WATER QUALITY MANAGEMENT PLAN

TRACT No. 16397

CITY OF VICTORVILLE, CA
SAN BERNARDINO COUNTY

December 06, 2017

Prepared by:

Ludwig Engineering
ASSOCIATES, INC.
Civil Engineering - Surveying - Planning

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MOJAVE RIVER WATERSHED

Water Quality Management Plan

For:

TRACT No. 16397

A.P.N. 3096-311-02

Prepared for:

R.Y. Properties

212 S. Palm Avenue Suite 200

Alhambra, CA. 91801-3185

(626) 282-3100

Prepared by:

Ludwig Engineering Associates, Inc.

109 E. Third Street

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Submittal Date: April 10, 2017

Revision No. and Date: 1st; December 6, 2017

Revision No. and Date:

Revision No. and Date:

Final Approval Date:_____

Project Owner's Certification

This Mojave River Watershed Water Quality Management Plan (WQMP) has been prepared for R.Y. Properties by Ludwig Engineering, Associates, INC. The WQMP is intended to comply with the requirements of the City of Victorville and the Phase II Small MS4 General Permit for the Mojave River Watershed. The undersigned, while it owns the subject property, is responsible for the implementation of the provisions of this plan and will ensure that this plan is amended as appropriate to reflect up-to-date conditions on the site consistent with the Phase II Small MS4 Permit and the intent of San Bernardino County (unincorporated areas of Phelan, Oak Hills, Spring Valley Lake and Victorville) and the incorporated cities of Hesperia and Victorville and the Town of Apple Valley. Once the undersigned transfers its interest in the property, its successors in interest and the city/county/town shall be notified of the transfer. The new owner will be informed of its responsibility under this WQMP. A copy of the approved WQMP shall be available on the subject site in perpetuity.

"I certify under a penalty of law that the provisions (implementation, operation, maintenance, and funding) of the WQMP have been accepted and that the plan will be transferred to future successors."

Project Data			
Permit/Application Number(s):	PLN16-00006	Grading Permit Number(s):	TBA
Tract/Parcel Map Number(s):	Tract No. 16397	Building Permit Number(s):	TBA
CUP, SUP, and/or APN (Specify Lot Numbers if Portions of Tract):			APN 3096-311-01

Owner's Signature		
Owner Name: **Greg Quan**		
Title	Representative	
Company	LA-DF Investment Fund 68	
Address	212 S. Palm Avenue Suite 200, Alhambra, CA 91801-3185	
Email	greg@rypropertiesinc.com	
Telephone #	(626) 282-3100	
Signature	Date	

Preparer's Certification

Project Data			
Permit/Application Number(s):	PLN16-00006	Grading Permit Number(s):	TBA
Tract/Parcel Map Number(s):	Tract No. 16397	Building Permit Number(s):	TBA
CUP, SUP, and/or APN (Specify Lot Numbers if Portions of Tract):			APN 3096-311-01

"The selection, sizing and design of stormwater treatment and other stormwater quality and quantity control measures in this plan were prepared under my oversight and meet the requirements of the California State Water Resources Control Board Order No. 2013-0001-DWQ.

Engineer: **Jim J. Fry**		PE Stamp Below
Title	Vice-President	
Company	Ludwig Engineering Associates, Inc.	
Address	109 E. Third	
Email	jjfry@ludwigeng.com	
Telephone #	(909) 884-8217	
Signature	Jimmy J. Fry	
Date	12-11-17	

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Forms

ATTACHMENTS:

SECTION 1

Section I – Introduction

This WQMP template has been prepared specifically for the Phase II Small MS4 General Permit in the Mojave River Watershed. This location is within the jurisdiction of the Lahontan Regional Water Quality Control Board (LRWQCB). This document should not be confused with the WQMP template for the Santa Ana Phase I area of San Bernardino County.

WQMP preparers must refer to the MS4 Permit for the Mojave Watershed WQMP template and Technical Guidance (TGD) document found at: http://cms.sbcounty.gov/dpw/Land/NPDES.aspx to find pertinent arid region and Mojave River Watershed specific references and requirements.

Section 1 Discretionary Permit(s)

Form 1-1 Project Information

Project Name	Tract No. 16397				
Project Owner Contact Name:	Greg Quan				
Mailing Address:	212 S. Palm Avenue, Suite 200, Alhambra, CA 91801-3185	E-mail Address:	greg@rypropertiesinc.com	Telephone:	(626)282-6588
Permit/Application Number(s):	PLN16-00006	Tract/Parcel Map Number(s):	16397		
Additional Information/ Comments:	The entire tract will be draining to the water quality basin to store the 2yr-24hr storm event, and mitigate the difference between the Pre and the Post 100yr volume runoff. The proposed subdivision site lies within the south Lahontan Hydrological basin planning area(SL) Region 6 and Mojave Hydrologic Unit 628.20, Upper Mojave HA				
Description of Project:	The Property is currently vacant & not in use, sloping about 1.5% from north to south, located on stable soil. An existing wash crosses the site, flowing north to south, about 1000 Ft. east of the westerly boundary. Plant and animal life is consistent with the desert region. There are no known cultural or historical aspects on this site. There are no scenic locations on or around this site. The project is bounded on the north by Dos Palmas Road, on the east by Mesa View Road, on the south by vacant land (APN 3096-321- 07, 3096-321-08, 3096-321-14, 3096-321-15, 3096-321-16), and on the west Bellflower Street. This project proposes to construct 319 single-family residences and 11 letter lots on an 80.75 acre site. Proposed development includes phases with different densities (from very low density to medium low density residential). Splitting the proposed subdivision will be a drainage channel, which will include a public access trail. A large dual-use basin will be constructed in the eastern portion of the project, providing a gathering place for the community. Average lot size of 6660 S.F., 13,195 lineal feet of new streets.				
Provide summary of Conceptual WQMP conditions (if previously submitted and approved). Attach complete copy.					

SECTION 2

Section 2 Project Description

2.1 Project Information

The WQMP shall provide the information listed below. The information provided for Conceptual/ Preliminary WQMP should give sufficient detail to identify the major proposed site design and LID BMPs and other anticipated water quality features that impact site planning. Final Project WQMP must specifically identify all BMP incorporated into the final site design and provide other detailed information as described herein.

The purpose of this information is to help determine the applicable development category, pollutants of concern, watershed description, and long term maintenance responsibilities for the project, and any applicable water quality credits. This information will be used in conjunction with the information in Section 3, Site Description, to establish the performance criteria and to select the LID BMP or other BMP for the project or other alternative programs that the project will participate in, which are described in Section 4.

2.1.1 Project Sizing Categorization

If the Project is greater than 5,000 square feet, and not on the excluded list as found on Section 1.4 of the TGD, the Project is a Regulated Development Project.

If the Project is creating and/or replacing greater than 2,500 square feet but less than 5,000 square feet of impervious surface area, then it is considered a Site Design Only project. This criterion is applicable to all development types including detached single family homes that create and/or replace greater than 2,500 square feet of impervious area and are not part of a larger plan of development.

Form 2.1-1 Description of Proposed Project

[1] Regulated Development Project Category (Select all that apply):

☒ #1 New development involving the creation of 5,000 ft² or more of impervious surface collectively over entire site	☐ #2 Significant re-development involving the addition or replacement of 5,000 ft² or more of impervious surface on an already developed site	☒ #3 Road Project – any road, sidewalk, or bicycle lane project that creates greater than 5,000 square feet of contiguous impervious surface	☐ #4 LUPs – linear underground/overhead projects that has a discrete location with 5,000 sq. ft. or more new constructed impervious surface

☐ Site Design Only (Project Total Square Feet > 2,500 but < 5,000 sq.ft.) Will require source control Site Design Measures. Use the "PCMP" Template. Do not use this WQMP Template.

[2] Project Area (ft2):	3,297,850	[3] Number of Dwelling Units:	319	[4] SIC Code:	1521, 1611, 1623

[5] Is Project going to be phased? Yes ☐ No ☒ If yes, ensure that the WQMP evaluates each phase as a distinct DA, requiring LID BMPs to address runoff at time of completion.

2.2 Property Ownership/Management

Describe the ownership/management of all portions of the project and site. State whether any infrastructure will transfer to public agencies (City, County, Caltrans, etc.) after project completion. State if a homeowners or property owners association will be formed and be responsible for the long-term maintenance of project stormwater facilities. Describe any lot-level stormwater features that will be the responsibility of individual property owners.

Form 2.2-1 Property Ownership/Management

Describe property ownership/management responsible for long-term maintenance of WQMP stormwater facilities:

Presently the Developer will be responsible for all BMP's Operation & Maintenance and as specified in Section 5 of this report. Afterwards no homeowners or property owners will be formed. Individual homeowners will be responsible for management and maintenance if any in-lot BMP's. The Water quality Basin operation and maintenance shall be annexed into the Drainage Facility Assessment District (DFAD). Annexation Map/Document will be provided when available.

2.3 Potential Stormwater Pollutants

Best Management Practices (BMP) measures for pollutant generating activities and sources shall be designed consistent with recommendations from the CASQA Stormwater BMP Handbook for New Development and Redevelopment (or an equivalent manual). Pollutant generating activities must be considered when determining the overall pollutants of concern for the Project as presented in Form 2.3-1.

Determine and describe expected stormwater pollutants of concern based on land uses and site activities (refer to Table 3-2 in the TGD for WQMP).

Form 2.3-1 Pollutants of Concern

Pollutant	Please check: E=Expected, N=Not Expected		Additional Information and Comments
Pathogens (Bacterial / Virus)	E ☒	N ☐	Urban Runoff, Storm Sewers. Receiving waters: No drainage facilities located within 2 miles of site. Mojave River
Nutrients - Phosphorous	E ☒	N ☐	Landscaping activities. Receiving waters; No drainage facilities located within 2 miles of site. Mojave River
Nutrients - Nitrogen	E ☒	N ☐	Landscaping activities. Receiving waters; No drainage facilities located within 2 miles of site. Mojave River
Noxious Aquatic Plants	E ☐	N ☒	Only on Landscaping areas. Receiving waters; No drainage facilities located within 2 miles of site. Mojave River
Sediment	E ☒	N ☐	Runoff from areas not Landscaped. During construction and grading. Receiving waters; No drainage facilities located within 2 miles of site. Mojave River
Metals	E ☒	N	Road Improvements, Break/Tire wear
Oil and Grease	E ☒	N ☐	Vehicular traffic on public streets. Receiving waters; No drainage facilities located within 2 miles of site. Mojave River
Tarsh/Debris	E ☒	N ☐	Trash bins. Residents and public use. Receiving waters; No drainage facilities located within 2 miles of site. Mojave River
Pesticides / Herbicides	E ☒	N ☐	Landscape activities. Receiving waters; No drainage facilities located within 2 miles of site. Mojave River
Organic Compounds	E ☒	N ☐	Only on Landscaped Areas. Receiving waters; No drainage facilities located within 2 miles of site. Mojave River
Other:	☒	☐	
Other:	☐	☐	
Other:	☐	☐	

SECTION 3

Section 3 Site and Watershed Description

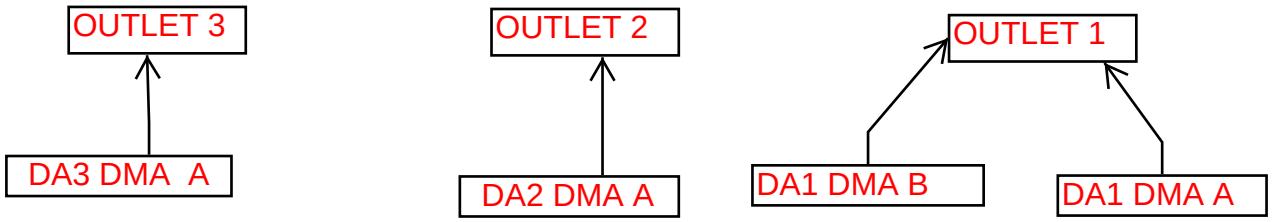
Describe the project site conditions that will facilitate the selection of BMPs through an analysis of the physical conditions and limitations of the site and its receiving waters. Identify distinct drainage areas (DA) that collect flow from a portion of the site and describe how runoff from each DA (and sub-watershed Drainage Management Areas (DMAs)) is conveyed to the site outlet(s). Refer to Section 3.2 in the TGD for WQMP. The form below is provided as an example. Then complete Forms 3.2 and 3.3 for each DA on the project site. If the project has more than one drainage area for stormwater management, then complete additional versions of these forms for each DA / outlet. A map presenting the DMAs must be included as an appendix to the WQMP document.

Form 3-1 Site Location and Hydrologic Features

Site coordinates take GPS measurement at approximate center of site	Latitude 34°29'51.29"N	Longitude 117°24'45.7"W	Thomas Bros Map page 4296

[1] San Bernardino County climatic region: **Desert**

[2] Does the site have more than one drainage area (DA): **Yes** No If no, proceed to Form 3-2. If yes, then use this form to show a conceptual schematic describing DMAs and hydrologic feature connecting DMAs to the site outlet(s). An example is provided below that can be modified for proposed project or a drawing clearly showing DMA and flow routing may be attached



Conveyance	Briefly describe on-site drainage features to convey runoff that is not retained within a DMA
DA1 DMA A to Outlet 1	Runoff is capture by a grass swales 6' wide with 5:1 side slope max and bed slope of 0.01 Min., conveys runoff through DMA A to the streets, and street flow to an open basin corner of Frederick Ct & Dos Palmas Road (typical).
DA1 DMA B to Outlet 1	Runoff is capture by a grass swales 6' wide with 5:1 side slope max and bed slope of 0.01 Min., conveys runoff through DMA B to the street, and street flow to an open basin (Lot "H") corner of Harvest Place & Gavin Court south of Dos Palmas Road. (typical).
DA2 DMA A to Outlet 2	Runoff is capture by a grass swales 6' wide with 5:1 side slope max and bed slope of 0.01 Min., conveys runoff through DMA A to the street, and street flow to an open basin (Lot "E") corner of Belardo Street & Harvest Place east of channel/south of Dos Palmas Road. (typical).
DA3 DMA A to Outlet 3	Runoff is capture by a grass swales 6' wide with 5:1 side slope max and bed slope of 0.01 Min., conveys runoff through DMA A to the street, and street flow to an open basin (Lot "C") corner of Cromwell Street & Nina Place south of Dos Palmas Road/west of Channel. (typical).

Form 3-2 Existing Hydrologic Characteristics for Drainage Area 1

For Drainage Area 1's sub-watershed DMA, provide the following characteristics	DA1 DMA A	DA1 DMA B		
1 DMA drainage area (ft^2)	219,887	1,027,429		
2 Existing site impervious area (ft^2)	0	0		
3 Antecedent moisture condition For desert areas, use http://www.sbcounty.gov/dpw/floodcontrol/pdf/20100412_map.pdf	3	3		
4 Hydrologic soil group Refer to County Hydrology Manual Addendum for Arid Regions – http://www.sbcounty.gov/dpw/floodcontrol/pdf/20100412_addendum.pdf	A	A		
5 Longest flowpath length (ft)	540	1,370		
6 Longest flowpath slope (ft/ft)	0.0074	0.0153		
7 Current land cover type(s) Select from Fig C-3 of Hydrology Manual	Barren land	Barren land		
8 Pre-developed pervious area condition: Based on the extent of wet season vegetated cover good >75%; Fair 50-75%; Poor <50% Attach photos of site to support rating	Poor	Poor		

Form 3-2 Existing Hydrologic Characteristics for Drainage Area 2

For Drainage Area 1's sub-watershed DMA, provide the following characteristics	DA2 DMA A			
1 DMA drainage area (ft^2)	735,541			
2 Existing site impervious area (ft^2)	0			
3 Antecedent moisture condition For desert areas, use http://www.sbcounty.gov/dpw/floodcontrol/pdf/20100412_map.pdf	3			
4 Hydrologic soil group Refer to County Hydrology Manual Addendum for Arid Regions – http://www.sbcounty.gov/dpw/floodcontrol/pdf/20100412_addendum.pdf	A			
5 Longest flowpath length (ft)	1,246			
6 Longest flowpath slope (ft/ft)	0.0110			
7 Current land cover type(s) Select from Fig C-3 of Hydrology Manual	Barren land			
8 Pre-developed pervious area condition: Based on the extent of wet season vegetated cover good >75%; Fair 50-75%; Poor <50% Attach photos of site to support rating	Poor			

Form 3-2 Existing Hydrologic Characteristics for Drainage Area 3

For Drainage Area 1's sub-watershed DMA, provide the following characteristics	DA3 DMA A			
1 DMA drainage area (ft^2)	1,075,794			
2 Existing site impervious area (ft^2)	0			
3 Antecedent moisture condition For desert areas, use http://www.sbcounty.gov/dpw/floodcontrol/pdf/20100412_map.pdf	3			
4 Hydrologic soil group Refer to County Hydrology Manual Addendum for Arid Regions – http://www.sbcounty.gov/dpw/floodcontrol/pdf/20100412_addendum.pdf	A			
5 Longest flowpath length (ft)	1,664			
6 Longest flowpath slope (ft/ft)	0.0098			
7 Current land cover type(s) Select from Fig C-3 of Hydrology Manual	Barren land			
8 Pre-developed pervious area condition: Based on the extent of wet season vegetated cover good >75%; Fair 50-75%; Poor <50% Attach photos of site to support rating	Poor			


Tract No. 16397
Looking south from Dos Palmas Road
Legend
TR 16397
Google earth
© 2016 INEGI
© 2016 Google
© 2017 Google
N
6.63 ft

Form 3-2 Existing Hydrologic Characteristics for Drainage Area 1 (use only as needed for additional DMA w/in DA 1)

For Drainage Area 1's sub-watershed DMA, provide the following characteristics	DMA E	DMA F	DMA G	DMA H
1 DMA drainage area (ft^2)				
2 Existing site impervious area (ft^2)				
3 Antecedent moisture condition For desert areas, use http://www.sbcounty.gov/dpw/floodcontrol/pdf/20100412_map.pdf				
4 Hydrologic soil group County Hydrology Manual Addendum for Arid Regions – http://www.sbcounty.gov/dpw/floodcontrol/pdf/20100412_addendum.pdf				
5 Longest flowpath length (ft)				
6 Longest flowpath slope (ft/ft)				
7 Current land cover type(s) Select from Fig C-3 of Hydrology Manual				
8 Pre-developed pervious area condition: Based on the extent of wet season vegetated cover good >75%; Fair 50-75%; Poor <50% Attach photos of site to support rating				

Form 3-3 Watershed Description Applies for All Drainage Areas

Receiving waters Refer to SWRCB site: http://www.waterboards.ca.gov/water_issues/programs/tmdl/integrated2010.shtml	**No Drainage facilities located within 2 miles of site. Mojave River**
Applicable TMDLs http://www.waterboards.ca.gov/water_issues/programs/tmdl/integrated2010.shtml	**No drainage facilities located within 2 miles of site.**
303(d) listed impairments http://www.waterboards.ca.gov/water_issues/programs/tmdl/integrated2010.shtml	**No drainage facilities located within 2 miles of site.**
Environmentally Sensitive Areas (ESA) Refer to Watershed Mapping Tool – http://sbcounty.permitrack.com/WAP	**Desert Tortoise Habitat Cat 2**
Hydromodification Assessment	☒ Yes Complete Hydromodification Assessment. Include Forms 4.2-2 through Form 4.2-5 and Hydromodification BMP Form 4.3-9 in submittal ☐ No **See Drainage Study provided separately**

WQMP Project Report

County of San Bernardino Stormwater Program

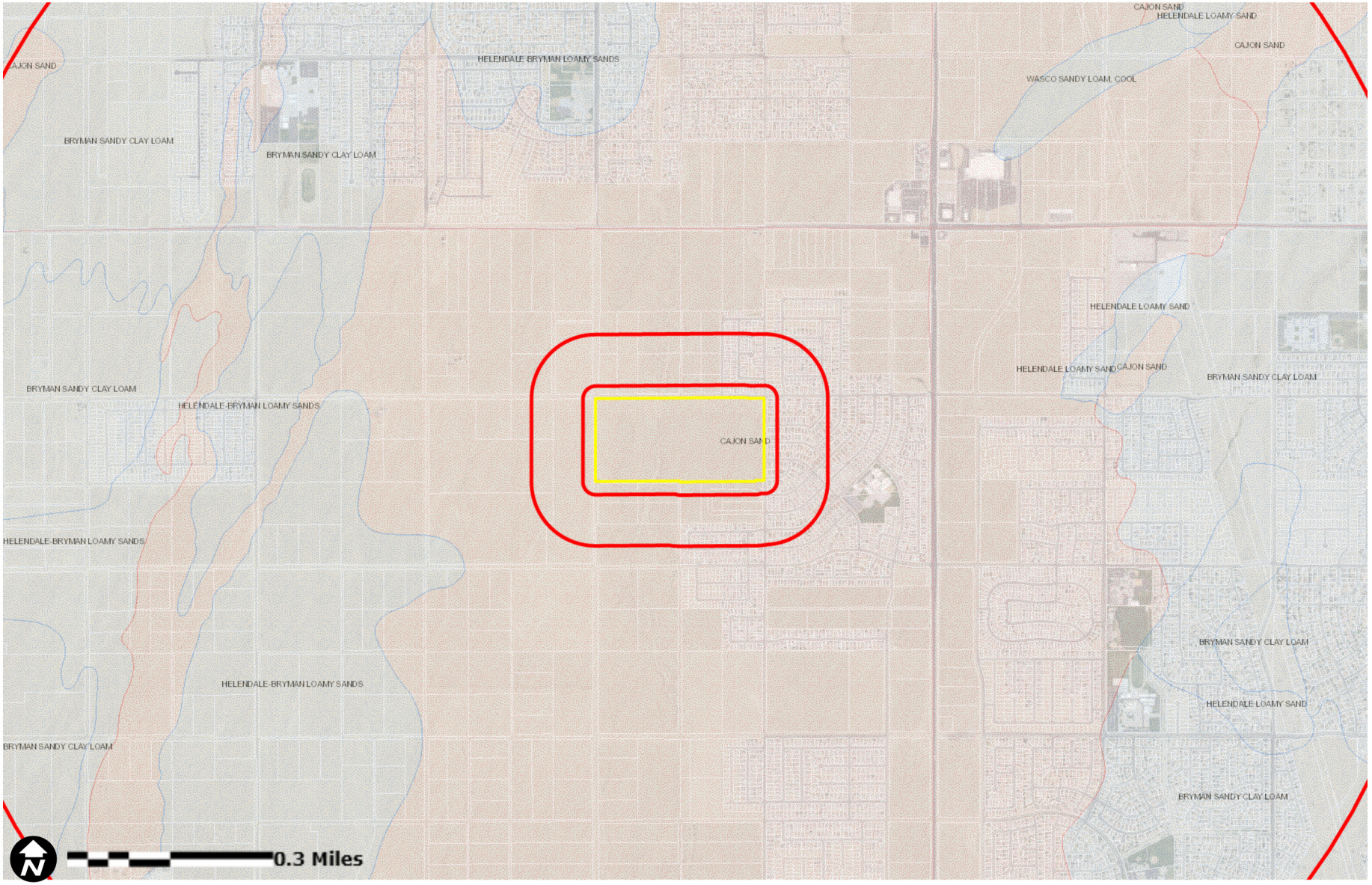
Santa Ana River Watershed Geodatabase

Wednesday, March 16, 2016

Note: The information provided in this report and on the Stormwater Geodatabase for the County of San Bernardino Stormwater Program is intended to provide basic guidance in the preparation of the applicant's Water Quality Management Plan (WQMP) and should not be relied upon without independent verification.

Project Site Parcel Number(s):	309631102
Project Site Acreage:	78.677
HCOC Exempt Area:	No
Closest Receiving Waters: (Applicant to verify based on local drainage facilities and topography.)	**System Number** - See Note **Facility Name** - See Note **Owner** - See Note
Closest channel segment's susceptibility to Hydromodification:	See Note
Highest downstream hydromodification susceptibility:	See Note
Is this drainage segment subject to TMDLs?	See Note
Are there downstream drainage segments subject to TMDLs?	See Note
Is this drainage segment a 303d listed stream?	See Note
Are there 303d listed streams downstream?	See Note
Are there unlined downstream waterbodies?	See Note
Project Site Onsite Soil Group(s):	A
Environmentally Sensitive Areas within 200':	DESERT TORTOISE HABITAT CAT 2
Groundwater Depth (FT):	No data available
Parcels with potential septic tanks within 1000':	No
Known Groundwater Contamination Plumes within 1000':	No
Studies and Reports Related to Project Site:	

Note: No drainage facilities located within 2 miles of site.



RBF CONSULTING GIS

Site Address: permitrack.sbcounty.gov/wap

County of San Bernardino
Stormwater Facility Mapping

SOILS - HYDRO GROUP

"A"

SECTION 4

Section 4 Best Management Practices (BMP)

4.1 Source Control BMPs and Site Design BMP Measures

The information and data in this section are required for both Regulated Development and Site Design Only Projects. Source Control BMPs and Site Design BMP Measures are the basis of site-specific pollution management.

4.1.1 Source Control BMPs

Non-structural and structural source control BMP are required to be incorporated into all new development and significant redevelopment projects. Form 4.1-1 and 4.1-2 are used to describe specific source control BMPs used in the WQMP or to explain why a certain BMP is not applicable. Table 7-3 of the TGD for WQMP provides a list of applicable source control BMP for projects with specific types of potential pollutant sources or activities. The source control BMP in this table must be implemented for projects with these specific types of potential pollutant sources or activities.

The preparers of this WQMP have reviewed the source control BMP requirements for new development and significant redevelopment projects. The preparers have also reviewed the specific BMP required for project as specified in Forms 4.1-1 and 4.1-2. All applicable non-structural and structural source control BMP shall be implemented in the project.

The identified list of source control BMPs correspond to the CASQA Stormwater BMP Handbook for New Development and Redevelopment.

X

Form 4.1-1 Non-Structural Source Control BMPs

Identifier	Name	Check One		Describe BMP Implementation OR, if not applicable, state reason
		Included	Not Applicable	
N1	Education of Property Owners, Tenants and Occupants on Stormwater BMPs	☒	☐	Upon final walk through of new homes with homeowners, the developer will provide educational Materials and pamphlets published by California regional water Quality Control Board, or other appropriate sources. See provided attachments.
N2	Activity Restrictions	☒	☐	The types of activities allowed within the Project will be limited to those allowed by the City of Victorville codes, regulations, and zoning ordinances.
N3	Landscape Management BMPs	☒	☐	Landscape plans will be consistent with the City of Victorville requirements for water conservation vegetation. Utilizing programmable irrigation systems, and/or rain shut off sensors to the maximum extent practicable.
N4	BMP Maintenance	☒	☐	Per Memorandum of Agreement of Storm Water Management Plan, and Form 5-1, Section 5 and Section 6.3
N5	Title 22 CCR Compliance (How development will comply)	☒	☐	No hazardous materials to be allowed for this project
N6	Local Water Quality Ordinances	☒	☐	Home owners to abide by the State, County and Local Water Ordinances, provide with the Educational material and pamphlets
N7	Spill Contingency Plan	☒	☐	Any spills of chemicals shall be properly cleaned up and the waste properly disposed of per all State, County and Local requirements. See SC-11 Educational Material Section.
N8	Underground Storage Tank Compliance	☐	☒	No storage tanks to be allowed for this project
N9	Hazardous Materials Disclosure Compliance	☐	☒	No hazardous materials to be allowed for this project

Form 4.1-1 Non-Structural Source Control BMPs

Identifier	Name	Check One		Describe BMP Implementation OR, if not applicable, state reason
		Included	Not Applicable	
N10	Uniform Fire Code Implementation	☒	☐	As Required per County of San Bernardino Fire Department
N11	Litter/Debris Control Program	☒	☐	Make sure trash container areas are screened or walled to prevent o ff-site transport of trash, See SD-32 Educational Material Section, attached.
N12	Employee Training	☐	☒	No employees, private residence
N13	Housekeeping of Loading Docks	☐	☒	Project does not feature any loading docks
N14	Catch Basin Inspection Program	☐	☒	Inspection per City Engineering Department
N15	Vacuum Sweeping of Private Streets and Parking Lots	☐	☒	There are no private streets
N16	Other Non-structural Measures for Public Agency Projects	☐	☒	N/A
N17	Comply with all other applicable NPDES permits	☒	☐	As Required

Form 4.1-2 Structural Source Control BMPs

Identifier	Name	Check One		Describe BMP Implementation OR, If not applicable, state reason
		Included	Not Applicable	
S1	Provide storm drain system stencilling and signage (CASQA New Development BMP Handbook SD-13)	☒	☐	Per City of Victorville standards and SD-13, per educational Materials section, attached.
S2	Design and construct outdoor material storage areas to reduce pollution introduction (CASQA New Development BMP Handbook SD-34)	☐	☒	No outdoor material storage allowed
S3	Design and construct trash and waste storage areas to reduce pollution introduction (CASQA New Development BMP Handbook SD-32)	☐	☒	Homeowners to use covered bins
S4	Use efficient irrigation systems & landscape design, water conservation, smart controllers, and source control (Statewide Model Landscape Ordinance; CASQA New Development BMP Handbook SD-12)	☒	☐	See SD-12, per educational material/pamphlets attached.
S5	Finish grade of landscaped areas at a minimum of 1-2 inches below top of curb, sidewalk, or pavement	☐	☒	To Maximum Extent Practicable
S6	Protect slopes and channels and provide energy dissipation (CASQA New Development BMP Handbook SD-10)	☒	☐	See SD-10 per educational material pamphlets attached (Vegetated Swales, ground cover at slopes Rock at Trenches etc.)
S7	Covered dock areas (CASQA New Development BMP Handbook SD-31)	☐	☒	Project does not Feature any Dock Areas
S8	Covered maintenance bays with spill containment plans (CASQA New Development BMP Handbook SD-31)	☐	☒	Not Feature per this project
S9	Vehicle wash areas with spill containment plans (CASQA New Development BMP Handbook SD-33)	☐	☒	Not Feature per this project
S10	Covered outdoor processing areas (CASQA New Development BMP Handbook SD-36)	☐	☒	Not Feature per this project

Form 4.1-2 Structural Source Control BMPs

Identifier	Name	Check One		Describe BMP Implementation OR, If not applicable, state reason
		Included	Not Applicable	
S11	Equipment wash areas with spill containment plans (CASQA New Development BMP Handbook SD-33)	☐	☒	The Project does not feature any wash areas
S12	Fueling areas (CASQA New Development BMP Handbook SD-30)	☐	☒	The Project does not feature any fueling areas
S13	Hillside landscaping (CASQA New Development BMP Handbook SD-10)	☐	☒	No hillside landscaping per this project
S14	Wash water control for food preparation areas	☐	☒	The Project does not feature any food preparation areas
S15	Community car wash racks (CASQA New Development BMP Handbook SD-33)	☐	☒	The Project does not feature any community car wash racks

4.1.2 Site Design BMPs

As part of the planning phase of a project, the site design practices associated with new LID requirements in the Phase II Small MS4 Permit must be considered. Site design BMP measures can result in smaller Design Capture Volume (DCV) to be managed by both LID and hydromodification control BMPs by reducing runoff generation.

As is stated in the Permit, it is necessary to evaluate site conditions such as soil type(s), existing vegetation and flow paths will influence the overall site design.

Describe site design and drainage plan including:

- A narrative of site design practices utilized or rationale for not using practices
- A narrative of how site plan incorporates preventive site design practices
- Include an attached Site Plan layout which shows how preventative site design practices are included in WQMP

Refer to Section 5.2 of the TGD for WQMP for more details.

Form 4.1-3 Site Design Practices Checklist

Site Design Practices If yes, explain how preventative site design practice is addressed in project site plan. If no, other LID BMPs must be selected to meet targets
Minimize impervious areas: Yes ☐ No ☒ Explanation: By Landscaping as much as possible, along walkways and driveways and property boundary to serve as permeable areas.
Maximize natural infiltration capacity; Including improvement and maintenance of soil: Yes ☐ No ☒ Explanation: Landscaping as much area as possible, provide home owners with education material to this effect..
Preserve existing drainage patterns and time of concentration: Yes ☐ No ☒ Explanation: Site will be totally graded, proposed Detention basin will extend time of concentration.
Disconnect impervious areas. Including rerouting of rooftop drainage pipes to drain stormwater to storage or infiltration BMPs instead of to storm drain : Yes ☐ No ☒ Explanation: Individual Lots only; Direct roof & walkway storm flows to adjacent landscaped areas, and or drainage swales to MEP
Use of Porous Pavement: Yes ☐ No ☒ Explanation: No Porous Pavement.
Protect existing vegetation and sensitive areas: Yes ☒ No Explanation: Site mass graded, the site is not expected to have an impact on any State or Federal listed wildlife species, and no other special status animal species. No desert tortoise encountered. See General Biological Resources Ass report provided.
Re-vegetate disturbed areas. Including planting and preservation of drought tolerant vegetation. : Yes ☒ No ☐ Explanation: Site Mass Graded, drought tolerant vegetation is proposed in and around basins, LAMD to the MEP.

Minimize unnecessary compaction in stormwater retention/infiltration basin/trench areas: Yes ☐ No ☒ Explanation: By limiting ground disturbance in these areas, regular maintenance will be to scarify non vegetated areas to the MEP.
Utilize naturalized/rock-lined drainage swales in place of underground piping or imperviously lined swales: Yes ☐ No ☒ Explanation: Proposed infiltration trenches (Rock) in basins only.
Stake off areas that will be used for landscaping to minimize compaction during construction : Yes ☐ No ☒ Explanation: Typically in and around basin to the MEP.
Use of Rain Barrels and Cisterns, Including the use of on-site water collection systems.: Yes ☐ No ☒ Explanation: Not used per developer, proposed community basin.
Stream Setbacks. Includes a specified distance from an adjacent steam: : Yes ☒ No ☐ Explanation: Per drainage plans attached.

It is noted that, in the Phase II Small MS4 Permit, site design elements for green roofs and vegetative swales are required. Due to the local climatology in the Mojave River Watershed, proactive measures are taken to maximize the amount of drought tolerant vegetation. It is not practical in this region to have green roofs or vegetative swales. As part of site design the project proponent should utilize locally recommended vegetation types for landscaping. Typical landscaping recommendations are found in following local references:

San Bernardino County Special Districts:

Guide to High Desert Landscaping -
http://www.specialdistricts.org/Modules/ShowDocument.aspx?documentid=795

Recommended High-Desert Plants -
http://www.specialdistricts.org/modules/showdocument.aspx?documentid=553

Mojave Water Agency:

Desert Ranch: http://www.mojavewater.org/files/desertranchgardenprototype.pdf

Summertree: http://www.mojavewater.org/files/Summertree-Native-Plant-Brochure.pdf

Thornless Garden: http://www.mojavewater.org/files/thornlessgardenprototype.pdf

Mediterranean Garden: http://www.mojavewater.org/files/mediterraneangardenprototype.pdf

Lush and Efficient Garden: http://www.mojavewater.org/files/lushandefficientgardenprototype.pdf

Alliance for Water Awareness and Conservation (AWAC) outdoor tips – http://hdawac.org/save-outdoors.html

4.2 Treatment BMPs

After implementation and design of both Source Control BMPs and Site Design BMP measures, any remaining runoff from impervious DMAs must be directed to one or more on-site, treatment BMPs (LID or biotreatment) designed to infiltrate, evaportranspire, and/or bioretain the amount of runoff specified in Permit Section E.12.e (ii)(c) Numeric Sizing Criteria for Storm Water Retention and Treatment.

4.2.1 Project Specific Hydrology Characterization

The purpose of this section of the Project WQMP is to establish targets for post-development hydrology based on performance criteria specified in Section E.12.e.ii.c and Section E.12.f of the Phase II Small MS4 Permit. These targets include runoff volume for water quality control (referred to as LID design capture volume), and runoff volume, time of concentration, and peak runoff for protection from hydromodification.

If the project has more than one outlet for stormwater runoff, then complete additional versions of these forms for each DA / outlet.

It is noted that in the Phase II Small MS4 Permit jurisdictions, the LID BMP Design Capture Volume criteria is based on the 2-year rain event. The hydromodification performance criterion is based on the 10-year rain event.

Methods applied in the following forms include:

- For LID BMP Design Capture Volume (DCV), San Bernardino County requires use of the P_6 method (Form 4.2-1) For pre- and post-development hydrologic calculation, San Bernardino County requires the use of the Rational Method (San Bernardino County Hydrology Manual Section D). Forms 4.2-2 through Form 4.2-5 calculate hydrologic variables including runoff volume, time of concentration, and peak runoff from the project site pre- and post-development using the Hydrology Manual Rational Method approach. For projects greater than 640 acres (1.0 mi^2), the Rational Method and these forms should not be used. For such projects, the Unit Hydrograph Method (San Bernardino County Hydrology Manual Section E) shall be applied for hydrologic calculations for hydromodification performance criteria.

Refer to Section 4 in the TGD for WQMP for detailed guidance and instructions.

NOAA Atlas 14, Volume 6, Version 2
Location name: Victorville, California, US*
Latitude: 34.4978°, Longitude: -117.4125°
Elevation: 3199 ft*
* source: Google Maps

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sarah Dietz, Sarah Heim, Lillian Hiner, Kazungu Maitaria, Deborah Martin, Sandra Pavlovic, Ishani Roy, Carl Trypaluk, Dale Unruh, Fenglin Yan, Michael Yekta, Tan Zhao, Geoffrey Bonnin, Daniel Brewer, Li-Chuan Chen, Tye Parzybok, John Yarchoan

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.078 (0.065-0.096)	0.112 (0.093-0.138)	0.158 (0.130-0.193)	0.195 (0.159-0.241)	0.246 (0.194-0.314)	0.285 (0.221-0.372)	0.326 (0.246-0.436)	0.368 (0.270-0.506)	0.425 (0.299-0.609)	0.469 (0.319-0.697)
10-min	0.112 (0.093-0.137)	0.161 (0.133-0.197)	0.226 (0.186-0.277)	0.279 (0.228-0.345)	0.352 (0.278-0.450)	0.409 (0.316-0.534)	0.467 (0.352-0.625)	0.527 (0.387-0.725)	0.609 (0.429-0.874)	0.673 (0.458-0.999)
15-min	0.136 (0.112-0.166)	0.195 (0.161-0.239)	0.273 (0.225-0.335)	0.337 (0.276-0.418)	0.426 (0.336-0.545)	0.494 (0.382-0.646)	0.565 (0.426-0.755)	0.637 (0.468-0.877)	0.737 (0.519-1.06)	0.814 (0.554-1.21)
30-min	0.202 (0.167-0.247)	0.289 (0.239-0.354)	0.406 (0.334-0.498)	0.501 (0.409-0.620)	0.632 (0.499-0.808)	0.734 (0.567-0.958)	0.838 (0.633-1.12)	0.946 (0.694-1.30)	1.09 (0.770-1.57)	1.21 (0.822-1.79)
60-min	0.267 (0.221-0.327)	0.384 (0.317-0.469)	0.537 (0.442-0.659)	0.664 (0.542-0.821)	0.837 (0.661-1.07)	0.972 (0.752-1.27)	1.11 (0.838-1.49)	1.25 (0.920-1.73)	1.45 (1.02-2.08)	1.60 (1.09-2.38)
2-hr	0.375 (0.310-0.458)	0.509 (0.420-0.623)	0.692 (0.570-0.849)	0.846 (0.691-1.05)	1.06 (0.841-1.36)	1.24 (0.958-1.62)	1.42 (1.07-1.90)	1.61 (1.19-2.22)	1.88 (1.33-2.70)	2.10 (1.43-3.12)
3-hr	0.468 (0.387-0.572)	0.625 (0.516-0.765)	0.842 (0.693-1.03)	1.03 (0.838-1.27)	1.29 (1.02-1.65)	1.51 (1.17-1.97)	1.73 (1.31-2.32)	1.98 (1.45-2.72)	2.32 (1.64-3.33)	2.60 (1.77-3.86)
6-hr	0.639 (0.528-0.781)	0.846 (0.698-1.04)	1.14 (0.935-1.39)	1.39 (1.13-1.72)	1.75 (1.39-2.24)	2.06 (1.59-2.69)	2.38 (1.80-3.18)	2.73 (2.01-3.76)	3.24 (2.28-4.65)	3.66 (2.49-5.44)
12-hr	0.797 (0.659-0.974)	1.09 (0.903-1.34)	1.51 (1.24-1.86)	1.87 (1.53-2.32)	2.40 (1.89-3.07)	2.83 (2.19-3.70)	3.30 (2.49-4.41)	3.80 (2.79-5.23)	4.54 (3.19-6.50)	5.14 (3.50-7.63)
24-hr	1.08 (0.961-1.25)	1.55 (1.37-1.79)	2.20 (1.94-2.54)	2.76 (2.42-3.22)	3.58 (3.03-4.31)	4.25 (3.53-5.22)	4.96 (4.02-6.25)	5.74 (4.52-7.44)	6.87 (5.19-9.28)	7.80 (5.70-10.9)
2-day	1.17 (1.04-1.34)	1.67 (1.48-1.92)	2.37 (2.09-2.74)	2.98 (2.61-3.47)	3.87 (3.28-4.65)	4.60 (3.82-5.65)	5.39 (4.36-6.79)	6.25 (4.93-8.10)	7.51 (5.68-10.1)	8.55 (6.25-12.0)
3-day	1.25 (1.11-1.43)	1.77 (1.57-2.04)	2.51 (2.22-2.90)	3.15 (2.76-3.67)	4.09 (3.47-4.93)	4.87 (4.04-5.99)	5.71 (4.62-7.19)	6.63 (5.22-8.59)	7.97 (6.03-10.8)	9.10 (6.65-12.7)
4-day	1.34 (1.19-1.54)	1.89 (1.68-2.18)	2.68 (2.37-3.10)	3.37 (2.95-3.92)	4.37 (3.70-5.26)	5.19 (4.31-6.38)	6.08 (4.93-7.66)	7.06 (5.56-9.15)	8.49 (6.42-11.5)	9.68 (7.07-13.5)
7-day	1.44 (1.28-1.66)	2.03 (1.80-2.34)	2.86 (2.52-3.30)	3.58 (3.13-4.17)	4.62 (3.91-5.56)	5.47 (4.54-6.73)	6.39 (5.17-8.05)	7.38 (5.82-9.56)	8.83 (6.67-11.9)	10.0 (7.31-14.0)
10-day	1.54 (1.36-1.77)	2.15 (1.91-2.48)	3.02 (2.67-3.49)	3.78 (3.31-4.40)	4.87 (4.13-5.86)	5.76 (4.78-7.08)	6.71 (5.44-8.45)	7.74 (6.10-10.0)	9.23 (6.98-12.5)	10.4 (7.63-14.6)
20-day	1.84 (1.63-2.12)	2.57 (2.28-2.96)	3.61 (3.19-4.17)	4.50 (3.95-5.25)	5.81 (4.92-6.99)	6.87 (5.70-8.45)	8.01 (6.49-10.1)	9.23 (7.27-12.0)	11.0 (8.29-14.8)	12.4 (9.05-17.3)
30-day	2.14 (1.90-2.46)	2.97 (2.63-3.42)	4.16 (3.67-4.80)	5.19 (4.55-6.05)	6.70 (5.68-8.07)	7.93 (6.58-9.75)	9.24 (7.48-11.6)	10.6 (8.39-13.8)	12.6 (9.56-17.1)	14.3 (10.4-19.9)
45-day	2.50 (2.22-2.88)	3.44 (3.05-3.97)	4.79 (4.23-5.54)	5.97 (5.23-6.96)	7.71 (6.54-9.29)	9.14 (7.59-11.2)	10.7 (8.63-13.4)	12.3 (9.68-15.9)	14.6 (11.0-19.7)	16.5 (12.0-23.0)
60-day	2.81 (2.49-3.23)	3.82 (3.38-4.40)	5.28 (4.66-6.10)	6.56 (5.75-7.65)	8.46 (7.17-10.2)	10.0 (8.32-12.3)	11.7 (9.48-14.7)	13.5 (10.6-17.5)	16.0 (12.1-21.7)	18.1 (13.2-25.3)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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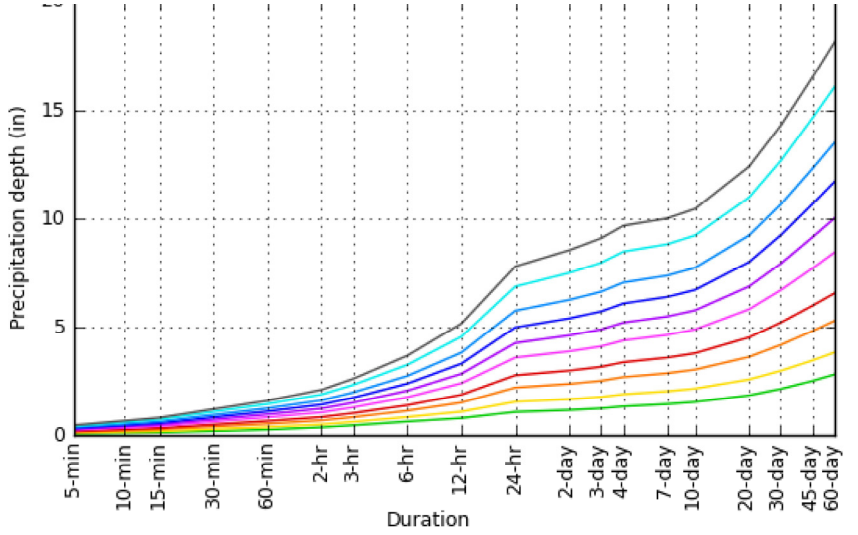
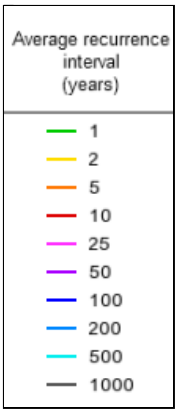
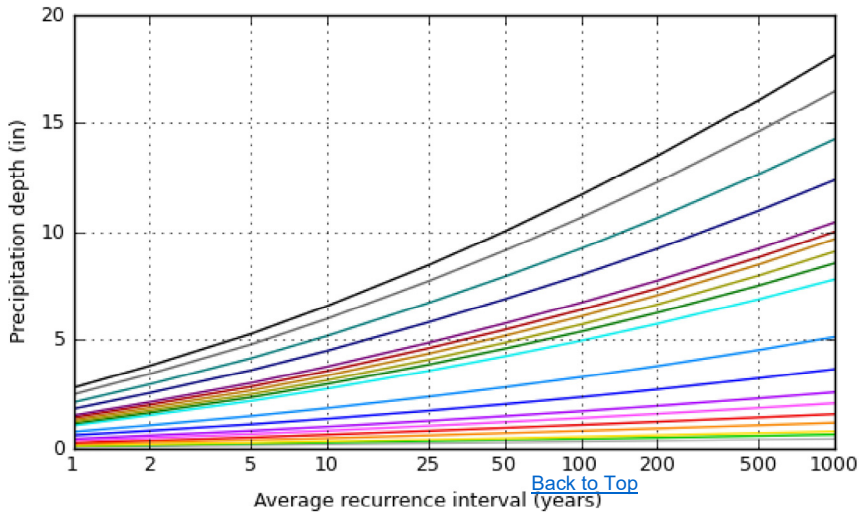
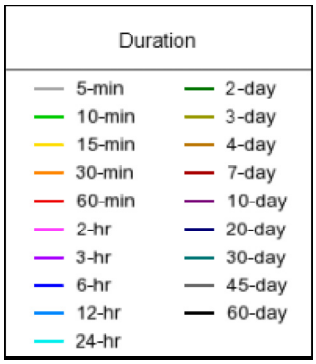
PF graphical









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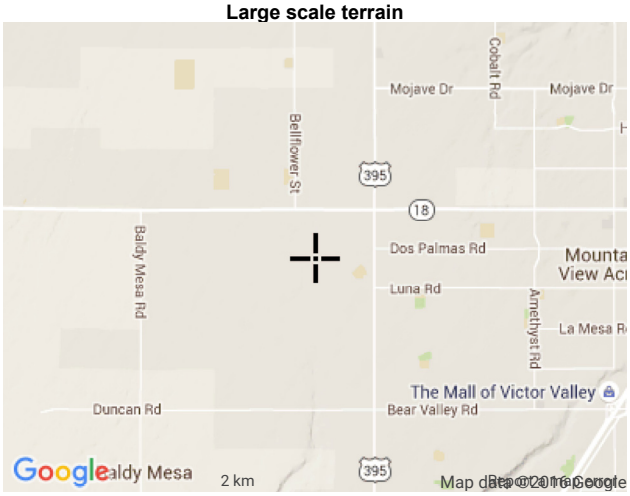
Maps & aerials

NOAA Atlas 14, Volume 6, Version 2

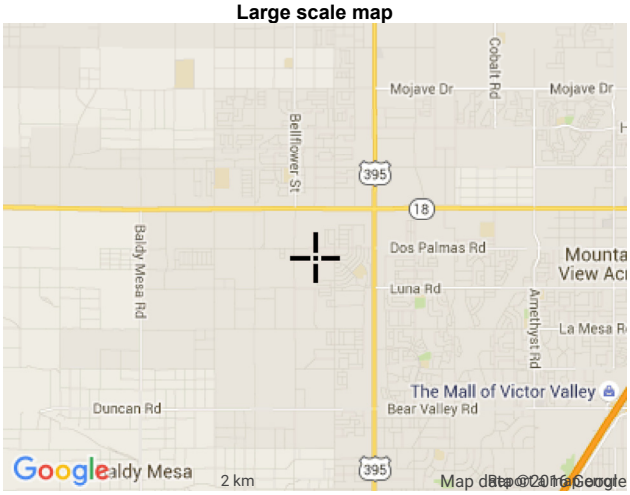
Created (GMT): Wed Mar 16 21:09:08 2016

Small scale terrain

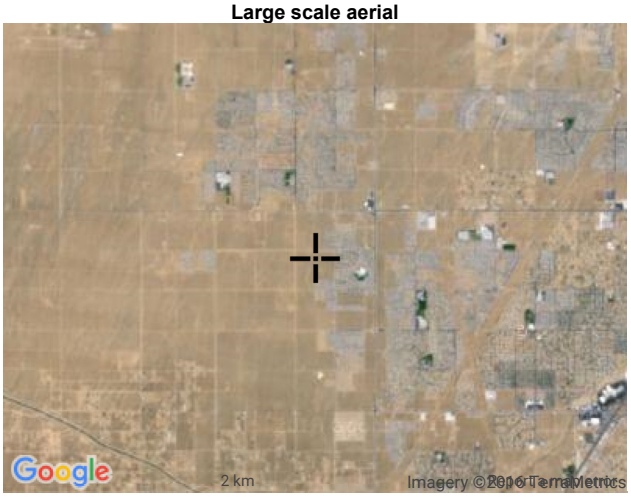
Large scale terrain



Large scale map



Large scale aerial



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US Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service
National Water Center
1325 East West Highway
Silver Spring, MD 20910

Form 4.2-1 LID BMP Performance Criteria for Design Capture Volume (DA 1) DMA A & B

[1] Project area DA 1 (ft^2): 1,246,817	[2] Imperviousness after applying preventative site design practices (Imp%): 0.5658	[3] Runoff Coefficient (Rc): **0.384** $R_c = 0.858(Imp\%)^{\wedge 3} - 0.78(Imp\%)^{\wedge 2} + 0.774(Imp\%) + 0.04$
[4] Determine 1-hour rainfall depth for a 2-year return period $P_{2yr\text{-}1hr}$ (in): **0.384** http://hdsc.nws.noaa.gov/hdsc/pfds/sa/sca_pfds.html		
[5] Compute P_6, Mean 6-hr Precipitation (inches): **0.475** P_6 = Item 4 * C_1, where C_1 is a function of site climatic region specified in Form 3-1 Item 1 (Desert = 1.2371)		
[6] Drawdown Rate Use 48 hours as the default condition. Selection and use of the 24 hour drawdown time condition is subject to approval by the local jurisdiction. The necessary BMP footprint is a function of drawdown time. While shorter drawdown times reduce the performance criteria for LID BMP design capture volume, the depth of water that can be stored is also reduced.		24-hrs ☐ **48-hrs** ☒
[7] Compute design capture volume, DCV (ft^3): **37,170** DCV = 1/12 * [Item 1* Item 3 *Item 5 * C_2], where C_2 is a function of drawdown rate (24-hr = 1.582; 48-hr = 1.963) Compute separate DCV for each outlet from the project site per schematic drawn in Form 3-1 Item 2		

Form 4.2-1 LID BMP Performance Criteria for Design Capture Volume (DA 2) DMA A

[1] Project area DA 2 (ft^2): 735,636	[2] Imperviousness after applying preventative site design practices (Imp%): 0.562	[3] ☐ ☐ Runoff Coefficient (Rc): **0.384** $R_c = 0.858(Imp\%)^{\wedge 3} - 0.78(Imp\%)^{\wedge 2} + 0.774(Imp\%) + 0.04$
[4] Determine 1-hour rainfall depth for a 2-year return period $P_{2yr\text{-}1hr}$ (in): **0.384** http://hdsc.nws.noaa.gov/hdsc/pfds/sa/sca_pfds.html		
[5] Compute P_6, Mean 6-hr Precipitation (inches): **0.475** P_6 = Item 4 * C_1, where C_1 is a function of site climatic region specified in Form 3-1 Item 1 (Desert = 1.2371)		
[6] Drawdown Rate Use 48 hours as the default condition. Selection and use of the 24 hour drawdown time condition is subject to approval by the local jurisdiction. The necessary BMP footprint is a function of drawdown time. While shorter drawdown times reduce the performance criteria for LID BMP design capture volume, the depth of water that can be stored is also reduced.		24-hrs **48-hrs**
[7] Compute design capture volume, DCV (ft^3): **21,776** DCV = 1/12 * [Item 1* Item 3 *Item 5 * C_2], where C_2 is a function of drawdown rate (24-hr = 1.582; 48-hr = 1.963) Compute separate DCV for each outlet from the project site per schematic drawn in Form 3-1 Item 2		

Form 4.2-1 LID BMP Performance Criteria for Design Capture Volume (DA 3) DMA A		
[1] Project area DA 1 (ft^2): 1,075,795	[2] Imperviousness after applying preventative site design practices (Imp%): 0.578	[3] Runoff Coefficient (Rc): **0.392** $R_c = 0.858(Imp\%)^{\wedge 3} - 0.78(Imp\%)^{\wedge 2} + 0.774(Imp\%) + 0.04$
[4] Determine 1-hour rainfall depth for a 2-year return period $P_{2yr\text{-}1hr}$ (in): **0.384** http://hdsc.nws.noaa.gov/hdsc/pfds/sa/sca_pfds.html		
[5] Compute P_6, Mean 6-hr Precipitation (inches): **0.475** P_6 = Item 4 *C_1, where C_1 is a function of site climatic region specified in Form 3-1 Item 1 (Desert = 1.2371)		
[6] Drawdown Rate Use 48 hours as the default condition. Selection and use of the 24 hour drawdown time condition is subject to approval by the local jurisdiction. The necessary BMP footprint is a function of drawdown time. While shorter drawdown times reduce the performance criteria for LID BMP design capture volume, the depth of water that can be stored is also reduced.		24-hrs **48-hrs**
[7] Compute design capture volume, DCV (ft^3): **32,810** DCV = 1/12 * [Item 1* Item 3 *Item 5 * C_2], where C_2 is a function of drawdown rate (24-hr = 1.582; 48-hr = 1.963) Compute separate DCV for each outlet from the project site per schematic drawn in Form 3-1 Item 2		

SEE DRAINAGE STUDY PROVIDED SEPARATELY (TYP. ALL AREAS)

Form 4.2-2 Summary of Hydromodification Assessment (DA 1, 2 & 3)

Is the change in post- and pre- condition flows captured on-site? : Yes **X** No

If "Yes", then complete Hydromodification assessment of site hydrology for 10yr storm event using Forms 4.2-3 through 4.2-5 and insert results below (Forms 4.2-3 through 4.2-5 may be replaced by computer software analysis based on the San Bernardino County Hydrology Manual- Addendum 1)

If "No," then proceed to Section 4.3 BMP Selection and Sizing

Condition	Runoff Volume (ft^3)	Time of Concentration (min)	Peak Runoff (cfs)
Pre-developed	1 Form 4.2-3 Item 12	2 Form 4.2-4 Item 13	3 Form 4.2-5 Item 10
Post-developed	4 Form 4.2-3 Item 13	5 Form 4.2-4 Item 14	6 Form 4.2-5 Item 14
Difference	7 Item 4 – Item 1	8 Item 2 – Item 5	9 Item 6 – Item 3
Difference (as % of pre-developed)	10 % Item 7 / Item 1	11 % Item 8 / Item 2	12 % Item 9 / Item 3

Form 4.2-3 Hydromodification Assessment for Runoff Volume (DA 1, 2 & 3)

Weighted Curve Number Determination for: Pre-developed DA	DMA A	DMA B	DMA C	DMA D	DMA E	DMA F	DMA G	DMA H
1a Land Cover type								
2a Hydrologic Soil Group (HSG)								
3a DMA Area, ft² sum of areas of DMA should equal area of DA								
4a Curve Number (CN) use Items 1 and 2 to select the appropriate CN from Appendix C-2 of the TGD for WQMP								
Weighted Curve Number Determination for: Post-developed DA	DMA A	DMA B	DMA C	DMA D	DMA E	DMA F	DMA G	DMA H
1b Land Cover type								
2b Hydrologic Soil Group (HSG)								
3b DMA Area, ft² sum of areas of DMA should equal area of DA								
4b Curve Number (CN) use Items 5 and 6 to select the appropriate CN from Appendix C-2 of the TGD for WQMP								

5 Pre-Developed area-weighted CN:	7 Pre-developed soil storage capacity, S (in): S = (1000 / Item 5) - 10	9 Initial abstraction, I_a (in): I_a = 0.2 * Item 7
6 Post-Developed area-weighted CN:	8 Post-developed soil storage capacity, S (in): S = (1000 / Item 6) - 10	10 Initial abstraction, I_a (in): I_a = 0.2 * Item 8

11 Precipitation for 10 yr, 24 hr storm (in):
Go to: http://hdsc.nws.noaa.gov/hdsc/pfds/sa/sca_pfds.html

12 Pre-developed Volume (ft³):
V_{pre} =(1 / 12) * (Item sum of Item 3) * [(Item 11 – Item 9)^2 / ((Item 11 – Item 9 + Item 7)

13 Post-developed Volume (ft³):
V_{pre} =(1 / 12) * (Item sum of Item 3) * [(Item 11 – Item 10)^2 / ((Item 11 – Item 10 + Item 8)

14 Volume Reduction needed to meet hydromodification requirement, (ft³):
Vhydro = (Item 13 * 0.95) – Item 12

Form 4.2-4 Hydromodification Assessment for Time of Concentration (DA 1, 2 & 3)

Compute time of concentration for pre and post developed conditions for each DA (For projects using the Hydrology Manual complete the form below)

Variables	Pre-developed DA1 Use additional forms if there are more than 4 DMA				Post-developed DA1 Use additional forms if there are more than 4 DMA			
	DMA A	DMA B	DMA C	DMA D	DMA A	DMA B	DMA C	DMA D
1 Length of flowpath (ft) Use Form 3-2 Item 5 for pre-developed condition								
2 Change in elevation (ft)								
3 Slope (ft/ft), S_o = Item 2 / Item 1								
4 Land cover								
5 Initial DMA Time of Concentration (min) Appendix C-1 of the TGD for WQMP								
6 Length of conveyance from DMA outlet to project site outlet (ft) May be zero if DMA outlet is at project site outlet								
7 Cross-sectional area of channel (ft^2)								
8 Wetted perimeter of channel (ft)								
9 Manning's roughness of channel (n)								
10 Channel flow velocity (ft/sec) V_{fps} = (1.49 / Item 9) * (Item 7/Item 8)^0.67 * (Item 3)^0.5								
11 Travel time to outlet (min) T_t = Item 6 / (Item 10 * 60)								
12 Total time of concentration (min) T_c = Item 5 + Item 11								

13 Pre-developed time of concentration (min):	Minimum of Item 12 pre-developed DMA
14 Post-developed time of concentration (min):	Minimum of Item 12 post-developed DMA
15 Additional time of concentration needed to meet hydromodification requirement (min):	$T_{C\text{-}Hydro}$ = (Item 13 * 0.95) – Item 14

Form 4.2-5 Hydromodification Assessment for Peak Runoff (DA 1, 2 & 3)

Compute peak runoff for pre- and post-developed conditions

Variables		Pre-developed DA to Project Outlet (Use additional forms if more than 3 DMA)			Post-developed DA to Project Outlet (Use additional forms if more than 3 DMA)		
		DMA A	DMA B	DMA C	DMA A	DMA B	DMA C
1 Rainfall Intensity for storm duration equal to time of concentration I_{peak} = 10^(LOG Form 4.2-1 Item 4 - 0.7 LOG Form 4.2-4 Item 5 /60)							
2 Drainage Area of each DMA (Acres) For DMA with outlet at project site outlet, include upstream DMA (Using example schematic in Form 3-1, DMA A will include drainage from DMA C)							
3 Ratio of pervious area to total area For DMA with outlet at project site outlet, include upstream DMA (Using example schematic in Form 3-1, DMA A will include drainage from DMA C)							
4 Pervious area infiltration rate (in/hr) Use pervious area CN and antecedent moisture condition with Appendix C-3 of the TGD for WQMP							
5 Maximum loss rate (in/hr) F_m = Item 3 * Item 4 Use area-weighted F_m from DMA with outlet at project site outlet, include upstream DMA (Using example schematic in Form 3-1, DMA A will include drainage from DMA C)							
6 Peak Flow from DMA (cfs) Q_p =Item 2 * 0.9 * (Item 1 - Item 5)							
7 Time of concentration adjustment factor for other DMA to site discharge point Form 4.2-4 Item 12 DMA / Other DMA upstream of site discharge point (If ratio is greater than 1.0, then use maximum value of 1.0)	DMA A	n/a			n/a		
	DMA B		n/a			n/a	
	DMA C			n/a			n/a

8 Pre-developed Q_p at T_c for DMA A:	9 Pre-developed Q_p at T_c for DMA B:	10 Pre-developed Q_p at T_c for DMA C:
Q_p = Item 6_{DMAA} + [Item 6_{DMAB} * (Item 1_{DMAA} - Item 5_{DMAB})/(Item 1_{DMAB} - Item 5_{DMAB})* Item $7_{DMAA/2}$] + [Item 6_{DMAC} * (Item 1_{DMAA} - Item 5_{DMAC})/(Item 1_{DMAC} - Item 5_{DMAC})* Item $7_{DMAA/3}$]	Q_p = Item 6_{DMAB} + [Item 6_{DMAA} * (Item 1_{DMAB} - Item 5_{DMAA})/(Item 1_{DMAA} - Item 5_{DMAA})* Item $7_{DMAB/1}$] + [Item 6_{DMAC} * (Item 1_{DMAB} - Item 5_{DMAC})/(Item 1_{DMAC} - Item 5_{DMAC})* Item $7_{DMAB/3}$]	Q_p = Item 6_{DMAC} + [Item 6_{DMAA} * (Item 1_{DMAC} - Item 5_{DMAA})/(Item 1_{DMAA} - Item 5_{DMAA})* Item $7_{DMAC/1}$] + [Item 6_{DMAB} * (Item 1_{DMAC} - Item 5_{DMAB})/(Item 1_{DMAB} - Item 5_{DMAB})* Item $7_{DMAC/2}$]

10 Peak runoff from pre-developed condition confluence analysis (cfs): Maximum of Item 8, 9, and 10 (including additional forms as needed)

11 Post-developed Q_p at T_c for DMA A:	12 Post-developed Q_p at T_c for DMA B:	13 Post-developed Q_p at T_c for DMA C:
Same as Item 8 for post-developed values	Same as Item 9 for post-developed values	Same as Item 10 for post-developed values

14 Peak runoff from post-developed condition confluence analysis (cfs): Maximum of Item 11, 12, and 13 (including additional forms as needed)

15 Peak runoff reduction needed to meet Hydromodification Requirement (cfs): $Q_{p\text{-}hydro}$ = (Item 14 * 0.95) – Item 10

4.3 BMP Selection and Sizing

Complete the following forms for each project site DA to document that the proposed treatment (LID/Bioretention) BMPs conform to the project DCV developed to meet performance criteria specified in the Phase II Small MS4 Permit (WQMP Template Section 4.2). For the LID DCV, the forms are ordered according to hierarchy of BMP selection as required by the Phase II Small MS4 Permit (see Section 5.3 in the TGD for WQMP). The forms compute the following for on-site LID BMP:

- Site Design Measures (Form 4.3-2)
- Retention and Infiltration BMPs (Form 4.3-3) or
- Biotreatment BMPs (Form 4.3-4).

> Please note that the selected BMPs may also be used as dual purpose for on-site, hydromodification mitigation and management.

At the end of each form, additional fields facilitate the determination of the extent of mitigation provided by the specific BMP category, allowing for use of the next category of BMP in the hierarchy, if necessary.

The first step in the analysis, using Section 5.3.2 of the TGD for WQMP, is to complete Forms 4.3-1 and 4.3-3) to determine if retention and infiltration BMPs are infeasible for the project. For each feasibility criterion in Form 4.3-1, if the answer is "Yes," provide all study findings that includes relevant calculations, maps, data sources, etc. used to make the determination of infeasibility.

Next, complete Form 4.3-2 to determine the feasibility of applicable Site Design BMPs, and, if their implementation is feasible, the extent of mitigation of the DCV.

If no site constraints exist that would limit the type of BMP to be implemented in a DA, evaluate the use of combinations of LID BMPs, including all applicable Site Design BMPs to maximize on-site retention of the DCV. If no combination of BMP can mitigate the entire DCV, implement the single BMP type, or combination of BMP types, that maximizes on-site retention of the DCV within the minimum effective area.

If the combination of site design, retention and/or infiltration BMPs is unable to mitigate the entire DCV, then the remainder of the volume-based performance criteria that cannot be achieved with site design, retention and/or infiltration BMPs must be managed through biotreatment BMPs. If biotreatment BMPs are used, then they must be sized to provide equivalent effectiveness based on Template Section 4.3.4.

4.3.1 Exceptions to Requirements for Bioretention Facilities

Contingent on a demonstration that use of bioretention or a facility of equivalent effectiveness is infeasible, other types of biotreatment or media filters (such as tree-box-type biofilters or in-vault media filters) may be used for the following categories of Regulated Projects:

1) Projects creating or replacing an acre or less of impervious area, and located in a designated pedestrian-oriented commercial district (i.e., smart growth projects), and having at least 85% of the entire project site covered by permanent structures;

2) Facilities receiving runoff solely from existing (pre-project) impervious areas; and

3) Historic sites, structures or landscapes that cannot alter their original configuration in order to maintain their historic integrity.

Form 4.3-1 Infiltration BMP Feasibility (DA 1, DA2 & DA3)
Feasibility Criterion – Complete evaluation for each DA on the Project Site
[1] Would infiltration BMP pose significant risk for groundwater related concerns? Yes ☐ No ☒ Refer to Section 5.3.2.1 of the TGD for WQMP
If Yes, Provide basis: (attach)
[2] Would installation of infiltration BMP significantly increase the risk of geotechnical hazards? Yes ☐ No ☒ (Yes, if the answer to any of the following questions is yes, as established by a geotechnical expert): □ The location is less than 50 feet away from slopes steeper than 15 percent □ The location is less than ten feet from building foundations or an alternative setback. □ A study certified by a geotechnical professional or an available watershed study determines that stormwater infiltration would result in significantly increased risks of geotechnical hazards.
If Yes, Provide basis: (attach)
[3] Would infiltration of runoff on a Project site violate downstream water rights? Yes ☐ No ☒
If Yes, Provide basis: (attach)
[4] Is proposed infiltration facility located on hydrologic soil group (HSG) D soils or does the site geotechnical investigation indicate presence of soil characteristics, which support categorization as D soils? Yes ☐ No ☒
If Yes, Provide basis: (attach)
[5] Is the design infiltration rate, after accounting for safety factor of 2.0, below proposed facility less than 0.3 in/hr (accounting for soil amendments)? **At this time using Infiltration rate per USDA/NRCS, soil group A.** Yes ☐ No ☒
If Yes, Provide basis: (attach)
[6] Would on-site infiltration or reduction of runoff over pre-developed conditions be partially or fully inconsistent with watershed management strategies as defined in the WAP, or impair beneficial uses? Yes ☐ No ☒ See Section 3.5 of the TGD for WQMP and WAP
If Yes, Provide basis: (attach)
[7] Any answer from Item 1 through Item 3 is "Yes": Yes ☐ No ☒ If yes, infiltration of any volume is not feasible onsite. Proceed to Form 4.3-4, Selection and Evaluation of Biotreatment BMP. If no, then proceed to Item 8 below.
[8] Any answer from Item 4 through Item 6 is "Yes": Yes ☐ No ☒ If yes, infiltration is permissible but is not required to be considered. Proceed to Form 4.3-2, Site Design BMP. If no, then proceed to Item 9, below.
[9] All answers to Item 1 through Item 6 are "No": Infiltration of the full DCV is potentially feasible, LID infiltration BMP must be designed to infiltrate the full DCV to the MEP. Proceed to Form 4.3-2, Site Design BMPs.

4.3.2 Site Design BMP

Section E.12.e. of the Small Phase II MS4 Permit emphasizes the use of LID preventative measures; and the use of Site Design Measures reduces the portion of the DCV that must be addressed in downstream BMPs. Therefore, all applicable Site Design Measures shall be provided except where they are mutually exclusive

with each other, or with other BMPs. Mutual exclusivity may result from overlapping BMP footprints such that either would be potentially feasible by itself, but both could not be implemented. Please note that while there are no numeric standards regarding the use of Site Design BMPs. If a project cannot feasibly meet BMP sizing requirements or cannot fully address hydromodification, feasibility of all applicable Site Design BMPs must be part of demonstrating that the BMP system has been designed to retain the maximum feasible portion of the DCV. Complete Form 4.3-2 to identify and calculate estimated retention volume from implementing site design BMP. Refer to Section 5.4 in the TGD for more detailed guidance.

Form 4.3-2 Site Design BMPs (DA 1)

1 Implementation of Impervious Area Dispersion BMP (i.e. routing runoff from impervious to pervious areas), excluding impervious areas planned for routing to on-lot infiltration BMP: Yes ☐ No ☒ If yes, complete Items 2-5; If no, proceed to Item 6	DA DMA BMP Type	DA DMA BMP Type	DA DMA BMP Type (Use additional forms for more BMPs)
2 Total impervious area draining to pervious area (ft^2)			
3 Ratio of pervious area receiving runoff to impervious area			
4 Retention volume achieved from impervious area dispersion (ft^3) V = Item2 * Item 3 * (0.5/12), assuming retention of 0.5 inches of runoff			
5 Sum of retention volume achieved from impervious area dispersion (ft^3): **0**	$V_{retention}$ =Sum of Item 4 for all BMPs		
6 Implementation of Localized On-lot Infiltration BMPs (e.g. on-lot rain gardens): Yes ☐ No ☒ If yes, complete Items 7-13 for aggregate of all on-lot infiltration BMP in each DA; If no, proceed to Item 14	DA DMA BMP Type	DA DMA BMP Type	DA DMA BMP Type (Use additional forms for more BMPs)
7 Ponding surface area (ft^2)			
8 Ponding depth (ft) (min. 0.5 ft.)			
9 Surface area of amended soil/gravel (ft^2)			
10 Average depth of amended soil/gravel (ft) (min. 1 ft.)			
11 Average porosity of amended soil/gravel			
12 Retention volume achieved from on-lot infiltration (ft^3) $V_{retention}$ = (Item 7 *Item 8) + (Item 9 * Item 10 * Item 11)			
13 Runoff volume retention from on-lot infiltration (ft^3): **0**	$V_{retention}$ =Sum of Item 12 for all BMPs		

Form 4.3-2 cont. Site Design BMPs (DA 1)

14 Implementation of Street Trees: Yes ☐ No ☒ If yes, complete Items 14-18. If no, proceed to Item 19	DA DMA BMP Type	DA DMA BMP Type	DA DMA BMP Type (Use additional forms for more BMPs)
15 Number of Street Trees			
16 Average canopy cover over impervious area (ft^2)			
17 Runoff volume retention from street trees (ft^3) $V_{retention}$ = Item 15 * Item 16 * (0.05/12) assume runoff retention of 0.05 inches			
18 Runoff volume retention from street tree BMPs (ft^3): **0** $V_{retention}$ = Sum of Item 17 for all BMPs			
19 Total Retention Volume from Site Design BMPs: Sum of Items 5, 13 and 18			

4.3.3 Infiltration BMPs

Use Form 4.3-3 to compute on-site retention of runoff from proposed retention and infiltration BMPs. Volume retention estimates are sensitive to the percolation rate used, which determines the amount of runoff that can be infiltrated within the specified drawdown time. The infiltration safety factor reduces field measured percolation to account for potential inaccuracy associated with field measurements, declining BMP performance over time, and compaction during construction. Appendix C of the TGD for WQMP provides guidance on estimating an appropriate safety factor to use in Form 4.3-3.

If site constraints limit the use of BMPs to a single type and implementation of retention and infiltration BMPs mitigate no more than 40% of the DCV, then they are considered infeasible and the Project Proponent may evaluate the effectiveness of BMPs lower in the LID hierarchy of use (Section 5.5 of the TGD for WQMP)

If implementation of infiltrations BMPs is feasible as determined using Form 4.3-1, then LID infiltration BMPs shall be implemented to the MEP (section 4.1 of the TGD for WQMP).

4.3.3.1 Allowed Variations for Special Site Conditions

The bioretention system design parameters of this Section may be adjusted for the following special site conditions:

1) Facilities located within 10 feet of structures or other potential geotechnical hazards established by the geotechnical expert for the project may incorporate an impervious cutoff wall between the bioretention facility and the structure or other geotechnical hazard.

2) Facilities with documented high concentrations of pollutants in underlying soil or groundwater, facilities located where infiltration could contribute to a geotechnical hazard, and facilities located on elevated plazas or other structures may incorporate an impervious liner and may locate the underdrain discharge at the bottom of the subsurface drainage/storage layer (this configuration is commonly known as a “flow-through planter”).

3) Facilities located in areas of high groundwater, highly infiltrative soils or where connection of underdrain to a surface drain or to a subsurface storm drain are infeasible, may omit the underdrain.

4) Facilities serving high-risk areas such as fueling stations, truck stops, auto repairs, and heavy industrial sites may be required to provide adequate pretreatment to address pollutants of concern unless these high-risk areas are isolated from storm water runoff or bioretention areas with no chance of spill migration.

.

Form 4.3-3 Infiltration LID BMP - including underground BMPs (DA 1)

1 Remaining LID DCV not met by site design BMP (ft^3): **37,170** V_{unmet} = Form 4.2-1 Item 7 - Form 4.3-2 Item19			
BMP Type Use columns to the right to compute runoff volume retention from proposed infiltration BMP (select BMP from Table 5-4 in TGD for WQMP) - Use additional forms for more BMPs	DA 1 DMA A & B BMP Type Infiltration Basin		
2 Infiltration rate of underlying soils (in/hr) See Section 5.4.2 and Appendix C of the TGD for WQMP for minimum requirements for assessment methods **Infiltration rate per NRCS, soil group A**	**12.97**		
3 Infiltration safety factor See TGD Section 5.4.2 and Appendix D	**4**		
4 Design percolation rate (in/hr) P_{design} = Item 2 / Item 3	**3.24**		
5 Ponded water drawdown time (hr) Copy Item 6 in Form 4.2-1	**48**		
6 Maximum ponding depth (ft) BMP specific, see Table 5-4 of the TGD for WQMP for BMP design details	**6**		
7 Ponding Depth (ft) d_{BMP} = Minimum of (1/12*Item 4*Item 5) or Item 6	**6**		
8 Infiltrating surface area, SA_{BMP} (ft^2) the lesser of the area needed for infiltration of full DCV or minimum space requirements from Table 5.7 of the TGD for WQMP	**15,704.6**		
9 Amended soil depth, d_{media} (ft) Only included in certain BMP types, see Table 5-4 in the TGD for WQMP for reference to BMP design details	**0**		
10 Amended soil porosity	**0.30**		
11 Gravel depth, d_{media} (ft) Only included in certain BMP types, see Table 5-4 of the TGD for WQMP for BMP design details	**0**		
12 Gravel porosity	**0.40**		
13 Duration of storm as basin is filling (hrs) Typical ~ 3hrs	**3**		
14 Above Ground Retention Volume (ft^3) $V_{retention}$ = Item 8 * [Item7 + (Item 9 * Item 10) + (Item 11 * Item 12) + (Item 13 * (Item 4 / 12))]	**106,948**		
15 Underground Retention Volume (ft^3) Volume determined using manufacturer's specifications and calculations	**0**		
16 Total Retention Volume from LID Infiltration BMPs: **106,948 Ft3** (Sum of Items 14 and 15 for all infiltration BMP included in plan)			
17 Fraction of DCV achieved with infiltration BMP: **100%** Retention% = Item 16 / Form 4.2-1 Item 7			
18 Is full LID DCV retained onsite with combination of hydrologic source control and LID retention/infiltration BMPs? **Yes** ☒ No ☐ If yes, demonstrate conformance using Form 4.3-10; If no, then reduce Item 3, Factor of Safety to 2.0 and increase Item 8, Infiltrating Surface Area, such that the portion of the site area used for retention and infiltration BMPs equals or exceeds the minimum effective area thresholds (Table 5-7 of the TGD for WQMP) for the applicable category of development and repeat all above calculations.			

Form 4.3-3 Infiltration LID BMP - including underground BMPs (DA 2)

1 Remaining LID DCV not met by site design BMP (ft^3): **21,776** V_{unmet} = Form 4.2-1 Item 7 - Form 4.3-2 Item19

BMP Type Use columns to the right to compute runoff volume retention from proposed infiltration BMP (select BMP from Table 5-4 in TGD for WQMP) - Use additional forms for more BMPs	DA 2 DMA A BMP Type Infiltration Basin		
2 Infiltration rate of underlying soils (in/hr) See Section 5.4.2 and Appendix C of the TGD for WQMP for minimum requirements for assessment methods **Infiltration rate per NRCS, soil group A**	**12.97**		
3 Infiltration safety factor See TGD Section 5.4.2 and Appendix D	**4**		
4 Design percolation rate (in/hr) P_{design} = Item 2 / Item 3	**3.24**		
5 Ponded water drawdown time (hr) Copy Item 6 in Form 4.2-1	**48**		
6 Maximum ponding depth (ft) BMP specific, see Table 5-4 of the TGD for WQMP for BMP design details	**6**		
7 Ponding Depth (ft) d_{BMP} = Minimum of (1/12*Item 4*Item 5) or Item 6	**6**		
8 Infiltrating surface area, SA_{BMP} (ft^2) the lesser of the area needed for infiltration of full DCV or minimum space requirements from Table 5.7 of the TGD for WQMP	**8,869.3**		
9 Amended soil depth, d_{media} (ft) Only included in certain BMP types, see Table 5-4 in the TGD for WQMP for reference to BMP design details	**0**		
10 Amended soil porosity	**0.30**		
11 Gravel depth, d_{media} (ft) Only included in certain BMP types, see Table 5-4 of the TGD for WQMP for BMP design details	**0**		
12 Gravel porosity	**0.40**		
13 Duration of storm as basin is filling (hrs) Typical ~ 3hrs	**3**		
14 Above Ground Retention Volume (ft^3) $V_{retention}$ = Item 8 * [Item7 + (Item 9 * Item 10) + (Item 11 * Item 12) + (Item 13 * (Item 4 / 12))]	**60,400**		
15 Underground Retention Volume (ft^3) Volume determined using manufacturer's specifications and calculations	**0**		

16 Total Retention Volume from LID Infiltration BMPs: **60,400 Ft3** (Sum of Items 14 and 15 for all infiltration BMP included in plan)

17 Fraction of DCV achieved with infiltration BMP: **100%** Retention% = Item 16 / Form 4.2-1 Item 7

18 Is full LID DCV retained onsite with combination of hydrologic source control and LID retention/infiltration BMPs? **Yes** No

If yes, demonstrate conformance using Form 4.3-10; If no, then reduce Item 3, Factor of Safety to 2.0 and increase Item 8, Infiltrating Surface Area, such that the portion of the site area used for retention and infiltration BMPs equals or exceeds the minimum effective area thresholds (Table 5-7 of the TGD for WQMP) for the applicable category of development and repeat all above calculations.

Form 4.3-3 Infiltration LID BMP - including underground BMPs (DA 3)

1 Remaining LID DCV not met by site design BMP (ft^3): **32,810** V_{unmet} = Form 4.2-1 Item 7 - Form 4.3-2 Item19

BMP Type Use columns to the right to compute runoff volume retention from proposed infiltration BMP (select BMP from Table 5-4 in TGD for WQMP) - Use additional forms for more BMPs	DA 3 DMA A BMP Type Infiltration Basin		
2 Infiltration rate of underlying soils (in/hr) See Section 5.4.2 and Appendix C of the TGD for WQMP for minimum requirements for assessment methods **Infiltration rate per NRCS, soil group A**	**12.97**		
3 Infiltration safety factor See TGD Section 5.4.2 and Appendix D	**4**		
4 Design percolation rate (in/hr) P_{design} = Item 2 / Item 3	**3.24**		
5 Ponded water drawdown time (hr) Copy Item 6 in Form 4.2-1	**48**		
6 Maximum ponding depth (ft) BMP specific, see Table 5-4 of the TGD for WQMP for BMP design details	**6**		
7 Ponding Depth (ft) d_{BMP} = Minimum of (1/12*Item 4*Item 5) or Item 6	**6**		
8 Infiltrating surface area, SA_{BMP} (ft^2) the lesser of the area needed for infiltration of full DCV or minimum space requirements from Table 5.7 of the TGD for WQMP	**12,149.4**		
9 Amended soil depth, d_{media} (ft) Only included in certain BMP types, see Table 5-4 in the TGD for WQMP for reference to BMP design details	**0**		
10 Amended soil porosity	**0.30**		
11 Gravel depth, d_{media} (ft) Only included in certain BMP types, see Table 5-4 of the TGD for WQMP for BMP design details	**0**		
12 Gravel porosity	**0.40**		
13 Duration of storm as basin is filling (hrs) Typical ~ 3hrs	**3**		
14 Above Ground Retention Volume (ft^3) $V_{retention}$ = Item 8 * [Item7 + (Item 9 * Item 10) + (Item 11 * Item 12) + (Item 13 * (Item 4 / 12))]	**82,737**		
15 Underground Retention Volume (ft^3) Volume determined using manufacturer's specifications and calculations	**0**		

16 Total Retention Volume from LID Infiltration BMPs: **82,737 Ft3** (Sum of Items 14 and 15 for all infiltration BMP included in plan)

17 Fraction of DCV achieved with infiltration BMP: **100%** Retention% = Item 16 / Form 4.2-1 Item 7

18 Is full LID DCV retained onsite with combination of hydrologic source control and LID retention/infiltration BMPs? **Yes** No

If yes, demonstrate conformance using Form 4.3-10; If no, then reduce Item 3, Factor of Safety to 2.0 and increase Item 8, Infiltrating Surface Area, such that the portion of the site area used for retention and infiltration BMPs equals or exceeds the minimum effective area thresholds (Table 5-7 of the TGD for WQMP) for the applicable category of development and repeat all above calculations.

4.3.4 Biotreatment BMP

Biotreatment BMPs may be considered if the full LID DCV cannot be met by maximizing retention and infiltration. A key consideration when using biotreatment BMP is the effectiveness of the proposed BMP in addressing the pollutants of concern for the project (see Table 5-5 of the TGD for WQMP).

Use Form 4.3-4 to summarize the potential for volume based and/or flow based biotreatment options to biotreat the remaining unmet LID DCV. Biotreatment computations are included as follows:

- Use Form 4.3-5 to compute biotreatment in small volume based biotreatment BMP (e.g. bioretention w/underdrains);
- Use Form 4.3-6 to compute biotreatment in large volume based biotreatment BMP (e.g. constructed wetlands);
- Use Form 4.3-7 to compute sizing criteria for flow-based biotreatment BMP (e.g. bioswales)

Form 4.3-4 Selection and Evaluation of Biotreatment BMP (DA 1)

1 Remaining LID DCV not met by site design , or infiltration, BMP for potential biotreatment (ft³): 0.0 Form 4.2-1 Item 7 - Form 4.3-2 Item 19 – Form 4.3-3 Item 16	List pollutants of concern Copy from Form 2.3-1. Pathogens, Nutrients,Sediment, Oil & Grease, Trash/Debris, Pesticides/Herbicides, Organic Compounds, Oxygen Demanding Compound.	
2 Biotreatment BMP Selected (Select biotreatment BMP(s) necessary to ensure all pollutants of concern are addressed through Unit Operations and Processes, described in Table 5-5 of the TGD for WQMP)	Volume-based biotreatment Use Forms 4.3-5 and 4.3-6 to compute treated volume	Flow-based biotreatment Use Form 4.3-7 to compute treated flow
	Retention/Detention Basin	
3 Volume biotreated in volume based biotreatment BMP (ft³): Form 4.3-5 Item 15 + Form 4.3-6 Item 13	4 Compute remaining LID DCV with implementation of volume based biotreatment BMP (ft³): 0.0 Item 1 – Item 3	5 Remaining fraction of LID DCV for sizing flow based biotreatment BMP: 0% Item 4 / Item 1

6 Flow-based biotreatment BMP capacity provided (cfs): 0.0 Use Figure 5-2 of the TGD for WQMP to determine flow capacity required to provide biotreatment of remaining percentage of unmet LID DCV (Item 5), for the project's precipitation zone (Form 3-1 Item 1)

7 Metrics for MEP determination:

- Provided a WQMP with the portion of site area used for suite of LID BMP equal to minimum thresholds in Table 5-7 of the TGD for WQMP for the proposed category of development: If maximized on-site retention BMPs is feasible for partial capture, then LID BMP implementation must be optimized to retain and infiltrate the maximum portion of the DCV possible within the prescribed minimum effective area. The remaining portion of the DCV shall then be mitigated using biotreatment BMP.

Form 4.3-5 Volume Based Biotreatment (DA 1, 2 & 3)
Bioretention and Planter Boxes with Underdrains

Biotreatment BMP Type (Bioretention w/underdrain, planter box w/underdrain, other comparable BMP)	DA DMA BMP Type	DA DMA BMP Type	DA DMA BMP Type (Use additional forms for more BMPs)
1 Pollutants addressed with BMP List all pollutant of concern that will be effectively reduced through specific Unit Operations and Processes described in Table 5-5 of the TGD for WQMP			
2 Amended soil infiltration rate Typical ~ 5.0			
3 Amended soil infiltration safety factor Typical ~ 2.0			
4 Amended soil design percolation rate (in/hr) P_{design} = Item 2 / Item 3			
5 Ponded water drawdown time (hr) Copy Item 6 from Form 4.2-1			
6 Maximum ponding depth (ft) see Table 5-6 of the TGD for WQMP for reference to BMP design details			
7 Ponding Depth (ft) d_{BMP} = Minimum of (1/12 * Item 4 * Item 5) or Item 6			
8 Amended soil surface area (ft^2)			
9 Amended soil depth (ft) see Table 5-6 of the TGD for WQMP for reference to BMP design details			
10 Amended soil porosity, n			
11 Gravel depth (ft) see Table 5-6 of the TGD for WQMP for reference to BMP design details			
12 Gravel porosity, n			
13 Duration of storm as basin is filling (hrs) Typical ~ 3hrs			
14 Biotreated Volume (ft^3) $V_{biotreated}$ = Item 8 * [(Item 7/2) + (Item 9 * Item 10) +(Item 11 * Item 12) + (Item 13 * (Item 4 / 12))]			
15 Total biotreated volume from bioretention and/or planter box with underdrains BMP: **0** Sum of Item 14 for all volume-based BMPs included in this form			

Form 4.3-6 Volume Based Biotreatment (DA 1, 2 & 3)
Constructed Wetlands and Extended Detention

Biotreatment BMP Type Constructed wetlands, extended wet detention, extended dry detention, or other comparable proprietary BMP. If BMP includes multiple modules (E.g. forebay and main basin), provide separate estimates for storage and pollutants treated in each module.	DA DMA BMP Type		DA DMA BMP Type (Use additional forms for more BMPs)	
	Forebay	Basin	Forebay	Basin
1 Pollutants addressed with BMP forebay and basin List all pollutant of concern that will be effectively reduced through specific Unit Operations and Processes described in Table 5-5 of the TGD for WQMP				
2 Bottom width (ft)				
3 Bottom length (ft)				
4 Bottom area (ft^2) A_{bottom} = Item 2 * Item 3				
5 Side slope (ft/ft)				
6 Depth of storage (ft)				
7 Water surface area (ft^2) $A_{surface}$ =(Item 2 + (2 * Item 5 * Item 6)) * (Item 3 + (2 * Item 5 * Item 6))				
8 Storage volume (ft^3) For BMP with a forebay, ensure fraction of total storage is within ranges specified in BMP specific fact sheets, see Table 5-6 of the TGD for WQMP for reference to BMP design details V =Item 6 / 3 * [Item 4 + Item 7 + (Item 4 * Item 7)^0.5]				
9 Drawdown Time (hrs) Copy Item 6 from Form 2.1				
10 Outflow rate (cfs) Q_{BMP} = (Item $8_{forebay}$ + Item 8_{basin}) / (Item 9 * 3600)				
11 Duration of design storm event (hrs)				
12 Biotreated Volume (ft^3) $V_{biotreated}$ = (Item $8_{forebay}$ + Item 8_{basin}) +(Item 10 * Item 11 * 3600)				
13 Total biotreated volume from constructed wetlands, extended dry detention, or extended wet detention : **0** (Sum of Item 12 for all BMP included in plan)				

Form 4.3-7 Flow Based Biotreatment (DA 1, 2 & 3)

Biotreatment BMP Type Vegetated swale, vegetated filter strip, or other comparable proprietary BMP	DA DMA BMP Type	DA DMA BMP Type	DA DMA BMP Type (Use additional forms for more BMPs)
1 Pollutants addressed with BMP List all pollutant of concern that will be effectively reduced through specific Unit Operations and Processes described in TGD Table 5-5			
2 Flow depth for water quality treatment (ft) BMP specific, see Table 5-6 of the TGD for WQMP for reference to BMP design details			
3 Bed slope (ft/ft) BMP specific, see Table 5-6 of the TGD for WQMP for reference to BMP design details			
4 Manning's roughness coefficient			
5 Bottom width (ft) b_w = (Form 4.3-5 Item 6 * Item 4) / (1.49 * Item 2^1.67 * Item 3^0.5)			
6 Side Slope (ft/ft) BMP specific, see Table 5-6 of the TGD for WQMP for reference to BMP design details			
7 Cross sectional area (ft^2) A = (Item 5 * Item 2) + (Item 6 * Item 2^2)			
8 Water quality flow velocity (ft/sec) V = Form 4.3-5 Item 6 / Item 7			
9 Hydraulic residence time (min) Pollutant specific, see Table 5-6 of the TGD for WQMP for reference to BMP design details			
10 Length of flow based BMP (ft) L = Item 8 * Item 9 * 60			
11 Water surface area at water quality flow depth (ft^2) SA_{top} = (Item 5 + (2 * Item 2 * Item 6)) * Item 10			

4.3.5 Conformance Summary

Complete Form 4.3-8 to demonstrate how on-site LID DCV is met with proposed site design, infiltration, and/or biotreatment BMP. The bottom line of the form is used to describe the basis for infeasibility determination for on-site LID BMP to achieve full LID DCV, and provides methods for computing remaining volume to be addressed in an alternative compliance plan. If the project has more than one outlet, then complete additional versions of this form for each outlet.

Form 4.3-8 Conformance Summary and Alternative Compliance Volume Estimate (DA 1)

1 Total LID DCV for the Project DA-1 (ft^3): **37,170** Copy Item 7 in Form 4.2-1

2 On-site retention with site design BMP (ft^3): **0** Copy Item18 in Form 4.3-2

3 On-site retention with LID infiltration BMP (ft^3): **106,948** Copy Item 16 in Form 4.3-3

4 On-site biotreatment with volume based biotreatment BMP (ft^3): **0** Copy Item 3 in Form 4.3-4

5 Flow capacity provided by flow based biotreatment BMP (cfs): **0** Copy Item 6 in Form 4.3-4

6 LID BMP performance criteria are achieved if answer to any of the following is "Yes":

- Full retention of LID DCV with site design or infiltration BMP: **Yes** ☒ No ☐
  If yes, sum of Items 2, 3, and 4 is greater than Item 1
- Combination of on-site retention BMPs for a portion of the LID DCV and volume-based biotreatment BMP that address all pollutants of concern for the remaining LID DCV: **Yes** ☒ No ☐
  If yes, a) sum of Items 2, 3, 4, and 5 is greater than Item 1, and Items 2, 3 and 4 are maximized; or b) Item 6 is greater than Form 4.3--5 Item 6 and Items 2, 3 and 4 are maximized
- On-site retention and infiltration is determined to be infeasible; therefore biotreatment BMP provides biotreatment for all pollutants of concern for full LID DCV: Yes ☐ **No** ☒
  If yes, Form 4.3-1 Items 7 and 8 were both checked yes

7 If the LID DCV is not achieved by any of these means, then the project may be allowed to develop an alternative compliance plan. Check box that describes the scenario which caused the need for alternative compliance:

- Combination of Site Design, retention and infiltration, , and biotreatment BMPs provide less than full LID DCV capture: ☐
  Checked yes if Form 4.3-4 Item 7is checked yes, Form 4.3-4 Item 6 is zero, and sum of Items 2, 3, 4, and 5 is less than Item 1. If so, apply water quality credits and calculate volume for alternative compliance, V_{alt} = (Item 1 – Item 2 – Item 3 – Item 4 – Item 5) * (100 - Form 2.4-1 Item 2)%

- Facilities, or a combination of facilities, of a different design than in Section E.12.e.(ii)(f) may be permitted if all of the following Phase II Small MS4 General Permit 2013-0001-DWQ 55 February 5, 2013 measures of equivalent effectiveness are demonstrated:
  1) Equal or greater amount of runoff infiltrated or evapotranspired; ☐
  2) Equal or lower pollutant concentrations in runoff that is discharged after biotreatment; ☐
  3) Equal or greater protection against shock loadings and spills; ☐
  4) Equal or greater accessibility and ease of inspection and maintenance. ☐

Form 4.3-8 Conformance Summary and Alternative Compliance Volume Estimate (DA 2)

1 Total LID DCV for the Project DA-1 (ft^3): **21,776** Copy Item 7 in Form 4.2-1

2 On-site retention with site design BMP (ft^3): **0** Copy Item18 in Form 4.3-2

3 On-site retention with LID infiltration BMP (ft^3): **60,400** Copy Item 16 in Form 4.3-3

4 On-site biotreatment with volume based biotreatment BMP (ft^3): **0** Copy Item 3 in Form 4.3-4

5 Flow capacity provided by flow based biotreatment BMP (cfs): **0** Copy Item 6 in Form 4.3-4

6 LID BMP performance criteria are achieved if answer to any of the following is "Yes":

- ☐ Full retention of LID DCV with site design or infiltration BMP: **Yes** No
  If yes, sum of Items 2, 3, and 4 is greater than Item 1
- ☐ Combination of on-site retention BMPs for a portion of the LID DCV and volume-based biotreatment BMP that address all pollutants of concern for the remaining LID DCV: **Yes** No
  If yes, a) sum of Items 2, 3, 4, and 5 is greater than Item 1, and Items 2, 3 and 4 are maximized; or b) Item 6 is greater than Form 4.3--5 Item 6 and Items 2, 3 and 4 are maximized
- ☐ On-site retention and infiltration is determined to be infeasible; therefore biotreatment BMP provides biotreatment for all pollutants of concern for full LID DCV: Yes **No**
  If yes, Form 4.3-1 Items 7 and 8 were both checked yes

7 If the LID DCV is not achieved by any of these means, then the project may be allowed to develop an alternative compliance plan. Check box that describes the scenario which caused the need for alternative compliance:

- ☐ Combination of Site Design, retention and infiltration, , and biotreatment BMPs provide less than full LID DCV capture:
  ☐
  Checked yes if Form 4.3-4 Item 7is checked yes, Form 4.3-4 Item 6 is zero, and sum of Items 2, 3, 4, and 5 is less than Item 1. If so, apply water quality credits and calculate volume for alternative compliance, V_{alt} = (Item 1 – Item 2 – Item 3 – Item 4 – Item 5) * (100 - Form 2.4-1 Item 2)%

- ☐ Facilities, or a combination of facilities, of a different design than in Section E.12.e.(ii)(f) may be permitted if all of the following Phase II Small MS4 General Permit 2013-0001-DWQ 55 February 5, 2013 measures of equivalent effectiveness are demonstrated:
  1) Equal or greater amount of runoff infiltrated or evapotranspired;
  2) Equal or lower pollutant concentrations in runoff that is discharged after biotreatment;
  3) Equal or greater protection against shock loadings and spills;
  4) Equal or greater accessibility and ease of inspection and maintenance.

Form 4.3-8 Conformance Summary and Alternative Compliance Volume Estimate (DA 3)

1 Total LID DCV for the Project DA-1 (ft^3): **32,810** Copy Item 7 in Form 4.2-1

2 On-site retention with site design BMP (ft^3): **0** Copy Item18 in Form 4.3-2

3 On-site retention with LID infiltration BMP (ft^3): **82,737** Copy Item 16 in Form 4.3-3

4 On-site biotreatment with volume based biotreatment BMP (ft^3): **0** Copy Item 3 in Form 4.3-4

5 Flow capacity provided by flow based biotreatment BMP (cfs): **0** Copy Item 6 in Form 4.3-4

6 LID BMP performance criteria are achieved if answer to any of the following is "Yes":

- ☐ Full retention of LID DCV with site design or infiltration BMP: **Yes** No
  If yes, sum of Items 2, 3, and 4 is greater than Item 1
- ☐ Combination of on-site retention BMPs for a portion of the LID DCV and volume-based biotreatment BMP that address all pollutants of concern for the remaining LID DCV: **Yes** No
  If yes, a) sum of Items 2, 3, 4, and 5 is greater than Item 1, and Items 2, 3 and 4 are maximized; or b) Item 6 is greater than Form 4.3--5 Item 6 and Items 2, 3 and 4 are maximized
- ☐ On-site retention and infiltration is determined to be infeasible; therefore biotreatment BMP provides biotreatment for all pollutants of concern for full LID DCV: Yes **No**
  If yes, Form 4.3-1 Items 7 and 8 were both checked yes

7 If the LID DCV is not achieved by any of these means, then the project may be allowed to develop an alternative compliance plan. Check box that describes the scenario which caused the need for alternative compliance:

- ☐ Combination of Site Design, retention and infiltration, , and biotreatment BMPs provide less than full LID DCV capture: ☐
  Checked yes if Form 4.3-4 Item 7is checked yes, Form 4.3-4 Item 6 is zero, and sum of Items 2, 3, 4, and 5 is less than Item 1. If so, apply water quality credits and calculate volume for alternative compliance, V_{alt} = (Item 1 – Item 2 – Item 3 – Item 4 – Item 5) * (100 - Form 2.4-1 Item 2)%

- ☐ Facilities, or a combination of facilities, of a different design than in Section E.12.e.(ii)(f) may be permitted if all of the following Phase II Small MS4 General Permit 2013-0001-DWQ 55 February 5, 2013 measures of equivalent effectiveness are demonstrated:
  1) Equal or greater amount of runoff infiltrated or evapotranspired;
  2) Equal or lower pollutant concentrations in runoff that is discharged after biotreatment;
  3) Equal or greater protection against shock loadings and spills;
  4) Equal or greater accessibility and ease of inspection and maintenance.

4.3.6 Hydromodification Control BMP

Use Form 4.3-9 to compute the remaining runoff volume retention, after Site Design BMPs are implemented, needed to address hydromodification, and the increase in time of concentration and decrease in peak runoff necessary to meet targets for protection of waterbodies with a potential hydromodification. Describe the proposed hydromodification treatment control BMP. Section 5.6 of the TGD for WQMP provides additional details on selection and evaluation of hydromodification control BMP.

SEE DRAINAGE STUDY, PROVIDED SEPARATELY

Form 4.3-9 Hydromodification Control BMPs (DA 1, 2 & 3)

1 Volume reduction needed for hydromodification performance criteria (ft^3): (Form 4.2-2 Item 4 * 0.95) – Form 4.2-2 Item 1	2 On-site retention with site design and infiltration, BMP (ft^3): Sum of Form 4.3-8 Items 2, 3, and 4. Evaluate option to increase implementation of on-site retention in Forms 4.3-2, 4.3-3, and 4.3-4 in excess of LID DCV toward achieving hydromodification volume reduction
3 Remaining volume for hydromodification volume capture (ft^3): Item 1 – Item 2	4 Volume capture provided by incorporating additional on-site BMPs (ft^3):

5 Is Form 4.2-2 Item 11 less than or equal to 5%: Yes No

If yes, hydromodification performance criteria is achieved. If no, select one or more mitigation options below:

- Demonstrate increase in time of concentration achieved by proposed LID site design, LID BMP, and additional on-site BMP
- Increase time of concentration by preserving pre-developed flow path and/or increase travel time by reducing slope and increasing cross-sectional area and roughness for proposed on-site conveyance facilities

6 Form 4.2-2 Item 12 less than or equal to 5%: Yes No

If yes, hydromodification performance criteria is achieved. If no, select one or more mitigation options below:

- Demonstrate reduction in peak runoff achieved by proposed LID site design, LID BMPs, and additional on-site retention BMPs

4.4 Alternative Compliance Plan (if applicable)

Describe an alternative compliance plan (if applicable) for projects not fully able to infiltrate, or biotreat the DCV via on-site LID practices. A project proponent must develop an alternative compliance plan to address the remainder of the LID DCV. Depending on project type some projects may qualify for water quality credits that can be applied to reduce the DCV that must be treated prior to development of an alternative compliance plan (see Form 2.4-1, Water Quality Credits). Form 4.3-9 Item 8 includes instructions on how to apply water quality credits when computing the DCV that must be met through alternative compliance.

Alternative Designs — Facilities, or a combination of facilities, of a different design than in Permit Section E.12.e.(ii)(f) may be permitted if all of the following measures of equivalent effectiveness are demonstrated:

1) Equal or greater amount of runoff infiltrated or evapotranspired;

2) Equal or lower pollutant concentrations in runoff that is discharged after biotreatment;

3) Equal or greater protection against shock loadings and spills;

4) Equal or greater accessibility and ease of inspection and maintenance.

The Project Proponent will need to obtain written approval for an alternative design from the Lahontan Regional Water Board Executive Officer (see Section 6 of the TGD for WQMP).

SECTION 5

Section 5 Inspection and Maintenance Responsibility for Post Construction BMP

All BMPs included as part of the project WQMP are required to be maintained through regular scheduled inspection and maintenance (refer to Section 8, Post Construction BMP Requirements, in the TGD for WQMP). Fully complete Form 5-1 summarizing all BMP included in the WQMP. Attach additional forms as needed. The WQMP shall also include a detailed Operation and Maintenance Plan for all BMP and a Maintenance Agreement. The Maintenance Agreement must also be attached to the WQMP.

Note that at time of Project construction completion, the Maintenance Agreement must be completed, signed, notarized and submitted to the County Stormwater Department

Form 5-1 BMP Inspection and Maintenance (use additional forms as necessary)

BMP	Responsible Party(s)	Inspection/ Maintenance Activities Required	Minimum Frequency of Activities
Infiltration Basin	City of Victorville Public Works	Maintain vegetation as needed	Ongoing, before annual storms & following rainfall events
Infiltration Basin (Cont.)	City of Victorville Public Works	Remove debris and litter from the entire basin to minimize clogging and improve aesthetics	Ongoing, before annual storms & following rainfall events
Infiltration Basin (Cont.)	City of Victorville Public Works	Check for obvious problems & repair as needed. Address odor, insects, and overgrowth issues associated with stagnant or standing water in basin bottom. There should be no long-term ponding water.	Ongoing, before annual storms & following rainfall events
Infiltration Basin (Cont.)	City of Victorville Public Works	Inspection of hydraulic and structural facilities. Examine the inlet for blockage, the embankment integrity, as well as damage to any structural element.	Annually. If possible schedule these inspections within 72 hours after significant rainfall.

Infiltration Basin (Cont.)	City of Victorville Public Works	Check basin depth for sediment build up and reduced total capacity. Scrape bottom as needed and remove sediment.	Annually. If possible schedule these inspections within 72 hours after significant rainfall.
Infiltration Basin (Cont.)	City of Victorville Public Works	Verify the basin bottom is allowing acceptable infiltration. Use disc or other method to aerate basin bottom only if there is actual significant loss of infiltrative capacity, rather than on a routine basis.	Annually. If possible schedule these inspections within 72 hours after significant rainfall.

SECTION 6

Section 6 WQMP Attachments

6.1. Site Plan and Drainage Plan

Include a site plan and drainage plan sheet set containing the following minimum information:

- Project location
- Site boundary
- Land uses and land covers, as applicable
- Suitability/feasibility constraints
- Structural Source Control BMP locations
- Site Design Hydrologic Source Control BMP locations
- LID BMP details
- Drainage delineations and flow information
- Drainage connections

6.2 Electronic Data Submittal

Minimum requirements include submittal of PDF exhibits in addition to hard copies. Format must not require specialized software to open. If the local jurisdiction requires specialized electronic document formats (as described in their Local Implementation Plan), this section will describe the contents (e.g., layering, nomenclature, geo-referencing, etc.) of these documents so that they may be interpreted efficiently and accurately.

6.3 Post Construction

Attach all O&M Plans and Maintenance Agreements for BMP to the WQMP.

6.4 Other Supporting Documentation

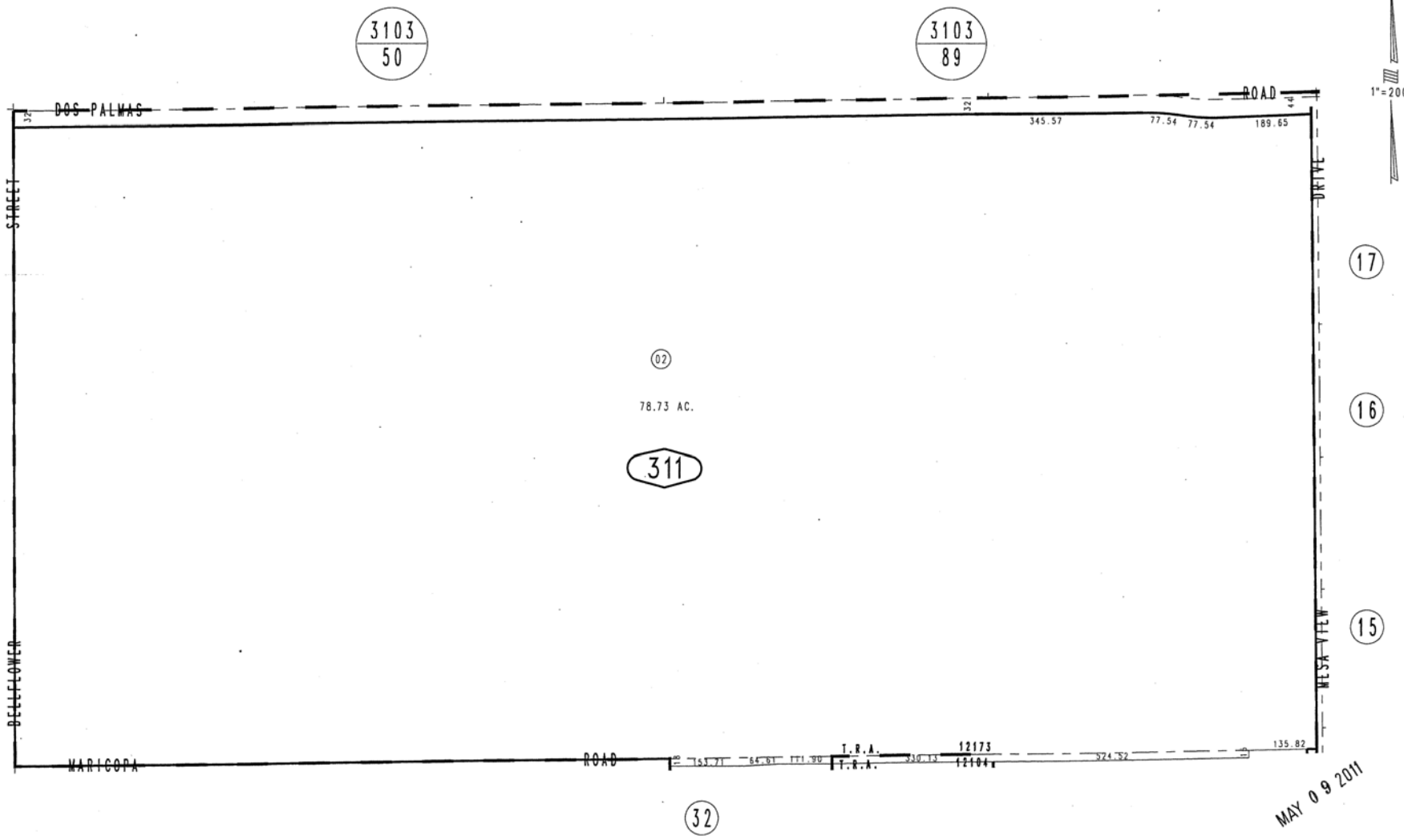
- BMP Educational Materials
- Activity Restriction – C,C&R's & Lease Agreements

THIS MAP IS FOR THE PURPOSE OF AD VALOREM TAXATION ONLY.

Ptn. N.W.1/4, Sec. 28,T.5N.,R.5W.,S.B.M.

City of Victorville
Tax Rate Area
12104,12173

3096 - 31



MAY 09 2011

REVISED
03/10/10 LH
04/29/10 LH
04/07/11 RU

DEC. 1991

Assessor's Map
Book 3096 Page 31
San Bernardino County

Electronically Recorded in Official Records, County of San Bernardino 10/01/2009 09:15 AM NC

LARRY WALKER
Auditor/Controller - Recorder

824 First American Title - Rancho

Doc #: 2009-0433420

Titles: 1 Pages: 4

Fees	18.00
Taxes	.00
Other	.00
PAID	18.00

RECORDING REQUESTED BY:
FIRST AMERICAN TITLE NHS
21921-29
MAIL TAX STATEMENTS TO:
WHEN RECORDED MAIL TO:

LA-DF INVESTMENT FUND 68, LLC
212 SOUTH PALM AVENUE, SUITE 200
ALHAMBRA, CA 91801-3105
ATTN: GREG QUAN
APN: PORTION OF 3096-321-02, 03, 04
AND ALL OF 3096-311-01

DOCUMENTARY TRANSFER TAX $0 TO PERFECT LOT LINE ADJUSTMENT

SPACE ABOVE THIS LINE FOR RECORDER'S USE

.....Computed on the consideration or value of property conveyed; OR

.....Computed on the consideration or value less liens or encumbrances remaining at time of sale.

Signature of Declarant or Agent determining tax - Firm Name

GRANT DEED

FOR A VALUABLE CONSIDERATION, receipt of which is hereby acknowledged,

LA-DF INVESTMENT FUND 68, LLC, A CALIFORNIA LIMITED LIABILITY COMPANY

hereby GRANT(S) to

LA-DF INVESTMENT FUND 68, LLC, A CALIFORNIA LIMITED LIABILITY COMPANY

the real property in the City of Victorville, County of San Bernardino, State of California, described as follows:

PARCEL "A" OF LOT LINE ADJUSTMENT NO. ADM07-00073, RECORDED SEPTEMBER 30, 2009 AS INSTRUMENT NO. 2009-0430324 OF OFFICIAL RECORDS AND DESCRIBED ON ATTACHED EXHBIT "A".

THIS DEED IS BEING RECORDED TO COMPLY WITH LOT LINE ADJUSTMENT NO. ADM07-00073, RECORDED SEPTEMBER 30, 2009 AS INSTRUMENT NO. 2009-0430324 OF OFFICIAL RECORDS.

Mail Tax Statements to
SAME AS ABOVE

Dated: September 21, 2009

LA-DF INVESTMENT FUND 68, LLC, A CALIFORNIA LIMITED LIABILITY COMPANY

BY: R.Y. PROPERTIES, INC., MANAGING MEMBER

BY: _____
ROBERT YU, PRESIDENT

STATE OF CALIFORNIA }
COUNTY OF LOS ANGELES }ss

On September 21, 2009 before me, Lillian Park, a notary public, personally appeared Robert Yu,

proved to me on the basis of satisfactory evidence to be the person(s) whose name(s) is/are subscribed to the within instrument and acknowledged to me that he/she/they executed the same in his/her/their authorized capacity(ies), and that by his/her/their signature(s) on the instrument the person(s) or the entity upon behalf of which the person(s) acted, executed the instrument. I certify under PENALTY OF PERJURY under the laws of the State of California that the foregoing paragraph is true and correct.

WITNESS my hand and official seal.

Signature _____

NRO1 LILLIAN PARK COMM. #1742113 Notary Public - California Los Angeles County My Comm. Expires May 24, 2011 NRO1

MAIL TAX STATEMENTS TO: SAME AS ABOVE

EXHIBIT "A"

PARCEL A:

THE NORTH ONE-HALF AND A PORTION OF THE SOUTH ONE-HALF OF THE NORTHWEST ONE-QUARTER OF SECTION 28, TOWNSHIP 5 NORTH, RANGE 5 WEST, SAN BERNARDINO BASE AND MERIDIAN, IN THE CITY OF VICTORVILLE, COUNTY OF SAN BERNARDINO, STATE OF CALIFORNIA, MORE PARTICULARLY DESCRIBED AS FOLLOWS:

BEGINNING AT THE NORTH QUARTER CORNER OF SAID SECTION 28;

THENCE SOUTH 00° 02' 06" WEST, 1328.90 FEET TO A POINT ON THE SOUTHERLY LINE OF SAID NORTH ONE-HALF OF THE NORTHWEST ONE-QUARTER OF SECTION 28;

THENCE SOUTH 89° 40' 28" WEST ALONG SAID SOUTHERLY LINE, 135.82 FEET;

THENCE SOUTH 00° 17' 59" EAST TO A POINT ON A LINE PARALLEL AND DISTANT 15.00' SOUTHERLY FROM SAID SOUTHERLY LINE, 15.00 FEET;

THENCE SOUTH 89° 40' 28" WEST ALONG SAID PARALLEL LINE, 966.55 FEET;

THENCE SOUTH 87° 00' 47" WEST, 64.61 FEET;

THENCE SOUTH 89° 40' 28" WEST, 153.71 FEET TO THE WEST LINE OF THE NORTHWEST ONE-QUARTER OF THE SOUTHEAST ONE-QUARTER OF THE NORTHWEST ONE-QUARTER OF SAID SECTION 28;

THENCE NORTH 00° 05' 31" EAST ALONG SAID WEST LINE, 18.00 FEET TO A POINT ON SAID SOUTHERLY LINE;

THENCE SOUTH 89° 40' 28" WEST ALONG SAID SOUTHERLY LINE, 1320.49 FEET TO THE SOUTHWEST CORNER OF SAID NORTH ONE-HALF OF THE NORTHWEST ONE-QUARTER OF SECTION 28;

THENCE NORTH 00° 08' 56" EAST ALONG THE WESTERLY LINE OF SAID NORTH ONE-HALF OF THE NORTHWEST ONE-QUARTER OF SECTION 28, 1324.72 FEET TO THE NORTHWEST CORNER OF SAID SECTION 28;

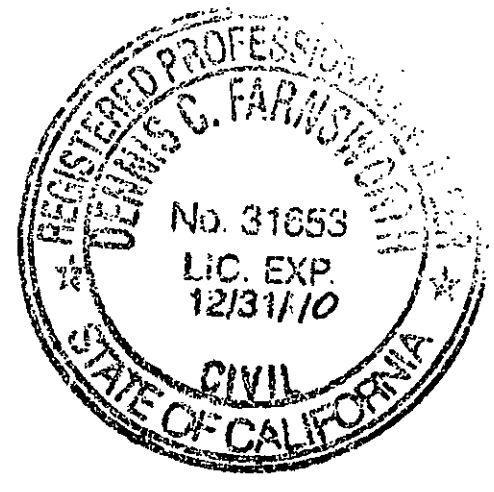
THENCE NORTH 89° 35' 00" EAST ALONG SAID NORTHERLY LINE, 2638.38 FEET TO THE **POINT OF BEGINNING**.

THE AREA OF THIS LAND IS APPROXIMATELY 3,520,569 S.F. (80.82 ACRES)
MORE OR LESS

THIS DOCUMENT WAS PREPARED UNDER SUPERVISION OF:

DENNIS C. FARNSWORTH
RCE: 31653 EXP. 12/31/10

8/20/09
DATE



RECORDING REQUESTED BY:

City of Victorville
Engineering Department

AND WHEN RECORDED MAIL TO:

City of Victorville
Engineering Department
14343 Civic Drive
Victorville, CA 92392

SPACE ABOVE THIS LINE FOR RECORDER'S USE

AGREEMENT

THIS PAGE ADDED TO PROVIDE ADEQUATE SPACE FOR RECORDING INFORMATION

Water Quality Management Plan and Stormwater Best Management Practices Transfer, Access and Maintenance Agreement

OWNER NAME: Greg Quan

PROPERTY ADDRESS: Tract No. 16397; SW corner of Dos Palmas Rd. and Mesa View Rd.

APN: 3096-311-02

THIS AGREEMENT is made and entered into in

_____, California, this _____ day of

_____, by and between

_____, hereinafter

referred to as Owner, and the CITY OF VICTORVILLE, a municipal corporation, located in the County of San Bernardino, State of California, hereinafter referred to as CITY;

WHEREAS, the Owner owns real property ("Property") in the City of Victorville, State of California, more specifically described in Exhibit "A" and depicted in Exhibit "B", each of which exhibits is attached hereto and incorporated herein by this reference;

WHEREAS, at the time of initial approval of development project known as

Tract No. 16397 within the Property described herein, the CITY required the project to employ Best Management Practices, hereinafter referred to as "BMPs," to minimize pollutants in urban runoff;

WHEREAS, the Owner has chosen to install and/or implement BMPs as described in the Water Quality Management Plan, on file with the CITY, hereinafter referred to as "WQMP", to minimize pollutants in urban runoff and to minimize other adverse impacts of urban runoff;

WHEREAS, said WQMP has been certified by the Owner and reviewed and approved by the City;

WHEREAS, the Owner is aware that periodic and continuous maintenance, including, but not necessarily limited to, filter material replacement and sediment removal, is required to assure peak performance of all BMPs in the WQMP and that, furthermore, such maintenance activity will require compliance with all Local, State, or Federal laws and regulations, including those pertaining to confined space and waste disposal methods, in effect at the time such maintenance occurs;

NOW THEREFORE, it is mutually stipulated and agreed as follows:

1. All maintenance or replacement of BMPs proposed as part of the WQMP are the sole responsibility of the Owner in accordance with the terms of this Agreement.

2. Owner hereby provides the City of Victorville's designee complete access, of any duration, to the BMPs and their immediate vicinity at any time, upon reasonable notice, or in the event of emergency, as determined by the City's Director of Public Works, no advance notice, for the purpose of inspection, sampling, testing of the Device, and in case of emergency, to undertake all necessary repairs or other preventative measures at owner's expense as provided in paragraph 3 below. The City shall make every effort at all times to minimize or avoid interference with Owner's use of the Property. Denial of access to any premises or facility that contains WQMP features is a violation of the City Stormwater Ordinance. If there is reasonable cause to believe that an illicit discharge or breach of the WQMP operation and maintenance commitments is occurring on the premises then the authorized enforcement agency may seek issuance of a search warrant from any court of competent jurisdiction in addition to other enforcement actions.

3. Owner shall use its best efforts diligently to maintain all BMPs in a manner assuring peak performance at all times. All reasonable precautions shall be exercised by Owner and Owner's representative or contractor in the removal and extraction of any material(s) from the BMPs and the ultimate disposal of the material(s) in a manner consistent with all relevant laws and regulations in effect at the time. As may be requested from time to time by the City, the Owner shall provide the City with documentation identifying the material(s) removed, the quantity, and disposal destination.

4. In the event Owner, or its successors or assigns, fails to accomplish the necessary maintenance contemplated by this Agreement, within five (5) days of being given written notice by the City , the City is hereby authorized to cause any maintenance necessary to be done and charge the entire cost and expense against the property and/or to the Owner or Owner's successors or assigns, including administrative costs, attorneys fees and interest thereon at the maximum rate authorized by the City Code from the date of the notice of expense until paid in full.

5. The City may require the owner to post security in form and for a time period satisfactory to the City to guarantee the performance of the obligations stated herein. Should the Owner fail to perform the obligations under the Agreement, the City may, in the case of a cash bond, act for the Owner using the proceeds from it, or in the case of a surety bond, require the sureties to perform the obligations of the Agreement. As an additional remedy, the Director of Public Works may withdraw any previous stormwater-related approval with respect to the property on which BMPs have been installed and/or implemented until such time as Owner repays to City its reasonable costs incurred in accordance with paragraph 3 above.

6. This agreement shall be recorded in the Office of the Recorder of San Bernardino County, California, at the expense of the Owner and shall constitute notice to all successors and assigns of the title to said Property of the obligation herein set forth, and also a lien in such amount as will fully reimburse the City, including interest as herein above set forth, subject to foreclosure in event of default in payment.

7. In event of legal action occasioned by any default or action of the Owner, or its successors or assigns, then the Owner and its successors or assigns agree(s) to hold the City harmless and pay all costs incurred by the City in enforcing the terms of this Agreement, including reasonable attorney's fees and costs, and that the same shall become a part of the lien against said Property.

8. It is the intent of the parties hereto that burdens and benefits herein undertaken shall constitute covenants that run with said Property and constitute a lien there against.

9. The obligations herein undertaken shall be binding upon the heirs, successors, executors, administrators and assigns of the parties hereto. The term "Owner" shall include not only the present Owner, but also its heirs, successors, executors, administrators, and assigns. Owner shall notify any successor to title of all or part of the Property about the existence of this Agreement. Owner shall provide such notice prior to such successor obtaining an interest in all or part of the Property. Owner shall provide a copy of such notice to the City at the same time such notice is provided to the successor.

10. Time is of the essence in the performance of this Agreement.

11. Any notice to a party required or called for in this Agreement shall be served in person, or by deposit in the U.S. Mail, first class postage prepaid, to the address set forth below. Notice(s) shall be deemed effective upon receipt, or seventy-two (72) hours after deposit in the U.S. Mail, whichever is earlier. A party may change a notice address only by providing written notice thereof to the other party.

12. The Owner its successors and assigns, hereby agrees to save and hold harmless the City, any of its departments, agencies, officers or employees, all of whom while working within their respective authority, from all cost, injury and damage incurred by any of the above, and from any other injury or damage to any person or property whatsoever, any of which is caused by an activity, condition or event arising out of the performance, preparation for performance or nonperformance of any provision of this agreement by the Owner, its agents, or any of its independent contractors.

IF TO CITY:
City of Victorville – Engineering Department

14343 Civic Drive,

Victorville, CA 92392

IF TO OWNER:

_____

_____

_____

IN WITNESS THEREOF, the parties hereto have affixed their signatures as of the date first written above.

OWNER:

Signature: _____

Name: _____

Title: _____

OWNER:

Signature: _____

Name: _____

Title: _____

NOTARIES ON FOLLOWING PAGE

A notary acknowledgement is required for recordation (attach appropriate acknowledgement).

ACCEPTED BY:

_____

Brian W. Gengler., City Engineer

Date: _____

Attachment: Standard Notary Acknowledgement

EXHIBIT A
(Legal Description)

TENTATIVE TRACT NO. 16397, BEING A SUBDIVISION OF THE FOLLOWING: PARCEL "A" OF LOT LINE ADJUSTMENT NO. ADM07-00073, RECORDED SEPTEMBER 30, 2009 AS INSTRUMENT NO. 2009-0430324 OF OFFICIAL RECORDS, DESCRIBED AS FOLLOWS:

THE NORTH ONE-HALF AND A PORTION OF THE SOUTH ONE-HALF OF THE NORTHWEST ONE-QUARTER OF SECTION 28, TOWNSHIP 5 NORTH, RANGE 5 WEST, SAN BERNARDINO BASE AND MERIDIAN, IN THE CITY OF VICTORVILLE, COUNTY OF SAN BERNARDINO, STATE OF CALIFORNIA, MORE PARTICULARLY DESCRIBED AS FOLLOWS:

BEGINNING AT THE NORTH QUARTER CORNER OF SAID SECTION 28;

THENCE SOUTH OO° 02' 06" WEST, 1,328.90 FEET TO A POINT ON THE SOUTHERLY LINE OF SAID NORTH ONE-HALF OF THE NORTHWEST ONE-QUARTER OF SECTION 28;

THENCE SOUTH 89°40' 28" WEST ALONG SAID SOUTHERLY LINE, 135.82 FEET;

THENCE SOUTH 00° 17' 59" EAST TO A POINT ON A LINE PARALLEL AND DISTANT 15.00 FEET SOUTHERLY FROM SAID SOUTHERLY LINE, 15.00 FEET;

THENCE SOUTH 89° 40' 28" WEST ALONG SAID PARALLEL LINE, 995.55 FEET;

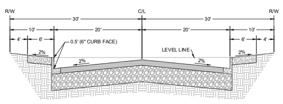
THENCE SOUTH 87° 00 '47" WEST, 64.61 FEET; THENCE SOUTH 89° 40' 28" WEST, 153.71 FEET TO THE WEST LINE OF THE NORTHWEST ONE-QUARTER OF THE SOUTHEAST ONE-QUARTER OF THE NORTHWEST ONE-QUARTER OF SAID SECTION 28;

THENCE NORTH 00° 05' 31" EAST ALONG SAID WEST LINE, 18.00 FEET TO A POINT ON SAID SOUTHERLY LINE;

THENCE SOUTH 89° 40' 28" WEST ALONG SAID SOUTHERLY LINE, 1,320.49 FEET TO THE SOUTHWEST CORNER OF SAID NORTH ONE-HALF OF THE NORTHWEST ONE-QUARTER OF SECTION 28;

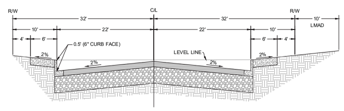
THENCE NORTH 00° 08' 56" EAST ALONG THE WESTERLY LINE OF SAID NORTH ONE-HALF OF THE NORTHWEST ONE-QUARTER OF SECTION 28, 1,324.72 FEET TO THE NORTHWEST CORNER OF SAID SECTION 28;

THENCE NORTH 89° 35' 00" EAST ALONG SAID NORTHERLY LINE, 2,638.38 FEET TO THE POINT OF BEGINNING.



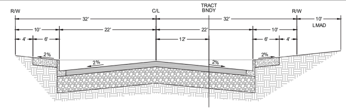
LOCAL STREET TYPICAL SECTION (60' R/W)

SCALES - H: 1" = 10' V: 1" = 2'



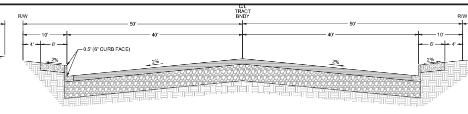
MESA VIEW TYPICAL SECTION (64' R/W)

SCALES - H: 1" = 10' V: 1" = 2'



DOS PALMAS TYPICAL SECTION (64' R/W/)

SCALES - H: 1" = 10' V: 1" = 2'



BELLFLOWER STREET TYPICAL SECTION (100' R/W)

SCALES - H: 1" = 10' V: 1" = 2'

IN THE CITY OF VICTORVILLE
COUNTY OF SAN BERNARDINO, CALIFORNIA

TENTATIVE TRACT MAP NO. 16397

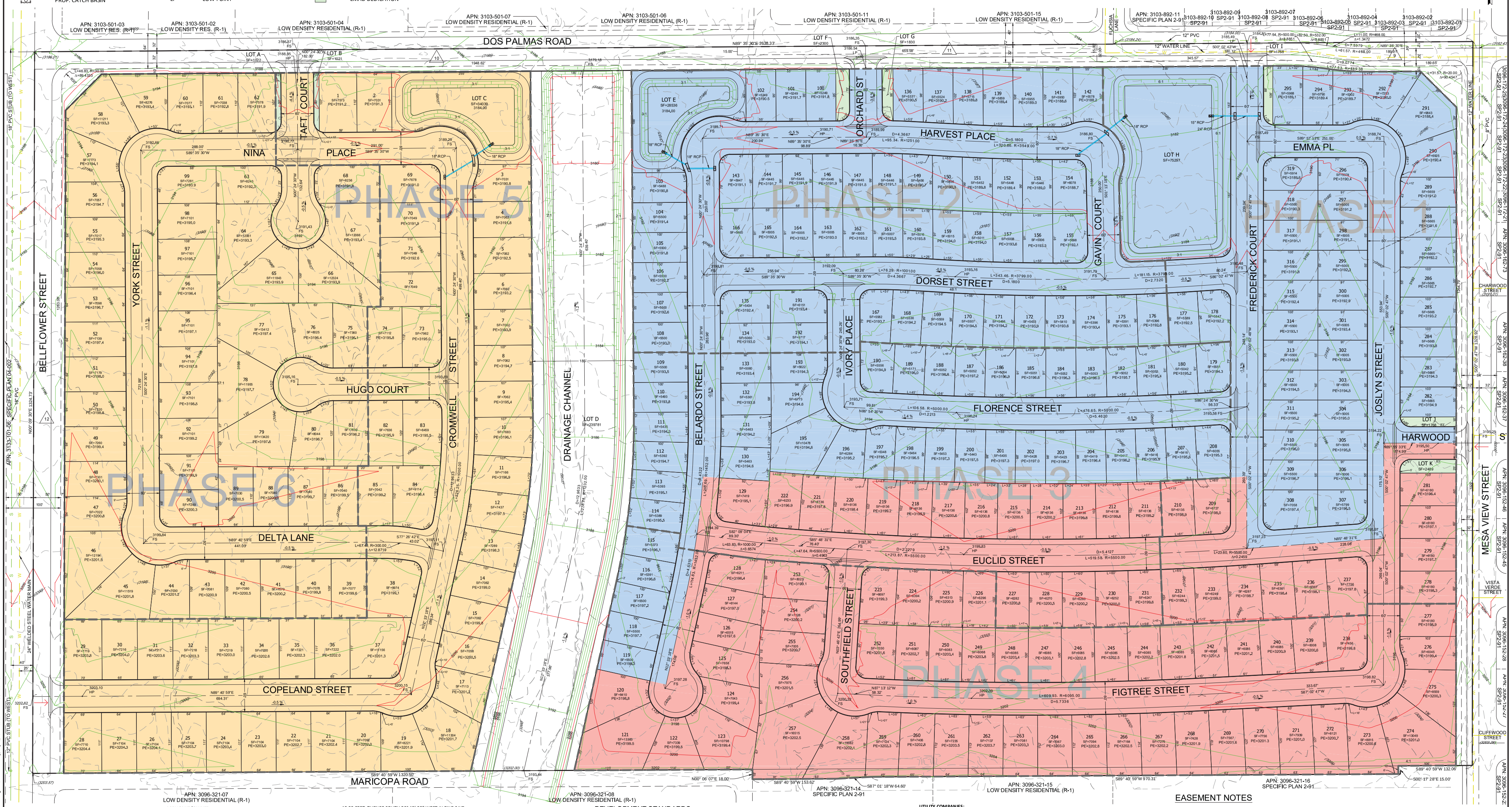
THE NORTH 1/2 AND A PORTION OF THE S 1/2 OF THE NW 1/4 OF SECTION 28, T5N, R5W, SBM, IN THE CITY OF VICTORVILLE, COUNTY OF SAN BERNARDINO, STATE OF CALIFORNIA, ACCORDING TO THE OFFICIAL PLAT OF SAID LAND APPROVED BY THE SURVEYOR GENERAL

EXHIBIT "B"

LEGEND

(720) EXIST. CONTOURS	FS	FINISHED SURFACE	EX. SEWER LINE		PA-1 MED. LOW RESIDENTIAL (MLR)
(723.36) EXIST. ELEVATIONS	PE	PAD ELEVATION	EX. WATER LINE		PA-2 LOW RESIDENTIAL (LR)
PROP. ELEVATIONS	GB	GRADE BREAK	PROP. REINFORCED CONCRETE PIPE		PA-3 VERY LOW RESIDENTIAL (VLR)
FIRE ACCESS TO SITE	HP	HIGH POINT	PROP. PHASE BOUNDARY		
PROP. CATCH BASIN	LP	LOW POINT	LMAD DEDICATION		

CUT/FILL VOLUMES		
CUT	FILL	NET
157,987 CY	167,357 CY	9370 CY (FILL)



APPLICANT/OWNER:
R.Y. PROPERTIES, INC.
212 SOUTH PALM AVENUE, SUITE 200
ALHAMBRA, CA 91801
PHONE : (626) 282-3100

ENGINEER:
LUDWIG ENGINEERING ASSOCIATES, INC.
109 E. 3RD ST
SAN BERNARDINO, CA 92410
PHONE: (909) 884-8217

ASSESSOR'S PARCEL NUMBER:
3096-311-02-0-000

LEGAL DESCRIPTION:
TENTATIVE TRACT NO. 16397, BEING A SUBDIVISION OF THE FOLLOWING:
PARCEL "A" OF LOT LINE ADJUSTMENT NO. ADM07-00073, RECORDED SEPTEMBER 30, 2009 AS INSTRUMENT NO. 2009-0430324 OF OFFICIAL RECORDS, DESCRIBED AS FOLLOWS: THE NORTH ONE-HALF AND A PORTION OF THE SOUTH ONE-HALF OF THE NORTHWEST ONE-QUARTER OF SECTION 28, TOWNSHIP 5 NORTH, RANGE 5 WEST, SAN BERNARDINO BASE AND MERIDIAN, IN THE CITY OF VICTORVILLE, COUNTY OF SAN BERNARDINO, STATE OF CALIFORNIA, MORE PARTICULARLY DESCRIBED AS FOLLOWS:
BEGINNING AT THE NORTH QUARTER CORNER OF SAID SECTION 28; THENCE SOUTH OO° 02' 06" WEST, 1,328.90 FEET TO A POINT ON THE SOUTHERLY LINE OF SAID NORTH ONE-HALF OF THE NORTHWEST ONE-QUARTER OF SECTION 28; THENCE SOUTH 89° 40' 28" WEST ALONG SAID SOUTHERLY LINE, 135.82 FEET; THENCE SOUTH 00° 17' 59" EAST TO A POINT ON A LINE PARALLEL AND DISTANT 15.00 FEET SOUTHERLY FROM SAID SOUTHERLY LINE, 15.00 FEET; THENCE SOUTH 89° 40' 28" WEST ALONG SAID PARALLEL LINE, 995.55 FEET; THENCE SOUTH 87° 00 '47" WEST, 64.61 FEET; THENCE SOUTH 89° 40' 28" WEST, 153.71 FEET TO THE WEST LINE OF THE NORTHWEST ONE-QUARTER OF THE SOUTHEAST ONE-QUARTER OF THE NORTHWEST ONE-QUARTER OF SAID SECTION 28; THENCE NORTH 00° 05' 31" EAST ALONG SAID WEST LINE, 18.00 FEET TO A POINT ON SAID SOUTHERLY LINE; THENCE SOUTH 89° 40' 28" WEST ALONG SAID SOUTHERLY LINE, 1,320.49 FEET TO THE SOUTHWEST CORNER OF SAID NORTH ONE-HALF OF THE NORTHWEST ONE-QUARTER OF SECTION 28; THENCE NORTH 00° 08' 56" EAST ALONG THE WESTERLY LINE OF SAID NORTH ONE-HALF OF THE NORTHWEST ONE-QUARTER OF SECTION 28, 1,324.72 FEET TO THE NORTHWEST CORNER OF SAID SECTION 28; THENCE NORTH 89° 35' 00" EAST ALONG SAID NORTHERLY LINE, 2,638.38 FEET TO THE POINT OF BEGINNING.

GENERAL PLAN:
EXISTING GENERAL PLAN: VISTA VERDE SPECIFIC PLAN
PROPOSED GENERAL PLAN: VISTA VERDE SPECIFIC PLAN

ZONING:
EXISTING ZONING: VISTA VERDE SPECIFIC PLAN
PROPOSED ZONING: VISTA VERDE SPECIFIC PLAN

BENCHMARK:

BRASS CAP IN THE TOP OF CURB AT THE SOUTHEAST BCR OF EAGLE RANCH PARKWAY AND BEDROCK ROAD.

ELEVATION: 3260.438

VICINITY MAP

SCALE: N.T.S.

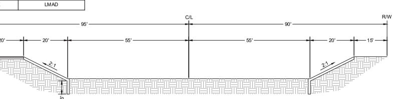
LETTERED LOT USAGE	
LETTER	USAGE
A	LMAD
B	LMAD
C	BASIN #3
D	DRAINAGE CHANNEL
E	BASIN #2
F	LMAD
G	LMAD
H	BASIN #1
I	LMAD
J	LMAD
K	LMAD

DEVELOPMENT STANDARDS:

GROSS ACREAGE:	80.75 AC	BUILDING SETBACKS:	
NET ACREAGE:	75.55 AC	18' - FRONT	
TOTAL NUMBERED LOTS:	319 LOTS	15' - REAR	
TOTAL LETTERED LOTS:	11 LOTS	10' - STREET SIDE YARD	
UNITS PER ACRE:	3.95	5' - SIDE YARD	
AVERAGE LOT SIZE:	6,660 SF		
LINEAL FEET NEW STREETS:	13,195'		

LOT MINIMUM DIMENSIONS:

	CATEGORY	AREA	WIDTH (INTERIOR/CORNER)	DEPTH	NO. LOTS
PA1	MEDIUM LOW RESIDENTIAL (MLR)	5,000 SF	50'/55'	90'	131
PA2	LOW RESIDENTIAL (LR)	6,000 SF	55'/60'	95'	89
PA3	VERY LOW RESIDENTIAL (VLR)	7,000 SF	60'/65'	100'	99



DRAINAGE CHANNEL TYPICAL SECTION

SCALES - H&V: 1" = 20'

UTILITY COMPANIES:

ELECTRIC:
SOUTHERN CALIFORNIA EDISON
P.O. BOX 1498
VICTORVILLE, CA 92393
(800) 655-4555

WATER:
VICTORVILLE WATER DISTRICT
P.O. BOX 5001
VICTORVILLE, CA 92393
(760) 955-5001

SEWER/REFUSE:
CITY OF VICTORVILLE
14343 CIVIC DRIVE
VICTORVILLE, CA 92392
(760) 955-5001

TELEPHONE:
FRONTIER COMMUNICATIONS
(855) 504-4913

NATURAL GAS:
SOUTHWEST GAS COMPANY
14950 CIRCLE DRIVE
VICTORVILLE, CA 92392
(877) 860-6020

TV:
CHARTER COMMUNICATIONS
12180 RIDGECREST RD #102
VICTORVILLE, CA 92392
(866) 499-8080

FIRE PROTECTION:
SAN BERNARDINO COUNTY FIRE
157 W. 5TH ST, 2ND FLOOR
SAN BERNARDINO, CA 92415
(909) 387-5974

GENERAL NOTES:

- EXISTING JOSHUA TREES TO BE RELOCATED PER CITY OF VICTORVILLE REQUIREMENTS
- BLOCK WALLS TO BE CONSTRUCTED BETWEEN LOTS, PER CITY STANDARD
- BASIS OF BEARINGS: THE BASIS OF ALL BEARINGS SHOWN HEREON WERE TAKEN FROM THE NORTH LINE OF THE N.W. 1/4 OF SECTION 28, T.5N., R.5W., S.B.M. AS SHOWN ON TRACT NO. 16107-1 RECORDED IN MAP BOOK 287, PAGES 28-32. BEARING BEING N 89°35'30" E
- CONTOURS BASED ON AERIAL SURVEY BY DIGITAL MAPPING INC, DATED 11/12/05

EASEMENT NOTES

9 AN OFFER OF DEDICATION FOR STREETS, HIGHWAYS, SEWER, DRAINAGE, PUBLIC UTILITIES, AND PUBLIC ACCESS PURPOSES AND INCIDENTAL PURPOSES, RECORDED FEBRUARY 5, 2004 AS INSTRUMENT NO. 2004-0090567 OF OFFICIAL RECORDS.
TO: CITY OF VICTORVILLE

10 AN OFFER OF DEDICATION FOR STREETS, HIGHWAYS, SEWER, DRAINAGE, PUBLIC UTILITIES, AND PUBLIC ACCESS PURPOSES AND INCIDENTAL PURPOSES, RECORDED APRIL 23, 2004 AS INSTRUMENT NO. 2004-0282936 OF OFFICIAL RECORDS.
TO: CITY OF VICTORVILLE

11 AN OFFER OF DEDICATION FOR STREETS, HIGHWAYS, SEWER, DRAINAGE, PUBLIC UTILITIES, AND PUBLIC ACCESS PURPOSES AND INCIDENTAL PURPOSES, RECORDED JANUARY 26, 2005 AS INSTRUMENT NO. 2005-0061546 OF OFFICIAL RECORDS.
TO: CITY OF VICTORVILLE

12 AN OFFER OF DEDICATION FOR STREETS, HIGHWAYS, SEWER, DRAINAGE, PUBLIC UTILITIES, AND PUBLIC ACCESS PURPOSES AND INCIDENTAL PURPOSES, RECORDED OCTOBER 31, 2006 AS INSTRUMENT NO. 2006-0741678 OF OFFICIAL RECORDS.
TO: CITY OF VICTORVILLE

XX INDICATES PLOTTED EASEMENT PER TITLE REPORT NO. NHSC-2740314 (29), FROM FIRST AMERICAN TITLE COMPANY, DATED MAY 8, 2017

REGISTERED PROFESSIONAL ENGINEER JIMMY J. FRY NO. C040692 Exp. 3-31-17 CIVIL STATE OF CALIFORNIA

PLOT DATE: May 15, 2017

CITY CASE NO. (to be assigned at plan submittal)

CITY OF VICTORVILLE ENGINEERING DEPARTMENT
14343 Civic Drive, Victorville, CA 92392 (760) 955-5000

Approved By:

Brian W. Gengler, RCE C44730
City Engineer

DATE

REV.	DESCRIPTION	DATE	BY

Ludwig Engineering Associates, Inc.
Civil Engineering - Surveying - Planning
109 East Third Street, San Bernardino, CA 92410, Phone: 909-884-8217, Fax: 909-889-0153
5890 Hwy. 95, Ste. B, Fort Mohave, AZ 86426, Phone: 928-768-1857, Fax: 928-768-7086
15252 Seneca Rd., Victorville, CA 92392, Phone: 760-951-7676, Fax: 760-241-0573
2126 McCulloch Blvd., Ste. 8, Lake Havasu City, AZ 86403, Phone: 928-680-6060, Fax: 928-854-6530

CITY OF VICTORVILLE
TENTATIVE TRACT 16397
TENTATIVE TRACT MAP

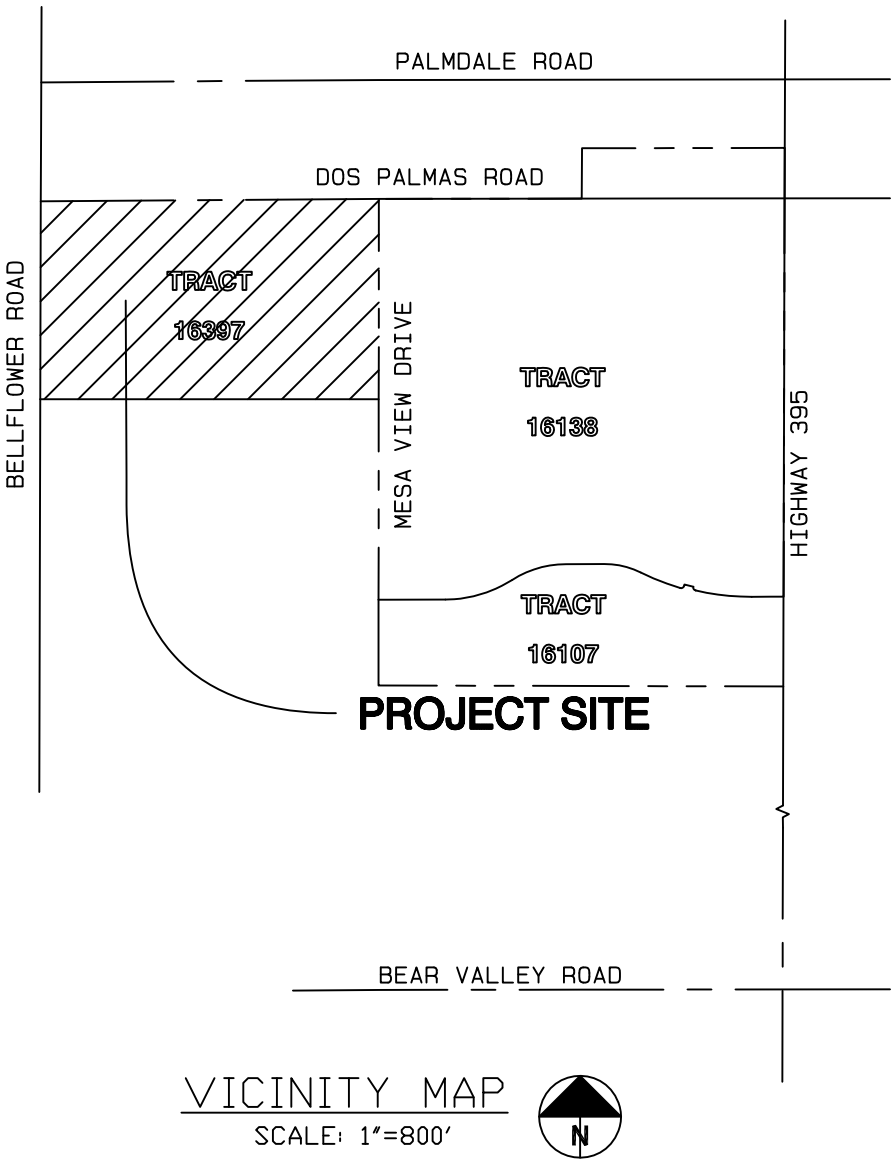
CLIENT:
RY PROPERTIES
212 SOUTH PALM AVE | ALHAMBRA, CA 91801

DESIGNED BY:	DRAWN BY:	CHECKED BY:
JEC	JEC	SS

SCALE 1" = 60'

SHEET 1 OF 1

C-1

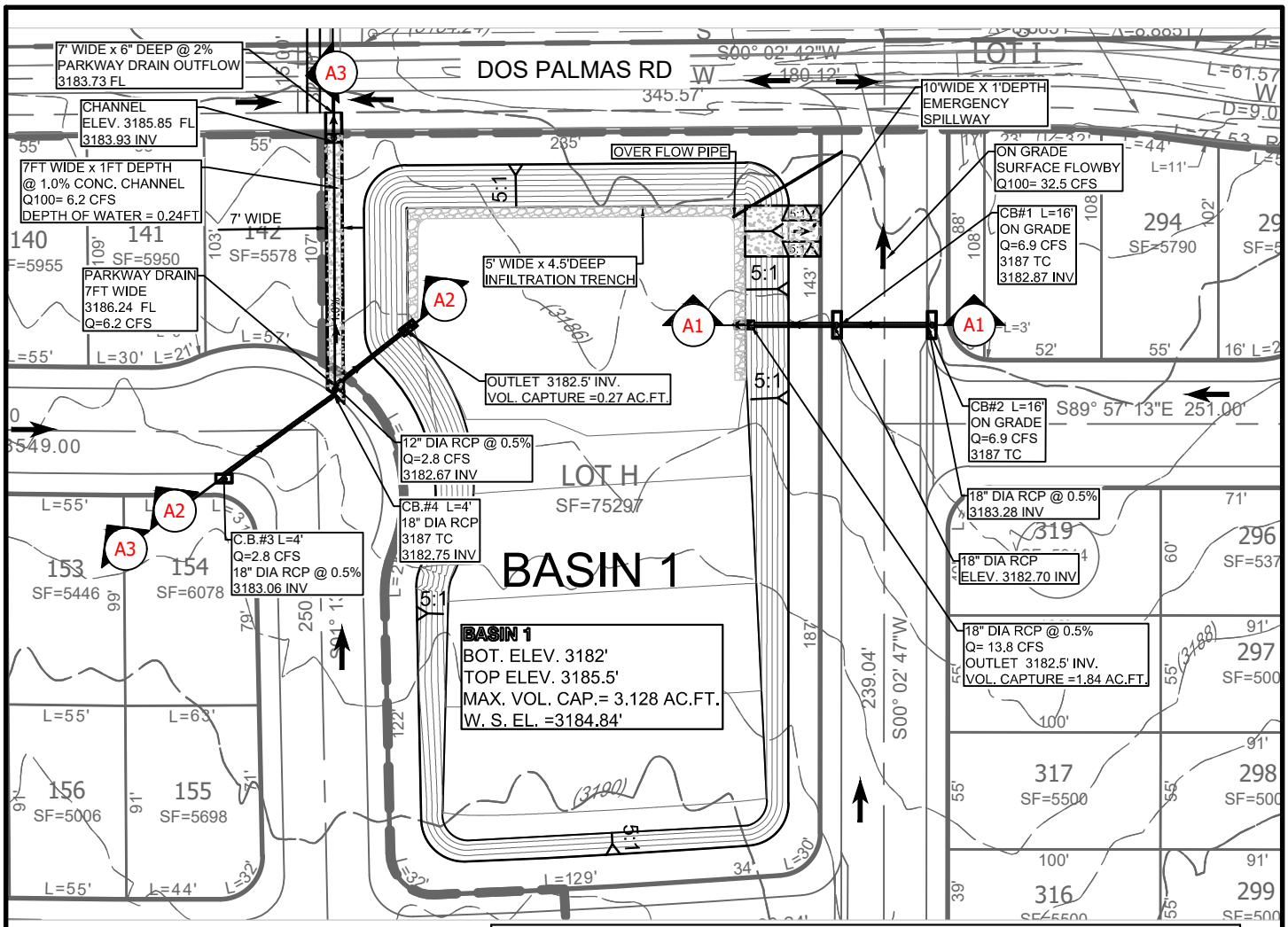


VICINITY MAP

SCALE: 1"=800'

N

BASINS CALCULATIONS



BASIN 1 STAGE STORAGE TABLE

ELEV	AREA (sq. ft.)	DEPTH (ft)	AREA (ac. ft.)	VOLUME (ac. ft.)	COML. VOL. (ac. ft.)	VOLUME VOL. (cu. ft.)
3,182.000	15,704.55	N/A	0.361			
				0.2062	0.2062	8984
3,182.500	20,231.71	1.000	0.464			
				0.2789	0.4851	21132
3,183.000	28,361.82	1.000	0.651			
				0.3769	0.8621	37552
3,183.500	37,315.50	1.000	0.857			
				0.4831	1.3452	58597
3,184.000	46,866.83	1.000	1.076			
				0.5607	1.9059	83020
3,184.500	50,821.92	1.000	1.167			
				0.5973	2.5031	109037
3,185.000	53,248.30	1.000	1.222			
				0.6254	3.1285	136278
3,185.500	55,715.44	1.000	1.279		TOTAL VOLUME	136,278

VOLUME CAPTURE = 2.11 AC.FT. WATER SURFACE ELEVATION =3184.84'

Ludwig Engineering ASSOCIATES, INC.
Civil Engineering • Surveying • Planning
109 East Third Street
San Bernardino, CA 92410
Phone: 909-884-8217
Fax: 909-889-0153

5890 Hwy. 95, Ste. B
Fort Mohave, AZ 88426
Phone: 928-768-1857
Fax: 928-768-7086

15252 Seneca Rd.
Victorville, CA 92392
Phone: 760-951-7676
Fax: 760-241-0573

2126 McCulloch Blvd., Ste. 8
Lake Havasu City, AZ 86403
Phone: 928-680-6060
Fax: 928-854-6530

CITY OF VICTORVILLE

TR. 16397

ONSITE DRAINAGE BASIN 1

CLIENT: RY PROPERTIES

SCALE 1":80'

SHEET 1 OF 3

DESIGNED BY:	DRAWN BY:	CHECKED BY:
AG	LC	JF

D-1

DMA - A * COVER INFORMATION:

COVER TYPE:	QTY.
ROOF:	54,771 SF.
CONCRETE D/W & S/W:	61,529 SF.
LANDSCAPING:	103,809 SF.
FUTURE IMPERVIOUS AREA	SF.
TOTAL:	220,109 S.F.

DMA - B COVER INFORMATION:

COVER TYPE:	QTY.
ROOF:	328,333 SF.
CONCRETE D/W & S/W:	291,006 SF.
LANDSCAPING:	407,369 SF.
FUTURE IMPERVIOUS AREA	SF.
TOTAL:	1,026,708 S.F.

1 5
2 6
3 7

TYPICAL SET BACKS
N.T.S.

DETENTION BASIN No. 1 SLOPE 5:1

ELEV. (FT)	AREA (SQ.FT.)	AREA (AC.)	VOLUME (AC.FT.)	CUML.VOL. (AC.FT.)
3181.5	12453.1	0.2859	0.0	0.0
3182.5	14895.8	0.3420	0.3139	0.3139
3183.5	19299.9	0.4431	0.3925	0.7064
3184.5	52900.7	1.2144	0.8287	1.5351
3185.5	57924.4	1.3298	0.8864	2.8073
3186.5	64228.3	1.4745	1.3444	2.8796
TOTAL VOLUME= 3.14 AC.FT.				

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Civil Engineering • Surveying • Planning
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Fax: 909-889-0153

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Fort Mohave, AZ 86426
Phone: 928-768-1857
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15252 Seneca Rd.
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Fax: 760-241-0573

2126 McCulloch Blvd., Ste. 8
Lake Havasu City, AZ 86403
Phone: 928-680-6060
Fax: 928-854-6530

CITY OF VICTORVILLE

TR. 16397

W.Q.M.P. BASIN 1 - BMP 1

CLIENT:
RY PROPERTIES

SCALE
1":200'

SHEET
1
OF
3

DESIGNED BY:	DRAWN BY:	CHECKED BY:
JC	LC	JF

W-1

Form 4.2-1 LID BMP Performance Criteria for Design Capture Volume

		User Input	
		User to Verify	
		Results	

1	Project area DA 1 (ft^2):	1,246,817	ft^2
2	Imperviousness after applying preventative site design practices (Imp%):	0.5658	Decimal %
3	Runoff Coefficient (Rc): $R_c = 0.858(Imp\%)^{\wedge 3} - 0.78(Imp\%)^{\wedge 2} + 0.774(Imp\%) + 0.04$	0.384	
4	Determine 1-hour rainfall depth for a 2-year return period P2yr-1hr (in):	0.384	in
5	Compute P6, Mean 6-hr Precipitation (inches): *P6 = Item 4 *C1, where C1 is a function of site climatic region specified in Form 3-1 Item 1 (Valley = 1.4807; Mountain = 1.909; Desert = 1.2371)*		
	Valley:	0.569	
	Mountian:	0.733	
	Desert:	0.475	
6	Drawdown Rate	48	hrs
7	Compute design capture volume, DCV (ft3): *DCV = 1/12 * [Item 1* Item 3 *Item 5 * C2], where C2 is a function of drawdown rate (24-hr = 1.582; 48-hr = 1.963) Compute separate DCV for each outlet from the project site per schematic drawn in Form 3-1 Item 2*		
	Valley:	44,490	ft^3
	Mountian:	57,359	ft^3
	Desert:	37,170	ft^3

Pervious Area = 541,368 ft^2

LOT "H" BASIN No. 1

BASIN # 1 ; WEST OF CHANNEL WITH PARK					
TT-16397 RETENTION BASIN 4-4-17					
Area of Basin @ PERIMETER ELEV=55,715.4 SF					
		5:1 SLOPE			
Elev. ft.	Area s.f.	Area a.c.	Volume ac-ft	Cuml. Volume ac.ft	Volume c.f.
3182	15704.6	0.361			
			0.2062	0.2062	8984
3182.5	20231.7	0.464			
			0.2789	0.4851	21132
3183	28361.8	0.651			
			0.3769	0.8621	37552
3183.5	37315.5	0.857			
			0.4831	1.3452	58597
3184	46866.8	1.076			
			0.5607	1.9059	83020
3184.5	50821.9	1.167			
			0.5973	2.5031	109037
3185	53248.3	1.222			
			0.6254	3.1285	136278
3185.5	55715.4	1.279			
				TOTAL VOLUME	136,278
Max. Net cum. Storage = 3.1285 Ac.Ft. W.S.E. = 3185.5'					

WSE = 3184.62

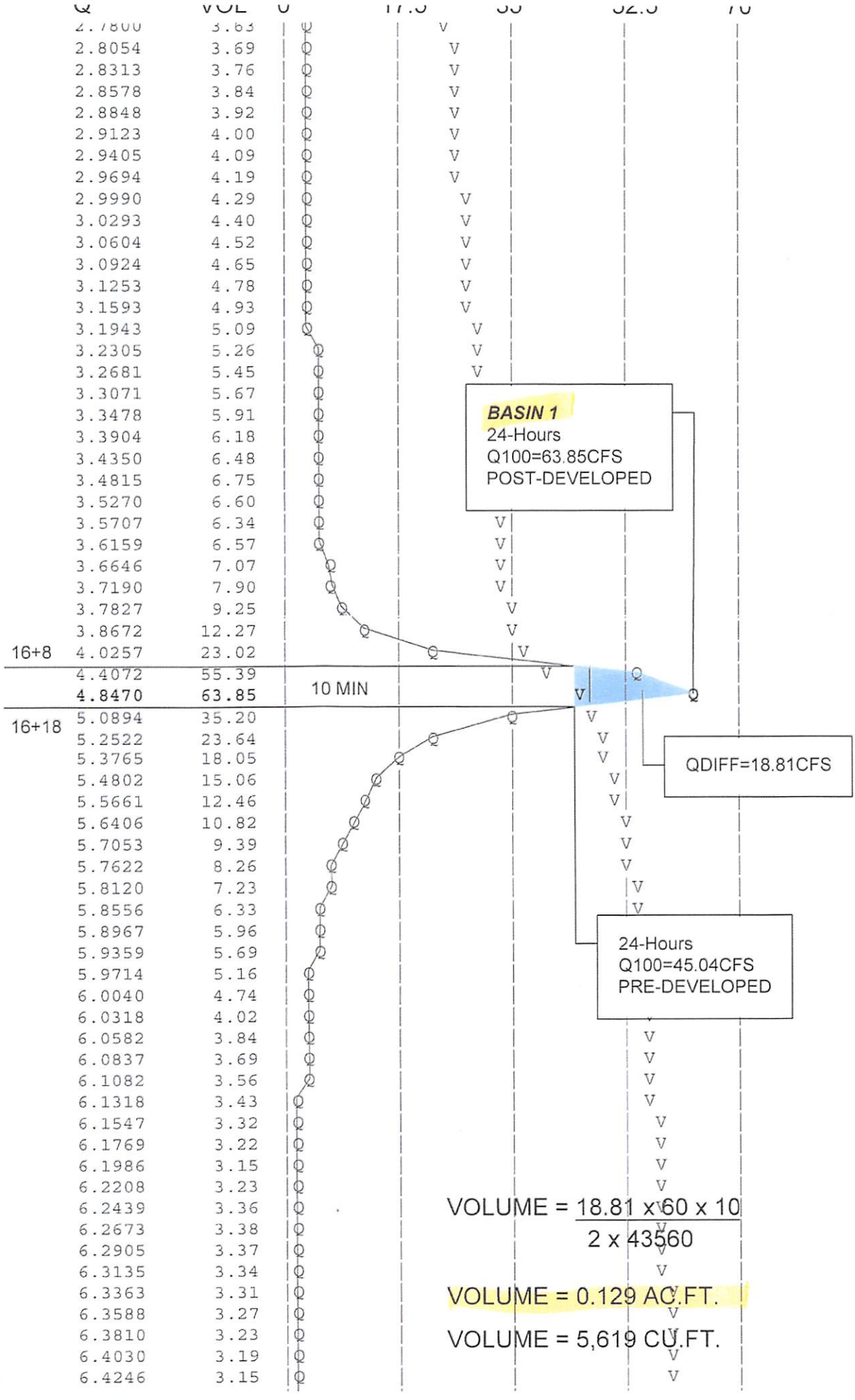
(2yr-24hr Volume ~~Design Capture Volume~~) + Differencial (Pre/Post)= 86,074.6 CF

PROVIDED

BASIN = 136,278 CF

TOTAL PROVIDED = 136,278 CF

TIME		Q	VOL
13+40		2.7800	3.63
13+45		2.8054	3.69
13+50		2.8313	3.76
13+55		2.8578	3.84
14+ 0		2.8848	3.92
14+ 5		2.9123	4.00
14+10		2.9405	4.09
14+15		2.9694	4.19
14+20		2.9990	4.29
14+25		3.0293	4.40
14+30		3.0604	4.52
14+35		3.0924	4.65
14+40		3.1253	4.78
14+45		3.1593	4.93
14+50		3.1943	5.09
14+55		3.2305	5.26
15+ 0		3.2681	5.45
15+ 5		3.3071	5.67
15+10		3.3478	5.91
15+15		3.3904	6.18
15+20		3.4350	6.48
15+25		3.4815	6.75
15+30		3.5270	6.60
15+35		3.5707	6.34
15+40		3.6159	6.57
15+45		3.6646	7.07
15+50		3.7190	7.90
15+55		3.7827	9.25
16+ 0		3.8672	12.27
16+ 5	16+8	4.0257	23.02
16+10		4.4072	55.39
16+15		**4.8470**	**63.85**
16+20	16+18	5.0894	35.20
16+25		5.2522	23.64
16+30		5.3765	18.05
16+35		5.4802	15.06
16+40		5.5661	12.46
16+45		5.6406	10.82
16+50		5.7053	9.39
16+55		5.7622	8.26
17+ 0		5.8120	7.23
17+ 5		5.8556	6.33
17+10		5.8967	5.96
17+15		5.9359	5.69
17+20		5.9714	5.16
17+25		6.0040	4.74
17+30		6.0318	4.02
17+35		6.0582	3.84
17+40		6.0837	3.69
17+45		6.1082	3.56
17+50		6.1318	3.43
17+55		6.1547	3.32
18+ 0		6.1769	3.22
18+ 5		6.1986	3.15
18+10		6.2208	3.23
18+15		6.2439	3.36
18+20		6.2673	3.38
18+25		6.2905	3.37
18+30		6.3135	3.34
18+35		6.3363	3.31
18+40		6.3588	3.27
18+45		6.3810	3.23
18+50		6.4030	3.19
18+55		6.4246	3.15



$$\text{VOLUME} = \frac{18.81 \times 60 \times 10}{2 \times 43560}$$

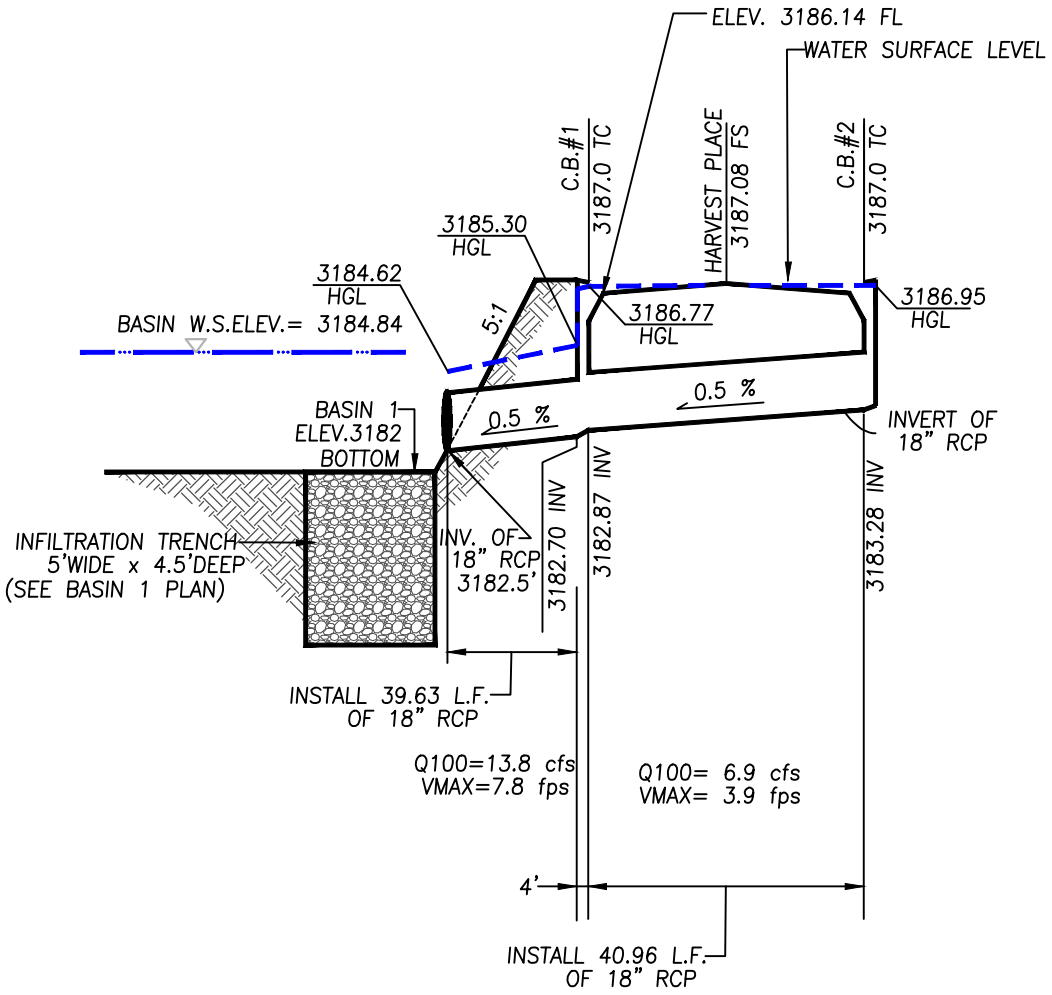
VOLUME = 0.129 AC.FT.

VOLUME = 5,619 CU.FT.

21+ 0	1.7383	0.51	|Q	|	|	|	V |
21+ 5	1.7418	0.51	|Q	|	|	|	V |
21+10	1.7453	0.50	|Q	|	|	|	V |
21+15	1.7487	0.50	Q	|	|	|	V |
21+20	1.7521	0.49	Q	|	|	|	V |
21+25	1.7555	0.49	Q	|	|	|	V |
21+30	1.7588	0.48	Q	|	|	|	V |
21+35	1.7621	0.48	Q	|	|	|	V |
21+40	1.7654	0.47	Q	|	|	|	V |
21+45	1.7686	0.47	Q	|	|	|	V |
21+50	1.7718	0.47	Q	|	|	|	V |
21+55	1.7750	0.46	Q	|	|	|	V |
22+ 0	1.7782	0.46	Q	|	|	|	V |
22+ 5	1.7813	0.46	Q	|	|	|	V |
22+10	1.7844	0.45	Q	|	|	|	V |
22+15	1.7875	0.45	Q	|	|	|	V |
22+20	1.7905	0.44	Q	|	|	|	V |
22+25	1.7936	0.44	Q	|	|	|	V |
22+30	1.7966	0.44	Q	|	|	|	V |
22+35	1.7996	0.43	Q	|	|	|	V |
22+40	1.8026	0.43	Q	|	|	|	V |
22+45	1.8055	0.43	Q	|	|	|	V |
22+50	1.8084	0.42	Q	|	|	|	V |
22+55	1.8113	0.42	Q	|	|	|	V|
23+ 0	1.8142	0.42	Q	|	|	|	V|
23+ 5	1.8171	0.42	Q	|	|	|	V|
23+10	1.8199	0.41	Q	|	|	|	V|
23+15	1.8227	0.41	Q	|	|	|	V|
23+20	1.8255	0.41	Q	|	|	|	V|
23+25	1.8283	0.40	Q	|	|	|	V|
23+30	1.8311	0.40	Q	|	|	|	V|
23+35	1.8338	0.40	Q	|	|	|	V|
23+40	1.8366	0.40	Q	|	|	|	V|
23+45	1.8393	0.39	Q	|	|	|	V|
23+50	1.8420	0.39	Q	|	|	|	V|
23+55	1.8447	0.39	Q	|	|	|	V|
24+ 0	**1.8473**	**0.39**	**Q**	|	|	|	**V|**

BASIN 1
2-YR, 24-HR STORM
VOLUME= 1.847 AC.FT.
(DCV)

1.847
0.129
1.976 AC-FT



SECTION "A1-A1"

BASIN 1 LINE "A1"

N.T.S.

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CITY OF VICTORVILLE

TR. 16397

PROFILE STORM DRAIN - BASIN 1 LINE "A1"

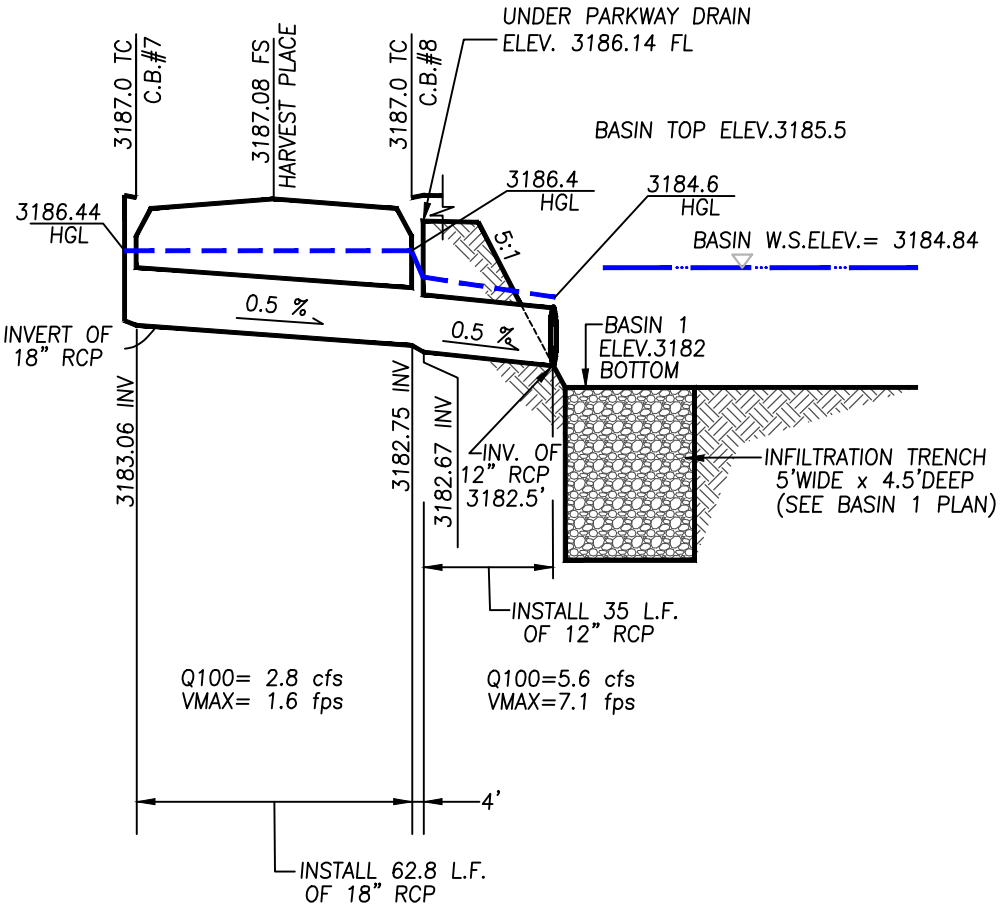
CLIENT: RY PROPERTIES

DESIGNED BY:	DRAWN BY:	CHECKED BY:
JC	LC	JF

SCALE: N.T.S.

SHEET 1 OF 4

D-1



SECTION "A2-A2"

BASIN 1 LINE "A2"

N.T.S.

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CITY OF VICTORVILLE

TR. 16397

PROFILE STORM DRAIN - BASIN 1 LINE "A2"

CLIENT: RY PROPERTIES

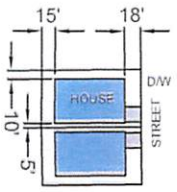
SCALE	SHEET
N.T.S.	2 OF 4

DESIGNED BY:	DRAWN BY:	CHECKED BY:	
JC	LC	JF	D-1

BASIN #2 LOT "B"

N

SCALE 1":200'



TYPICAL SET BACKS
N.T.S.

1 5
2 6
3 7

DA - * COVER INFORMATION:

COVER TYPE:	QTY.
ROOF:	215,663 SF.
CONCRETE D/W & S/W:	197,862 SF.
LANDSCAPING:	322,111 SF.
FUTURE IMPERVIOUS AREA	SF.
TOTAL:	735,636 S.F.

DETENTION BASIN No. 2 SLOPE 3:1

ELEV. (FT)	AREA (SQ.FT.)	AREA (AC.)	VOLUME (AC.FT.)	CUML.VOL. (AC.FT.)
3180	11732.9	0.2693		
3181	13449.1	0.3087	0.2890	0.2890
3182	15246.2	0.3500	0.3294	0.6184
3183	17125.4	0.3931	0.3716	0.9900
3186.6	W.Q.M.P.	VOLUME	CAPTURE	1.18
3184	19087.8	0.4382	0.4157	1.4057
3185	21132.7	0.4851	0.4617	1.8673

TOTAL VOLUME= 1.18 AC.FT.

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CITY OF VICTORVILLE

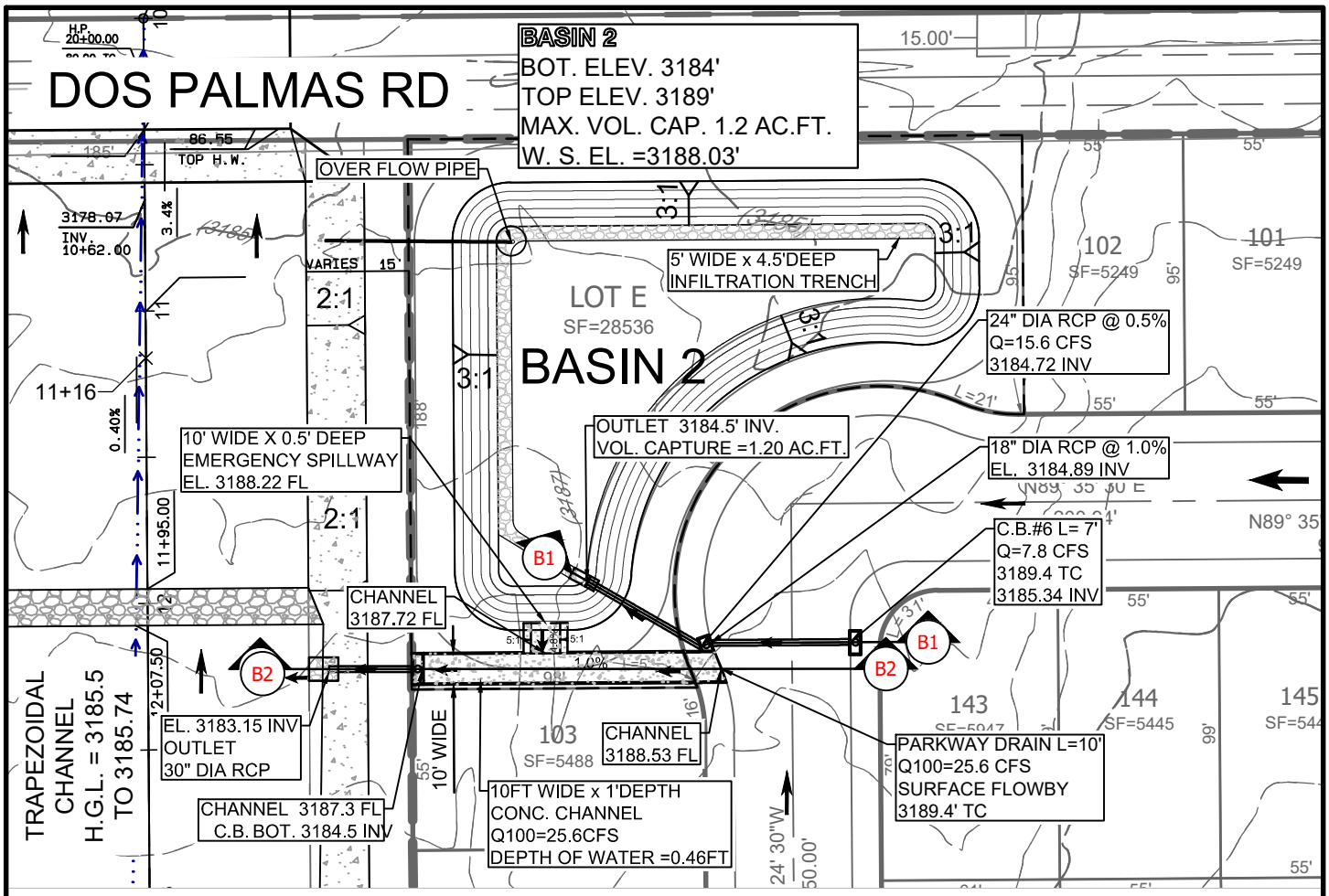
TR. 16397

W.Q.M.P. BASIN 2 - BMP 2

CLIENT: RY PROPERTIES

SCALE	SHEET
1":200'	2 OF 3

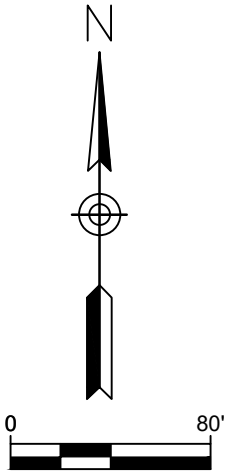
DESIGNED BY:	DRAWN BY:	CHECKED BY:	
JC	LC	JF	W-2



BASIN 2 STAGE STORAGE TABLE

ELEV	AREA (sq. ft.)	DEPTH (ft)	AREA (ac. ft.)	VOLUME (ac. ft.)	COML. VOL. (ac. ft.)	VOLUME VOL. (cu. ft.)
3,184.000	8869.3	N/A	0.204			
				0.2209	0.2209	9623
3,185.000	10,377.5	1.000	0.238			
				0.2562	0.4771	20783
3,186.000	11,941.91	1.000	0.274			
				0.2928	0.7699	33536
3,187.000	13,562.89	1.000	0.311			
				0.3306	1.1005	47937
3,188.000	15,240.56	1.000	0.350			
				0.3698	1.4703	64045
3,189.000	16,974.90	1.000	0.390			
					TOTAL VOLUME	64,045

VOLUME CAPTURE = 1.2 AC.FT. **WATER SURFACE ELEVATION =3188.03'**



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CITY OF VICTORVILLE

TR. 16397

ONSITE DRAINAGE BASIN 2 PLAN

CLIENT: RY PROPERTIES

DESIGNED BY:	DRAWN BY:	CHECKED BY:
AG	LC	JF

SCALE 1":60'

SHEET 1 OF 3

D-1

Form 4.2-1 LID BMP Performance Criteria for Design Capture Volume

		User Input	
		User to Verify	
		Results	

1	Project area DA 2 (ft^2):	735,636	ft^2
2	Imperviousness after applying preventative site design practices (Imp%):	0.5620	Decimal %
3	Runoff Coefficient (Rc): $R_c = 0.858(Imp\%)^{3} - 0.78(Imp\%)^{2} + 0.774(Imp\%) + 0.04$	0.381	
4	Determine 1-hour rainfall depth for a 2-year return period P2yr-1hr (in):	0.384	in
5	Compute P6, Mean 6-hr Precipitation (inches): *P6 = Item 4 *C1, where C1 is a function of site climatic region specified in Form 3-1 Item 1 (Valley = 1.4807; Mountain = 1.909; Desert = 1.2371)*		
	Valley:	0.569	
	Mountian:	0.733	
	Desert:	0.475	
6	Drawdown Rate	48	hrs
7	Compute design capture volume, DCV (ft3): *DCV = 1/12 * [Item 1* Item 3 *Item 5 * C2], where C2 is a function of drawdown rate (24-hr = 1.582; 48-hr = 1.963)* *Compute separate DCV for each outlet from the project site per schematic drawn in Form 3-1 Item 2*		
	Valley:	26,064	ft^3
	Mountian:	33,603	ft^3
	Desert:	21,776	ft^3

Pervious Area =	322,209	ft^2

LOT "E"

BASIN No. 2

BASIN # 2; EAST OF CHANNEL					
TT-16397 RETENTION BASIN 4-03-17					
Area of Basin @ PERIMETER ELEV= 16974.9 SF					
		3:1 SLOPE			
Elev. ft.	Area s.f.	Area a.c.	Volume ac-ft	Cuml. Volume ac.ft	Volume c.f.
3184	8869.3	0.204			
			0.2209	0.2209	9623
3185	10377.5	0.238			
			0.2562	0.4771	20783
3186	11941.9	0.274			
			0.2928	0.7699	33536
3187	13562.9	0.311			
			0.3306	1.1005	47937
3188	15240.6	0.350			
			0.3698	1.4703	64045
3189	16974.9	0.390			
				TOTAL VOLUME	64,045
Max. Net cum. Storage = 1.4703 Ac.Ft. W.S.E. = 3189'					

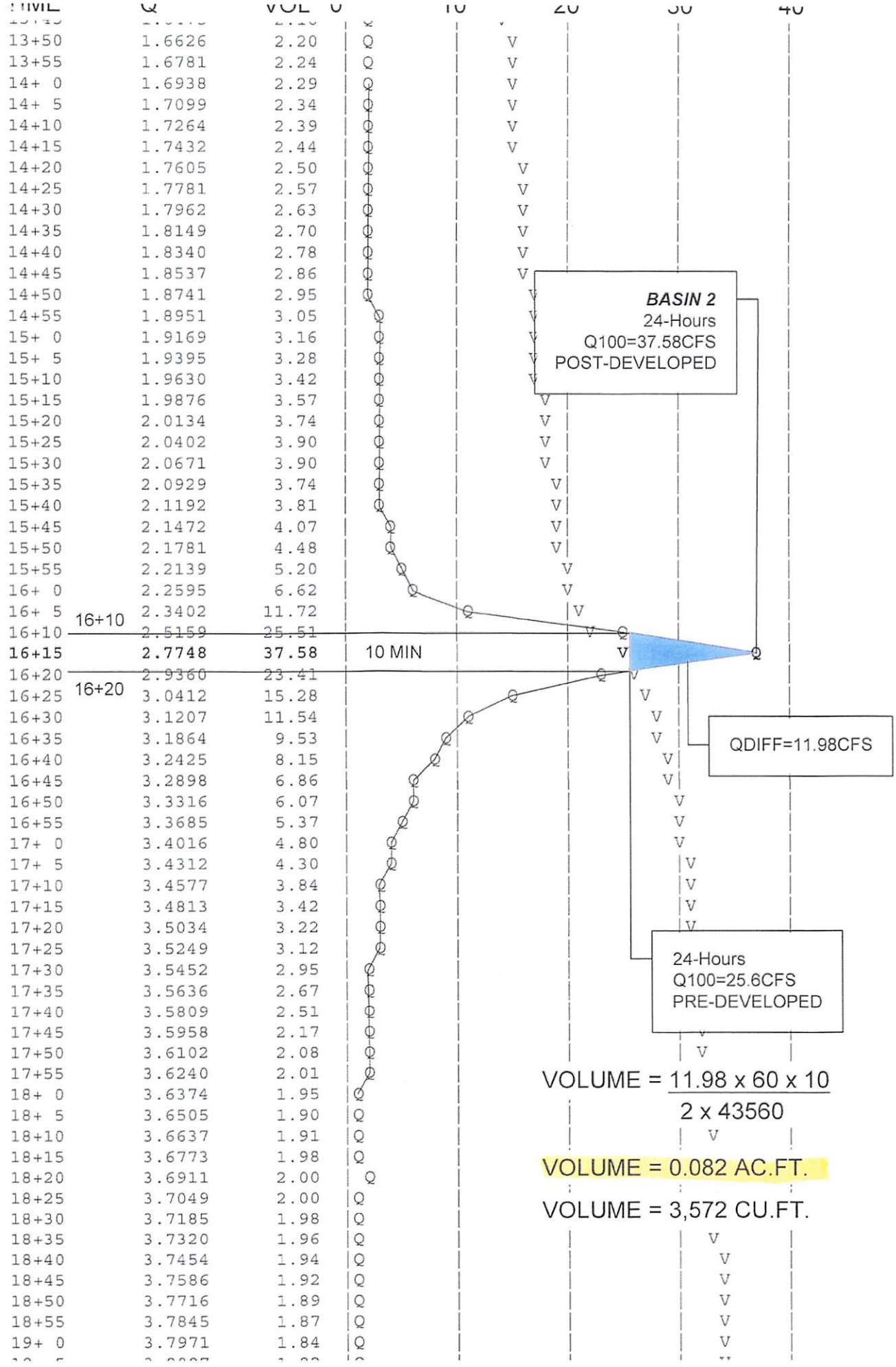
WSE = 3188.22'

(2yr-24hr Volume Design Capture Volume) + Differencial (Pre/Post)= 51,400.8 CF ⇒ 1.18 Ac-FT

PROVIDED

BASIN = 64,045 CF

TOTAL PROVIDED = 64,045 CF

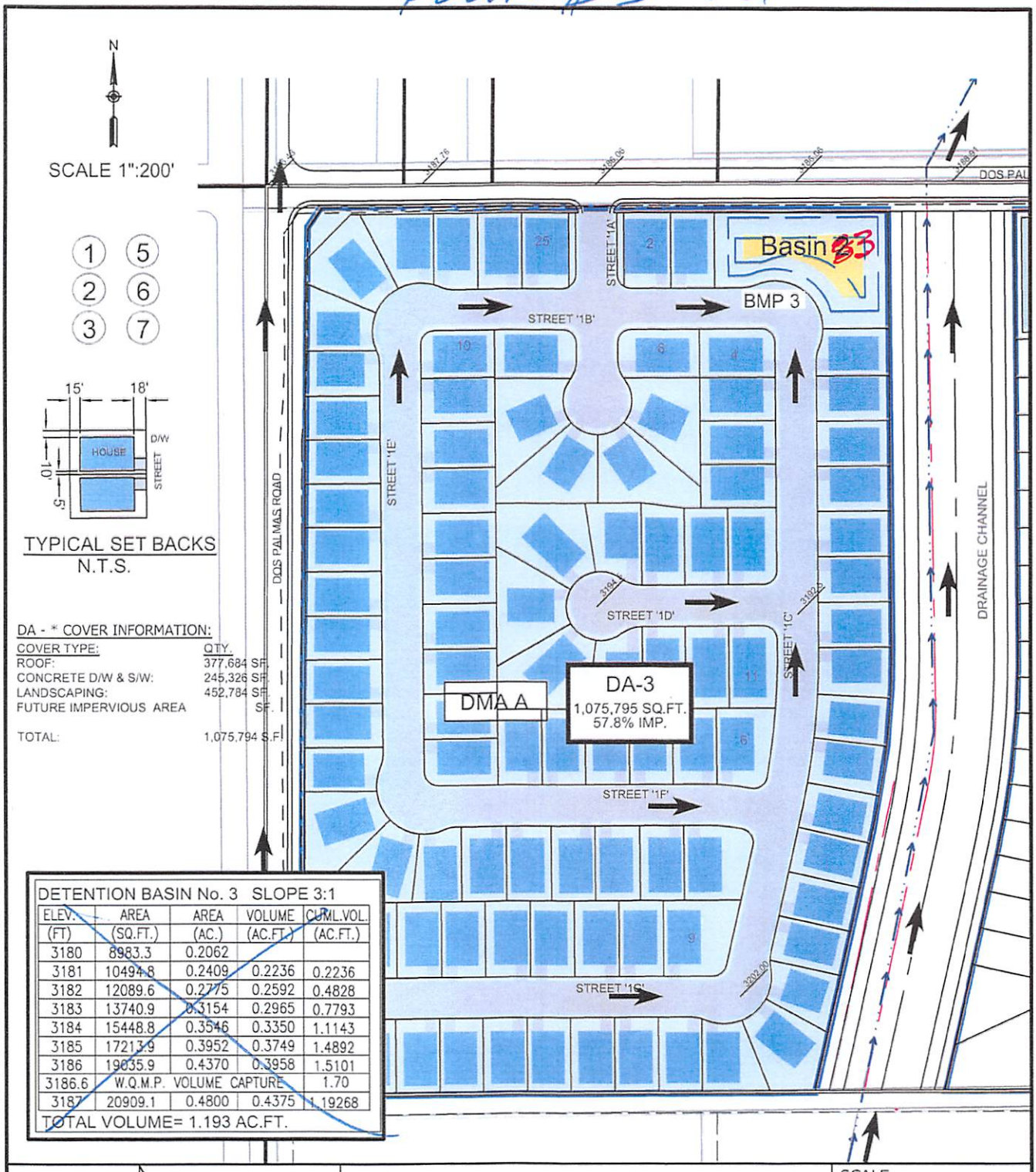

TIME Q VOL 0 10 20 30 40
13+50 1.6626 2.20
13+55 1.6781 2.24
14+ 0 1.6938 2.29
14+ 5 1.7099 2.34
14+10 1.7264 2.39
14+15 1.7432 2.44
14+20 1.7605 2.50
14+25 1.7781 2.57
14+30 1.7962 2.63
14+35 1.8149 2.70
14+40 1.8340 2.78
14+45 1.8537 2.86
14+50 1.8741 2.95
14+55 1.8951 3.05
15+ 0 1.9169 3.16
15+ 5 1.9395 3.28
15+10 1.9630 3.42
15+15 1.9876 3.57
15+20 2.0134 3.74
15+25 2.0402 3.90
15+30 2.0671 3.90
15+35 2.0929 3.74
15+40 2.1192 3.81
15+45 2.1472 4.07
15+50 2.1781 4.48
15+55 2.2139 5.20
16+ 0 2.2595 6.62
16+ 5 2.3402 11.72
16+10 2.5159 25.51
16+15 2.7748 37.58
16+20 2.9360 23.41
16+25 3.0412 15.28
16+30 3.1207 11.54
16+35 3.1864 9.53
16+40 3.2425 8.15
16+45 3.2898 6.86
16+50 3.3316 6.07
16+55 3.3685 5.37
17+ 0 3.4016 4.80
17+ 5 3.4312 4.30
17+10 3.4577 3.84
17+15 3.4813 3.42
17+20 3.5034 3.22
17+25 3.5249 3.12
17+30 3.5452 2.95
17+35 3.5636 2.67
17+40 3.5809 2.51
17+45 3.5958 2.17
17+50 3.6102 2.08
17+55 3.6240 2.01
18+ 0 3.6374 1.95
18+ 5 3.6505 1.90
18+10 3.6637 1.91
18+15 3.6773 1.98
18+20 3.6911 2.00
18+25 3.7049 2.00
18+30 3.7185 1.98
18+35 3.7320 1.96
18+40 3.7454 1.94
18+45 3.7586 1.92
18+50 3.7716 1.89
18+55 3.7845 1.87
19+ 0 3.7971 1.84
16+10
16+20
10 MIN
BASIN 2
24-Hours
Q100=37.58CFS
POST-DEVELOPED
QDIFF=11.98CFS
24-Hours
Q100=25.6CFS
PRE-DEVELOPED
VOLUME = 11.98 x 60 x 10 / 2 x 43560
VOLUME = 0.082 AC.FT.
VOLUME = 3,572 CU.FT.

25+10	1.0951	0.01	Q	|	|	|	V|
25+15	1.0951	0.01	Q	|	|	|	V|
25+20	1.0952	0.00	Q	|	|	|	V|
25+25	1.0952	0.00	Q	|	|	|	V|
25+30	1.0952	0.00	Q	|	|	|	V|
25+35	1.0952	0.00	Q	|	|	|	V|
25+40	**1.0952**	**0.00**	**Q**	**|**	**|**	**|**	**V**

BASIN 2
2-YR, 24-HR STORM
VOLUME= 1.095 AC.FT.
(DCV)

TOTAL Volume = 1.095 + 0.0820 ⇒ 1.18 Ac-FT
51,270.1 CF

BASIN #3 LOT "C"



DA - * COVER INFORMATION:

COVER TYPE:	QTY.
ROOF:	377,684 SF.
CONCRETE D/W & S/W:	245,326 SF.
LANDSCAPING:	452,784 SF.
FUTURE IMPERVIOUS AREA	SF.
TOTAL:	1,075,794 S.F.

DETENTION BASIN No. 3 SLOPE 3:1

ELEV. (FT)	AREA (SQ.FT.)	AREA (AC.)	VOLUME (AC.FT.)	CUML.VOL. (AC.FT.)
3180	8983.3	0.2062		
3181	10494.8	0.2409	0.2236	0.2236
3182	12089.6	0.2775	0.2592	0.4828
3183	13740.9	0.3154	0.2965	0.7793
3184	15448.8	0.3546	0.3350	1.1143
3185	17213.9	0.3952	0.3749	1.4892
3186	19035.9	0.4370	0.3958	1.5101
3186.6	W.Q.M.P. VOLUME CAPTURE			1.70
3187	20909.1	0.4800	0.4375	1.19268

TOTAL VOLUME= 1.193 AC.FT.

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CITY OF VICTORVILLE

TR. 16397

W.Q.M.P. BASIN 3 - BMP 3

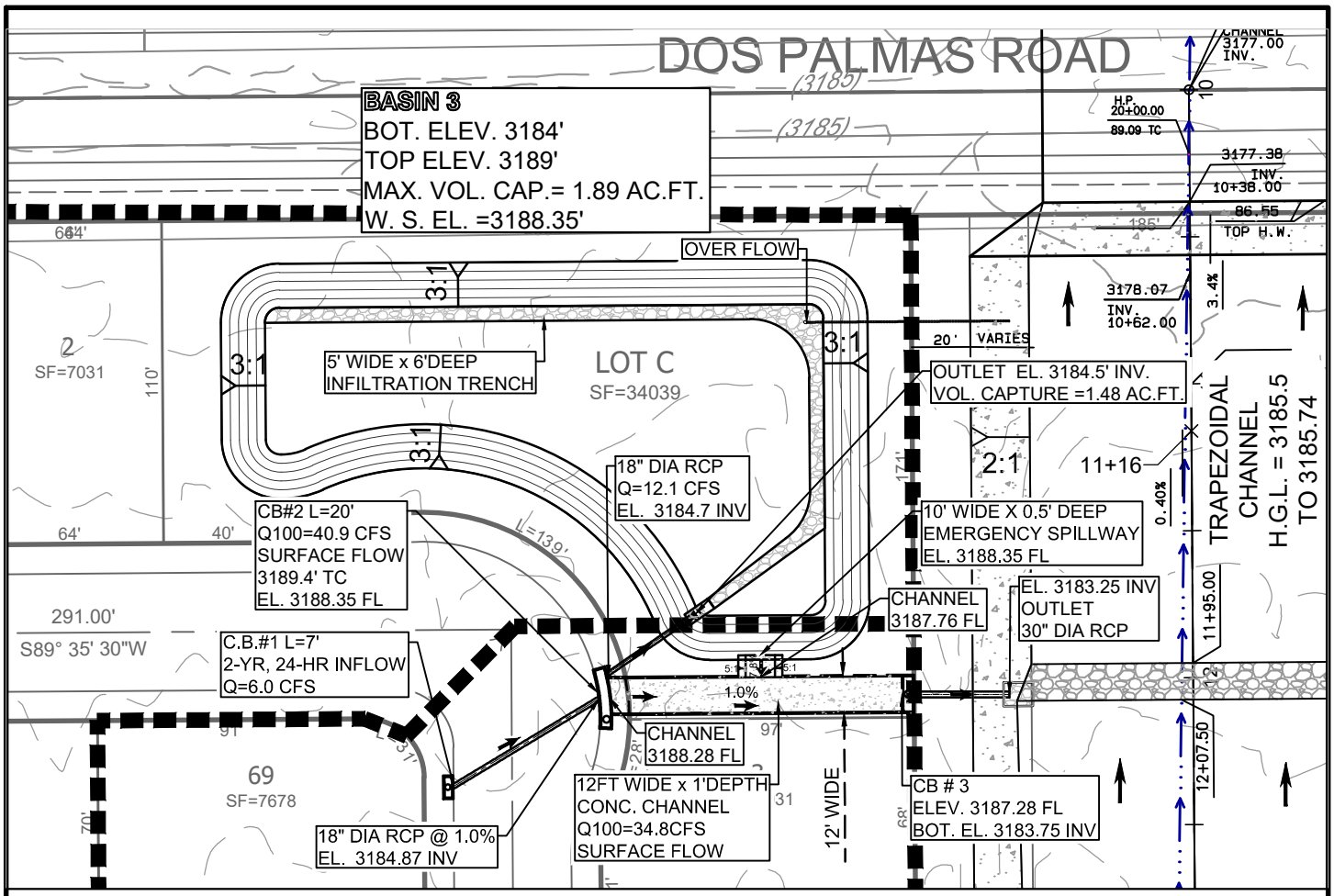
CLIENT: RY PROPERTIES

SCALE 1":200'

SHEET 1 OF 3

DESIGNED BY:	DRAWN BY:	CHECKED BY:
JC	LC	JF

W-3



N

BASIN 3 STAGE STORAGE TABLE

ELEV	AREA (sq. ft.)	DEPTH (ft)	AREA (ac. ft.)	VOLUME (ac. ft.)	COML. VOL. (ac. ft.)	VOLUME VOL. (cu. ft.)
3,184.000	12,149.42	N/A	0.279			
				0.2978	0.2978	12972
3,185.000	13,794.24	1.000	0.317			
				0.3362	0.6340	27619
3,186.000	15,499.78	1.000	0.356			
				0.3761	1.0101	44002
3,187.000	17,266.72	1.000	0.396			
				0.4173	1.4275	62180
3,188.000	19,089.76	1.000	0.438			
				0.481	1.8871	82201
3,189.000	20,950.88	1.000	0.481			
					TOTAL VOLUME	82,201

MAX. NET CUML. STORAGE = 1.8871 AC.FT. WATER SURFACE ELEVATION =3188.35

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CITY OF VICTORVILLE

TR. 16397

ONSITE DRAINAGE BASIN 3 PLAN

CLIENT: RY PROPERTIES

SCALE	SHEET
1":60'	1 OF 3

DESIGNED BY:	DRAWN BY:	CHECKED BY:	
AG	LC	JF	D-1

Form 4.2-1 LID BMP Performance Criteria for Design Capture Volume

		User Input	
		User to Verify	
		Results	

1	Project area DA 3 (ft^2):	1,075,795	ft^2
2	Imperviousness after applying preventative site design practices (Imp%):	0.5780	Decimal %
3	Runoff Coefficient (Rc): $R_c = 0.858(Imp\%)^{3} - 0.78(Imp\%)^{2} + 0.774(Imp\%) + 0.04$	0.392	
4	Determine 1-hour rainfall depth for a 2-year return period P2yr-1hr (in):	0.384	in
5	Compute P6, Mean 6-hr Precipitation (inches): *P6 = Item 4 *C1, where C1 is a function of site climatic region specified in Form 3-1 Item 1 (Valley = 1.4807; Mountain = 1.909; Desert = 1.2371)*		
	Valley:	0.569	
	Mountian:	0.733	
	Desert:	0.475	
6	Drawdown Rate	48	hrs
7	Compute design capture volume, DCV (ft3): *DCV = 1/12 * [Item 1* Item 3 *Item 5 * C2], where C2 is a function of drawdown rate (24-hr = 1.582; 48-hr = 1.963)* *Compute separate DCV for each outlet from the project site per schematic drawn in Form 3-1 Item 2*		
	Valley:	39,271	ft^3
	Mountian:	50,630	ft^3
	Desert:	32,810	ft^3

Pervious Area =	453,985	ft^2

BASIN No. 3

BASIN # 3; WEST OF CHANNEL					
TT-16397 RETENTION BASIN 4-05-17					
Area of Basin @ PERIMETER ELEV= 20950.9 SF					
		3:1 SLOPE			
Elev. ft.	Area s.f.	Area a.c.	Volume ac-ft	Cuml. Volume ac.ft	Volume c.f.
3184	12149.4	0.279			
			0.2978	0.2978	12972
3185	13794.2	0.317			
			0.3362	0.6340	27619
3186	15499.8	0.356			
			0.3761	1.0101	44002
3187	17266.7	0.396			
			0.4173	1.4275	62180
3188	19089.8	0.438			
			0.4596	1.8871	82201
3189	20950.9	0.481			
				TOTAL VOLUME	82,201
Max. Net cum. Storage = 1.8871 Ac.Ft. W.S.E. = 3189'					

WSE = 3188.35

(~~Design Capture Volume~~ 24hr-24hr Volume + Differencial (Pre/Post)= 69,260.4 CF ⇒ 1.59 AC-FT

PROVIDED

BASIN = 82,201 CF ⇒ 1.8871 AC-FT

TOTAL PROVIDED = 82,201 CF ⇒ 1.8871 AC-FT

Ludwig Engineering
109 E. Third St.
San Bernardino, CA 92410
Ph. 909-884-8217 Fax 909-889-0153

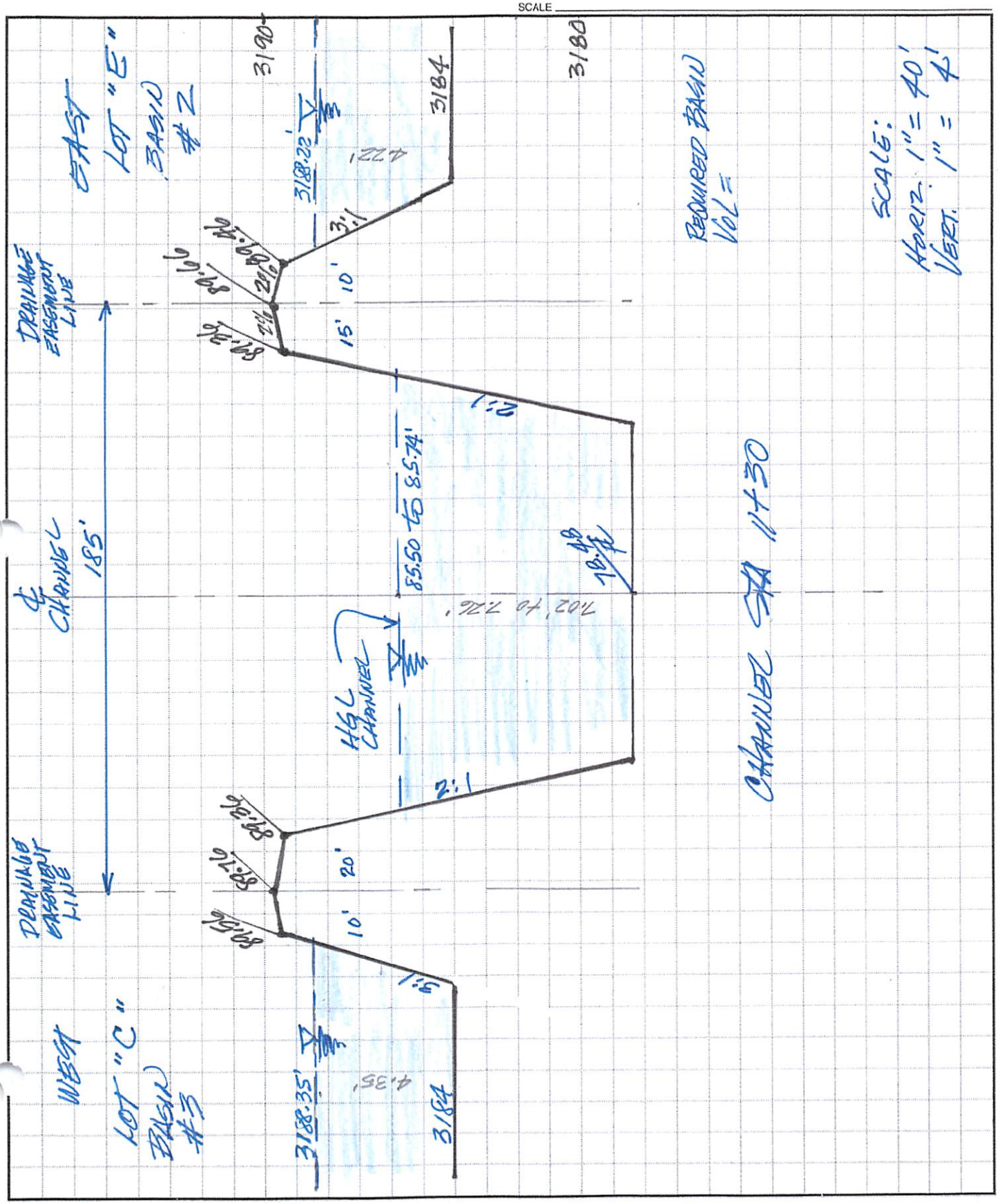
JOB _____

SHEET NO. _____ OF _____

CALCULATED BY _____ DATE _____

CHECKED BY _____ DATE _____

SCALE _____

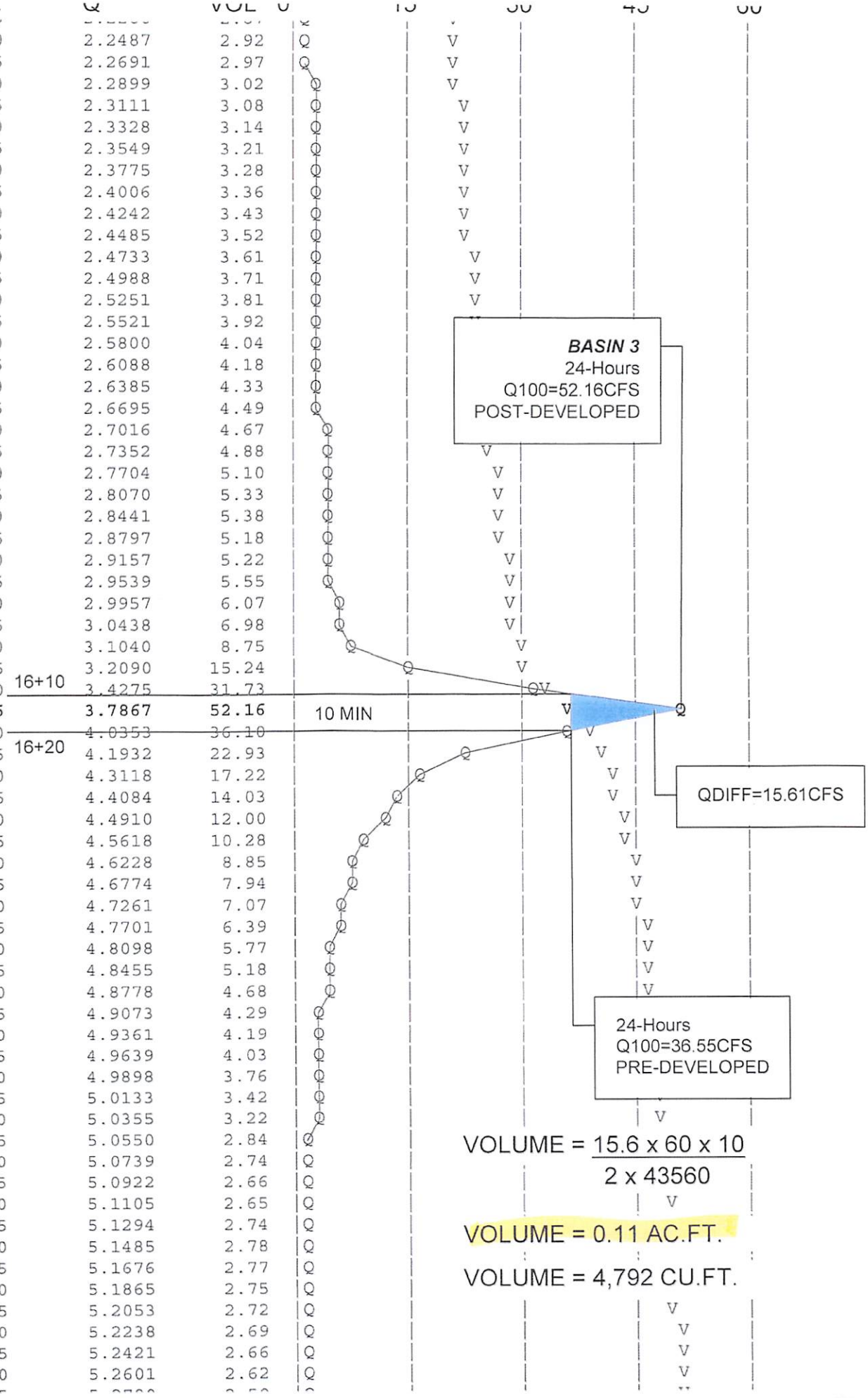


TIME	Q	VOL
13+40	2.2487	2.92
13+45	2.2691	2.97
13+50	2.2899	3.02
13+55	2.3111	3.08
14+ 0	2.3328	3.14
14+ 5	2.3549	3.21
14+10	2.3775	3.28
14+15	2.4006	3.36
14+20	2.4242	3.43
14+25	2.4485	3.52
14+30	2.4733	3.61
14+35	2.4988	3.71
14+40	2.5251	3.81
14+45	2.5521	3.92
14+50	2.5800	4.04
14+55	2.6088	4.18
15+ 0	2.6385	4.33
15+ 5	2.6695	4.49
15+10	2.7016	4.67
15+15	2.7352	4.88
15+20	2.7704	5.10
15+25	2.8070	5.33
15+30	2.8441	5.38
15+35	2.8797	5.18
15+40	2.9157	5.22
15+45	2.9539	5.55
15+50	2.9957	6.07
15+55	3.0438	6.98
16+ 0	3.1040	8.75
16+ 5	3.2090	15.24
16+10	3.4275	31.73
16+15	**3.7867**	**52.16**
16+20	4.0353	36.10
16+25	4.1932	22.93
16+30	4.3118	17.22
16+35	4.4084	14.03
16+40	4.4910	12.00
16+45	4.5618	10.28
16+50	4.6228	8.85
16+55	4.6774	7.94
17+ 0	4.7261	7.07
17+ 5	4.7701	6.39
17+10	4.8098	5.77
17+15	4.8455	5.18
17+20	4.8778	4.68
17+25	4.9073	4.29
17+30	4.9361	4.19
17+35	4.9639	4.03
17+40	4.9898	3.76
17+45	5.0133	3.42
17+50	5.0355	3.22
17+55	5.0550	2.84
18+ 0	5.0739	2.74
18+ 5	5.0922	2.66
18+10	5.1105	2.65
18+15	5.1294	2.74
18+20	5.1485	2.78
18+25	5.1676	2.77
18+30	5.1865	2.75
18+35	5.2053	2.72
18+40	5.2238	2.69
18+45	5.2421	2.66
18+50	5.2601	2.62

16+10

16+20

10 MIN



$$\text{VOLUME} = \frac{15.6 \times 60 \times 10}{2 \times 43560}$$

VOLUME = 0.11 AC.FT.

VOLUME = 4,792 CU.FT.

20+20	1.3741	0.45	Q	|	|	|	V |
20+25	1.3772	0.45	Q	|	|	|	V |
20+30	1.3802	0.44	Q	|	|	|	V |
20+35	1.3832	0.44	Q	|	|	|	V |
20+40	1.3862	0.43	Q	|	|	|	V |
20+45	1.3892	0.43	Q	|	|	|	V |
20+50	1.3921	0.42	Q	|	|	|	V |
20+55	1.3950	0.42	Q	|	|	|	V |
21+ 0	1.3978	0.41	Q	|	|	|	V |
21+ 5	1.4007	0.41	Q	|	|	|	V |
21+10	1.4035	0.41	Q	|	|	|	V |
21+15	1.4062	0.40	Q	|	|	|	V |
21+20	1.4090	0.40	Q	|	|	|	V |
21+25	1.4117	0.39	Q	|	|	|	V |
21+30	1.4144	0.39	Q	|	|	|	V |
21+35	1.4171	0.39	Q	|	|	|	V |
21+40	1.4197	0.38	Q	|	|	|	V |
21+45	1.4223	0.38	Q	|	|	|	V |
21+50	1.4249	0.38	Q	|	|	|	V |
21+55	1.4275	0.37	Q	|	|	|	V |
22+ 0	1.4301	0.37	Q	|	|	|	V |
22+ 5	1.4326	0.37	Q	|	|	|	V |
22+10	1.4351	0.36	Q	|	|	|	V |
22+15	1.4376	0.36	Q	|	|	|	V |
22+20	1.4401	0.36	Q	|	|	|	V |
22+25	1.4425	0.36	Q	|	|	|	V |
22+30	1.4449	0.35	Q	|	|	|	V |
22+35	1.4474	0.35	Q	|	|	|	V |
22+40	1.4497	0.35	Q	|	|	|	V |
22+45	1.4521	0.34	Q	|	|	|	V |
22+50	1.4545	0.34	Q	|	|	|	V |
22+55	1.4568	0.34	Q	|	|	|	V |
23+ 0	1.4591	0.34	Q	|	|	|	V|
23+ 5	1.4615	0.34	Q	|	|	|	V|
23+10	1.4637	0.33	Q	|	|	|	V|
23+15	1.4660	0.33	Q	|	|	|	V|
23+20	1.4683	0.33	Q	|	|	|	V|
23+25	1.4705	0.33	Q	|	|	|	V|
23+30	1.4728	0.32	Q	|	|	|	V|
23+35	1.4750	0.32	Q	|	|	|	V|
23+40	1.4772	0.32	Q	|	|	|	V|
23+45	1.4794	0.32	Q	|	|	|	V|
23+50	1.4815	0.32	Q	|	|	|	V|
23+55	1.4837	0.31	Q	|	|	|	V|
24+ 0	**1.4858**	**0.31**	**Q**	|	|	|	**V**|

BASIN 3
2-YR, 24-HR STORM
VOLUME= 1.48 AC.F.T.
(DCV)

SOILS
USDA/NRCS

United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for San Bernardino County, California, Mojave River Area

March 30, 2017

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil

scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report
Soil Map

MAP LEGEND

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

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

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

Background
- Aerial Photography

MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: San Bernardino County, California, Mojave River Area
Survey Area Data: Version 8, Sep 12, 2016

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

Date(s) aerial images were photographed: May 5, 2010—Feb 4, 2015

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background

MAP LEGEND

MAP INFORMATION

imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

San Bernardino County, California, Mojave River Area (CA671)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
112	CAJON SAND, 0 TO 2 PERCENT SLOPES	425.6	100.0%
Totals for Area of Interest		**425.6**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however,

onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

San Bernardino County, California, Mojave River Area

112—CAJON SAND, 0 TO 2 PERCENT SLOPES

Map Unit Setting

National map unit symbol: hkrj
Elevation: 1,800 to 3,200 feet
Mean annual precipitation: 3 to 6 inches
Mean annual air temperature: 59 to 66 degrees F
Frost-free period: 180 to 290 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Cajon and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Cajon

Setting

Landform: Alluvial fans
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from granite sources

Typical profile

H1 - 0 to 7 inches: sand
H2 - 7 to 25 inches: sand
H3 - 25 to 45 inches: gravelly sand
H4 - 45 to 60 inches: stratified sand to loamy fine sand

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 1 percent
Available water storage in profile: Low (about 4.1 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: A
Ecological site: Sandy (R030XF012CA)
Hydric soil rating: No

Minor Components

Manet

Percent of map unit: 5 percent

Landform: Playas
Hydric soil rating: Yes

Kimberlina
Percent of map unit: 5 percent

Helendale
Percent of map unit: 5 percent

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GENERAL BIOLOGICAL RESOURCES ASSESSMENT

GENERAL BIOLOGICAL RESOURCES ASSESSMENT

TENTATIVE TRACT 16397

VICTORVILLE, CALIFORNIA

Prepared for:

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Palm Avenue, Suite 200
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Prepared by:

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Report prepared by: R. Arnold
Project: #2016-34

September 25, 2017

TITLE PAGE

Date Report Written: September 25, 2017

Date Field Work Completed: September 25, 2017

Report Title: General Biological Resources Assessment

TPM & Assessor's Parcel Number: TPM 16397

Prepared for: **RY Properties**

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1.0 INTRODUCTION AND SUMMARY

Biological surveys were conducted on September 25, 2017 on a 80-acre parcel (gross acreage) located south of Dos Palmas Road and west of Mesa View Drive in the City of Victorville, California (Township 5 North, Range 5 West, Section 33, USGS Baldy Mesa, California Quadrangle 1996) (Appendix A: Figures 1, 2, 3 & 4). As part of the environmental process, California Department of Fish and Wildlife (CDFW) and U.S. Fish and Wildlife Service (USFWS) data sources were reviewed. Following the data review, biological surveys were performed on the site during which the biological resources on the property and in the surrounding areas were documented by biologists from RCA Associates, LLC (Randy Arnold and Parker Smith).

As part of the surveys, the property site and the adjoining lands were evaluated for the presence of native habitats which could potentially support populations of sensitive wildlife species. A focused survey was also conducted for the desert tortoise and burrowing owl, and a habitat assessment was performed for the Mohave ground squirrel. The property was also evaluated for the presence of sensitive habitats including wetlands, vernal pools, riparian habitats, and jurisdictional areas.

Based on data from USFWS, CDFW, and a search of the California Natural Diversity Database (CNDDB, 2017), there are four sensitive wildlife species that have been documented in the region within approximately five miles of the project site. These sensitive species include desert tortoise (*Gopherus agassizii*), burrowing owl (*Athene cunicularia*), Mohave ground squirrel (*Spermophilus mohavensis*), and loggerhead shrike (*Lanius ludovicianus*). Scientific nomenclature for this report is based on the following references: Hickman (1993), Munz (1974), Stebbins (2003), Sibley (2000) and Whitaker (1980).

2.0 EXISTING CONDITIONS

The property is approximately 80-acres in size and is located south of Dos Palmas Road and west of Mesa View Drive in the City of Victorville, California (T5N, R5W, Section 33, USGS Baldy Mesa, California Quadrangle) (Appendix A: Figures 1 and 2). The site supports a relatively undisturbed plant community dominated by rubberbrush (*Chrysothamnus nauseosus*), creosote bush (*Larrea tridentata*), and white bur-sage (*Ambrosia dumosa*) (Figure 3). Other plants noted included observed included erodium (*Erodium cicutarium*), brome grass (*Bromus sp.*), and schismus (*Schismus sp.*). A residential development borders the site directly to the south and east, with vacant land bordering the site to the north and west. A large desert wash is located in the center portion of the site and is oriented in a north-south direction (Figure 4). No sensitive wildlife species were observed during the September 25, 2017 field investigations.

3.0 METHODOLOGIES

Biological surveys were conducted on September 25, 2017 during which biologists from RCA Associates LLC initially walked meandering transects throughout the site to collect data on the plant and animal communities. Following completion of the initial reconnaissance survey, focused surveys were conducted for the burrowing owl and desert tortoise, and a habitat assessment was also performed for the Mohave ground squirrel. The applicable methodologies are summarized below. Surveys were performed on the site and in the surrounding area from about 0800 to about 1200 hours. Weather conditions during the September 25, 2017 survey consisted of winds 0 to 5 mph, temperatures in the mid 60's (AM) to mid-70's (PM) (ºF) with clear skies. All plants and animals detected during the field investigations were recorded and are provided in Tables 1 & 2 along with other species that have been documented in the area (Appendix A).

Desert Tortoise: The site was surveyed for desert tortoises by Randall Arnold and Parker Smith, and as required by the CDFW and USFWS survey protocol, 10 meter, parallel belt transects were walked in an east-west direction until the entire property had been checked for tortoises and/or tortoise sign (burrows, tracks, scats, etc.). Surveys in the zone of influence (ZOI) were also conducted to the north and west of the site where vacant land was present. All transects were walked at a pace that allowed careful observations along the transect routes and in the immediate vicinity. Field notes were recorded regarding native plant assemblages, wildlife sign, and human affects in order to determine the presence or absence of suitable tortoise foraging habitat.

Burrowing Owl: A habitat assessment was conducted for the burrowing owl in conjunction with the general biological surveys to determine if the site supports suitable habitat for the species. Following completion of the habitat assessment, it was determined that the site does support suitable habitat for the burrowing owl; therefore, a focused survey was conducted for burrowing owls and for occupiable (i.e., suitable) burrows which could potentially be utilized by owls. As part of the burrow survey,

transects were walked throughout the site during which any suitable burrows were evaluated for owls and owl sign. Burrowing owls typically utilize burrows which have been excavated by other animals (squirrels, coyotes, foxes, dogs, etc.) since owls cannot excavate their own burrows. CDFW protocol also requires surveys be conducted in the surrounding area out to a distance of about 500 feet; therefore, surveys were performed in the vacant areas adjacent to the site to the north and west.

Mohave Ground Squirrel: A habitat assessment was performed for the Mohave ground squirrel as per CDFW protocol including an analysis of the on-site habitat, evaluation of local populations, and assessment of connectivity with habitats in the surrounding area which might support populations of the Mohave ground squirrel.

4.0 LITERATURE SEARCH

As part of the environmental process, a search of the California Natural Diversity Database (CNDDB, 2017) was performed. Based on this review, it was determined that several sensitive wildlife species have been documented within approximately 5-miles of the property. The following table provides data on each species.

Table 4-1: Federal and State Listed Species and State Species of Special Concern.
T = Threatened; E = Endangered; SSC = Species of special concern; CNDDB = California Natural Diversity Data Base

Name	Listing Status	Habitat Requirements	Presence/Absence	Comments
Burrowing owl *(Athene cunicularia)*	Fed: None State: None CDFW: SC	Open, dry annual or perennial grasslands, deserts & scrublands	Species not observed on the site. Site does support suitable habitat for the species.	Species is documented in the general region CNDDB (2017)
Desert tortoise (*Gopherus agassizii*)	Fed: T State: T	Joshua tree woodland Mojavean desert scrub Sonoran desert scrub	Species not observed on the site. Site does not support suitable habitat for the species.	Species is documented in the general region CNDDB (2017)
Loggerhead shrike (*Lanius ludovicianus*)	Fed: None State: None CDFW: SC	Desert wash Joshua tree woodland Mojavean desert scrub Pinon & juniper woodlands	Species not observed on the site. Site does not support suitable habitat for the species.	Species is documented in the general region CNDDB (2017)
Sagebrush loeflingia (*Loeflingia squarrosa var. artemisiarum*)	Fed: None State: None CNPS: 2B.2	Desert dunes Great Basin scrub Sonoran desert scrub	Species not observed on the site. Site does not support suitable habitat for the species.	Species is documented in the general region CNDDB (2017)
Short-joint beavertail (*Opuntia basilaris var. brachyclada*)	Fed: None State: None CNPS: 1B.1	Chaparral Joshua tree woodland Mojavean desert scrub Pinon & juniper woodlands	Species not observed on the site.	Species is documented in the general region CNDDB (2017)
Mohave ground squirrel (*Xerospermophilus mohavensis*)	Fed: None State: T	Chenopod scrub Joshua tree woodland Mojavean desert scrub	Species not observed on the site. Site does not support suitable habitat for the species.	Species is documented in the general region CNDDB (2017)

5.0 RESULTS

5.1 General Biological Resources

A relatively undisturbed creosote bush community covers most of the property. Most of the creosote bushes were from 2 to 4 feet in height and the property shows some sign of human disturbance including debris piles, vehicle tracks, off-road vehicle paths, etc. Perennials scattered throughout the property included rubberbrush (*Chrysothamnus nauseous*), creosote bush (*Larrea tridentata*), white bur-sage (*Ambrosia dumosa*) and Russian thistle (*Salsola tragus*). Annuals observed included brome grass (*Bromus sp.*), schismus (*Schismus sp.*), and erodium (*Erodium texanum*). Birds identified during the surveys included ravens (*Corvus corax*), sage sparrows (*Artemisiospiza nevadensis*), rock pigeon (*Columba livia*), mourning dove (*Zenaida macroura*), and lark sparrow (*Chondestes grammacus*).

The only mammals observed were black-tailed jackrabbits (*Lepus californicus*), California ground squirrel (Spermophilus beecheyi), and cottontail (Sylvilagus auduboni. However, numerous small mammal burrows were also noted and some of these may be utilized by Merriam's kangaroo rats (*Dipodomys merriami*) and Antelope ground squirrels (*Ammospermophilus leucurus*) which are common in the area. Reptiles observed were limited to western whiptail lizards (*Cnemidophorus tigris*) and side-blotched lizards (*Uta stansburiana*). Coyotes (*Canis latrans*) also traverse the site during hunting activities as indicated by the numerous scats and abandoned burrows observed. No distinct wildlife corridors were identified on the site or in adjacent areas.

5.2 Federal and State Listed Species

Mohave Ground Squirrel: Mohave ground squirrel populations have been documented in the area with the nearest observation about 2.5 miles south of the property (Occurrence #318, Baldy Mesa, California Quad), and this observation was recorded in 2005 during a live-trapping survey (CNDDB, 2017). There are no recent observations of the species in the immediate area surrounding the site (CNDDB, 2017) and the species is very unlikely to occur on the site based on the following criteria:

1. Presence of developments immediately adjacent to the site;
2. Limited number of recent documented observations in the general region;
3. Limited connectivity with other vacant habitats in the region; and
4. The presence of human disturbance to the site.

Desert Tortoise: Desert tortoises have been documented in the area; however, there are no recent observations of this species in the immediate vicinity of the site. In addition, no tortoises or tortoise sign (i.e., burrows, scats, tracks, etc.) were observed on the site during the protocol surveys conducted on September 25, 2017.

Loggerhead shrike: The loggerhead shrike has been documented in the region; however, there are no recent observations of this species in the immediate area (CNDDB, 2017). The habitat on the site is not suitable for the species; consequently, there is a very low probability shrikes will utilize the site in the future.

5.3 Wildlife Species of Special Concern & Special Status Plants

Burrowing Owl: There are numerous owl colonies that have been observed in the general region, and there are numerous documented owl colonies within about five miles of the site (CNDDB, 2017). No owls were observed during the field investigations, and no suitable (i.e., "occupiable") burrows or burrowing owl sign (whitewash, castings, etc.) were observed on the site. Based on the results of the field investigations and the absence of owl sign, the species is not expected to inhabit the property at the present time. However, a pre-construction survey will be required by CDFW immediately prior to the start of any future site clearing activities to determine if the species has moved onto the site since completion of the September 25, 2017 surveys.

Sagebrush Loefklingia & Short-jointed Beavertail cactus: No loeflingia or beavertail cactus were observed on the site during the field investigations. Sagebrush loeflingioa typically inhabit desert dunes and is not expected to occur on the property given the

absence of suitable habitat. Beavertail cactus are readily identifiable and if present on the site, would have been observed during the extensive field investigations conducted throughout the site. However, no cacti were observed and the species is not expected to occur on the site in the near future.

6.0 Impacts and Mitigation Measures

6.1 General Biological Resources

Future development of the site will impact the general biological resources present on the site, and most of the vegetation will likely be removed during future development activities. However, wildlife on the site is somewhat limited and future activities will generate minimal impacts on wildlife species known to occur in the area. Species with limited mobility (i.e., small mammals and reptiles) will experience some increases in mortality during the construction phase; although, more mobile species (i.e., birds, large mammals) will be displaced into adjacent areas and will likely experience negligible impacts. Loss of about 80-acres of desert vegetation is not expected to have a significant cumulative impact on the overall biological resources in the region given the presence of similar habitat throughout the surrounding region.

6.2 Federal and State Listed and Species of Special Concern

Development of the property is not expected to impact any special status animal species that have been documented in the area (CNDDB, 2017). As noted in Section 5.3, no desert tortoises or tortoise sign were observed on the site or zone of influence, nor were any burrowing owls observed on the property during the protocol surveys. Suitable owl burrows and burrowing owl sign (whitewash, castings, etc.) were not observed on the site or in the zone of influence (ZOI).

As per CDFW protocol, the survey results are valid for only 30 days; therefore, CDFW will require a 30-day pre-construction survey be performed prior to the start of any future clearing/grading activities to determine if owls have moved on to the site since completion of the September 25, 2017 surveys. The site does not supports adequate habitat for the Mohave ground squirrel; furthermore, based on the limited number of documented observations for the region, current habitat conditions, and low population levels, the probability of the species inhabiting the site is extremely low.

7.0 CONCLUSIONS AND RECOMMENDATIONS

Future on-site activities will result in the removal of about 80-acres of desert scrub vegetation; however, any future activities are not expected to have a significant cumulative impact on the general biological resources in the surrounding region. In addition, development of the site is not expected to have an impact on any State or Federal listed wildlife species, and no other special status animal species (i.e., State "species of special concern") are expected to be impacted.

If any special status species are observed on the property during future development activities, CDFW and USFWS (as applicable) should be contacted to discuss specific mitigation measures which may be required for the individual species. CDFW and USFWS are the only agencies which can grant authorization for the "take" of any sensitive species.

8.0 BIBLIOGRAPHY

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CERTIFICATION

I hereby certify that the statements furnished above and in the attached exhibits, present the data and information required for this biological evaluation, and that the facts, statements, and information presented are true and correct to the best of my knowledge and belief. Field work conducted for this assessment was performed by me or other biologists under my direct supervision. I certify that I have not signed a non-disclosure or consultant confidentiality agreement with the project applicant or applicant's representative and that I have no financial interest in the project.

Date: 09/25/2017 Signed: Randy Arnold
Report Author

Field Work Performed By: Randall Arnold
Senior Biologist

Field Work Performed By: Parker Smith
Biological Field Technician

Appendix A

Tables and Figures

Table 1 - Plants observed on the site and known to occur in the area.

Common Name	Scientific Name	Location
Sage	*Salvia* sp.	Surrounding area
Schismus	*Schismus barbatus*	On-site
Brome grass	*Bromus ps.*	"
Bur-sage	*Ambrosia dumosa*	Surrounding area
Paperbag plant	*Salazaria Mexicana*	"
Ephedra	*Ephedra nevadensis*	"
Buckwheat	*Eriogonum sp.*	"
Anderson's thornbush	*Lycium andersonii*	"
Joshua tree	*Yucca brevifolia*	"
Creosote bush	*Larrea tridentate*	On-site
Cholla	*Opuntis acanthocarpa*	Surrounding area
Rubberbrush	*Chrysothamnus naueosus*	On-site & surrounding area
Russian thistle	*Salsola tragus*	"
Erodium	*Erodium cicutarium*	"

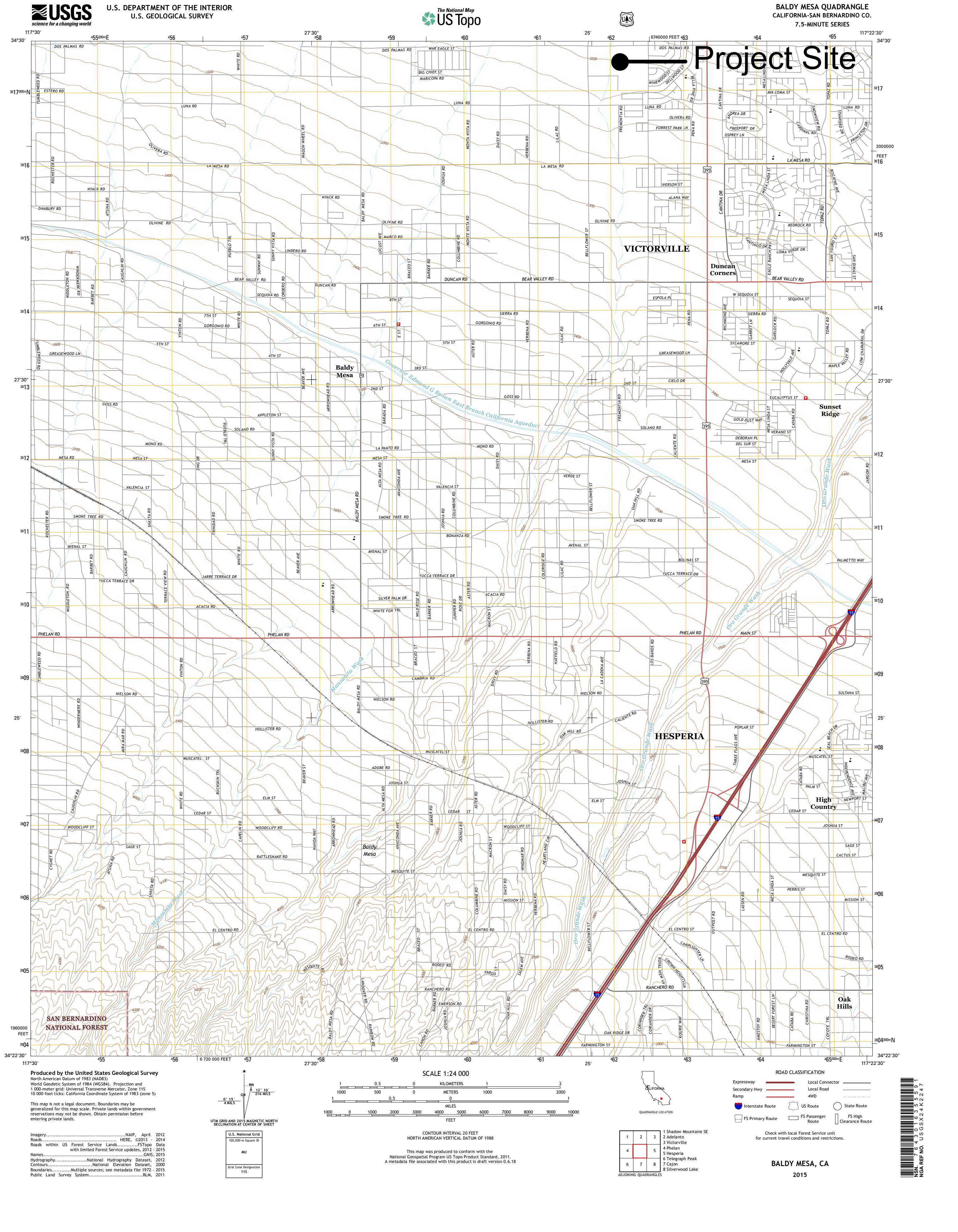
Table 2 - Wildlife observed on the site and those species expected to the area.

Common Name	Scientific Name	Location
Common raven	*Corvus corax*	On-site & surrounding area.
Sage sparrow	*Amphispiza belli*	"
Cactus wren	*Campylorhynchus brunneicapillus*	Surrounding area
American kestrel	*Falco sparverius*	"
Jackrabbit	*Lepus Californicus*	"
Antelope ground squirrel	*Ammospermophilus leucurus*	"
Side-blotched lizard	*Uta stansburiana*	On-site & surrounding area
Western whiptail lizard	*Cnemidophorus tigris*	"
Mourning dove	*Zenaida macroura*	"
California ground squirrel	*Spermophilus beecheyi*	"
Brewer's blackbird	*Euphagus cyanocephalus*	Surrounding area
Gambel's quail	*Callipepla gambelii*	"
Desert cottontail	*Sylvilagus auduboni*	On-site & surrounding area
Coyotes	*Canis latrans*	"
Merriam's kangaroo rat	*Dipodomys merriami*	Surrounding area
Song sparrow	*Melospiza melodia*	"
Desert spiny lizard	*Sceloporus magister*	"
Rock pigeon	*Columba livia*	"

Note: The above Tables are not comprehensive lists of every plant or animal species which may occur in the area, but are a list of those common species which have been identified on the site or in the region by biologists from RCA Associates, LLC.


Figure 1
Vicinity Map
Legend
City/Community
Project Boundary
Oro Grande
Adelanto
Victorville
Project Site
Mountain View Acres
Apple Va
Pinon Hills
Phelan
Hesperia
Google Earth
© 2017 Google
N
10 mi

Figure 2



USGS
science for a changing world
U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY
The National Map
US Topo
BALDY MESA QUADRANGLE
CALIFORNIA-SAN BERNARDINO CO.
7.5-MINUTE SERIES
Project Site
VICTORVILLE
Duncan Corners
Baldy Mesa
Sunset Ridge
Governor Edmund G Brown East Branch California Aqueduct
HESPERIA
High Country
Oak Hills
SAN BERNARDINO NATIONAL FOREST
Oro Grande Wash
Manzanita Wash
PHELAN RD
BEAR VALLEY RD
LA MESA RD
MAIN ST
SCALE 1:24 000
CONTOUR INTERVAL 20 FEET
NORTH AMERICAN VERTICAL DATUM OF 1988
Produced by the United States Geological Survey
ROAD CLASSIFICATION
ADJOINING QUADRANGLES
1 Shadow Mountains SE
2 Adelanto
3 Victorville
4 Phelan
5 Hesperia
6 Telegraph Peak
7 Cajon
8 Silverwood Lake
BALDY MESA, CA
2015

CENTER LOOKING NORTH

CENTER LOOKING EAST

FIGURE 3
SITE PHOTOS

CENTER LOOKING SOUTH

CENTER LOOKING WEST

FIGURE 3
SITE PHOTOS

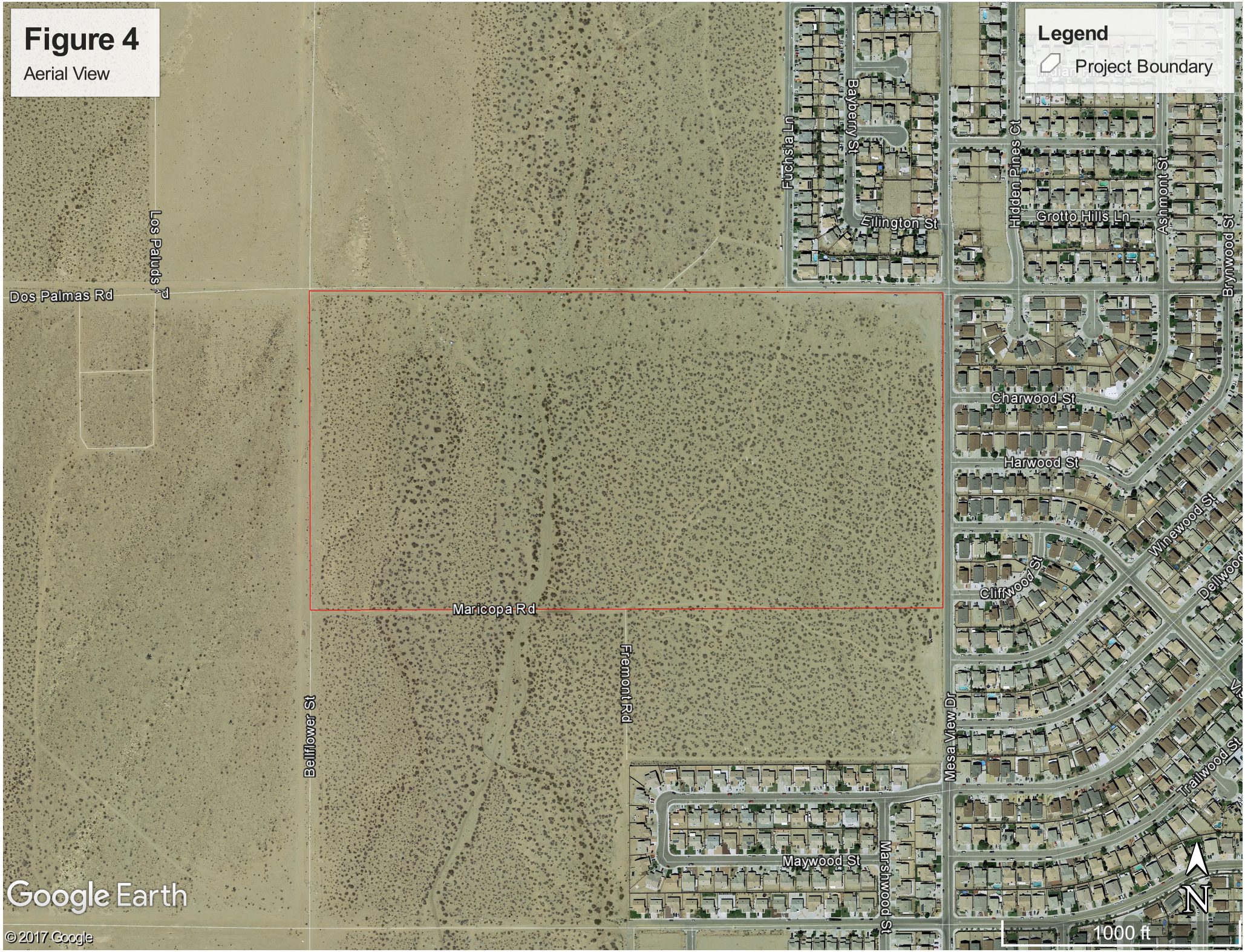


Figure 4
Aerial View
Legend
Project Boundary
Dos Palmas Rd
Los Palus Rd
Maricopa Rd
Bellflower St
Fremont Rd
Baybery St
Fuchsia Ln
Ellington St
Hidden Pines Ct
Grotto Hills Ln
Ashmont St
Brywood St
Charwood St
Harwood St
Winewood St
Cliffwood St
Dellwood
Mesa View Dr
Trailwood St
Maywood St
Marshwood St
Google Earth
© 2017 Google
N
1000 ft

HYDROLOGY & HYDRAULICS

U n i t H y d r o g r a p h A n a l y s i s

Study date 04/05/17

++

San Bernardino County Synthetic Unit Hydrology Method
Manual date - August 1986

Program License Serial Number 4070

2-YEAR, 24-HOURS UNIT HYDROGRAPH POST-DEVELOPED CONDITION
TR. 16397, CITY OF VICTORVILLE
AREA A8 TO A11 (EAST OF TRAPEZOIDAL CHANNEL, BASIN 1)
FILE: 16397UNITHYDA8CASIN12YR.OUT

Storm Event Year = 2

Antecedent Moisture Condition = 1

English (in-lb) Input Units Used

English Rainfall Data (Inches) Input Values Used

English Units used in output format

Area averaged rainfall intensity isohyetal data:

Sub-Area (Ac.)	Duration (hours)	Isohyetal (In)
Rainfall data for year 2		
23.57	1	0.38
Rainfall data for year 2		
23.57	6	0.85
Rainfall data for year 2		
23.57	24	1.55

++

******** Area-averaged max loss rate, Fm ********

SCS curve No.(AMCII)	SCS curve NO.(AMC 1)	Area (Ac.)	Area Fraction	Fp(Fig C6) (In/Hr)	Ap (dec.)	Fm (In/Hr)
32.0	16.6	23.57	1.000	1.000	0.426	0.426

Area-averaged adjusted loss rate Fm (In/Hr) = 0.426

********* Area-Averaged low loss rate fraction, Yb **********

Area (Ac.)	Area Fract	SCS CN (AMC2)	SCS CN (AMC1)	S	Pervious Yield Fr
10.03	0.426	32.0	16.6	7.75	0.000
13.54	0.574	98.0	98.0	0.20	0.858

Area-averaged catchment yield fraction, Y = 0.493
Area-averaged low loss fraction, Yb = 0.507
User entry of time of concentration = 0.291 (hours)
++
Watershed area = 23.57(Ac.)
Catchment Lag time = 0.233 hours
Unit interval = 5.000 minutes
Unit interval percentage of lag time = 35.7556
Hydrograph baseflow = 0.00(CFS)
Average maximum watershed loss rate(Fm) = 0.426(In/Hr)
Average low loss rate fraction (Yb) = 0.507 (decimal)
DESERT S-Graph Selected
Computed peak 5-minute rainfall = 0.182(In)
Computed peak 30-minute rainfall = 0.312(In)
Specified peak 1-hour rainfall = 0.384(In)
Computed peak 3-hour rainfall = 0.623(In)
Specified peak 6-hour rainfall = 0.846(In)
Specified peak 24-hour rainfall = 1.550(In)

Rainfall depth area reduction factors:
Using a total area of 23.57(Ac.) (Ref: fig. E-4)

5-minute factor = 0.999 Adjusted rainfall = 0.182(In)
30-minute factor = 0.999 Adjusted rainfall = 0.312(In)
1-hour factor = 0.999 Adjusted rainfall = 0.384(In)
3-hour factor = 1.000 Adjusted rainfall = 0.623(In)
6-hour factor = 1.000 Adjusted rainfall = 0.846(In)
24-hour factor = 1.000 Adjusted rainfall = 1.550(In)

U n i t H y d r o g r a p h

++

Interval Number	'S' Graph Mean values	Unit Hydrograph ((CFS))
	(K = 285.05 (CFS))	
1	2.308	6.578
2	14.128	33.693
3	42.320	80.361

4	60.956	53.123
5	70.947	28.479
6	77.623	19.032
7	82.364	13.512
8	86.017	10.413
9	88.881	8.164
10	91.015	6.083
11	92.802	5.094
12	94.274	4.196
13	95.472	3.413
14	96.450	2.790
15	97.232	2.229
16	97.821	1.679
17	98.201	1.084
18	98.609	1.161
19	99.038	1.223
20	99.448	1.171
21	99.706	0.735
22	100.000	0.367

Peak Unit Number	Adjusted mass rainfall (In)	Unit rainfall (In)
1	0.1820	0.1820
2	0.2241	0.0421
3	0.2531	0.0290
4	0.2759	0.0228
5	0.2950	0.0191
6	0.3116	0.0166
7	0.3263	0.0147
8	0.3396	0.0133
9	0.3519	0.0122
10	0.3632	0.0113
11	0.3737	0.0105
12	0.3836	0.0099
13	0.3974	0.0138
14	0.4106	0.0132
15	0.4233	0.0127
16	0.4356	0.0122
17	0.4474	0.0118
18	0.4588	0.0114
19	0.4699	0.0111
20	0.4807	0.0108
21	0.4911	0.0105
22	0.5013	0.0102
23	0.5113	0.0099
24	0.5210	0.0097
25	0.5305	0.0095
26	0.5397	0.0093
27	0.5488	0.0091
28	0.5577	0.0089
29	0.5664	0.0087
30	0.5749	0.0085
31	0.5833	0.0084
32	0.5916	0.0082

33	0.5997	0.0081
34	0.6076	0.0080
35	0.6155	0.0078
36	0.6232	0.0077
37	0.6307	0.0076
38	0.6382	0.0075
39	0.6456	0.0074
40	0.6528	0.0072
41	0.6599	0.0071
42	0.6670	0.0070
43	0.6740	0.0070
44	0.6808	0.0069
45	0.6876	0.0068
46	0.6943	0.0067
47	0.7009	0.0066
48	0.7074	0.0065
49	0.7139	0.0065
50	0.7203	0.0064
51	0.7266	0.0063
52	0.7329	0.0062
53	0.7390	0.0062
54	0.7452	0.0061
55	0.7512	0.0061
56	0.7572	0.0060
57	0.7631	0.0059
58	0.7690	0.0059
59	0.7748	0.0058
60	0.7806	0.0058
61	0.7863	0.0057
62	0.7920	0.0057
63	0.7976	0.0056
64	0.8031	0.0056
65	0.8086	0.0055
66	0.8141	0.0055
67	0.8195	0.0054
68	0.8249	0.0054
69	0.8302	0.0053
70	0.8355	0.0053
71	0.8407	0.0052
72	0.8459	0.0052
73	0.8510	0.0051
74	0.8561	0.0051
75	0.8612	0.0050
76	0.8662	0.0050
77	0.8711	0.0050
78	0.8760	0.0049
79	0.8809	0.0049
80	0.8858	0.0049
81	0.8906	0.0048
82	0.8954	0.0048
83	0.9001	0.0048
84	0.9049	0.0047
85	0.9095	0.0047
86	0.9142	0.0047

87	0.9188	0.0046
88	0.9234	0.0046
89	0.9280	0.0046
90	0.9325	0.0045
91	0.9371	0.0045
92	0.9415	0.0045
93	0.9460	0.0045
94	0.9504	0.0044
95	0.9548	0.0044
96	0.9592	0.0044
97	0.9636	0.0044
98	0.9679	0.0043
99	0.9722	0.0043
100	0.9765	0.0043
101	0.9807	0.0043
102	0.9849	0.0042
103	0.9892	0.0042
104	0.9933	0.0042
105	0.9975	0.0042
106	1.0016	0.0041
107	1.0058	0.0041
108	1.0098	0.0041
109	1.0139	0.0041
110	1.0180	0.0041
111	1.0220	0.0040
112	1.0260	0.0040
113	1.0300	0.0040
114	1.0340	0.0040
115	1.0379	0.0040
116	1.0419	0.0039
117	1.0458	0.0039
118	1.0497	0.0039
119	1.0535	0.0039
120	1.0574	0.0039
121	1.0612	0.0038
122	1.0651	0.0038
123	1.0689	0.0038
124	1.0727	0.0038
125	1.0764	0.0038
126	1.0802	0.0038
127	1.0839	0.0037
128	1.0876	0.0037
129	1.0913	0.0037
130	1.0950	0.0037
131	1.0987	0.0037
132	1.1024	0.0037
133	1.1060	0.0036
134	1.1096	0.0036
135	1.1132	0.0036
136	1.1168	0.0036
137	1.1204	0.0036
138	1.1240	0.0036
139	1.1275	0.0036
140	1.1311	0.0035

141	1.1346	0.0035
142	1.1381	0.0035
143	1.1416	0.0035
144	1.1451	0.0035
145	1.1485	0.0035
146	1.1520	0.0035
147	1.1554	0.0034
148	1.1588	0.0034
149	1.1623	0.0034
150	1.1657	0.0034
151	1.1690	0.0034
152	1.1724	0.0034
153	1.1758	0.0034
154	1.1791	0.0034
155	1.1825	0.0033
156	1.1858	0.0033
157	1.1891	0.0033
158	1.1924	0.0033
159	1.1957	0.0033
160	1.1990	0.0033
161	1.2023	0.0033
162	1.2055	0.0033
163	1.2088	0.0032
164	1.2120	0.0032
165	1.2152	0.0032
166	1.2184	0.0032
167	1.2216	0.0032
168	1.2248	0.0032
169	1.2280	0.0032
170	1.2312	0.0032
171	1.2343	0.0032
172	1.2375	0.0031
173	1.2406	0.0031
174	1.2437	0.0031
175	1.2469	0.0031
176	1.2500	0.0031
177	1.2531	0.0031
178	1.2561	0.0031
179	1.2592	0.0031
180	1.2623	0.0031
181	1.2653	0.0031
182	1.2684	0.0030
183	1.2714	0.0030
184	1.2745	0.0030
185	1.2775	0.0030
186	1.2805	0.0030
187	1.2835	0.0030
188	1.2865	0.0030
189	1.2895	0.0030
190	1.2925	0.0030
191	1.2954	0.0030
192	1.2984	0.0030
193	1.3013	0.0029
194	1.3043	0.0029

195	1.3072	0.0029
196	1.3101	0.0029
197	1.3130	0.0029
198	1.3160	0.0029
199	1.3188	0.0029
200	1.3217	0.0029
201	1.3246	0.0029
202	1.3275	0.0029
203	1.3304	0.0029
204	1.3332	0.0029
205	1.3361	0.0029
206	1.3389	0.0028
207	1.3418	0.0028
208	1.3446	0.0028
209	1.3474	0.0028
210	1.3502	0.0028
211	1.3530	0.0028
212	1.3558	0.0028
213	1.3586	0.0028
214	1.3614	0.0028
215	1.3642	0.0028
216	1.3669	0.0028
217	1.3697	0.0028
218	1.3724	0.0028
219	1.3752	0.0027
220	1.3779	0.0027
221	1.3807	0.0027
222	1.3834	0.0027
223	1.3861	0.0027
224	1.3888	0.0027
225	1.3915	0.0027
226	1.3942	0.0027
227	1.3969	0.0027
228	1.3996	0.0027
229	1.4023	0.0027
230	1.4049	0.0027
231	1.4076	0.0027
232	1.4103	0.0027
233	1.4129	0.0027
234	1.4156	0.0026
235	1.4182	0.0026
236	1.4208	0.0026
237	1.4235	0.0026
238	1.4261	0.0026
239	1.4287	0.0026
240	1.4313	0.0026
241	1.4339	0.0026
242	1.4365	0.0026
243	1.4391	0.0026
244	1.4417	0.0026
245	1.4443	0.0026
246	1.4468	0.0026
247	1.4494	0.0026
248	1.4520	0.0026

249	1.4545	0.0026
250	1.4571	0.0025
251	1.4596	0.0025
252	1.4621	0.0025
253	1.4647	0.0025
254	1.4672	0.0025
255	1.4697	0.0025
256	1.4722	0.0025
257	1.4747	0.0025
258	1.4772	0.0025
259	1.4797	0.0025
260	1.4822	0.0025
261	1.4847	0.0025
262	1.4872	0.0025
263	1.4897	0.0025
264	1.4922	0.0025
265	1.4946	0.0025
266	1.4971	0.0025
267	1.4995	0.0025
268	1.5020	0.0025
269	1.5044	0.0024
270	1.5069	0.0024
271	1.5093	0.0024
272	1.5117	0.0024
273	1.5142	0.0024
274	1.5166	0.0024
275	1.5190	0.0024
276	1.5214	0.0024
277	1.5238	0.0024
278	1.5262	0.0024
279	1.5286	0.0024
280	1.5310	0.0024
281	1.5334	0.0024
282	1.5358	0.0024
283	1.5381	0.0024
284	1.5405	0.0024
285	1.5429	0.0024
286	1.5452	0.0024
287	1.5476	0.0024
288	1.5500	0.0024

Unit Period (number)	Unit Rainfall (In)	Unit Soil-Loss (In)	Effective Rainfall (In)
1	0.0024	0.0012	0.0012
2	0.0024	0.0012	0.0012
3	0.0024	0.0012	0.0012
4	0.0024	0.0012	0.0012
5	0.0024	0.0012	0.0012
6	0.0024	0.0012	0.0012
7	0.0024	0.0012	0.0012
8	0.0024	0.0012	0.0012
9	0.0024	0.0012	0.0012

10	0.0024	0.0012	0.0012
11	0.0024	0.0012	0.0012
12	0.0024	0.0012	0.0012
13	0.0024	0.0012	0.0012
14	0.0024	0.0012	0.0012
15	0.0025	0.0012	0.0012
16	0.0025	0.0012	0.0012
17	0.0025	0.0013	0.0012
18	0.0025	0.0013	0.0012
19	0.0025	0.0013	0.0012
20	0.0025	0.0013	0.0012
21	0.0025	0.0013	0.0012
22	0.0025	0.0013	0.0012
23	0.0025	0.0013	0.0012
24	0.0025	0.0013	0.0012
25	0.0025	0.0013	0.0012
26	0.0025	0.0013	0.0013
27	0.0026	0.0013	0.0013
28	0.0026	0.0013	0.0013
29	0.0026	0.0013	0.0013
30	0.0026	0.0013	0.0013
31	0.0026	0.0013	0.0013
32	0.0026	0.0013	0.0013
33	0.0026	0.0013	0.0013
34	0.0026	0.0013	0.0013
35	0.0026	0.0013	0.0013
36	0.0026	0.0013	0.0013
37	0.0026	0.0013	0.0013
38	0.0027	0.0013	0.0013
39	0.0027	0.0014	0.0013
40	0.0027	0.0014	0.0013
41	0.0027	0.0014	0.0013
42	0.0027	0.0014	0.0013
43	0.0027	0.0014	0.0013
44	0.0027	0.0014	0.0013
45	0.0027	0.0014	0.0013
46	0.0027	0.0014	0.0013
47	0.0027	0.0014	0.0014
48	0.0028	0.0014	0.0014
49	0.0028	0.0014	0.0014
50	0.0028	0.0014	0.0014
51	0.0028	0.0014	0.0014
52	0.0028	0.0014	0.0014
53	0.0028	0.0014	0.0014
54	0.0028	0.0014	0.0014
55	0.0028	0.0014	0.0014
56	0.0028	0.0014	0.0014
57	0.0029	0.0015	0.0014
58	0.0029	0.0015	0.0014
59	0.0029	0.0015	0.0014
60	0.0029	0.0015	0.0014
61	0.0029	0.0015	0.0014
62	0.0029	0.0015	0.0014
63	0.0029	0.0015	0.0014

64	0.0029	0.0015	0.0014
65	0.0030	0.0015	0.0015
66	0.0030	0.0015	0.0015
67	0.0030	0.0015	0.0015
68	0.0030	0.0015	0.0015
69	0.0030	0.0015	0.0015
70	0.0030	0.0015	0.0015
71	0.0030	0.0015	0.0015
72	0.0030	0.0015	0.0015
73	0.0031	0.0016	0.0015
74	0.0031	0.0016	0.0015
75	0.0031	0.0016	0.0015
76	0.0031	0.0016	0.0015
77	0.0031	0.0016	0.0015
78	0.0031	0.0016	0.0015
79	0.0032	0.0016	0.0016
80	0.0032	0.0016	0.0016
81	0.0032	0.0016	0.0016
82	0.0032	0.0016	0.0016
83	0.0032	0.0016	0.0016
84	0.0032	0.0016	0.0016
85	0.0033	0.0017	0.0016
86	0.0033	0.0017	0.0016
87	0.0033	0.0017	0.0016
88	0.0033	0.0017	0.0016
89	0.0033	0.0017	0.0016
90	0.0033	0.0017	0.0016
91	0.0034	0.0017	0.0017
92	0.0034	0.0017	0.0017
93	0.0034	0.0017	0.0017
94	0.0034	0.0017	0.0017
95	0.0034	0.0017	0.0017
96	0.0035	0.0018	0.0017
97	0.0035	0.0018	0.0017
98	0.0035	0.0018	0.0017
99	0.0035	0.0018	0.0017
100	0.0035	0.0018	0.0017
101	0.0036	0.0018	0.0018
102	0.0036	0.0018	0.0018
103	0.0036	0.0018	0.0018
104	0.0036	0.0018	0.0018
105	0.0037	0.0019	0.0018
106	0.0037	0.0019	0.0018
107	0.0037	0.0019	0.0018
108	0.0037	0.0019	0.0018
109	0.0038	0.0019	0.0018
110	0.0038	0.0019	0.0019
111	0.0038	0.0019	0.0019
112	0.0038	0.0019	0.0019
113	0.0039	0.0020	0.0019
114	0.0039	0.0020	0.0019
115	0.0039	0.0020	0.0019
116	0.0039	0.0020	0.0019
117	0.0040	0.0020	0.0020

118	0.0040	0.0020	0.0020
119	0.0040	0.0020	0.0020
120	0.0041	0.0021	0.0020
121	0.0041	0.0021	0.0020
122	0.0041	0.0021	0.0020
123	0.0042	0.0021	0.0020
124	0.0042	0.0021	0.0021
125	0.0042	0.0021	0.0021
126	0.0043	0.0022	0.0021
127	0.0043	0.0022	0.0021
128	0.0043	0.0022	0.0021
129	0.0044	0.0022	0.0022
130	0.0044	0.0022	0.0022
131	0.0045	0.0023	0.0022
132	0.0045	0.0023	0.0022
133	0.0045	0.0023	0.0022
134	0.0046	0.0023	0.0023
135	0.0046	0.0023	0.0023
136	0.0047	0.0024	0.0023
137	0.0047	0.0024	0.0023
138	0.0048	0.0024	0.0023
139	0.0048	0.0024	0.0024
140	0.0049	0.0025	0.0024
141	0.0049	0.0025	0.0024
142	0.0050	0.0025	0.0024
143	0.0050	0.0026	0.0025
144	0.0051	0.0026	0.0025
145	0.0052	0.0026	0.0026
146	0.0052	0.0027	0.0026
147	0.0053	0.0027	0.0026
148	0.0054	0.0027	0.0026
149	0.0055	0.0028	0.0027
150	0.0055	0.0028	0.0027
151	0.0056	0.0028	0.0028
152	0.0057	0.0029	0.0028
153	0.0058	0.0029	0.0028
154	0.0058	0.0030	0.0029
155	0.0059	0.0030	0.0029
156	0.0060	0.0030	0.0030
157	0.0061	0.0031	0.0030
158	0.0062	0.0031	0.0030
159	0.0063	0.0032	0.0031
160	0.0064	0.0032	0.0031
161	0.0065	0.0033	0.0032
162	0.0066	0.0034	0.0033
163	0.0068	0.0034	0.0033
164	0.0069	0.0035	0.0034
165	0.0070	0.0036	0.0035
166	0.0071	0.0036	0.0035
167	0.0074	0.0037	0.0036
168	0.0075	0.0038	0.0037
169	0.0077	0.0039	0.0038
170	0.0078	0.0040	0.0039
171	0.0081	0.0041	0.0040

172	0.0082	0.0042	0.0041
173	0.0085	0.0043	0.0042
174	0.0087	0.0044	0.0043
175	0.0091	0.0046	0.0045
176	0.0093	0.0047	0.0046
177	0.0097	0.0049	0.0048
178	0.0099	0.0050	0.0049
179	0.0105	0.0053	0.0052
180	0.0108	0.0055	0.0053
181	0.0114	0.0058	0.0056
182	0.0118	0.0060	0.0058
183	0.0127	0.0064	0.0063
184	0.0132	0.0067	0.0065
185	0.0099	0.0050	0.0049
186	0.0105	0.0053	0.0052
187	0.0122	0.0062	0.0060
188	0.0133	0.0068	0.0066
189	0.0166	0.0084	0.0082
190	0.0191	0.0097	0.0094
191	0.0290	0.0147	0.0143
192	0.0421	0.0213	0.0207
193	0.1820	0.0355	0.1465
194	0.0228	0.0116	0.0112
195	0.0147	0.0075	0.0073
196	0.0113	0.0057	0.0056
197	0.0138	0.0070	0.0068
198	0.0122	0.0062	0.0060
199	0.0111	0.0056	0.0055
200	0.0102	0.0052	0.0050
201	0.0095	0.0048	0.0047
202	0.0089	0.0045	0.0044
203	0.0084	0.0043	0.0041
204	0.0080	0.0040	0.0039
205	0.0076	0.0038	0.0037
206	0.0072	0.0037	0.0036
207	0.0070	0.0035	0.0034
208	0.0067	0.0034	0.0033
209	0.0065	0.0033	0.0032
210	0.0062	0.0032	0.0031
211	0.0061	0.0031	0.0030
212	0.0059	0.0030	0.0029
213	0.0057	0.0029	0.0028
214	0.0056	0.0028	0.0027
215	0.0054	0.0027	0.0027
216	0.0053	0.0027	0.0026
217	0.0051	0.0026	0.0025
218	0.0050	0.0025	0.0025
219	0.0049	0.0025	0.0024
220	0.0048	0.0024	0.0024
221	0.0047	0.0024	0.0023
222	0.0046	0.0023	0.0023
223	0.0045	0.0023	0.0022
224	0.0044	0.0022	0.0022
225	0.0044	0.0022	0.0021

226	0.0043	0.0022	0.0021
227	0.0042	0.0021	0.0021
228	0.0041	0.0021	0.0020
229	0.0041	0.0021	0.0020
230	0.0040	0.0020	0.0020
231	0.0040	0.0020	0.0019
232	0.0039	0.0020	0.0019
233	0.0038	0.0019	0.0019
234	0.0038	0.0019	0.0019
235	0.0037	0.0019	0.0018
236	0.0037	0.0019	0.0018
237	0.0036	0.0018	0.0018
238	0.0036	0.0018	0.0018
239	0.0036	0.0018	0.0017
240	0.0035	0.0018	0.0017
241	0.0035	0.0018	0.0017
242	0.0034	0.0017	0.0017
243	0.0034	0.0017	0.0017
244	0.0034	0.0017	0.0017
245	0.0033	0.0017	0.0016
246	0.0033	0.0017	0.0016
247	0.0032	0.0016	0.0016
248	0.0032	0.0016	0.0016
249	0.0032	0.0016	0.0016
250	0.0031	0.0016	0.0016
251	0.0031	0.0016	0.0015
252	0.0031	0.0016	0.0015
253	0.0031	0.0016	0.0015
254	0.0030	0.0015	0.0015
255	0.0030	0.0015	0.0015
256	0.0030	0.0015	0.0015
257	0.0029	0.0015	0.0015
258	0.0029	0.0015	0.0014
259	0.0029	0.0015	0.0014
260	0.0029	0.0015	0.0014
261	0.0029	0.0014	0.0014
262	0.0028	0.0014	0.0014
263	0.0028	0.0014	0.0014
264	0.0028	0.0014	0.0014
265	0.0028	0.0014	0.0014
266	0.0027	0.0014	0.0013
267	0.0027	0.0014	0.0013
268	0.0027	0.0014	0.0013
269	0.0027	0.0014	0.0013
270	0.0027	0.0013	0.0013
271	0.0026	0.0013	0.0013
272	0.0026	0.0013	0.0013
273	0.0026	0.0013	0.0013
274	0.0026	0.0013	0.0013
275	0.0026	0.0013	0.0013
276	0.0025	0.0013	0.0013
277	0.0025	0.0013	0.0012
278	0.0025	0.0013	0.0012
279	0.0025	0.0013	0.0012

280	0.0025	0.0013	0.0012
281	0.0025	0.0013	0.0012
282	0.0025	0.0012	0.0012
283	0.0024	0.0012	0.0012
284	0.0024	0.0012	0.0012
285	0.0024	0.0012	0.0012
286	0.0024	0.0012	0.0012
287	0.0024	0.0012	0.0012
288	0.0024	0.0012	0.0012

Total soil rain loss = 0.73(In)
Total effective rainfall = 0.82(In)
Peak flow rate in flood hydrograph = 14.29(CFS)

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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	5.0	10.0	15.0	20.0
0+ 5	0.0001	0.01	Q				
0+10	0.0004	0.05	Q				
0+15	0.0013	0.14	Q				
0+20	0.0027	0.20	Q				
0+25	0.0044	0.24	Q				
0+30	0.0061	0.26	Q				
0+35	0.0080	0.27	Q				
0+40	0.0100	0.29	Q				
0+45	0.0121	0.30	Q				
0+50	0.0142	0.31	Q				
0+55	0.0163	0.31	Q				
1+ 0	0.0185	0.32	Q				
1+ 5	0.0207	0.32	Q				
1+10	0.0230	0.33	Q				
1+15	0.0253	0.33	Q				
1+20	0.0276	0.33	Q				
1+25	0.0299	0.34	Q				
1+30	0.0322	0.34	Q				
1+35	0.0346	0.34	Q				
1+40	0.0369	0.34	Q				
1+45	0.0393	0.35	Q				
1+50	0.0417	0.35	QV				
1+55	0.0441	0.35	QV				
2+ 0	0.0465	0.35	QV				
2+ 5	0.0489	0.35	QV				
2+10	0.0514	0.35	QV				
2+15	0.0538	0.35	QV				
2+20	0.0562	0.35	QV				
2+25	0.0587	0.36	QV				
2+30	0.0611	0.36	QV				

2+35	0.0636	0.36	QV				
2+40	0.0661	0.36	QV				
2+45	0.0686	0.36	QV				
2+50	0.0711	0.36	QV				
2+55	0.0735	0.36	QV				
3+ 0	0.0761	0.36	QV				
3+ 5	0.0786	0.37	QV				
3+10	0.0811	0.37	Q V				
3+15	0.0836	0.37	Q V				
3+20	0.0862	0.37	Q V				
3+25	0.0887	0.37	Q V				
3+30	0.0913	0.37	Q V				
3+35	0.0939	0.37	Q V				
3+40	0.0964	0.37	Q V				
3+45	0.0990	0.38	Q V				
3+50	0.1016	0.38	Q V				
3+55	0.1042	0.38	Q V				
4+ 0	0.1069	0.38	Q V				
4+ 5	0.1095	0.38	Q V				
4+10	0.1121	0.38	Q V				
4+15	0.1148	0.38	Q V				
4+20	0.1174	0.39	Q V				
4+25	0.1201	0.39	Q V				
4+30	0.1228	0.39	Q V				
4+35	0.1255	0.39	Q V				
4+40	0.1282	0.39	Q V				
4+45	0.1309	0.39	Q V				
4+50	0.1336	0.40	Q V				
4+55	0.1364	0.40	Q V				
5+ 0	0.1391	0.40	Q V				
5+ 5	0.1419	0.40	Q V				
5+10	0.1446	0.40	Q V				
5+15	0.1474	0.40	Q V				
5+20	0.1502	0.41	Q V				
5+25	0.1530	0.41	Q V				
5+30	0.1558	0.41	Q V				
5+35	0.1587	0.41	Q V				
5+40	0.1615	0.41	Q V				
5+45	0.1643	0.41	Q V				
5+50	0.1672	0.42	Q V				
5+55	0.1701	0.42	Q V				
6+ 0	0.1730	0.42	Q V				
6+ 5	0.1759	0.42	Q V				
6+10	0.1788	0.42	Q V				
6+15	0.1817	0.43	Q V				
6+20	0.1847	0.43	Q V				
6+25	0.1876	0.43	Q V				
6+30	0.1906	0.43	Q V				
6+35	0.1936	0.43	Q V				
6+40	0.1966	0.44	Q V				
6+45	0.1996	0.44	Q V				
6+50	0.2027	0.44	Q V				
6+55	0.2057	0.44	Q V				
7+ 0	0.2088	0.44	Q V				

7+ 5	0.2118	0.45	Q	V	|	|	|	|
7+10	0.2149	0.45	Q	V	|	|	|	|
7+15	0.2180	0.45	Q	V	|	|	|	|
7+20	0.2212	0.45	Q	V	|	|	|	|
7+25	0.2243	0.46	Q	V	|	|	|	|
7+30	0.2275	0.46	Q	V	|	|	|	|
7+35	0.2306	0.46	Q	V	|	|	|	|
7+40	0.2338	0.46	Q	V	|	|	|	|
7+45	0.2370	0.47	Q	V	|	|	|	|
7+50	0.2403	0.47	Q	V	|	|	|	|
7+55	0.2435	0.47	Q	V	|	|	|	|
8+ 0	0.2468	0.47	Q	V	|	|	|	|
8+ 5	0.2501	0.48	Q	V	|	|	|	|
8+10	0.2533	0.48	Q	V	|	|	|	|
8+15	0.2567	0.48	Q	V	|	|	|	|
8+20	0.2600	0.48	Q	V	|	|	|	|
8+25	0.2634	0.49	Q	V	|	|	|	|
8+30	0.2667	0.49	Q	V	|	|	|	|
8+35	0.2701	0.49	Q	V	|	|	|	|
8+40	0.2736	0.50	Q	V	|	|	|	|
8+45	0.2770	0.50	Q	V	|	|	|	|
8+50	0.2804	0.50	|Q	V	|	|	|	|
8+55	0.2839	0.51	|Q	V	|	|	|	|
9+ 0	0.2874	0.51	|Q	V	|	|	|	|
9+ 5	0.2910	0.51	|Q	V	|	|	|	|
9+10	0.2945	0.52	|Q	V	|	|	|	|
9+15	0.2981	0.52	|Q	V	|	|	|	|
9+20	0.3017	0.52	|Q	V	|	|	|	|
9+25	0.3053	0.53	|Q	V	|	|	|	|
9+30	0.3089	0.53	|Q	V	|	|	|	|
9+35	0.3126	0.53	|Q	V	|	|	|	|
9+40	0.3163	0.54	|Q	V	|	|	|	|
9+45	0.3200	0.54	|Q	V	|	|	|	|
9+50	0.3238	0.54	|Q	V	|	|	|	|
9+55	0.3275	0.55	|Q	V	|	|	|	|
10+ 0	0.3313	0.55	|Q	V	|	|	|	|
10+ 5	0.3352	0.56	|Q	V	|	|	|	|
10+10	0.3390	0.56	|Q	V	|	|	|	|
10+15	0.3429	0.56	|Q	V	|	|	|	|
10+20	0.3468	0.57	|Q	V	|	|	|	|
10+25	0.3508	0.57	|Q	V	|	|	|	|
10+30	0.3548	0.58	|Q	V	|	|	|	|
10+35	0.3588	0.58	|Q	V	|	|	|	|
10+40	0.3628	0.59	|Q	V	|	|	|	|
10+45	0.3669	0.59	|Q	V	|	|	|	|
10+50	0.3710	0.60	|Q	V	|	|	|	|
10+55	0.3752	0.60	|Q	V	|	|	|	|
11+ 0	0.3794	0.61	|Q	V	|	|	|	|
11+ 5	0.3836	0.61	|Q	V	|	|	|	|
11+10	0.3878	0.62	|Q	V	|	|	|	|
11+15	0.3921	0.62	|Q	V	|	|	|	|
11+20	0.3965	0.63	|Q	V	|	|	|	|
11+25	0.4009	0.64	|Q	V	|	|	|	|
11+30	0.4053	0.64	|Q	V	|	|	|	|

11+35	0.4097	0.65	|Q	V	|	|	|
11+40	0.4142	0.65	|Q	V	|	|	|
11+45	0.4188	0.66	|Q	V	|	|	|
11+50	0.4234	0.67	|Q	V	|	|	|
11+55	0.4280	0.67	|Q	V	|	|	|
12+ 0	0.4327	0.68	|Q	V	|	|	|
12+ 5	0.4375	0.69	|Q	V	|	|	|
12+10	0.4423	0.70	|Q	|V	|	|	|
12+15	0.4472	0.71	|Q	|V	|	|	|
12+20	0.4521	0.72	|Q	|V	|	|	|
12+25	0.4571	0.73	|Q	|V	|	|	|
12+30	0.4622	0.74	|Q	|V	|	|	|
12+35	0.4673	0.74	|Q	|V	|	|	|
12+40	0.4725	0.75	|Q	|V	|	|	|
12+45	0.4778	0.76	|Q	|V	|	|	|
12+50	0.4831	0.77	|Q	| V	|	|	|
12+55	0.4885	0.78	|Q	| V	|	|	|
13+ 0	0.4940	0.80	|Q	| V	|	|	|
13+ 5	0.4995	0.81	|Q	| V	|	|	|
13+10	0.5052	0.82	|Q	| V	|	|	|
13+15	0.5109	0.83	|Q	| V	|	|	|
13+20	0.5167	0.84	|Q	| V	|	|	|
13+25	0.5226	0.86	|Q	| V	|	|	|
13+30	0.5286	0.87	|Q	| V	|	|	|
13+35	0.5347	0.89	|Q	| V	|	|	|
13+40	0.5409	0.90	|Q	| V	|	|	|
13+45	0.5472	0.92	|Q	| V	|	|	|
13+50	0.5536	0.93	|Q	| V	|	|	|
13+55	0.5602	0.95	|Q	| V	|	|	|
14+ 0	0.5669	0.97	|Q	| V	|	|	|
14+ 5	0.5737	0.99	|Q	| V	|	|	|
14+10	0.5806	1.01	| Q	| V	|	|	|
14+15	0.5877	1.03	| Q	| V	|	|	|
14+20	0.5950	1.06	| Q	| V	|	|	|
14+25	0.6025	1.08	| Q	| V	|	|	|
14+30	0.6101	1.11	| Q	| V	|	|	|
14+35	0.6179	1.14	| Q	| V	|	|	|
14+40	0.6260	1.17	| Q	| V	|	|	|
14+45	0.6343	1.20	| Q	| V	|	|	|
14+50	0.6428	1.24	| Q	| V	|	|	|
14+55	0.6516	1.28	| Q	| V	|	|	|
15+ 0	0.6607	1.32	| Q	| V	|	|	|
15+ 5	0.6701	1.37	| Q	| V	|	|	|
15+10	0.6799	1.42	| Q	| V	|	|	|
15+15	0.6901	1.48	| Q	| V	|	|	|
15+20	0.7008	1.55	| Q	| V	|	|	|
15+25	0.7120	1.62	| Q	| V	|	|	|
15+30	0.7232	1.63	| Q	| V	|	|	|
15+35	0.7339	1.55	| Q	| V	|	|	|
15+40	0.7445	1.55	| Q	| V	|	|	|
15+45	0.7558	1.64	| Q	| V	|	|	|
15+50	0.7681	1.78	| Q	| V|	|	|	|
15+55	0.7821	2.03	| Q	| V|	|	|	|
16+ 0	0.7989	2.45	| Q	| V|	|	|	|

```
16+ 5    0.8266    4.02  |       Q |         V         |         |
16+10    0.8832    8.22  |         |     Q   |V        |         |
16+15    0.9816   14.29  |         |         |   V   Q |         |
16+20    1.0524   10.27  |         |         Q     V   |         |
16+25    1.0973    6.52  |         |  Q      |      V  |         |
16+30    1.1311    4.91  |        Q|         |       V |         |
16+35    1.1589    4.03  |       Q |         |       V |         |
16+40    1.1828    3.47  |     Q   |         |        V|         |
16+45    1.2035    3.01  |     Q   |         |        V|         |
16+50    1.2214    2.59  |    Q    |         |         V         |
16+55    1.2374    2.34  |   Q     |         |         V         |
17+ 0    1.2519    2.10  |   Q     |         |         |V        |
17+ 5    1.2650    1.90  |  Q      |         |         |V        |
17+10    1.2769    1.73  |  Q      |         |         |V        |
17+15    1.2878    1.57  |  Q      |         |         | V       |
17+20    1.2976    1.43  | Q       |         |         | V       |
17+25    1.3066    1.29  | Q       |         |         | V       |
17+30    1.3152    1.25  | Q       |         |         | V       |
17+35    1.3236    1.21  | Q       |         |         | V       |
17+40    1.3315    1.16  | Q       |         |         |  V      |
17+45    1.3388    1.05  | Q       |         |         |  V      |
17+50    1.3454    0.96  |Q        |         |         |  V      |
17+55    1.3515    0.88  |Q        |         |         |  V      |
18+ 0    1.3573    0.85  |Q        |         |         |  V      |
18+ 5    1.3630    0.82  |Q        |         |         |  V      |
18+10    1.3685    0.80  |Q        |         |         |   V     |
18+15    1.3738    0.77  |Q        |         |         |   V     |
18+20    1.3790    0.75  |Q        |         |         |   V     |
18+25    1.3840    0.73  |Q        |         |         |   V     |
18+30    1.3889    0.71  |Q        |         |         |   V     |
18+35    1.3937    0.70  |Q        |         |         |   V     |
18+40    1.3984    0.68  |Q        |         |         |   V     |
18+45    1.4030    0.67  |Q        |         |         |   V     |
18+50    1.4075    0.65  |Q        |         |         |    V    |
18+55    1.4119    0.64  |Q        |         |         |    V    |
19+ 0    1.4162    0.63  |Q        |         |         |    V    |
19+ 5    1.4204    0.62  |Q        |         |         |    V    |
19+10    1.4246    0.61  |Q        |         |         |    V    |
19+15    1.4287    0.59  |Q        |         |         |    V    |
19+20    1.4327    0.58  |Q        |         |         |    V    |
19+25    1.4367    0.58  |Q        |         |         |    V    |
19+30    1.4406    0.57  |Q        |         |         |    V    |
19+35    1.4444    0.56  |Q        |         |         |    V    |
19+40    1.4482    0.55  |Q        |         |         |     V   |
19+45    1.4519    0.54  |Q        |         |         |     V   |
19+50    1.4556    0.53  |Q        |         |         |     V   |
19+55    1.4593    0.53  |Q        |         |         |     V   |
20+ 0    1.4628    0.52  |Q        |         |         |     V   |
20+ 5    1.4664    0.51  |Q        |         |         |     V   |
20+10    1.4699    0.51  |Q        |         |         |     V   |
20+15    1.4733    0.50  |Q        |         |         |     V   |
20+20    1.4767    0.49  Q         |         |         |     V   |
20+25    1.4801    0.49  Q         |         |         |     V   |
20+30    1.4834    0.48  Q         |         |         |     V   |
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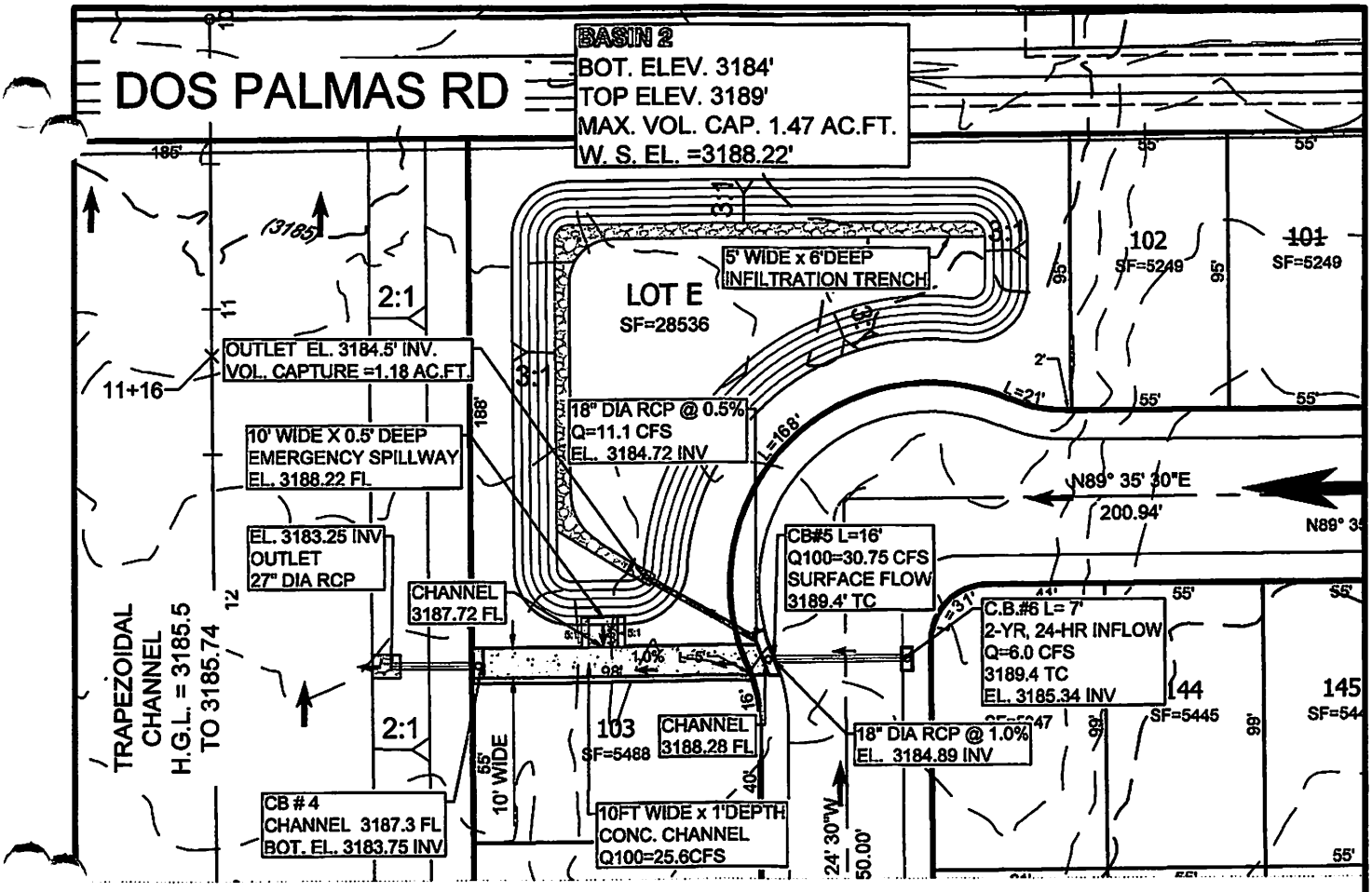
20+35	1.4867	0.48	Q	|	|	|	V |
20+40	1.4899	0.47	Q	|	|	|	V |
20+45	1.4931	0.47	Q	|	|	|	V |
20+50	1.4963	0.46	Q	|	|	|	V |
20+55	1.4994	0.46	Q	|	|	|	V |
21+ 0	1.5026	0.45	Q	|	|	|	V |
21+ 5	1.5056	0.45	Q	|	|	|	V |
21+10	1.5087	0.44	Q	|	|	|	V |
21+15	1.5117	0.44	Q	|	|	|	V |
21+20	1.5147	0.43	Q	|	|	|	V |
21+25	1.5177	0.43	Q	|	|	|	V |
21+30	1.5206	0.43	Q	|	|	|	V |
21+35	1.5235	0.42	Q	|	|	|	V |
21+40	1.5264	0.42	Q	|	|	|	V |
21+45	1.5292	0.41	Q	|	|	|	V |
21+50	1.5321	0.41	Q	|	|	|	V |
21+55	1.5349	0.41	Q	|	|	|	V |
22+ 0	1.5376	0.40	Q	|	|	|	V |
22+ 5	1.5404	0.40	Q	|	|	|	V |
22+10	1.5431	0.40	Q	|	|	|	V |
22+15	1.5459	0.39	Q	|	|	|	V |
22+20	1.5486	0.39	Q	|	|	|	V |
22+25	1.5512	0.39	Q	|	|	|	V |
22+30	1.5539	0.38	Q	|	|	|	V |
22+35	1.5565	0.38	Q	|	|	|	V |
22+40	1.5591	0.38	Q	|	|	|	V |
22+45	1.5617	0.38	Q	|	|	|	V |
22+50	1.5643	0.37	Q	|	|	|	V |
22+55	1.5668	0.37	Q	|	|	|	V |
23+ 0	1.5694	0.37	Q	|	|	|	V|
23+ 5	1.5719	0.37	Q	|	|	|	V|
23+10	1.5744	0.36	Q	|	|	|	V|
23+15	1.5769	0.36	Q	|	|	|	V|
23+20	1.5793	0.36	Q	|	|	|	V|
23+25	1.5818	0.36	Q	|	|	|	V|
23+30	1.5842	0.35	Q	|	|	|	V|
23+35	1.5866	0.35	Q	|	|	|	V|
23+40	1.5890	0.35	Q	|	|	|	V|
23+45	1.5914	0.35	Q	|	|	|	V|
23+50	1.5938	0.34	Q	|	|	|	V|
23+55	1.5961	0.34	Q	|	|	|	V|
24+ 0	**1.5985**	**0.34**	**Q**	|	|	|	**V**|

2-YR, 24-HR
VOLUME= 1.598 AC.FT.
POST-DEVELOPED
(EAST INLET TO BASIN 1)



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BASIN 2 STAGE STORAGE TABLE

ELEV	AREA (sq. ft.)	DEPTH (ft)	AREA (ac. ft.)	VOLUME (ac. ft.)	COML. VOL. (ac. ft.)	VOLUME VOL. (cu. ft.)
3,184.000	8869.3	N/A	0.204			
				0.2209	0.2209	9623
3,185.000	10,377.5	1.000	0.238			
				0.2562	0.4771	20783
3,186.000	11,941.91	1.000	0.274			
				0.2928	0.7699	33536
3,187.000	13,562.89	1.000	0.311			
				0.3306	1.1005	47937
3,188.000	15,240.56	1.000	0.350			
				0.3698	1.4703	64045
3,189.000	16,974.90	1.000	0.390			
					TOTAL VOLUME	64,045

MAX. NET CUML. STORAGE = 1.4703 AC.FT. WATER SURFACE ELEVATION =3189'

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Fax: 928-854-6530

CITY OF VICTORVILLE

TR. 16397

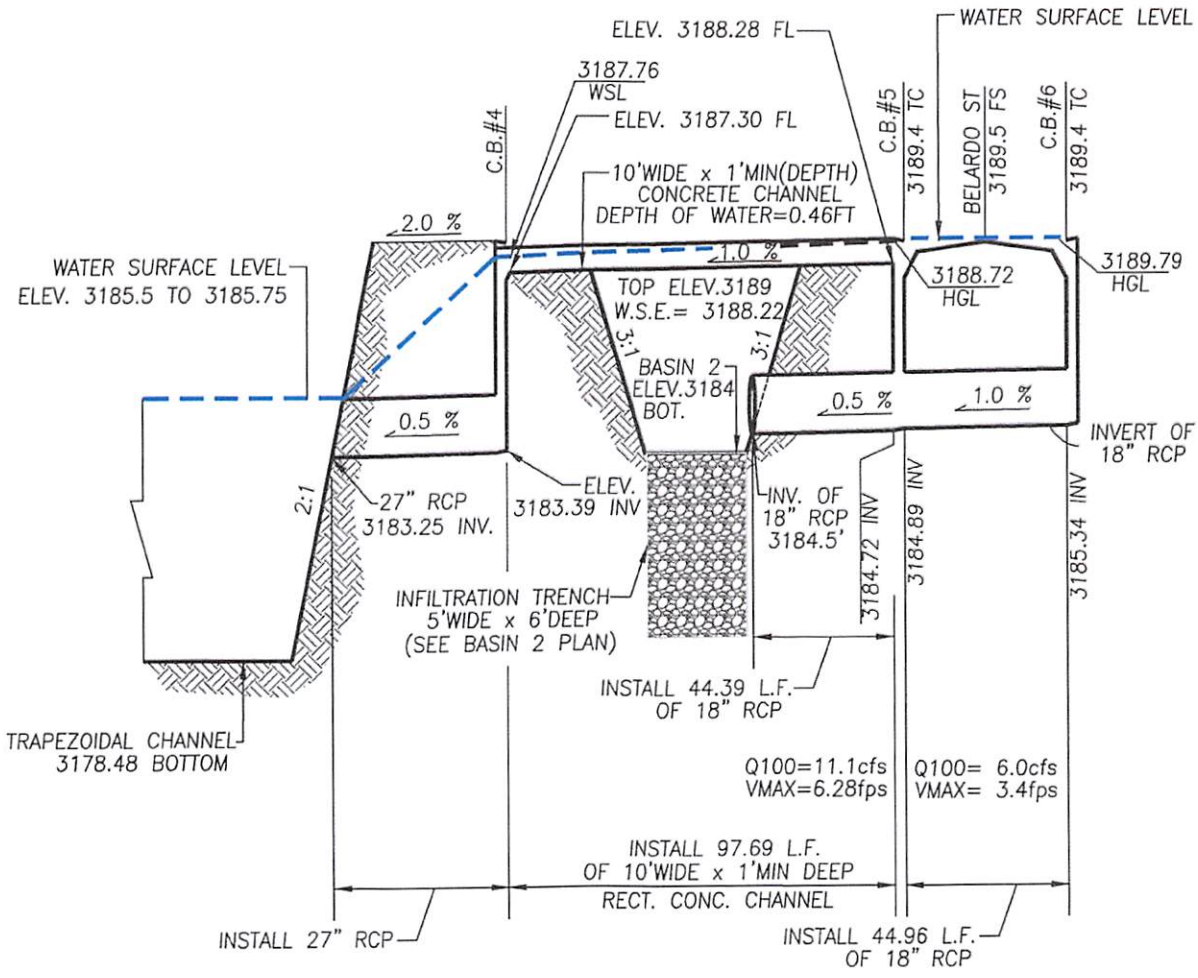
W.Q.M.P. BASIN 2 PLAN

CLIENT: RY PROPERTIES

SCALE 1":60'

SHEET 1 OF 2

DESIGNED BY:	DRAWN BY:	CHECKED BY:	
AG	LC	JF	D-1



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CITY OF VICTORVILLE

TR. 16397

W.Q.M.P. PROFILE - BASIN 2

CLIENT: RY PROPERTIES

SCALE	SHEET
N.T.S.	2 OF 2

DESIGNED BY:	DRAWN BY:	CHECKED BY:	
AG	LC	JF	D-1

U n i t H y d r o g r a p h A n a l y s i s

Study date 04/05/17

++

San Bernardino County Synthetic Unit Hydrology Method
Manual date - August 1986

Program License Serial Number 4070

2-YEAR, 24-HOURS UNIT HYDROGRAPH POST-DEVELOPED CONDITION
TR. 16397, CITY OF VICTORVILLE
AREA A5 TO A7 (EAST OF TRAPEZOIDAL CHANNEL, BASIN 2)
FILE: 16397UNITHYDA5POSTE2YR.OUT

Storm Event Year = 2

Antecedent Moisture Condition = 1

English (in-lb) Input Units Used

English Rainfall Data (Inches) Input Values Used

English Units used in output format

Area averaged rainfall intensity isohyetal data:

Sub-Area (Ac.)	Duration (hours)	Isohyetal (In)
Rainfall data for year 2		
16.89	1	0.38
Rainfall data for year 2		
16.89	6	0.85
Rainfall data for year 2		
16.89	24	1.55

++

******** Area-averaged max loss rate, Fm ********

SCS curve No.(AMCII)	SCS curve NO.(AMC 1)	Area (Ac.)	Area Fraction	Fp(Fig C6) (In/Hr)	Ap (dec.)	Fm (In/Hr)
32.0	16.6	16.89	1.000	1.000	0.459	0.459

Area-averaged adjusted loss rate Fm (In/Hr) = 0.459

********* Area-Averaged low loss rate fraction, Yb **********

Area (Ac.)	Area Fract	SCS CN (AMC2)	SCS CN (AMC1)	S	Pervious Yield Fr
7.75	0.459	32.0	16.6	7.75	0.000
9.14	0.541	98.0	98.0	0.20	0.858

Area-averaged catchment yield fraction, Y = 0.464
Area-averaged low loss fraction, Yb = 0.536
User entry of time of concentration = 0.271 (hours)
++
Watershed area = 16.89(Ac.)
Catchment Lag time = 0.216 hours
Unit interval = 5.000 minutes
Unit interval percentage of lag time = 38.5089
Hydrograph baseflow = 0.00(CFS)
Average maximum watershed loss rate(Fm) = 0.459(In/Hr)
Average low loss rate fraction (Yb) = 0.536 (decimal)
DESERT S-Graph Selected
Computed peak 5-minute rainfall = 0.182(In)
Computed peak 30-minute rainfall = 0.312(In)
Specified peak 1-hour rainfall = 0.384(In)
Computed peak 3-hour rainfall = 0.623(In)
Specified peak 6-hour rainfall = 0.846(In)
Specified peak 24-hour rainfall = 1.550(In)

Rainfall depth area reduction factors:
Using a total area of 16.89(Ac.) (Ref: fig. E-4)

5-minute factor = 0.999 Adjusted rainfall = 0.182(In)
30-minute factor = 0.999 Adjusted rainfall = 0.312(In)
1-hour factor = 0.999 Adjusted rainfall = 0.384(In)
3-hour factor = 1.000 Adjusted rainfall = 0.623(In)
6-hour factor = 1.000 Adjusted rainfall = 0.846(In)
24-hour factor = 1.000 Adjusted rainfall = 1.550(In)

U n i t H y d r o g r a p h
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Interval Number	'S' Graph Mean values	Unit Hydrograph ((CFS))
(K = 204.26 (CFS))		
1	2.588	5.286
2	17.032	29.504
3	46.914	61.039

4	64.092	35.088
5	73.522	19.262
6	79.820	12.864
7	84.274	9.097
8	87.782	7.167
9	90.315	5.174
10	92.354	4.163
11	94.019	3.401
12	95.342	2.702
13	96.415	2.193
14	97.258	1.721
15	97.872	1.254
16	98.276	0.826
17	98.725	0.917
18	99.187	0.944
19	99.574	0.791
20	99.818	0.499
21	100.000	0.371

Peak Unit Number	Adjusted mass rainfall (In)	Unit rainfall (In)
1	0.1821	0.1821
2	0.2242	0.0421
3	0.2531	0.0290
4	0.2760	0.0228
5	0.2951	0.0191
6	0.3117	0.0166
7	0.3264	0.0148
8	0.3398	0.0133
9	0.3520	0.0122
10	0.3633	0.0113
11	0.3738	0.0105
12	0.3837	0.0099
13	0.3975	0.0138
14	0.4107	0.0132
15	0.4234	0.0127
16	0.4357	0.0122
17	0.4475	0.0118
18	0.4589	0.0114
19	0.4700	0.0111
20	0.4808	0.0108
21	0.4912	0.0105
22	0.5014	0.0102
23	0.5114	0.0099
24	0.5211	0.0097
25	0.5305	0.0095
26	0.5398	0.0093
27	0.5489	0.0091
28	0.5577	0.0089
29	0.5665	0.0087
30	0.5750	0.0085
31	0.5834	0.0084
32	0.5916	0.0082
33	0.5997	0.0081

34	0.6077	0.0080
35	0.6155	0.0078
36	0.6232	0.0077
37	0.6308	0.0076
38	0.6382	0.0075
39	0.6456	0.0074
40	0.6528	0.0072
41	0.6600	0.0071
42	0.6670	0.0070
43	0.6740	0.0070
44	0.6808	0.0069
45	0.6876	0.0068
46	0.6943	0.0067
47	0.7009	0.0066
48	0.7075	0.0065
49	0.7139	0.0065
50	0.7203	0.0064
51	0.7266	0.0063
52	0.7329	0.0062
53	0.7391	0.0062
54	0.7452	0.0061
55	0.7512	0.0061
56	0.7572	0.0060
57	0.7632	0.0059
58	0.7690	0.0059
59	0.7748	0.0058
60	0.7806	0.0058
61	0.7863	0.0057
62	0.7920	0.0057
63	0.7976	0.0056
64	0.8031	0.0056
65	0.8087	0.0055
66	0.8141	0.0055
67	0.8195	0.0054
68	0.8249	0.0054
69	0.8302	0.0053
70	0.8355	0.0053
71	0.8408	0.0052
72	0.8460	0.0052
73	0.8511	0.0051
74	0.8561	0.0051
75	0.8612	0.0050
76	0.8662	0.0050
77	0.8711	0.0050
78	0.8761	0.0049
79	0.8809	0.0049
80	0.8858	0.0049
81	0.8906	0.0048
82	0.8954	0.0048
83	0.9002	0.0048
84	0.9049	0.0047
85	0.9096	0.0047
86	0.9142	0.0047
87	0.9189	0.0046

88	0.9235	0.0046
89	0.9280	0.0046
90	0.9326	0.0045
91	0.9371	0.0045
92	0.9416	0.0045
93	0.9460	0.0045
94	0.9504	0.0044
95	0.9548	0.0044
96	0.9592	0.0044
97	0.9636	0.0044
98	0.9679	0.0043
99	0.9722	0.0043
100	0.9765	0.0043
101	0.9807	0.0043
102	0.9850	0.0042
103	0.9892	0.0042
104	0.9934	0.0042
105	0.9975	0.0042
106	1.0017	0.0041
107	1.0058	0.0041
108	1.0099	0.0041
109	1.0139	0.0041
110	1.0180	0.0041
111	1.0220	0.0040
112	1.0260	0.0040
113	1.0300	0.0040
114	1.0340	0.0040
115	1.0379	0.0040
116	1.0419	0.0039
117	1.0458	0.0039
118	1.0497	0.0039
119	1.0536	0.0039
120	1.0574	0.0039
121	1.0613	0.0038
122	1.0651	0.0038
123	1.0689	0.0038
124	1.0727	0.0038
125	1.0764	0.0038
126	1.0802	0.0038
127	1.0839	0.0037
128	1.0877	0.0037
129	1.0914	0.0037
130	1.0950	0.0037
131	1.0987	0.0037
132	1.1024	0.0037
133	1.1060	0.0036
134	1.1096	0.0036
135	1.1132	0.0036
136	1.1168	0.0036
137	1.1204	0.0036
138	1.1240	0.0036
139	1.1275	0.0036
140	1.1311	0.0035
141	1.1346	0.0035

142	1.1381	0.0035
143	1.1416	0.0035
144	1.1451	0.0035
145	1.1485	0.0035
146	1.1520	0.0035
147	1.1554	0.0034
148	1.1589	0.0034
149	1.1623	0.0034
150	1.1657	0.0034
151	1.1691	0.0034
152	1.1724	0.0034
153	1.1758	0.0034
154	1.1792	0.0034
155	1.1825	0.0033
156	1.1858	0.0033
157	1.1891	0.0033
158	1.1924	0.0033
159	1.1957	0.0033
160	1.1990	0.0033
161	1.2023	0.0033
162	1.2055	0.0033
163	1.2088	0.0032
164	1.2120	0.0032
165	1.2152	0.0032
166	1.2184	0.0032
167	1.2216	0.0032
168	1.2248	0.0032
169	1.2280	0.0032
170	1.2312	0.0032
171	1.2343	0.0032
172	1.2375	0.0031
173	1.2406	0.0031
174	1.2438	0.0031
175	1.2469	0.0031
176	1.2500	0.0031
177	1.2531	0.0031
178	1.2562	0.0031
179	1.2592	0.0031
180	1.2623	0.0031
181	1.2654	0.0031
182	1.2684	0.0030
183	1.2715	0.0030
184	1.2745	0.0030
185	1.2775	0.0030
186	1.2805	0.0030
187	1.2835	0.0030
188	1.2865	0.0030
189	1.2895	0.0030
190	1.2925	0.0030
191	1.2954	0.0030
192	1.2984	0.0030
193	1.3013	0.0029
194	1.3043	0.0029
195	1.3072	0.0029

196	1.3101	0.0029
197	1.3131	0.0029
198	1.3160	0.0029
199	1.3189	0.0029
200	1.3218	0.0029
201	1.3246	0.0029
202	1.3275	0.0029
203	1.3304	0.0029
204	1.3332	0.0029
205	1.3361	0.0029
206	1.3389	0.0028
207	1.3418	0.0028
208	1.3446	0.0028
209	1.3474	0.0028
210	1.3502	0.0028
211	1.3530	0.0028
212	1.3558	0.0028
213	1.3586	0.0028
214	1.3614	0.0028
215	1.3642	0.0028
216	1.3669	0.0028
217	1.3697	0.0028
218	1.3725	0.0028
219	1.3752	0.0027
220	1.3779	0.0027
221	1.3807	0.0027
222	1.3834	0.0027
223	1.3861	0.0027
224	1.3888	0.0027
225	1.3915	0.0027
226	1.3942	0.0027
227	1.3969	0.0027
228	1.3996	0.0027
229	1.4023	0.0027
230	1.4050	0.0027
231	1.4076	0.0027
232	1.4103	0.0027
233	1.4129	0.0027
234	1.4156	0.0026
235	1.4182	0.0026
236	1.4209	0.0026
237	1.4235	0.0026
238	1.4261	0.0026
239	1.4287	0.0026
240	1.4313	0.0026
241	1.4339	0.0026
242	1.4365	0.0026
243	1.4391	0.0026
244	1.4417	0.0026
245	1.4443	0.0026
246	1.4468	0.0026
247	1.4494	0.0026
248	1.4520	0.0026
249	1.4545	0.0026

250	1.4571	0.0025
251	1.4596	0.0025
252	1.4622	0.0025
253	1.4647	0.0025
254	1.4672	0.0025
255	1.4697	0.0025
256	1.4722	0.0025
257	1.4748	0.0025
258	1.4773	0.0025
259	1.4798	0.0025
260	1.4822	0.0025
261	1.4847	0.0025
262	1.4872	0.0025
263	1.4897	0.0025
264	1.4922	0.0025
265	1.4946	0.0025
266	1.4971	0.0025
267	1.4995	0.0025
268	1.5020	0.0025
269	1.5044	0.0024
270	1.5069	0.0024
271	1.5093	0.0024
272	1.5117	0.0024
273	1.5142	0.0024
274	1.5166	0.0024
275	1.5190	0.0024
276	1.5214	0.0024
277	1.5238	0.0024
278	1.5262	0.0024
279	1.5286	0.0024
280	1.5310	0.0024
281	1.5334	0.0024
282	1.5358	0.0024
283	1.5382	0.0024
284	1.5405	0.0024
285	1.5429	0.0024
286	1.5453	0.0024
287	1.5476	0.0024
288	1.5500	0.0024

Unit Period (number)	Unit Rainfall (In)	Unit Soil-Loss (In)	Effective Rainfall (In)
1	0.0024	0.0013	0.0011
2	0.0024	0.0013	0.0011
3	0.0024	0.0013	0.0011
4	0.0024	0.0013	0.0011
5	0.0024	0.0013	0.0011
6	0.0024	0.0013	0.0011
7	0.0024	0.0013	0.0011
8	0.0024	0.0013	0.0011
9	0.0024	0.0013	0.0011
10	0.0024	0.0013	0.0011

11	0.0024	0.0013	0.0011
12	0.0024	0.0013	0.0011
13	0.0024	0.0013	0.0011
14	0.0024	0.0013	0.0011
15	0.0025	0.0013	0.0011
16	0.0025	0.0013	0.0011
17	0.0025	0.0013	0.0011
18	0.0025	0.0013	0.0011
19	0.0025	0.0013	0.0012
20	0.0025	0.0013	0.0012
21	0.0025	0.0013	0.0012
22	0.0025	0.0013	0.0012
23	0.0025	0.0014	0.0012
24	0.0025	0.0014	0.0012
25	0.0025	0.0014	0.0012
26	0.0025	0.0014	0.0012
27	0.0026	0.0014	0.0012
28	0.0026	0.0014	0.0012
29	0.0026	0.0014	0.0012
30	0.0026	0.0014	0.0012
31	0.0026	0.0014	0.0012
32	0.0026	0.0014	0.0012
33	0.0026	0.0014	0.0012
34	0.0026	0.0014	0.0012
35	0.0026	0.0014	0.0012
36	0.0026	0.0014	0.0012
37	0.0026	0.0014	0.0012
38	0.0027	0.0014	0.0012
39	0.0027	0.0014	0.0012
40	0.0027	0.0014	0.0012
41	0.0027	0.0014	0.0012
42	0.0027	0.0014	0.0012
43	0.0027	0.0014	0.0013
44	0.0027	0.0015	0.0013
45	0.0027	0.0015	0.0013
46	0.0027	0.0015	0.0013
47	0.0027	0.0015	0.0013
48	0.0028	0.0015	0.0013
49	0.0028	0.0015	0.0013
50	0.0028	0.0015	0.0013
51	0.0028	0.0015	0.0013
52	0.0028	0.0015	0.0013
53	0.0028	0.0015	0.0013
54	0.0028	0.0015	0.0013
55	0.0028	0.0015	0.0013
56	0.0028	0.0015	0.0013
57	0.0029	0.0015	0.0013
58	0.0029	0.0015	0.0013
59	0.0029	0.0015	0.0013
60	0.0029	0.0015	0.0013
61	0.0029	0.0016	0.0013
62	0.0029	0.0016	0.0014
63	0.0029	0.0016	0.0014
64	0.0029	0.0016	0.0014

65	0.0030	0.0016	0.0014
66	0.0030	0.0016	0.0014
67	0.0030	0.0016	0.0014
68	0.0030	0.0016	0.0014
69	0.0030	0.0016	0.0014
70	0.0030	0.0016	0.0014
71	0.0030	0.0016	0.0014
72	0.0030	0.0016	0.0014
73	0.0031	0.0016	0.0014
74	0.0031	0.0016	0.0014
75	0.0031	0.0017	0.0014
76	0.0031	0.0017	0.0014
77	0.0031	0.0017	0.0015
78	0.0031	0.0017	0.0015
79	0.0032	0.0017	0.0015
80	0.0032	0.0017	0.0015
81	0.0032	0.0017	0.0015
82	0.0032	0.0017	0.0015
83	0.0032	0.0017	0.0015
84	0.0032	0.0017	0.0015
85	0.0033	0.0017	0.0015
86	0.0033	0.0018	0.0015
87	0.0033	0.0018	0.0015
88	0.0033	0.0018	0.0015
89	0.0033	0.0018	0.0015
90	0.0033	0.0018	0.0015
91	0.0034	0.0018	0.0016
92	0.0034	0.0018	0.0016
93	0.0034	0.0018	0.0016
94	0.0034	0.0018	0.0016
95	0.0034	0.0018	0.0016
96	0.0035	0.0019	0.0016
97	0.0035	0.0019	0.0016
98	0.0035	0.0019	0.0016
99	0.0035	0.0019	0.0016
100	0.0035	0.0019	0.0016
101	0.0036	0.0019	0.0017
102	0.0036	0.0019	0.0017
103	0.0036	0.0019	0.0017
104	0.0036	0.0019	0.0017
105	0.0037	0.0020	0.0017
106	0.0037	0.0020	0.0017
107	0.0037	0.0020	0.0017
108	0.0037	0.0020	0.0017
109	0.0038	0.0020	0.0017
110	0.0038	0.0020	0.0017
111	0.0038	0.0020	0.0018
112	0.0038	0.0020	0.0018
113	0.0039	0.0021	0.0018
114	0.0039	0.0021	0.0018
115	0.0039	0.0021	0.0018
116	0.0039	0.0021	0.0018
117	0.0040	0.0021	0.0018
118	0.0040	0.0021	0.0019

119	0.0040	0.0022	0.0019
120	0.0041	0.0022	0.0019
121	0.0041	0.0022	0.0019
122	0.0041	0.0022	0.0019
123	0.0042	0.0022	0.0019
124	0.0042	0.0022	0.0019
125	0.0042	0.0023	0.0020
126	0.0043	0.0023	0.0020
127	0.0043	0.0023	0.0020
128	0.0043	0.0023	0.0020
129	0.0044	0.0023	0.0020
130	0.0044	0.0024	0.0020
131	0.0045	0.0024	0.0021
132	0.0045	0.0024	0.0021
133	0.0045	0.0024	0.0021
134	0.0046	0.0024	0.0021
135	0.0046	0.0025	0.0021
136	0.0047	0.0025	0.0022
137	0.0047	0.0025	0.0022
138	0.0048	0.0025	0.0022
139	0.0048	0.0026	0.0022
140	0.0049	0.0026	0.0023
141	0.0049	0.0026	0.0023
142	0.0050	0.0027	0.0023
143	0.0050	0.0027	0.0023
144	0.0051	0.0027	0.0024
145	0.0052	0.0028	0.0024
146	0.0052	0.0028	0.0024
147	0.0053	0.0029	0.0025
148	0.0054	0.0029	0.0025
149	0.0055	0.0029	0.0025
150	0.0055	0.0030	0.0026
151	0.0056	0.0030	0.0026
152	0.0057	0.0030	0.0026
153	0.0058	0.0031	0.0027
154	0.0058	0.0031	0.0027
155	0.0059	0.0032	0.0028
156	0.0060	0.0032	0.0028
157	0.0061	0.0033	0.0028
158	0.0062	0.0033	0.0029
159	0.0063	0.0034	0.0029
160	0.0064	0.0034	0.0030
161	0.0065	0.0035	0.0030
162	0.0066	0.0035	0.0031
163	0.0068	0.0036	0.0031
164	0.0069	0.0037	0.0032
165	0.0070	0.0038	0.0033
166	0.0071	0.0038	0.0033
167	0.0074	0.0039	0.0034
168	0.0075	0.0040	0.0035
169	0.0077	0.0041	0.0036
170	0.0078	0.0042	0.0036
171	0.0081	0.0043	0.0038
172	0.0082	0.0044	0.0038

173	0.0085	0.0046	0.0040
174	0.0087	0.0047	0.0040
175	0.0091	0.0049	0.0042
176	0.0093	0.0050	0.0043
177	0.0097	0.0052	0.0045
178	0.0099	0.0053	0.0046
179	0.0105	0.0056	0.0049
180	0.0108	0.0058	0.0050
181	0.0114	0.0061	0.0053
182	0.0118	0.0063	0.0055
183	0.0127	0.0068	0.0059
184	0.0132	0.0071	0.0061
185	0.0099	0.0053	0.0046
186	0.0105	0.0056	0.0049
187	0.0122	0.0065	0.0057
188	0.0133	0.0072	0.0062
189	0.0166	0.0089	0.0077
190	0.0191	0.0102	0.0089
191	0.0290	0.0155	0.0135
192	0.0421	0.0226	0.0195
193	0.1821	0.0382	0.1438
194	0.0228	0.0122	0.0106
195	0.0148	0.0079	0.0068
196	0.0113	0.0061	0.0052
197	0.0138	0.0074	0.0064
198	0.0122	0.0066	0.0057
199	0.0111	0.0059	0.0051
200	0.0102	0.0055	0.0047
201	0.0095	0.0051	0.0044
202	0.0089	0.0048	0.0041
203	0.0084	0.0045	0.0039
204	0.0080	0.0043	0.0037
205	0.0076	0.0041	0.0035
206	0.0072	0.0039	0.0034
207	0.0070	0.0037	0.0032
208	0.0067	0.0036	0.0031
209	0.0065	0.0035	0.0030
210	0.0062	0.0033	0.0029
211	0.0061	0.0032	0.0028
212	0.0059	0.0031	0.0027
213	0.0057	0.0031	0.0026
214	0.0056	0.0030	0.0026
215	0.0054	0.0029	0.0025
216	0.0053	0.0028	0.0025
217	0.0051	0.0027	0.0024
218	0.0050	0.0027	0.0023
219	0.0049	0.0026	0.0023
220	0.0048	0.0026	0.0022
221	0.0047	0.0025	0.0022
222	0.0046	0.0025	0.0021
223	0.0045	0.0024	0.0021
224	0.0044	0.0024	0.0021
225	0.0044	0.0023	0.0020
226	0.0043	0.0023	0.0020

227	0.0042	0.0023	0.0020
228	0.0041	0.0022	0.0019
229	0.0041	0.0022	0.0019
230	0.0040	0.0022	0.0019
231	0.0040	0.0021	0.0018
232	0.0039	0.0021	0.0018
233	0.0038	0.0021	0.0018
234	0.0038	0.0020	0.0018
235	0.0037	0.0020	0.0017
236	0.0037	0.0020	0.0017
237	0.0036	0.0020	0.0017
238	0.0036	0.0019	0.0017
239	0.0036	0.0019	0.0016
240	0.0035	0.0019	0.0016
241	0.0035	0.0019	0.0016
242	0.0034	0.0018	0.0016
243	0.0034	0.0018	0.0016
244	0.0034	0.0018	0.0016
245	0.0033	0.0018	0.0015
246	0.0033	0.0018	0.0015
247	0.0032	0.0017	0.0015
248	0.0032	0.0017	0.0015
249	0.0032	0.0017	0.0015
250	0.0031	0.0017	0.0015
251	0.0031	0.0017	0.0014
252	0.0031	0.0017	0.0014
253	0.0031	0.0016	0.0014
254	0.0030	0.0016	0.0014
255	0.0030	0.0016	0.0014
256	0.0030	0.0016	0.0014
257	0.0029	0.0016	0.0014
258	0.0029	0.0016	0.0014
259	0.0029	0.0016	0.0013
260	0.0029	0.0015	0.0013
261	0.0029	0.0015	0.0013
262	0.0028	0.0015	0.0013
263	0.0028	0.0015	0.0013
264	0.0028	0.0015	0.0013
265	0.0028	0.0015	0.0013
266	0.0027	0.0015	0.0013
267	0.0027	0.0015	0.0013
268	0.0027	0.0014	0.0013
269	0.0027	0.0014	0.0012
270	0.0027	0.0014	0.0012
271	0.0026	0.0014	0.0012
272	0.0026	0.0014	0.0012
273	0.0026	0.0014	0.0012
274	0.0026	0.0014	0.0012
275	0.0026	0.0014	0.0012
276	0.0025	0.0014	0.0012
277	0.0025	0.0014	0.0012
278	0.0025	0.0013	0.0012
279	0.0025	0.0013	0.0012
280	0.0025	0.0013	0.0012

281	0.0025	0.0013	0.0011
282	0.0025	0.0013	0.0011
283	0.0024	0.0013	0.0011
284	0.0024	0.0013	0.0011
285	0.0024	0.0013	0.0011
286	0.0024	0.0013	0.0011
287	0.0024	0.0013	0.0011
288	0.0024	0.0013	0.0011

Total soil rain loss = 0.77(In)
Total effective rainfall = 0.78(In)
Peak flow rate in flood hydrograph = 10.43(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	5.0	10.0	15.0	20.0
0+ 5	0.0000	0.01	Q				
0+10	0.0003	0.04	Q				
0+15	0.0010	0.10	Q				
0+20	0.0020	0.14	Q				
0+25	0.0031	0.16	Q				
0+30	0.0044	0.18	Q				
0+35	0.0057	0.19	Q				
0+40	0.0071	0.20	Q				
0+45	0.0085	0.20	Q				
0+50	0.0099	0.21	Q				
0+55	0.0114	0.21	Q				
1+ 0	0.0129	0.22	Q				
1+ 5	0.0144	0.22	Q				
1+10	0.0159	0.22	Q				
1+15	0.0175	0.23	Q				
1+20	0.0190	0.23	Q				
1+25	0.0206	0.23	Q				
1+30	0.0222	0.23	Q				
1+35	0.0238	0.23	Q				
1+40	0.0254	0.23	Q				
1+45	0.0270	0.23	Q				
1+50	0.0286	0.24	QV				
1+55	0.0303	0.24	QV				
2+ 0	0.0319	0.24	QV				
2+ 5	0.0335	0.24	QV				
2+10	0.0352	0.24	QV				
2+15	0.0368	0.24	QV				
2+20	0.0385	0.24	QV				
2+25	0.0401	0.24	QV				
2+30	0.0418	0.24	QV				
2+35	0.0434	0.24	QV				

2+40	0.0451	0.24	QV	|	|	|	|
2+45	0.0468	0.24	QV	|	|	|	|
2+50	0.0485	0.24	QV	|	|	|	|
2+55	0.0502	0.25	QV	|	|	|	|
3+ 0	0.0519	0.25	QV	|	|	|	|
3+ 5	0.0536	0.25	QV	|	|	|	|
3+10	0.0553	0.25	Q V	|	|	|	|
3+15	0.0570	0.25	Q V	|	|	|	|
3+20	0.0587	0.25	Q V	|	|	|	|
3+25	0.0604	0.25	Q V	|	|	|	|
3+30	0.0622	0.25	Q V	|	|	|	|
3+35	0.0639	0.25	Q V	|	|	|	|
3+40	0.0657	0.25	Q V	|	|	|	|
3+45	0.0674	0.25	Q V	|	|	|	|
3+50	0.0692	0.26	Q V	|	|	|	|
3+55	0.0709	0.26	Q V	|	|	|	|
4+ 0	0.0727	0.26	Q V	|	|	|	|
4+ 5	0.0745	0.26	Q V	|	|	|	|
4+10	0.0763	0.26	Q V	|	|	|	|
4+15	0.0781	0.26	Q V	|	|	|	|
4+20	0.0799	0.26	Q V	|	|	|	|
4+25	0.0817	0.26	Q V	|	|	|	|
4+30	0.0835	0.26	Q V	|	|	|	|
4+35	0.0853	0.26	Q V	|	|	|	|
4+40	0.0871	0.27	Q V	|	|	|	|
4+45	0.0890	0.27	Q V	|	|	|	|
4+50	0.0908	0.27	Q V	|	|	|	|
4+55	0.0927	0.27	Q V	|	|	|	|
5+ 0	0.0945	0.27	Q V	|	|	|	|
5+ 5	0.0964	0.27	Q V	|	|	|	|
5+10	0.0983	0.27	Q V	|	|	|	|
5+15	0.1002	0.27	Q V	|	|	|	|
5+20	0.1020	0.27	Q V	|	|	|	|
5+25	0.1039	0.28	Q V	|	|	|	|
5+30	0.1058	0.28	Q V	|	|	|	|
5+35	0.1078	0.28	Q V	|	|	|	|
5+40	0.1097	0.28	Q V	|	|	|	|
5+45	0.1116	0.28	Q V	|	|	|	|
5+50	0.1136	0.28	Q V	|	|	|	|
5+55	0.1155	0.28	Q V	|	|	|	|
6+ 0	0.1175	0.28	Q V	|	|	|	|
6+ 5	0.1194	0.29	Q V	|	|	|	|
6+10	0.1214	0.29	Q V	|	|	|	|
6+15	0.1234	0.29	Q V	|	|	|	|
6+20	0.1254	0.29	Q V	|	|	|	|
6+25	0.1274	0.29	Q V	|	|	|	|
6+30	0.1294	0.29	Q V	|	|	|	|
6+35	0.1314	0.29	Q V	|	|	|	|
6+40	0.1335	0.30	Q V	|	|	|	|
6+45	0.1355	0.30	Q V	|	|	|	|
6+50	0.1375	0.30	Q V	|	|	|	|
6+55	0.1396	0.30	Q V	|	|	|	|
7+ 0	0.1417	0.30	Q V	|	|	|	|
7+ 5	0.1438	0.30	Q V	|	|	|	|

7+10	0.1459	0.30	Q	V	|	|	|	|
7+15	0.1480	0.31	Q	V	|	|	|	|
7+20	0.1501	0.31	Q	V	|	|	|	|
7+25	0.1522	0.31	Q	V	|	|	|	|
7+30	0.1543	0.31	Q	V	|	|	|	|
7+35	0.1565	0.31	Q	V	|	|	|	|
7+40	0.1586	0.31	Q	V	|	|	|	|
7+45	0.1608	0.32	Q	V	|	|	|	|
7+50	0.1630	0.32	Q	V	|	|	|	|
7+55	0.1652	0.32	Q	V	|	|	|	|
8+ 0	0.1674	0.32	Q	V	|	|	|	|
8+ 5	0.1696	0.32	Q	V	|	|	|	|
8+10	0.1719	0.32	Q	V	|	|	|	|
8+15	0.1741	0.33	Q	V	|	|	|	|
8+20	0.1764	0.33	Q	V	|	|	|	|
8+25	0.1786	0.33	Q	V	|	|	|	|
8+30	0.1809	0.33	Q	V	|	|	|	|
8+35	0.1832	0.33	Q	V	|	|	|	|
8+40	0.1855	0.34	Q	V	|	|	|	|
8+45	0.1879	0.34	Q	V	|	|	|	|
8+50	0.1902	0.34	Q	V	|	|	|	|
8+55	0.1926	0.34	Q	V	|	|	|	|
9+ 0	0.1949	0.34	Q	V	|	|	|	|
9+ 5	0.1973	0.35	Q	V	|	|	|	|
9+10	0.1997	0.35	Q	V	|	|	|	|
9+15	0.2022	0.35	Q	V	|	|	|	|
9+20	0.2046	0.35	Q	V	|	|	|	|
9+25	0.2070	0.36	Q	V	|	|	|	|
9+30	0.2095	0.36	Q	V	|	|	|	|
9+35	0.2120	0.36	Q	V	|	|	|	|
9+40	0.2145	0.36	Q	V	|	|	|	|
9+45	0.2170	0.37	Q	V	|	|	|	|
9+50	0.2195	0.37	Q	V	|	|	|	|
9+55	0.2221	0.37	Q	V	|	|	|	|
10+ 0	0.2247	0.37	Q	V	|	|	|	|
10+ 5	0.2273	0.38	Q	V	|	|	|	|
10+10	0.2299	0.38	Q	V	|	|	|	|
10+15	0.2325	0.38	Q	V	|	|	|	|
10+20	0.2352	0.39	Q	V	|	|	|	|
10+25	0.2379	0.39	Q	V	|	|	|	|
10+30	0.2405	0.39	Q	V	|	|	|	|
10+35	0.2433	0.39	Q	V	|	|	|	|
10+40	0.2460	0.40	Q	V	|	|	|	|
10+45	0.2488	0.40	Q	V	|	|	|	|
10+50	0.2516	0.40	Q	V	|	|	|	|
10+55	0.2544	0.41	Q	V	|	|	|	|
11+ 0	0.2572	0.41	Q	V	|	|	|	|
11+ 5	0.2601	0.42	Q	V	|	|	|	|
11+10	0.2629	0.42	Q	V	|	|	|	|
11+15	0.2659	0.42	Q	V	|	|	|	|
11+20	0.2688	0.43	Q	V	|	|	|	|
11+25	0.2718	0.43	Q	V	|	|	|	|
11+30	0.2748	0.43	Q	V	|	|	|	|
11+35	0.2778	0.44	Q	V	|	|	|	|

11+40	0.2808	0.44	Q	V	|	|	|
11+45	0.2839	0.45	Q	V	|	|	|
11+50	0.2870	0.45	Q	V	|	|	|
11+55	0.2902	0.46	Q	V	|	|	|
12+ 0	0.2934	0.46	Q	V	|	|	|
12+ 5	0.2966	0.47	Q	V	|	|	|
12+10	0.2999	0.47	Q	V	|	|	|
12+15	0.3032	0.48	Q	|V	|	|	|
12+20	0.3065	0.49	Q	|V	|	|	|
12+25	0.3099	0.49	Q	|V	|	|	|
12+30	0.3133	0.50	Q	|V	|	|	|
12+35	0.3168	0.51	|Q	|V	|	|	|
12+40	0.3203	0.51	|Q	|V	|	|	|
12+45	0.3239	0.52	|Q	|V	|	|	|
12+50	0.3275	0.53	|Q	|V	|	|	|
12+55	0.3312	0.53	|Q	| V	|	|	|
13+ 0	0.3349	0.54	|Q	| V	|	|	|
13+ 5	0.3387	0.55	|Q	| V	|	|	|
13+10	0.3425	0.56	|Q	| V	|	|	|
13+15	0.3464	0.56	|Q	| V	|	|	|
13+20	0.3503	0.57	|Q	| V	|	|	|
13+25	0.3543	0.58	|Q	| V	|	|	|
13+30	0.3584	0.59	|Q	| V	|	|	|
13+35	0.3626	0.60	|Q	| V	|	|	|
13+40	0.3668	0.61	|Q	| V	|	|	|
13+45	0.3710	0.62	|Q	| V	|	|	|
13+50	0.3754	0.63	|Q	| V	|	|	|
13+55	0.3799	0.65	|Q	| V	|	|	|
14+ 0	0.3844	0.66	|Q	| V	|	|	|
14+ 5	0.3890	0.67	|Q	| V	|	|	|
14+10	0.3937	0.69	|Q	| V	|	|	|
14+15	0.3986	0.70	|Q	| V	|	|	|
14+20	0.4035	0.72	|Q	| V	|	|	|
14+25	0.4086	0.74	|Q	| V	|	|	|
14+30	0.4138	0.75	|Q	| V	|	|	|
14+35	0.4191	0.77	|Q	| V	|	|	|
14+40	0.4246	0.79	|Q	| V	|	|	|
14+45	0.4302	0.82	|Q	| V	|	|	|
14+50	0.4360	0.84	|Q	| V	|	|	|
14+55	0.4420	0.87	|Q	| V	|	|	|
15+ 0	0.4482	0.90	|Q	| V	|	|	|
15+ 5	0.4546	0.93	|Q	| V	|	|	|
15+10	0.4613	0.97	|Q	| V	|	|	|
15+15	0.4683	1.01	| Q	| V	|	|	|
15+20	0.4756	1.06	| Q	| V	|	|	|
15+25	0.4832	1.10	| Q	| V	|	|	|
15+30	0.4907	1.10	| Q	| V	|	|	|
15+35	0.4979	1.05	| Q	| V	|	|	|
15+40	0.5052	1.05	| Q	| V	|	|	|
15+45	0.5129	1.12	| Q	| V	|	|	|
15+50	0.5213	1.22	| Q	| V|	|	|	|
15+55	0.5310	1.40	| Q	| V|	|	|	|
16+ 0	0.5428	1.71	| Q	| V|	|	|	|
16+ 5	0.5628	2.91	| Q	| V	|	|	|

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16+10       0.6073       6.46 |         | Q       | V       |         |
16+15       0.6792      10.43 |         |         Q   V     |         |
16+20       0.7256       6.74 |         |  Q      |     V   |         |
16+25       0.7554       4.33 |       Q |         |      V  |         |
16+30       0.7780       3.27 |     Q   |         |       V |         |
16+35       0.7965       2.69 |    Q    |         |        V|         |
16+40       0.8125       2.33 |   Q     |         |        V|         |
16+45       0.8260       1.96 |  Q      |         |         V         |
16+50       0.8379       1.73 |  Q      |         |         V         |
16+55       0.8485       1.54 |  Q      |         |         V         |
17+ 0       0.8580       1.38 | Q       |         |         |V        |
17+ 5       0.8666       1.24 | Q       |         |         |V        |
17+10       0.8743       1.12 | Q       |         |         |V        |
17+15       0.8813       1.01 | Q       |         |         | V       |
17+20       0.8875       0.91 |Q        |         |         | V       |
17+25       0.8937       0.89 |Q        |         |         | V       |
17+30       0.8995       0.85 |Q        |         |         | V       |
17+35       0.9050       0.80 |Q        |         |         |  V      |
17+40       0.9101       0.73 |Q        |         |         |  V      |
17+45       0.9147       0.68 |Q        |         |         |  V      |
17+50       0.9189       0.61 |Q        |         |         |  V      |
17+55       0.9230       0.59 |Q        |         |         |  V      |
18+ 0       0.9269       0.57 |Q        |         |         |  V      |
18+ 5       0.9306       0.55 |Q        |         |         |  V      |
18+10       0.9343       0.53 |Q        |         |         |   V     |
18+15       0.9379       0.52 |Q        |         |         |   V     |
18+20       0.9413       0.50 |Q        |         |         |   V     |
18+25       0.9447       0.49 Q         |         |         |   V     |
18+30       0.9480       0.48 Q         |         |         |   V     |
18+35       0.9512       0.47 Q         |         |         |   V     |
18+40       0.9544       0.46 Q         |         |         |   V     |
18+45       0.9575       0.45 Q         |         |         |   V     |
18+50       0.9605       0.44 Q         |         |         |    V    |
18+55       0.9634       0.43 Q         |         |         |    V    |
19+ 0       0.9663       0.42 Q         |         |         |    V    |
19+ 5       0.9692       0.41 Q         |         |         |    V    |
19+10       0.9720       0.41 Q         |         |         |    V    |
19+15       0.9747       0.40 Q         |         |         |    V    |
19+20       0.9775       0.39 Q         |         |         |    V    |
19+25       0.9801       0.39 Q         |         |         |    V    |
19+30       0.9827       0.38 Q         |         |         |    V    |
19+35       0.9853       0.38 Q         |         |         |    V    |
19+40       0.9879       0.37 Q         |         |         |     V   |
19+45       0.9904       0.36 Q         |         |         |     V   |
19+50       0.9929       0.36 Q         |         |         |     V   |
19+55       0.9953       0.35 Q         |         |         |     V   |
20+ 0       0.9977       0.35 Q         |         |         |     V   |
20+ 5       1.0001       0.35 Q         |         |         |     V   |
20+10       1.0024       0.34 Q         |         |         |     V   |
20+15       1.0048       0.34 Q         |         |         |     V   |
20+20       1.0071       0.33 Q         |         |         |     V   |
20+25       1.0093       0.33 Q         |         |         |     V   |
20+30       1.0116       0.32 Q         |         |         |     V   |
20+35       1.0138       0.32 Q         |         |         |      V  |
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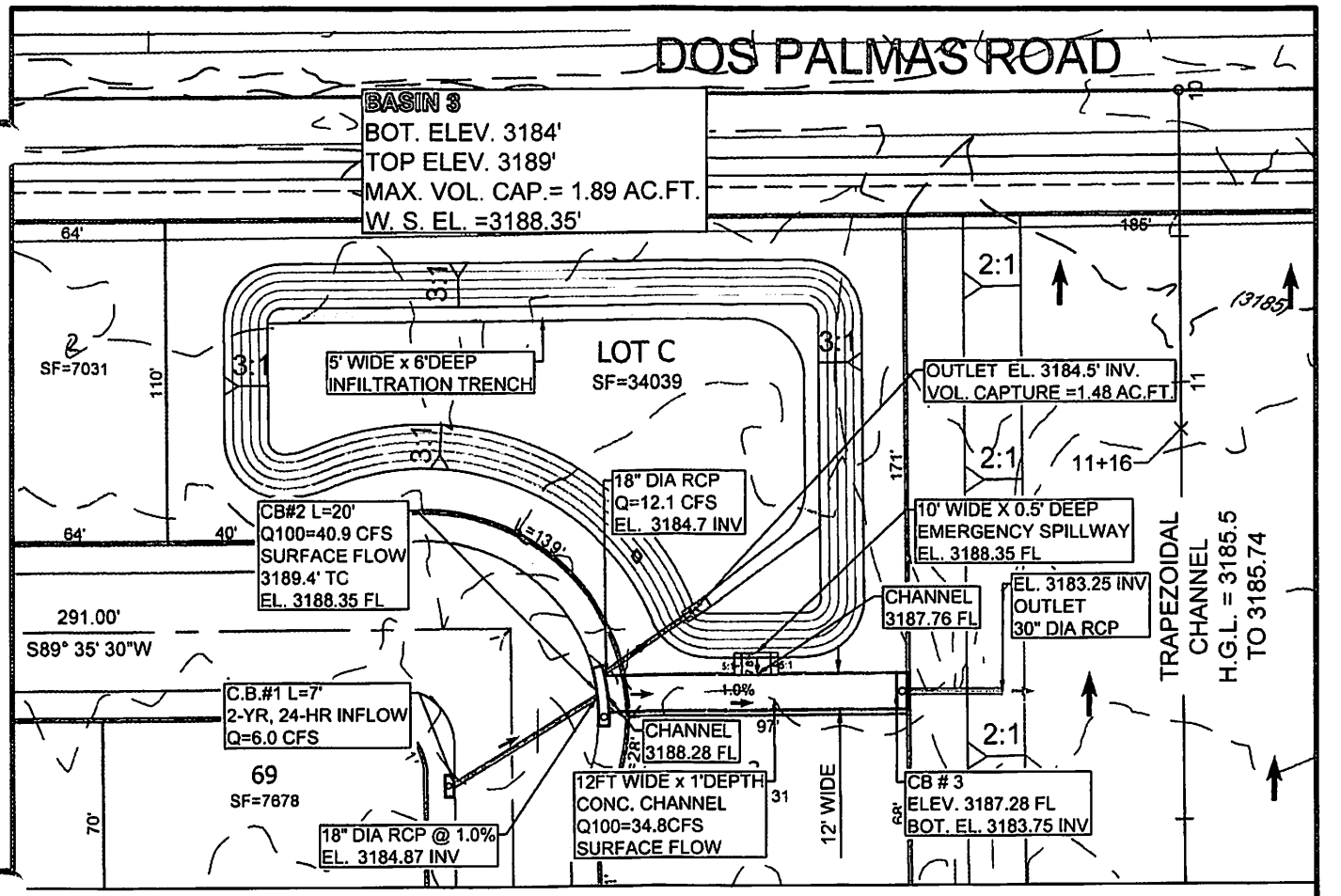
20+40	1.0160	0.32	Q				V
20+45	1.0181	0.31	Q				V
20+50	1.0203	0.31	Q				V
20+55	1.0224	0.31	Q				V
21+ 0	1.0245	0.30	Q				V
21+ 5	1.0266	0.30	Q				V
21+10	1.0286	0.30	Q				V
21+15	1.0306	0.30	Q				V
21+20	1.0327	0.29	Q				V
21+25	1.0347	0.29	Q				V
21+30	1.0366	0.29	Q				V
21+35	1.0386	0.28	Q				V
21+40	1.0405	0.28	Q				V
21+45	1.0425	0.28	Q				V
21+50	1.0444	0.28	Q				V
21+55	1.0463	0.27	Q				V
22+ 0	1.0481	0.27	Q				V
22+ 5	1.0500	0.27	Q				V
22+10	1.0518	0.27	Q				V
22+15	1.0537	0.27	Q				V
22+20	1.0555	0.26	Q				V
22+25	1.0573	0.26	Q				V
22+30	1.0591	0.26	Q				V
22+35	1.0609	0.26	Q				V
22+40	1.0626	0.26	Q				V
22+45	1.0644	0.25	Q				V
22+50	1.0661	0.25	Q				V
22+55	1.0678	0.25	Q				V
23+ 0	1.0695	0.25	Q				V
23+ 5	1.0712	0.25	Q				V
23+10	1.0729	0.24	Q				V
23+15	1.0746	0.24	Q				V
23+20	1.0763	0.24	Q				V
23+25	1.0779	0.24	Q				V
23+30	1.0796	0.24	Q				V
23+35	1.0812	0.24	Q				V
23+40	1.0828	0.24	Q				V
23+45	1.0844	0.23	Q				V
23+50	1.0860	0.23	Q				V
23+55	1.0876	0.23	Q				V
24+ 0	**1.0892**	**0.23**	**Q**				**V**

2-YR, 24-HR
VOLUME = 1.09 AC.FT.
POST-DEVELOPED



BASIN 3 STAGE STORAGE TABLE

ELEV	AREA (sq. ft.)	DEPTH (ft)	AREA (ac. ft.)	VOLUME (ac. ft.)	COML. VOL. (ac. ft.)	VOLUME VOL. (cu. ft.)
3,184.000	12,149.42	N/A	0.279			
				0.2978	0.2978	12972
3,185.000	13,794.24	1.000	0.317			
				0.3362	0.6340	27619
3,186.000	15,499.78	1.000	0.356			
				0.3761	1.0101	44002
3,187.000	17,266.72	1.000	0.396			
				0.4173	1.4275	62180
3,188.000	19,089.76	1.000	0.438			
				0.481	1.8871	82201
3,189.000	20,950.88	1.000	0.481			
					TOTAL VOLUME	82,201

MAX. NET CUML. STORAGE = 1.8871 AC.FT. WATER SURFACE ELEVATION =3188.35

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Phone: 928-680-6060
Fax: 928-854-6530

CITY OF VICTORVILLE

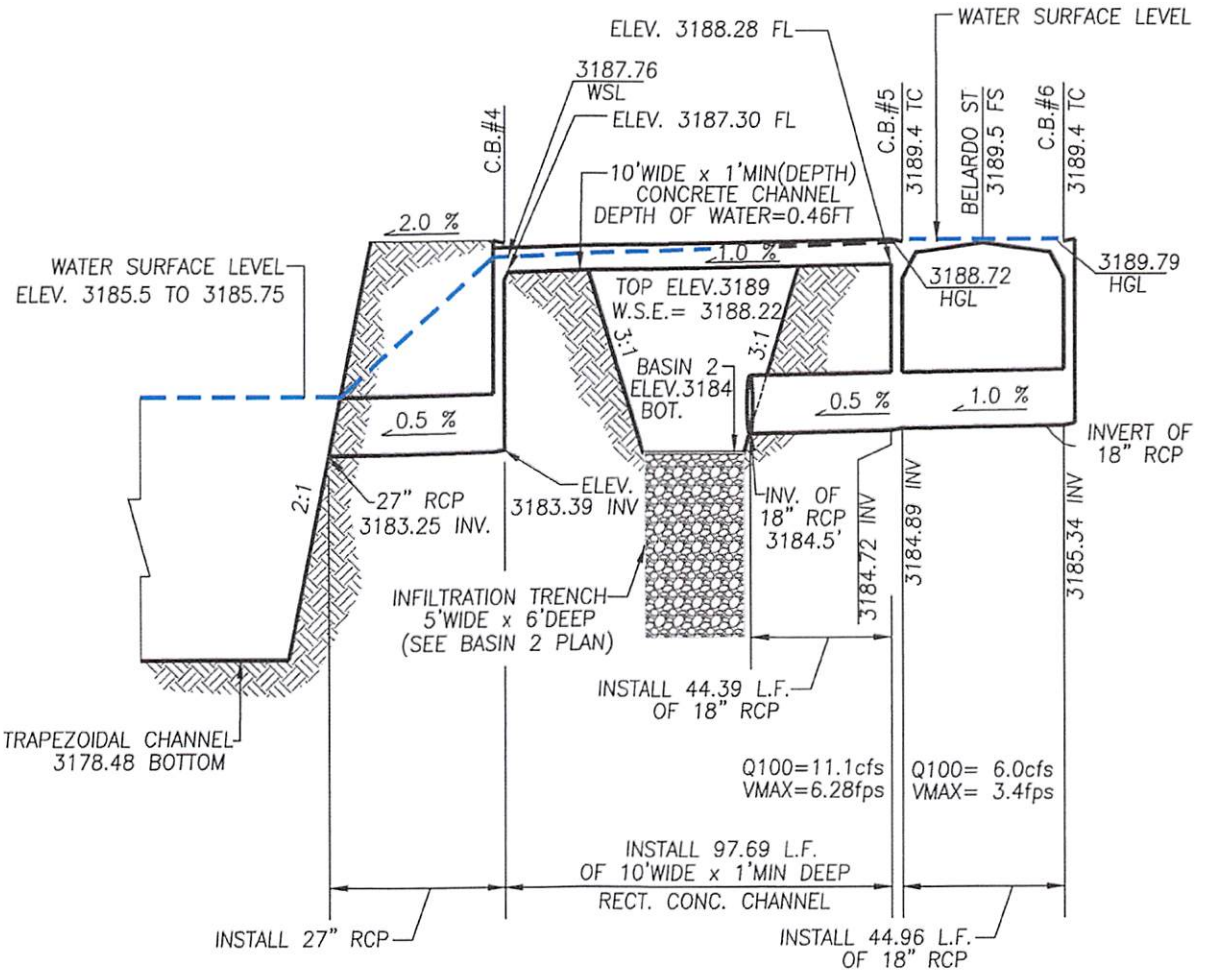
TR. 16397

W.Q.M.P. BASIN 3 PLAN

CLIENT: RY PROPERTIES

SCALE	SHEET
1":60'	1 OF 2

DESIGNED BY:	DRAWN BY:	CHECKED BY:	
AG	LC	JF	D-1



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CITY OF VICTORVILLE

TR. 16397

W.Q.M.P. - BASIN 2

CLIENT: RY PROPERTIES

SCALE	SHEET	
N.T.S.	2 OF 2	
DESIGNED BY: AG	DRAWN BY: LC	CHECKED BY: JF
		D-1

U n i t H y d r o g r a p h A n a l y s i s

Study date 04/05/17

++

San Bernardino County Synthetic Unit Hydrology Method
Manual date - August 1986

Program License Serial Number 4070

2-YEAR, 24-HOURS UNIT HYDROGRAPH POST-DEVELOPED CONDITION
TR. 16397, CITY OF VICTORVILLE
AREA A1 TO A4 (WEST OF TRAPEZOIDAL CHANNEL, BASIN 3)
FILE: 16397UNITHYDA1PSOT2YR.OUT

Storm Event Year = 2

Antecedent Moisture Condition = 1

English (in-lb) Input Units Used

English Rainfall Data (Inches) Input Values Used

English Units used in output format

Area averaged rainfall intensity isohyetal data:

Sub-Area (Ac.)	Duration (hours)	Isohyetal (In)
Rainfall data for year 2		
24.70	1	0.38
Rainfall data for year 2		
24.70	6	0.85
Rainfall data for year 2		
24.70	24	1.55

++

******** Area-averaged max loss rate, Fm ********

SCS curve No.(AMCII)	SCS curve NO.(AMC 1)	Area (Ac.)	Area Fraction	Fp(Fig C6) (In/Hr)	Ap (dec.)	Fm (In/Hr)
32.0	16.6	24.70	1.000	1.000	0.500	0.500

Area-averaged adjusted loss rate Fm (In/Hr) = 0.500

********* Area-Averaged low loss rate fraction, Yb **********

Area (Ac.)	Area Fract	SCS CN (AMC2)	SCS CN (AMC1)	S	Pervious Yield Fr
12.35	0.500	32.0	16.6	7.75	0.000
12.35	0.500	98.0	98.0	0.20	0.858

Area-averaged catchment yield fraction, Y = 0.429
Area-averaged low loss fraction, Yb = 0.571
User entry of time of concentration = 0.345 (hours)
++
Watershed area = 24.70(Ac.)
Catchment Lag time = 0.276 hours
Unit interval = 5.000 minutes
Unit interval percentage of lag time = 30.1644
Hydrograph baseflow = 0.00(CFS)
Average maximum watershed loss rate(Fm) = 0.500(In/Hr)
Average low loss rate fraction (Yb) = 0.571 (decimal)
DESERT S-Graph Selected
Computed peak 5-minute rainfall = 0.182(In)
Computed peak 30-minute rainfall = 0.312(In)
Specified peak 1-hour rainfall = 0.384(In)
Computed peak 3-hour rainfall = 0.623(In)
Specified peak 6-hour rainfall = 0.846(In)
Specified peak 24-hour rainfall = 1.550(In)

Rainfall depth area reduction factors:
Using a total area of 24.70(Ac.) (Ref: fig. E-4)

5-minute factor = 0.999 Adjusted rainfall = 0.182(In)
30-minute factor = 0.999 Adjusted rainfall = 0.312(In)
1-hour factor = 0.999 Adjusted rainfall = 0.384(In)
3-hour factor = 1.000 Adjusted rainfall = 0.623(In)
6-hour factor = 1.000 Adjusted rainfall = 0.846(In)
24-hour factor = 1.000 Adjusted rainfall = 1.550(In)

U n i t H y d r o g r a p h

++

Interval Number	'S' Graph Mean values	Unit Hydrograph ((CFS))
(K = 298.72 (CFS))		
1	1.776	5.306
2	9.519	23.128
3	31.050	64.318

4	52.569	64.281
5	64.487	35.599
6	72.076	22.671
7	77.560	16.380
8	81.657	12.239
9	84.899	9.685
10	87.621	8.130
11	89.700	6.213
12	91.407	5.097
13	92.879	4.398
14	94.135	3.752
15	95.170	3.092
16	96.056	2.647
17	96.819	2.278
18	97.402	1.741
19	97.874	1.410
20	98.182	0.922
21	98.520	1.010
22	98.882	1.081
23	99.244	1.081
24	99.552	0.918
25	99.744	0.574
26	100.000	0.287

Peak Unit Number	Adjusted mass rainfall (In)	Unit rainfall (In)
1	0.1820	0.1820
2	0.2241	0.0421
3	0.2531	0.0290
4	0.2759	0.0228
5	0.2950	0.0191
6	0.3115	0.0166
7	0.3263	0.0147
8	0.3396	0.0133
9	0.3518	0.0122
10	0.3631	0.0113
11	0.3737	0.0105
12	0.3836	0.0099
13	0.3974	0.0138
14	0.4106	0.0132
15	0.4233	0.0127
16	0.4355	0.0122
17	0.4474	0.0118
18	0.4588	0.0114
19	0.4699	0.0111
20	0.4807	0.0108
21	0.4911	0.0105
22	0.5013	0.0102
23	0.5113	0.0099
24	0.5210	0.0097
25	0.5304	0.0095
26	0.5397	0.0093
27	0.5488	0.0091
28	0.5577	0.0089

29	0.5664	0.0087
30	0.5749	0.0085
31	0.5833	0.0084
32	0.5916	0.0082
33	0.5997	0.0081
34	0.6076	0.0080
35	0.6155	0.0078
36	0.6232	0.0077
37	0.6307	0.0076
38	0.6382	0.0075
39	0.6455	0.0074
40	0.6528	0.0072
41	0.6599	0.0071
42	0.6670	0.0070
43	0.6739	0.0070
44	0.6808	0.0069
45	0.6876	0.0068
46	0.6943	0.0067
47	0.7009	0.0066
48	0.7074	0.0065
49	0.7139	0.0065
50	0.7203	0.0064
51	0.7266	0.0063
52	0.7329	0.0062
53	0.7390	0.0062
54	0.7452	0.0061
55	0.7512	0.0061
56	0.7572	0.0060
57	0.7631	0.0059
58	0.7690	0.0059
59	0.7748	0.0058
60	0.7806	0.0058
61	0.7863	0.0057
62	0.7920	0.0057
63	0.7976	0.0056
64	0.8031	0.0056
65	0.8086	0.0055
66	0.8141	0.0055
67	0.8195	0.0054
68	0.8249	0.0054
69	0.8302	0.0053
70	0.8355	0.0053
71	0.8407	0.0052
72	0.8459	0.0052
73	0.8510	0.0051
74	0.8561	0.0051
75	0.8612	0.0050
76	0.8662	0.0050
77	0.8711	0.0050
78	0.8760	0.0049
79	0.8809	0.0049
80	0.8858	0.0049
81	0.8906	0.0048
82	0.8954	0.0048

83	0.9001	0.0048
84	0.9049	0.0047
85	0.9095	0.0047
86	0.9142	0.0047
87	0.9188	0.0046
88	0.9234	0.0046
89	0.9280	0.0046
90	0.9325	0.0045
91	0.9371	0.0045
92	0.9415	0.0045
93	0.9460	0.0045
94	0.9504	0.0044
95	0.9548	0.0044
96	0.9592	0.0044
97	0.9636	0.0044
98	0.9679	0.0043
99	0.9722	0.0043
100	0.9765	0.0043
101	0.9807	0.0043
102	0.9849	0.0042
103	0.9891	0.0042
104	0.9933	0.0042
105	0.9975	0.0042
106	1.0016	0.0041
107	1.0057	0.0041
108	1.0098	0.0041
109	1.0139	0.0041
110	1.0180	0.0041
111	1.0220	0.0040
112	1.0260	0.0040
113	1.0300	0.0040
114	1.0340	0.0040
115	1.0379	0.0040
116	1.0419	0.0039
117	1.0458	0.0039
118	1.0497	0.0039
119	1.0535	0.0039
120	1.0574	0.0039
121	1.0612	0.0038
122	1.0651	0.0038
123	1.0689	0.0038
124	1.0727	0.0038
125	1.0764	0.0038
126	1.0802	0.0038
127	1.0839	0.0037
128	1.0876	0.0037
129	1.0913	0.0037
130	1.0950	0.0037
131	1.0987	0.0037
132	1.1024	0.0037
133	1.1060	0.0036
134	1.1096	0.0036
135	1.1132	0.0036
136	1.1168	0.0036

137	1.1204	0.0036
138	1.1240	0.0036
139	1.1275	0.0036
140	1.1311	0.0035
141	1.1346	0.0035
142	1.1381	0.0035
143	1.1416	0.0035
144	1.1451	0.0035
145	1.1485	0.0035
146	1.1520	0.0035
147	1.1554	0.0034
148	1.1588	0.0034
149	1.1623	0.0034
150	1.1657	0.0034
151	1.1690	0.0034
152	1.1724	0.0034
153	1.1758	0.0034
154	1.1791	0.0034
155	1.1825	0.0033
156	1.1858	0.0033
157	1.1891	0.0033
158	1.1924	0.0033
159	1.1957	0.0033
160	1.1990	0.0033
161	1.2023	0.0033
162	1.2055	0.0033
163	1.2088	0.0032
164	1.2120	0.0032
165	1.2152	0.0032
166	1.2184	0.0032
167	1.2216	0.0032
168	1.2248	0.0032
169	1.2280	0.0032
170	1.2312	0.0032
171	1.2343	0.0032
172	1.2375	0.0031
173	1.2406	0.0031
174	1.2437	0.0031
175	1.2468	0.0031
176	1.2500	0.0031
177	1.2531	0.0031
178	1.2561	0.0031
179	1.2592	0.0031
180	1.2623	0.0031
181	1.2653	0.0031
182	1.2684	0.0030
183	1.2714	0.0030
184	1.2745	0.0030
185	1.2775	0.0030
186	1.2805	0.0030
187	1.2835	0.0030
188	1.2865	0.0030
189	1.2895	0.0030
190	1.2925	0.0030

191	1.2954	0.0030
192	1.2984	0.0030
193	1.3013	0.0029
194	1.3043	0.0029
195	1.3072	0.0029
196	1.3101	0.0029
197	1.3130	0.0029
198	1.3159	0.0029
199	1.3188	0.0029
200	1.3217	0.0029
201	1.3246	0.0029
202	1.3275	0.0029
203	1.3304	0.0029
204	1.3332	0.0029
205	1.3361	0.0029
206	1.3389	0.0028
207	1.3417	0.0028
208	1.3446	0.0028
209	1.3474	0.0028
210	1.3502	0.0028
211	1.3530	0.0028
212	1.3558	0.0028
213	1.3586	0.0028
214	1.3614	0.0028
215	1.3642	0.0028
216	1.3669	0.0028
217	1.3697	0.0028
218	1.3724	0.0028
219	1.3752	0.0027
220	1.3779	0.0027
221	1.3807	0.0027
222	1.3834	0.0027
223	1.3861	0.0027
224	1.3888	0.0027
225	1.3915	0.0027
226	1.3942	0.0027
227	1.3969	0.0027
228	1.3996	0.0027
229	1.4023	0.0027
230	1.4049	0.0027
231	1.4076	0.0027
232	1.4103	0.0027
233	1.4129	0.0027
234	1.4156	0.0026
235	1.4182	0.0026
236	1.4208	0.0026
237	1.4235	0.0026
238	1.4261	0.0026
239	1.4287	0.0026
240	1.4313	0.0026
241	1.4339	0.0026
242	1.4365	0.0026
243	1.4391	0.0026
244	1.4417	0.0026

245	1.4443	0.0026
246	1.4468	0.0026
247	1.4494	0.0026
248	1.4520	0.0026
249	1.4545	0.0026
250	1.4571	0.0025
251	1.4596	0.0025
252	1.4621	0.0025
253	1.4647	0.0025
254	1.4672	0.0025
255	1.4697	0.0025
256	1.4722	0.0025
257	1.4747	0.0025
258	1.4772	0.0025
259	1.4797	0.0025
260	1.4822	0.0025
261	1.4847	0.0025
262	1.4872	0.0025
263	1.4897	0.0025
264	1.4921	0.0025
265	1.4946	0.0025
266	1.4971	0.0025
267	1.4995	0.0025
268	1.5020	0.0025
269	1.5044	0.0024
270	1.5069	0.0024
271	1.5093	0.0024
272	1.5117	0.0024
273	1.5142	0.0024
274	1.5166	0.0024
275	1.5190	0.0024
276	1.5214	0.0024
277	1.5238	0.0024
278	1.5262	0.0024
279	1.5286	0.0024
280	1.5310	0.0024
281	1.5334	0.0024
282	1.5358	0.0024
283	1.5381	0.0024
284	1.5405	0.0024
285	1.5429	0.0024
286	1.5452	0.0024
287	1.5476	0.0024
288	1.5500	0.0024

Unit Period (number)	Unit Rainfall (In)	Unit Soil-Loss (In)	Effective Rainfall (In)
1	0.0024	0.0013	0.0010
2	0.0024	0.0013	0.0010
3	0.0024	0.0014	0.0010
4	0.0024	0.0014	0.0010
5	0.0024	0.0014	0.0010

6	0.0024	0.0014	0.0010
7	0.0024	0.0014	0.0010
8	0.0024	0.0014	0.0010
9	0.0024	0.0014	0.0010
10	0.0024	0.0014	0.0010
11	0.0024	0.0014	0.0010
12	0.0024	0.0014	0.0010
13	0.0024	0.0014	0.0010
14	0.0024	0.0014	0.0010
15	0.0025	0.0014	0.0011
16	0.0025	0.0014	0.0011
17	0.0025	0.0014	0.0011
18	0.0025	0.0014	0.0011
19	0.0025	0.0014	0.0011
20	0.0025	0.0014	0.0011
21	0.0025	0.0014	0.0011
22	0.0025	0.0014	0.0011
23	0.0025	0.0014	0.0011
24	0.0025	0.0014	0.0011
25	0.0025	0.0014	0.0011
26	0.0025	0.0015	0.0011
27	0.0026	0.0015	0.0011
28	0.0026	0.0015	0.0011
29	0.0026	0.0015	0.0011
30	0.0026	0.0015	0.0011
31	0.0026	0.0015	0.0011
32	0.0026	0.0015	0.0011
33	0.0026	0.0015	0.0011
34	0.0026	0.0015	0.0011
35	0.0026	0.0015	0.0011
36	0.0026	0.0015	0.0011
37	0.0026	0.0015	0.0011
38	0.0027	0.0015	0.0011
39	0.0027	0.0015	0.0011
40	0.0027	0.0015	0.0011
41	0.0027	0.0015	0.0012
42	0.0027	0.0015	0.0012
43	0.0027	0.0015	0.0012
44	0.0027	0.0015	0.0012
45	0.0027	0.0016	0.0012
46	0.0027	0.0016	0.0012
47	0.0027	0.0016	0.0012
48	0.0028	0.0016	0.0012
49	0.0028	0.0016	0.0012
50	0.0028	0.0016	0.0012
51	0.0028	0.0016	0.0012
52	0.0028	0.0016	0.0012
53	0.0028	0.0016	0.0012
54	0.0028	0.0016	0.0012
55	0.0028	0.0016	0.0012
56	0.0028	0.0016	0.0012
57	0.0029	0.0016	0.0012
58	0.0029	0.0016	0.0012
59	0.0029	0.0016	0.0012

60	0.0029	0.0017	0.0012
61	0.0029	0.0017	0.0012
62	0.0029	0.0017	0.0013
63	0.0029	0.0017	0.0013
64	0.0029	0.0017	0.0013
65	0.0030	0.0017	0.0013
66	0.0030	0.0017	0.0013
67	0.0030	0.0017	0.0013
68	0.0030	0.0017	0.0013
69	0.0030	0.0017	0.0013
70	0.0030	0.0017	0.0013
71	0.0030	0.0017	0.0013
72	0.0030	0.0017	0.0013
73	0.0031	0.0018	0.0013
74	0.0031	0.0018	0.0013
75	0.0031	0.0018	0.0013
76	0.0031	0.0018	0.0013
77	0.0031	0.0018	0.0013
78	0.0031	0.0018	0.0013
79	0.0032	0.0018	0.0014
80	0.0032	0.0018	0.0014
81	0.0032	0.0018	0.0014
82	0.0032	0.0018	0.0014
83	0.0032	0.0018	0.0014
84	0.0032	0.0018	0.0014
85	0.0033	0.0019	0.0014
86	0.0033	0.0019	0.0014
87	0.0033	0.0019	0.0014
88	0.0033	0.0019	0.0014
89	0.0033	0.0019	0.0014
90	0.0033	0.0019	0.0014
91	0.0034	0.0019	0.0014
92	0.0034	0.0019	0.0014
93	0.0034	0.0019	0.0015
94	0.0034	0.0019	0.0015
95	0.0034	0.0020	0.0015
96	0.0035	0.0020	0.0015
97	0.0035	0.0020	0.0015
98	0.0035	0.0020	0.0015
99	0.0035	0.0020	0.0015
100	0.0035	0.0020	0.0015
101	0.0036	0.0020	0.0015
102	0.0036	0.0020	0.0015
103	0.0036	0.0021	0.0015
104	0.0036	0.0021	0.0016
105	0.0037	0.0021	0.0016
106	0.0037	0.0021	0.0016
107	0.0037	0.0021	0.0016
108	0.0037	0.0021	0.0016
109	0.0038	0.0021	0.0016
110	0.0038	0.0022	0.0016
111	0.0038	0.0022	0.0016
112	0.0038	0.0022	0.0016
113	0.0039	0.0022	0.0017

114	0.0039	0.0022	0.0017
115	0.0039	0.0022	0.0017
116	0.0039	0.0022	0.0017
117	0.0040	0.0023	0.0017
118	0.0040	0.0023	0.0017
119	0.0040	0.0023	0.0017
120	0.0041	0.0023	0.0017
121	0.0041	0.0023	0.0018
122	0.0041	0.0024	0.0018
123	0.0042	0.0024	0.0018
124	0.0042	0.0024	0.0018
125	0.0042	0.0024	0.0018
126	0.0043	0.0024	0.0018
127	0.0043	0.0025	0.0018
128	0.0043	0.0025	0.0019
129	0.0044	0.0025	0.0019
130	0.0044	0.0025	0.0019
131	0.0045	0.0025	0.0019
132	0.0045	0.0026	0.0019
133	0.0045	0.0026	0.0019
134	0.0046	0.0026	0.0020
135	0.0046	0.0026	0.0020
136	0.0047	0.0027	0.0020
137	0.0047	0.0027	0.0020
138	0.0048	0.0027	0.0020
139	0.0048	0.0028	0.0021
140	0.0049	0.0028	0.0021
141	0.0049	0.0028	0.0021
142	0.0050	0.0028	0.0021
143	0.0050	0.0029	0.0022
144	0.0051	0.0029	0.0022
145	0.0052	0.0030	0.0022
146	0.0052	0.0030	0.0022
147	0.0053	0.0030	0.0023
148	0.0054	0.0031	0.0023
149	0.0055	0.0031	0.0023
150	0.0055	0.0031	0.0024
151	0.0056	0.0032	0.0024
152	0.0057	0.0032	0.0024
153	0.0058	0.0033	0.0025
154	0.0058	0.0033	0.0025
155	0.0059	0.0034	0.0025
156	0.0060	0.0034	0.0026
157	0.0061	0.0035	0.0026
158	0.0062	0.0035	0.0027
159	0.0063	0.0036	0.0027
160	0.0064	0.0036	0.0027
161	0.0065	0.0037	0.0028
162	0.0066	0.0038	0.0028
163	0.0068	0.0039	0.0029
164	0.0069	0.0039	0.0029
165	0.0070	0.0040	0.0030
166	0.0071	0.0041	0.0031
167	0.0074	0.0042	0.0032

168	0.0075	0.0043	0.0032
169	0.0077	0.0044	0.0033
170	0.0078	0.0045	0.0034
171	0.0081	0.0046	0.0035
172	0.0082	0.0047	0.0035
173	0.0085	0.0049	0.0037
174	0.0087	0.0050	0.0037
175	0.0091	0.0052	0.0039
176	0.0093	0.0053	0.0040
177	0.0097	0.0055	0.0042
178	0.0099	0.0057	0.0043
179	0.0105	0.0060	0.0045
180	0.0108	0.0062	0.0046
181	0.0114	0.0065	0.0049
182	0.0118	0.0068	0.0051
183	0.0127	0.0073	0.0054
184	0.0132	0.0076	0.0057
185	0.0099	0.0056	0.0042
186	0.0105	0.0060	0.0045
187	0.0122	0.0070	0.0052
188	0.0133	0.0076	0.0057
189	0.0166	0.0095	0.0071
190	0.0191	0.0109	0.0082
191	0.0290	0.0166	0.0124
192	0.0421	0.0240	0.0180
193	0.1820	0.0417	0.1403
194	0.0228	0.0130	0.0098
195	0.0147	0.0084	0.0063
196	0.0113	0.0065	0.0048
197	0.0138	0.0079	0.0059
198	0.0122	0.0070	0.0052
199	0.0111	0.0063	0.0048
200	0.0102	0.0058	0.0044
201	0.0095	0.0054	0.0041
202	0.0089	0.0051	0.0038
203	0.0084	0.0048	0.0036
204	0.0080	0.0045	0.0034
205	0.0076	0.0043	0.0032
206	0.0072	0.0041	0.0031
207	0.0070	0.0040	0.0030
208	0.0067	0.0038	0.0029
209	0.0065	0.0037	0.0028
210	0.0062	0.0036	0.0027
211	0.0061	0.0035	0.0026
212	0.0059	0.0034	0.0025
213	0.0057	0.0033	0.0024
214	0.0056	0.0032	0.0024
215	0.0054	0.0031	0.0023
216	0.0053	0.0030	0.0023
217	0.0051	0.0029	0.0022
218	0.0050	0.0029	0.0021
219	0.0049	0.0028	0.0021
220	0.0048	0.0027	0.0021
221	0.0047	0.0027	0.0020

222	0.0046	0.0026	0.0020
223	0.0045	0.0026	0.0019
224	0.0044	0.0025	0.0019
225	0.0044	0.0025	0.0019
226	0.0043	0.0024	0.0018
227	0.0042	0.0024	0.0018
228	0.0041	0.0024	0.0018
229	0.0041	0.0023	0.0017
230	0.0040	0.0023	0.0017
231	0.0040	0.0023	0.0017
232	0.0039	0.0022	0.0017
233	0.0038	0.0022	0.0016
234	0.0038	0.0022	0.0016
235	0.0037	0.0021	0.0016
236	0.0037	0.0021	0.0016
237	0.0036	0.0021	0.0016
238	0.0036	0.0021	0.0015
239	0.0036	0.0020	0.0015
240	0.0035	0.0020	0.0015
241	0.0035	0.0020	0.0015
242	0.0034	0.0020	0.0015
243	0.0034	0.0019	0.0015
244	0.0034	0.0019	0.0014
245	0.0033	0.0019	0.0014
246	0.0033	0.0019	0.0014
247	0.0032	0.0019	0.0014
248	0.0032	0.0018	0.0014
249	0.0032	0.0018	0.0014
250	0.0031	0.0018	0.0013
251	0.0031	0.0018	0.0013
252	0.0031	0.0018	0.0013
253	0.0031	0.0017	0.0013
254	0.0030	0.0017	0.0013
255	0.0030	0.0017	0.0013
256	0.0030	0.0017	0.0013
257	0.0029	0.0017	0.0013
258	0.0029	0.0017	0.0013
259	0.0029	0.0017	0.0012
260	0.0029	0.0016	0.0012
261	0.0029	0.0016	0.0012
262	0.0028	0.0016	0.0012
263	0.0028	0.0016	0.0012
264	0.0028	0.0016	0.0012
265	0.0028	0.0016	0.0012
266	0.0027	0.0016	0.0012
267	0.0027	0.0016	0.0012
268	0.0027	0.0015	0.0012
269	0.0027	0.0015	0.0011
270	0.0027	0.0015	0.0011
271	0.0026	0.0015	0.0011
272	0.0026	0.0015	0.0011
273	0.0026	0.0015	0.0011
274	0.0026	0.0015	0.0011
275	0.0026	0.0015	0.0011

276	0.0025	0.0015	0.0011
277	0.0025	0.0014	0.0011
278	0.0025	0.0014	0.0011
279	0.0025	0.0014	0.0011
280	0.0025	0.0014	0.0011
281	0.0025	0.0014	0.0011
282	0.0025	0.0014	0.0011
283	0.0024	0.0014	0.0010
284	0.0024	0.0014	0.0010
285	0.0024	0.0014	0.0010
286	0.0024	0.0014	0.0010
287	0.0024	0.0014	0.0010
288	0.0024	0.0013	0.0010

Total soil rain loss = 0.82(In)
Total effective rainfall = 0.73(In)
Peak flow rate in flood hydrograph = 11.52(CFS)

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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	5.0	10.0	15.0	20.0
0+ 5	0.0000	0.01	Q				
0+10	0.0002	0.03	Q				
0+15	0.0009	0.09	Q				
0+20	0.0020	0.16	Q				
0+25	0.0033	0.20	Q				
0+30	0.0048	0.22	Q				
0+35	0.0064	0.24	Q				
0+40	0.0082	0.25	Q				
0+45	0.0099	0.26	Q				
0+50	0.0118	0.27	Q				
0+55	0.0137	0.28	Q				
1+ 0	0.0156	0.28	Q				
1+ 5	0.0176	0.29	Q				
1+10	0.0196	0.29	Q				
1+15	0.0216	0.30	Q				
1+20	0.0237	0.30	Q				
1+25	0.0258	0.30	Q				
1+30	0.0279	0.30	Q				
1+35	0.0300	0.31	Q				
1+40	0.0321	0.31	Q				
1+45	0.0343	0.31	Q				
1+50	0.0364	0.31	Q				
1+55	0.0386	0.32	QV				
2+ 0	0.0408	0.32	QV				
2+ 5	0.0430	0.32	QV				
2+10	0.0452	0.32	QV				

2+15	0.0474	0.32	QV				
2+20	0.0496	0.32	QV				
2+25	0.0518	0.32	QV				
2+30	0.0541	0.32	QV				
2+35	0.0563	0.33	QV				
2+40	0.0586	0.33	QV				
2+45	0.0608	0.33	QV				
2+50	0.0631	0.33	QV				
2+55	0.0654	0.33	QV				
3+ 0	0.0677	0.33	QV				
3+ 5	0.0699	0.33	QV				
3+10	0.0722	0.33	QV				
3+15	0.0745	0.33	QV				
3+20	0.0769	0.34	Q V				
3+25	0.0792	0.34	Q V				
3+30	0.0815	0.34	Q V				
3+35	0.0839	0.34	Q V				
3+40	0.0862	0.34	Q V				
3+45	0.0886	0.34	Q V				
3+50	0.0909	0.34	Q V				
3+55	0.0933	0.34	Q V				
4+ 0	0.0957	0.35	Q V				
4+ 5	0.0981	0.35	Q V				
4+10	0.1005	0.35	Q V				
4+15	0.1029	0.35	Q V				
4+20	0.1053	0.35	Q V				
4+25	0.1077	0.35	Q V				
4+30	0.1102	0.35	Q V				
4+35	0.1126	0.36	Q V				
4+40	0.1151	0.36	Q V				
4+45	0.1175	0.36	Q V				
4+50	0.1200	0.36	Q V				
4+55	0.1225	0.36	Q V				
5+ 0	0.1250	0.36	Q V				
5+ 5	0.1275	0.36	Q V				
5+10	0.1300	0.37	Q V				
5+15	0.1326	0.37	Q V				
5+20	0.1351	0.37	Q V				
5+25	0.1377	0.37	Q V				
5+30	0.1402	0.37	Q V				
5+35	0.1428	0.37	Q V				
5+40	0.1454	0.38	Q V				
5+45	0.1480	0.38	Q V				
5+50	0.1506	0.38	Q V				
5+55	0.1532	0.38	Q V				
6+ 0	0.1558	0.38	Q V				
6+ 5	0.1585	0.38	Q V				
6+10	0.1611	0.39	Q V				
6+15	0.1638	0.39	Q V				
6+20	0.1665	0.39	Q V				
6+25	0.1691	0.39	Q V				
6+30	0.1719	0.39	Q V				
6+35	0.1746	0.39	Q V				
6+40	0.1773	0.40	Q V				

6+45	0.1800	0.40	Q	V	|	|	|	|
6+50	0.1828	0.40	Q	V	|	|	|	|
6+55	0.1856	0.40	Q	V	|	|	|	|
7+ 0	0.1883	0.40	Q	V	|	|	|	|
7+ 5	0.1911	0.41	Q	V	|	|	|	|
7+10	0.1940	0.41	Q	V	|	|	|	|
7+15	0.1968	0.41	Q	V	|	|	|	|
7+20	0.1996	0.41	Q	V	|	|	|	|
7+25	0.2025	0.41	Q	V	|	|	|	|
7+30	0.2053	0.42	Q	V	|	|	|	|
7+35	0.2082	0.42	Q	V	|	|	|	|
7+40	0.2111	0.42	Q	V	|	|	|	|
7+45	0.2140	0.42	Q	V	|	|	|	|
7+50	0.2170	0.43	Q	V	|	|	|	|
7+55	0.2199	0.43	Q	V	|	|	|	|
8+ 0	0.2229	0.43	Q	V	|	|	|	|
8+ 5	0.2259	0.43	Q	V	|	|	|	|
8+10	0.2289	0.44	Q	V	|	|	|	|
8+15	0.2319	0.44	Q	V	|	|	|	|
8+20	0.2349	0.44	Q	V	|	|	|	|
8+25	0.2380	0.44	Q	V	|	|	|	|
8+30	0.2410	0.45	Q	V	|	|	|	|
8+35	0.2441	0.45	Q	V	|	|	|	|
8+40	0.2472	0.45	Q	V	|	|	|	|
8+45	0.2503	0.45	Q	V	|	|	|	|
8+50	0.2535	0.46	Q	V	|	|	|	|
8+55	0.2566	0.46	Q	V	|	|	|	|
9+ 0	0.2598	0.46	Q	V	|	|	|	|
9+ 5	0.2630	0.46	Q	V	|	|	|	|
9+10	0.2662	0.47	Q	V	|	|	|	|
9+15	0.2695	0.47	Q	V	|	|	|	|
9+20	0.2727	0.47	Q	V	|	|	|	|
9+25	0.2760	0.48	Q	V	|	|	|	|
9+30	0.2793	0.48	Q	V	|	|	|	|
9+35	0.2827	0.48	Q	V	|	|	|	|
9+40	0.2860	0.49	Q	V	|	|	|	|
9+45	0.2894	0.49	Q	V	|	|	|	|
9+50	0.2928	0.49	Q	V	|	|	|	|
9+55	0.2962	0.50	Q	V	|	|	|	|
10+ 0	0.2997	0.50	|Q	V	|	|	|	|
10+ 5	0.3032	0.50	|Q	V	|	|	|	|
10+10	0.3067	0.51	|Q	V	|	|	|	|
10+15	0.3102	0.51	|Q	V	|	|	|	|
10+20	0.3137	0.52	|Q	V	|	|	|	|
10+25	0.3173	0.52	|Q	V	|	|	|	|
10+30	0.3209	0.52	|Q	V	|	|	|	|
10+35	0.3246	0.53	|Q	V	|	|	|	|
10+40	0.3282	0.53	|Q	V	|	|	|	|
10+45	0.3319	0.54	|Q	V	|	|	|	|
10+50	0.3357	0.54	|Q	V	|	|	|	|
10+55	0.3394	0.55	|Q	V	|	|	|	|
11+ 0	0.3432	0.55	|Q	V	|	|	|	|
11+ 5	0.3471	0.56	|Q	V	|	|	|	|
11+10	0.3509	0.56	|Q	V	|	|	|	|

11+15	0.3548	0.57	|Q	V|	|	|	|
11+20	0.3587	0.57	|Q	V|	|	|	|
11+25	0.3627	0.58	|Q	V|	|	|	|
11+30	0.3667	0.58	|Q	V|	|	|	|
11+35	0.3708	0.59	|Q	V|	|	|	|
11+40	0.3748	0.59	|Q	V	|	|	|
11+45	0.3790	0.60	|Q	V	|	|	|
11+50	0.3831	0.60	|Q	V	|	|	|
11+55	0.3873	0.61	|Q	V	|	|	|
12+ 0	0.3916	0.62	|Q	V	|	|	|
12+ 5	0.3959	0.62	|Q	V	|	|	|
12+10	0.4002	0.63	|Q	V	|	|	|
12+15	0.4047	0.64	|Q	V	|	|	|
12+20	0.4091	0.65	|Q	V	|	|	|
12+25	0.4136	0.66	|Q	|V	|	|	|
12+30	0.4182	0.67	|Q	|V	|	|	|
12+35	0.4229	0.67	|Q	|V	|	|	|
12+40	0.4276	0.68	|Q	|V	|	|	|
12+45	0.4323	0.69	|Q	|V	|	|	|
12+50	0.4371	0.70	|Q	|V	|	|	|
12+55	0.4420	0.71	|Q	|V	|	|	|
13+ 0	0.4470	0.72	|Q	|V	|	|	|
13+ 5	0.4520	0.73	|Q	| V	|	|	|
13+10	0.4571	0.74	|Q	| V	|	|	|
13+15	0.4623	0.75	|Q	| V	|	|	|
13+20	0.4675	0.76	|Q	| V	|	|	|
13+25	0.4728	0.77	|Q	| V	|	|	|
13+30	0.4782	0.79	|Q	| V	|	|	|
13+35	0.4837	0.80	|Q	| V	|	|	|
13+40	0.4893	0.81	|Q	| V	|	|	|
13+45	0.4950	0.83	|Q	| V	|	|	|
13+50	0.5008	0.84	|Q	| V	|	|	|
13+55	0.5067	0.86	|Q	| V	|	|	|
14+ 0	0.5127	0.87	|Q	| V	|	|	|
14+ 5	0.5189	0.89	|Q	| V	|	|	|
14+10	0.5251	0.91	|Q	| V	|	|	|
14+15	0.5315	0.93	|Q	| V	|	|	|
14+20	0.5380	0.95	|Q	| V	|	|	|
14+25	0.5447	0.97	|Q	| V	|	|	|
14+30	0.5516	1.00	|Q	| V	|	|	|
14+35	0.5586	1.02	| Q	| V	|	|	|
14+40	0.5658	1.05	| Q	| V	|	|	|
14+45	0.5732	1.08	| Q	| V	|	|	|
14+50	0.5809	1.11	| Q	| V	|	|	|
14+55	0.5888	1.14	| Q	| V	|	|	|
15+ 0	0.5969	1.18	| Q	| V	|	|	|
15+ 5	0.6053	1.22	| Q	| V	|	|	|
15+10	0.6140	1.27	| Q	| V	|	|	|
15+15	0.6231	1.32	| Q	| V	|	|	|
15+20	0.6326	1.38	| Q	| V	|	|	|
15+25	0.6425	1.43	| Q	| V	|	|	|
15+30	0.6526	1.46	| Q	| V	|	|	|
15+35	0.6624	1.43	| Q	| V	|	|	|
15+40	0.6721	1.40	| Q	| V	|	|	|

15+45	0.6821	1.46	Q V
15+50	0.6929	1.57	Q V
15+55	0.7050	1.76	Q V
16+ 0	0.7193	2.07	Q V
16+ 5	0.7418	3.27	Q V
16+10	0.7839	6.12	Q V
16+15	0.8632	11.52	Q
16+20	**0.9406**	**11.24**	**Q V**
16+25	0.9900	7.18	Q V
16+30	1.0257	5.18	Q V
16+35	1.0545	4.19	Q V
16+40	1.0789	3.53	Q V
16+45	1.1000	3.07	Q V
16+50	1.1189	2.74	Q V
16+55	1.1352	2.38	Q V
17+ 0	1.1499	2.13	Q V
17+ 5	1.1634	1.95	Q V
17+10	1.1757	1.79	Q V
17+15	1.1869	1.63	Q V
17+20	1.1973	1.50	Q V
17+25	1.2069	1.40	Q V
17+30	1.2156	1.27	Q V
17+35	1.2238	1.18	Q V
17+40	1.2312	1.08	Q V
17+45	1.2384	1.05	Q V
17+50	1.2455	1.03	Q V
17+55	1.2524	0.99	Q V
18+ 0	1.2588	0.94	Q V
18+ 5	1.2648	0.86	Q V
18+10	1.2702	0.79	Q V
18+15	1.2752	0.73	Q V
18+20	1.2801	0.71	Q V
18+25	1.2848	0.69	Q V
18+30	1.2895	0.67	Q V
18+35	1.2939	0.65	Q V
18+40	1.2983	0.64	Q V
18+45	1.3026	0.62	Q V
18+50	1.3068	0.61	Q V
18+55	1.3109	0.60	Q V
19+ 0	1.3149	0.58	Q V
19+ 5	1.3189	0.57	Q V
19+10	1.3227	0.56	Q V
19+15	1.3265	0.55	Q V
19+20	1.3303	0.54	Q V
19+25	1.3339	0.53	Q V
19+30	1.3375	0.52	Q V
19+35	1.3411	0.52	Q V
19+40	1.3446	0.51	Q V
19+45	1.3480	0.50	Q V
19+50	1.3514	0.49	Q V
19+55	1.3548	0.49	Q V
20+ 0	1.3581	0.48	Q V
20+ 5	1.3613	0.47	Q V
20+10	1.3646	0.47	Q V

20+15	1.3677	0.46	Q				V	
20+20	1.3709	0.46	Q				V	
20+25	1.3740	0.45	Q				V	
20+30	1.3770	0.44	Q				V	
20+35	1.3801	0.44	Q				V	
20+40	1.3831	0.43	Q				V	
20+45	1.3860	0.43	Q				V	
20+50	1.3889	0.42	Q				V	
20+55	1.3918	0.42	Q				V	
21+ 0	1.3947	0.42	Q				V	
21+ 5	1.3975	0.41	Q				V	
21+10	1.4003	0.41	Q				V	
21+15	1.4031	0.40	Q				V	
21+20	1.4059	0.40	Q				V	
21+25	1.4086	0.40	Q				V	
21+30	1.4113	0.39	Q				V	
21+35	1.4140	0.39	Q				V	
21+40	1.4166	0.38	Q				V	
21+45	1.4192	0.38	Q				V	
21+50	1.4218	0.38	Q				V	
21+55	1.4244	0.37	Q				V	
22+ 0	1.4270	0.37	Q				V	
22+ 5	1.4295	0.37	Q				V	
22+10	1.4320	0.36	Q				V	
22+15	1.4345	0.36	Q				V	
22+20	1.4370	0.36	Q				V	
22+25	1.4394	0.36	Q				V	
22+30	1.4419	0.35	Q				V	
22+35	1.4443	0.35	Q				V	
22+40	1.4467	0.35	Q				V	
22+45	1.4491	0.35	Q				V	
22+50	1.4514	0.34	Q				V	
22+55	1.4538	0.34	Q				V	
23+ 0	1.4561	0.34	Q				V	
23+ 5	1.4584	0.34	Q				V	
23+10	1.4607	0.33	Q				V	
23+15	1.4630	0.33	Q				V	
23+20	1.4652	0.33	Q				V	
23+25	1.4675	0.33	Q				V	
23+30	1.4697	0.32	Q				V	
23+35	1.4719	0.32	Q				V	
23+40	1.4741	0.32	Q				V	
23+45	1.4763	0.32	Q				V	
23+50	1.4785	0.32	Q				V	
23+55	1.4806	0.31	Q				V	
24+ 0	**1.4828**	**0.31**	**Q**				**V**	

2-YR, 24-HR
VOLUME = 1.48 AC.FT.
POST-DEVELOPED

INSTRUCTIONS FOR USE OF FIG. 1073.03
CAPACITY OF CURB OPENING INLETS IN A LOW POINT OR SUMP

This nomograph is based on the following conditions:

(1) The curb opening inlet (no grate) is located at a low point in the grade.

(2) All flow coming to the inlet must eventually enter the inlet and will pond until sufficient head is built up so the outflow through the inlet will equal the peak inflow from the gutters.

Enter the nomograph with any two of the three values h, Q/L, H/h, and read the third.

Where h = Total height of opening in feet
L = Total length of opening in feet
H = Depth of water at the entrance in feet
Q = Total peak rate of flow to the inlet in cfs

Normally Q, L, and h will be known, and the nomograph can be used to determine the depth of water H at the inlet. The spread of the water on the street will depend upon the cross slope of the pavement.

The hydraulic basis of the nomograph is as follows:

(1) For heads (depths of water) up to the height of the opening $\left(\frac{H}{h} \leqslant 1\right)$, the inlet is assumed to act as a weir with the flow passing through critical depth at the entrance and following the formula

$$Q = 3.087\ LH^{3/2}$$

(2) For heads equal to or greater than twice the height of opening $\left(\frac{H}{h} \geqslant 2\right)$, the inlet is assumed to act as an orifice following the formula

$$\frac{Q}{L} = 5.62\ h^{3/2} \left(\frac{H'}{h}\right)^{1/2}$$

This is a rearrangement of the standard orifice formula $Q = CA\sqrt{2gH}$ with C = 0.7 and H' equal to the head on the middle of the inlet opening $\left(H' = H - \frac{h}{2}\right)$.

(3) For heads with H/h between 1 and 2, a transition was used as the operation of the inlet is indefinite.

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INSTRUCTIONS FOR USE OF FIGURE 1073.01 (a) AND (b) "CAPACITY OF CURB OPENING INLETS ON CONTINUOUS GRADE"

Figure 1073.01 applies only to curb or side opening inlets on continuous grades.

The capacity of the inlet depends upon the length of opening and the depth of flow at the opening. This depth in turn depends upon the amount of depression of the flow line at the inlet and the cross slope, longitudinal slope, and the roughness of the gutter.

To use the figure the following information must be known.

1. Length (L) and height of inlet.
2. Depth (a) of flow line depression, if any, at the inlet.
3. Design discharge (Q_a) in the gutter or information as to drainage area, rainfall intensity, and runoff coefficients from which a design discharge can be estimated. Any carryover from a previous inlet must be included.
4. Depth of flow in normal gutter for the particular longitudinal and cross slopes at the inlet in question. This may be determined from one of the following figures: 1072.06, or 1072.08.

lure

1. Enter fig. 1073.01 (a) with depth of flow, y, and gutter depression at the inlet, a, and determine Q_a/L_a, the interception per foot of inlet opening if the inlet were intercepting 100% of the gutter flow.
2. Determine length of inlet L_a required to intercept 100% of the gutter flow. L_a = total gutter flow Q_a divided by the factor Q_a/L_a.
3. Compute ratio L/L_a where L = actual length of inlet in question.
4. Enter fig. 1073.01 (b) with L/L_a and a/y and determine ratio Q/Q_a, the proportion of the total gutter flow intercepted by the inlet in question.
5. Flow intercepted, Q, is this ratio Q/Q_a times the total gutter flow Q_a.
6. Flow carried over to next inlet is $Q_a - Q$.

GENERAL CRITERIA - INLETS

CURB OPENING TYPE

The capacity of a curb opening inlet on a continuous grade varies directly with:

a. Depth of water at the inlet entrance

b. Length of clear opening

The depth of water at the inlet entrance for a given discharge varies--

Directly with:

a. Cross slope of the pavement at the curb

b. Amount of warping or depression of the gutter flow line at the inlet

c. Roughness of the flow line

Inversely with:

a. Longitudinal slope of the gutter

The capacity of a curb opening inlet when intercepting 100 percent of the flow in the gutter is given by the formula:

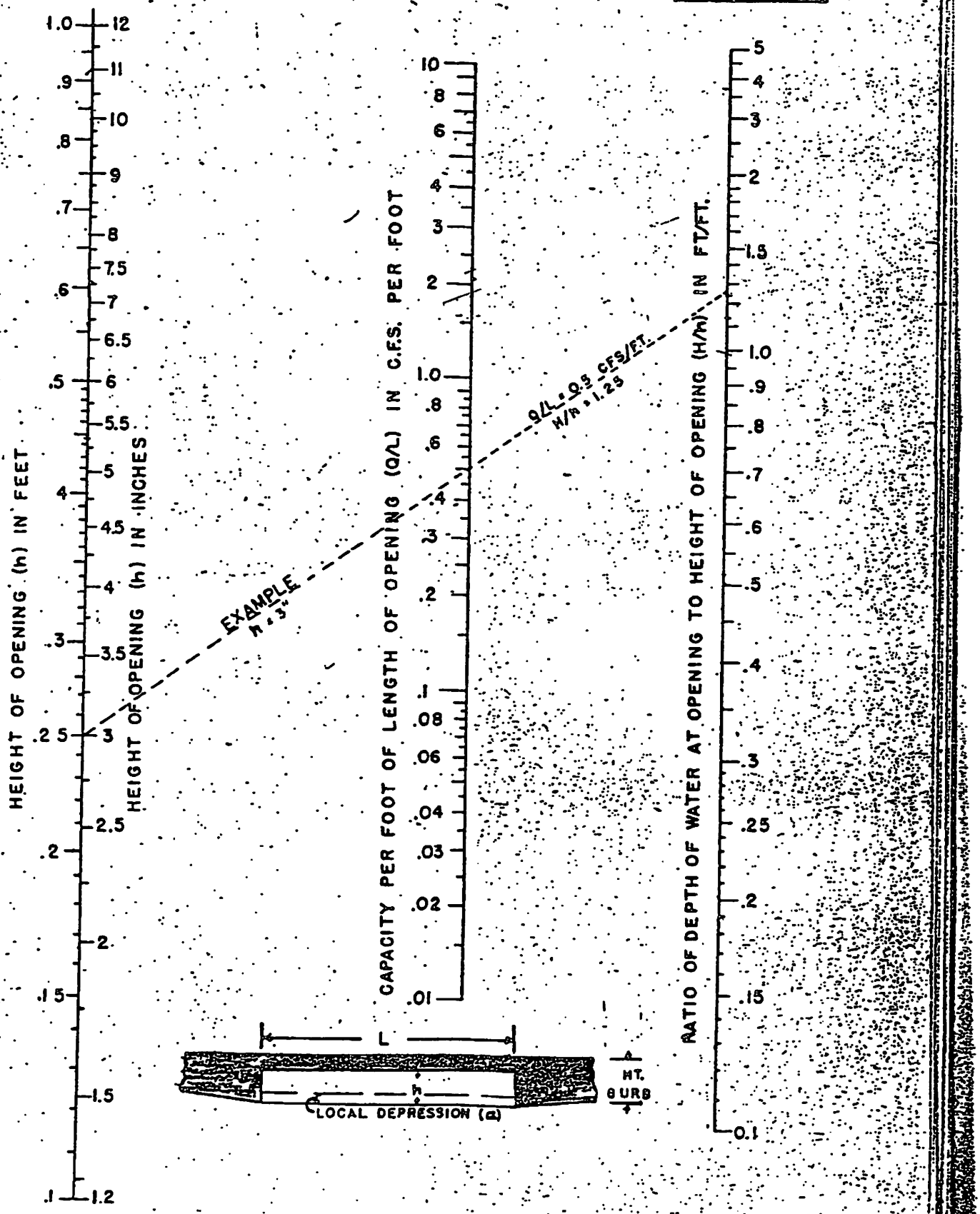
$$Q = 0.7\ L\ (a + y)^{3/2}$$

Where y = Depth of flow in approach gutter (Ft.)
a = Depth of depression of F. L. at inlet (Ft.)
L = Length of clear opening (Ft.)

The capacity of a curb opening inlet is increased somewhat by allowing part of flow to go by not as much as with a grate inlet.

The capacity of a curb opening inlet in a sump or low point varies directly with the length of the inlet and the depth of water at the entrance. The inlet will operate as a weir until the water submerges the entrance. When the depth of water is about twice the height of the entrance or more, it will operate as an orifice. Between these two depths it will operate somewhere between the two. The capacity may be computed graphically by use of fig. 1043. Using the length of clear opening as "b" and the height of opening as "a".

1073.03

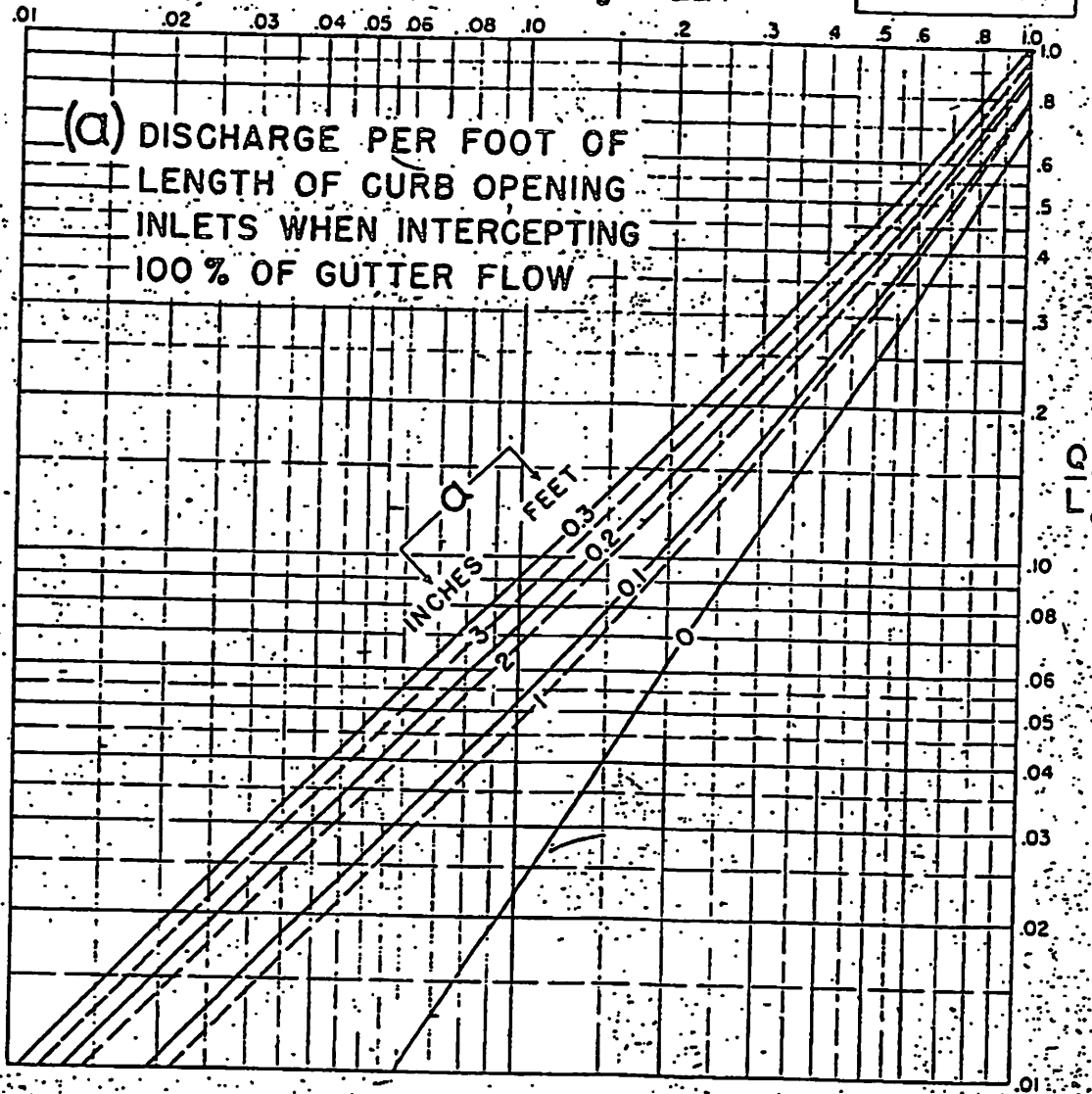


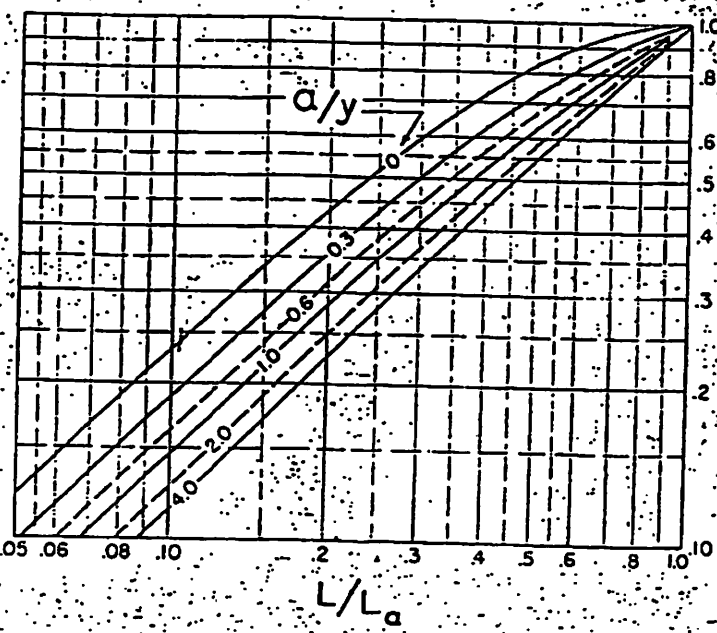
JAN., 1951

BUREAU OF PUBLIC ROADS
DIVISION TWO WASH., D. C.

NOMOGRAPH FOR CAPACITY OF CURB OPENING INLETS AT LOW POINTS

1073.01





(b)

PARTIAL INTERCEPTION RATIO FOR INLETS OF LENGTH LESS THAN L_a

JULY 1950

BUREAU OF PUBLIC ROADS
DIVISION TWO WASH., D. C.

CAPACITY OF CURB OPENING INLETS ON CONTINUOUS GRADE

EDUCATIONAL MATERIALS

Non-Stormwater Discharges SC-10

Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize
- Product Substitution

Description

Non-stormwater discharges are those flows that do not consist entirely of stormwater. Some non-stormwater discharges do not include pollutants and may be discharged to the storm drain. These include uncontaminated groundwater and natural springs. There are also some non-stormwater discharges that typically do not contain pollutants and may be discharged to the storm drain with conditions. These include car washing, air conditioner condensate, etc. However there are certain non-stormwater discharges that pose environmental concern. These discharges may originate from illegal dumping or from internal floor drains, appliances, industrial processes, sinks, and toilets that are connected to the nearby storm drainage system. These discharges (which may include: process waste waters, cooling waters, wash waters, and sanitary wastewater) can carry substances such as paint, oil, fuel and other automotive fluids, chemicals and other pollutants into storm drains. They can generally be detected through a combination of detection and elimination. The ultimate goal is to effectively eliminate non-stormwater discharges to the stormwater drainage system through implementation of measures to detect, correct, and enforce against illicit connections and illegal discharges of pollutants on streets and into the storm drain system and creeks.

Targeted Constituents

Sediment	
Nutrients	✓
Trash	
Metals	✓
Bacteria	✓
Oil and Grease	✓
Organics	✓

Approach

Initially the industry must make an assessment of non-stormwater discharges to determine which types must be eliminated or addressed through BMPs. The focus of the following approach is in the elimination of non-stormwater discharges.

CASQA California Stormwater Quality Association

Pollution Prevention

- Ensure that used oil, used antifreeze, and hazardous chemical recycling programs are being implemented. Encourage litter control.

Suggested Protocols

Recommended Complaint Investigation Equipment

- Field Screening Analysis
  - pH paper or meter
  - Commercial stormwater pollutant screening kit that can detect for reactive phosphorus, nitrate nitrogen, ammonium nitrogen, specific conductance, and turbidity
  - Sample jars
  - Sample collection pole
  - A tool to remove access hole covers
- Laboratory Analysis
  - Sample cooler
  - Ice
  - Sample jars and labels
  - Chain of custody forms
- Documentation
  - Camera
  - Notebook
  - Pens
  - Notice of Violation forms
  - Educational materials

General

- Develop clear protocols and lines of communication for effectively prohibiting non-stormwater discharges, especially those that are not classified as hazardous. These are often not responded to as effectively as they need to be.
- Stencil or demarcate storm drains, where applicable, to prevent illegal disposal of pollutants. Storm drain inlets should have messages such as "Dump No Waste Drains to Stream" stenciled or demarcated next to them to warn against ignorant or intentional dumping of pollutants into the storm drainage system.

- See SC44 Stormwater Drainage System Maintenance for additional information.

Illicit Connections

- Locate discharges from the industrial storm drainage system to the municipal storm drain system through review of "as-built" piping schematics.
- Isolate problem areas and plug illicit discharge points.
- Locate and evaluate all discharges to the industrial storm drain system.

Visual Inspection and Inventory

- Inventory and inspect each discharge point during dry weather.
- Keep in mind that drainage from a storm event can continue for a day or two following the end of a storm and groundwater may infiltrate the underground stormwater collection system. Also, non-stormwater discharges are often intermittent and may require periodic inspections.

Review Infield Piping

- A review of the "as-built" piping schematic is a way to determine if there are any connections to the stormwater collection system.
- Inspect the path of floor drains in older buildings.

Smoke Testing

- Smoke testing of wastewater and stormwater collection systems is used to detect connections between the two systems.
- During dry weather the stormwater collection system is filled with smoke and then traced to sources. The appearance of smoke at the base of a toilet indicates that there may be a connection between the sanitary and the stormwater system.

Dye Testing

- A dye test can be performed by simply releasing a dye into either your sanitary or process wastewater system and examining the discharge points from the stormwater collection system for discoloration.

TV Inspection of Drainage System

- TV Cameras can be employed to visually identify illicit connections to the industrial storm drainage system.

Illegal Dumping

- Regularly inspect and clean up hot spots and other storm drainage areas where illegal dumping and disposal occurs.
- On paved surfaces, clean up spills with as little water as possible. Use a rag for small spills, a damp mop for general cleanup, and absorbent material for larger spills. If the spilled material is hazardous, then the used cleanup materials are also hazardous and must be sent to a certified laundry (rags) or disposed of as hazardous waste.

- Never hose down or bury dry material spills. Sweep up the material and dispose of properly.
- Use adsorbent materials on small spills rather than hosing down the spill. Remove the adsorbent materials promptly and dispose of properly.
- For larger spills, a private spill cleanup company or Hazmat team may be necessary.

Once a site has been cleaned:

- Post "No Dumping" signs with a phone number for reporting dumping and disposal.
- Landscaping and beautification efforts of hot spots may also discourage future dumping, as well as provide open space and increase property values.
- Lighting or barriers may also be needed to discourage future dumping.
- See fact sheet SC11 Spill Prevention, Control, and Cleanup.

Inspection

- Regularly inspect and clean up hot spots and other storm drainage areas where illegal dumping and disposal occurs.
- Conduct field investigations of the industrial storm drain system for potential sources of non-stormwater discharges.
- Pro-actively conduct investigations of high priority areas. Based on historical data, prioritize specific geographic areas and/or incident type for pro-active investigations.

Reporting

- A database is useful for defining and tracking the magnitude and location of the problem.
- Report prohibited non-stormwater discharges observed during the course of normal daily activities so they can be investigated, contained, and cleaned up or eliminated.
- Document that non-stormwater discharges have been eliminated by recording tests performed, methods used, dates of testing, and any on-site drainage points observed.
- Document and report annually the results of the program.
- Maintain documentation of illicit connection and illegal dumping incidents, including significant conditionally exempt discharges that are not properly managed.

Training

- Training of technical staff in identifying and documenting illegal dumping incidents is required.
- Consider posting the quick reference table near storm drains to reinforce training.
- Train employees to identify non-stormwater discharges and report discharges to the appropriate departments.

- Educate employees about spill prevention and cleanup.
- Well-trained employees can reduce human errors that lead to accidental releases or spills. The employee should have the tools and knowledge to immediately begin cleaning up a spill should one occur. Employees should be familiar with the Spill Prevention Control and Countermeasure Plan.
- Determine and implement appropriate outreach efforts to reduce non-permissible non-stormwater discharges.
- Conduct spill response drills annually (if no events occurred to evaluate your plan) in cooperation with other industries.
- When a responsible party is identified, educate the party on the impacts of his or her actions.

Spill Response and Prevention

- See SC11 Spill Prevention Control and Cleanup.

Other Considerations

- Many facilities do not have accurate, up-to-date schematic drawings.

Requirements

Costs (including capital and operation & maintenance)

- The primary cost is for staff time and depends on how aggressively a program is implemented.
- Cost for containment and disposal is borne by the discharger.
- Illicit connections can be difficult to locate especially if there is groundwater infiltration.
- Indoor floor drains may require re-plumbing if cross-connections to storm drains are detected.

Maintenance (including administrative and staffing)

- Illegal dumping and illicit connection violations requires technical staff to detect and investigate them.

Supplemental Information

Further Detail of the BMP

Illegal Dumping

- Substances illegally dumped on streets and into the storm drain systems and creeks include paints, used oil and other automotive fluids, construction debris, chemicals, fresh concrete, leaves, grass clippings, and pet wastes. All of these wastes cause stormwater and receiving water quality problems as well as clog the storm drain system itself.
- Establish a system for tracking incidents. The system should be designed to identify the following:
  - Illegal dumping hot spots

- Types and quantities (in some cases) of wastes
- Patterns in time of occurrence (time of day/night, month, or year)
- Mode of dumping (abandoned containers, "midnight dumping" from moving vehicles, direct dumping of materials, accidents/spills)
- Responsible parties

One of the keys to success of reducing or eliminating illegal dumping is increasing the number of people at the facility who are aware of the problem and who have the tools to at least identify the incident, if not correct it. Therefore, train field staff to recognize and report the incidents.

What constitutes a "non-stormwater" discharge?

- Non-stormwater discharges to the stormwater collection system may include any water used directly in the manufacturing process (process wastewater), air conditioning condensate and coolant, non-contact cooling water, cooling equipment condensate, outdoor secondary containment water, vehicle and equipment wash water, sink and drinking fountain wastewater, sanitary wastes, or other wastewaters.

Permit Requirements

- Facilities subject to stormwater permit requirements must include a certification that the stormwater collection system has been tested or evaluated for the presence of non-stormwater discharges. The State's General Industrial Stormwater Permit requires that non-stormwater discharges be eliminated prior to implementation of the facility's SWPPP.

Performance Evaluation

- Review annually internal investigation results; assess whether goals were met and what changes or improvements are necessary.
- Obtain feedback from personnel assigned to respond to, or inspect for, illicit connections and illegal dumping incidents.

References and Resources

California's Nonpoint Source Program Plan http://www.swrcb.ca.gov/nps/index.html

Clark County Storm Water Pollution Control Manual
http://www.co.clark.wa.us/pubworks/bmpman.pdf

King County Storm Water Pollution Control Manual http://dnr.metrokc.gov/wlr/dss/spcm.htm

Santa Clara Valley Urban Runoff Pollution Prevention Program http://www.scvurppp.org

The Storm Water Managers Resource Center http://www.stormwatercenter.net/

Drainage System Maintenance SC-44

Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize

Description

As a consequence of its function, the stormwater conveyance system collects and transports urban runoff and stormwater that may contain certain pollutants. The protocols in this fact sheet are intended to reduce pollutants reaching receiving waters through proper conveyance system operation and maintenance.

Targeted Constituents

Sediment	✓
Nutrients	
Trash	✓
Metals	
Bacteria	✓
Oil and Grease	
Organics	

Approach

Pollution Prevention

Maintain catch basins, stormwater inlets, and other stormwater conveyance structures on a regular basis to remove pollutants, reduce high pollutant concentrations during the first flush of storms, prevent clogging of the downstream conveyance system, restore catch basins' sediment trapping capacity, and ensure the system functions properly hydraulically to avoid flooding.

Suggested Protocols

Catch Basins/Inlet Structures

- Staff should regularly inspect facilities to ensure compliance with the following:
  - Immediate repair of any deterioration threatening structural integrity.
  - Cleaning before the sump is 40% full. Catch basins should be cleaned as frequently as needed to meet this standard.
  - Stenciling of catch basins and inlets (see SC34 Waste Handling and Disposal).

- Clean catch basins, storm drain inlets, and other conveyance structures before the wet season to remove sediments and debris accumulated during the summer.
- Conduct inspections more frequently during the wet season for problem areas where sediment or trash accumulates more often. Clean and repair as needed.
- Keep accurate logs of the number of catch basins cleaned.
- Store wastes collected from cleaning activities of the drainage system in appropriate containers or temporary storage sites in a manner that prevents discharge to the storm drain.
- Dewater the wastes if necessary with outflow into the sanitary sewer if permitted. Water should be treated with an appropriate filtering device prior to discharge to the sanitary sewer. If discharge to the sanitary sewer is not allowed, water should be pumped or vacuumed to a tank and properly disposed. Do not dewater near a storm drain or stream.

Storm Drain Conveyance System

- Locate reaches of storm drain with deposit problems and develop a flushing schedule that keeps the pipe clear of excessive buildup.
- Collect and pump flushed effluent to the sanitary sewer for treatment whenever possible.

Pump Stations

- Clean all storm drain pump stations prior to the wet season to remove silt and trash.
- Do not allow discharge to reach the storm drain system when cleaning a storm drain pump station or other facility.
- Conduct routine maintenance at each pump station.
- Inspect, clean, and repair as necessary all outlet structures prior to the wet season.

Open Channel

- Modify storm channel characteristics to improve channel hydraulics, increase pollutant removals, and enhance channel/creek aesthetic and habitat value.
- Conduct channel modification/improvement in accordance with existing laws. Any person, government agency, or public utility proposing an activity that will change the natural (emphasis added) state of any river, stream, or lake in California, must enter into a Steam or Lake Alteration Agreement with the Department of Fish and Game. The developer-applicant should also contact local governments (city, county, special districts), other state agencies (SWRCB, RWQCB, Department of Forestry, Department of Water Resources), and Federal Corps of Engineers and USFWS.

Illicit Connections and Discharges

- Look for evidence of illegal discharges or illicit connections during routine maintenance of conveyance system and drainage structures:
  - Is there evidence of spills such as paints, discoloring, etc?

- Are there any odors associated with the drainage system?
- Record locations of apparent illegal discharges/illicit connections?
- Track flows back to potential dischargers and conduct aboveground inspections. This can be done through visual inspection of upgradient manholes or alternate techniques including zinc chloride smoke testing, fluorometric dye testing, physical inspection testing, or television camera inspection.
- Eliminate the discharge once the origin of flow is established.

- Stencil or demarcate storm drains, where applicable, to prevent illegal disposal of pollutants. Storm drain inlets should have messages such as "Dump No Waste Drains to Stream" stenciled next to them to warn against ignorant or intentional dumping of pollutants into the storm drainage system.
- Refer to fact sheet SC-10 Non-Stormwater Discharges.

Illegal Dumping

- Inspect and clean up hot spots and other storm drainage areas regularly where illegal dumping and disposal occurs.
- Establish a system for tracking incidents. The system should be designed to identify the following:
  - Illegal dumping hot spots
  - Types and quantities (in some cases) of wastes
  - Patterns in time of occurrence (time of day/night, month, or year)
  - Mode of dumping (abandoned containers, "midnight dumping" from moving vehicles, direct dumping of materials, accidents/spills)
  - Responsible parties
- Post "No Dumping" signs in problem areas with a phone number for reporting dumping and disposal. Signs should also indicate fines and penalties for illegal dumping.
- Refer to fact sheet SC-10 Non-Stormwater Discharges.

Training

- Train crews in proper maintenance activities, including record keeping and disposal.
- Allow only properly trained individuals to handle hazardous materials/wastes.
- Have staff involved in detection and removal of illicit connections trained in the following:
  - OSHA-required Health and Safety Training (29 CFR 1910.120) plus annual refresher training (as needed).

- OSHA Confined Space Entry training (Cal-OSHA Confined Space, Title 8 and Federal OSHA 29 CFR 1910.146).

- Procedural training (field screening, sampling, smoke/dye testing, TV inspection).

Spill Response and Prevention

- Investigate all reports of spills, leaks, and/or illegal dumping promptly.
- Clean up all spills and leaks using "dry" methods (with absorbent materials and/or rags) or dig up, remove, and properly dispose of contaminated soil.
- Refer to fact sheet SC-11 Spill Prevention, Control, and Cleanup.

Other Considerations (Limitations and Regulations)

- Clean-up activities may create a slight disturbance for local aquatic species. Access to items and material on private property may be limited. Trade-offs may exist between channel hydraulics and water quality/riparian habitat. If storm channels or basins are recognized as wetlands, many activities, including maintenance, may be subject to regulation and permitting.
- Storm drain flushing is most effective in small diameter pipes (36-inch diameter pipe or less, depending on water supply and sediment collection capacity). Other considerations associated with storm drain flushing may include the availability of a water source, finding a downstream area to collect sediments, liquid/sediment disposal, and prohibition against disposal of flushed effluent to sanitary sewer in some areas.
- Regulations may include adoption of substantial penalties for illegal dumping and disposal.
- Local municipal codes may include sections prohibiting discharge of soil, debris, refuse, hazardous wastes, and other pollutants into the storm drain system.

Requirements

Costs

- An aggressive catch basin cleaning program could require a significant capital and O&M budget.
- The elimination of illegal dumping is dependent on the availability, convenience, and cost of alternative means of disposal. The primary cost is for staff time. Cost depends on how aggressively a program is implemented. Other cost considerations for an illegal dumping program include:

  - Purchase and installation of signs.
  - Rental of vehicle(s) to haul illegally-disposed items and material to landfills.
  - Rental of heavy equipment to remove larger items (e.g., car bodies) from channels.
  - Purchase of landfill space to dispose of illegally-dumped items and material.

- Methods used for illicit connection detection (smoke testing, dye testing, visual inspection, and flow monitoring) can be costly and time-consuming. Site-specific factors, such as the level of impervious area, the density and ages of buildings, and type of land use will determine the level of investigation necessary.

Maintenance

- Two-person teams may be required to clean catch basins with vactor trucks.
- Teams of at least two people plus administrative personnel are required to identify illicit discharges, depending on the complexity of the storm sewer system.
- Arrangements must be made for proper disposal of collected wastes.
- Technical staff are required to detect and investigate illegal dumping violations.

Supplemental Information

Further Detail of the BMP

Storm Drain Flushing

Flushing is a common maintenance activity used to improve pipe hydraulics and to remove pollutants in storm drainage systems. Flushing may be designed to hydraulically convey accumulated material to strategic locations, such as an open channel, another point where flushing will be initiated, or the sanitary sewer and the treatment facilities, thus preventing resuspension and overflow of a portion of the solids during storm events. Flushing prevents "plug flow" discharges of concentrated pollutant loadings and sediments. Deposits can hinder the designed conveyance capacity of the storm drain system and potentially cause backwater conditions in severe cases of clogging.

Storm drain flushing usually takes place along segments of pipe with grades that are too flat to maintain adequate velocity to keep particles in suspension. An upstream manhole is selected to place an inflatable device that temporarily plugs the pipe. Further upstream, water is pumped into the line to create a flushing wave. When the upstream reach of pipe is sufficiently full to cause a flushing wave, the inflated device is rapidly deflated with the assistance of a vacuum pump, thereby releasing the backed up water and resulting in the cleaning of the storm drain segment.

To further reduce impacts of stormwater pollution, a second inflatable device placed well downstream may be used to recollect the water after the force of the flushing wave has dissipated. A pump may then be used to transfer the water and accumulated material to the sanitary sewer for treatment. In some cases, an interceptor structure may be more practical or required to recollect the flushed waters.

It has been found that cleansing efficiency of periodic flush waves is dependent upon flush volume, flush discharge rate, sewer slope, sewer length, sewer flow rate, sewer diameter, and population density. As a rule of thumb, the length of line to be flushed should not exceed 700 feet. At this maximum recommended length, the percent removal efficiency ranges between 65-75% for organics and 55-65% for dry weather grit/inorganic material. The percent removal efficiency drops rapidly beyond that. Water is commonly supplied by a water truck, but fire hydrants can also supply water. To make the best use of water, it is recommended that reclaimed water be used or that fire hydrant line flushing coincide with storm sewer flushing.

References and Resources

California's Nonpoint Source Program Plan http://www.swrcb.ca.gov/nps/index.html

Clark County Storm Water Pollution Control Manual
http://www.co.clark.wa.us/pubworks/bmpman.pdf

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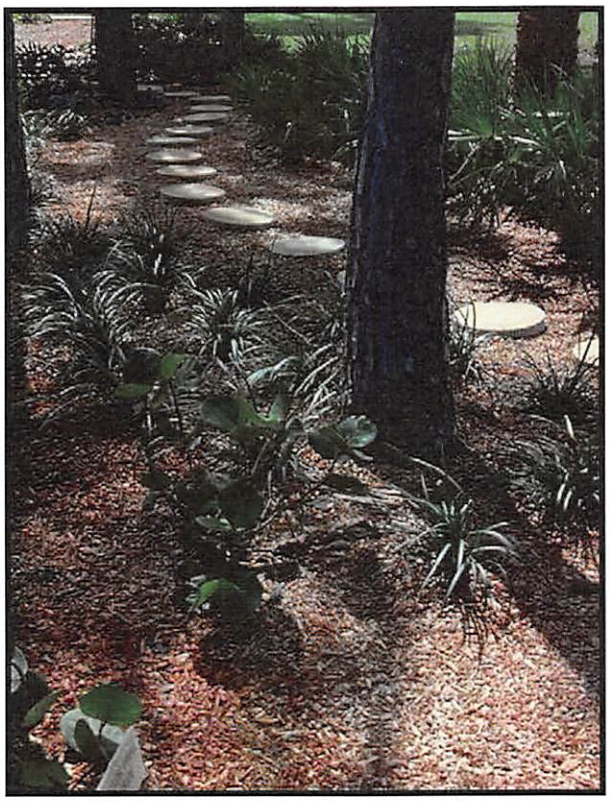
Site Design & Landscape Planning SD-10



Design Objectives

- ☑ Maximize Infiltration
- ☑ Provide Retention
- ☑ Slow Runoff
- ☑ Minimize Impervious Land Coverage
- Prohibit Dumping of Improper Materials
- Contain Pollutants
- Collect and Convey

Description

Each project site possesses unique topographic, hydrologic, and vegetative features, some of which are more suitable for development than others. Integrating and incorporating appropriate landscape planning methodologies into the project design is the most effective action that can be done to minimize surface and groundwater contamination from stormwater.

Approach

Landscape planning should couple consideration of land suitability for urban uses with consideration of community goals and projected growth. Project plan designs should conserve natural areas to the extent possible, maximize natural water storage and infiltration opportunities, and protect slopes and channels.

Suitable Applications

Appropriate applications include residential, commercial and industrial areas planned for development or redevelopment.

Design Considerations

Design requirements for site design and landscapes planning should conform to applicable standards and specifications of agencies with jurisdiction and be consistent with applicable General Plan and Local Area Plan policies.

CASQA
CALIFORNIA STORMWATER QUALITY ASSOCIATION

Designing New Installations

Begin the development of a plan for the landscape unit with attention to the following general principles:

- Formulate the plan on the basis of clearly articulated community goals. Carefully identify conflicts and choices between retaining and protecting desired resources and community growth.
- Map and assess land suitability for urban uses. Include the following landscape features in the assessment: wooded land, open unwooded land, steep slopes, erosion-prone soils, foundation suitability, soil suitability for waste disposal, aquifers, aquifer recharge areas, wetlands, floodplains, surface waters, agricultural lands, and various categories of urban land use. When appropriate, the assessment can highlight outstanding local or regional resources that the community determines should be protected (e.g., a scenic area, recreational area, threatened species habitat, farmland, fish run). Mapping and assessment should recognize not only these resources but also additional areas needed for their sustenance.

Project plan designs should conserve natural areas to the extent possible, maximize natural water storage and infiltration opportunities, and protect slopes and channels.

Conserve Natural Areas during Landscape Planning

If applicable, the following items are required and must be implemented in the site layout during the subdivision design and approval process, consistent with applicable General Plan and Local Area Plan policies:

- Cluster development on least-sensitive portions of a site while leaving the remaining land in a natural undisturbed condition.
- Limit clearing and grading of native vegetation at a site to the minimum amount needed to build lots, allow access, and provide fire protection.
- Maximize trees and other vegetation at each site by planting additional vegetation, clustering tree areas, and promoting the use of native and/or drought tolerant plants.
- Promote natural vegetation by using parking lot islands and other landscaped areas.
- Preserve riparian areas and wetlands.

Maximize Natural Water Storage and Infiltration Opportunities Within the Landscape Unit

- Promote the conservation of forest cover. Building on land that is already deforested affects basin hydrology to a lesser extent than converting forested land. Loss of forest cover reduces interception storage, detention in the organic forest floor layer, and water losses by evapotranspiration, resulting in large peak runoff increases and either their negative effects or the expense of countering them with structural solutions.
- Maintain natural storage reservoirs and drainage corridors, including depressions, areas of permeable soils, swales, and intermittent streams. Develop and implement policies and

regulations to discourage the clearing, filling, and channelization of these features. Utilize them in drainage networks in preference to pipes, culverts, and engineered ditches.

- Evaluating infiltration opportunities by referring to the stormwater management manual for the jurisdiction and pay particular attention to the selection criteria for avoiding groundwater contamination, poor soils, and hydrogeological conditions that cause these facilities to fail. If necessary, locate developments with large amounts of impervious surfaces or a potential to produce relatively contaminated runoff away from groundwater recharge areas.

Protection of Slopes and Channels during Landscape Design

- Convey runoff safely from the tops of slopes.
- Avoid disturbing steep or unstable slopes.
- Avoid disturbing natural channels.
- Stabilize disturbed slopes as quickly as possible.
- Vegetate slopes with native or drought tolerant vegetation.
- Control and treat flows in landscaping and/or other controls prior to reaching existing natural drainage systems.
- Stabilize temporary and permanent channel crossings as quickly as possible, and ensure that increases in run-off velocity and frequency caused by the project do not erode the channel.
- Install energy dissipaters, such as riprap, at the outlets of new storm drains, culverts, conduits, or channels that enter unlined channels in accordance with applicable specifications to minimize erosion. Energy dissipaters shall be installed in such a way as to minimize impacts to receiving waters.
- Line on-site conveyance channels where appropriate, to reduce erosion caused by increased flow velocity due to increases in tributary impervious area. The first choice for linings should be grass or some other vegetative surface, since these materials not only reduce runoff velocities, but also provide water quality benefits from filtration and infiltration. If velocities in the channel are high enough to erode grass or other vegetative linings, riprap, concrete, soil cement, or geo-grid stabilization are other alternatives.
- Consider other design principles that are comparable and equally effective.

Redeveloping Existing Installations

Various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.) define "redevelopment" in terms of amounts of additional impervious area, increases in gross floor area and/or exterior construction, and land disturbing activities with structural or impervious surfaces. The definition of " redevelopment" must be consulted to determine whether or not the requirements for new development apply to areas intended for redevelopment. If the definition applies, the steps outlined under "designing new installations" above should be followed.

Redevelopment may present significant opportunity to add features which had not previously been implemented. Examples include incorporation of depressions, areas of permeable soils, and swales in newly redeveloped areas. While some site constraints may exist due to the status of already existing infrastructure, opportunities should not be missed to maximize infiltration, slow runoff, reduce impervious areas, disconnect directly connected impervious areas.

Other Resources

A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), Los Angeles County Department of Public Works, May 2002.

Stormwater Management Manual for Western Washington, Washington State Department of Ecology, August 2001.

Model Standard Urban Storm Water Mitigation Plan (SUSMP) for San Diego County, Port of San Diego, and Cities in San Diego County, February 14, 2002.

Model Water Quality Management Plan (WQMP) for County of Orange, Orange County Flood Control District, and the Incorporated Cities of Orange County, Draft February 2003.

Ventura Countywide Technical Guidance Manual for Stormwater Quality Control Measures, July 2002.

Roof Runoff Controls SD-11

Rain Garden

Design Objectives

- ☑ Maximize Infiltration
- ☑ Provide Retention
- ☑ Slow Runoff
- Minimize Impervious Land Coverage
- Prohibit Dumping of Improper Materials
- ☑ Contain Pollutants
- Collect and Convey

Description

Various roof runoff controls are available to address stormwater that drains off rooftops. The objective is to reduce the total volume and rate of runoff from individual lots, and retain the pollutants on site that may be picked up from roofing materials and atmospheric deposition. Roof runoff controls consist of directing the roof runoff away from paved areas and mitigating flow to the storm drain system through one of several general approaches: cisterns or rain barrels; dry wells or infiltration trenches; pop-up emitters, and foundation planting. The first three approaches require the roof runoff to be contained in a gutter and downspout system. Foundation planting provides a vegetated strip under the drip line of the roof.

Approach

Design of individual lots for single-family homes as well as lots for higher density residential and commercial structures should consider site design provisions for containing and infiltrating roof runoff or directing roof runoff to vegetative swales or buffer areas. Retained water can be reused for watering gardens, lawns, and trees. Benefits to the environment include reduced demand for potable water used for irrigation, improved stormwater quality, increased groundwater recharge, decreased runoff volume and peak flows, and decreased flooding potential.

Suitable Applications

Appropriate applications include residential, commercial and industrial areas planned for development or redevelopment.

Design Considerations

Designing New Installations

Cisterns or Rain Barrels

One method of addressing roof runoff is to direct roof downspouts to cisterns or rain barrels. A cistern is an above ground storage vessel with either a manually operated valve or a permanently open outlet. Roof runoff is temporarily stored and then released for irrigation or infiltration between storms. The number of rain

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barrels needed is a function of the rooftop area. Some low impact developers recommend that every house have at least 2 rain barrels, with a minimum storage capacity of 1000 liters. Roof barrels serve several purposes including mitigating the first flush from the roof which has a high volume, amount of contaminants, and thermal load. Several types of rain barrels are commercially available. Consideration must be given to selecting rain barrels that are vector proof and childproof. In addition, some barrels are designed with a bypass valve that filters out grit and other contaminants and routes overflow to a soak-away pit or rain garden.

If the cistern has an operable valve, the valve can be closed to store stormwater for irrigation or infiltration between storms. This system requires continual monitoring by the resident or grounds crews, but provides greater flexibility in water storage and metering. If a cistern is provided with an operable valve and water is stored inside for long periods, the cistern must be covered to prevent mosquitoes from breeding.

A cistern system with a permanently open outlet can also provide for metering stormwater runoff. If the cistern outlet is significantly smaller than the size of the downspout inlet (say ¼ to ½ inch diameter), runoff will build up inside the cistern during storms, and will empty out slowly after peak intensities subside. This is a feasible way to mitigate the peak flow increases caused by rooftop impervious land coverage, especially for the frequent, small storms.

Dry wells and Infiltration Trenches

Roof downspouts can be directed to dry wells or infiltration trenches. A dry well is constructed by excavating a hole in the ground and filling it with an open graded aggregate, and allowing the water to fill the dry well and infiltrate after the storm event. An underground connection from the downspout conveys water into the dry well, allowing it to be stored in the voids. To minimize sedimentation from lateral soil movement, the sides and top of the stone storage matrix can be wrapped in a permeable filter fabric, though the bottom may remain open. A perforated observation pipe can be inserted vertically into the dry well to allow for inspection and maintenance.

In practice, dry wells receiving runoff from single roof downspouts have been successful over long periods because they contain very little sediment. They must be sized according to the amount of rooftop runoff received, but are typically 4 to 5 feet square, and 2 to 3 feet deep, with a minimum of 1-foot soil cover over the top (maximum depth of 10 feet).

To protect the foundation, dry wells must be set away from the building at least 10 feet. They must be installed in solids that accommodate infiltration. In poorly drained soils, dry wells have very limited feasibility.

Infiltration trenches function in a similar manner and would be particularly effective for larger roof areas. An infiltration trench is a long, narrow, rock-filled trench with no outlet that receives stormwater runoff. These are described under Treatment Controls.

Pop-up Drainage Emitter

Roof downspouts can be directed to an underground pipe that daylights some distance from the building foundation, releasing the roof runoff through a pop-up emitter. Similar to a pop-up irrigation head, the emitter only opens when there is flow from the roof. The emitter remains flush to the ground during dry periods, for ease of lawn or landscape maintenance.

Foundation Planting

Landscape planting can be provided around the base to allow increased opportunities for stormwater infiltration and protect the soil from erosion caused by concentrated sheet flow coming off the roof. Foundation plantings can reduce the physical impact of water on the soil and provide a subsurface matrix of roots that encourage infiltration. These plantings must be sturdy enough to tolerate the heavy runoff sheet flows, and periodic soil saturation.

Redeveloping Existing Installations

Various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.) define "redevelopment" in terms of amounts of additional impervious area, increases in gross floor area and/or exterior construction, and land disturbing activities with structural or impervious surfaces. The definition of " redevelopment" must be consulted to determine whether or not the requirements for new development apply to areas intended for redevelopment. If the definition applies, the steps outlined under "designing new installations" above should be followed.

Supplemental Information

Examples

- City of Ottawa's Water Links Surface –Water Quality Protection Program
- City of Toronto Downspout Disconnection Program
- City of Boston, MA, Rain Barrel Demonstration Program

Other Resources

Hager, Marty Catherine, Stormwater, "Low-Impact Development", January/February 2003. www.stormh2o.com

Low Impact Urban Design Tools, Low Impact Development Design Center, Beltsville, MD. www.lid-stormwater.net

Start at the Source, Bay Area Stormwater Management Agencies Association, 1999 Edition

Efficient Irrigation SD-12

Design Objectives

- ☑ Maximize Infiltration
- ☑ Provide Retention
- ☑ Slow Runoff
- Minimize Impervious Land Coverage
- Prohibit Dumping of Improper Materials
- Contain Pollutants
- Collect and Convey

Description

Irrigation water provided to landscaped areas may result in excess irrigation water being conveyed into stormwater drainage systems.

Approach

Project plan designs for development and redevelopment should include application methods of irrigation water that minimize runoff of excess irrigation water into the stormwater conveyance system.

Suitable Applications

Appropriate applications include residential, commercial and industrial areas planned for development or redevelopment. (Detached residential single-family homes are typically excluded from this requirement.)

Design Considerations

Designing New Installations

The following methods to reduce excessive irrigation runoff should be considered, and incorporated and implemented where determined applicable and feasible by the Permittee:

- Employ rain-triggered shutoff devices to prevent irrigation after precipitation.
- Design irrigation systems to each landscape area's specific water requirements.
- Include design featuring flow reducers or shutoff valves triggered by a pressure drop to control water loss in the event of broken sprinkler heads or lines.
- Implement landscape plans consistent with County or City water conservation resolutions, which may include provision of water sensors, programmable irrigation times (for short cycles), etc.

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- Design timing and application methods of irrigation water to minimize the runoff of excess irrigation water into the storm water drainage system.
- Group plants with similar water requirements in order to reduce excess irrigation runoff and promote surface filtration. Choose plants with low irrigation requirements (for example, native or drought tolerant species). Consider design features such as:
  - Using mulches (such as wood chips or bar) in planter areas without ground cover to minimize sediment in runoff
  - Installing appropriate plant materials for the location, in accordance with amount of sunlight and climate, and use native plant materials where possible and/or as recommended by the landscape architect
  - Leaving a vegetative barrier along the property boundary and interior watercourses, to act as a pollutant filter, where appropriate and feasible
  - Choosing plants that minimize or eliminate the use of fertilizer or pesticides to sustain growth
- Employ other comparable, equally effective methods to reduce irrigation water runoff.

Redeveloping Existing Installations

Various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.) define "redevelopment" in terms of amounts of additional impervious area, increases in gross floor area and/or exterior construction, and land disturbing activities with structural or impervious surfaces. The definition of " redevelopment" must be consulted to determine whether or not the requirements for new development apply to areas intended for redevelopment. If the definition applies, the steps outlined under "designing new installations" above should be followed.

Other Resources

A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), Los Angeles County Department of Public Works, May 2002.

Model Standard Urban Storm Water Mitigation Plan (SUSMP) for San Diego County, Port of San Diego, and Cities in San Diego County, February 14, 2002.

Model Water Quality Management Plan (WQMP) for County of Orange, Orange County Flood Control District, and the Incorporated Cities of Orange County, Draft February 2003.

Ventura Countywide Technical Guidance Manual for Stormwater Quality Control Measures, July 2002.

Storm Drain Signage SD-13

Design Objectives

- Maximize Infiltration
- Provide Retention
- Slow Runoff
- Minimize Impervious Land Coverage
- ☑ Prohibit Dumping of Improper Materials
- Contain Pollutants
- Collect and Convey

Description

Waste materials dumped into storm drain inlets can have severe impacts on receiving and ground waters. Posting notices regarding discharge prohibitions at storm drain inlets can prevent waste dumping. Storm drain signs and stencils are highly visible source controls that are typically placed directly adjacent to storm drain inlets.

Approach

The stencil or affixed sign contains a brief statement that prohibits dumping of improper materials into the urban runoff conveyance system. Storm drain messages have become a popular method of alerting the public about the effects of and the prohibitions against waste disposal.

Suitable Applications

Stencils and signs alert the public to the destination of pollutants discharged to the storm drain. Signs are appropriate in residential, commercial, and industrial areas, as well as any other area where contributions or dumping to storm drains is likely.

Design Considerations

Storm drain message markers or placards are recommended at all storm drain inlets within the boundary of a development project. The marker should be placed in clear sight facing toward anyone approaching the inlet from either side. All storm drain inlet locations should be identified on the development site map.

Designing New Installations

The following methods should be considered for inclusion in the project design and show on project plans:

- Provide stenciling or labeling of all storm drain inlets and catch basins, constructed or modified, within the project area with prohibitive language. Examples include "NO DUMPING

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– DRAINS TO OCEAN" and/or other graphical icons to discourage illegal dumping.

- Post signs with prohibitive language and/or graphical icons, which prohibit illegal dumping at public access points along channels and creeks within the project area.

Note - Some local agencies have approved specific signage and/or storm drain message placards for use. Consult local agency stormwater staff to determine specific requirements for placard types and methods of application.

Redeveloping Existing Installations

Various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.) define "redevelopment" in terms of amounts of additional impervious area, increases in gross floor area and/or exterior construction, and land disturbing activities with structural or impervious surfaces. If the project meets the definition of "redevelopment", then the requirements stated under " designing new installations" above should be included in all project design plans.

Additional Information

Maintenance Considerations

- Legibility of markers and signs should be maintained. If required by the agency with jurisdiction over the project, the owner/operator or homeowner's association should enter into a maintenance agreement with the agency or record a deed restriction upon the property title to maintain the legibility of placards or signs.

Placement

- Signage on top of curbs tends to weather and fade.

- Signage on face of curbs tends to be worn by contact with vehicle tires and sweeper brooms.

Supplemental Information

Examples

- Most MS4 programs have storm drain signage programs. Some MS4 programs will provide stencils, or arrange for volunteers to stencil storm drains as part of their outreach program.

Other Resources

A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), Los Angeles County Department of Public Works, May 2002.

Model Standard Urban Storm Water Mitigation Plan (SUSMP) for San Diego County, Port of San Diego, and Cities in San Diego County, February 14, 2002.

Model Water Quality Management Plan (WQMP) for County of Orange, Orange County Flood Control District, and the Incorporated Cities of Orange County, Draft February 2003.

Ventura Countywide Technical Guidance Manual for Stormwater Quality Control Measures, July 2002.

Trash Storage Areas SD-32

Description

Trash storage areas are areas where a trash receptacle (s) are located for use as a repository for solid wastes. Stormwater runoff from areas where trash is stored or disposed of can be polluted. In addition, loose trash and debris can be easily transported by water or wind into nearby storm drain inlets, channels, and/or creeks. Waste handling operations that may be sources of stormwater pollution include dumpsters, litter control, and waste piles.

Approach

This fact sheet contains details on the specific measures required to prevent or reduce pollutants in stormwater runoff associated with trash storage and handling. Preventative measures including enclosures, containment structures, and impervious pavements to mitigate spills, should be used to reduce the likelihood of contamination.

Design Objectives

- Maximize Infiltration
- Provide Retention
- Slow Runoff
- Minimize Impervious Land Coverage
- Prohibit Dumping of Improper Materials
- ☑ Contain Pollutants
- Collect and Convey

Suitable Applications

Appropriate applications include residential, commercial and industrial areas planned for development or redevelopment. (Detached residential single-family homes are typically excluded from this requirement.)

Design Considerations

Design requirements for waste handling areas are governed by Building and Fire Codes, and by current local agency ordinances and zoning requirements. The design criteria described in this fact sheet are meant to enhance and be consistent with these code and ordinance requirements. Hazardous waste should be handled in accordance with legal requirements established in Title 22, California Code of Regulation.

Wastes from commercial and industrial sites are typically hauled by either public or commercial carriers that may have design or access requirements for waste storage areas. The design criteria in this fact sheet are recommendations and are not intended to be in conflict with requirements established by the waste hauler. The waste hauler should be contacted prior to the design of your site trash collection areas. Conflicts or issues should be discussed with the local agency.

Designing New Installations

Trash storage areas should be designed to consider the following structural or treatment control BMPs:

- Design trash container areas so that drainage from adjoining roofs and pavement is diverted around the area(s) to avoid run-on. This might include berming or grading the waste handling area to prevent run-on of stormwater.
- Make sure trash container areas are screened or walled to prevent off-site transport of trash.

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- Use lined bins or dumpsters to reduce leaking of liquid waste.
- Provide roofs, awnings, or attached lids on all trash containers to minimize direct precipitation and prevent rainfall from entering containers.
- Pave trash storage areas with an impervious surface to mitigate spills.
- Do not locate storm drains in immediate vicinity of the trash storage area.
- Post signs on all dumpsters informing users that hazardous materials are not to be disposed of therein.

Redeveloping Existing Installations

Various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.) define "redevelopment" in terms of amounts of additional impervious area, increases in gross floor area and/or exterior construction, and land disturbing activities with structural or impervious surfaces. The definition of " redevelopment" must be consulted to determine whether or not the requirements for new development apply to areas intended for redevelopment. If the definition applies, the steps outlined under "designing new installations" above should be followed.

Additional Information

Maintenance Considerations

The integrity of structural elements that are subject to damage (i.e., screens, covers, and signs) must be maintained by the owner/operator. Maintenance agreements between the local agency and the owner/operator may be required. Some agencies will require maintenance deed restrictions to be recorded of the property title. If required by the local agency, maintenance agreements or deed restrictions must be executed by the owner/operator before improvement plans are approved.

Other Resources

A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), Los Angeles County Department of Public Works, May 2002.

Model Standard Urban Storm Water Mitigation Plan (SUSMP) for San Diego County, Port of San Diego, and Cities in San Diego County, February 14, 2002.

Model Water Quality Management Plan (WQMP) for County of Orange, Orange County Flood Control District, and the Incorporated Cities of Orange County, Draft February 2003.

Ventura Countywide Technical Guidance Manual for Stormwater Quality Control Measures, July 2002.

Infiltration Trench TC-10

Design Considerations

- Accumulation of Metals
- Clogged Soil Outlet Structures
- Vegetation/Landscape Maintenance

Description

An infiltration trench is a long, narrow, rock-filled trench with no outlet that receives stormwater runoff. Runoff is stored in the void space between the stones and infiltrates through the bottom and into the soil matrix. Infiltration trenches perform well for removal of fine sediment and associated pollutants. Pretreatment using buffer strips, swales, or detention basins is important for limiting amounts of coarse sediment entering the trench which can clog and render the trench ineffective.

Targeted Constituents

☑	Sediment	■
☑	Nutrients	■
☑	Trash	■
☑	Metals	■
☑	Bacteria	■
☑	Oil and Grease	■
☑	Organics	■

Legend ***(Removal Effectiveness)***

- ● Low
- ▲ Medium
- ■ High

California Experience

Caltrans constructed two infiltration trenches at highway maintenance stations in Southern California. Of these, one failed to operate to the design standard because of average soil infiltration rates lower than that measured in the single infiltration test. This highlights the critical need for appropriate evaluation of the site. Once in operation, little maintenance was required at either site.

Advantages

- Provides 100% reduction in the load discharged to surface waters.
- An important benefit of infiltration trenches is the approximation of pre-development hydrology during which a significant portion of the average annual rainfall runoff is infiltrated rather than flushed directly to creeks.
- If the water quality volume is adequately sized, infiltration trenches can be useful for providing control of channel forming (erosion) and high frequency (generally less than the 2-year) flood events.

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- As an underground BMP, trenches are unobtrusive and have little impact of site aesthetics.

Limitations

- Have a high failure rate if soil and subsurface conditions are not suitable.
- May not be appropriate for industrial sites or locations where spills may occur.
- The maximum contributing area to an individual infiltration practice should generally be less than 5 acres.
- Infiltration basins require a minimum soil infiltration rate of 0.5 inches/hour, not appropriate at sites with Hydrologic Soil Types C and D.
- If infiltration rates exceed 2.4 inches/hour, then the runoff should be fully treated prior to infiltration to protect groundwater quality.
- Not suitable on fill sites or steep slopes.
- Risk of groundwater contamination in very coarse soils.
- Upstream drainage area must be completely stabilized before construction.
- Difficult to restore functioning of infiltration trenches once clogged.

Design and Sizing Guidelines

- Provide pretreatment for infiltration trenches in order to reduce the sediment load. Pretreatment refers to design features that provide settling of large particles before runoff reaches a management practice, easing the long-term maintenance burden. Pretreatment is important for all structural stormwater management practices, but it is particularly important for infiltration practices. To ensure that pretreatment mechanisms are effective, designers should incorporate practices such as grassed swales, vegetated filter strips, detention, or a plunge pool in series.
- Specify locally available trench rock that is 1.5 to 2.5 inches in diameter.
- Determine the trench volume by assuming the WQV will fill the void space based on the computed porosity of the rock matrix (normally about 35%).
- Determine the bottom surface area needed to drain the trench within 72 hr by dividing the WQV by the infiltration rate.

$$d = \frac{WQV + RFV}{SA}$$

- Calculate trench depth using the following equation:

where:

D = Trench depth

WQV	=	Water quality volume
RFV	=	Rock fill volume
SA	=	Surface area of the trench bottom

- The use of vertical piping, either for distribution or infiltration enhancement shall not be allowed to avoid device classification as a Class V injection well per 40 CFR146.5(e)(4).
- Provide observation well to allow observation of drain time.
- May include a horizontal layer of filter fabric just below the surface of the trench to retain sediment and reduce the potential for clogging.

Construction/Inspection Considerations

Stabilize the entire area draining to the facility before construction begins. If impossible, place a diversion berm around the perimeter of the infiltration site to prevent sediment entrance during construction. Stabilize the entire contributing drainage area before allowing any runoff to enter once construction is complete.

Performance

Infiltration trenches eliminate the discharge of the water quality volume to surface receiving waters and consequently can be considered to have 100% removal of all pollutants within this volume. Transport of some of these constituents to groundwater is likely, although the attenuation in the soil and subsurface layers will be substantial for many constituents.

Infiltration trenches can be expected to remove up to 90 percent of sediments, metals, coliform bacteria and organic matter, and up to 60 percent of phosphorus and nitrogen in the infiltrated runoff (Schueler, 1992). Biochemical oxygen demand (BOD) removal is estimated to be between 70 to 80 percent. Lower removal rates for nitrate, chlorides and soluble metals should be expected, especially in sandy soils (Schueler, 1992). Pollutant removal efficiencies may be improved by using washed aggregate and adding organic matter and loam to the subsoil. The stone aggregate should be washed to remove dirt and fines before placement in the trench. The addition of organic material and loam to the trench subsoil may enhance metals removal through adsorption.

Siting Criteria

The use of infiltration trenches may be limited by a number of factors, including type of native soils, climate, and location of groundwater table. Site characteristics, such as excessive slope of the drainage area, fine-grained soil types, and proximate location of the water table and bedrock, may preclude the use of infiltration trenches. Generally, infiltration trenches are not suitable for areas with relatively impermeable soils containing clay and silt or in areas with fill.

As with any infiltration BMP, the potential for groundwater contamination must be carefully considered, especially if the groundwater is used for human consumption or agricultural purposes. The infiltration trench is not suitable for sites that use or store chemicals or hazardous materials unless hazardous and toxic materials are prevented from entering the trench. In these areas, other BMPs that do not allow interaction with the groundwater should be considered.

The potential for spills can be minimized by aggressive pollution prevention measures. Many municipalities and industries have developed comprehensive spill prevention control and countermeasure (SPCC) plans. These plans should be modified to include the infiltration trench and the contributing drainage area. For example, diversion structures can be used to prevent spills from entering the infiltration trench. Because of the potential to contaminate groundwater, extensive site investigation must be undertaken early in the site planning process to establish site suitability for the installation of an infiltration trench.

Longevity can be increased by careful geotechnical evaluation prior to construction and by designing and implementing an inspection and maintenance plan. Soil infiltration rates and the water table depth should be evaluated to ensure that conditions are satisfactory for proper operation of an infiltration trench. Pretreatment structures, such as a vegetated buffer strip or water quality inlet, can increase longevity by removing sediments, hydrocarbons, and other materials that may clog the trench. Regular maintenance, including the replacement of clogged aggregate, will also increase the effectiveness and life of the trench.

Evaluation of the viability of a particular site is the same as for infiltration basins and includes:

- Determine soil type (consider RCS soil type 'A, B or C' only) from mapping and consult USDA soil survey tables to review other parameters such as the amount of silt and clay, presence of a restrictive layer or seasonal high water table, and estimated permeability. The soil should not have more than 30 percent clay or more than 40 percent of clay and silt combined. Eliminate sites that are clearly unsuitable for infiltration.

- Groundwater separation should be at least 3 m from the basin invert to the measured ground water elevation. There is concern at the state and regional levels of the impact on groundwater quality from infiltrated runoff, especially when the separation between groundwater and the surface is small.

- Location away from buildings, slopes and highway pavement (greater than 6 m) and wells and bridge structures (greater than 30 m). Sites constructed of fill, having a base flow or with a slope greater than 15 percent should not be considered.

- Ensure that adequate head is available to operate flow splitter structures (to allow the basin to be offline) without ponding in the splitter structure or creating backwater upstream of the splitter.

- Base flow should not be present in the tributary watershed.

Secondary Screening Based on Site Geotechnical Investigation

- At least three in-hole conductivity tests shall be performed using USBR 7300-89 or Bouwer-Rice procedures (the latter if groundwater is encountered within the boring), two tests at different locations within the proposed basin and the third down gradient by no more than approximately 10 m. The tests shall measure permeability in the side slopes and the bed within a depth of 3 m of the invert.

- The minimum acceptable hydraulic conductivity as measured in any of the three required test holes is 13 mm/hr. If any test hole shows less than the minimum value, the site should be disqualified from further consideration.

- Exclude from consideration sites constructed in fill or partially in fill unless no silts or clays are present in the soil boring. Fill tends to be compacted, with clays in a dispersed rather than flocculated state, greatly reducing permeability.
- The geotechnical investigation should be such that a good understanding is gained as to how the stormwater runoff will move in the soil (horizontally or vertically) and if there are any geological conditions that could inhibit the movement of water.

Maintenance

Infiltration trenches required the least maintenance of any of the BMPs evaluated in the Caltrans study, with approximately 17 field hours spent on the operation and maintenance of each site. Inspection of the infiltration trench was the largest field activity, requiring approximately 8 hr/yr.

In addition to reduced water quality performance, clogged infiltration trenches with surface standing water can become a nuisance due to mosquito breeding. If the trench takes more than 72 hours to drain, then the rock fill should be removed and all dimensions of the trench should be increased by 2 inches to provide a fresh surface for infiltration.

Cost

Construction Cost

Infiltration trenches are somewhat expensive, when compared to other stormwater practices, in terms of cost per area treated. Typical construction costs, including contingency and design costs, are about \$5 per ft^3 of stormwater treated (SWRPC, 1991; Brown and Schueler, 1997). Actual construction costs may be much higher. The average construction cost of two infiltration trenches installed by Caltrans in southern California was about \$50/ft^3; however, these were constructed as retrofit installations.

Infiltration trenches typically consume about 2 to 3 percent of the site draining to them, which is relatively small. In addition, infiltration trenches can fit into thin, linear areas. Thus, they can generally fit into relatively unusable portions of a site.

Maintenance Cost

One cost concern associated with infiltration practices is the maintenance burden and longevity. If improperly sited or maintained, infiltration trenches have a high failure rate. In general, maintenance costs for infiltration trenches are estimated at between 5 percent and 20 percent of the construction cost. More realistic values are probably closer to the 20-percent range, to ensure long-term functionality of the practice.

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Information Resources

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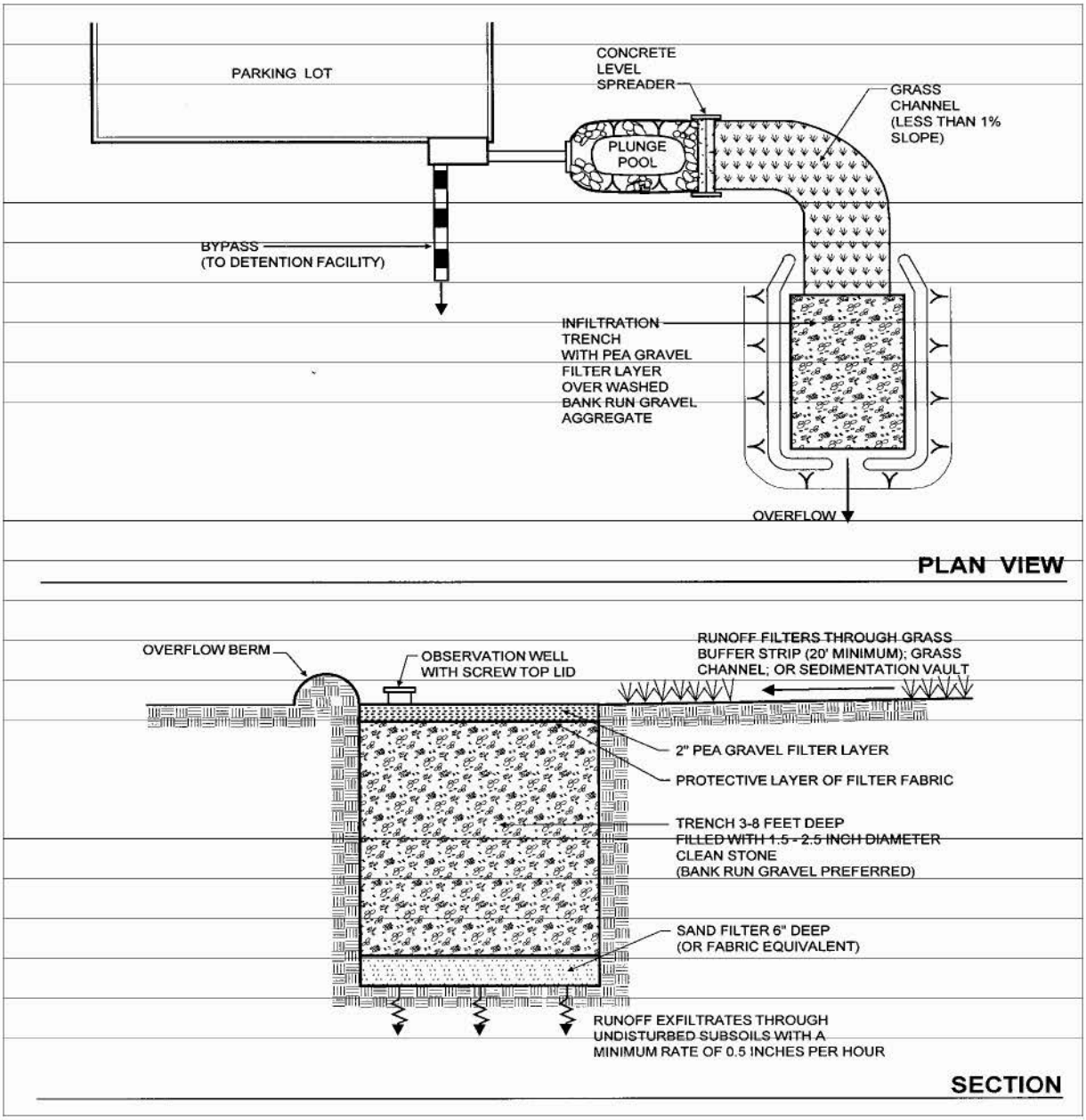
Infiltration Trench TC-10



Infiltration Basin TC-11

Design Considerations

- Soil for Infiltration
- Slope
- Aesthetics

Targeted Constituents

☑	Sediment	■
☑	Nutrients	■
☑	Trash	■
☑	Metals	■
☑	Bacteria	■
☑	Oil and Grease	■
☑	Organics	■

Legend *(Removal Effectiveness)*

● Low ■ High

▲ Medium

Description

An infiltration basin is a shallow impoundment that is designed to infiltrate stormwater. Infiltration basins use the natural filtering ability of the soil to remove pollutants in stormwater runoff. Infiltration facilities store runoff until it gradually exfiltrates through the soil and eventually into the water table. This practice has high pollutant removal efficiency and can also help recharge groundwater, thus helping to maintain low flows in stream systems. Infiltration basins can be challenging to apply on many sites, however, because of soils requirements. In addition, some studies have shown relatively high failure rates compared with other management practices.

California Experience

Infiltration basins have a long history of use in California, especially in the Central Valley. Basins located in Fresno were among those initially evaluated in the National Urban Runoff Program and were found to be effective at reducing the volume of runoff, while posing little long-term threat to groundwater quality (EPA, 1983; Schroeder, 1995). Proper siting of these devices is crucial as underscored by the experience of Caltrans in siting two basins in Southern California. The basin with marginal separation from groundwater and soil permeability failed immediately and could never be rehabilitated.

Advantages

- Provides 100% reduction in the load discharged to surface waters.
- The principal benefit of infiltration basins is the approximation of pre-development hydrology during which a

significant portion of the average annual rainfall runoff is infiltrated and evaporated rather than flushed directly to creeks.

- If the water quality volume is adequately sized, infiltration basins can be useful for providing control of channel forming (erosion) and high frequency (generally less than the 2-year) flood events.

Limitations

- May not be appropriate for industrial sites or locations where spills may occur.
- Infiltration basins require a minimum soil infiltration rate of 0.5 inches/hour, not appropriate at sites with Hydrologic Soil Types C and D.
- If infiltration rates exceed 2.4 inches/hour, then the runoff should be fully treated prior to infiltration to protect groundwater quality.
- Not suitable on fill sites or steep slopes.
- Risk of groundwater contamination in very coarse soils.
- Upstream drainage area must be completely stabilized before construction.
- Difficult to restore functioning of infiltration basins once clogged.

Design and Sizing Guidelines

- Water quality volume determined by local requirements or sized so that 85% of the annual runoff volume is captured.
- Basin sized so that the entire water quality volume is infiltrated within 48 hours.
- Vegetation establishment on the basin floor may help reduce the clogging rate.

Construction/Inspection Considerations

- Before construction begins, stabilize the entire area draining to the facility. If impossible, place a diversion berm around the perimeter of the infiltration site to prevent sediment entrance during construction or remove the top 2 inches of soil after the site is stabililized. Stabilize the entire contributing drainage area, including the side slopes, before allowing any runoff to enter once construction is complete.
- Place excavated material such that it can not be washed back into the basin if a storm occurs during construction of the facility.
- Build the basin without driving heavy equipment over the infiltration surface. Any equipment driven on the surface should have extra-wide ("low pressure") tires. Prior to any construction, rope off the infiltration area to stop entrance by unwanted equipment.
- After final grading, till the infiltration surface deeply.
- Use appropriate erosion control seed mix for the specific project and location.

Performance

As water migrates through porous soil and rock, pollutant attenuation mechanisms include precipitation, sorption, physical filtration, and bacterial degradation. If functioning properly, this approach is presumed to have high removal efficiencies for particulate pollutants and moderate removal of soluble pollutants. Actual pollutant removal in the subsurface would be expected to vary depending upon site-specific soil types. This technology eliminates discharge to surface waters except for the very largest storms; consequently, complete removal of all stormwater constituents can be assumed.

There remain some concerns about the potential for groundwater contamination despite the findings of the NURP and Nightingale (1975; 1987a,b,c; 1989). For instance, a report by Pitt et al. (1994) highlighted the potential for groundwater contamination from intentional and unintentional stormwater infiltration. That report recommends that infiltration facilities not be sited in areas where high concentrations are present or where there is a potential for spills of toxic material. Conversely, Schroeder (1995) reported that there was no evidence of groundwater impacts from an infiltration basin serving a large industrial catchment in Fresno, CA.

Siting Criteria

The key element in siting infiltration basins is identifying sites with appropriate soil and hydrogeologic properties, which is critical for long term performance. In one study conducted in Prince George's County, Maryland (Galli, 1992), all of the infiltration basins investigated clogged within 2 years. It is believed that these failures were for the most part due to allowing infiltration at sites with rates of less than 0.5 in/hr, basing siting on soil type rather than field infiltration tests, and poor construction practices that resulted in soil compaction of the basin invert.

A study of 23 infiltration basins in the Pacific Northwest showed better long-term performance in an area with highly permeable soils (Hilding, 1996). In this study, few of the infiltration basins had failed after 10 years. Consequently, the following guidelines for identifying appropriate soil and subsurface conditions should be rigorously adhered to.

- Determine soil type (consider RCS soil type 'A, B or C' only) from mapping and consult USDA soil survey tables to review other parameters such as the amount of silt and clay, presence of a restrictive layer or seasonal high water table, and estimated permeability. The soil should not have more than 30% clay or more than 40% of clay and silt combined. Eliminate sites that are clearly unsuitable for infiltration.

- Groundwater separation should be at least 3 m from the basin invert to the measured ground water elevation. There is concern at the state and regional levels of the impact on groundwater quality from infiltrated runoff, especially when the separation between groundwater and the surface is small.

- Location away from buildings, slopes and highway pavement (greater than 6 m) and wells and bridge structures (greater than 30 m). Sites constructed of fill, having a base flow or with a slope greater than 15% should not be considered.

- Ensure that adequate head is available to operate flow splitter structures (to allow the basin to be offline) without ponding in the splitter structure or creating backwater upstream of the splitter.

- Base flow should not be present in the tributary watershed.

Secondary Screening Based on Site Geotechnical Investigation

- At least three in-hole conductivity tests shall be performed using USBR 7300-89 or Bouwer-Rice procedures (the latter if groundwater is encountered within the boring), two tests at different locations within the proposed basin and the third down gradient by no more than approximately 10 m. The tests shall measure permeability in the side slopes and the bed within a depth of 3 m of the invert.

- The minimum acceptable hydraulic conductivity as measured in any of the three required test holes is 13 mm/hr. If any test hole shows less than the minimum value, the site should be disqualified from further consideration.

- Exclude from consideration sites constructed in fill or partially in fill unless no silts or clays are present in the soil boring. Fill tends to be compacted, with clays in a dispersed rather than flocculated state, greatly reducing permeability.

- The geotechnical investigation should be such that a good understanding is gained as to how the stormwater runoff will move in the soil (horizontally or vertically) and if there are any geological conditions that could inhibit the movement of water.

Additional Design Guidelines

(1) Basin Sizing - The required water quality volume is determined by local regulations or sufficient to capture 85% of the annual runoff.

(2) Provide pretreatment if sediment loading is a maintenance concern for the basin.

(3) Include energy dissipation in the inlet design for the basins. Avoid designs that include a permanent pool to reduce opportunity for standing water and associated vector problems.

(4) Basin invert area should be determined by the equation:

$$A = \frac{WQV}{kt}$$

where A = Basin invert area (m^2)

WQV = water quality volume (m^3)

k = 0.5 times the lowest field-measured hydraulic conductivity (m/hr)

t = drawdown time (48 hr)

(5) The use of vertical piping, either for distribution or infiltration enhancement shall not be allowed to avoid device classification as a Class V injection well per 40 CFR146.5(e)(4).

Maintenance

Regular maintenance is critical to the successful operation of infiltration basins. Recommended operation and maintenance guidelines include:

- Inspections and maintenance to ensure that water infiltrates into the subsurface completely (recommended infiltration rate of 72 hours or less) and that vegetation is carefully managed to prevent creating mosquito and other vector habitats.
- Observe drain time for the design storm after completion or modification of the facility to confirm that the desired drain time has been obtained.
- Schedule semiannual inspections for beginning and end of the wet season to identify potential problems such as erosion of the basin side slopes and invert, standing water, trash and debris, and sediment accumulation.
- Remove accumulated trash and debris in the basin at the start and end of the wet season.
- Inspect for standing water at the end of the wet season.
- Trim vegetation at the beginning and end of the wet season to prevent establishment of woody vegetation and for aesthetic and vector reasons.
- Remove accumulated sediment and regrade when the accumulated sediment volume exceeds 10% of the basin.
- If erosion is occurring within the basin, revegetate immediately and stabilize with an erosion control mulch or mat until vegetation cover is established.
- To avoid reversing soil development, scarification or other disturbance should only be performed when there are actual signs of clogging, rather than on a routine basis. Always remove deposited sediments before scarification, and use a hand-guided rotary tiller, if possible, or a disc harrow pulled by a very light tractor.

Cost

Infiltration basins are relatively cost-effective practices because little infrastructure is needed when constructing them. One study estimated the total construction cost at about $2 per ft (adjusted for inflation) of storage for a 0.25-acre basin (SWRPC, 1991). As with other BMPs, these published cost estimates may deviate greatly from what might be incurred at a specific site. For instance, Caltrans spent about $18/ft^3 for the two infiltration basins constructed in southern California, each of which had a water quality volume of about 0.34 ac.-ft. Much of the higher cost can be attributed to changes in the storm drain system necessary to route the runoff to the basin locations.

Infiltration basins typically consume about 2 to 3% of the site draining to them, which is relatively small. Additional space may be required for buffer, landscaping, access road, and fencing. Maintenance costs are estimated at 5 to 10% of construction costs.

One cost concern associated with infiltration practices is the maintenance burden and longevity. If improperly maintained, infiltration basins have a high failure rate. Thus, it may be necessary to replace the basin with a different technology after a relatively short period of time.

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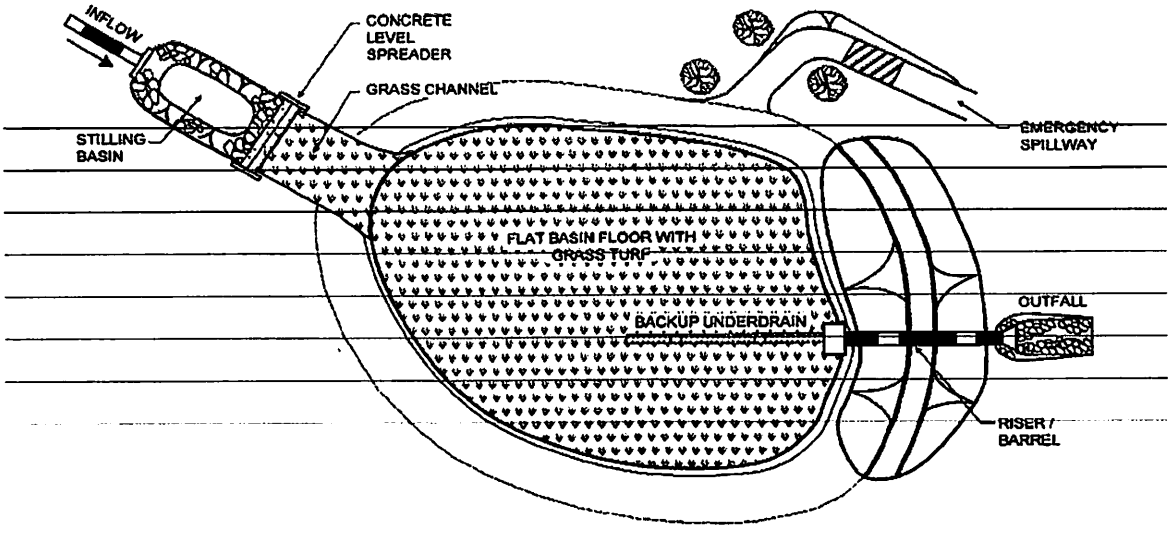
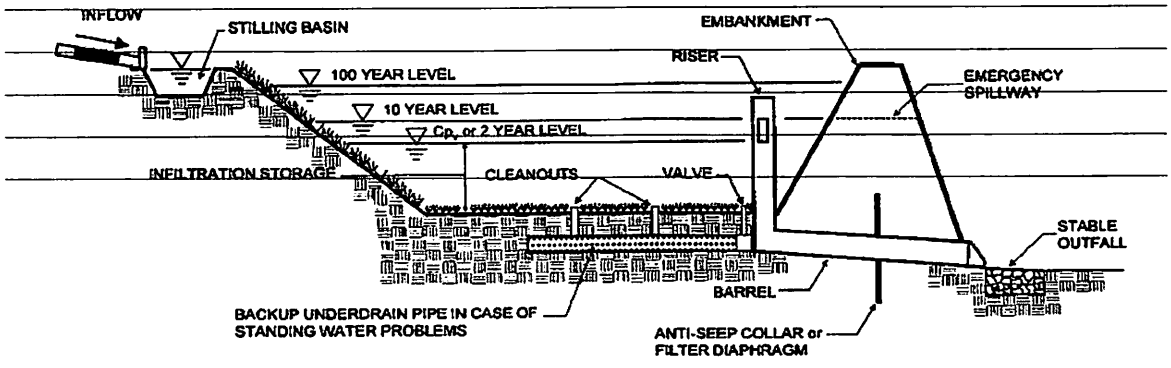


PLAN VIEW



PROFILE

PAMPHLETS

NOTICE

DISCHARGE INTO OUR WATERWAYS, ACCIDENTAL OR NOT, CAN LEAD TO ENFORCEMENT ACTIONS, WHICH CAN INCLUDE FINES.

WHEN WORKING WITH CONCRETE

USE THE 3Cs

CONTROL

Locate the nearest storm drain and ensure nothing can enter or be discharged into it. Use plastic covers and sandbags when working within 50' of a storm drain or catch basin.

CONTAIN

Isolate area and secure bags of cement after they are open. Keep cement, sand and aggregate (wet/dry) and slurries from saw cutting, from flowing into the streets, gutter and storm drains or being blown away. Cover bags of cement in case of rain.

CAPTURE

Sweep dry residue or vacuum wet concrete residue and dispose of properly. Create a designated washout area for equipment and tools and place away from driveways and storm drains. Dispose of concrete/plaster waste and rinsewater by hauling off to an approved disposal site.

To report illegal dumping, call **(877) WASTE18** or visit **sbcountystormwater.org**

SAN BERNARDINO COUNTY STORMWATER POLLUTION PREVENTION

Big Bear • Chino • Chino Hills • Colton • Fontana • Grand Terrace • Highland • Loma Linda • Montclair • Ontario • Rancho Cucamonga
Redlands • Rialto • San Bernardino • San Bernardino County • San Bernardino County Flood Control District • Upland • Yucaipa

AVISO

LA DESCARGA EN NUESTRAS VÍAS FLUVIALES, DE FORMA ACCIDENTAL O NO, PUEDE LLEVAR A TOMAR MEDIDAS PARA CUMPLIR CON LA LEY QUE PUEDEN INCLUIR MULTAS.

CUANDO TRABAJE CON CONCRETO APLIQUE LAS 3 C

CONTROL

Ubique el desagüe pluvial más cercano y asegúrese de que nada pueda entrar en él o que pueda descargarse allí. Use cubiertas de plástico y bolsas de arena cuando trabaje a una distancia de 50' de un desagüe pluvial o sumidero.

CONTENCIÓN

Aísle el área y asegure las bolsas de cemento una vez que las haya abierto. Impida que el cemento, la arena y los componentes del concreto (secos y húmedos) y los residuos acuosos resultantes después de cortar con sierra, fluyan hacia la calle, la alcantarilla y los desagües o que se vuelen con el viento.
Cubra las bolsas de cemento en caso de lluvia.

CAPTURA

Barra los residuos secos o limpie con una aspiradora los residuos de concreto húmedo y elimínelos en forma apropiada. Cree un área específica para enjuagar equipos y herramientas, y colóquela lejos de las entradas de automóviles y de los desagües pluviales.
Desheche los residuos de concreto o yeso y el agua de enjuague, llevándolos a un sitio aprobado para su eliminación.

Para informar sobre el vaciado ilegal de residuos, llame al **(877) WASTE18** o visite el sitio: **sbcountystormwater.org**

PREVENCIÓN DE CONTAMINACIÓN DE AGUAS PLUVIALES EN EL CONDADO DE SAN BERNARDINO

Big Bear • Chino • Chino Hills • Colton • Fontana • Grand Terrace • Highland • Loma Linda • Montclair • Ontario • Rancho Cucamonga • Redlands
Rialto • San Bernardino • Condado de San Bernardino • Distrito de Control de Inundaciones del Condado de San Bernardino • Upland • Yucaipa

SPOT-APPLY

pesticides directly on the problem rather than blanketing the whole area.

sbcountystormwater.org

A SAFE GARDEN:
A LOT DEPENDS ON IT.

San Bernardino County STORMWATER PROGRAM

(877) WASTE18

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ESCASAMENTE

aplique pesticidas directamente en el problema en lugar de distribuirlo en todo el jardín.

sbcountystormwater.org

UN J ARDÍN SANO:
MUCHO DEPENDE DE EL.

San Bernardino County
STORMWATER PROGRAM

(877) WASTE18

Arte Cortesía del Programa de Agua Pluvial de la Ciudad de Los Angeles. Impreso en papel reciclado.

A SAFE GARDEN:
A LOT DEPENDS ON IT.

Protect your family and community when using pesticides and fertilizers.

- **STRATEGICALLY** apply products on your lawn when rain is not expected. Rain can wash toxic chemicals from your lawn into local waterways.
- **SPOT-APPLY** products directly on the problem instead of the whole area. Use less chemicals, and conserve the supply of your product.
- **SAFELY** dispose of unwanted products. The County of San Bernardino offers 9 HHW Centers that accept pesticides, fertilizers and other toxic waste FREE of charge.

To report illegal dumping, call
(877) WASTE18 or visit
sbcountystormwater.org

San Bernardino County STORMWATER PROGRAM

Artwork Courtesy of the City of Los Angeles Stormwater Program. Printed on recycled paper.

UN JARDÍN SANO:
MUCHO DEPENDE DE ÉL.

Proteja a su familia y a su comunidad cuando utilice pesticidas y fertilizantes.

- **ESTRATÉGICAMENTE** aplique productos en su césped solamente cuando no se espera lluvia. La lluvia puede llevarse químicos tóxicos de su césped hacia los canales pluviales en su área.
- **ESCASAMENTE** aplique los productos directamente en el área en donde exista el problema en lugar de distribuirlo en todo el jardín. Así, utilizará menos productos químicos y le rendirá más.
- **ELIMINE** productos tóxicos sanamente. El Condado de San Bernardino ofrece 9 centros de recolección que aceptan pesticidas, fertilizantes y otros desechos tóxicos GRATUITAMENTE.

Para reportar actividades ilegales llamar al
(877) WASTE18 o visite
sbcountystormwater.org

San Bernardino County STORMWATER PROGRAM

Arte Cortesía del Programa de Agua Pluvial de la Ciudad de Los Angeles. Impreso en papel reciclado.

TOO TOXIC TO TRASH

Dispose of your **HOUSEHOLD HAZARDOUS WASTE** (HHW) at a **FREE** HHW Center near you. Examples of items collected: pesticides, fertilizers, paints, cleaners, antifreeze, batteries, motor oil, oil filters, and electronic waste.

SERVICE AREA	LOCATION	DAYS OPEN	HOURS
Big Bear Lake (does not accept E-waste)	42040 Garstin Dr. (cross: Big Bear Blvd.)	Saturdays	9 a.m. - 2 p.m.
Chino	5050 Schaefer Ave. (cross: 4th St.)	2nd & 4th Sat.	8 a.m. - 1 p.m.
Fontana (Fontana residents only)	16454 Orange Way (cross: Cypress Ave.) Note: Provide a trash bill and a driver's license as proof of residency.	Saturdays	8 a.m. - 12 p.m.
Ontario	1430 S. Cucamonga Ave. (cross: Belmont St.)	Fri. & Sat.	9 a.m. - 2 p.m.
Rancho Cucamonga	8794 Lion Street. (Off 9th St, between Vineyard and Hellman)	Saturdays	8 a.m. - 12 p.m.
Redlands	500 Kansas St. (cross: Park Ave.)	Saturdays	9:30 a.m. - 12:30 p.m.
Rialto (does not accept E-waste)	246 Willow Ave. (cross: Rialto Ave.)	2nd & 4th Fri. & Sat.	8 a.m. - 12 p.m.
San Bernardino	2824 East 'W' St., 302 (cross: Victoria Ave.)	Mon. – Fri.	9 a.m. - 4 p.m.
Upland	1370 N. Benson Ave. (cross: 14th St.)	Saturdays	9 a.m. - 2 p.m.

San Bernardino County STORMWATER PROGRAM

To report illegal dumping, call (877) WASTE18
or visit sbcountystormwater.org

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TAKE ONE

MUY TÓXICO PARA LA BASURA

Desháguese de sus **DESECHOS PELIGROSOS** gratuitamente en un centro de recolección cerca de usted. Ejemplos de artículos que se aceptan: pesticidas, fertilizantes, pinturas, limpiadores, anticongelante, baterías, aceite de motores y filtros, y aparatos electrónicos.

ÁREA DE SERVICIO	UBICACIÓN	ABIERTO	HORARIO
Big Bear Lake (no se acepta materiales electronicas)	42040 Garstin Dr. (Big Bear Blvd.)	Sábado	9 a.m. - 2 p.m.
Chino	5050 Schaefer Ave. (4th St.)	2nd & 4th Sábado	8 a.m. - 1 p.m.
Fontana (residentes de Fontana solamente)	16454 Orange Way (Cypress Ave.) Nota: Presentar un recibo de basura y licencia de conducir como prueba de residencia.	Sábado	8 a.m. - 12 p.m.
Ontario	1430 S. Cucamonga Ave. (Belmont St.)	Viernes & Sábado	9 a.m. - 2 p.m.
Rancho Cucamonga	8794 Lion Street (Off 9th St, between Vineyard & Hellman)	Sábado	8 a.m. - 12 p.m.
Redlands	500 Kansas St. (Park Ave.)	Sábado	9:30 a.m. - 12:30 p.m.
Rialto (no se acepta materiales electronicas)	246 Willow Ave. (Rialto Ave.)	2nd & 4th Virnes & Sábado	8 a.m. - 12 p.m.
San Bernardino	2824 East 'W' St., 302 (Victoria Ave.)	Lunes – Viernes	9 a.m. - 4 p.m.
Upland	1370 N. Benson Ave. (14th St.)	Sábado	9 a.m. - 2 p.m.

San Bernardino County STORMWATER PROGRAM

Para reportar actividades ilegales llamar al (877) WASTE18
o visite sbcountystormwater.org

Arte Cortesía del Programa de Agua Pluvial de la Ciudad de Los Angeles. Impreso en papel reciclado.

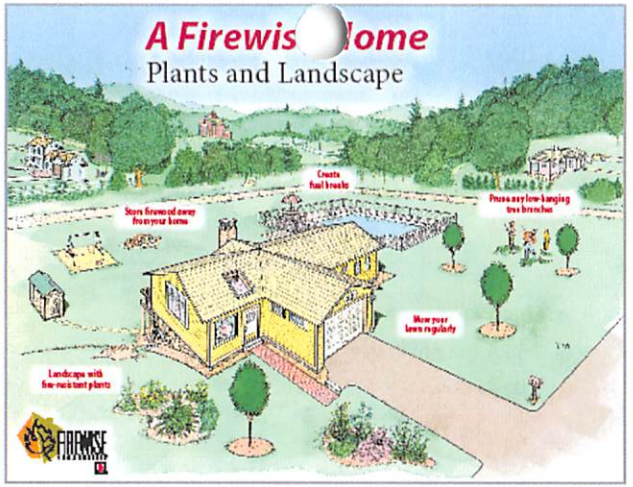
TOME UNO

Home Safety Checklist

Simple fixes from roof to foundation to make your home safer from embers and radiant heat.

HOME SAFETY CHECKLIST

- ☐ Clean roofs and gutters of dead leaves, debris and pine needles that could catch embers.
- ☐ Replace or repair any loose or missing shingles or roof tiles to prevent ember penetration.
- ☐ Enclose under-eave and soffit vents or screen with metal mesh to prevent ember entry.
- ☐ Cover exterior attic vents with metal wire mesh no larger than 1/8 inch to prevent sparks from entering the home.
- ☐ Repair or replace damaged or loose window screens and any broken windows.
- ☐ Screen or box-in areas below patios and decks with wire mesh to prevent debris and combustible materials from accumulating.
- ☐ Move any flammable material away from wall exteriors – mulch, flammable plants, leaves and needles, firewood piles – anything that can burn.
- ☐ Remove anything stored underneath decks or porches.



For More Information

For more information about how to protect your home and property, as well as Firewise plant lists and other resources, visit the Firewise website at www.firewise.org, and see the "homeowners" section.

For more tips on what to do when wildfire is approaching and how to safely evacuate, visit the Ready, Set, Go! website sponsored by the International Association of Fire Chiefs at www.wildlandfirersg.org. Talk to your local fire department to learn more about specific wildfire risks in your area.

Saving Lives and Property from Wildfire!

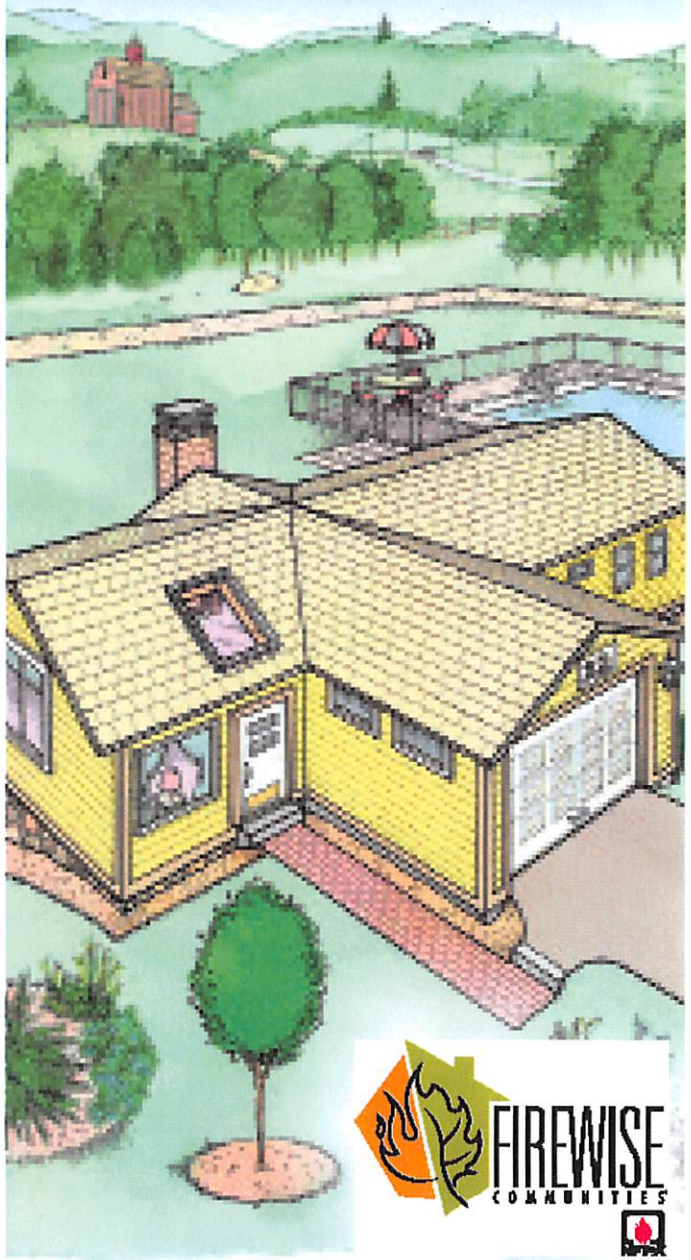
Firewise® is a program of the National Fire Protection Association.

This publication was produced in cooperation with the USDA Forest Service, US Department of the Interior and the National Association of State Foresters.

FWC22612

How to Have a Firewise® Home

You can make your home safer from wildfire. Learn how with these helpful tips!



A Firewise® Home

FIREWISE LANDSCAPING

1. Home Ignition Zone

Keep leaves and needles off your roof and deck. Create a fuel-free area within 3-5 feet of your home's perimeter. From 5 feet to a minimum of 30 feet out, thin and space vegetation, remove dead leaves and needles, prune shrubs and tree limbs. Keep areas around decks, sheds, fences and swing sets clear of debris and vegetation.

2. Landscaping and Firewise Plants

To prevent fire spread, trim back branches that overhang structures and prune branches of large trees up to 6 to 10 feet from the ground. Remove plants containing resins, oils, and waxes; make sure organic mulch is at least 5 feet from structures. Choose Firewise plants – find lists at www.firewise.org or from your local Cooperative Extension service.

BE PREPARED

3. Disaster Plan

Develop, discuss and practice an emergency action plan with everyone in your home. Include details for pets, large animals and livestock. Program cell phones with emergency numbers. Know two ways out of your neighborhood and have a pre-designated meeting place. Have tools such as a shovel, rake, axe, handsaw, or chainsaw available, and maintain an emergency water source. Always leave if you feel unsafe – don't wait to be notified.

4. Emergency Responder Access

Identify your home and neighborhood with legible, clearly marked street names and numbers. Make your driveway at least 12 feet wide with a vertical clearance of 15 feet and a slope of less than 5 percent to provide access to emergency vehicles.

FIREWISE CONSTRUCTION

5. Fire-Resistant Roof Construction

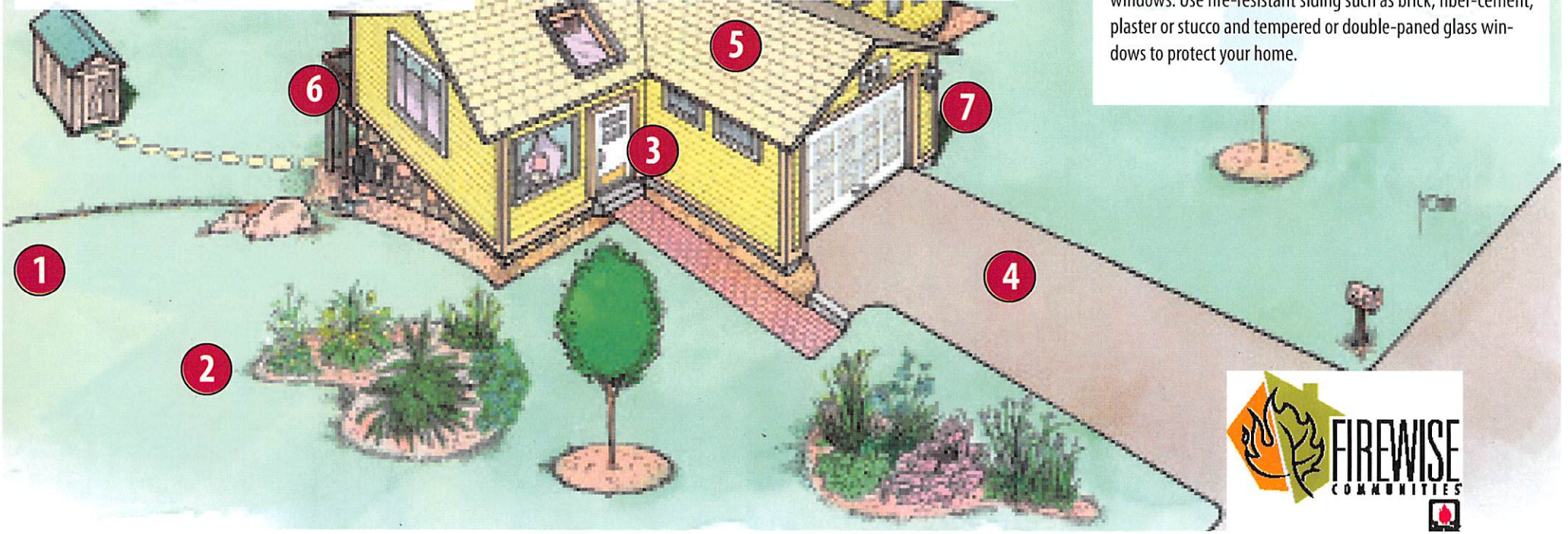
Use fire-rated shingles such as asphalt, metal, slate, clay tile or concrete products. A fire-resistant sub-roof adds protection. Box in eaves, but provide adequate ventilation to prevent condensation and mildew. Roof and attic vents should be screened to prevent ember entry.

6. Fire-Resistant Attachments

Any attachments to your home such as decks, porches, and fences must be fire-resistant. If not, your entire home is vulnerable to ignition.

7. Fire-Resistant Walls and Windows

Embers can collect in small nooks and crannies and ignite combustible materials; radiant heat from flames can crack windows. Use fire-resistant siding such as brick, fiber-cement, plaster or stucco and tempered or double-paned glass windows to protect your home.



FIREWISE COMMUNITIES

LANDSCAPE MAINTENANCE

DISCHARGE TO THE STORM DRAIN, **ACCIDENTAL OR NOT**, COULD LEAD TO ENFORCEMENT ACTIONS, WHICH COULD INCLUDE FINES.

Follow the best practices below to **prevent water pollution from landscaping activities.**

RECYCLE YARD WASTE

- Recycle leaves, grass clippings and other yard waste.
- Do not blow, sweep, rake or hose yard waste into the street or catch basin.
- **Try grasscycling:** the natural recycling of grass by leaving clippings on the lawn when mowing.

  For more information, please visit: **www.calrecycle.ca.gov/organics/grasscycling**

USE FERTILIZERS, HERBICIDES AND PESTICIDES SAFELY

- Fertilizers, herbicides and pesticides are often carried into the storm drain system by sprinkler runoff. Use natural and non-toxic alternatives as often as possible.
- If you must use chemical fertilizers, herbicides or pesticides:
  - Spot apply, rather than blanketing entire areas.
  - Avoid applying near curbs and driveways, and **never** before a rain.
  - Apply fertilizers as needed: when plants could best use it and when the potential runoff would be low.
  - Follow the manufacturer's instructions carefully—this will not only give the best results, but will save money.

USE WATER WISELY

- Control the amount of water and direction of sprinklers. Sprinklers should only be on long enough to allow water to soak into the ground, but not so long as to cause runoff.
- Periodically inspect, fix leaks and realign sprinkler heads.
- Plant native vegetation to reduce the need of water, fertilizers, herbicides and pesticides.

HOMEOWNERS

KEEP THESE TIPS IN MIND WHEN HIRING PROFESSIONAL LANDSCAPERS AND REMIND AS NECESSARY.

Leftover pesticides, fertilizers, and herbicides contaminate landfills and should be disposed of through a Hazardous Waste Facility.

For more information on proper disposal call,

(909) 382-5401 or 1-800-OILY CAT.

*FREE for San Bernardino County residents only. Businesses can call for cost inquiries and to schedule an appointment.

To report illegal dumping, call (877) WASTE18 or visit sbcountystormwater.org
To report toxic spills, call 1(800) 33 TOXIC
To dispose of hazardous waste, call 1(800) OILY CAT

sbcountystormwater.org

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MANTENIMIENTO DE JARDINERÍA

LAS DESCARGAS A LOS DESAGUES PLUVIALES, DE MANERA ACCIDENTAL O NO, PUEDEN INDUCIR A LA APLICACIÓN DE MULTAS Y OTRAS MEDIDAS.

Siga las mejores prácticas descritas debajo para evitar la contaminación del agua por actividades de jardinería.

RECICLAJE DE LOS DESECHOS DE JARDÍN

- Reciclar las hojas, recortes de césped y otros desechos de jardín.
- No soplar, barrer, o usar la manguera para empujar los desechos de jardín a la calle.
- **Poner a prueba el reciclaje de césped (grasscycling): la manera natural de reciclar el césped dejando los recortes sobre el césped cuando son cortados. Para más información, visite la página web: www.calrecycle.ca.gov/organics/grasscycling**

USAR FERTILIZANTES, HERBICIDAS Y PESTICIDAS DE MANERA SEGURA

- Los fertilizantes, herbicidas y pesticidas son arrastrados con frecuencia hacia el sistema de desagüe pluvial mediante el escurrimiento de los rociadores. Use alternativas naturales no tóxicas siempre que sea posible.
- Si tiene que usar fertilizantes, herbicidas o pesticidas químicos:
  Aplicar solo en el sitio necesario, en lugar de cubrir todas las áreas.
  Evitar aplicar cerca de los bordillos y las calzadas, y nunca antes de que llueva.
  Aplicar los fertilizantes cuando sea necesario: esto es, cuando las plantas mejor podrían usarlo y el posible escurrimiento sea bajo.
  Seguir las instrucciones del fabricante cuidadosamente – esto no solo le proporcionará los mejores resultados, pero le permitirá ahorrar dinero.

USAR EL AGUA DE MANERA PRUDENTE

- Controlar la cantidad de agua y la orientación de los rociadores. Los rociadores deben ser **solo lo suficientemente largos como para** permitir que el agua remoje el suelo, pero no tan largos que causen un escurrimiento.
- Inspeccione, repare los escapes y alinee los aspersores periódicamente.
- Siembre plantas nativas para reducir el uso de agua, fertilizantes, herbicidas y pesticidas.

PROPIETARIOS DE HOGARES

Tengan en cuenta estos consejos cuando contraten a paisajistas profesionales y recuérdenselos según sea necesario.

Los sobrantes de pesticidas, fertilizantes y herbicidas contaminan los vertederos y deben ser desechados a través de Plantas de Tratamiento para Residuos Peligrosos.

Para más información sobre el manejo adecuado de residuos peligrosos, llame a (909) 382-5401 o 1-800-OILY CAT.

*GRATIS únicamente para los residentes del Condado de San Bernardino. Las empresas pueden llamar para indagar sobre los costos y concertar una cita

Para denunciar el vertido ilegal de basura, llame al (877) WASTE18 o visite sbcountystormwater.org
Para denunciar derrames tóxicos, llame al 1(800) 33 TOXIC
Para desechar residuos peligrosos, llame al 1(800) OILY CAT

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Paint SAFELY

PAINTS that are water-based are less toxic and should be used whenever possible.

BRUSHES with water-based paint should be washed in the sink. Those with oil-based paint should be cleaned with paint thinner.

SAFELY dispose of unwanted paint. The County of San Bernardino offers 9 HHW Centers that accept paint and other toxic waste FREE of charge.

WE DID IT OURSELVES
AND WE DID IT RIGHT

To report illegal dumping, call
(877) WASTE18 or visit
sbcountystormwater.org

San Bernardino County STORMWATER PROGRAM

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Pinte De Manera

S A N A

PINTURAS a base de agua son menos tóxicas y debe de utilizarlas cuando sea posible.

BROCHAS a base de agua deben ser lavadas en el lavabo. Esas con pintura a base de aceite deben ser limpiadas con disolvente.

SANAMENTE desháguese de la pintura que no necesita. El Condado de San Bernardino ofrece 9 centros de recolección que aceptan pintura y otros desechos tóxicos GRATUITAMENTE.

LO HICIMOS NOSOTROS MISMOS
Y LO HICIMOS BIEN

Para reportar actividades ilegales llamar al
(877) WASTE18 o visite
sbcountystormwater.org

San Bernardino County STORMWATER PROGRAM

Arte Cortesía del Programa de Agua Pluvial de la Ciudad de Los Angeles. Impreso en papel reciclado.

WE DID IT OURSELVES AND WE DID IT RIGHT

When painting your home, protect your family and community.

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San Bernardino County STORMWATER PROGRAM

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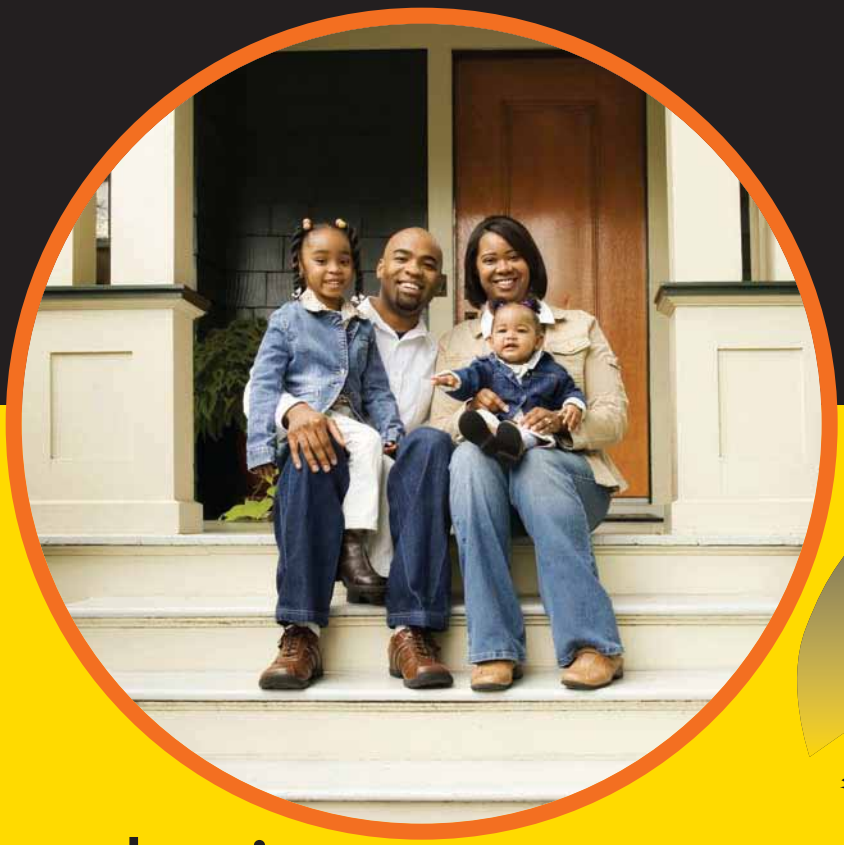

Cuando pinte su casa, proteja a su familia y a su comunidad.

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PICK UP
After Your Pet!

Protect the health of your pet and the environment

For more information about current campaigns visit **sbcountystormwater.org/dog**

facebook.com/sbcountystormwater

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WHY IT MATTERS

PROTECT
YOUR FAMILY AND YOUR PET

- Dog waste can infect children and adults with disease-causing bacteria and parasites.
- Your dog can get infected from the waste of other dogs.

PROTECT
OUR ENVIRONMENT

Leaving dog waste on the streets or on your property can have a negative impact on water quality. Pet waste that's not disposed of properly flows untreated through the storm drain system and directly into our local water bodies. Pet waste is a pollutant that contains nutrients, parasites and bacteria that can affect the quality of our rivers and the ocean and make the water unsafe for swimming, drinking or fishing.

BAG IT AND TRASH IT

It's that simple to protect our health and the environment!

- Keep a supply of bags near your dog leash or tie them to the leash
- Use a poop scooper
- Bring several plastic bags with you
- Reuse plastic grocery bags or purchase special doggie waste bags at pet supplies stores
- Make sure your pet's waste gets into a trash can

Encourage your neighbors and other pet owners to do the right thing and pick up after their pets.




¡RECOJA los desechos de sus mascotas!

Proteja la salud de su mascota y el medio ambiente

Si desea más información, visite
sbcountystormwater.org/dog

facebook.com/sbcountystormwater

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POR QUÉ ES IMPORTANTE

PROTEJA
A SU FAMILIA Y A SU MASCOTA

- Los desechos de los perros pueden infectar a niños y adultos con enfermedades causadas por bacterias y parásitos.
- Su perro puede contraer una infección de los desechos de otros perros.

PROTEJA
EL MEDIO AMBIENTE

Dejar desechos de perros en la calle o en su propiedad puede tener un impacto negativo en la calidad del agua. Los desechos de mascotas que no se eliminan de la propiedad fluyen sin tratamiento por el sistema de drenaje de tormentas y llegan directamente a las masas de agua locales. Los desechos de mascotas son agentes contaminantes que contienen nutrientes, parásitos y bacterias que pueden afectar la calidad de nuestros ríos y océanos, y hacer que el agua no sea segura para nadar, beber o pescar.

COLÓQUELA EN UNA BOLSA Y TÍRELA EN LA BASURA

Así de simple es proteger nuestra salud y el medio ambiente.

- Guarde algunas bolsas cerca de la correa de su perro o átelas a la correa;
- Use una cuchara para recojer el desecho;
- Lleve varias bolsas plásticas;
- Reutilice bolsas plásticas de comestibles o compre bolsas especiales para desechos de perros en las tiendas para mascotas;
- Asegúrese de tirar los desechos de su perro en un cesto de basura.

Aliente a sus vecinos y otros dueños de mascotas a hacer lo correcto y levantar los desechos de sus mascotas.




Refills available at most pet stores

Join your fellow pet owners in keeping your community clean - pick up after your pet.

sbcountystormwater.org
or (877) WASTE18

San Bernardino County
STORMWATER PROGRAM

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WISHFUL THINKING...

UNTIL THIS IS A REALITY,

PLEASE PICK UP AFTER YOUR PET.

San Bernardino County STORMWATER PROGRAM

sbcountystormwater.org
or (877) WASTE18

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Pool Discharge Tips

Maintain your pool properly and help protect the environment

DID YOU KNOW?

Routine swimming pool maintenance generates a variety of wastes such as cleaning wastewater, filter back-wash residues, biocides and acid washes that can contribute to stormwater pollution. Chlorine and other pool chemicals can harm our waterways when they are discharged improperly.

Share these good housekeeping practices with your pool service personnel to keep pollutants out of our waterways:

HOLD IT BEFORE YOU DRAIN IT.

- De-chlorinate the water before draining the pool to the storm drain.
- Consult with your pool contractor before de-chlorinating the pool to learn about your options.

IMPORTANT:

- Dispose of filter backwash solids in the trash or landscape area.
- Neutralize acid washes before discharging to the sewer. Do not discharge to the storm drain.

SHUT: Shut off the chlorination system or stop adding chlorine.

HOLD: Hold the water in the pool for at least 5 days or add a de-chlorinating agent.

TEST: Use a pool testing kit to ensure the level of chlorine is at 0.1ppm before discharging the water.

- Make sure all debris is removed and chemicals are dissipated.
- pH of pool water should be between 6.5 and 8.5 before discharging.
- Make sure the water is free of any discoloration, mosquitoes, dirt or algae.

DRAIN: Check with your city for local requirements before discharging your pool to the storm drain or sewer.

- **Alternative 1:** Sanitary Sewer — Some cities allow pools to be drained to the sanitary sewer during non-peak hours.
- **Alternative 2:** Lawn or Garden — Discharge the pool water through the lawn or garden. The flow should be controlled to prevent erosion problems or the water entering a neighbor's property.
- **For Saltwater Pools:** Saltwater pools should only be drained to the sewer or hauled away.

To report illegal dumping, call (877) WASTE18 or visit sbcountystormwater.org

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Consejos para Vaciar su Piscina

Conserve su piscina en buen estado y ayude a proteger el medio ambiente

¿Sabía que...?

El mantenimiento de la piscina genera desechos, como las aguas residuales de limpieza, los residuos del agua estancada de los filtros y los lavados al ácido y otros químicos, que pueden contribuir a la contaminación de las aguas en las alcantarillas. El cloro y otros productos químicos para piscinas pueden dañar el medio ambiente cuando se desechan de manera inadecuada.

Comparta estas buenas prácticas de limpieza con su personal de servicio de piscinas para mantener las alcantarillas libres de contaminantes:

ESPERE ANTES DE VACIAR.

- Debe eliminar el cloro del agua antes de vaciar la piscina en las alcantarillas.
- Consulte con su contratista de piscina para obtener más información sobre sus opciones.

IMPORTANTE:

- Deseche los sólidos del agua estancada de los filtros en la basura o en el jardín.
- Neutralice los lavados al ácido antes de vaciarlos en la alcantarilla. No deseche nada contaminante en las alcantarillas.

CORTAR:

Corte el sistema de cloración o deje de agregar cloro.

CONSERVAR:

Conserve el agua en la piscina 5 días o agregue un agente de descloración.

PROBAR:

Utilice un equipo de pruebas para piscinas con el fin de asegurar que el nivel de cloro esté en 0.1ppm antes de vaciar el agua.

- Asegúrese de retirar todos los desechos y disipar los químicos.
- El pH del agua de la piscina debe estar entre 6.5 y 8.5 antes del vaciado.
- Asegúrese de que el agua no contenga contaminacion, zancudos, suciedad o algas.

VACIAR:

Verifique los requisitos locales de su ciudad antes de vaciar su piscina en el desagüe de las alcantarillas.

- **Alternativa 1:** Drenaje Sanitario — Algunas ciudades permiten que las piscinas se vacíen en el drenaje sanitario.
- **Alternativa 2:** Césped o Jardín — Vacíe el agua de la piscina en el césped o jardín. Se debe controlar la corriente de agua para evitar problemas de erosión o que el agua entre en la propiedad del vecino.
- **Para las Piscinas de Agua Salada:** Estas piscinas solo se deben ser vaciados en la alcantarilla o se debe transportar el agua y los residuos a algún lugar adecuado.

Para reportar desechos ilegales, comuníquese al (877) WASTE18 o visite sbcountystormwater.org
facebook.com/sbcountystormwater

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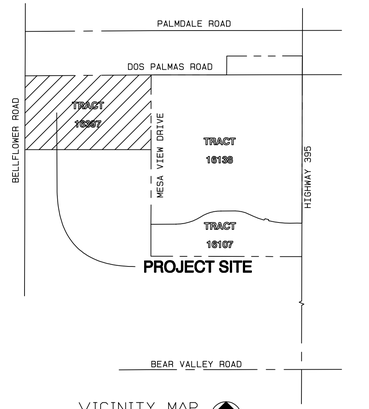
MAPS

PRELIMINARY
WATER QUALITY MANAGEMENT PLAN
TRACT MAP No. 16397
June 11, 2018

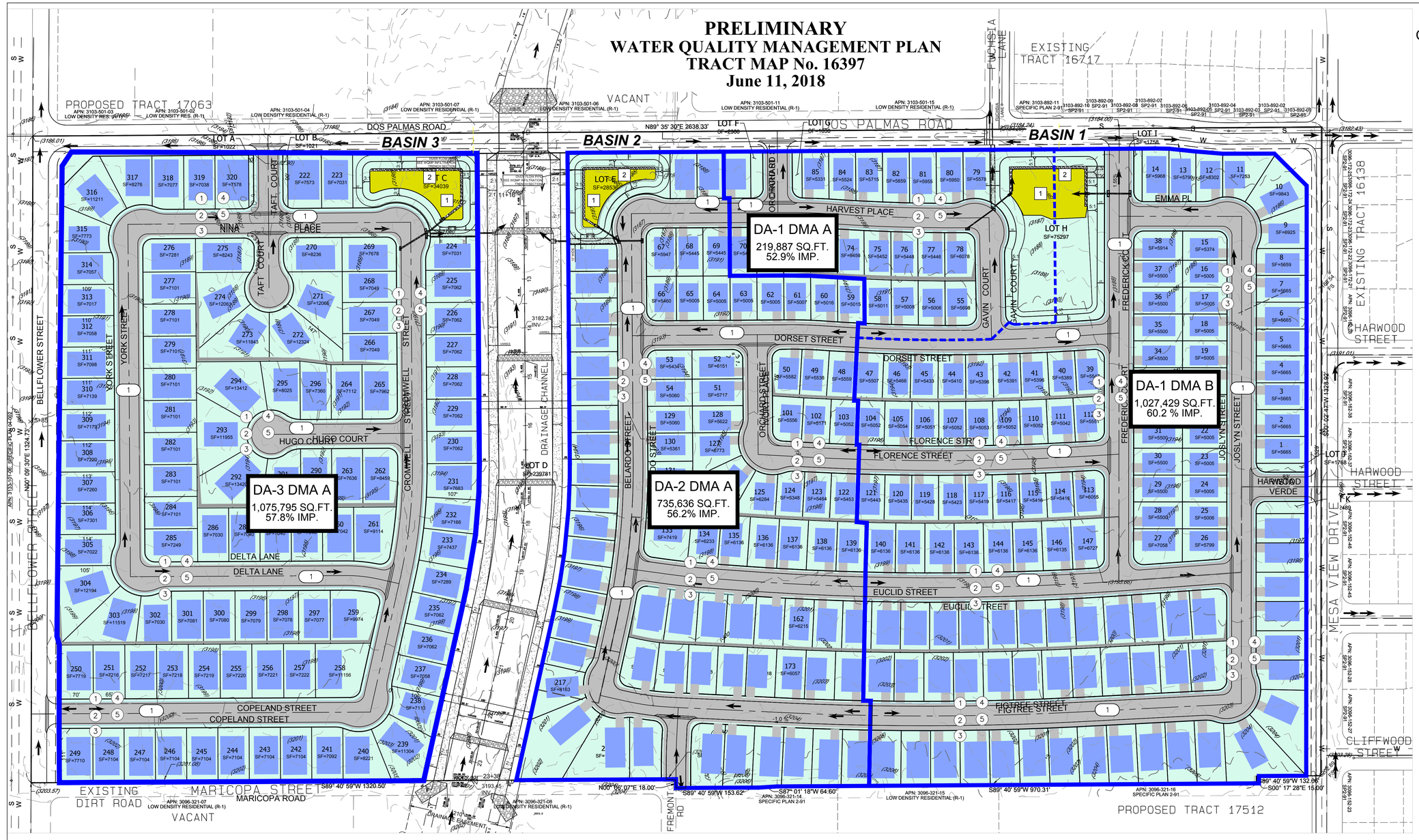
IN THE CITY OF VICTORVILLE,
COUNTY OF SAN BERNARDINO, CALIFORNIA
VESTING TENTATIVE MAP

TRACT NO. 16397

BEING A SUBDIVISION OF THE NORTH 1/2 OF THE NORTHWEST 1/4 OF SECTION 28, TOWNSHIP 5N, RANGE 5W, S.B.B. & M.
LUDWIG ENGINEERING APRIL, 2017



VICINITY MAP
SCALE: 1"=800'



LEGEND

- DRAINAGE MANAGEMENT AREAS
- SITE BOUNDARY/DRAINAGE AREAS
- SWALE OR FLOW LINE
- DRAIN INLET
- PROPOSED CONCRETE AREAS
- PROPOSED CONCRETE PAVING AREAS
- PROPOSED STRUCTURES
- PROPOSED LANDSCAPING AREAS
- TOP / TOE — INDICATES PROPOSED SLOPES
- DA - 1 DMA A / 220,109 SF / 52.837% IMP — INDICATES DRAINAGE MANAGEMENT AREA; INDICATES ACREAGE OF DRAINAGE AREA; INDICATES PERCENTAGE OF DRAINAGE AREA
- INDICATES SURFACE FLOW

PROPOSED PROJECT IMPROVEMENTS:

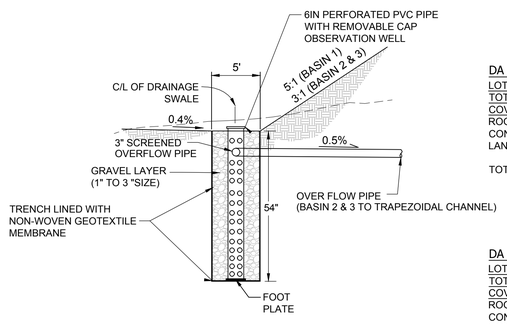
(1) PROPOSED CONCRETE PAVEMENT

PROPOSED TREATMENT CONTROL BMP'S:

(1) INFILTRATION DETENTION BASIN
(2) INFILTRATION TRENCH

N

0 100' 200'



BASIN INFILTRATION TRENCH (TYPICAL)
NOT TO SCALE

DA - 1 COVER INFORMATION:
LOT 262 TO LOT 319 ONLY
TOTAL LOTS= 143

COVER TYPE:	QTY.
ROOF:	383,105 SF.
CONCRETE D/W & S/W & STREET:	352,218 SF.
LANDSCAPING:	511,983 SF.
TOTAL:	1,247,306 S.F.

DA - 2 COVER INFORMATION:
LOT 101 TO LOT 261 ONLY
TOTAL LOTS= 76

COVER TYPE:	QTY.
ROOF:	215,620 SF.
CONCRETE D/W & S/W & STREET:	197,862 SF.
LANDSCAPING:	321,747 SF.
TOTAL:	735,229 S.F.

DA - 3 COVER INFORMATION:
LOT 1 TO LOT 99 ONLY
TOTAL LOTS = 100

COVER TYPE:	QTY.
ROOF:	377,684 SF.
CONCRETE D/W & S/W & STREET:	245,553 SF.
LANDSCAPING:	452,558 SF.
TOTAL:	1,075,795 S.F.

SITE WIDE BMP'S:

(1) SPILL CONTINGENCY
(2) EDUCATION OF PROPERTY OWNERS
(3) LANDSCAPE MANAGEMENT
(4) ACTIVITIES RESTRICTION
(5) IRRIGATION SYSTEM

LOTS 1 - 319 ONLY
AREAS

TOTAL ACREAGE (GROSS)	3,058,329 SF
PERVIOUS AREA	1,286,287 SF
IMPERVIOUS AREA	1,172,042 SF

WQMP BMP AS-BUILT CERTIFICATE

I HEREBY CERTIFY THAT THE NECESSARY WATER QUALITY MANAGEMENT PLAN BEST MANAGEMENT PRACTICE DEVICES HAVE BEEN CONSTRUCTED UNDER MY SUPERVISION AND ARE FUNCTIONAL TO THE BEST OF MY KNOWLEDGE AS OF THE DATE BELOW.

SIGNATURE DATE

REGISTERED PROFESSIONAL ENGINEER
JIMMY J. FRY
NO. C040692
Exp. 3-31-19
CIVIL
STATE OF CALIFORNIA

Ludwig Engineering
ASSOCIATES, INC.
Civil Engineering • Surveying • Planning
109 East Third Street
San Bernardino, CA 92410
Phone: 909-884-8217
Fax: 909-889-0153

15252 Seneca Rd.
Victorville, CA 92392
Phone: 760-951-7676
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5890 Hwy. 95, Ste. 8
Fort Mohave, AZ 86426
Phone: 928-768-1857
Fax: 928-768-7086

2126 McCulloch Blvd., Ste. 8
Lake Havasu City, AZ 86403
Phone: 928-680-6060
Fax: 928-854-6530

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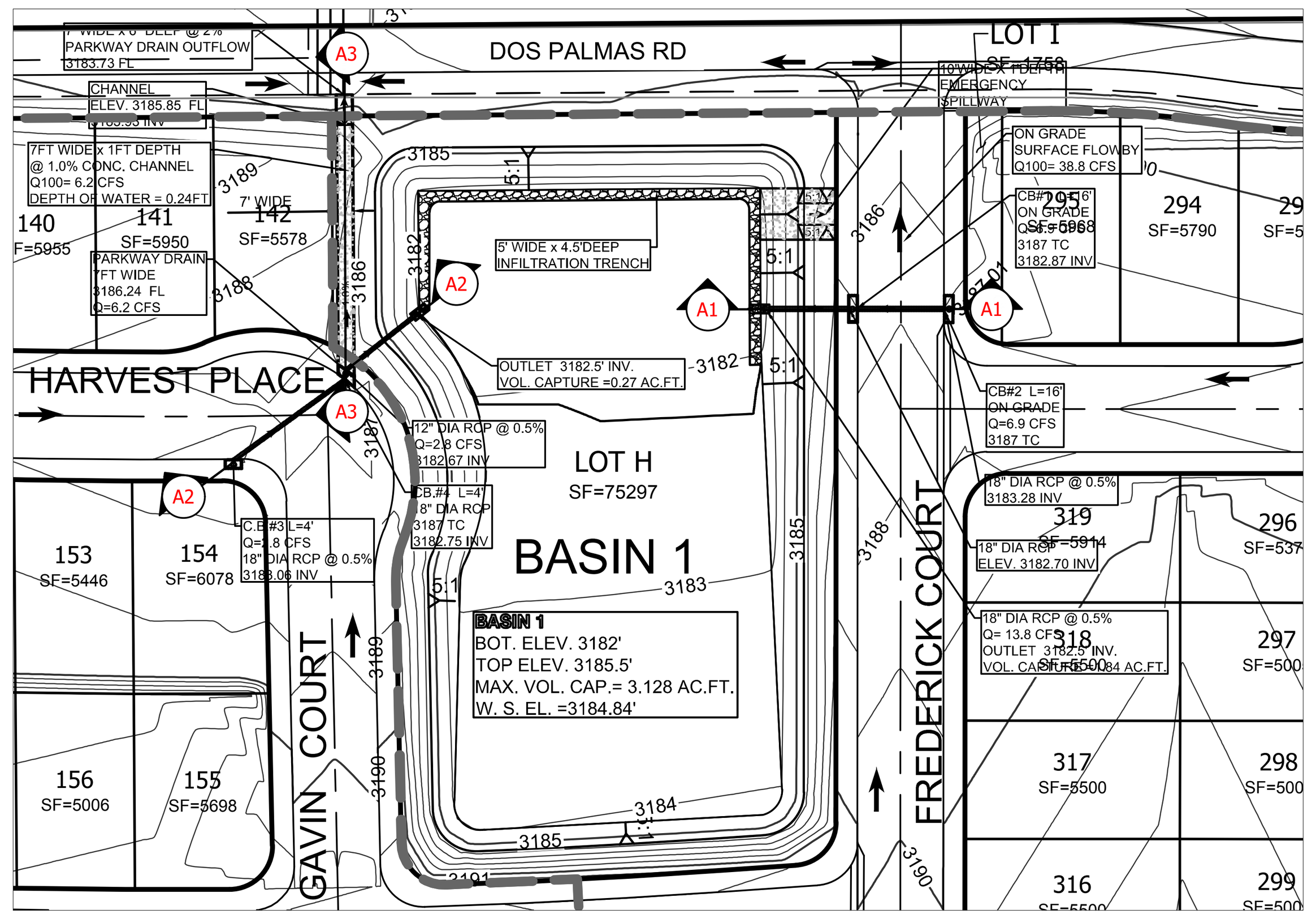
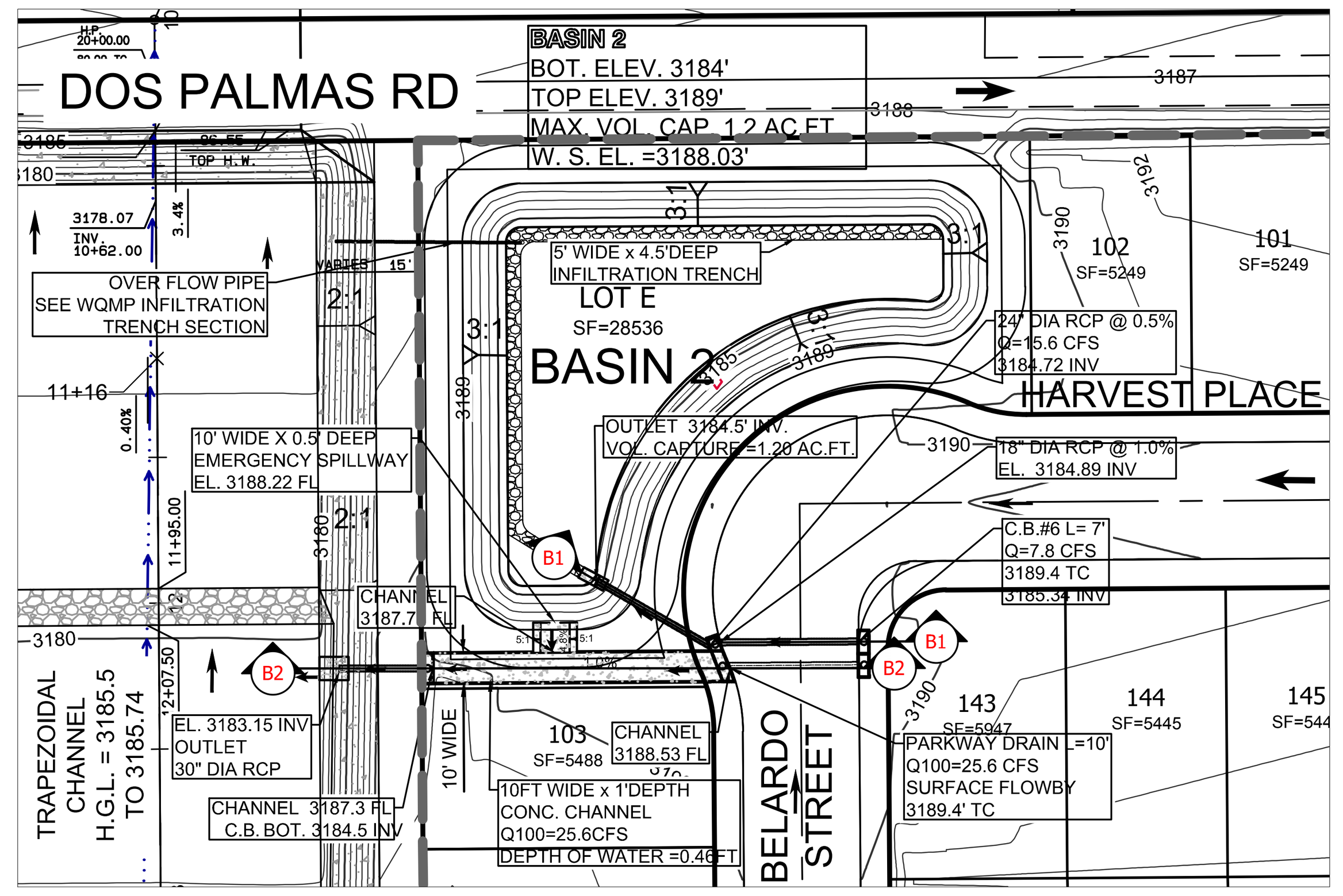


BASIN 1 PLAN

BASIN 1 STAGE STORAGE TABLE

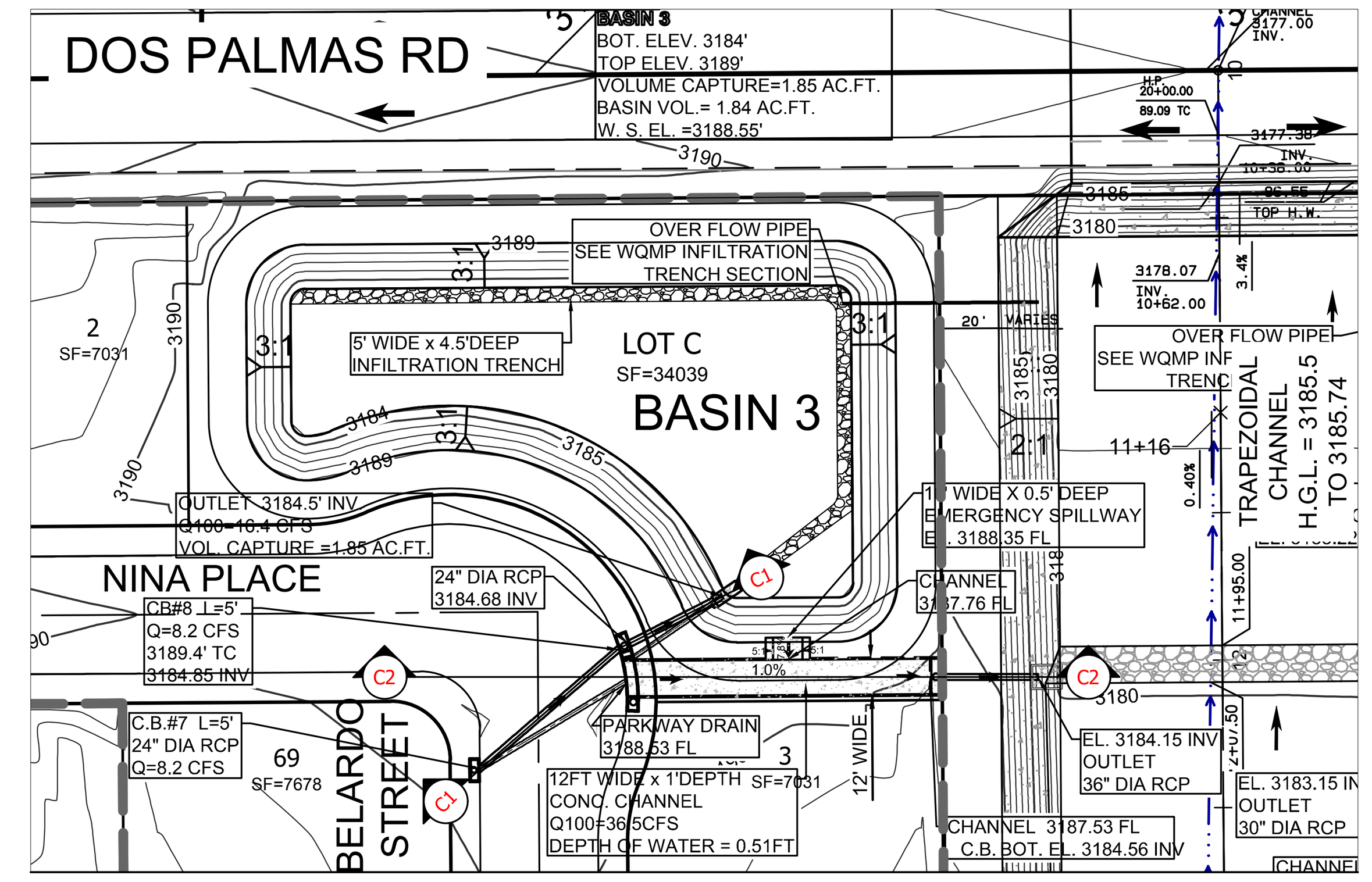
ELEV	AREA (sq. ft.)	DEPTH (ft)	AREA (ac. ft.)	VOLUME (ac. ft.)	COML. VOL. (ac. ft.)	VOLUME VOL. (cu. ft.)
3,182.000	15,704.55	N/A	0.361			
				0.2062	0.2062	8984
3,182.500	20,231.71	1.000	0.464			
				0.2789	0.4851	21132
3,183.000	28,361.82	1.000	0.651			
				0.3769	0.8621	37552
3,183.500	37,315.50	1.000	0.857			
				0.4831	1.3452	58597
3,184.000	46,866.83	1.000	1.076			
				0.5607	1.9059	83020
3,184.500	50,821.92	1.000	1.167			
				0.5973	2.5031	109037
3,185.000	53,248.30	1.000	1.222			
				0.6254	3.1285	136278
3,185.500	55,715.44	1.000	1.279	TOTAL VOLUME		136,278
VOLUME CAPTURE = 2.11 AC.FT.				WATER SURFACE ELEVATION =3184.84'		



BASIN 2 PLAN

BASIN 2 STAGE STORAGE TABLE

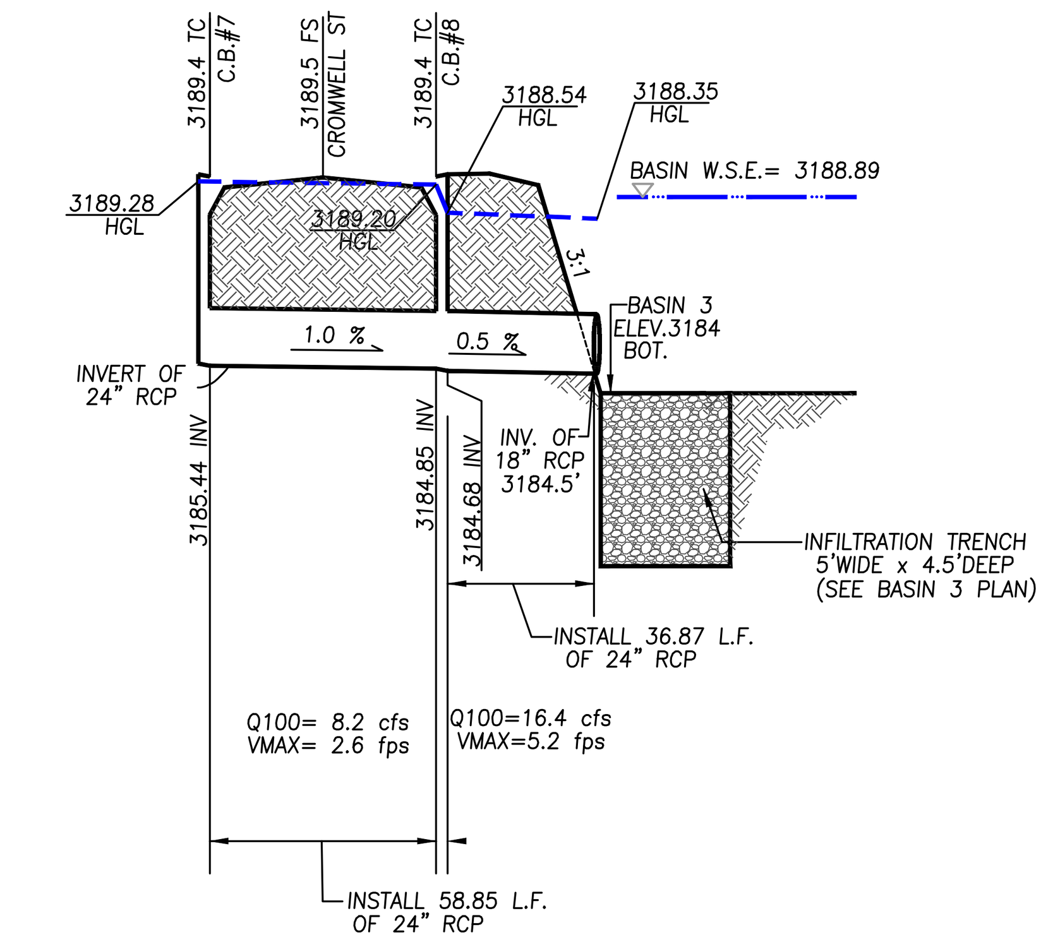
ELEV	AREA (sq. ft.)	DEPTH (ft)	AREA (ac. ft.)	VOLUME (ac. ft.)	COML. VOL. (ac. ft.)	VOLUME VOL. (cu. ft.)
3,184.000	8869.3	N/A	0.204			
				0.2209	0.2209	9623
3,185.000	10,377.5	1.000	0.238			
				0.2562	0.4771	20783
3,186.000	11,941.91	1.000	0.274			
				0.2928	0.7699	33536
3,187.000	13,562.89	1.000	0.311			
				0.3306	1.1005	47937
3,188.000	15,240.56	1.000	0.350			
				0.3698	1.4703	64045
3,189.000	16,974.90	1.000	0.390			
				TOTAL VOLUME		64,045
VOLUME CAPTURE = 1.2 AC.FT.				WATER SURFACE ELEVATION =3188.03'		



BASIN 3 PLAN

BASIN 3 STAGE STORAGE TABLE

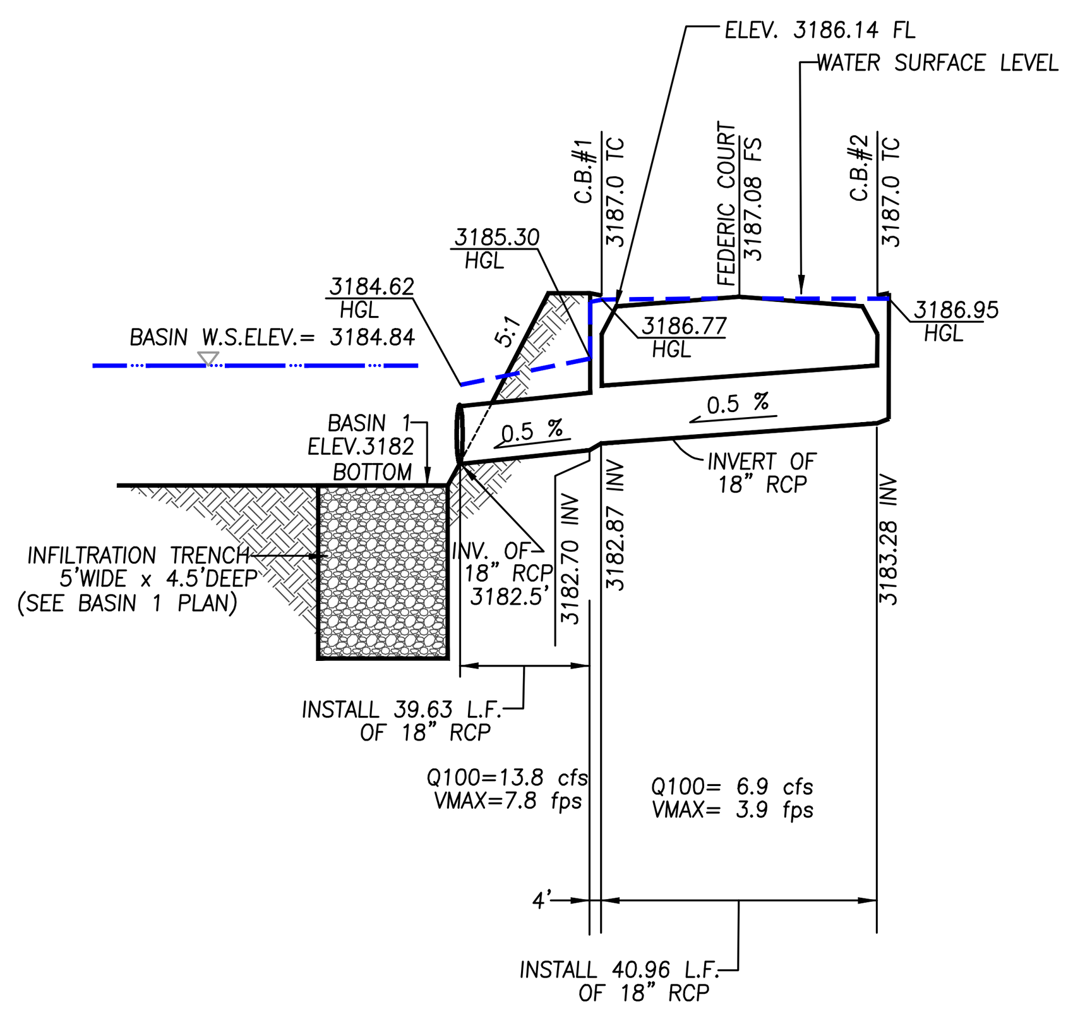
ELEV	AREA (sq. ft.)	DEPTH (ft)	AREA (ac. ft.)	VOLUME (ac. ft.)	COML. VOL. (ac. ft.)	VOLUME VOL. (cu. ft.)
3,184.000	12,149.42	N/A	0.279			
				0.2978	0.2978	12972
3,185.000	13,794.24	1.000	0.317			
				0.3362	0.6340	27619
3,186.000	15,499.78	1.000	0.356			
				0.3761	1.0101	44002
3,187.000	17,266.72	1.000	0.396			
				0.4173	1.4275	62180
3,188.000	19,089.76	1.000	0.438			
				0.481	1.8871	82201
3,189.000	20,950.88	1.000	0.481			
				TOTAL VOLUME		82,201
VOLUME CAPTURE = 1.84 AC.FT.				WATER SURFACE ELEVATION =3188.89'		



SECTION "C1-C1"

BASIN 3 LINE "C1"

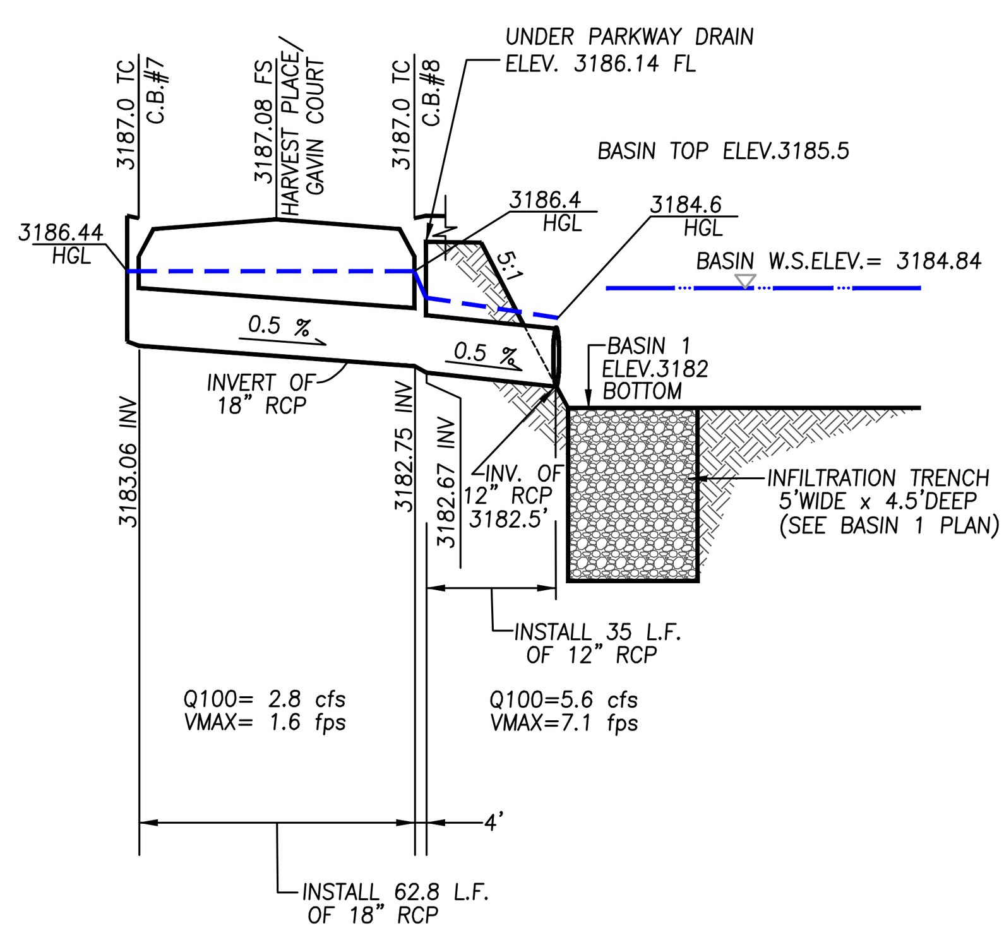
N.T.S.



SECTION "A1-A1"

BASIN 1 LINE "A1"

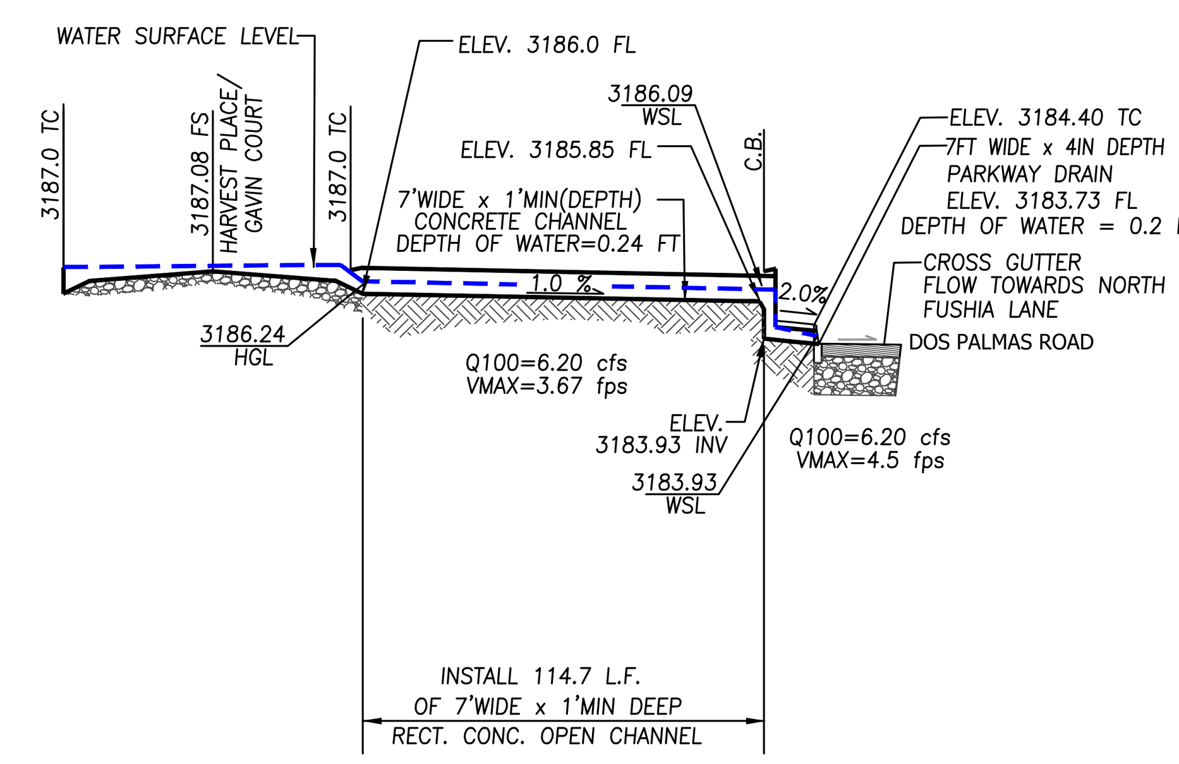
N.T.S.



SECTION "A2-A2"

BASIN 1 LINE "A2"

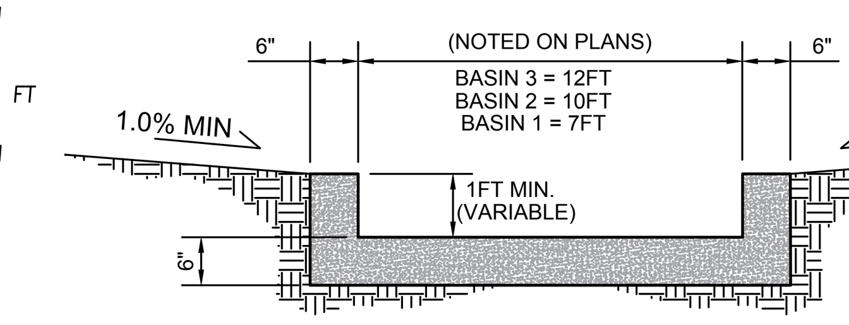
N.T.S.



SECTION "A3-A3"

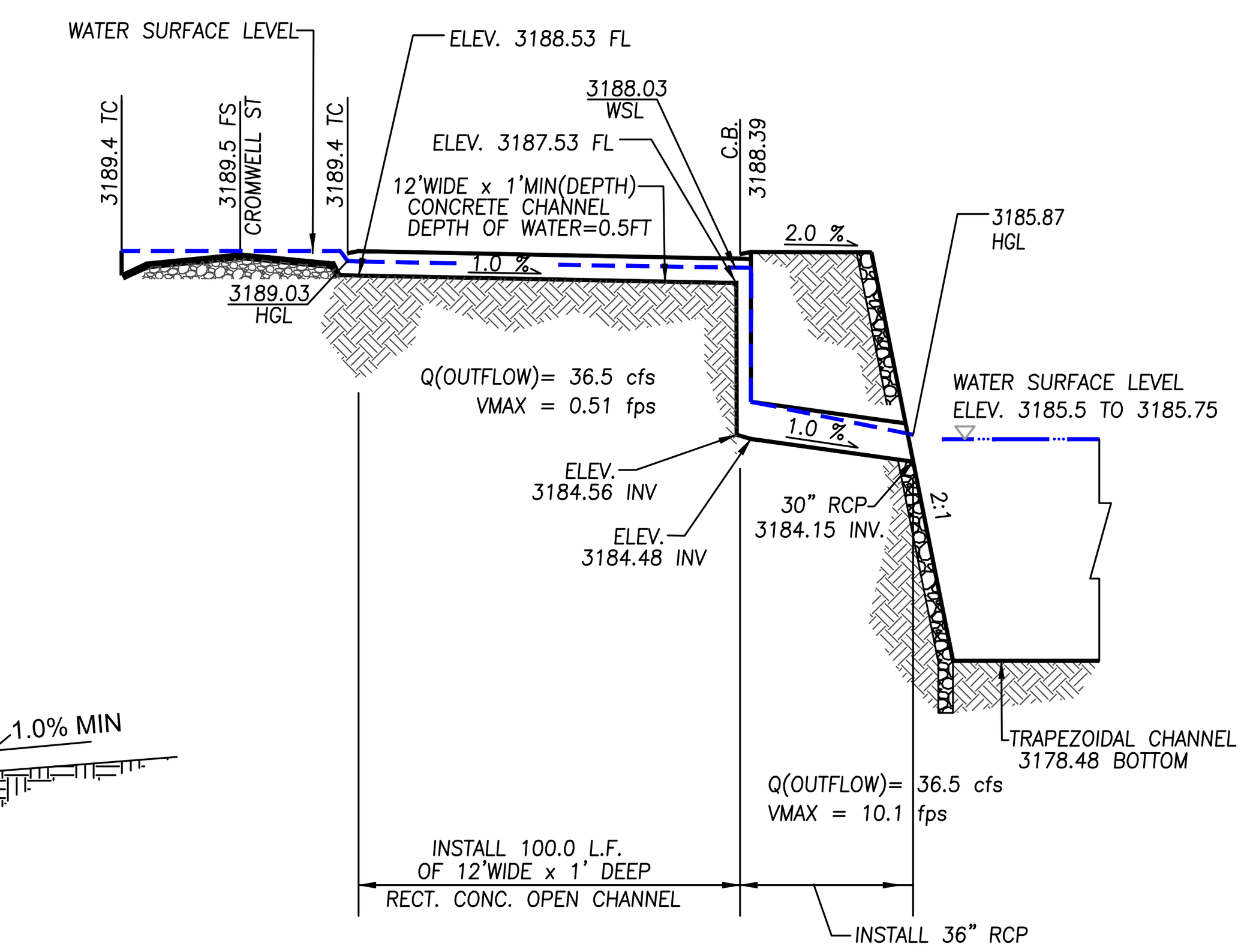
BASIN 1 PARKWAY DRAIN

N.T.S.



FLOWBY CONCRETE CHANNEL

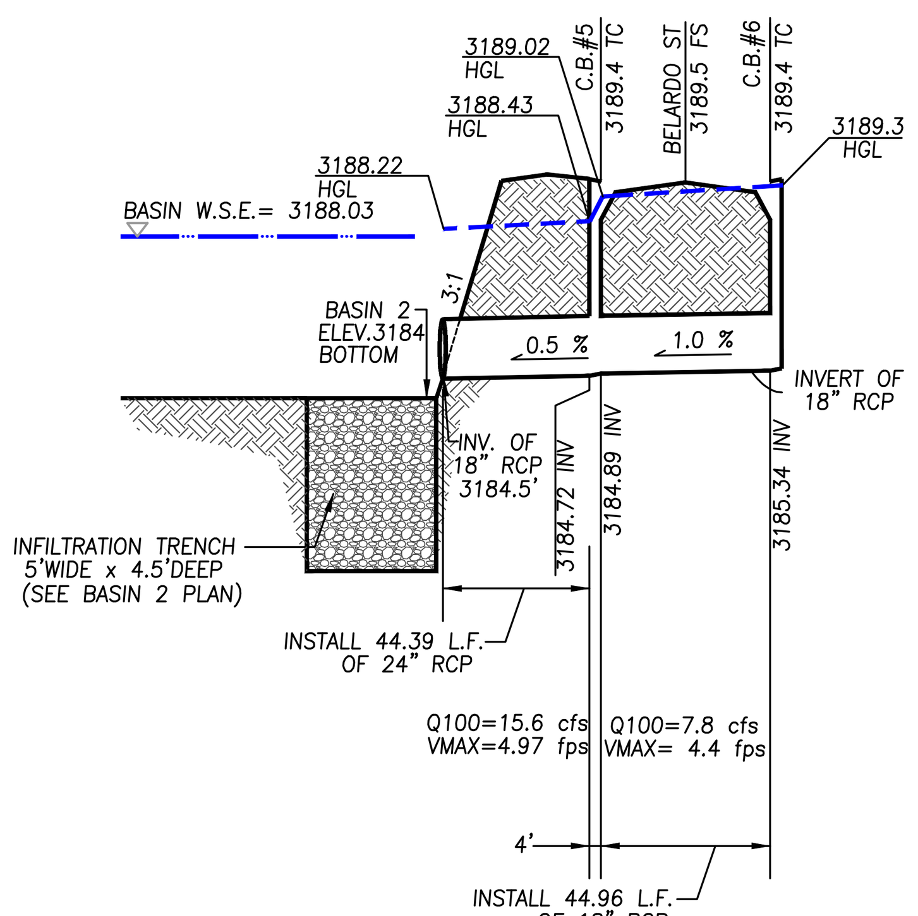
NOT TO SCALE



SECTION "C2-C2"

BASIN 3 PARKWAY DRAIN

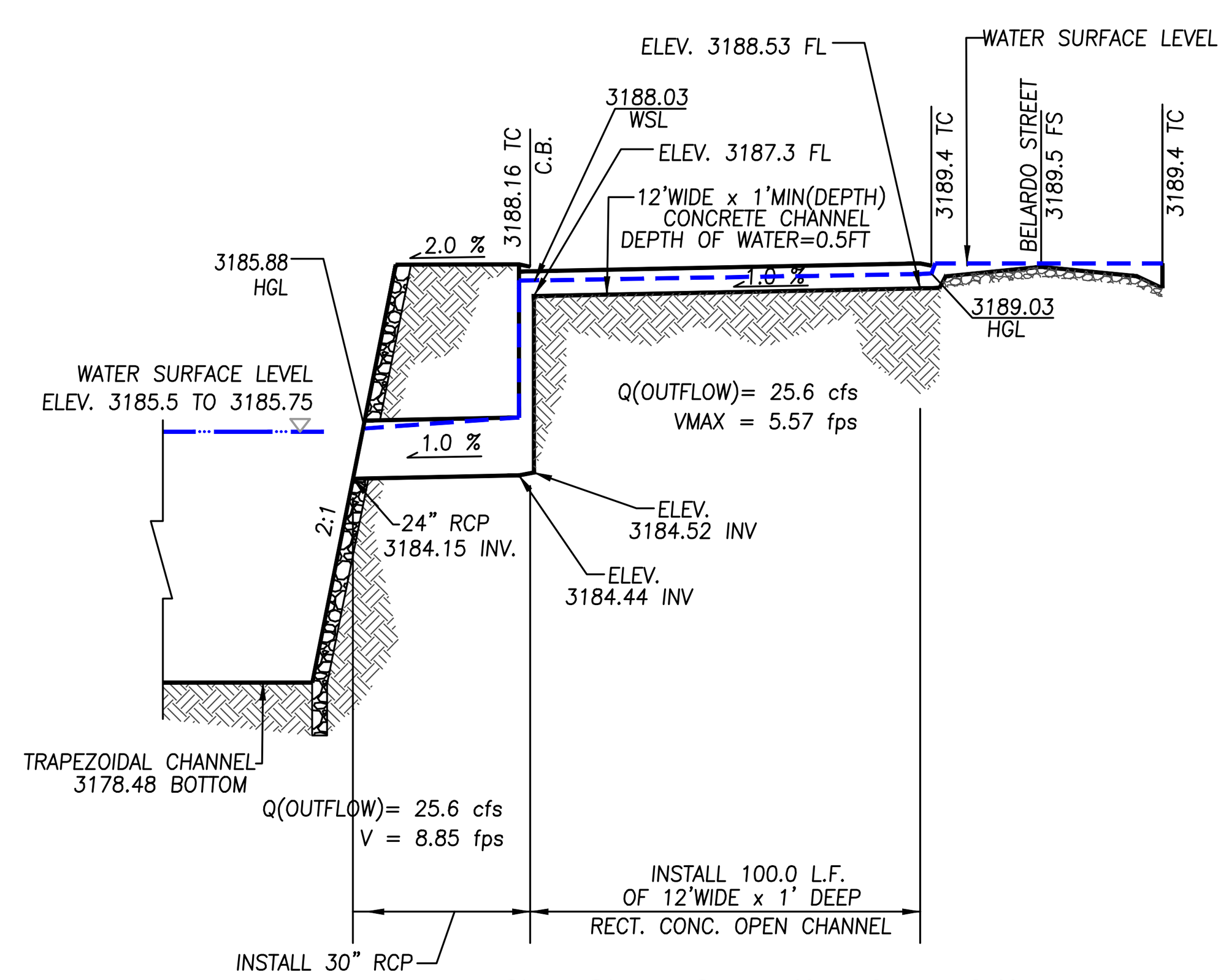
N.T.S.



SECTION "B1-B1"

BASIN 2 LINE "B1"

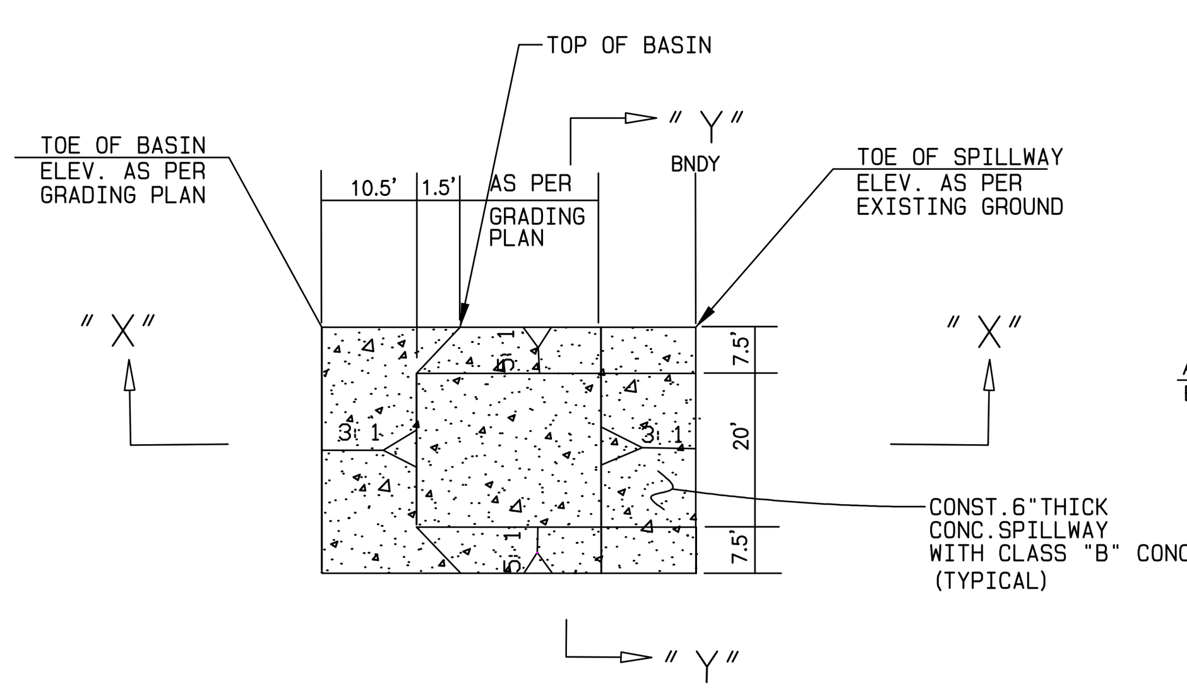
N.T.S.



SECTION "B2-B2"

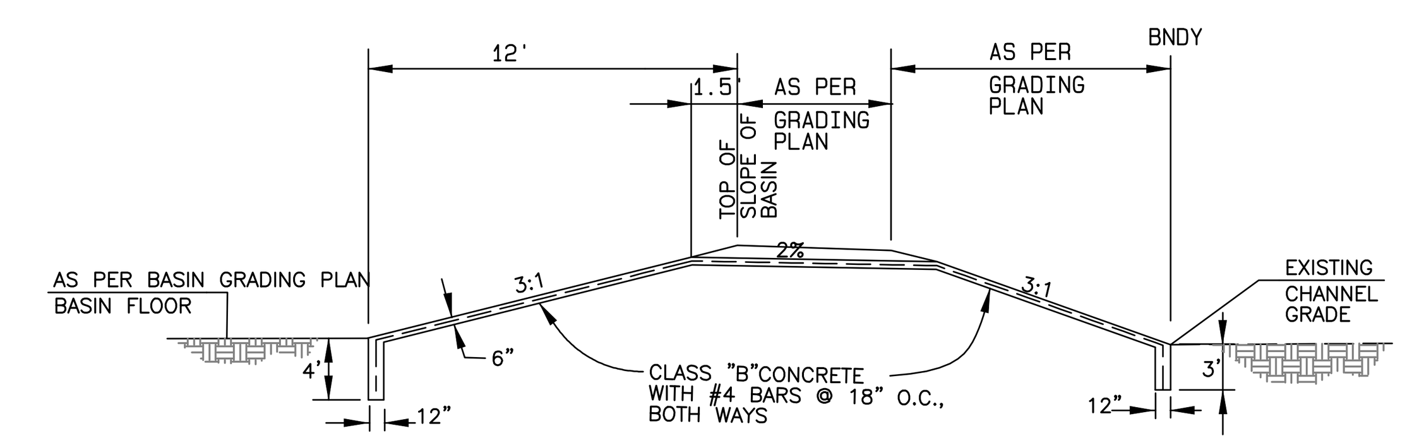
BASIN 2 PARKWAY DRAIN

N.T.S.



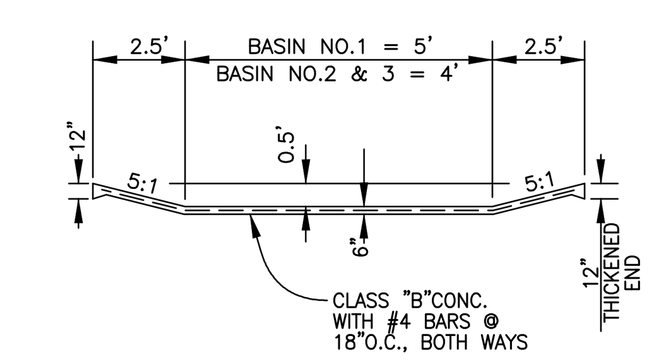
PLAN VIEW
TYPICAL BASIN SPILLWAY

N. T. S.



TYPICAL SECTION X-X

N. T. S.



TYPICAL SECTION Y-Y

N. T. S.

REGISTERED PROFESSIONAL ENGINEER
JIMMY J. FRY
NO. C040692
Exp. 3-31-19
CIVIL
STATE OF CALIFORNIA

REV.	DESCRIPTION	DATE	BY

Ludwig Engineering ASSOCIATES, INC.
Civil Engineering • Surveying • Planning
109 East Third Street, San Bernardino, CA 92410, Phone: 909-884-8217, Fax: 909-889-0153
5890 Hwy. 95, Ste. B, Fort Mohave, AZ 86426, Phone: 928-768-1857, Fax: 928-768-7086
15252 Seneca Rd., Victorville, CA 92392, Phone: 760-951-7676, Fax: 760-241-0573
2126 McCulloch Blvd., Ste. 8, Lake Havasu City, AZ 86403, Phone: 928-680-6080, Fax: 928-854-6530

CITY OF VICTORVILLE
TR. 16397
W.Q.M.P. BASIN 1, 2 & 3 PLAN & PROFILE

CLIENT:
R.Y. PROPERTIES

DESIGNED BY: AG | DRAWN BY: LC | CHECKED BY: JF

SCALE AS SHOWN

PLOT STYLE: NCS US Standard.stb PROJECT LOCATION & NAME: V:\pland\TR. 16397 (RY)\ENGINEERING\WQMP\TT16397_WQMP_Map_12-7-2017.dwg PLOT TIME: Friday, December 08, 2017 3:53:51 PM LAYOUT: 24 X 36 DETAILS