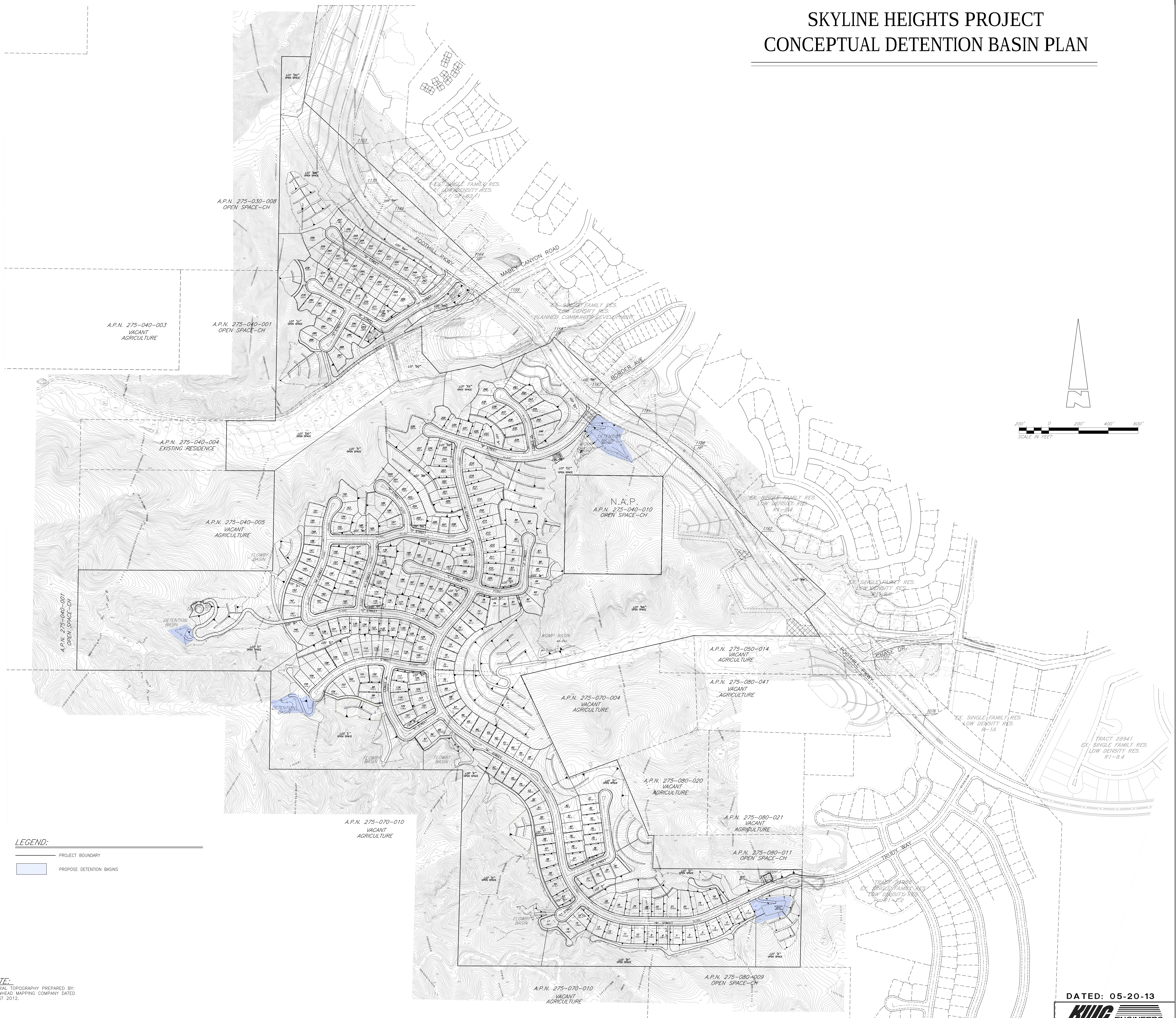
PROPOSED TRIBUTARY AREA = 272.25 AC

DETENTION REQUIRED = 2.06 AC-FT

Project Detention:

The Skyline Heights project proposes to mitigate increase runoff due to development through the use of proposed onsite detention basins. These detention basins will be design to detain the required detention volume which will also meet the HCOC requirement for Area C so that the post-development hydrograph mimicks the pre-development hydrograph for the 2-year return frequency. A site plan shows the location of the proposed onsite detention basins.

SKYLINE HEIGHTS PROJECT CONCEPTUAL DETENTION BASIN PLAN



NOTE:
1. AERIAL TOPOGRAPHY PREPARED BY:
ARROWHEAD MAPPING COMPANY DATED
AUGUST 2012.

DATED: 05-20-13



Unit Hydrograph Analysis

Copyright (c) CIVILCADD/CIVILDESIGN, 1989 - 2004, Version 7.0

Study date 05/01/13 File: 1344unit2exc242.out

+++++

Riverside County Synthetic Unit Hydrology Method
RCFC & WCD Manual date - April 1978

Program License Serial Number 6062

English (in-lb) Input Units Used
English Rainfall Data (Inches) Input Values Used

English Units used in output format

SKYLINE HEIGHTS
UNIT HYDROGRAPH
EXISTING CONDITION
AREA C 2-YEAR STORM 24-HOUR

Drainage Area = 311.59 (Ac.) = 0.487 Sq. Mi.
Drainage Area for Depth-Area Areal Adjustment = 311.59 (Ac.) = 0.487
Sq. Mi.
Length along longest watercourse = 7273.00 (Ft.)
Length along longest watercourse measured to centroid = 2540.00 (Ft.)
Length along longest watercourse = 1.377 Mi.
Length along longest watercourse measured to centroid = 0.481 Mi.
Difference in elevation = 1484.00 (Ft.)
Slope along watercourse = 1077.3436 Ft./Mi.
Average Manning's 'N' = 0.040
Lag time = 0.218 Hr.
Lag time = 13.07 Min.
25% of lag time = 3.27 Min.
40% of lag time = 5.23 Min.
Unit time = 5.00 Min.
Duration of storm = 24 Hour(s)
User Entered Base Flow = 0.00 (CFS)

2 YEAR Area rainfall data:

Area (Ac.) [1]	Rainfall (In) [2]	Weighting [1*2]
311.59	3.00	934.77

100 YEAR Area rainfall data:

Area (Ac.) [1]	Rainfall (In) [2]	Weighting [1*2]
----------------	-------------------	-----------------

311.59

10.50

3271.69

STORM EVENT (YEAR) = 2.00
 Area Averaged 2-Year Rainfall = 3.000(In)
 Area Averaged 100-Year Rainfall = 10.500(In)

Point rain (area averaged) = 3.000(In)
 Areal adjustment factor = 99.94 %
 Adjusted average point rain = 2.998(In)

Sub-Area Data:

Area(Ac.) Runoff Index Impervious %
 311.590 84.00 0.000
 Total Area Entered = 311.59(Ac.)

RI	RI	Infil. Rate	Impervious	Adj. Infil. Rate	Area%	F
AMC2	AMC-1	(In/Hr)	(Dec.%)	(In/Hr)	(Dec.)	(In/Hr)
84.0	68.6	0.377	0.000	0.377	1.000	0.377
Sum (F) =						0.377

Area averaged mean soil loss (F) (In/Hr) = 0.377

Minimum soil loss rate ((In/Hr)) = 0.189

(for 24 hour storm duration)

Soil loss rate (decimal) = 0.900

Unit Hydrograph
 FOOTHILL S-Curve

Unit Hydrograph Data

Unit time period (hrs)	Time % of lag	Distribution Graph %	Unit Hydrograph (CFS)
1	0.083	38.248	2.948
2	0.167	76.496	10.746
3	0.250	114.744	28.526
4	0.333	152.992	24.367
5	0.417	191.240	10.353
6	0.500	229.488	6.906
7	0.583	267.736	4.889
8	0.667	305.984	3.596
9	0.750	344.232	2.599
10	0.833	382.480	1.792
11	0.917	420.728	1.133
12	1.000	458.976	0.521
13	1.083	497.224	0.405
14	1.167	535.472	0.317
15	1.250	573.720	0.245
16	1.333	611.968	0.293
17	1.417	650.216	0.189
18	1.500	688.464	0.114
19	1.583	726.712	0.061
Sum = 100.000		Sum=	314.024

Unit Time Pattern Storm Rain Loss rate(In./Hr) Effective

	(Hr.)	Percent	(In/Hr)	Max	Low	(In/Hr)
1	0.08	0.07	0.024	0.669	0.022	0.00
2	0.17	0.07	0.024	0.666	0.022	0.00
3	0.25	0.07	0.024	0.663	0.022	0.00
4	0.33	0.10	0.036	0.661	0.032	0.00
5	0.42	0.10	0.036	0.658	0.032	0.00
6	0.50	0.10	0.036	0.656	0.032	0.00
7	0.58	0.10	0.036	0.653	0.032	0.00
8	0.67	0.10	0.036	0.651	0.032	0.00
9	0.75	0.10	0.036	0.648	0.032	0.00
10	0.83	0.13	0.048	0.645	0.043	0.00
11	0.92	0.13	0.048	0.643	0.043	0.00
12	1.00	0.13	0.048	0.640	0.043	0.00
13	1.08	0.10	0.036	0.638	0.032	0.00
14	1.17	0.10	0.036	0.635	0.032	0.00
15	1.25	0.10	0.036	0.633	0.032	0.00
16	1.33	0.10	0.036	0.630	0.032	0.00
17	1.42	0.10	0.036	0.628	0.032	0.00
18	1.50	0.10	0.036	0.625	0.032	0.00
19	1.58	0.10	0.036	0.623	0.032	0.00
20	1.67	0.10	0.036	0.620	0.032	0.00
21	1.75	0.10	0.036	0.618	0.032	0.00
22	1.83	0.13	0.048	0.615	0.043	0.00
23	1.92	0.13	0.048	0.613	0.043	0.00
24	2.00	0.13	0.048	0.610	0.043	0.00
25	2.08	0.13	0.048	0.608	0.043	0.00
26	2.17	0.13	0.048	0.605	0.043	0.00
27	2.25	0.13	0.048	0.603	0.043	0.00
28	2.33	0.13	0.048	0.600	0.043	0.00
29	2.42	0.13	0.048	0.598	0.043	0.00
30	2.50	0.13	0.048	0.596	0.043	0.00
31	2.58	0.17	0.060	0.593	0.054	0.01
32	2.67	0.17	0.060	0.591	0.054	0.01
33	2.75	0.17	0.060	0.588	0.054	0.01
34	2.83	0.17	0.060	0.586	0.054	0.01
35	2.92	0.17	0.060	0.583	0.054	0.01
36	3.00	0.17	0.060	0.581	0.054	0.01
37	3.08	0.17	0.060	0.579	0.054	0.01
38	3.17	0.17	0.060	0.576	0.054	0.01
39	3.25	0.17	0.060	0.574	0.054	0.01
40	3.33	0.17	0.060	0.571	0.054	0.01
41	3.42	0.17	0.060	0.569	0.054	0.01
42	3.50	0.17	0.060	0.567	0.054	0.01
43	3.58	0.17	0.060	0.564	0.054	0.01
44	3.67	0.17	0.060	0.562	0.054	0.01
45	3.75	0.17	0.060	0.560	0.054	0.01
46	3.83	0.20	0.072	0.557	0.065	0.01
47	3.92	0.20	0.072	0.555	0.065	0.01
48	4.00	0.20	0.072	0.553	0.065	0.01
49	4.08	0.20	0.072	0.550	0.065	0.01
50	4.17	0.20	0.072	0.548	0.065	0.01
51	4.25	0.20	0.072	0.546	0.065	0.01
52	4.33	0.23	0.084	0.543	0.076	0.01
53	4.42	0.23	0.084	0.541	0.076	0.01
54	4.50	0.23	0.084	0.539	0.076	0.01
55	4.58	0.23	0.084	0.536	0.076	0.01
56	4.67	0.23	0.084	0.534	0.076	0.01
57	4.75	0.23	0.084	0.532	0.076	0.01

58	4.83	0.27	0.096	0.529	0.086	0.01
59	4.92	0.27	0.096	0.527	0.086	0.01
60	5.00	0.27	0.096	0.525	0.086	0.01
61	5.08	0.20	0.072	0.522	0.065	0.01
62	5.17	0.20	0.072	0.520	0.065	0.01
63	5.25	0.20	0.072	0.518	0.065	0.01
64	5.33	0.23	0.084	0.516	0.076	0.01
65	5.42	0.23	0.084	0.513	0.076	0.01
66	5.50	0.23	0.084	0.511	0.076	0.01
67	5.58	0.27	0.096	0.509	0.086	0.01
68	5.67	0.27	0.096	0.507	0.086	0.01
69	5.75	0.27	0.096	0.504	0.086	0.01
70	5.83	0.27	0.096	0.502	0.086	0.01
71	5.92	0.27	0.096	0.500	0.086	0.01
72	6.00	0.27	0.096	0.498	0.086	0.01
73	6.08	0.30	0.108	0.496	0.097	0.01
74	6.17	0.30	0.108	0.493	0.097	0.01
75	6.25	0.30	0.108	0.491	0.097	0.01
76	6.33	0.30	0.108	0.489	0.097	0.01
77	6.42	0.30	0.108	0.487	0.097	0.01
78	6.50	0.30	0.108	0.485	0.097	0.01
79	6.58	0.33	0.120	0.482	0.108	0.01
80	6.67	0.33	0.120	0.480	0.108	0.01
81	6.75	0.33	0.120	0.478	0.108	0.01
82	6.83	0.33	0.120	0.476	0.108	0.01
83	6.92	0.33	0.120	0.474	0.108	0.01
84	7.00	0.33	0.120	0.472	0.108	0.01
85	7.08	0.33	0.120	0.469	0.108	0.01
86	7.17	0.33	0.120	0.467	0.108	0.01
87	7.25	0.33	0.120	0.465	0.108	0.01
88	7.33	0.37	0.132	0.463	0.119	0.01
89	7.42	0.37	0.132	0.461	0.119	0.01
90	7.50	0.37	0.132	0.459	0.119	0.01
91	7.58	0.40	0.144	0.457	0.130	0.01
92	7.67	0.40	0.144	0.455	0.130	0.01
93	7.75	0.40	0.144	0.453	0.130	0.01
94	7.83	0.43	0.156	0.450	0.140	0.02
95	7.92	0.43	0.156	0.448	0.140	0.02
96	8.00	0.43	0.156	0.446	0.140	0.02
97	8.08	0.50	0.180	0.444	0.162	0.02
98	8.17	0.50	0.180	0.442	0.162	0.02
99	8.25	0.50	0.180	0.440	0.162	0.02
100	8.33	0.50	0.180	0.438	0.162	0.02
101	8.42	0.50	0.180	0.436	0.162	0.02
102	8.50	0.50	0.180	0.434	0.162	0.02
103	8.58	0.53	0.192	0.432	0.173	0.02
104	8.67	0.53	0.192	0.430	0.173	0.02
105	8.75	0.53	0.192	0.428	0.173	0.02
106	8.83	0.57	0.204	0.426	0.183	0.02
107	8.92	0.57	0.204	0.424	0.183	0.02
108	9.00	0.57	0.204	0.422	0.183	0.02
109	9.08	0.63	0.228	0.420	0.205	0.02
110	9.17	0.63	0.228	0.418	0.205	0.02
111	9.25	0.63	0.228	0.416	0.205	0.02
112	9.33	0.67	0.240	0.414	0.216	0.02
113	9.42	0.67	0.240	0.412	0.216	0.02
114	9.50	0.67	0.240	0.410	0.216	0.02
115	9.58	0.70	0.252	0.408	0.227	0.03

116	9.67	0.70	0.252	0.406	0.227	0.03
117	9.75	0.70	0.252	0.404	0.227	0.03
118	9.83	0.73	0.264	0.402	0.237	0.03
119	9.92	0.73	0.264	0.400	0.237	0.03
120	10.00	0.73	0.264	0.398	0.237	0.03
121	10.08	0.50	0.180	0.396	0.162	0.02
122	10.17	0.50	0.180	0.394	0.162	0.02
123	10.25	0.50	0.180	0.392	0.162	0.02
124	10.33	0.50	0.180	0.391	0.162	0.02
125	10.42	0.50	0.180	0.389	0.162	0.02
126	10.50	0.50	0.180	0.387	0.162	0.02
127	10.58	0.67	0.240	0.385	0.216	0.02
128	10.67	0.67	0.240	0.383	0.216	0.02
129	10.75	0.67	0.240	0.381	0.216	0.02
130	10.83	0.67	0.240	0.379	0.216	0.02
131	10.92	0.67	0.240	0.377	0.216	0.02
132	11.00	0.67	0.240	0.376	0.216	0.02
133	11.08	0.63	0.228	0.374	0.205	0.02
134	11.17	0.63	0.228	0.372	0.205	0.02
135	11.25	0.63	0.228	0.370	0.205	0.02
136	11.33	0.63	0.228	0.368	0.205	0.02
137	11.42	0.63	0.228	0.366	0.205	0.02
138	11.50	0.63	0.228	0.365	0.205	0.02
139	11.58	0.57	0.204	0.363	0.183	0.02
140	11.67	0.57	0.204	0.361	0.183	0.02
141	11.75	0.57	0.204	0.359	0.183	0.02
142	11.83	0.60	0.216	0.357	0.194	0.02
143	11.92	0.60	0.216	0.356	0.194	0.02
144	12.00	0.60	0.216	0.354	0.194	0.02
145	12.08	0.83	0.300	0.352	0.270	0.03
146	12.17	0.83	0.300	0.350	0.270	0.03
147	12.25	0.83	0.300	0.349	0.270	0.03
148	12.33	0.87	0.312	0.347	0.281	0.03
149	12.42	0.87	0.312	0.345	0.281	0.03
150	12.50	0.87	0.312	0.343	0.281	0.03
151	12.58	0.93	0.336	0.342	0.302	0.03
152	12.67	0.93	0.336	0.340	0.302	0.03
153	12.75	0.93	0.336	0.338	0.302	0.03
154	12.83	0.97	0.348	0.336	---	0.01
155	12.92	0.97	0.348	0.335	---	0.01
156	13.00	0.97	0.348	0.333	---	0.01
157	13.08	1.13	0.408	0.331	---	0.08
158	13.17	1.13	0.408	0.330	---	0.08
159	13.25	1.13	0.408	0.328	---	0.08
160	13.33	1.13	0.408	0.326	---	0.08
161	13.42	1.13	0.408	0.325	---	0.08
162	13.50	1.13	0.408	0.323	---	0.08
163	13.58	0.77	0.276	0.321	0.248	0.03
164	13.67	0.77	0.276	0.320	0.248	0.03
165	13.75	0.77	0.276	0.318	0.248	0.03
166	13.83	0.77	0.276	0.316	0.248	0.03
167	13.92	0.77	0.276	0.315	0.248	0.03
168	14.00	0.77	0.276	0.313	0.248	0.03
169	14.08	0.90	0.324	0.312	---	0.01
170	14.17	0.90	0.324	0.310	---	0.01
171	14.25	0.90	0.324	0.308	---	0.02
172	14.33	0.87	0.312	0.307	---	0.00
173	14.42	0.87	0.312	0.305	---	0.01

174	14.50	0.87	0.312	0.304	---	0.01
175	14.58	0.87	0.312	0.302	---	0.01
176	14.67	0.87	0.312	0.301	---	0.01
177	14.75	0.87	0.312	0.299	---	0.01
178	14.83	0.83	0.300	0.298	---	0.00
179	14.92	0.83	0.300	0.296	---	0.00
180	15.00	0.83	0.300	0.295	---	0.01
181	15.08	0.80	0.288	0.293	0.259	0.03
182	15.17	0.80	0.288	0.292	0.259	0.03
183	15.25	0.80	0.288	0.290	0.259	0.03
184	15.33	0.77	0.276	0.289	0.248	0.03
185	15.42	0.77	0.276	0.287	0.248	0.03
186	15.50	0.77	0.276	0.286	0.248	0.03
187	15.58	0.63	0.228	0.284	0.205	0.02
188	15.67	0.63	0.228	0.283	0.205	0.02
189	15.75	0.63	0.228	0.281	0.205	0.02
190	15.83	0.63	0.228	0.280	0.205	0.02
191	15.92	0.63	0.228	0.278	0.205	0.02
192	16.00	0.63	0.228	0.277	0.205	0.02
193	16.08	0.13	0.048	0.276	0.043	0.00
194	16.17	0.13	0.048	0.274	0.043	0.00
195	16.25	0.13	0.048	0.273	0.043	0.00
196	16.33	0.13	0.048	0.271	0.043	0.00
197	16.42	0.13	0.048	0.270	0.043	0.00
198	16.50	0.13	0.048	0.269	0.043	0.00
199	16.58	0.10	0.036	0.267	0.032	0.00
200	16.67	0.10	0.036	0.266	0.032	0.00
201	16.75	0.10	0.036	0.264	0.032	0.00
202	16.83	0.10	0.036	0.263	0.032	0.00
203	16.92	0.10	0.036	0.262	0.032	0.00
204	17.00	0.10	0.036	0.260	0.032	0.00
205	17.08	0.17	0.060	0.259	0.054	0.01
206	17.17	0.17	0.060	0.258	0.054	0.01
207	17.25	0.17	0.060	0.257	0.054	0.01
208	17.33	0.17	0.060	0.255	0.054	0.01
209	17.42	0.17	0.060	0.254	0.054	0.01
210	17.50	0.17	0.060	0.253	0.054	0.01
211	17.58	0.17	0.060	0.251	0.054	0.01
212	17.67	0.17	0.060	0.250	0.054	0.01
213	17.75	0.17	0.060	0.249	0.054	0.01
214	17.83	0.13	0.048	0.248	0.043	0.00
215	17.92	0.13	0.048	0.247	0.043	0.00
216	18.00	0.13	0.048	0.245	0.043	0.00
217	18.08	0.13	0.048	0.244	0.043	0.00
218	18.17	0.13	0.048	0.243	0.043	0.00
219	18.25	0.13	0.048	0.242	0.043	0.00
220	18.33	0.13	0.048	0.241	0.043	0.00
221	18.42	0.13	0.048	0.239	0.043	0.00
222	18.50	0.13	0.048	0.238	0.043	0.00
223	18.58	0.10	0.036	0.237	0.032	0.00
224	18.67	0.10	0.036	0.236	0.032	0.00
225	18.75	0.10	0.036	0.235	0.032	0.00
226	18.83	0.07	0.024	0.234	0.022	0.00
227	18.92	0.07	0.024	0.233	0.022	0.00
228	19.00	0.07	0.024	0.231	0.022	0.00
229	19.08	0.10	0.036	0.230	0.032	0.00
230	19.17	0.10	0.036	0.229	0.032	0.00
231	19.25	0.10	0.036	0.228	0.032	0.00

232	19.33	0.13	0.048	0.227	0.043	0.00
233	19.42	0.13	0.048	0.226	0.043	0.00
234	19.50	0.13	0.048	0.225	0.043	0.00
235	19.58	0.10	0.036	0.224	0.032	0.00
236	19.67	0.10	0.036	0.223	0.032	0.00
237	19.75	0.10	0.036	0.222	0.032	0.00
238	19.83	0.07	0.024	0.221	0.022	0.00
239	19.92	0.07	0.024	0.220	0.022	0.00
240	20.00	0.07	0.024	0.219	0.022	0.00
241	20.08	0.10	0.036	0.218	0.032	0.00
242	20.17	0.10	0.036	0.217	0.032	0.00
243	20.25	0.10	0.036	0.216	0.032	0.00
244	20.33	0.10	0.036	0.215	0.032	0.00
245	20.42	0.10	0.036	0.214	0.032	0.00
246	20.50	0.10	0.036	0.213	0.032	0.00
247	20.58	0.10	0.036	0.212	0.032	0.00
248	20.67	0.10	0.036	0.212	0.032	0.00
249	20.75	0.10	0.036	0.211	0.032	0.00
250	20.83	0.07	0.024	0.210	0.022	0.00
251	20.92	0.07	0.024	0.209	0.022	0.00
252	21.00	0.07	0.024	0.208	0.022	0.00
253	21.08	0.10	0.036	0.207	0.032	0.00
254	21.17	0.10	0.036	0.207	0.032	0.00
255	21.25	0.10	0.036	0.206	0.032	0.00
256	21.33	0.07	0.024	0.205	0.022	0.00
257	21.42	0.07	0.024	0.204	0.022	0.00
258	21.50	0.07	0.024	0.203	0.022	0.00
259	21.58	0.10	0.036	0.203	0.032	0.00
260	21.67	0.10	0.036	0.202	0.032	0.00
261	21.75	0.10	0.036	0.201	0.032	0.00
262	21.83	0.07	0.024	0.200	0.022	0.00
263	21.92	0.07	0.024	0.200	0.022	0.00
264	22.00	0.07	0.024	0.199	0.022	0.00
265	22.08	0.10	0.036	0.198	0.032	0.00
266	22.17	0.10	0.036	0.198	0.032	0.00
267	22.25	0.10	0.036	0.197	0.032	0.00
268	22.33	0.07	0.024	0.197	0.022	0.00
269	22.42	0.07	0.024	0.196	0.022	0.00
270	22.50	0.07	0.024	0.195	0.022	0.00
271	22.58	0.07	0.024	0.195	0.022	0.00
272	22.67	0.07	0.024	0.194	0.022	0.00
273	22.75	0.07	0.024	0.194	0.022	0.00
274	22.83	0.07	0.024	0.193	0.022	0.00
275	22.92	0.07	0.024	0.193	0.022	0.00
276	23.00	0.07	0.024	0.192	0.022	0.00
277	23.08	0.07	0.024	0.192	0.022	0.00
278	23.17	0.07	0.024	0.191	0.022	0.00
279	23.25	0.07	0.024	0.191	0.022	0.00
280	23.33	0.07	0.024	0.191	0.022	0.00
281	23.42	0.07	0.024	0.190	0.022	0.00
282	23.50	0.07	0.024	0.190	0.022	0.00
283	23.58	0.07	0.024	0.190	0.022	0.00
284	23.67	0.07	0.024	0.189	0.022	0.00
285	23.75	0.07	0.024	0.189	0.022	0.00
286	23.83	0.07	0.024	0.189	0.022	0.00
287	23.92	0.07	0.024	0.189	0.022	0.00
288	24.00	0.07	0.024	0.189	0.022	0.00
Sum =		100.0			Sum =	3.5

Flood volume = Effective rainfall 0.29(In)
 times area 311.6(Ac.)/[(In)/(Ft.)) = 7.6(Ac.Ft)
 Total soil loss = 2.71(In)
 Total soil loss = 70.271(Ac.Ft)
 Total rainfall = 3.00(In)
 Flood volume = 330153.6 Cubic Feet
 Total soil loss = 3060996.5 Cubic Feet

 Peak flow rate of this hydrograph = 22.933(CFS)

+++++

24 - H O U R S T O R M
 R u n o f f H y d r o g r a p h

 Hydrograph in 5 Minute intervals ((CFS))

Time(h+m)	Volume Ac.Ft	Q(CFS)	0	7.5	15.0	22.5	30.0
0+ 5	0.0002	0.02	Q				
0+10	0.0009	0.10	Q				
0+15	0.0031	0.32	Q				
0+20	0.0066	0.51	Q				
0+25	0.0109	0.63	Q				
0+30	0.0164	0.79	VQ				
0+35	0.0227	0.92	VQ				
0+40	0.0295	0.99	VQ				
0+45	0.0366	1.03	VQ				
0+50	0.0440	1.07	VQ				
0+55	0.0518	1.14	VQ				
1+ 0	0.0605	1.26	VQ				
1+ 5	0.0698	1.35	VQ				
1+10	0.0791	1.35	VQ				
1+15	0.0879	1.28	VQ				
1+20	0.0962	1.21	VQ				
1+25	0.1044	1.18	VQ				
1+30	0.1124	1.17	VQ				
1+35	0.1204	1.16	VQ				
1+40	0.1283	1.15	VQ				
1+45	0.1362	1.14	VQ				
1+50	0.1441	1.15	VQ				
1+55	0.1523	1.19	VQ				
2+ 0	0.1612	1.29	VQ				
2+ 5	0.1707	1.38	VQ				
2+10	0.1805	1.42	VQ				
2+15	0.1905	1.45	Q				
2+20	0.2006	1.47	Q				
2+25	0.2108	1.48	Q				
2+30	0.2210	1.49	Q				
2+35	0.2314	1.51	VQ				
2+40	0.2421	1.55	VQ				
2+45	0.2535	1.66	VQ				
2+50	0.2656	1.75	VQ				
2+55	0.2779	1.79	VQ				
3+ 0	0.2905	1.82	VQ				
3+ 5	0.3032	1.84	VQ				
3+10	0.3159	1.85	VQ				
3+15	0.3288	1.86	VQ				

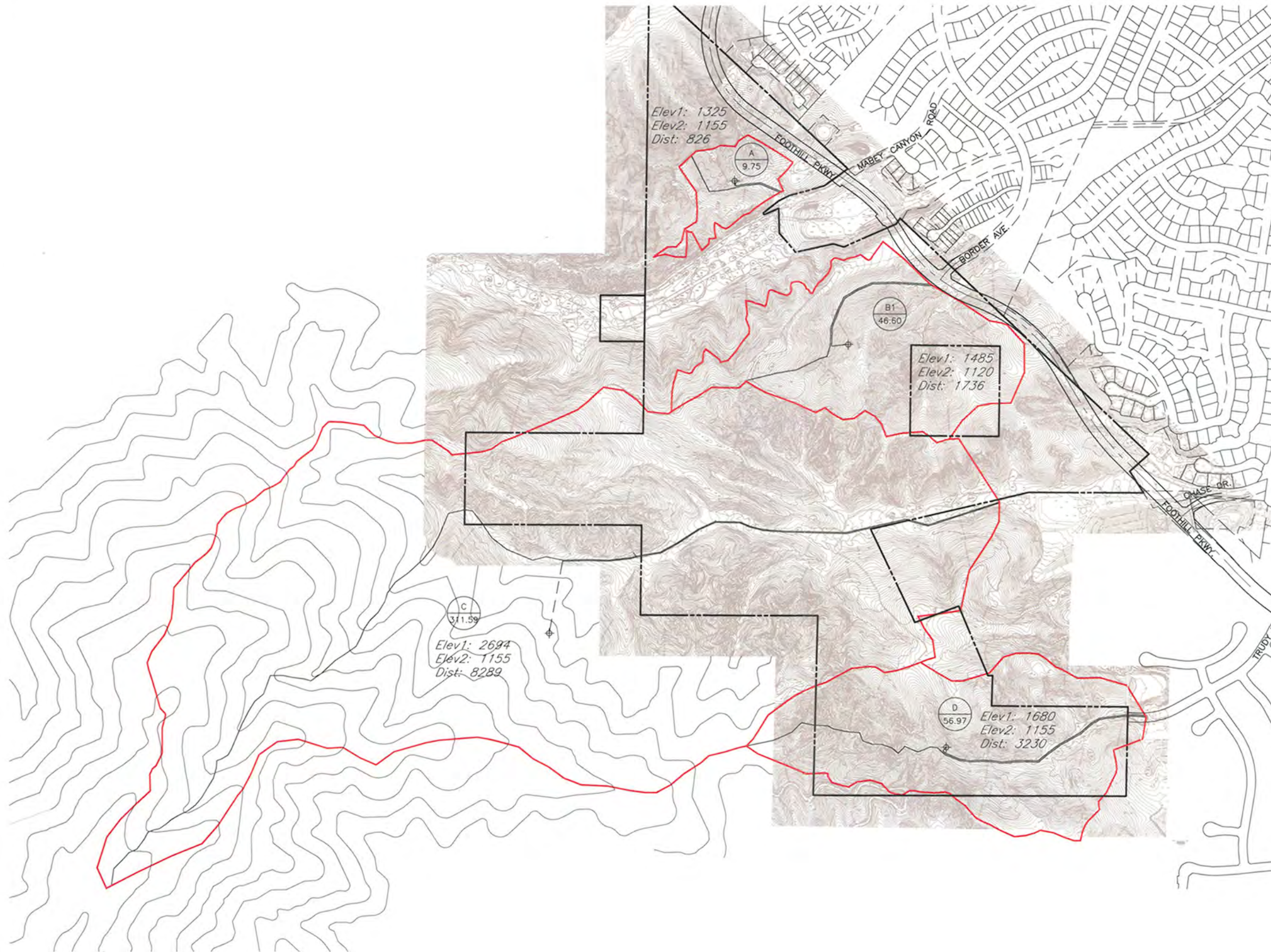
3+20	0.3417	1.87	VQ			
3+25	0.3546	1.88	VQ			
3+30	0.3675	1.88	VQ			
3+35	0.3805	1.88	Q			
3+40	0.3934	1.88	Q			
3+45	0.4064	1.88	Q			
3+50	0.4194	1.89	Q			
3+55	0.4327	1.93	Q			
4+ 0	0.4468	2.04	Q			
4+ 5	0.4615	2.13	Q			
4+10	0.4765	2.17	Q			
4+15	0.4916	2.20	Q			
4+20	0.5070	2.23	Q			
4+25	0.5227	2.28	VQ			
4+30	0.5392	2.40	VQ			
4+35	0.5565	2.50	VQ			
4+40	0.5740	2.54	Q			
4+45	0.5917	2.57	Q			
4+50	0.6096	2.60	Q			
4+55	0.6279	2.66	Q			
5+ 0	0.6470	2.78	Q			
5+ 5	0.6666	2.85	Q			
5+10	0.6860	2.82	Q			
5+15	0.7041	2.63	Q			
5+20	0.7212	2.48	Q			
5+25	0.7381	2.45	Q			
5+30	0.7555	2.52	Q			
5+35	0.7733	2.59	QV			
5+40	0.7916	2.65	QV			
5+45	0.8106	2.77	QV			
5+50	0.8304	2.87	QV			
5+55	0.8504	2.91	QV			
6+ 0	0.8707	2.94	QV			
6+ 5	0.8912	2.98	QV			
6+10	0.9121	3.04	Q			
6+15	0.9338	3.15	Q			
6+20	0.9562	3.25	QV			
6+25	0.9789	3.29	QV			
6+30	1.0018	3.32	QV			
6+35	1.0249	3.35	QV			
6+40	1.0484	3.41	QV			
6+45	1.0727	3.53	QV			
6+50	1.0977	3.63	QV			
6+55	1.1230	3.67	QV			
7+ 0	1.1484	3.70	Q V			
7+ 5	1.1741	3.72	Q V			
7+10	1.1998	3.74	Q V			
7+15	1.2256	3.75	Q V			
7+20	1.2515	3.77	QV			
7+25	1.2778	3.81	QV			
7+30	1.3048	3.92	QV			
7+35	1.3325	4.03	Q V			
7+40	1.3608	4.11	Q V			
7+45	1.3900	4.24	Q V			
7+50	1.4200	4.36	Q V			
7+55	1.4507	4.46	Q V			
8+ 0	1.4824	4.60	QV			
8+ 5	1.5150	4.74	QV			

8+10	1.5486	4.88	Q	V				
8+15	1.5840	5.13	Q	V				
8+20	1.6208	5.34	QV					
8+25	1.6582	5.44	QV					
8+30	1.6961	5.50	QV					
8+35	1.7344	5.56	Q	V				
8+40	1.7732	5.63	Q	V				
8+45	1.8129	5.76	Q	V				
8+50	1.8534	5.88	Q	V				
8+55	1.8945	5.97	Q	V				
9+ 0	1.9366	6.11	Q	V				
9+ 5	1.9797	6.25	Q	V				
9+10	2.0237	6.39	Q	V				
9+15	2.0694	6.64	Q	V				
9+20	2.1166	6.86	Q	V				
9+25	2.1648	7.00	Q	V				
9+30	2.2142	7.17	Q	V				
9+35	2.2646	7.32	Q	V				
9+40	2.3158	7.43	Q	V				
9+45	2.3680	7.59	Q	V				
9+50	2.4212	7.72	Q	V				
9+55	2.4752	7.83	Q	V				
10+ 0	2.5301	7.98	Q	V				
10+ 5	2.5853	8.02	Q	V				
10+10	2.6390	7.80	Q	V				
10+15	2.6878	7.08	Q	V				
10+20	2.7324	6.47	Q	V				
10+25	2.7752	6.22	Q	V				
10+30	2.8169	6.05	Q	V				
10+35	2.8581	5.99	Q	V				
10+40	2.9001	6.10	Q	V				
10+45	2.9454	6.57	Q	V				
10+50	2.9935	6.99	Q	V				
10+55	3.0428	7.15	Q	V				
11+ 0	3.0929	7.27	Q	V				
11+ 5	3.1434	7.34	Q	V				
11+10	3.1941	7.36	Q	V				
11+15	3.2444	7.30	Q	V				
11+20	3.2942	7.23	Q	V				
11+25	3.3439	7.21	Q	V				
11+30	3.3934	7.19	Q	V				
11+35	3.4427	7.16	Q	V				
11+40	3.4914	7.07	Q	V				
11+45	3.5385	6.85	Q	V				
11+50	3.5845	6.67	Q	V				
11+55	3.6302	6.64	Q	V				
12+ 0	3.6763	6.69	Q	V				
12+ 5	3.7233	6.82	Q	V				
12+10	3.7723	7.12	Q	V				
12+15	3.8265	7.88	Q	V				
12+20	3.8853	8.53	Q	V				
12+25	3.9463	8.85	Q	V				
12+30	4.0092	9.15	Q	V				
12+35	4.0739	9.39	Q	V				
12+40	4.1401	9.61	Q	V				
12+45	4.2084	9.92	Q	V				
12+50	4.2770	9.96	Q	V				
12+55	4.3414	9.35	Q	V				

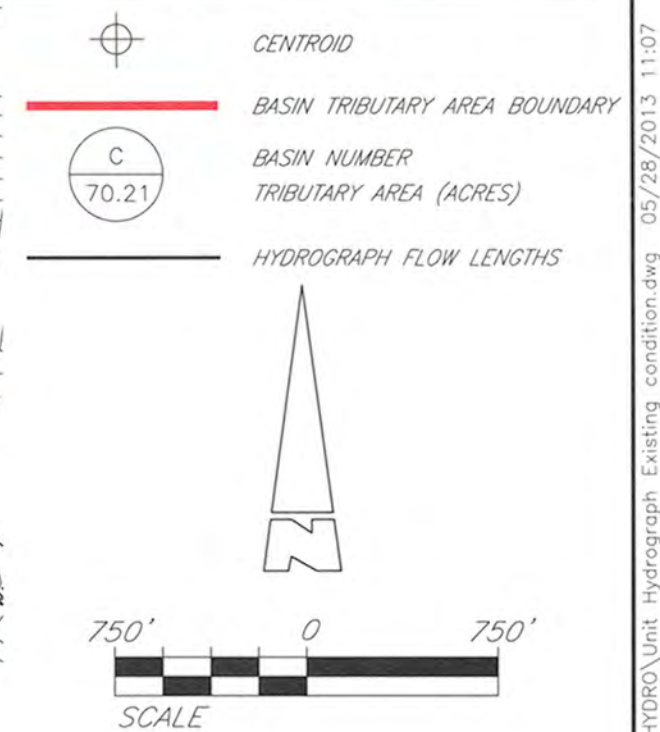
13+ 0	4.3931	7.51		Q		V	
13+ 5	4.4389	6.64		Q		V	
13+10	4.4963	8.34			Q	V	
13+15	4.5904	13.67				V	
13+20	4.7171	18.38				Q	
13+25	4.8587	20.57				V	Q
13+30	5.0115	22.18				V	Q
13+35	5.1694	22.93				V	Q
13+40	5.3212	22.04				VQ	
13+45	5.4428	17.66				V	
13+50	5.5376	13.76			Q	V	
13+55	5.6217	12.21				V	
14+ 0	5.6984	11.13					V
14+ 5	5.7688	10.22			Q		V
14+10	5.8319	9.16			Q		V
14+15	5.8831	7.44					V
14+20	5.9251	6.10			Q		V
14+25	5.9621	5.37			Q		V
14+30	5.9916	4.28			Q		V
14+35	6.0156	3.48		Q			V
14+40	6.0383	3.31		Q			V
14+45	6.0613	3.33		Q			V
14+50	6.0845	3.36		Q			V
14+55	6.1065	3.21		Q			V
15+ 0	6.1235	2.46		Q			V
15+ 5	6.1381	2.12	Q				V
15+10	6.1579	2.88	Q				V
15+15	6.1921	4.97		Q			V
15+20	6.2383	6.70			Q		V
15+25	6.2891	7.38			Q		V
15+30	6.3424	7.74			Q		V
15+35	6.3971	7.94			Q		V
15+40	6.4522	7.99			Q		V
15+45	6.5054	7.73			Q		V
15+50	6.5569	7.47			Q		V
15+55	6.6078	7.39			Q		V
16+ 0	6.6581	7.31			Q		V
16+ 5	6.7069	7.09			Q		V
16+10	6.7513	6.44			Q		V
16+15	6.7844	4.81			Q		V
16+20	6.8080	3.42		Q			V
16+25	6.8275	2.83		Q			V
16+30	6.8443	2.44		Q			V
16+35	6.8591	2.15		Q			V
16+40	6.8722	1.90		Q			V
16+45	6.8836	1.64		Q			V
16+50	6.8935	1.45	Q				V
16+55	6.9028	1.34	Q				V
17+ 0	6.9116	1.28	Q				V
17+ 5	6.9203	1.26	Q				V
17+10	6.9293	1.31	Q				V
17+15	6.9397	1.50	Q				V
17+20	6.9512	1.67	Q				V
17+25	6.9631	1.73	Q				V
17+30	6.9753	1.77	Q				V
17+35	6.9877	1.80	Q				V
17+40	7.0003	1.83	Q				V
17+45	7.0130	1.85	Q				V

17+50	7.0258	1.85	Q				V
17+55	7.0383	1.82	Q				V
18+ 0	7.0501	1.71	Q				V
18+ 5	7.0613	1.62	Q				V
18+10	7.0722	1.59	Q				V
18+15	7.0830	1.56	Q				V
18+20	7.0936	1.55	Q				V
18+25	7.1042	1.53	Q				V
18+30	7.1147	1.53	Q				V
18+35	7.1251	1.51	Q				V
18+40	7.1352	1.46	Q				V
18+45	7.1445	1.35	Q				V
18+50	7.1531	1.25	Q				V
18+55	7.1611	1.17	Q				V
19+ 0	7.1683	1.03	Q				V
19+ 5	7.1747	0.93	Q				V
19+10	7.1811	0.92	Q				V
19+15	7.1879	0.99	Q				V
19+20	7.1953	1.07	Q				V
19+25	7.2031	1.13	Q				V
19+30	7.2117	1.25	Q				V
19+35	7.2210	1.34	Q				V
19+40	7.2303	1.35	Q				V
19+45	7.2391	1.28	Q				V
19+50	7.2473	1.20	Q				V
19+55	7.2551	1.13	Q				V
20+ 0	7.2621	1.01	Q				V
20+ 5	7.2684	0.92	Q				V
20+10	7.2746	0.91	Q				V
20+15	7.2814	0.98	Q				V
20+20	7.2887	1.05	Q				V
20+25	7.2961	1.08	Q				V
20+30	7.3036	1.09	Q				V
20+35	7.3112	1.10	Q				V
20+40	7.3189	1.11	Q				V
20+45	7.3266	1.12	Q				V
20+50	7.3342	1.11	Q				V
20+55	7.3416	1.07	Q				V
21+ 0	7.3483	0.97	Q				V
21+ 5	7.3544	0.89	Q				V
21+10	7.3605	0.89	Q				V
21+15	7.3672	0.97	Q				V
21+20	7.3744	1.03	Q				V
21+25	7.3814	1.02	Q				V
21+30	7.3878	0.93	Q				V
21+35	7.3937	0.86	Q				V
21+40	7.3997	0.87	Q				V
21+45	7.4063	0.96	Q				V
21+50	7.4134	1.03	Q				V
21+55	7.4204	1.02	Q				V
22+ 0	7.4268	0.93	Q				V
22+ 5	7.4327	0.86	Q				V
22+10	7.4387	0.87	Q				V
22+15	7.4453	0.96	Q				V
22+20	7.4523	1.03	Q				V
22+25	7.4593	1.02	Q				V
22+30	7.4657	0.93	Q				V
22+35	7.4715	0.85	Q				V

22+40	7.4772	0.82	Q				V
22+45	7.4827	0.80	Q				V
22+50	7.4881	0.79	Q				V
22+55	7.4934	0.78	Q				V
23+ 0	7.4987	0.77	Q				V
23+ 5	7.5040	0.76	Q				V
23+10	7.5092	0.76	Q				V
23+15	7.5144	0.76	Q				V
23+20	7.5196	0.76	Q				V
23+25	7.5249	0.76	Q				V
23+30	7.5301	0.76	Q				V
23+35	7.5353	0.75	Q				V
23+40	7.5405	0.75	Q				V
23+45	7.5456	0.75	Q				V
23+50	7.5508	0.75	Q				V
23+55	7.5560	0.75	Q				V
24+ 0	7.5612	0.75	Q				V
24+ 5	7.5662	0.73	Q				V
24+10	7.5707	0.65	Q				V
24+15	7.5737	0.44	Q				V
24+20	7.5755	0.25	Q				V
24+25	7.5767	0.17	Q				V
24+30	7.5775	0.12	Q				V
24+35	7.5781	0.08	Q				V
24+40	7.5785	0.06	Q				V
24+45	7.5787	0.04	Q				V
24+50	7.5789	0.02	Q				V
24+55	7.5790	0.02	Q				V
25+ 0	7.5791	0.01	Q				V
25+ 5	7.5792	0.01	Q				V
25+10	7.5792	0.01	Q				V
25+15	7.5793	0.00	Q				V
25+20	7.5793	0.00	Q				V
25+25	7.5793	0.00	Q				V
25+30	7.5793	0.00	Q				V



LEGEND



UNIT HYDROGRAPH MAP
EXISTING CONDITION
FOR
SKYLINE HEIGHTS
COUNTY RIVERSIDE

HYD: VAE
DRAFT: MLL
CHECK: VAE

KWC ENGINEERS
CIVIL ENGINEERING, PLANNING AND CONSTRUCTION MANAGEMENT
1880 COMPTON AVENUE, SUITE 100 • GORDON, CA 92081 • 3370 • 909-734-2130

SHEET
1
OF
1

Unit Hydrograph Analysis

Copyright (c) CIVILCADD/CIVILDESIGN, 1989 - 2004, Version 7.0

Study date 05/01/13 File: 1344unit2propc242.out

+++++

Riverside County Synthetic Unit Hydrology Method
RCFC & WCD Manual date - April 1978

Program License Serial Number 6062

English (in-lb) Input Units Used
English Rainfall Data (Inches) Input Values Used

English Units used in output format

SKYLINE HEIGHTS
UNIT HYDROGRAPH
PROPOSED CONDITION
AREA C 2-YEAR STORM 24-HOUR

Drainage Area = 272.25 (Ac.) = 0.425 Sq. Mi.
Drainage Area for Depth-Area Areal Adjustment = 272.25 (Ac.) = 0.425 Sq. Mi.
Length along longest watercourse = 7273.00 (Ft.)
Length along longest watercourse measured to centroid = 2540.00 (Ft.)
Length along longest watercourse = 1.377 Mi.
Length along longest watercourse measured to centroid = 0.481 Mi.
Difference in elevation = 1484.00 (Ft.)
Slope along watercourse = 1077.3436 Ft./Mi.
Average Manning's 'N' = 0.045
Lag time = 0.245 Hr.
Lag time = 14.71 Min.
25% of lag time = 3.68 Min.
40% of lag time = 5.88 Min.
Unit time = 5.00 Min.
Duration of storm = 24 Hour(s)
User Entered Base Flow = 0.00 (CFS)

2 YEAR Area rainfall data:

Area (Ac.) [1]	Rainfall (In) [2]	Weighting [1*2]
272.25	3.00	816.75

100 YEAR Area rainfall data:

Area (Ac.) [1]	Rainfall (In) [2]	Weighting [1*2]
----------------	-------------------	-----------------

272.25

10.50

2858.63

STORM EVENT (YEAR) = 2.00
 Area Averaged 2-Year Rainfall = 3.000(In)
 Area Averaged 100-Year Rainfall = 10.500(In)

Point rain (area averaged) = 3.000(In)
 Areal adjustment factor = 99.95 %
 Adjusted average point rain = 2.998(In)

Sub-Area Data:

Area(Ac.)	Runoff Index	Impervious %
272.250	82.60	0.080
Total Area Entered = 272.25(Ac.)		

RI	RI	Infil. Rate	Impervious	Adj. Infil. Rate	Area%	F
AMC2	AMC-1	(In/Hr)	(Dec.%)	(In/Hr)	(Dec.)	(In/Hr)
82.6	66.6	0.398	0.080	0.370	1.000	0.370
Sum (F) =						0.370

Area averaged mean soil loss (F) (In/Hr) = 0.370

Minimum soil loss rate ((In/Hr)) = 0.185

(for 24 hour storm duration)

Soil low loss rate (decimal) = 0.839

Unit Hydrograph
 FOOTHILL S-Curve

Unit Hydrograph Data

Unit time period (hrs)	Time % of lag	Distribution Graph %	Unit Hydrograph (CFS)
1	0.083	33.998	2.525
2	0.167	67.996	8.593
3	0.250	101.995	20.618
4	0.333	135.993	28.882
5	0.417	169.991	11.818
6	0.500	203.989	7.541
7	0.583	237.988	5.385
8	0.667	271.986	4.065
9	0.750	305.984	3.080
10	0.833	339.982	2.310
11	0.917	373.980	1.649
12	1.000	407.979	1.165
13	1.083	441.977	0.567
14	1.167	475.975	0.388
15	1.250	509.973	0.336
16	1.333	543.971	0.238
17	1.417	577.970	0.227
18	1.500	611.968	0.262
19	1.583	645.966	0.165
20	1.667	679.964	0.110
21	1.750	713.963	0.075
Sum = 100.000		Sum=	274.377

Unit	Time (Hr.)	Pattern Percent	Storm Rain (In/Hr)	Loss rate(In./Hr)		Effective (In/Hr)
				Max	Low	
1	0.08	0.07	0.024	0.655	0.020	0.00
2	0.17	0.07	0.024	0.653	0.020	0.00
3	0.25	0.07	0.024	0.650	0.020	0.00
4	0.33	0.10	0.036	0.648	0.030	0.01
5	0.42	0.10	0.036	0.645	0.030	0.01
6	0.50	0.10	0.036	0.643	0.030	0.01
7	0.58	0.10	0.036	0.640	0.030	0.01
8	0.67	0.10	0.036	0.638	0.030	0.01
9	0.75	0.10	0.036	0.635	0.030	0.01
10	0.83	0.13	0.048	0.633	0.040	0.01
11	0.92	0.13	0.048	0.630	0.040	0.01
12	1.00	0.13	0.048	0.628	0.040	0.01
13	1.08	0.10	0.036	0.625	0.030	0.01
14	1.17	0.10	0.036	0.623	0.030	0.01
15	1.25	0.10	0.036	0.620	0.030	0.01
16	1.33	0.10	0.036	0.618	0.030	0.01
17	1.42	0.10	0.036	0.615	0.030	0.01
18	1.50	0.10	0.036	0.613	0.030	0.01
19	1.58	0.10	0.036	0.610	0.030	0.01
20	1.67	0.10	0.036	0.608	0.030	0.01
21	1.75	0.10	0.036	0.605	0.030	0.01
22	1.83	0.13	0.048	0.603	0.040	0.01
23	1.92	0.13	0.048	0.601	0.040	0.01
24	2.00	0.13	0.048	0.598	0.040	0.01
25	2.08	0.13	0.048	0.596	0.040	0.01
26	2.17	0.13	0.048	0.593	0.040	0.01
27	2.25	0.13	0.048	0.591	0.040	0.01
28	2.33	0.13	0.048	0.589	0.040	0.01
29	2.42	0.13	0.048	0.586	0.040	0.01
30	2.50	0.13	0.048	0.584	0.040	0.01
31	2.58	0.17	0.060	0.581	0.050	0.01
32	2.67	0.17	0.060	0.579	0.050	0.01
33	2.75	0.17	0.060	0.577	0.050	0.01
34	2.83	0.17	0.060	0.574	0.050	0.01
35	2.92	0.17	0.060	0.572	0.050	0.01
36	3.00	0.17	0.060	0.569	0.050	0.01
37	3.08	0.17	0.060	0.567	0.050	0.01
38	3.17	0.17	0.060	0.565	0.050	0.01
39	3.25	0.17	0.060	0.562	0.050	0.01
40	3.33	0.17	0.060	0.560	0.050	0.01
41	3.42	0.17	0.060	0.558	0.050	0.01
42	3.50	0.17	0.060	0.555	0.050	0.01
43	3.58	0.17	0.060	0.553	0.050	0.01
44	3.67	0.17	0.060	0.551	0.050	0.01
45	3.75	0.17	0.060	0.548	0.050	0.01
46	3.83	0.20	0.072	0.546	0.060	0.01
47	3.92	0.20	0.072	0.544	0.060	0.01
48	4.00	0.20	0.072	0.542	0.060	0.01
49	4.08	0.20	0.072	0.539	0.060	0.01
50	4.17	0.20	0.072	0.537	0.060	0.01
51	4.25	0.20	0.072	0.535	0.060	0.01
52	4.33	0.23	0.084	0.532	0.070	0.01
53	4.42	0.23	0.084	0.530	0.070	0.01
54	4.50	0.23	0.084	0.528	0.070	0.01
55	4.58	0.23	0.084	0.526	0.070	0.01

56	4.67	0.23	0.084	0.523	0.070	0.01
57	4.75	0.23	0.084	0.521	0.070	0.01
58	4.83	0.27	0.096	0.519	0.081	0.02
59	4.92	0.27	0.096	0.517	0.081	0.02
60	5.00	0.27	0.096	0.514	0.081	0.02
61	5.08	0.20	0.072	0.512	0.060	0.01
62	5.17	0.20	0.072	0.510	0.060	0.01
63	5.25	0.20	0.072	0.508	0.060	0.01
64	5.33	0.23	0.084	0.505	0.070	0.01
65	5.42	0.23	0.084	0.503	0.070	0.01
66	5.50	0.23	0.084	0.501	0.070	0.01
67	5.58	0.27	0.096	0.499	0.081	0.02
68	5.67	0.27	0.096	0.497	0.081	0.02
69	5.75	0.27	0.096	0.494	0.081	0.02
70	5.83	0.27	0.096	0.492	0.081	0.02
71	5.92	0.27	0.096	0.490	0.081	0.02
72	6.00	0.27	0.096	0.488	0.081	0.02
73	6.08	0.30	0.108	0.486	0.091	0.02
74	6.17	0.30	0.108	0.484	0.091	0.02
75	6.25	0.30	0.108	0.481	0.091	0.02
76	6.33	0.30	0.108	0.479	0.091	0.02
77	6.42	0.30	0.108	0.477	0.091	0.02
78	6.50	0.30	0.108	0.475	0.091	0.02
79	6.58	0.33	0.120	0.473	0.101	0.02
80	6.67	0.33	0.120	0.471	0.101	0.02
81	6.75	0.33	0.120	0.469	0.101	0.02
82	6.83	0.33	0.120	0.466	0.101	0.02
83	6.92	0.33	0.120	0.464	0.101	0.02
84	7.00	0.33	0.120	0.462	0.101	0.02
85	7.08	0.33	0.120	0.460	0.101	0.02
86	7.17	0.33	0.120	0.458	0.101	0.02
87	7.25	0.33	0.120	0.456	0.101	0.02
88	7.33	0.37	0.132	0.454	0.111	0.02
89	7.42	0.37	0.132	0.452	0.111	0.02
90	7.50	0.37	0.132	0.450	0.111	0.02
91	7.58	0.40	0.144	0.448	0.121	0.02
92	7.67	0.40	0.144	0.446	0.121	0.02
93	7.75	0.40	0.144	0.444	0.121	0.02
94	7.83	0.43	0.156	0.441	0.131	0.03
95	7.92	0.43	0.156	0.439	0.131	0.03
96	8.00	0.43	0.156	0.437	0.131	0.03
97	8.08	0.50	0.180	0.435	0.151	0.03
98	8.17	0.50	0.180	0.433	0.151	0.03
99	8.25	0.50	0.180	0.431	0.151	0.03
100	8.33	0.50	0.180	0.429	0.151	0.03
101	8.42	0.50	0.180	0.427	0.151	0.03
102	8.50	0.50	0.180	0.425	0.151	0.03
103	8.58	0.53	0.192	0.423	0.161	0.03
104	8.67	0.53	0.192	0.421	0.161	0.03
105	8.75	0.53	0.192	0.419	0.161	0.03
106	8.83	0.57	0.204	0.417	0.171	0.03
107	8.92	0.57	0.204	0.415	0.171	0.03
108	9.00	0.57	0.204	0.413	0.171	0.03
109	9.08	0.63	0.228	0.411	0.191	0.04
110	9.17	0.63	0.228	0.410	0.191	0.04
111	9.25	0.63	0.228	0.408	0.191	0.04
112	9.33	0.67	0.240	0.406	0.201	0.04
113	9.42	0.67	0.240	0.404	0.201	0.04

114	9.50	0.67	0.240	0.402	0.201	0.04
115	9.58	0.70	0.252	0.400	0.211	0.04
116	9.67	0.70	0.252	0.398	0.211	0.04
117	9.75	0.70	0.252	0.396	0.211	0.04
118	9.83	0.73	0.264	0.394	0.221	0.04
119	9.92	0.73	0.264	0.392	0.221	0.04
120	10.00	0.73	0.264	0.390	0.221	0.04
121	10.08	0.50	0.180	0.388	0.151	0.03
122	10.17	0.50	0.180	0.387	0.151	0.03
123	10.25	0.50	0.180	0.385	0.151	0.03
124	10.33	0.50	0.180	0.383	0.151	0.03
125	10.42	0.50	0.180	0.381	0.151	0.03
126	10.50	0.50	0.180	0.379	0.151	0.03
127	10.58	0.67	0.240	0.377	0.201	0.04
128	10.67	0.67	0.240	0.375	0.201	0.04
129	10.75	0.67	0.240	0.374	0.201	0.04
130	10.83	0.67	0.240	0.372	0.201	0.04
131	10.92	0.67	0.240	0.370	0.201	0.04
132	11.00	0.67	0.240	0.368	0.201	0.04
133	11.08	0.63	0.228	0.366	0.191	0.04
134	11.17	0.63	0.228	0.364	0.191	0.04
135	11.25	0.63	0.228	0.363	0.191	0.04
136	11.33	0.63	0.228	0.361	0.191	0.04
137	11.42	0.63	0.228	0.359	0.191	0.04
138	11.50	0.63	0.228	0.357	0.191	0.04
139	11.58	0.57	0.204	0.356	0.171	0.03
140	11.67	0.57	0.204	0.354	0.171	0.03
141	11.75	0.57	0.204	0.352	0.171	0.03
142	11.83	0.60	0.216	0.350	0.181	0.03
143	11.92	0.60	0.216	0.348	0.181	0.03
144	12.00	0.60	0.216	0.347	0.181	0.03
145	12.08	0.83	0.300	0.345	0.252	0.05
146	12.17	0.83	0.300	0.343	0.252	0.05
147	12.25	0.83	0.300	0.342	0.252	0.05
148	12.33	0.87	0.312	0.340	0.262	0.05
149	12.42	0.87	0.312	0.338	0.262	0.05
150	12.50	0.87	0.312	0.336	0.262	0.05
151	12.58	0.93	0.336	0.335	---	0.00
152	12.67	0.93	0.336	0.333	---	0.00
153	12.75	0.93	0.336	0.331	---	0.00
154	12.83	0.97	0.348	0.330	---	0.02
155	12.92	0.97	0.348	0.328	---	0.02
156	13.00	0.97	0.348	0.326	---	0.02
157	13.08	1.13	0.408	0.325	---	0.08
158	13.17	1.13	0.408	0.323	---	0.08
159	13.25	1.13	0.408	0.321	---	0.09
160	13.33	1.13	0.408	0.320	---	0.09
161	13.42	1.13	0.408	0.318	---	0.09
162	13.50	1.13	0.408	0.317	---	0.09
163	13.58	0.77	0.276	0.315	0.231	0.04
164	13.67	0.77	0.276	0.313	0.231	0.04
165	13.75	0.77	0.276	0.312	0.231	0.04
166	13.83	0.77	0.276	0.310	0.231	0.04
167	13.92	0.77	0.276	0.309	0.231	0.04
168	14.00	0.77	0.276	0.307	0.231	0.04
169	14.08	0.90	0.324	0.305	---	0.02
170	14.17	0.90	0.324	0.304	---	0.02
171	14.25	0.90	0.324	0.302	---	0.02

172	14.33	0.87	0.312	0.301	---	0.01
173	14.42	0.87	0.312	0.299	---	0.01
174	14.50	0.87	0.312	0.298	---	0.01
175	14.58	0.87	0.312	0.296	---	0.02
176	14.67	0.87	0.312	0.295	---	0.02
177	14.75	0.87	0.312	0.293	---	0.02
178	14.83	0.83	0.300	0.292	---	0.01
179	14.92	0.83	0.300	0.290	---	0.01
180	15.00	0.83	0.300	0.289	---	0.01
181	15.08	0.80	0.288	0.287	---	0.00
182	15.17	0.80	0.288	0.286	---	0.00
183	15.25	0.80	0.288	0.284	---	0.00
184	15.33	0.77	0.276	0.283	0.231	0.04
185	15.42	0.77	0.276	0.281	0.231	0.04
186	15.50	0.77	0.276	0.280	0.231	0.04
187	15.58	0.63	0.228	0.278	0.191	0.04
188	15.67	0.63	0.228	0.277	0.191	0.04
189	15.75	0.63	0.228	0.276	0.191	0.04
190	15.83	0.63	0.228	0.274	0.191	0.04
191	15.92	0.63	0.228	0.273	0.191	0.04
192	16.00	0.63	0.228	0.271	0.191	0.04
193	16.08	0.13	0.048	0.270	0.040	0.01
194	16.17	0.13	0.048	0.269	0.040	0.01
195	16.25	0.13	0.048	0.267	0.040	0.01
196	16.33	0.13	0.048	0.266	0.040	0.01
197	16.42	0.13	0.048	0.265	0.040	0.01
198	16.50	0.13	0.048	0.263	0.040	0.01
199	16.58	0.10	0.036	0.262	0.030	0.01
200	16.67	0.10	0.036	0.261	0.030	0.01
201	16.75	0.10	0.036	0.259	0.030	0.01
202	16.83	0.10	0.036	0.258	0.030	0.01
203	16.92	0.10	0.036	0.257	0.030	0.01
204	17.00	0.10	0.036	0.255	0.030	0.01
205	17.08	0.17	0.060	0.254	0.050	0.01
206	17.17	0.17	0.060	0.253	0.050	0.01
207	17.25	0.17	0.060	0.251	0.050	0.01
208	17.33	0.17	0.060	0.250	0.050	0.01
209	17.42	0.17	0.060	0.249	0.050	0.01
210	17.50	0.17	0.060	0.248	0.050	0.01
211	17.58	0.17	0.060	0.246	0.050	0.01
212	17.67	0.17	0.060	0.245	0.050	0.01
213	17.75	0.17	0.060	0.244	0.050	0.01
214	17.83	0.13	0.048	0.243	0.040	0.01
215	17.92	0.13	0.048	0.242	0.040	0.01
216	18.00	0.13	0.048	0.240	0.040	0.01
217	18.08	0.13	0.048	0.239	0.040	0.01
218	18.17	0.13	0.048	0.238	0.040	0.01
219	18.25	0.13	0.048	0.237	0.040	0.01
220	18.33	0.13	0.048	0.236	0.040	0.01
221	18.42	0.13	0.048	0.235	0.040	0.01
222	18.50	0.13	0.048	0.233	0.040	0.01
223	18.58	0.10	0.036	0.232	0.030	0.01
224	18.67	0.10	0.036	0.231	0.030	0.01
225	18.75	0.10	0.036	0.230	0.030	0.01
226	18.83	0.07	0.024	0.229	0.020	0.00
227	18.92	0.07	0.024	0.228	0.020	0.00
228	19.00	0.07	0.024	0.227	0.020	0.00
229	19.08	0.10	0.036	0.226	0.030	0.01

230	19.17	0.10	0.036	0.225	0.030	0.01
231	19.25	0.10	0.036	0.224	0.030	0.01
232	19.33	0.13	0.048	0.223	0.040	0.01
233	19.42	0.13	0.048	0.222	0.040	0.01
234	19.50	0.13	0.048	0.221	0.040	0.01
235	19.58	0.10	0.036	0.220	0.030	0.01
236	19.67	0.10	0.036	0.219	0.030	0.01
237	19.75	0.10	0.036	0.218	0.030	0.01
238	19.83	0.07	0.024	0.217	0.020	0.00
239	19.92	0.07	0.024	0.216	0.020	0.00
240	20.00	0.07	0.024	0.215	0.020	0.00
241	20.08	0.10	0.036	0.214	0.030	0.01
242	20.17	0.10	0.036	0.213	0.030	0.01
243	20.25	0.10	0.036	0.212	0.030	0.01
244	20.33	0.10	0.036	0.211	0.030	0.01
245	20.42	0.10	0.036	0.210	0.030	0.01
246	20.50	0.10	0.036	0.209	0.030	0.01
247	20.58	0.10	0.036	0.208	0.030	0.01
248	20.67	0.10	0.036	0.207	0.030	0.01
249	20.75	0.10	0.036	0.206	0.030	0.01
250	20.83	0.07	0.024	0.206	0.020	0.00
251	20.92	0.07	0.024	0.205	0.020	0.00
252	21.00	0.07	0.024	0.204	0.020	0.00
253	21.08	0.10	0.036	0.203	0.030	0.01
254	21.17	0.10	0.036	0.202	0.030	0.01
255	21.25	0.10	0.036	0.202	0.030	0.01
256	21.33	0.07	0.024	0.201	0.020	0.00
257	21.42	0.07	0.024	0.200	0.020	0.00
258	21.50	0.07	0.024	0.199	0.020	0.00
259	21.58	0.10	0.036	0.199	0.030	0.01
260	21.67	0.10	0.036	0.198	0.030	0.01
261	21.75	0.10	0.036	0.197	0.030	0.01
262	21.83	0.07	0.024	0.196	0.020	0.00
263	21.92	0.07	0.024	0.196	0.020	0.00
264	22.00	0.07	0.024	0.195	0.020	0.00
265	22.08	0.10	0.036	0.195	0.030	0.01
266	22.17	0.10	0.036	0.194	0.030	0.01
267	22.25	0.10	0.036	0.193	0.030	0.01
268	22.33	0.07	0.024	0.193	0.020	0.00
269	22.42	0.07	0.024	0.192	0.020	0.00
270	22.50	0.07	0.024	0.191	0.020	0.00
271	22.58	0.07	0.024	0.191	0.020	0.00
272	22.67	0.07	0.024	0.190	0.020	0.00
273	22.75	0.07	0.024	0.190	0.020	0.00
274	22.83	0.07	0.024	0.189	0.020	0.00
275	22.92	0.07	0.024	0.189	0.020	0.00
276	23.00	0.07	0.024	0.188	0.020	0.00
277	23.08	0.07	0.024	0.188	0.020	0.00
278	23.17	0.07	0.024	0.188	0.020	0.00
279	23.25	0.07	0.024	0.187	0.020	0.00
280	23.33	0.07	0.024	0.187	0.020	0.00
281	23.42	0.07	0.024	0.186	0.020	0.00
282	23.50	0.07	0.024	0.186	0.020	0.00
283	23.58	0.07	0.024	0.186	0.020	0.00
284	23.67	0.07	0.024	0.186	0.020	0.00
285	23.75	0.07	0.024	0.185	0.020	0.00
286	23.83	0.07	0.024	0.185	0.020	0.00
287	23.92	0.07	0.024	0.185	0.020	0.00

288 24.00 0.07 0.024 0.185 0.020 0.00
 Sum = 100.0 Sum = 5.1
 Flood volume = Effective rainfall 0.42(In)
 times area 272.3(Ac.)/[(In)/(Ft.)) = 9.6(Ac.Ft)
 Total soil loss = 2.57(In)
 Total soil loss = 58.390(Ac.Ft)
 Total rainfall = 3.00(In)
 Flood volume = 419737.4 Cubic Feet
 Total soil loss = 2543488.6 Cubic Feet

 Peak flow rate of this hydrograph = 21.073(CFS)

+++++

24 - H O U R S T O R M
 R u n o f f H y d r o g r a p h

 Hydrograph in 5 Minute intervals ((CFS))

Time(h+m)	Volume Ac.Ft	Q(CFS)	0	7.5	15.0	22.5	30.0
0+ 5	0.0002	0.03	Q				
0+10	0.0010	0.12	Q				
0+15	0.0033	0.34	Q				
0+20	0.0078	0.66	Q				
0+25	0.0135	0.83	VQ				
0+30	0.0205	1.01	VQ				
0+35	0.0289	1.22	VQ				
0+40	0.0381	1.33	VQ				
0+45	0.0478	1.40	VQ				
0+50	0.0579	1.47	VQ				
0+55	0.0686	1.55	V Q				
1+ 0	0.0802	1.69	V Q				
1+ 5	0.0930	1.85	V Q				
1+10	0.1059	1.88	V Q				
1+15	0.1184	1.82	V Q				
1+20	0.1302	1.70	V Q				
1+25	0.1416	1.66	V Q				
1+30	0.1529	1.65	V Q				
1+35	0.1642	1.63	V Q				
1+40	0.1754	1.62	V Q				
1+45	0.1865	1.61	V Q				
1+50	0.1976	1.62	V Q				
1+55	0.2090	1.66	V Q				
2+ 0	0.2212	1.76	V Q				
2+ 5	0.2344	1.91	V Q				
2+10	0.2480	1.98	VQ				
2+15	0.2619	2.02	VQ				
2+20	0.2759	2.04	VQ				
2+25	0.2901	2.06	VQ				
2+30	0.3045	2.08	VQ				
2+35	0.3190	2.10	VQ				
2+40	0.3338	2.16	VQ				
2+45	0.3495	2.27	V Q				
2+50	0.3662	2.43	V Q				
2+55	0.3834	2.49	V Q				
3+ 0	0.4009	2.54	V Q				
3+ 5	0.4185	2.57	V Q				

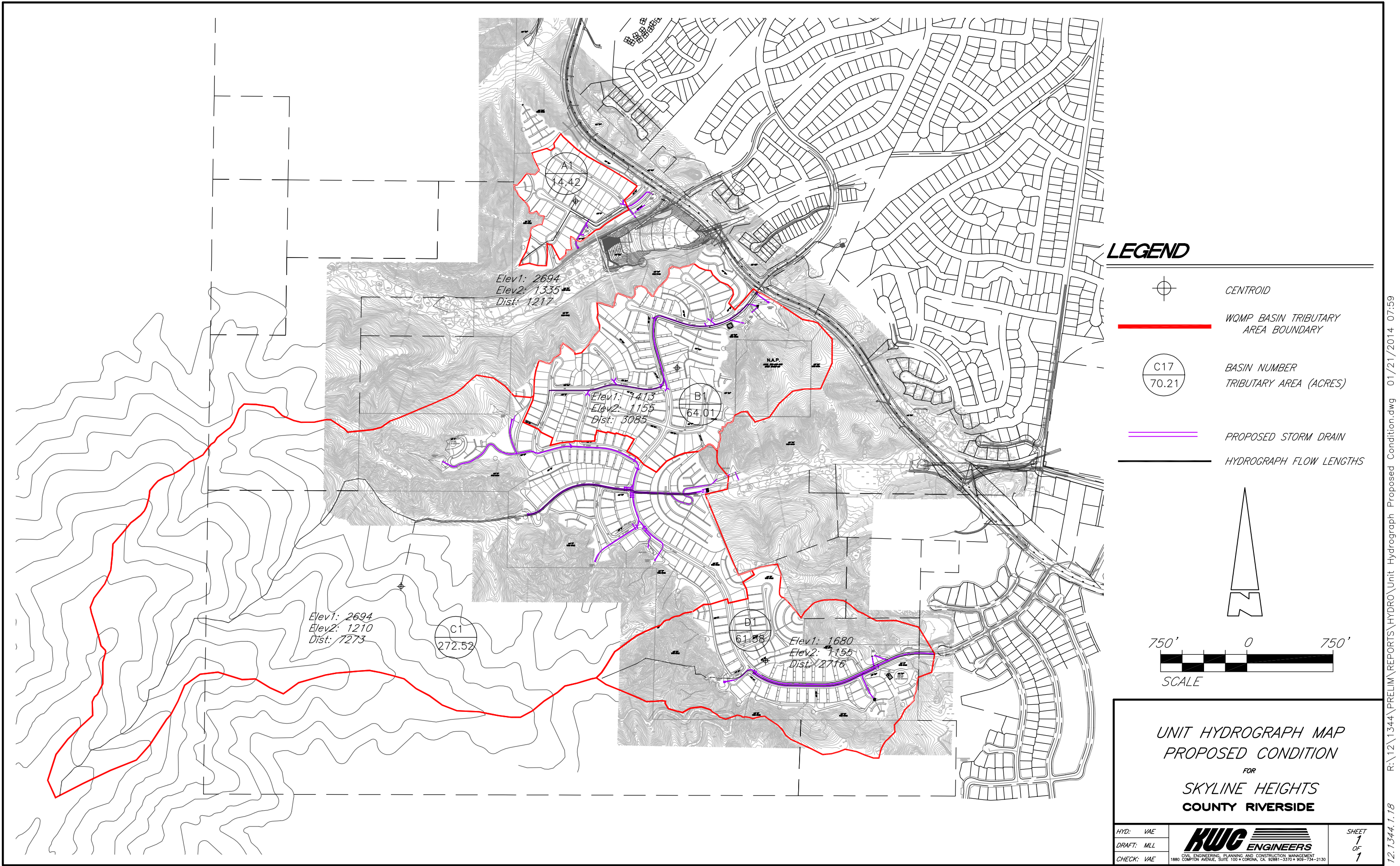
3+10	0.4363	2.59	V Q			
3+15	0.4543	2.61	V Q			
3+20	0.4723	2.62	V Q			
3+25	0.4904	2.63	VQ			
3+30	0.5086	2.63	VQ			
3+35	0.5267	2.64	VQ			
3+40	0.5449	2.64	VQ			
3+45	0.5631	2.64	VQ			
3+50	0.5814	2.66	VQ			
3+55	0.6000	2.70	VQ			
4+ 0	0.6194	2.81	VQ			
4+ 5	0.6398	2.97	VQ			
4+10	0.6607	3.03	V Q			
4+15	0.6818	3.07	V Q			
4+20	0.7033	3.11	V Q			
4+25	0.7252	3.18	VQ			
4+30	0.7479	3.30	VQ			
4+35	0.7718	3.47	VQ			
4+40	0.7962	3.54	VQ			
4+45	0.8209	3.59	VQ			
4+50	0.8459	3.63	VQ			
4+55	0.8714	3.70	VQ			
5+ 0	0.8978	3.83	V Q			
5+ 5	0.9251	3.97	V Q			
5+10	0.9523	3.95	V Q			
5+15	0.9784	3.78	VQ			
5+20	1.0026	3.52	Q			
5+25	1.0264	3.46	Q			
5+30	1.0506	3.51	Q			
5+35	1.0757	3.63	Q			
5+40	1.1012	3.71	Q			
5+45	1.1276	3.83	VQ			
5+50	1.1551	3.99	VQ			
5+55	1.1831	4.06	VQ			
6+ 0	1.2114	4.11	Q			
6+ 5	1.2400	4.16	Q			
6+10	1.2692	4.23	Q			
6+15	1.2992	4.36	Q			
6+20	1.3304	4.53	VQ			
6+25	1.3621	4.60	VQ			
6+30	1.3940	4.64	VQ			
6+35	1.4263	4.69	VQ			
6+40	1.4591	4.76	Q			
6+45	1.4927	4.89	Q			
6+50	1.5275	5.05	Q			
6+55	1.5629	5.13	Q			
7+ 0	1.5985	5.17	Q			
7+ 5	1.6343	5.21	Q			
7+10	1.6704	5.23	Q			
7+15	1.7065	5.25	QV			
7+20	1.7428	5.28	Q			
7+25	1.7796	5.33	Q			
7+30	1.8171	5.45	Q			
7+35	1.8558	5.62	Q			
7+40	1.8952	5.73	Q			
7+45	1.9357	5.88	QV			
7+50	1.9776	6.08	Q			
7+55	2.0203	6.21	Q			

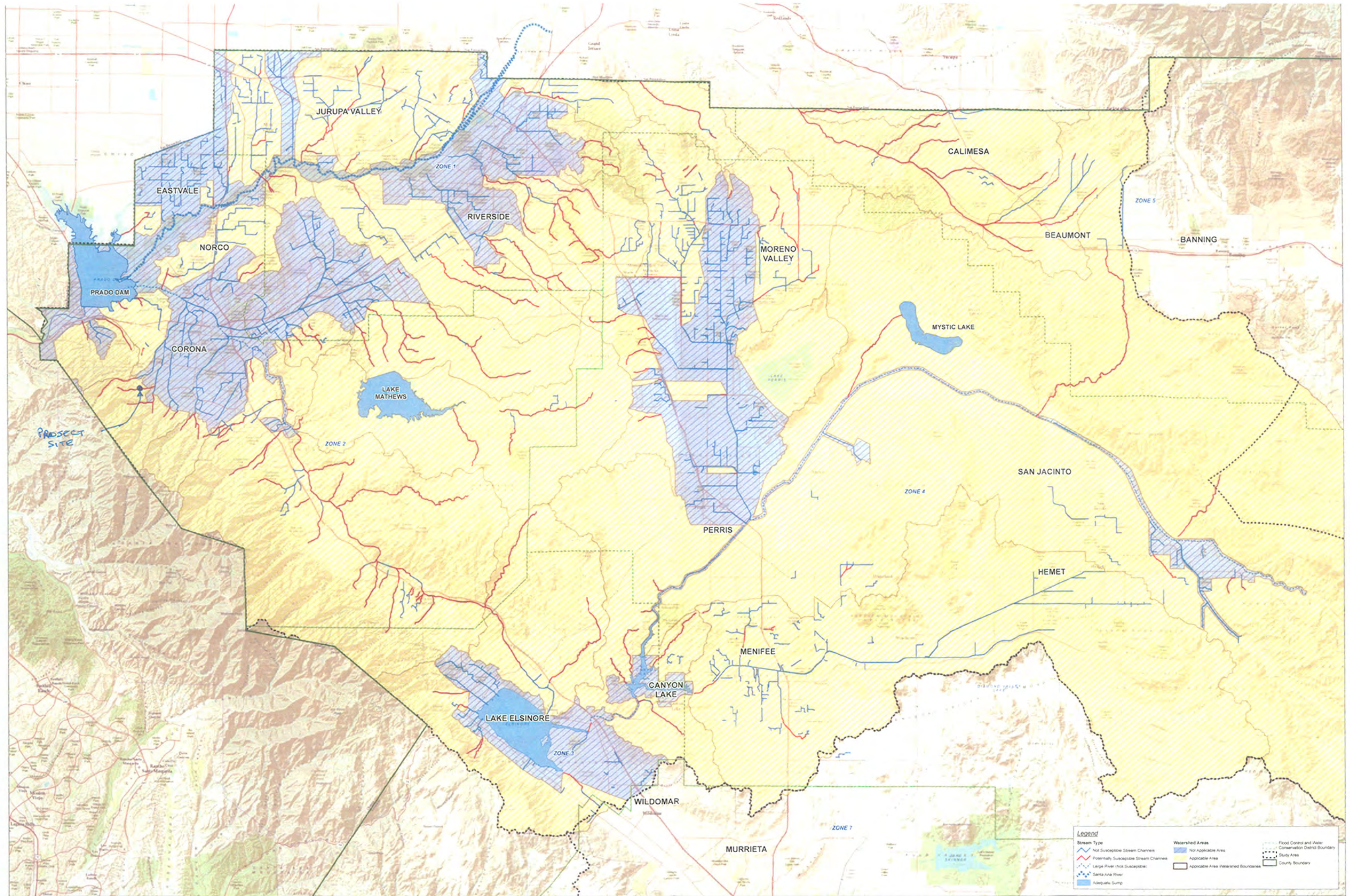
8+ 0	2.0642	6.37	Q			
8+ 5	2.1096	6.59	Q			
8+10	2.1563	6.78	VQ			
8+15	2.2049	7.06	Q			
8+20	2.2560	7.41	Q			
8+25	2.3081	7.57	VQ			
8+30	2.3609	7.67	VQ			
8+35	2.4144	7.76	Q			
8+40	2.4685	7.86	Q			
8+45	2.5237	8.01	Q			
8+50	2.5802	8.21	Q			
8+55	2.6376	8.34	VQ			
9+ 0	2.6961	8.50	Q			
9+ 5	2.7562	8.72	Q			
9+10	2.8174	8.90	Q			
9+15	2.8806	9.18	VQ			
9+20	2.9463	9.54	Q			
9+25	3.0135	9.74	Q			
9+30	3.0820	9.96	VQ			
9+35	3.1523	10.20	Q			
9+40	3.2237	10.36	Q			
9+45	3.2963	10.55	VQ			
9+50	3.3706	10.78	VQ			
9+55	3.4458	10.93	Q			
10+ 0	3.5223	11.11	Q			
10+ 5	3.5996	11.22	Q			
10+10	3.6753	11.00	QV			
10+15	3.7462	10.30	Q V			
10+20	3.8101	9.28	Q V			
10+25	3.8712	8.87	Q V			
10+30	3.9306	8.62	Q V			
10+35	3.9892	8.51	Q V			
10+40	4.0484	8.60	Q V			
10+45	4.1107	9.04	Q V			
10+50	4.1776	9.72	Q V			
10+55	4.2463	9.98	Q V			
11+ 0	4.3162	10.14	Q V			
11+ 5	4.3868	10.25	Q V			
11+10	4.4577	10.30	Q V			
11+15	4.5283	10.26	Q V			
11+20	4.5983	10.16	Q V			
11+25	4.6681	10.13	Q V			
11+30	4.7378	10.12	Q V			
11+35	4.8071	10.07	Q V			
11+40	4.8757	9.96	Q V			
11+45	4.9428	9.73	Q V			
11+50	5.0078	9.44	Q V			
11+55	5.0722	9.35	Q V			
12+ 0	5.1368	9.38	Q V			
12+ 5	5.2028	9.57	Q V			
12+10	5.2710	9.91	Q V			
12+15	5.3446	10.68	Q V			
12+20	5.4257	11.77	Q V			
12+25	5.5101	12.26	Q V			
12+30	5.5972	12.65	Q V			
12+35	5.6845	12.67	Q V			
12+40	5.7653	11.74	Q V			
12+45	5.8284	9.17	Q V			

12+50	5.8671	5.62		Q		V	
12+55	5.8993	4.67		Q		V	
13+ 0	5.9319	4.73		Q		V	
13+ 5	5.9716	5.77		Q		V	
13+10	6.0228	7.44		Q		V	
13+15	6.0992	11.09			Q	V	
13+20	6.2104	16.15			Q	V	
13+25	6.3375	18.44				Q V	
13+30	6.4757	20.08				Q	
13+35	6.6209	21.07				VQ	
13+40	6.7657	21.03				Q	
13+45	6.8979	19.19				Q	
13+50	7.0081	16.01			Q	V	
13+55	7.1105	14.87			Q	V	
14+ 0	7.2080	14.15			Q	V	
14+ 5	7.3004	13.42			Q	V	
14+10	7.3858	12.40			Q	V	
14+15	7.4593	10.67		Q		V	
14+20	7.5174	8.43		Q		V	
14+25	7.5684	7.41		Q		V	
14+30	7.6125	6.41		Q		V	
14+35	7.6496	5.37		Q		V	
14+40	7.6842	5.03		Q		V	
14+45	7.7180	4.91		Q		V	
14+50	7.7514	4.85		Q		V	
14+55	7.7837	4.68		Q		V	
15+ 0	7.8125	4.19		Q		V	
15+ 5	7.8361	3.42		Q		V	
15+10	7.8572	3.06		Q		V	
15+15	7.8741	2.46		Q		V	
15+20	7.8877	1.98	Q			V	
15+25	7.9066	2.74	Q			V	
15+30	7.9407	4.95		Q		V	
15+35	7.9959	8.01		Q		V	
15+40	8.0583	9.06		Q		V	
15+45	8.1230	9.40		Q		V	
15+50	8.1874	9.35		Q		V	
15+55	8.2530	9.52		Q		V	
16+ 0	8.3197	9.69		Q		V	
16+ 5	8.3860	9.63		Q		V	
16+10	8.4482	9.04		Q		V	
16+15	8.4995	7.45		Q		V	
16+20	8.5351	5.17		Q		V	
16+25	8.5643	4.23		Q		V	
16+30	8.5894	3.64		Q		V	
16+35	8.6115	3.21		Q		V	
16+40	8.6312	2.86		Q		V	
16+45	8.6486	2.53		Q		V	
16+50	8.6638	2.21	Q			V	
16+55	8.6777	2.02	Q			V	
17+ 0	8.6907	1.89	Q			V	
17+ 5	8.7034	1.84	Q			V	
17+10	8.7163	1.88	Q			V	
17+15	8.7304	2.05	Q			V	
17+20	8.7464	2.32	Q			V	
17+25	8.7631	2.42	Q			V	
17+30	8.7801	2.48	Q			V	
17+35	8.7975	2.52	Q			V	

17+40	8.8150	2.55	Q	V
17+45	8.8327	2.57	Q	V
17+50	8.8505	2.58	Q	V
17+55	8.8681	2.55	Q	V
18+ 0	8.8850	2.46	Q	V
18+ 5	8.9009	2.31	Q	V
18+10	8.9164	2.25	Q	V
18+15	8.9317	2.21	Q	V
18+20	8.9467	2.19	Q	V
18+25	8.9616	2.17	Q	V
18+30	8.9765	2.15	Q	V
18+35	8.9911	2.13	Q	V
18+40	9.0054	2.08	Q	V
18+45	9.0190	1.96	Q	V
18+50	9.0313	1.79	Q	V
18+55	9.0429	1.68	Q	V
19+ 0	9.0534	1.53	Q	V
19+ 5	9.0628	1.36	Q	V
19+10	9.0719	1.32	Q	V
19+15	9.0814	1.37	Q	V
19+20	9.0917	1.50	Q	V
19+25	9.1026	1.58	Q	V
19+30	9.1143	1.70	Q	V
19+35	9.1271	1.86	Q	V
19+40	9.1401	1.88	Q	V
19+45	9.1526	1.82	Q	V
19+50	9.1643	1.69	Q	V
19+55	9.1754	1.61	Q	V
20+ 0	9.1856	1.48	Q	V
20+ 5	9.1947	1.33	Q	V
20+10	9.2036	1.30	Q	V
20+15	9.2130	1.36	Q	V
20+20	9.2231	1.47	Q	V
20+25	9.2335	1.51	Q	V
20+30	9.2440	1.53	Q	V
20+35	9.2546	1.54	Q	V
20+40	9.2653	1.55	Q	V
20+45	9.2761	1.57	Q	V
20+50	9.2869	1.56	Q	V
20+55	9.2973	1.52	Q	V
21+ 0	9.3071	1.42	Q	V
21+ 5	9.3159	1.28	Q	V
21+10	9.3246	1.26	Q	V
21+15	9.3337	1.33	Q	V
21+20	9.3436	1.44	Q	V
21+25	9.3535	1.44	Q	V
21+30	9.3628	1.35	Q	V
21+35	9.3713	1.23	Q	V
21+40	9.3797	1.23	Q	V
21+45	9.3887	1.31	Q	V
21+50	9.3986	1.43	Q	V
21+55	9.4084	1.43	Q	V
22+ 0	9.4177	1.35	Q	V
22+ 5	9.4261	1.23	Q	V
22+10	9.4345	1.22	Q	V
22+15	9.4435	1.30	Q	V
22+20	9.4533	1.42	Q	V
22+25	9.4631	1.43	Q	V

22+30	9.4724	1.35	Q				V
22+35	9.4807	1.21	Q				V
22+40	9.4887	1.16	Q				V
22+45	9.4965	1.13	Q				V
22+50	9.5042	1.11	Q				V
22+55	9.5118	1.10	Q				V
23+ 0	9.5193	1.09	Q				V
23+ 5	9.5267	1.08	Q				V
23+10	9.5341	1.07	Q				V
23+15	9.5415	1.07	Q				V
23+20	9.5488	1.06	Q				V
23+25	9.5561	1.06	Q				V
23+30	9.5635	1.06	Q				V
23+35	9.5708	1.06	Q				V
23+40	9.5781	1.06	Q				V
23+45	9.5854	1.06	Q				V
23+50	9.5927	1.06	Q				V
23+55	9.6000	1.06	Q				V
24+ 0	9.6073	1.06	Q				V
24+ 5	9.6144	1.03	Q				V
24+10	9.6209	0.94	Q				V
24+15	9.6258	0.72	Q				V
24+20	9.6287	0.42	Q				V
24+25	9.6307	0.29	Q				V
24+30	9.6322	0.21	Q				V
24+35	9.6333	0.15	Q				V
24+40	9.6340	0.11	Q				V
24+45	9.6346	0.08	Q				V
24+50	9.6350	0.05	Q				V
24+55	9.6352	0.04	Q				V
25+ 0	9.6354	0.03	Q				V
25+ 5	9.6355	0.02	Q				V
25+10	9.6356	0.01	Q				V
25+15	9.6357	0.01	Q				V
25+20	9.6358	0.01	Q				V
25+25	9.6358	0.01	Q				V
25+30	9.6358	0.00	Q				V
25+35	9.6358	0.00	Q				V
25+40	9.6358	0.00	Q				V





Appendix 8: Source Control

Pollutant Sources/Source Control Checklist

STORMWATER POLLUTANT SOURCES / SOURCE CONTROL CHECKLIST

How to use this worksheet (also see instructions in Section G of the WQMP Template):

1. Review Column 1 and identify which of these potential sources of stormwater pollutants apply to your site. Check each box that applies.
2. Review Column 2 and incorporate all of the corresponding applicable BMPs in your WQMP Exhibit.
3. Review Columns 3 and 4 and incorporate all of the corresponding applicable permanent controls and operational BMPs in your WQMP. Use the format shown in Table G.1 on page 23 of this WQMP Template. Describe your specific BMPs in an accompanying narrative, and explain any special conditions or situations that required omitting BMPs or substituting alternative BMPs for those shown here.

... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE			
1	2	3	4
Potential Sources of Runoff Pollutants	Permanent Controls—Show on WQMP Drawings	Permanent Controls—List in WQMP Table and Narrative	Operational BMPs—Include in WQMP Table and Narrative
☒ A. On-site storm drain inlets	☒ Locations of inlets.	☒ Mark all inlets with the words "Only Rain Down the Storm Drain" or similar. Catch Basin Markers may be available from the Riverside County Flood Control and Water Conservation District, call 951.955.1200 to verify.	☒ Maintain and periodically repaint or replace inlet markings. ☒ Provide stormwater pollution prevention information to new site owners, lessees, or operators. ☒ See applicable operational BMPs in Fact Sheet SC-44, "Drainage System Maintenance," in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com ☒ Include the following in lease agreements: "Tenant shall not allow anyone to discharge anything to storm drains or to store or deposit materials so as to create a potential discharge to storm drains."
☐ B. Interior floor drains and elevator shaft sump pumps ☐ C. Interior parking garages		☐ State that interior floor drains and elevator shaft sump pumps will be plumbed to sanitary sewer. ☐ State that parking garage floor drains will be plumbed to the sanitary sewer.	☐ Inspect and maintain drains to prevent blockages and overflow. ☐ Inspect and maintain drains to prevent blockages and overflow.

STORMWATER POLLUTANT SOURCES/SOURCE CONTROL CHECKLIST

... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE				
IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	1	2	3	4
Potential Sources of Runoff Pollutants	Permanent Controls—Show on WQMP Drawings	Permanent Controls—List in WQMP Table and Narrative	Operational BMPs—Include in WQMP Table and Narrative	
☐ D1. Need for future indoor & structural pest control		☐ Note building design features that discourage entry of pests.	☐ Provide Integrated Pest Management information to owners, lessees, and operators.	
☒ D2. Landscape/Outdoor Pesticide Use	☒ Show locations of native trees or areas of shrubs and ground cover to be undisturbed and retained. ☒ Show self-retaining landscape areas, if any. ☒ Show stormwater treatment and hydrograph modification management BMPs. (See instructions in Chapter 3, Step 5 and guidance in Chapter 5.)	State that final landscape plans will accomplish all of the following. ☒ Preserve existing native trees, shrubs, and ground cover to the maximum extent possible. ☒ Design landscaping to minimize irrigation and runoff, to promote surface infiltration where appropriate, and to minimize the use of fertilizers and pesticides that can contribute to stormwater pollution. ☒ Where landscaped areas are used to retain or detain stormwater, specify plants that are tolerant of saturated soil conditions. ☒ Consider using pest-resistant plants, especially adjacent to hardscape. ☒ To insure successful establishment, select plants appropriate to site soils, slopes, climate, sun, wind, rain, land use, air movement, ecological consistency, and plant interactions.	☒ Maintain landscaping using minimum or no pesticides. ☒ See applicable operational BMPs in “What you should know for....Landscape and Gardening” at http://reflood.org/stormwater/Error! Hyperlink reference not valid. ☒ Provide IPM information to new owners, lessees and operators.	

STORMWATER POLLUTANT SOURCES / SOURCE CONTROL CHECKLIST

... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE			
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
☐ E. Pools, spas, ponds, decorative fountains, and other water features.	☐ Show location of water feature and a sanitary sewer cleanout in an accessible area within 10 feet. (Exception: Public pools must be plumbed according to County Department of Environmental Health Guidelines.)	If the Co-Permittee requires pools to be plumbed to the sanitary sewer, place a note on the plans and state in the narrative that this connection will be made according to local requirements.	☐ See applicable operational BMPs in "Guidelines for Maintaining Your Swimming Pool, Jacuzzi and Garden Fountain" at http://rcflood.org/stormwater/
☐ F. Food service	☐ For restaurants, grocery stores, and other food service operations, show location (indoors or in a covered area outdoors) of a floor sink or other area for cleaning floor mats, containers, and equipment. ☐ On the drawing, show a note that this drain will be connected to a grease interceptor before discharging to the sanitary sewer.	☐ Describe the location and features of the designated cleaning area. ☐ Describe the items to be cleaned in this facility and how it has been sized to insure that the largest items can be accommodated.	☐ See the brochure, "The Food Service Industry Best Management Practices for: Restaurants, Grocery Stores, Delicatessens and Bakeries" at http://rcflood.org/stormwater/ Provide this brochure to new site owners, lessees, and operators.
☐ G. Refuse areas	☐ Show where site refuse and recycled materials will be handled and stored for pickup. See local municipal requirements for sizes and other details of refuse areas. ☐ If dumpsters or other receptacles are outdoors, show how the designated area will be covered, graded, and paved to prevent runoff and show locations of berms to prevent runoff from the area. ☐ Any drains from dumpsters, compactors, and tallow bin areas shall be connected to a grease removal device before discharge to sanitary sewer.	☐ State how site refuse will be handled and provide supporting detail to what is shown on plans. ☐ State that signs will be posted on or near dumpsters with the words "Do not dump hazardous materials here" or similar.	☐ State how the following will be implemented: Provide adequate number of receptacles. Inspect receptacles regularly; repair or replace leaky receptacles. Keep receptacles covered. Prohibit/prevent dumping of liquid or hazardous wastes. Post "no hazardous materials" signs. Inspect and pick up litter daily and clean up spills immediately. Keep spill control materials available on-site. See Fact Sheet SC-34, "Waste Handling and Disposal" in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com

STORMWATER POLLUTANT SOURCES/SOURCE CONTROL CHECKLIST

IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE			
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative	
☐ H. Industrial processes.	☐ Show process area.	☐ If industrial processes are to be located on site, state: "All process activities to be performed indoors. No processes to drain to exterior or to storm drain system."	☐ See Fact Sheet SC-10, "Non-Stormwater Discharges" in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com See the brochure "Industrial & Commercial Facilities Best Management Practices for: Industrial, Commercial Facilities" at http://rcflood.org/stormwater/	

STORMWATER POLLUTANT SOURCES/SOURCE CONTROL CHECKLIST

IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
☐ I. Outdoor storage of equipment or materials. (See rows J and K for source control measures for vehicle cleaning, repair, and maintenance.)	☐ Show any outdoor storage areas, including how materials will be covered. Show how areas will be graded and bermed to prevent runoff or run-off from area. ☐ Storage of non-hazardous liquids shall be covered by a roof and/or drain to the sanitary sewer system, and be contained by berms, dikes, liners, or vaults. ☐ Storage of hazardous materials and wastes must be in compliance with the local hazardous materials ordinance and a Hazardous Materials Management Plan for the site.	Include a detailed description of materials to be stored, storage areas, and structural features to prevent pollutants from entering storm drains. Where appropriate, reference documentation of compliance with the requirements of Hazardous Materials Programs for: ▪ Hazardous Waste Generation ▪ Hazardous Materials Release Response and Inventory ▪ California Accidental Release (CalARP) ▪ Aboveground Storage Tank ▪ Uniform Fire Code Article 80 Section 103(b) & (c) 1991 ▪ Underground Storage Tank www.cchealth.org/groups/hazmat/	☐ See the Fact Sheets SC-31, "Outdoor Liquid Container Storage" and SC-33, "Outdoor Storage of Raw Materials" in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com

STORMWATER POLLUTANT SOURCES / SOURCE CONTROL CHECKLIST

1 IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	2 ... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
☒ J. Vehicle and Equipment Cleaning	☐ Show on drawings as appropriate: (1) Commercial/industrial facilities having vehicle/equipment cleaning needs shall either provide a covered, bermed area for washing activities or discourage vehicle/equipment washing by removing hose bibs and installing signs prohibiting such uses. (2) Multi-dwelling complexes shall have a paved, bermed, and covered car wash area (unless car washing is prohibited on-site and hoses are provided with an automatic shut-off to discourage such use). (3) Washing areas for cars, vehicles, and equipment shall be paved, designed to prevent run-on to or runoff from the area, and plumbed to drain to the sanitary sewer. (4) Commercial car wash facilities shall be designed such that no runoff from the facility is discharged to the storm drain system. Wastewater from the facility shall discharge to the sanitary sewer, or a wastewater reclamation system shall be installed.	☒ If a car wash area is not provided, describe any measures taken to discourage on-site car washing and explain how these will be enforced.	Describe operational measures to implement the following (if applicable): ☐ Wastewater from vehicle and equipment washing operations shall not be discharged to the storm drain system. Refer to "Outdoor Cleaning Activities and Professional Mobile Service Providers" for many of the Potential Sources of Runoff Pollutants categories below. Brochure can be found at http://rcflood.org/stormwater/ ☐ Car dealerships and similar may rinse cars with water only.

STORMWATER POLLUTANT SOURCES / SOURCE CONTROL CHECKLIST

IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
☐ K. Vehicle/Equipment Repair and Maintenance	☐ Accommodate all vehicle equipment repair and maintenance indoors. Or designate an outdoor work area and design the area to prevent run-on and runoff of stormwater. ☐ Show secondary containment for exterior work areas where motor oil, brake fluid, gasoline, diesel fuel, radiator fluid, acid-containing batteries or other hazardous materials or hazardous wastes are used or stored. Drains shall not be installed within the secondary containment areas. ☐ Add a note on the plans that states either (1) there are no floor drains, or (2) floor drains are connected to wastewater pretreatment systems prior to discharge to the sanitary sewer and an industrial waste discharge permit will be obtained.	☐ State that no vehicle repair or maintenance will be done outdoors, or else describe the required features of the outdoor work area. ☐ State that there are no floor drains or if there are floor drains, note the agency from which an industrial waste discharge permit will be obtained and that the design meets that agency's requirements. ☐ State that there are no tanks, containers or sinks to be used for parts cleaning or rinsing or, if there are, note the agency from which an industrial waste discharge permit will be obtained and that the design meets that agency's requirements.	In the Stormwater Control Plan, note that all of the following restrictions apply to use the site: ☐ No person shall dispose of, nor permit the disposal, directly or indirectly of vehicle fluids, hazardous materials, or rinsewater from parts cleaning into storm drains. ☐ No vehicle fluid removal shall be performed outside a building, nor on asphalt or ground surfaces, whether inside or outside a building, except in such a manner as to ensure that any spilled fluid will be in an area of secondary containment. Leaking vehicle fluids shall be contained or drained from the vehicle immediately. ☐ No person shall leave unattended drip parts or other open containers containing vehicle fluid, unless such containers are in use or in an area of secondary containment. Refer to "Automotive Maintenance & Car Care Best Management Practices for Auto Body Shops, Auto Repair Shops, Car Dealerships, Gas Stations and Fleet Service Operations". Brochure can be found at http://reflood.org/stormwater/ Refer to Outdoor Cleaning Activities and Professional Mobile Service Providers for many of the Potential Sources of Runoff Pollutants categories below. Brochure can be found at http://reflood.org/stormwater/	

STORMWATER POLLUTANT SOURCES / SOURCE CONTROL CHECKLIST

... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE			
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
☐ L. Fuel Dispensing Areas	☐ Fueling areas ⁶ shall have impermeable floors (i.e., portland cement concrete or equivalent smooth impervious surface) that are: a) graded at the minimum slope necessary to prevent ponding; and b) separated from the rest of the site by a grade break that prevents run-on of stormwater to the maximum extent practicable. ☐ Fueling areas shall be covered by a canopy that extends a minimum of ten feet in each direction from each pump. [Alternative: The fueling area must be covered and the cover's minimum dimensions must be equal to or greater than the area within the grade break or fuel dispensing area ¹ .] The canopy [or cover] shall not drain onto the fueling area.		☐ The property owner shall dry sweep the fueling area routinely. ☐ See the Fact Sheet SD-30, "Fueling Areas" in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com

⁶ The fueling area shall be defined as the area extending a minimum of 6.5 feet from the corner of each fuel dispenser or the length at which the hose and nozzle assembly may be operated plus a minimum of one foot, whichever is greater.

STORMWATER POLLUTANT SOURCES/SOURCE CONTROL CHECKLIST

IF THESE SOURCES WILL BE ON THE PROJECT SITE ...		... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative	
☐ M. Loading Docks	☐ Show a preliminary design for the loading dock area, including roofing and drainage. Loading docks shall be covered and/or graded to minimize run-on to and runoff from the loading area. Roof downspouts shall be positioned to direct stormwater away from the loading area. Water from loading dock areas shall be drained to the sanitary sewer, or diverted and collected for ultimate discharge to the sanitary sewer. ☐ Loading dock areas draining directly to the sanitary sewer shall be equipped with a spill control valve or equivalent device, which shall be kept closed during periods of operation. ☐ Provide a roof overhang over the loading area or install door skirts (cowling) at each bay that enclose the end of the trailer.		☐ Move loaded and unloaded items indoors as soon as possible. ☐ See Fact Sheet SC-30, "Outdoor Loading and Unloading," in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com	

STORMWATER POLLUTANT SOURCES/SOURCE CONTROL CHECKLIST

... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE			
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
☐ N. Fire Sprinkler Test Water		☐ Provide a means to drain fire sprinkler test water to the sanitary sewer.	☐ See the note in Fact Sheet SC-41, "Building and Grounds Maintenance," in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com
☐ O. Miscellaneous Drain or Wash Water or Other Sources ☐ Boiler drain lines ☐ Condensate drain lines ☐ Rooftop equipment ☐ Drainage sumps ☐ Roofing, gutters, and trim. ☐ Other sources		☐ Boiler drain lines shall be directly or indirectly connected to the sanitary sewer system and may not discharge to the storm drain system. ☐ Condensate drain lines may discharge to landscaped areas if the flow is small enough that runoff will not occur. Condensate drain lines may not discharge to the storm drain system. ☐ Rooftop equipment with potential to produce pollutants shall be roofed and/or have secondary containment. ☐ Any drainage sumps on-site shall feature a sediment sump to reduce the quantity of sediment in pumped water. ☐ Avoid roofing, gutters, and trim made of copper or other unprotected metals that may leach into runoff. Include controls for other sources as specified by local reviewer.	

STORMWATER POLLUTANT SOURCES/SOURCE CONTROL CHECKLIST

IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE			
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative	
☐ P. Plazas, sidewalks, and parking lots.			☐ Sweep plazas, sidewalks, and parking lots regularly to prevent accumulation of litter and debris. Collect debris from pressure washing to prevent entry into the storm drain system. Collect washwater containing any cleaning agent or degreaser and discharge to the sanitary sewer not to a storm drain.	

Appendix 9: O&M

Operation and Maintenance Plan and Documentation of Finance, Maintenance and Recording Mechanisms

To be provided with Final WQMP

Appendix 10: Educational Materials

BMP Fact Sheets, Maintenance Guidelines and Other End-User BMP Information



Design Considerations

- Tributary Area
- Area Required
- Hydraulic Head

Description

Dry extended detention ponds (a.k.a. dry ponds, extended detention basins, detention ponds, extended detention ponds) are basins whose outlets have been designed to detain the stormwater runoff from a water quality design storm for some minimum time (e.g., 48 hours) to allow particles and associated pollutants to settle. Unlike wet ponds, these facilities do not have a large permanent pool. They can also be used to provide flood control by including additional flood detention storage.

California Experience

Caltrans constructed and monitored 5 extended detention basins in southern California with design drain times of 72 hours. Four of the basins were earthen, less costly and had substantially better load reduction because of infiltration that occurred, than the concrete basin. The Caltrans study reaffirmed the flexibility and performance of this conventional technology. The small headloss and few siting constraints suggest that these devices are one of the most applicable technologies for stormwater treatment.

Advantages

- Due to the simplicity of design, extended detention basins are relatively easy and inexpensive to construct and operate.
- Extended detention basins can provide substantial capture of sediment and the toxics fraction associated with particulates.
- Widespread application with sufficient capture volume can provide significant control of channel erosion and enlargement caused by changes to flow frequency

Targeted Constituents

☒	Sediment	▲
☒	Nutrients	■
☒	Trash	■
☒	Metals	▲
☒	Bacteria	▲
☒	Oil and Grease	▲
☒	Organics	▲

Legend (Removal Effectiveness)

●	Low	■	High
▲	Medium		



relationships resulting from the increase of impervious cover in a watershed.

Limitations

- Limitation of the diameter of the orifice may not allow use of extended detention in watersheds of less than 5 acres (would require an orifice with a diameter of less than 0.5 inches that would be prone to clogging).
- Dry extended detention ponds have only moderate pollutant removal when compared to some other structural stormwater practices, and they are relatively ineffective at removing soluble pollutants.
- Although wet ponds can increase property values, dry ponds can actually detract from the value of a home due to the adverse aesthetics of dry, bare areas and inlet and outlet structures.

Design and Sizing Guidelines

- Capture volume determined by local requirements or sized to treat 85% of the annual runoff volume.
- Outlet designed to discharge the capture volume over a period of hours.
- Length to width ratio of at least 1.5:1 where feasible.
- Basin depths optimally range from 2 to 5 feet.
- Include energy dissipation in the inlet design to reduce resuspension of accumulated sediment.
- A maintenance ramp and perimeter access should be included in the design to facilitate access to the basin for maintenance activities and for vector surveillance and control.
- Use a draw down time of 48 hours in most areas of California. Draw down times in excess of 48 hours may result in vector breeding, and should be used only after coordination with local vector control authorities. Draw down times of less than 48 hours should be limited to BMP drainage areas with coarse soils that readily settle and to watersheds where warming may be determined to downstream fisheries.

Construction/Inspection Considerations

- Inspect facility after first large to storm to determine whether the desired residence time has been achieved.
- When constructed with small tributary area, orifice sizing is critical and inspection should verify that flow through additional openings such as bolt holes does not occur.

Performance

One objective of stormwater management practices can be to reduce the flood hazard associated with large storm events by reducing the peak flow associated with these storms. Dry extended detention basins can easily be designed for flood control, and this is actually the primary purpose of most detention ponds.

Dry extended detention basins provide moderate pollutant removal, provided that the recommended design features are incorporated. Although they can be effective at removing some pollutants through settling, they are less effective at removing soluble pollutants because of the absence of a permanent pool. Several studies are available on the effectiveness of dry extended detention ponds including one recently concluded by Caltrans (2002).

The load reduction is greater than the concentration reduction because of the substantial infiltration that occurs. Although the infiltration of stormwater is clearly beneficial to surface receiving waters, there is the potential for groundwater contamination. Previous research on the effects of incidental infiltration on groundwater quality indicated that the risk of contamination is minimal.

There were substantial differences in the amount of infiltration that were observed in the earthen basins during the Caltrans study. On average, approximately 40 percent of the runoff entering the unlined basins infiltrated and was not discharged. The percentage ranged from a high of about 60 percent to a low of only about 8 percent for the different facilities. Climatic conditions and local water table elevation are likely the principal causes of this difference. The least infiltration occurred at a site located on the coast where humidity is higher and the basin invert is within a few meters of sea level. Conversely, the most infiltration occurred at a facility located well inland in Los Angeles County where the climate is much warmer and the humidity is less, resulting in lower soil moisture content in the basin floor at the beginning of storms.

Vegetated detention basins appear to have greater pollutant removal than concrete basins. In the Caltrans study, the concrete basin exported sediment and associated pollutants during a number of storms. Export was not as common in the earthen basins, where the vegetation appeared to help stabilize the retained sediment.

Siting Criteria

Dry extended detention ponds are among the most widely applicable stormwater management practices and are especially useful in retrofit situations where their low hydraulic head requirements allow them to be sited within the constraints of the existing storm drain system. In addition, many communities have detention basins designed for flood control. It is possible to modify these facilities to incorporate features that provide water quality treatment and/or channel protection. Although dry extended detention ponds can be applied rather broadly, designers need to ensure that they are feasible at the site in question. This section provides basic guidelines for siting dry extended detention ponds.

In general, dry extended detention ponds should be used on sites with a minimum area of 5 acres. With this size catchment area, the orifice size can be on the order of 0.5 inches. On smaller sites, it can be challenging to provide channel or water quality control because the orifice diameter at the outlet needed to control relatively small storms becomes very small and thus prone to clogging. In addition, it is generally more cost-effective to control larger drainage areas due to the economies of scale.

Extended detention basins can be used with almost all soils and geology, with minor design adjustments for regions of rapidly percolating soils such as sand. In these areas, extended detention ponds may need an impermeable liner to prevent ground water contamination.

The base of the extended detention facility should not intersect the water table. A permanently wet bottom may become a mosquito breeding ground. Research in Southwest Florida (Santana et al., 1994) demonstrated that intermittently flooded systems, such as dry extended detention ponds, produce more mosquitoes than other pond systems, particularly when the facilities remained wet for more than 3 days following heavy rainfall.

A study in Prince George's County, Maryland, found that stormwater management practices can increase stream temperatures (Galli, 1990). Overall, dry extended detention ponds increased temperature by about 5°F. In cold water streams, dry ponds should be designed to detain stormwater for a relatively short time (i.e., 24 hours) to minimize the amount of warming that occurs in the basin.

Additional Design Guidelines

In order to enhance the effectiveness of extended detention basins, the dimensions of the basin must be sized appropriately. Merely providing the required storage volume will not ensure maximum constituent removal. By effectively configuring the basin, the designer will create a long flow path, promote the establishment of low velocities, and avoid having stagnant areas of the basin. To promote settling and to attain an appealing environment, the design of the basin should consider the length to width ratio, cross-sectional areas, basin slopes and pond configuration, and aesthetics (Young et al., 1996).

Energy dissipation structures should be included for the basin inlet to prevent resuspension of accumulated sediment. The use of stilling basins for this purpose should be avoided because the standing water provides a breeding area for mosquitoes.

Extended detention facilities should be sized to completely capture the water quality volume. A micropool is often recommended for inclusion in the design and one is shown in the schematic diagram. These small permanent pools greatly increase the potential for mosquito breeding and complicate maintenance activities; consequently, they are not recommended for use in California.

A large aspect ratio may improve the performance of detention basins; consequently, the outlets should be placed to maximize the flowpath through the facility. The ratio of flowpath length to width from the inlet to the outlet should be at least 1.5:1 (L:W) where feasible. Basin depths optimally range from 2 to 5 feet.

The facility's drawdown time should be regulated by an orifice or weir. In general, the outflow structure should have a trash rack or other acceptable means of preventing clogging at the entrance to the outflow pipes. The outlet design implemented by Caltrans in the facilities constructed in San Diego County used an outlet riser with orifices



Figure 1
Example of Extended Detention Outlet Structure

sized to discharge the water quality volume, and the riser overflow height was set to the design storm elevation. A stainless steel screen was placed around the outlet riser to ensure that the orifices would not become clogged with debris. Sites either used a separate riser or broad crested weir for overflow of runoff for the 25 and greater year storms. A picture of a typical outlet is presented in Figure 1.

The outflow structure should be sized to allow for complete drawdown of the water quality volume in 72 hours. No more than 50% of the water quality volume should drain from the facility within the first 24 hours. The outflow structure can be fitted with a valve so that discharge from the basin can be halted in case of an accidental spill in the watershed.

Summary of Design Recommendations

- (1) **Facility Sizing** - The required water quality volume is determined by local regulations or the basin should be sized to capture and treat 85% of the annual runoff volume. See Section 5.5.1 of the handbook for a discussion of volume-based design.

Basin Configuration - A high aspect ratio may improve the performance of detention basins; consequently, the outlets should be placed to maximize the flowpath through the facility. The ratio of flowpath length to width from the inlet to the outlet should be at least 1.5:1 (L:W). The flowpath length is defined as the distance from the inlet to the outlet as measured at the surface. The width is defined as the mean width of the basin. Basin depths optimally range from 2 to 5 feet. The basin may include a sediment forebay to provide the opportunity for larger particles to settle out.

A micropool should not be incorporated in the design because of vector concerns. For online facilities, the principal and emergency spillways must be sized to provide 1.0 foot of freeboard during the 25-year event and to safely pass the flow from 100-year storm.

- (2) **Pond Side Slopes** - Side slopes of the pond should be 3:1 (H:V) or flatter for grass stabilized slopes. Slopes steeper than 3:1 (H:V) must be stabilized with an appropriate slope stabilization practice.
- (3) **Basin Lining** - Basins must be constructed to prevent possible contamination of groundwater below the facility.
- (4) **Basin Inlet** - Energy dissipation is required at the basin inlet to reduce resuspension of accumulated sediment and to reduce the tendency for short-circuiting.
- (5) **Outflow Structure** - The facility's drawdown time should be regulated by a gate valve or orifice plate. In general, the outflow structure should have a trash rack or other acceptable means of preventing clogging at the entrance to the outflow pipes.

The outflow structure should be sized to allow for complete drawdown of the water quality volume in 72 hours. No more than 50% of the water quality volume should drain from the facility within the first 24 hours. The outflow structure should be fitted with a valve so that discharge from the basin can be halted in case of an accidental spill in the watershed. This same valve also can be used to regulate the rate of discharge from the basin.

The discharge through a control orifice is calculated from:

$$Q = CA(2g(H-H_o))^{0.5}$$

where: Q = discharge (ft^3/s)
 C = orifice coefficient
 A = area of the orifice (ft^2)
 g = gravitational constant (32.2)
 H = water surface elevation (ft)
 H_o = orifice elevation (ft)

Recommended values for C are 0.66 for thin materials and 0.80 when the material is thicker than the orifice diameter. This equation can be implemented in spreadsheet form with the pond stage/volume relationship to calculate drain time. To do this, use the initial height of the water above the orifice for the water quality volume. Calculate the discharge and assume that it remains constant for approximately 10 minutes. Based on that discharge, estimate the total discharge during that interval and the new elevation based on the stage volume relationship. Continue to iterate until H is approximately equal to H_o . When using multiple orifices the discharge from each is summed.

- (6) **Splitter Box** - When the pond is designed as an offline facility, a splitter structure is used to isolate the water quality volume. The splitter box, or other flow diverting approach, should be designed to convey the 25-year storm event while providing at least 1.0 foot of freeboard along pond side slopes.
- (7) **Erosion Protection at the Outfall** - For online facilities, special consideration should be given to the facility's outfall location. Flared pipe end sections that discharge at or near the stream invert are preferred. The channel immediately below the pond outfall should be modified to conform to natural dimensions, and lined with large stone riprap placed over filter cloth. Energy dissipation may be required to reduce flow velocities from the primary spillway to non-erosive velocities.
- (8) **Safety Considerations** - Safety is provided either by fencing of the facility or by managing the contours of the pond to eliminate dropoffs and other hazards. Earthen side slopes should not exceed 3:1 (H:V) and should terminate on a flat safety bench area. Landscaping can be used to impede access to the facility. The primary spillway opening must not permit access by small children. Outfall pipes above 48 inches in diameter should be fenced.

Maintenance

Routine maintenance activity is often thought to consist mostly of sediment and trash and debris removal; however, these activities often constitute only a small fraction of the maintenance hours. During a recent study by Caltrans, 72 hours of maintenance was performed annually, but only a little over 7 hours was spent on sediment and trash removal. The largest recurring activity was vegetation management, routine mowing. The largest absolute number of hours was associated with vector control because of mosquito breeding that occurred in the stilling basins (example of standing water to be avoided) installed as energy dissipaters. In most cases, basic housekeeping practices such as removal of debris accumulations and vegetation

management to ensure that the basin dewater completely in 48-72 hours is sufficient to prevent creating mosquito and other vector habitats.

Consequently, maintenance costs should be estimated based primarily on the mowing frequency and the time required. Mowing should be done at least annually to avoid establishment of woody vegetation, but may need to be performed much more frequently if aesthetics are an important consideration.

Typical activities and frequencies include:

- Schedule semiannual inspection for the beginning and end of the wet season for standing water, slope stability, sediment accumulation, trash and debris, and presence of burrows.
- Remove accumulated trash and debris in the basin and around the riser pipe during the semiannual inspections. The frequency of this activity may be altered to meet specific site conditions.
- Trim vegetation at the beginning and end of the wet season and inspect monthly to prevent establishment of woody vegetation and for aesthetic and vector reasons.
- Remove accumulated sediment and re-grade about every 10 years or when the accumulated sediment volume exceeds 10 percent of the basin volume. Inspect the basin each year for accumulated sediment volume.

Cost

Construction Cost

The construction costs associated with extended detention basins vary considerably. One recent study evaluated the cost of all pond systems (Brown and Schueler, 1997). Adjusting for inflation, the cost of dry extended detention ponds can be estimated with the equation:

$$C = 12.4V^{0.760}$$

where: C = Construction, design, and permitting cost, and
V = Volume (ft³).

Using this equation, typical construction costs are:

\$ 41,600 for a 1 acre-foot pond

\$ 239,000 for a 10 acre-foot pond

\$ 1,380,000 for a 100 acre-foot pond

Interestingly, these costs are generally slightly higher than the predicted cost of wet ponds (according to Brown and Schueler, 1997) on a cost per total volume basis, which highlights the difficulty of developing reasonably accurate construction estimates. In addition, a typical facility constructed by Caltrans cost about \$160,000 with a capture volume of only 0.3 ac-ft.

An economic concern associated with dry ponds is that they might detract slightly from the value of adjacent properties. One study found that dry ponds can actually detract from the

perceived value of homes adjacent to a dry pond by between 3 and 10 percent (Emmerling-Dinovo, 1995).

Maintenance Cost

For ponds, the annual cost of routine maintenance is typically estimated at about 3 to 5 percent of the construction cost (EPA website). Alternatively, a community can estimate the cost of the maintenance activities outlined in the maintenance section. Table 1 presents the maintenance costs estimated by Caltrans based on their experience with five basins located in southern California. Again, it should be emphasized that the vast majority of hours are related to vegetation management (mowing).

Table 1 Estimated Average Annual Maintenance Effort

Activity	Labor Hours	Equipment & Material (\$)	Cost
Inspections	4	7	183
Maintenance	49	126	2282
Vector Control	0	0	0
Administration	3	0	132
Materials		535	535
Total	56	\$668	\$3,132

References and Sources of Additional Information

Brown, W., and T. Schueler. 1997. *The Economics of Stormwater BMPs in the Mid-Atlantic Region*. Prepared for Chesapeake Research Consortium. Edgewater, MD. Center for Watershed Protection. Ellicott City, MD.

Denver Urban Drainage and Flood Control District. 1992. *Urban Storm Drainage Criteria Manual—Volume 3: Best Management Practices*. Denver, CO.

Emmerling-Dinovo, C. 1995. Stormwater Detention Basins and Residential Locational Decisions. *Water Resources Bulletin* 31(3): 515–521

Galli, J. 1990. *Thermal Impacts Associated with Urbanization and Stormwater Management Best Management Practices*. Metropolitan Washington Council of Governments. Prepared for Maryland Department of the Environment, Baltimore, MD.

GKY, 1989, *Outlet Hydraulics of Extended Detention Facilities* for the Northern Virginia Planning District Commission.

MacRae, C. 1996. Experience from Morphological Research on Canadian Streams: Is Control of the Two-Year Frequency Runoff Event the Best Basis for Stream Channel Protection? In *Effects of Watershed Development and Management on Aquatic Ecosystems*. American Society of Civil Engineers. Edited by L. Roesner. Snowbird, UT. pp. 144–162.

Maryland Dept of the Environment, 2000, Maryland Stormwater Design Manual: Volumes 1 & 2, prepared by MDE and Center for Watershed Protection.

<http://www.mde.state.md.us/environment/wma/stormwatermanual/index.html>

Metzger, M. E., D. F. Messer, C. L. Beitia, C. M. Myers, and V. L. Kramer. 2002. The Dark Side Of Stormwater Runoff Management: Disease Vectors Associated With Structural BMPs. *Stormwater* 3(2): 24-39.

Santana, F., J. Wood, R. Parsons, and S. Chamberlain. 1994. Control of Mosquito Breeding in Permitted Stormwater Systems. Prepared for Southwest Florida Water Management District, Brooksville, FL.

Schueler, T. 1997. Influence of Ground Water on Performance of Stormwater Ponds in Florida. *Watershed Protection Techniques* 2(4):525-528.

Watershed Management Institute (WMI). 1997. *Operation, Maintenance, and Management of Stormwater Management Systems*. Prepared for U.S. Environmental Protection Agency, Office of Water, Washington, DC.

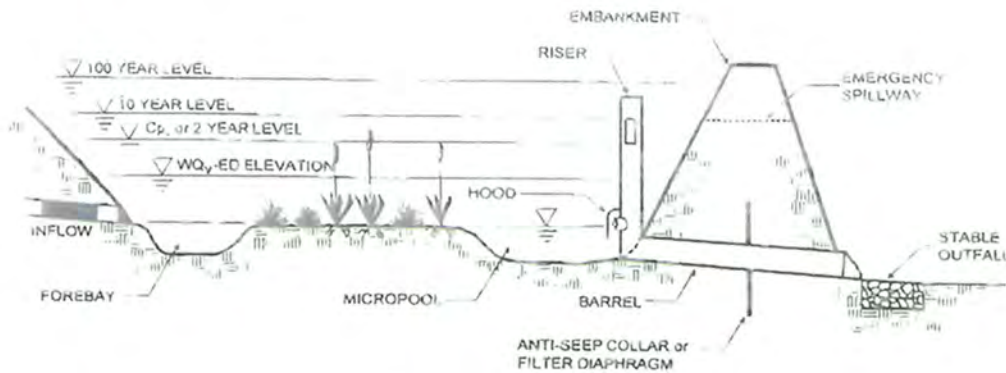
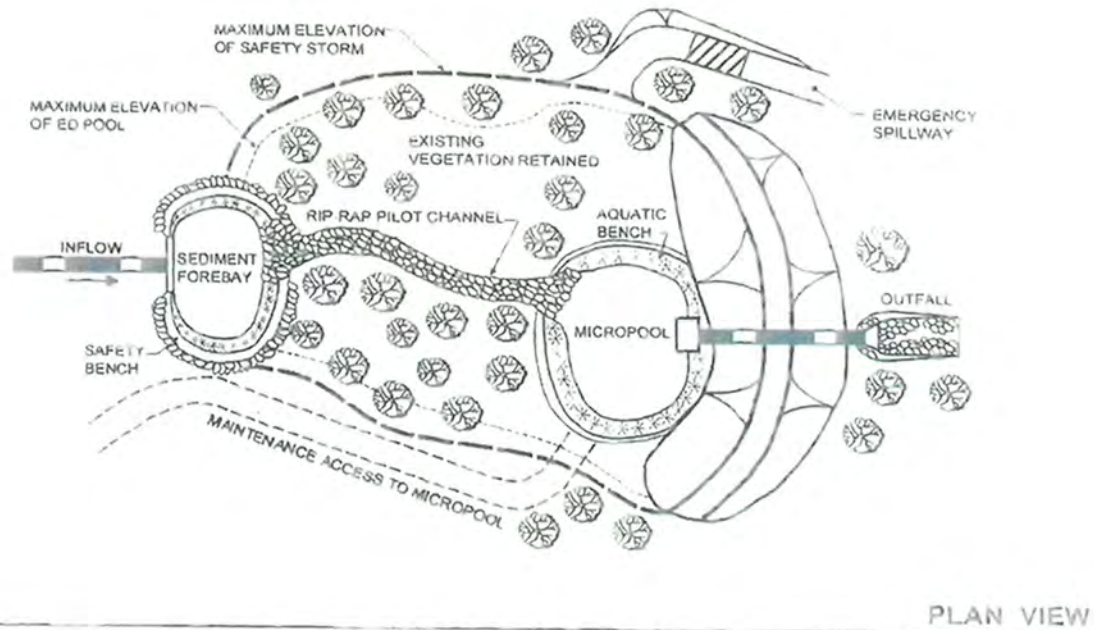
Young, G.K., et al., 1996, *Evaluation and Management of Highway Runoff Water Quality*, Publication No. FHWA-PD-96-032, U.S. Department of Transportation, Federal Highway Administration, Office of Environment and Planning.

Information Resources

Center for Watershed Protection (CWP), Environmental Quality Resources, and Loiederman Associates. 1997. *Maryland Stormwater Design Manual*. Draft. Prepared for Maryland Department of the Environment, Baltimore, MD.

Center for Watershed Protection (CWP). 1997. *Stormwater BMP Design Supplement for Cold Climates*. Prepared for U.S. Environmental Protection Agency, Office of Wetlands, Oceans and Watersheds, Washington, DC.

U.S. Environmental Protection Agency (USEPA). 1993. *Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters*. EPA-840-B-92-002. U.S. Environmental Protection Agency, Office of Water, Washington, DC.



Schematic of an Extended Detention Basin (MDE, 2000)