

Appendix G

Hydrology and Hydraulics Report

MOJAVE RIVER WATERSHED

Water Quality Management Plan

For:

AutoZone Victorville

PSUB20-00104

Prepared for:

Insert Owner/Developer Name

123 S. Front Street, 3rd Floor

Memphis, TN 38103

901-495-8714

Prepared by:

Kimley-Horn and Associates

1100 W Town and Country Road, Suite 700

Orange, CA

714-705-1374

Submittal Date: 7/26/2021

Revision No. and Date: #1 - July 21st, 2021

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Revision No. and Date: #3 - July 6th, 2022

Revision No. and Date: Insert No and Current Revision Date

Revision No. and Date: Insert No and Current Revision Date

Final Approval Date: _____

Project Owner's Certification

This Mojave River Watershed Water Quality Management Plan (WQMP) has been prepared for AutoZone Parts, Inc by Kimley-Horn and Associates. The WQMP is intended to comply with the requirements of the City of Victorville and San Bernardino County 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):	PSUB20-00104	Grading Permit Number(s):	N/A
Tract/Parcel Map Number(s):	N/A	Building Permit Number(s):	N/A
CUP, SUP, and/or APN (Specify Lot Numbers if Portions of Tract):			039403136
Owner's Signature			
Owner Name: AutoZone Parts, Inc - Mitch Bramlitt			
Title	Developer/Owner		
Company	AutoZone Parts, Inc		
Address	123 S. Front Street, 3 rd Floor		
Email	mitch.bramlitt@autozone.com		
Telephone #			
Signature		Date	

Preparer's Certification

Project Data			
Permit/Application Number(s):	PSUB20-00104	Grading Permit Number(s):	N/A
Tract/Parcel Map Number(s):	N/A	Building Permit Number(s):	N/A
CUP, SUP, and/or APN (Specify Lot Numbers if Portions of Tract):			039403136

"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: Jacob Glaze, P.E.		PE Stamp Below  EXP. 12-31-23
Title	Civil Engineer	
Company	Kimley-Horn and Associates, Inc.	
Address	1100 W Town and Country Road, Suite 700, Orange, CA 92868	
Email	Jacob.Glaze@kimley-horn.com	
Telephone #	714-705-1374	
Signature		
Date		

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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		AutoZone Victorville			
Project Owner Contact Name:		AutoZone Parts, Inc - Mitch Bramlitt			
Mailing Address:	123 S. Front Street, 3rd Floor	E-mail Address:		Telephone:	
Permit/Application Number(s):		PSUB20-00104 BLDC21-00096	Tract/Parcel Map Number(s):		
Additional Information/ Comments:		N/A			
Description of Project:		The project involves the construction of a 7,381 SF commercial retail shop on a previously undeveloped property, located along Mojave Drive and El Evado Rd in the City of Victorville. The project also includes the construction of an associated parking lot with asphalt pavement, concrete pavement, concrete sidewalks, landscaping, and a trash enclosure. In the proposed condition, stormwater runoff will sheet flow to a curb and gutter, then to a valley gutter adjacent to the parking stalls along the proposed building, and into a vegetated swale which outlets into the proposed infiltration basin (BMP 1). Other Landscape areas distributed throughout the site will be self treating. Another portion of the parking lot drains to curb and gutter and through a parkway drain and to another vegetated swale which outlets to the proposed infiltration basin (BMP 1). The proposed basing will have an overflow structure that will outlet to a storm drain pipe which ties into the neighboring developments outlet pipe and will flow to the connection at El Evado Ave. The Design Capture Volume will be treated by the proposed infiltration basin. The previous use of the land is vacant land and drainage would go from west to east for the longest drainage path at 208ft long at 2%. The existing soil type is Soil Group A & B according to the San Bernardino Stormwater mapping tool. The slopes range from 2-5% and the most prevelant soil being Bryman loamy fine sand.			

Provide summary of Conceptual WQMP conditions (if previously submitted and approved). Attach complete copy.	N/A
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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 ft ² or more of impervious surface collectively over entire site	☐ #2 Significant re-development involving the addition or replacement of 5,000 ft ² 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
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☐ 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 (ft ²):	45,738	³ Number of Dwelling Units:	N/A	⁴ SIC Code:	5531 - Auto and Home Supply stores
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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.

Project Description Cont.

The proposed project will provide two drainage routes for on-site drainage. The proposed drainage will run from the southeast corner of the site to the northwest corner. The eastern side of the proposed site will be tying into the adjacent development and providing access to the neighboring development at two access points. Given the area to the east will be developed for a different use, our grading at the two access points keeps runoff from their site entering ours and the proposed project's runoff flowing to the east development. The drainage in both routes will sheet flow from the south east to the north and into curb and gutter. The Drainage area to the northeast will eventually drain to a valley gutter and outlet to a vegetated swale graded to the proposed BMP 1. The west drainage are will sheet flow to curb and gutter and through a parkway drain under proposed curb and sidewalk and into another vegetated swale graded to the proposed BMP 1.

The site consists of 15,580 sf of pervious cover and 30,160 sf of impervious cover.

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:

The property owner (Owner), AutoZone Parts, Inc, will be responsible for the long-term operations and maintenance of all WQMP stormwater facilities within the project site. The point of contact of the Owner is AutoZone Parts, Inc., with full contact information located under Section 1 of this WQMP.

The Owner will also be responsible for the implementation, long-term operations and maintenance, and funding of the WQMP stormwater facilities described hereon, and will amend this WQMP as needed to reflect any changes to the hydrologic conditions of the property. In addition, the Owner accepts full responsibility for the interim operation and maintenance of the WQMP stormwater facilities.

This WQMP will be reviewed with the facility operator, facility supervisors, employees, maintenance and service contractors, or any other party (or parties) having responsibility for implementing portions of this WQMP. At least one copy of this WQMP will be maintained at the project site or project office in perpetuity.

No onsite public facilities will be installed for this development but connection to existing public utilities will require the following publicly maintained offsite facilities:

Water

Sanitary Sewer

Storm Drain

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.

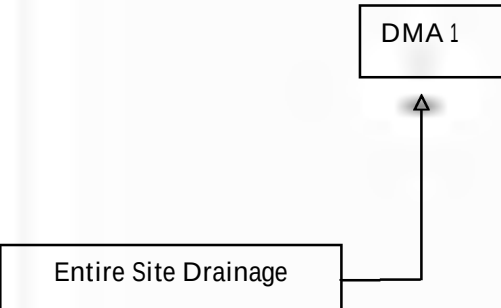
Determine and describe expected stormwater pollutants of concern based on land uses and site activities (refer to Table 3-2 in the TGD for WQMP).

Form 2.3-1 Pollutants of Concern			
Pollutant	Please check: E=Expected, N=Not Expected		Additional Information and Comments
Pathogens (Bacterial / Virus)	E ☒	N ☐	Pavement Runoff (Pollutant of Concern)
Nutrients - Phosphorous	E ☒	N ☐	Primary sources of nutrients are fertilizers and eroded soils.
Nutrients - Nitrogen	E ☒	N ☐	Primary sources of nutrients are fertilizers and eroded soils (Pollutant of Concern)
Noxious Aquatic Plants	E ☐	N ☒	N/A
Sediment	E ☒	N ☐	Source: Construction and grading at landscaped areas.
Metals	E ☒	N ☐	Source: Brake pad dust and tire tread wear from vehicle traffic. (Pollutant of Concern)
Oil and Grease	E ☒	N ☐	Source: Vehicular traffic
Trash/Debris	E ☒	N ☐	Public waste, and general waste products on landscape.
Pesticides / Herbicides	E ☒	N ☐	At landscaped areas only
Organic Compounds	E ☒	N ☐	At landscaped areas only
Other: Oxygen Demanding Compound	E ☒	N ☐	At landscaped areas only
Other:	E ☐	N ☐	
Other:	E ☐	N ☐	

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 34.529218	Longitude -117.348624	Thomas Bros Map page 4295
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	All drainage for this property will be retained on site.		
DA1 to BMP1	Drainage sheet flows to curb and gutter, then to a valley gutter and into a vegetated swale at both the north and south ends of the site. Both vegetated swales are graded to outlet at the proposed infiltration basin. All Landscape areas are considered to be self-treating.		
N/A			
N/A			
N/A			

Form 3-2 Existing Hydrologic Characteristics for Drainage Area 1

For Drainage Area 1's sub-watershed DMA, provide the following characteristics	DMA 1	DMA B	DMA C	DMA D
¹ DMA drainage area (ft ²)	45,738			
² Existing site impervious area (ft ²)	0			
³ Antecedent moisture condition <i>For desert areas, use http://www.sbcounty.gov/dpw/floodcontrol/pdf/20100412_map.pdf</i>	II			
⁴ Hydrologic soil group <i>Refer to County Hydrology Manual Addendum for Arid Regions – http://www.sbcounty.gov/dpw/floodcontrol/pdf/20100412_addendum.pdf</i>	C			
⁵ Longest flowpath length (ft)	208			
⁶ Longest flowpath slope (ft/ft)	.02			
⁷ Current land cover type(s) <i>Select from Fig C-3 of Hydrology Manual</i>	Barren			
⁸ Pre-developed pervious area condition: <i>Based on the extent of wet season vegetated cover good >75%; Fair 50-75%; Poor <50% Attach photos of site to support rating</i>	Fair			

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 <i>For desert areas, use</i> http://www.sbcounty.gov/dpw/floodcontrol/pdf/20100412_map.pdf				
⁴ Hydrologic soil group <i>County Hydrology Manual Addendum for Arid Regions –</i> 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) <i>Select from Fig C-3 of Hydrology Manual</i>				
⁸ Pre-developed pervious area condition: <i>Based on the extent of wet season vegetated cover good >75%; Fair 50-75%; Poor <50% Attach photos of site to support rating</i>				

Form 3-3 Watershed Description for Drainage Area

Receiving waters

Refer to SWRCB site:

http://www.waterboards.ca.gov/water_issues/programs/tmdl/integrated2010.shtml

Mojave River (Upper Narrows to Lower Narrows) and (Below Lower narrows)

Applicable TMDLs

http://www.waterboards.ca.gov/water_issues/programs/tmdl/integrated2010.shtml

Fluoride, sulfates, total dissolved solids

303(d) listed impairments

http://www.waterboards.ca.gov/water_issues/programs/tmdl/integrated2010.shtml

Fluoride, sulfates, total dissolved solids

Environmentally Sensitive Areas (ESA)

Refer to Watershed Mapping Tool –

<http://sbcounty.permitrack.com/WAP>

Not within and ESA

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

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.

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	☒	☐	The developer will provide educational pamphlets published by California State Regional Water Quality Control Boards – Santa Ana Region, or other appropriate sources.
N2	Activity Restrictions	☒	☐	The types of activities allowed within the Project will be limited to those allowed by the City of San Bernardino codes, regulations, and zoning ordinances.
N3	Landscape Management BMPs	☒	☐	Landscape plans will be consistent with the City of San Bernardino requirements for water conservation vegetation. Utilizing programmable irrigation systems, and/or rain shut off sensors.
N4	BMP Maintenance	☒	☐	Per Owner's Certification and Maintenance Agreement
N5	Title 22 CCR Compliance (How development will comply)	☒	☐	Project to comply with Title 22 CCR
N6	Local Water Quality Ordinances	☒	☐	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
N8	Underground Storage Tank Compliance	☐	☐	No storage tanks to be allowed for this project
N9	Hazardous Materials Disclosure Compliance	☒	☐	Hazardous Waste Procedures Manual included within Section 6 of report herein

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 San Bernardino County
N11	Litter/Debris Control Program	☒	☐	Private parking lot will be maintained by the Owner/Tenants. Public streets will be maintained by the City of San Bernardino.
N12	Employee Training	☒	☐	Provide an ongoing education material
N13	Housekeeping of Loading Docks	☐	☒	Project does not feature any loading docks
N14	Catch Basin Inspection Program	☒	☐	Inspection by property owner and per Maintenance Agreement
N15	Vacuum Sweeping of Private Streets and Parking Lots	☒	☐	Only parking lot once a month per maintenance schedule
N16	Other Non-structural Measures for Public Agency Projects	☐	☒	N/A
N17	Comply with all other applicable NPDES permits	☐	☒	N/A

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)	☒	☐	SD Stencilling will be provided by the developer and maintained only onsite private storm drains.
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)	☒	☐	Provided Trash enclosure location per site plan.
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)	☒	☐	Landscaping to be designed per state guidelines.
S5	Finish grade of landscaped areas at a minimum of 1-2 inches below top of curb, sidewalk, or pavement	☒	☐	Per the Landscape Plans.
S6	Protect slopes and channels and provide energy dissipation (CASQA New Development BMP Handbook SD-10)	☒	☐	Slopes are vegetated along Pomona Rincon Rd.
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 featured per this project.
S9	Vehicle wash areas with spill containment plans (CASQA New Development BMP Handbook SD-33)	☐	☒	No featured per this project.
S10	Covered outdoor processing areas (CASQA New Development BMP Handbook SD-36)	☐	☒	Not featured 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)	☐	☒	Not featured per this project.
S12	Fueling areas (CASQA New Development BMP Handbook SD-30)	☐	☒	Not featured per this project.
S13	Hillside landscaping (CASQA New Development BMP Handbook SD-10)	☐	☒	Not featured per this project.
S14	Wash water control for food preparation areas	☐	☒	Not featured per this project.
S15	Community car wash racks (CASQA New Development BMP Handbook SD-33)	☐	☒	Not featured per this project.

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 <i>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</i>	
Minimize impervious areas: Yes ☒ No ☐ Explanation: This is addressed in the project site plan through the optimized design of proposed hardscape, which will allow for a maximum area of proposed landscaping within the property boundary.	
Maximize natural infiltration capacity; Including improvement and maintenance of soil: Yes ☒ No ☐ Explanation: Proposed landscaped areas, infiltration basin, and vegetated swale maximize natural infiltration capacity.	
Preserve existing drainage patterns and time of concentration: Yes ☐ No ☒ Explanation: Some alterations were made to site drainage patterns and time of concentration, due to site layout, available space and neighboring development access drives that we must tie into.	
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: Proposed landscape planters break up impervious areas of site. Roof drainage drains to BMP and self treating landscaping	
Use of Porous Pavement.: Yes ☐ No ☒ Explanation:	
Protect existing vegetation and sensitive areas: Yes ☒ No ☐ Explanation:	
Re-vegetate disturbed areas. Including planting and preservation of drought tolerant vegetation. : Yes ☒ No ☐ Explanation: Proposed planters are to be landscaped.	

Minimize unnecessary compaction in stormwater retention/infiltration basin/trench areas: Yes ☒ No ☐ Explanation: WQMP exhibit provided to GC to minimize compaction in detention areas.
Utilize naturalized/rock-lined drainage swales in place of underground piping or imperviously lined swales: Yes ☐ No ☒ Explanation: Proposed vegetated swale to gradually cease into landscaping.
Stake off areas that will be used for landscaping to minimize compaction during construction : Yes ☒ No ☐ Explanation: Landscaped plan provided to GC to minimize this compaction.
Use of Rain Barrels and Cisterns, Including the use of on-site water collection systems.: Yes ☐ No ☒ Explanation:
Stream Setbacks. Includes a specified distance from an adjacent stream: : Yes ☐ No ☒ Explanation:

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, evapotranspire, 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 mi²), 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.

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

¹ Project area DA 1 (ft ²): 45,738	² Imperviousness after applying preventative site design practices (Imp%): 66.0%	³ Runoff Coefficient (Rc): 0.45 $R_c = 0.858(\text{Imp}\%)^{\wedge}3 - 0.78(\text{Imp}\%)^{\wedge}2 + 0.774(\text{Imp}\%) + 0.04$
⁴ Determine 1-hour rainfall depth for a 2-year return period P _{2yr-1hr} (in): .373 http://hdsc.nws.noaa.gov/hdsc/pfds/sa/sca_pfds.html		
⁵ Compute P ₆ , Mean 6-hr Precipitation (inches): 0.46 <i>P₆ = Item 4 * C₁, where C₁ is a function of site climatic region specified in Form 3-1 Item 1 (Desert = 1.2371)</i>		
⁶ Drawdown Rate <i>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.</i>		24-hrs ☐ 48-hrs ☒
⁷ Compute design capture volume, DCV (ft ³): 1549.0 <i>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</i>		

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

Is the change in post- and pre- condition flows captured on-site? : Yes ☒ 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 1253 <i>Form 4.2-3 Item 12</i>	² 8.94 <i>Form 4.2-4 Item 13</i>	³ 3.58 <i>Form 4.2-5 Item 10</i>
Post-developed	⁴ 1903 <i>Form 4.2-3 Item 13</i>	⁵ 6.7 <i>Form 4.2-4 Item 14</i>	⁶ 4.27 <i>Form 4.2-5 Item 14</i>
Difference	⁷ 649 <i>Item 4 – Item 1</i>	⁸ 2.24 <i>Item 2 – Item 5</i>	⁹ 0.69 <i>Item 6 – Item 3</i>
Difference (as % of pre-developed)	¹⁰ 51.8% <i>Item 7 / Item 1</i>	¹¹ 25.06% <i>Item 8 / Item 2</i>	¹² 18.0% <i>Item 9 / Item 3</i>

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

Weighted Curve Number Determination for: <u>Pre-developed DA</u>	DMA A	DMA B	DMA C	DMA D	DMA E	DMA F	DMA G	DMA H
1a Land Cover type	BARREN							
2a Hydrologic Soil Group (HSG)	C							
3a DMA Area, ft ² <i>sum of areas of DMA should equal area of DA</i>	45378							
4a Curve Number (CN) <i>use Items 1 and 2 to select the appropriate CN from Appendix C-2 of the TGD for WQMP</i>	91							
Weighted Curve Number Determination for: <u>Post-developed DA</u>	DMA A	DMA B	DMA C	DMA D	DMA E	DMA F	DMA G	DMA H
1b Land Cover type	Commercial							
2b Hydrologic Soil Group (HSG)	C							
3b DMA Area, ft ² <i>sum of areas of DMA should equal area of DA</i>	45378							
4b Curve Number (CN) <i>use Items 5 and 6 to select the appropriate CN from Appendix C-2 of the TGD for WQMP</i>	75							
5 Pre-Developed area-weighted CN: 91	7 Pre-developed soil storage capacity, S (in): .98 $S = (1000 / \text{Item 5}) - 10$					9 Initial abstraction, I _a (in): 0.20 $I_a = 0.2 * \text{Item 7}$		
6 Post-Developed area-weighted CN: 75	8 Post-developed soil storage capacity, S (in): 3.33 $S = (1000 / \text{Item 6}) - 10$					10 Initial abstraction, I _a (in): 0.67 $I_a = 0.2 * \text{Item 8}$		
11 Precipitation for 10 yr, 24 hr storm (in): 2.24 Go to: http://hdsc.nws.noaa.gov/hdsc/pfds/sa/sca_pfds.html								
12 Pre-developed Volume (ft ³): 1253 $V_{pre} = (1 / 12) * (\text{Item sum of Item 3}) * [(\text{Item 11} - \text{Item 9})^2 / ((\text{Item 11} - \text{Item 9} + \text{Item 7}))]$								
13 Post-developed Volume (ft ³): 1903 $V_{pre} = (1 / 12) * (\text{Item sum of Item 3}) * [(\text{Item 11} - \text{Item 10})^2 / ((\text{Item 11} - \text{Item 10} + \text{Item 8}))]$								
14 Volume Reduction needed to meet hydromodification requirement, (ft ³): 555 $V_{hydro} = (\text{Item 13} * 0.95) - \text{Item 12}$								

Form 4.2-4 Hydromodification Assessment for Time of Concentration (DA 1)

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 <i>Use additional forms if there are more than 4 DMA</i>				Post-developed DA1 <i>Use additional forms if there are more than 4 DMA</i>			
	DMA A	DMA B	DMA C	DMA D	DMA A	DMA B	DMA C	DMA D
1 Length of flowpath (ft) <i>Use Form 3-2 Item 5 for pre-developed condition</i>	208				300			
2 Change in elevation (ft)	4.15				5.36			
3 Slope (ft/ft), $S_o = \text{Item 2} / \text{Item 1}$	.02				.02			
4 Land cover	Undeveloped				Commercial			
5 Initial DMA Time of Concentration (min) <i>Appendix C-1 of the TGD for WQMP</i>	9.8				6.25			
6 Length of conveyance from DMA outlet to project site outlet (ft) <i>May be zero if DMA outlet is at project site outlet</i>	0				0			
7 Cross-sectional area of channel (ft ²)	0				.0625			
8 Wetted perimeter of channel (ft)	0				3			
9 Manning's roughness of channel (n)	0				.012			
10 Channel flow velocity (ft/sec) $V_{fps} = (1.49 / \text{Item 9}) * (\text{Item 7} / \text{Item 8})^{0.67} * (\text{Item 3})^{0.5}$	0				1.31			
11 Travel time to outlet (min) $T_t = \text{Item 6} / (\text{Item 10} * 60)$	0				0			
12 Total time of concentration (min) $T_c = \text{Item 5} + \text{Item 11}$	9.8				6.25			
13 Pre-developed time of concentration (min): 9.8 <i>Minimum of Item 12 pre-developed DMA</i>								

14 Post-developed time of concentration (min): 6.25 *Minimum of Item 12 post-developed DMA*

15 Additional time of concentration needed to meet hydromodification requirement (min): 3.06 $T_{C-Hydro} = (Item\ 13 * 0.95) - Item\ 14$

Form 4.2-5 Hydromodification Assessment for Peak Runoff (DA 1)

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) <i>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)</i>						
3 Ratio of pervious area to total area <i>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)</i>						
4 Pervious area infiltration rate (in/hr) <i>Use pervious area CN and antecedent moisture condition with Appendix C-3 of the TGD for WQMP</i>	6.5					
5 Maximum loss rate (in/hr) $F_m = Item\ 3 * Item\ 4$ <i>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)</i>						
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 <i>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)</i>	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: $Q_p = Item\ 6_{DMAA} + [Item\ 6_{DMAB} * (Item\ 1_{DMAA} - Item\ 5_{DMAB}) / (Item\ 1_{DMAB} - Item\ 5_{DMAB}) * Item\ 7_{DMAA/2}] + [Item\ 6_{DMAC} * (Item\ 1_{DMAA} - Item\ 5_{DMAC}) / (Item\ 1_{DMAC} - Item\ 5_{DMAC}) * Item\ 7_{DMAA/3}]$	9 Pre-developed Q_p at T_c for DMA B: $Q_p = Item\ 6_{DMAB} + [Item\ 6_{DMAA} * (Item\ 1_{DMAB} - Item\ 5_{DMAA}) / (Item\ 1_{DMAA} - Item\ 5_{DMAA}) * Item\ 7_{DMAB/1}] + [Item\ 6_{DMAC} * (Item\ 1_{DMAB} - Item\ 5_{DMAC}) / (Item\ 1_{DMAC} - Item\ 5_{DMAC}) * Item\ 7_{DMAB/3}]$			10 Pre-developed Q_p at T_c for DMA C: $Q_p = Item\ 6_{DMAC} + [Item\ 6_{DMAA} * (Item\ 1_{DMAC} - Item\ 5_{DMAA}) / (Item\ 1_{DMAA} - Item\ 5_{DMAA}) * Item\ 7_{DMAC/1}] + [Item\ 6_{DMAB} * (Item\ 1_{DMAC} - Item\ 5_{DMAB}) / (Item\ 1_{DMAB} - Item\ 5_{DMAB}) * Item\ 7_{DMAC/2}]$		
10 Peak runoff from pre-developed condition confluence analysis (cfs): <i>Maximum of Item 8, 9, and 10 (including additional forms as needed)</i>						
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:		

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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): <i>needed)</i>	Maximum of Item 11, 12, and 13 (including additional forms as	
15 Peak runoff reduction needed to meet Hydromodification Requirement (cfs):	$Q_{p-hydro} = (Item\ 14 * 0.95) - Item\ 10$	

4.3 BMP Selection and Sizing

Complete the following forms for each project site DA to document that the proposed treatment (LID/Bioretenention) 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)

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)? 6.5in/hr

Yes ☐ No ☒

If Yes, Provide basis: (attached perc tests)

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 1 DMA 1 BMP Type Infiltration basin	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) $V = \text{Item 2} * \text{Item 3} * (0.5/12)$, assuming retention of 0.5 inches of runoff			
5 Sum of retention volume achieved from impervious area dispersion (ft ³):		$V_{\text{retention}} = \text{Sum of Item 4 for all BMPs}$	
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) $V_{\text{retention}} = (\text{Item 7} * \text{Item 8}) + (\text{Item 9} * \text{Item 10} * \text{Item 11})$			

13 Runoff volume retention from on-lot infiltration (ft ³): <i>V_{retention} = Sum of Item 12 for all BMPs</i>			
Form 4.3-2 cont. Site Design BMPs (DA 1)			
14 Implementation of Street Trees: Yes ☐ No ☒ <i>If yes, complete Items 14-18. If no, proceed to Item 19</i>	DA DMA BMP Type	DA DMA BMP Type	DA DMA BMP Type <i>(Use additional forms for more BMPs)</i>
15 Number of Street Trees			
16 Average canopy cover over impervious area (ft ²)			
17 Runoff volume retention from street trees (ft ³) <i>V_{retention} = Item 15 * Item 16 * (0.05/12) assume runoff retention of 0.05 inches</i>			
18 Runoff volume retention from street tree BMPs (ft ³): <i>V_{retention} = Sum of Item 17 for all BMPs</i>			
19 Total Retention Volume from Site Design BMPs: 1598 <i>Sum of Items 5, 13 and 18</i>			

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): 1549 $V_{unmet} = \text{Form 4.2-1 Item 7} - \text{Form 4.3-2 Item 19}$			
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 1 BMP Type 1	DA DMA BMP Type	DA DMA BMP Type (Use additional forms for more BMPs)
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	6.50		
³ Infiltration safety factor See TGD Section 5.4.2 and Appendix D	2.0		
⁴ Design percolation rate (in/hr) $P_{design} = \text{Item 2} / \text{Item 3}$	3.25		
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	3		
⁷ Ponding Depth (ft) $d_{BMP} = \text{Minimum of } (1/12 * \text{Item 4} * \text{Item 5}) \text{ or Item 6}$	3		
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	467		
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		
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		
¹³ Duration of storm as basin is filling (hrs) Typical ~ 3hrs	3		
¹⁴ Above Ground Retention Volume (ft ³) $V_{retention} = \text{Item 8} * [\text{Item 7} + (\text{Item 9} * \text{Item 10}) + (\text{Item 11} * \text{Item 12}) + (\text{Item 13} * (\text{Item 4} / 12))]$	1780		
¹⁵ Underground Retention Volume (ft ³) Volume determined using manufacturer's specifications and calculations	0		
¹⁶ Total Retention Volume from LID Infiltration BMPs: 1780 (Sum of Items 14 and 15 for all infiltration BMP included in plan)			
¹⁷ Fraction of DCV achieved with infiltration BMP: 100% $\text{Retention\%} = \text{Item 16} / \text{Form 4.2-1 Item 7}$			
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 (ft ³): 0 <i>Form 4.2-1 Item 7 - Form 4.3-2 Item 19 – Form 4.3-3 Item 16</i>		List pollutants of concern <i>Copy from Form 2.3-1.</i> Pathogens (Bacterial / Virus), Phosphorous, Nitrogen, Sediment, Metals, Oil and Grease, Trash/Debris, Pesticides / Herbicides, Organic Compounds, Oxygen Demanding Compounds	
² Biotreatment BMP Selected <i>(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)</i>	Volume-based biotreatment <i>Use Forms 4.3-5 and 4.3-6 to compute treated volume</i>		Flow-based biotreatment <i>Use Form 4.3-7 to compute treated flow</i>
	☐ Bioretention with underdrain ☐ Planter box with underdrain ☐ Constructed wetlands ☐ Wet extended detention ☐ Dry extended detention		☐ Vegetated swale ☐ Vegetated filter strip ☐ Proprietary biotreatment
³ Volume biotreated in volume based biotreatment BMP (ft ³): 0 <i>Form 4.3-5 Item 15 + Form 4.3-6 Item 13</i>	⁴ Compute remaining LID DCV with implementation of volume based biotreatment BMP (ft ³): 0 <i>Item 1 – Item 3</i>		⁵ Remaining fraction of LID DCV for sizing flow based biotreatment BMP: 0% <i>Item 4 / Item 1</i>
⁶ Flow-based biotreatment BMP capacity provided (cfs): 0 <i>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)</i>			
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: ☒ <i>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.</i>			

Form 4.3-5 Volume Based Biotreatment (DA 1) – Bioretention and Planter Boxes with Underdrains

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

Form 4.3-6 Volume Based Biotreatment (DA 1) – Constructed Wetlands and Extended Detention

Biotreatment BMP Type <i>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.</i>	DA DMA BMP Type		DA DMA BMP Type <i>(Use additional forms for more BMPs)</i>	
	Forebay	Basin	Forebay	Basin
¹ Pollutants addressed with BMP forebay and basin <i>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</i>	N/A			
² Bottom width (ft)				
³ Bottom length (ft)				
⁴ Bottom area (ft ²) <i>A_{bottom} = Item 2 * Item 3</i>				
⁵ Side slope (ft/ft)				
⁶ Depth of storage (ft)				
⁷ Water surface area (ft ²) <i>A_{surface} = (Item 2 + (2 * Item 5 * Item 6)) * (Item 3 + (2 * Item 5 * Item 6))</i>				
⁸ Storage volume (ft ³) <i>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</i> <i>V = Item 6 / 3 * [Item 4 + Item 7 + (Item 4 * Item 7)^0.5]</i>				
⁹ Drawdown Time (hrs) <i>Copy Item 6 from Form 2.1</i>				
¹⁰ Outflow rate (cfs) <i>Q_{BMP} = (Item 8_{forebay} + Item 8_{basin}) / (Item 9 * 3600)</i>				
¹¹ Duration of design storm event (hrs)				
¹² Biotreated Volume (ft ³) <i>V_{biotreated} = (Item 8_{forebay} + Item 8_{basin}) + (Item 10 * Item 11 * 3600)</i>				
¹³ Total biotreated volume from constructed wetlands, extended dry detention, or extended wet detention : <i>(Sum of Item 12 for all BMP included in plan)</i>				

Form 4.3-7 Flow Based Biotreatment (DA 1)

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

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): 1780 <i>Copy Item 7 in Form 4.2-1</i>
2	On-site retention with site design BMP (ft ³): 0 <i>Copy Item 18 in Form 4.3-2</i>
3	On-site retention with LID infiltration BMP (ft ³): 1780 <i>Copy Item 16 in Form 4.3-3</i>
4	On-site biotreatment with volume based biotreatment BMP (ft ³): 0 <i>Copy Item 3 in Form 4.3-4</i>
5	Flow capacity provided by flow based biotreatment BMP (cfs): 0 <i>Copy Item 6 in Form 4.3-4</i>
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 ☐ <i>If yes, sum of Items 2, 3, and 4 is greater than Item 1</i> - 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 ☒ <i>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</i> - 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 ☒ <i>If yes, Form 4.3-1 Items 7 and 8 were both checked yes</i>
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: ☐ <i>Checked yes if Form 4.3-4 Item 7 is 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, $V_{alt} = (Item\ 1 - Item\ 2 - Item\ 3 - Item\ 4 - Item\ 5) * (100 - Form\ 2.4-1\ Item\ 2)\%$</i> - 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.

Form 4.3-9 Hydromodification Control BMPs (DA 1)	
¹ Volume reduction needed for hydromodification performance criteria (ft ³): 555 (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): 0 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): 555 Item 1 – Item 2	⁴ Volume capture provided by incorporating additional on-site BMPs (ft ³): 555
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 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
Landscape d Areas	Owner	Mow, weed, trim, and remove accumulation of trash and debris	Twice a Month
Irrigation Systems	Owner	Replace/repair leaking or broken sprinklers	As Needed
Infiltratio n Basin	Owner	Remove accumulation of trash and debris, and sediment accumulation at the start and end of the wet season	Semi-annual at the beginning and end of the wet season
Parkway Drain	Owner	Visually inspect parkway drain outlet for signs of blockage, clogging, and sediment accumulation. Remove obstruction(s) as needed	Quarterly, twice during wet season.

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

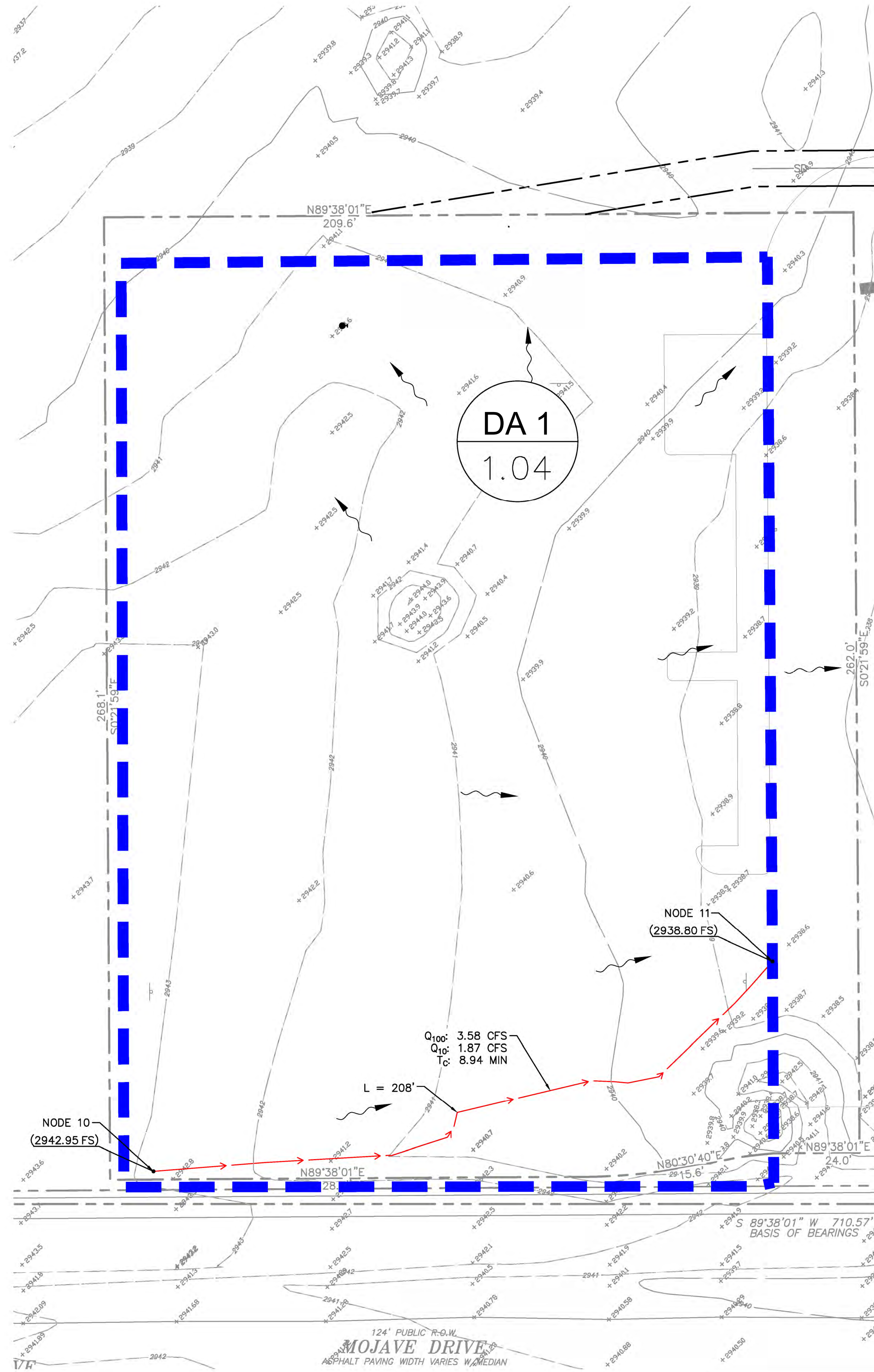
Minimum requirements include submittal of PDF exhibits in addition to hard copies. Format must not require specialized software to open. If the local jurisdiction requires specialized electronic document formats (as described in their Local Implementation Plan), this section will describe the contents (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

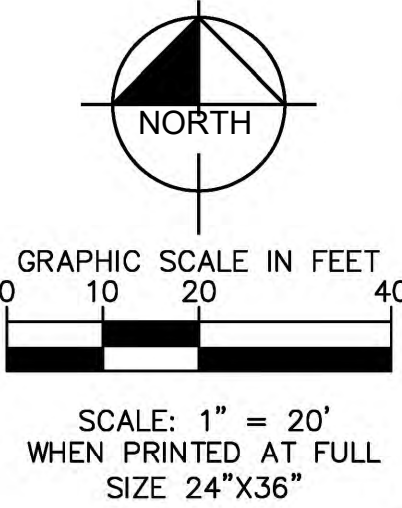


LEGEND

- PROPERTY LINE
- PROPOSED CONTOUR
- EXISTING CONTOUR
- EASEMENT LINE
- DRAINAGE AREA (DA)
- FLOW PATH
- DIRECTION OF FLOW
- DA NAME
- DA AREA (IN ACRES)

DATA SUMMARY

ADDRESS: NORTHWEST MOJAVE DR & EL EVADO RD
APN: 039403136
ZONING DISTRICT: C-2, GEN COMMERCIAL
FLOOD ZONE: ZONE X - AREA DETERMINED TO BE OUTSIDE OF .2% ANNUAL CHANCE FLOOD PLAN
TOTAL PROJECT AREA: 45,378 (1.04 AC)



BLDC21-00096

Kimley»Horn

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1100 TOWN AND COUNTRY RD, SUITE 700, ORANGE, CA 92668
PHONE: 714-939-1030 FAX: 714-938-9488
WWW.KIMLEY-HORN.COM



CITY OF VICTORVILLE
ENGINEERING DEPARTMENT
14343 Civic Drive, Victorville, Ca. 92392 (760) 955-5158

NO.	REVISION	BY	DATE

HYDROLOGY EXISTING CONDITIONS

FIELD BOOK NO. (S)
BENCH MARK:
CITY BENCHMARK:
#V-213; DESCRIPTION: "Mojave Dr. @ El Evado Rd., TO 2' West of SW BCR".
ELEVATION = 2937.86'
COV CONTROL #V-213

DESIGN BY: JO
DRAWN BY: JO
CHECKED BY: CF
DATE: 7/6/2022

SHEET NO.
OF

DRAWING No.
XX-00

PROJECT NO.
TBD



CITY CASE NO.

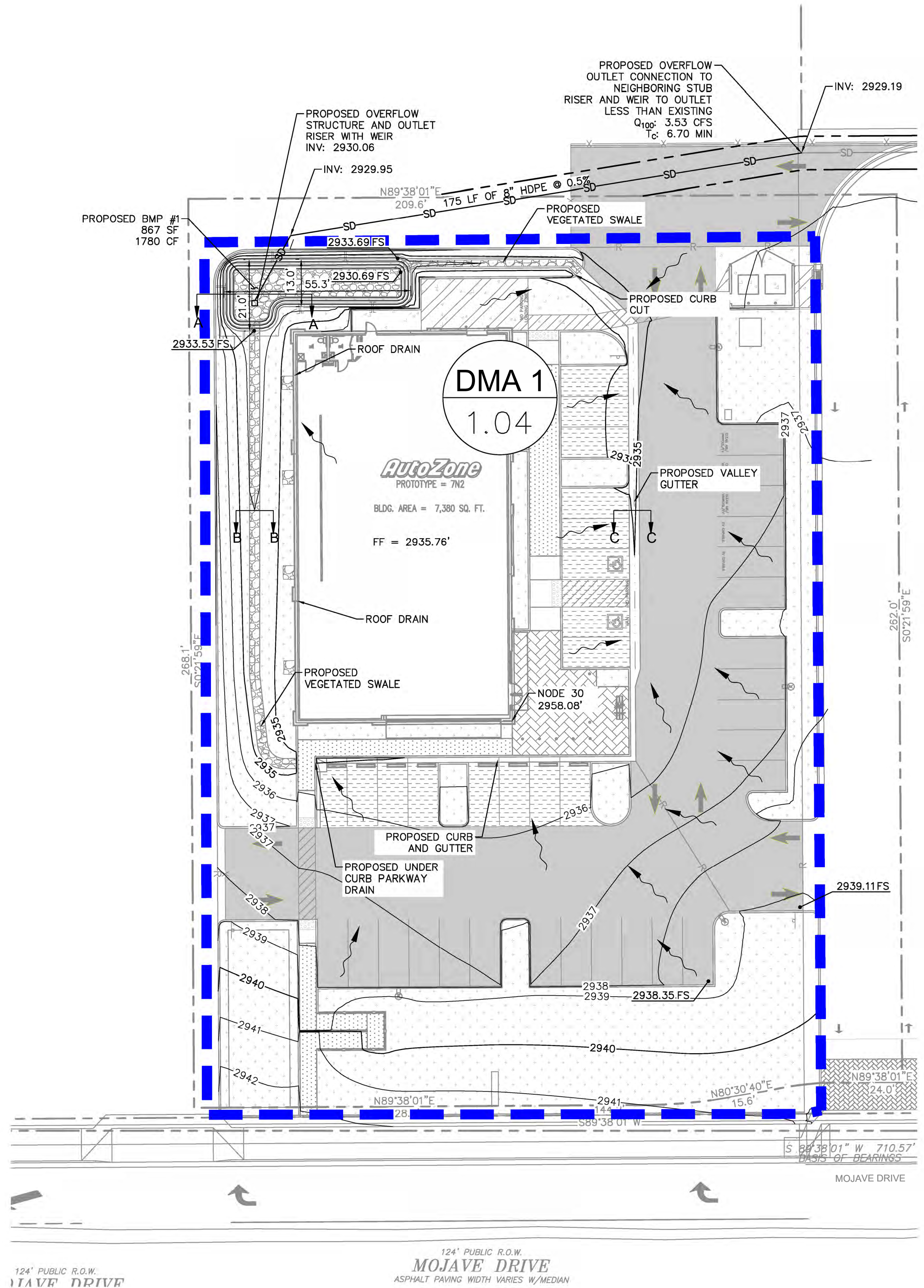
CITY OF VICTORVILLE
ENGINEERING DEPARTMENT
14343 Civic Drive, Victorville, CA 92392 (760) 955-5000

Approved By:

Brian W. Gengler, RCE-C44730
City Engineer

DATE





124' PUBLIC R.O.W.
MOJAVE DRIVE
ASPHALT PAVING WIDTH VARIES W/MEDIAN

LEGEND

PROPERTY LINE

PROPOSED CONTOUR

EXISTING CONTOUR

EASEMENT LINE

STREET CENTERLINE

DRAINAGE MANAGEMENT AREA (DMA)

DIRECTION OF FLOW

DMA NAME

DMA AREA (IN ACRES)

DATA SUMMARY

ADDRESS:

NORTHWEST MOJAVE DR & EL EVADO RD

APN:

039403136

ZONING DISTRICT:

C-2, GEN COMMERCIAL

FLOOD ZONE:

ZONE X - AREA DETERMINED TO BE OUTSIDE OF .2% ANNUAL CHANCE FLOOD PLAN

TOTAL PROJECT AREA:

45,378 (1.04 AC)

DMA	SURFACE TYPE	AREA (SF)	AREA (AC)	(REQUIRED) DESIGN CAPTURE VOLUME FT ³	PROVIDED TREATMENT VOLUME FT ³
DMA TOTAL EXISTING	CONC./ASPH.	N/A	N/A	1549.0	1780.0
	LANDSCAPING	45,378	1.04		
DMA TOTAL PROPOSED	CONC./ASPH.	30,160	0.69	1549.0	1780.0
	LANDSCAPING	15,580	0.36		
DMA NET CHANGE	CONC./ASPH.	30,160	0.69	1549.0	1780.0
	LANDSCAPING	(29,798)	0.68		

TREATMENT CONTROL & SOURCE CONTROL BMP'S	
BMP ID	BMP DESCRIPTION
MODULAR WETLANDS	
SC-43	PARKING AREA MAINTENANCE
SC-44	DRAINAGE SYSTEM MAINTENANCE
SC-71	PLAZA & SIDEWALK CLEANING
SC-73	LANDSCAPE MAINTENANCE
SD-10	SITE DESIGN AND LANDSCAPE PLANNING
SD-11	ROOF RUNOFF CONTROL
SD-12	EFFICIENT IRRIGATION

CITY CASE NO.

CITY OF VICTORVILLE

ENGINEERING DEPARTMENT

14343 Civic Drive, Victorville, CA 92392 (760) 955-5000

Approved By:

Brian W. Gengler, RCE C44730

City Engineer

DATE

800-227-2600

Call 2 Full Working Days in Advance

EXP. 03-31-24

BLDC21-00096

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DRAWN BY: JO
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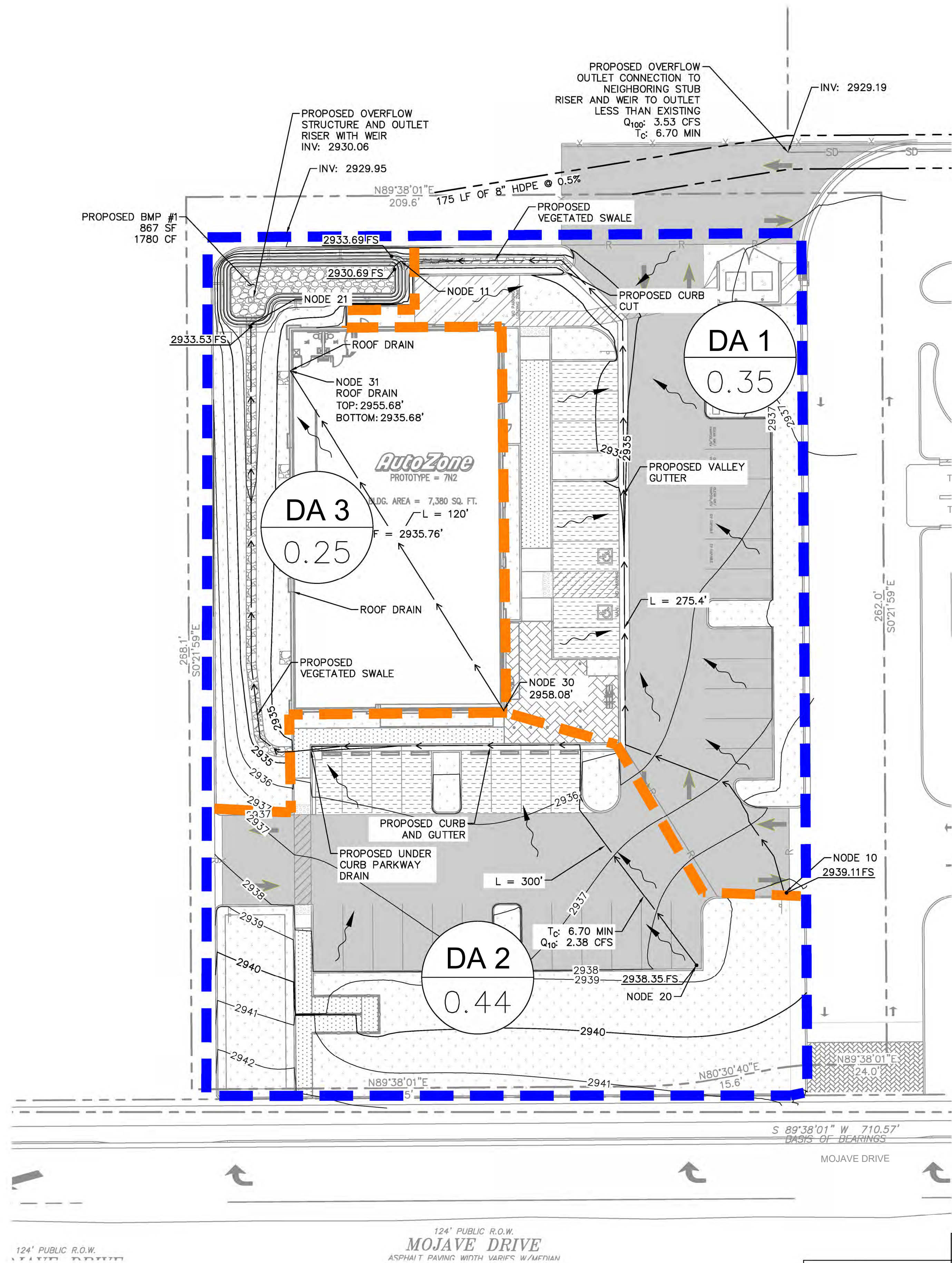
SHEET NO.
OF

DRAWING No.
XX-00
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WQMP EXHIBIT

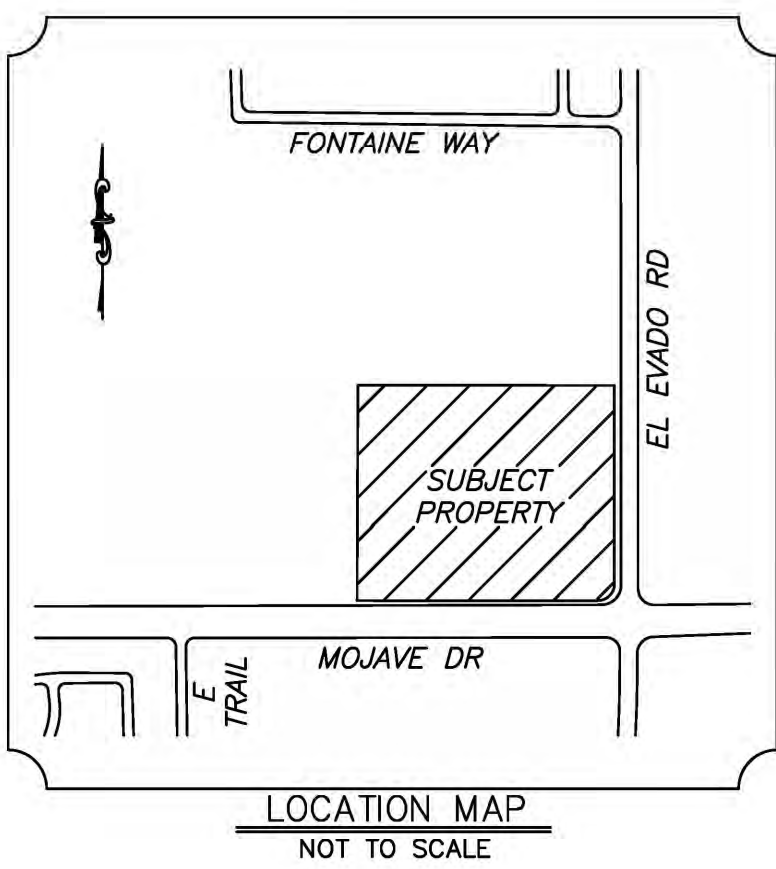
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File Name: K:\ORA_LDEV\AutoZone\xxxxxxx - VICTORVILLE\Reports\WQMP\Exhibits\WQMP Exhibit.dwg



LEGEND

- PROPERTY LINE
- 760 PROPOSED CONTOUR
- 760 EXISTING CONTOUR
- EASEMENT LINE
- DRAINAGE MANAGEMENT AREA (DMA)
- DRAINAGE AREA (DA)
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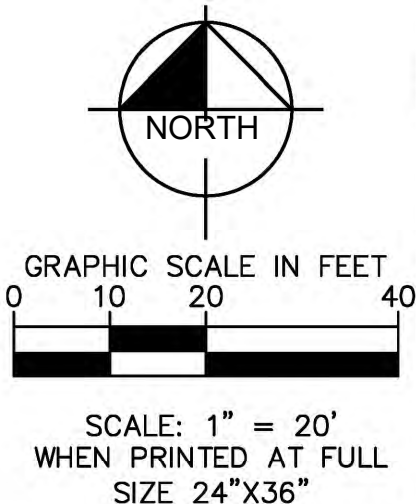
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FLOOD ZONE: ZONE X - AREA DETERMINED TO BE OUTSIDE OF .2% ANNUAL CHANCE FLOOD PLAN
TOTAL PROJECT AREA: 45,378 (1.04 AC)

DMA	SURFACE TYPE	AREA (SF)	AREA (AC)
DMA 1 0.35 AC	CONC./ASPH.	11,761	0.27
	LANDSCAPING	3,441	0.08
DMA 2 0.44	CONC./ASPH.	10,063	0.23
	LANDSCAPING	9,103	0.21
DMA 3 0.25	CONC./ASPH.	7405	0.17
	LANDSCAPING	3623	0.08

MITIGATION SUMMARY

Q₁₀ EXISTING: 3.58 CFS
Q₁₀ PROPOSED: 4.22 CFS
NOTE: OUTLET STRUCTURE RELEASES AT 3.53 CFS



BLDC21-00096

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DESIGN BY: JO
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DATE: 7/6/2022

SHEET NO. _____ OF _____
DRAWING No. XX-00
PROJECT No. TBD



CITY CASE NO.

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

Approved By: Brian W. Gengler, RCE C44730
City Engineer

DATE





WQMP Project Report

County of San Bernardino Stormwater Program

Santa Ana River Watershed Geodatabase

Monday, February 01, 2021

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):	039403137, 039403136
Project Site Acreage:	36.813
HCOC Exempt Area:	No
Closest Receiving Waters:	System Number -
(Applicant to verify based on local drainage facilities and topography.)	Facility Name - El Evado Channel
	Owner - OTHERS
Closest channel segment's susceptibility to Hydromodification:	EHM
Highest downstream hydromodification susceptibility:	NULL
Is this drainage segment subject to TMDLs?	No
Are there downstream drainage segments subject to TMDLs?	No
Is this drainage segment a 303d listed stream?	No
Are there 303d listed streams downstream?	No
Are there unlined downstream waterbodies?	No
Project Site Onsite Soil Group(s):	A, B
Environmentally Sensitive Areas within 200':	DESERT TORTOISE HABITAT CAT 3, MOJAVE GROUND SQUIRREL
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:	



NOAA Atlas 14, Volume 6, Version 2
Location name: Victorville, California, USA*
Latitude: 34.5295°, Longitude: -117.349°
Elevation: 2944.48 ft**

* source: ESRI Maps
 ** source: USGS



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 & aeries](#)

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches/hour)¹										
Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	1.15 (0.948-1.40)	1.58 (1.31-1.94)	2.20 (1.80-2.69)	2.71 (2.21-3.36)	3.46 (2.74-4.43)	4.07 (3.14-5.32)	4.72 (3.56-6.32)	5.42 (3.98-7.46)	6.43 (4.54-9.23)	7.26 (4.94-10.8)
10-min	0.822 (0.678-1.01)	1.13 (0.936-1.39)	1.57 (1.29-1.93)	1.94 (1.58-2.41)	2.48 (1.96-3.17)	2.92 (2.26-3.81)	3.38 (2.55-4.53)	3.89 (2.85-5.35)	4.61 (3.25-6.61)	5.21 (3.54-7.73)
15-min	0.664 (0.548-0.812)	0.916 (0.756-1.12)	1.27 (1.04-1.56)	1.57 (1.28-1.94)	2.00 (1.58-2.56)	2.35 (1.82-3.07)	2.73 (2.06-3.65)	3.13 (2.30-4.31)	3.72 (2.62-5.33)	4.20 (2.86-6.23)
30-min	0.454 (0.374-0.554)	0.626 (0.516-0.768)	0.866 (0.712-1.06)	1.07 (0.874-1.33)	1.37 (1.08-1.75)	1.61 (1.24-2.10)	1.86 (1.41-2.49)	2.14 (1.57-2.95)	2.54 (1.79-3.64)	2.87 (1.95-4.26)
60-min	0.268 (0.221-0.328)	0.370 (0.305-0.453)	0.511 (0.420-0.628)	0.632 (0.515-0.783)	0.806 (0.636-1.03)	0.948 (0.733-1.24)	1.10 (0.830-1.47)	1.26 (0.927-1.74)	1.50 (1.06-2.15)	1.69 (1.15-2.51)
2-hr	0.186 (0.154-0.228)	0.250 (0.206-0.306)	0.338 (0.278-0.416)	0.414 (0.338-0.512)	0.522 (0.412-0.668)	0.610 (0.472-0.797)	0.703 (0.530-0.941)	0.802 (0.589-1.11)	0.944 (0.665-1.36)	1.06 (0.722-1.57)
3-hr	0.148 (0.122-0.181)	0.197 (0.163-0.241)	0.265 (0.218-0.325)	0.322 (0.263-0.399)	0.405 (0.320-0.518)	0.471 (0.364-0.616)	0.541 (0.409-0.725)	0.617 (0.453-0.849)	0.724 (0.509-1.04)	0.810 (0.551-1.20)
6-hr	0.100 (0.082-0.122)	0.132 (0.109-0.162)	0.177 (0.146-0.217)	0.215 (0.175-0.266)	0.268 (0.212-0.343)	0.311 (0.240-0.406)	0.356 (0.269-0.477)	0.404 (0.296-0.556)	0.471 (0.332-0.676)	0.526 (0.358-0.781)
12-hr	0.063 (0.052-0.077)	0.085 (0.070-0.104)	0.114 (0.094-0.140)	0.139 (0.113-0.172)	0.173 (0.137-0.222)	0.200 (0.155-0.262)	0.229 (0.172-0.306)	0.258 (0.190-0.356)	0.300 (0.211-0.430)	0.333 (0.227-0.495)
24-hr	0.041 (0.036-0.047)	0.056 (0.050-0.065)	0.076 (0.068-0.088)	0.093 (0.082-0.109)	0.117 (0.099-0.141)	0.135 (0.112-0.166)	0.154 (0.125-0.194)	0.174 (0.137-0.225)	0.201 (0.152-0.272)	0.223 (0.163-0.312)
2-day	0.023 (0.020-0.026)	0.032 (0.028-0.037)	0.044 (0.039-0.051)	0.054 (0.047-0.063)	0.068 (0.058-0.082)	0.079 (0.065-0.097)	0.090 (0.073-0.114)	0.102 (0.080-0.132)	0.119 (0.090-0.160)	0.132 (0.096-0.184)
3-day	0.017 (0.015-0.019)	0.023 (0.020-0.027)	0.032 (0.028-0.037)	0.040 (0.035-0.046)	0.050 (0.042-0.060)	0.058 (0.048-0.071)	0.066 (0.054-0.084)	0.075 (0.059-0.098)	0.088 (0.066-0.119)	0.098 (0.071-0.137)
4-day	0.013 (0.012-0.015)	0.019 (0.016-0.021)	0.026 (0.023-0.030)	0.032 (0.028-0.037)	0.040 (0.034-0.048)	0.046 (0.038-0.057)	0.053 (0.043-0.067)	0.060 (0.047-0.078)	0.070 (0.053-0.095)	0.078 (0.057-0.109)
7-day	0.008 (0.007-0.009)	0.011 (0.010-0.013)	0.016 (0.014-0.018)	0.019 (0.017-0.022)	0.024 (0.020-0.029)	0.028 (0.023-0.034)	0.032 (0.026-0.040)	0.036 (0.028-0.046)	0.041 (0.031-0.056)	0.046 (0.033-0.064)
10-day	0.006 (0.005-0.007)	0.008 (0.007-0.010)	0.011 (0.010-0.013)	0.014 (0.012-0.016)	0.017 (0.015-0.021)	0.020 (0.017-0.025)	0.023 (0.019-0.029)	0.026 (0.020-0.034)	0.030 (0.023-0.040)	0.033 (0.024-0.046)
20-day	0.003 (0.003-0.004)	0.005 (0.004-0.006)	0.007 (0.006-0.008)	0.008 (0.007-0.010)	0.010 (0.009-0.012)	0.012 (0.010-0.015)	0.014 (0.011-0.017)	0.015 (0.012-0.020)	0.018 (0.014-0.024)	0.020 (0.014-0.028)
30-day	0.003 (0.002-0.003)	0.004 (0.003-0.004)	0.005 (0.005-0.006)	0.006 (0.006-0.007)	0.008 (0.007-0.010)	0.009 (0.008-0.012)	0.011 (0.009-0.014)	0.012 (0.010-0.016)	0.014 (0.011-0.019)	0.016 (0.012-0.022)
45-day	0.002 (0.002-0.002)	0.003 (0.003-0.003)	0.004 (0.004-0.005)	0.005 (0.004-0.006)	0.006 (0.006-0.008)	0.008 (0.006-0.009)	0.009 (0.007-0.011)	0.010 (0.008-0.013)	0.012 (0.009-0.016)	0.014 (0.010-0.019)
60-day	0.002 (0.001-0.002)	0.002 (0.002-0.003)	0.003 (0.003-0.004)	0.004 (0.004-0.005)	0.005 (0.005-0.007)	0.007 (0.005-0.008)	0.008 (0.006-0.010)	0.009 (0.007-0.012)	0.011 (0.008-0.014)	0.012 (0.009-0.017)

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.

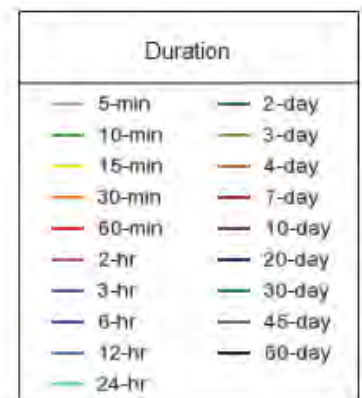
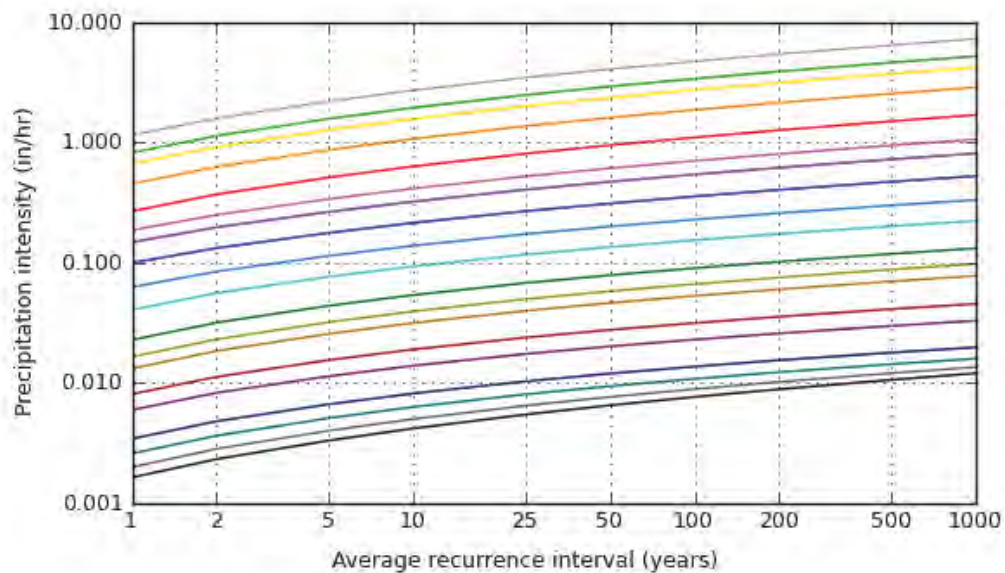
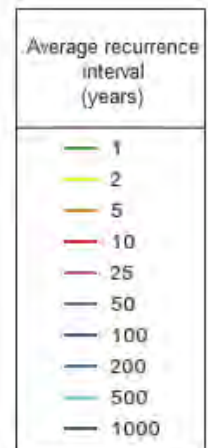
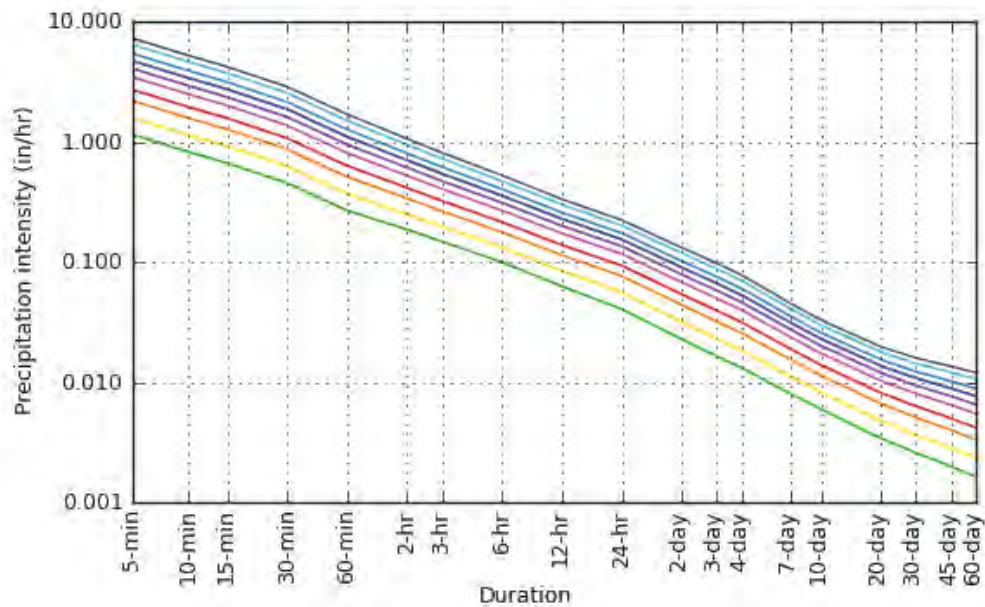
Please refer to NOAA Atlas 14 document for more information.

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PF graphical

PDS-based intensity-duration-frequency (IDF) curves

Latitude: 34.5295°, Longitude: -117.3490°



NOAA Atlas 14, Volume 6, Version 2

Created (GMT): Thu Feb 4 03:30:53 2021

[Back to Top](#)**Maps & aeriels****Small scale terrain**



Large scale terrain



Large scale map



Large scale aerial



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1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

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RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
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Ver. 18.0 Release Date: 07/01/2011 License ID 1499

Analysis prepared by:

Kimley-Horn and Associates, Inc.
765 The City Drive
Suite 200
Orange, CA 92868

***** DESCRIPTION OF STUDY

* AUTOZONE VICTORVILLE 10YR 24HR EXISTING
*
* R.A. 7/22/21
*
* AZV1024E.RES
*

*

FILE NAME: AZV1024E.DAT
TIME/DATE OF STUDY: 13:26 07/27/2021

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===

USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:

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--*TIME-OF-CONCENTRATION MODEL*--

USER SPECIFIED STORM EVENT(YEAR) = 10.00
SPECIFIED MINIMUM PIPE SIZE(INCH) = 8.00
SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE =
1.00

USER-DEFINED TABLED RAINFALL USED
NUMBER OF [TIME,INTENSITY] DATA PAIRS = 3
1) 5.00; 2.710
2) 60.00; 0.632
3) 360.00; 0.215

ANTECEDENT MOISTURE CONDITION (AMC) II ASSUMED FOR RATIONAL METHOD

*USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW
MODEL*

MANNING		HALF- CROWN TO		STREET-CROSSFALL:		CURB GUTTER-GEOMETRIES:			
NO.	WIDTH (FT)	CROSSFALL (FT)	IN- SIDE	OUT- / SIDE/	PARK- WAY	HEIGHT (FT)	WIDTH (FT)	LIP (FT)	HIKE (FT)
1	30.0	20.0	0.018	0.018	0.020	0.67	2.00	0.0313	0.167

0.0150

GLOBAL STREET FLOW-DEPTH CONSTRAINTS:

1. Relative Flow-Depth = 0.00 FEET
as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
 2. (Depth)*(Velocity) Constraint = 6.0 (FT*FT/S)
- *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
*USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

FLOW PROCESS FROM NODE 10.00 TO NODE 11.00 IS CODE = 21

>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
>>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<

=====

INITIAL SUBAREA FLOW-LENGTH (FEET) = 208.00
ELEVATION DATA: UPSTREAM (FEET) = 2942.95 DOWNSTREAM (FEET) = 2938.80

$$T_c = K * [(LENGTH ** 3.00) / (ELEVATION CHANGE)] ** 0.20$$

SUBAREA ANALYSIS USED MINIMUM T_c (MIN.) = 8.937

* 10 YEAR RAINFALL INTENSITY (INCH/HR) = 2.561

SUBAREA T_c AND LOSS RATE DATA (AMC II):

DEVELOPMENT TYPE/	SCS SOIL	AREA	F_p	A_p	SCS
LAND USE	GROUP	(ACRES)	(INCH/HR)	(DECIMAL)	CN
PUBLIC PARK	C	1.00	0.57	0.850	69

8.94

SUBAREA AVERAGE PERVIOUS LOSS RATE, F_p (INCH/HR) = 0.57

SUBAREA AVERAGE PERVIOUS AREA FRACTION, A_p = 0.850

SUBAREA RUNOFF (CFS) = 1.87

TOTAL AREA (ACRES) = 1.00 PEAK FLOW RATE (CFS) = 1.87

=====

END OF STUDY SUMMARY:

TOTAL AREA (ACRES) = 1.00 T_c (MIN.) = 8.94
EFFECTIVE AREA (ACRES) = 1.00 AREA-AVERAGED F_m (INCH/HR) = 0.48

AREA-AVERAGED F_p (INCH/HR) = 0.57 AREA-AVERAGED A_p = 0.850
PEAK FLOW RATE (CFS) = 1.87

=====
===

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END OF RATIONAL METHOD ANALYSIS

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Analysis prepared by:

Kimley-Horn and Associates, Inc.
765 The City Drive
Suite 200
Orange, CA 92868

***** DESCRIPTION OF STUDY

* AUTOZONE VICTORVILLE 100YR EXISTING
*
* R.A. 7/22/21
*
* AZV100E.RES
*

*

FILE NAME: AZV100E.DAT
TIME/DATE OF STUDY: 13:45 07/23/2021

=====
===

USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:

=====
===

--*TIME-OF-CONCENTRATION MODEL*--

USER SPECIFIED STORM EVENT(YEAR) = 100.00
SPECIFIED MINIMUM PIPE SIZE(INCH) = 8.00
SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE =
1.00

USER-DEFINED TABLED RAINFALL USED

NUMBER OF [TIME,INTENSITY] DATA PAIRS = 3

1) 5.00; 4.720
2) 60.00; 1.100
3) 180.00; 0.541

ANTECEDENT MOISTURE CONDITION (AMC) III ASSUMED FOR RATIONAL METHOD

*USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW
MODEL*

MANNING		HALF- CROWN TO		STREET-CROSSFALL:		CURB GUTTER-GEOMETRIES:			
NO.	WIDTH (FT)	CROSSFALL (FT)	IN- SIDE	OUT- / SIDE/	PARK- WAY	HEIGHT (FT)	WIDTH (FT)	LIP (FT)	HIKE (FT)
1	30.0	20.0	0.018	0.018	0.020	0.67	2.00	0.0313	0.167

0.0150

GLOBAL STREET FLOW-DEPTH CONSTRAINTS:

1. Relative Flow-Depth = 0.00 FEET
as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
 2. (Depth)*(Velocity) Constraint = 6.0 (FT*FT/S)
- *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
*USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

FLOW PROCESS FROM NODE 10.00 TO NODE 11.00 IS CODE = 21

>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
>>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<

=====

INITIAL SUBAREA FLOW-LENGTH (FEET) = 208.00
ELEVATION DATA: UPSTREAM (FEET) = 2942.95 DOWNSTREAM (FEET) = 2938.80

$$T_c = K * [(LENGTH ** 3.00) / (ELEVATION CHANGE)] ** 0.20$$

SUBAREA ANALYSIS USED MINIMUM T_c (MIN.) = 8.937

* 100 YEAR RAINFALL INTENSITY (INCH/HR) = 4.461

SUBAREA T_c AND LOSS RATE DATA (AMC III):

DEVELOPMENT TYPE/	SCS SOIL	AREA	F_p	A_p	SCS
LAND USE	GROUP	(ACRES)	(INCH/HR)	(DECIMAL)	CN

PUBLIC PARK	C	1.00	0.27	0.850	86
-------------	---	------	------	-------	----

8.94

SUBAREA AVERAGE PERVIOUS LOSS RATE, F_p (INCH/HR) = 0.27

SUBAREA AVERAGE PERVIOUS AREA FRACTION, A_p = 0.850

SUBAREA RUNOFF (CFS) = 3.81

TOTAL AREA (ACRES) = 1.00 PEAK FLOW RATE (CFS) = 3.81

=====

END OF STUDY SUMMARY:

TOTAL AREA (ACRES) = 1.00 T_c (MIN.) = 8.94
EFFECTIVE AREA (ACRES) = 1.00 AREA-AVERAGED F_m (INCH/HR) = 0.23

AREA-AVERAGED F_p (INCH/HR) = 0.27 AREA-AVERAGED A_p = 0.850
PEAK FLOW RATE (CFS) = 3.81

=====

=====

END OF RATIONAL METHOD ANALYSIS

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Ver. 18.0 Release Date: 07/01/2011 License ID 1499

Analysis prepared by:

Kimley-Horn and Associates, Inc.
765 The City Drive
Suite 200
Orange, CA 92868

***** DESCRIPTION OF STUDY

* AUTOZONE VICTORVILLE 10YR PROPOSED
*
* RA 8/3/2021
*
* AZ10P
*

*

FILE NAME: AZV10P.DAT
TIME/DATE OF STUDY: 13:36 08/03/2021

=====
===

USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:

=====
===

--*TIME-OF-CONCENTRATION MODEL*--

USER SPECIFIED STORM EVENT(YEAR) = 10.00
SPECIFIED MINIMUM PIPE SIZE(INCH) = 8.00
SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE =
1.00

USER-DEFINED TABLED RAINFALL USED

NUMBER OF [TIME,INTENSITY] DATA PAIRS = 3

1) 5.00; 2.710
2) 60.00; 0.632
3) 180.00; 0.322

ANTECEDENT MOISTURE CONDITION (AMC) II ASSUMED FOR RATIONAL METHOD

*USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW
MODEL*

MANNING		HALF- CROWN TO	STREET-CROSSFALL:			CURB	GUTTER-GEOMETRIES:		
NO.	WIDTH (FT)	CROSSFALL (FT)	IN- SIDE	/ OUT- SIDE/	PARK- WAY	HEIGHT (FT)	WIDTH (FT)	LIP (FT)	HIKE (FT)
1	30.0	20.0	0.018	0.018	0.020	0.67	2.00	0.0313	0.167

0.0150

GLOBAL STREET FLOW-DEPTH CONSTRAINTS:

1. Relative Flow-Depth = 0.00 FEET
as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
 2. (Depth)*(Velocity) Constraint = 6.0 (FT*FT/S)
- *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
*USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

FLOW PROCESS FROM NODE 10.00 TO NODE 11.00 IS CODE = 21

>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
>>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<

=====

INITIAL SUBAREA FLOW-LENGTH (FEET) = 275.00
ELEVATION DATA: UPSTREAM (FEET) = 2939.11 DOWNSTREAM (FEET) = 2933.61

$$T_c = K * [(LENGTH ** 3.00) / (ELEVATION CHANGE)] ** 0.20$$

SUBAREA ANALYSIS USED MINIMUM T_c (MIN.) = 6.700

* 10 YEAR RAINFALL INTENSITY (INCH/HR) = 2.646

SUBAREA T_c AND LOSS RATE DATA (AMC II):

DEVELOPMENT TYPE/	SCS SOIL	AREA	F_p	A_p	SCS
LAND USE	GROUP	(ACRES)	(INCH/HR)	(DECIMAL)	CN
APARTMENTS	C	0.35	0.57	0.200	69

6.70

SUBAREA AVERAGE PERVIOUS LOSS RATE, F_p (INCH/HR) = 0.57

SUBAREA AVERAGE PERVIOUS AREA FRACTION, A_p = 0.200

SUBAREA RUNOFF (CFS) = 0.80

TOTAL AREA (ACRES) = 0.35 PEAK FLOW RATE (CFS) = 0.80

FLOW PROCESS FROM NODE 11.00 TO NODE 11.00 IS CODE = 1

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----
>>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<

=====
===
TOTAL NUMBER OF STREAMS = 3
CONFLUENCE VALUES USED FOR INDEPENDENT STREAM 1 ARE:
TIME OF CONCENTRATION(MIN.) = 6.70
RAINFALL INTENSITY(INCH/HR) = 2.65
AREA-AVERAGED Fm(INCH/HR) = 0.11
AREA-AVERAGED Fp(INCH/HR) = 0.57
AREA-AVERAGED Ap = 0.20
EFFECTIVE STREAM AREA(ACRES) = 0.35
TOTAL STREAM AREA(ACRES) = 0.35
PEAK FLOW RATE(CFS) AT CONFLUENCE = 0.80

*****
***
FLOW PROCESS FROM NODE 20.00 TO NODE 21.00 IS CODE = 21
-----
----
>>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
>>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<

=====
===
INITIAL SUBAREA FLOW-LENGTH(FEET) = 226.50
ELEVATION DATA: UPSTREAM(FEET) = 2938.78 DOWNSTREAM(FEET) =
2933.63

Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) = 6.043
* 10 YEAR RAINFALL INTENSITY(INCH/HR) = 2.671
SUBAREA Tc AND LOSS RATE DATA(AMC II):
DEVELOPMENT TYPE/ SCS SOIL AREA Fp Ap SCS
Tc
LAND USE GROUP (ACRES) (INCH/HR) (DECIMAL) CN
(MIN.)
APARTMENTS C 0.44 0.57 0.200 69
6.04
SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) = 0.57
SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap = 0.200
SUBAREA RUNOFF(CFS) = 1.01
TOTAL AREA(ACRES) = 0.44 PEAK FLOW RATE(CFS) = 1.01

*****
***
FLOW PROCESS FROM NODE 21.00 TO NODE 11.00 IS CODE = 1
-----
----
>>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<

```

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=====
===
TOTAL NUMBER OF STREAMS = 3
CONFLUENCE VALUES USED FOR INDEPENDENT STREAM 2 ARE:
TIME OF CONCENTRATION(MIN.) = 6.04
RAINFALL INTENSITY(INCH/HR) = 2.67
AREA-AVERAGED Fm(INCH/HR) = 0.11
AREA-AVERAGED Fp(INCH/HR) = 0.57
AREA-AVERAGED Ap = 0.20
EFFECTIVE STREAM AREA(ACRES) = 0.44
TOTAL STREAM AREA(ACRES) = 0.44
PEAK FLOW RATE(CFS) AT CONFLUENCE = 1.01

*****
***
FLOW PROCESS FROM NODE 30.00 TO NODE 31.00 IS CODE = 22
-----
----
>>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
>>>>>USE SPECIFIED Tc VALUE FOR INITIAL SUBAREA<<<

=====
===
INITIAL SUBAREA FLOW-LENGTH(FEET) = 226.50
USER SPECIFIED Tc(MIN.) = 5.000
* 10 YEAR RAINFALL INTENSITY(INCH/HR) = 2.710
SUBAREA LOSS RATE DATA(AMC II):
DEVELOPMENT TYPE/ SCS SOIL AREA Fp Ap SCS
LAND USE GROUP (ACRES) (INCH/HR) (DECIMAL) CN
COMMERCIAL C 0.25 0.57 0.100 69
SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) = 0.57
SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap = 0.100
SUBAREA RUNOFF(CFS) = 0.60
TOTAL AREA(ACRES) = 0.25 PEAK FLOW RATE(CFS) = 0.60

*****
***
FLOW PROCESS FROM NODE 31.00 TO NODE 11.00 IS CODE = 1
-----
----
>>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
>>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<

=====
===
TOTAL NUMBER OF STREAMS = 3
CONFLUENCE VALUES USED FOR INDEPENDENT STREAM 3 ARE:
TIME OF CONCENTRATION(MIN.) = 5.00
RAINFALL INTENSITY(INCH/HR) = 2.71
AREA-AVERAGED Fm(INCH/HR) = 0.06
AREA-AVERAGED Fp(INCH/HR) = 0.57

```

AREA-AVERAGED $A_p = 0.10$
 EFFECTIVE STREAM AREA(ACRES) = 0.25
 TOTAL STREAM AREA(ACRES) = 0.25
 PEAK FLOW RATE(CFS) AT CONFLUENCE = 0.60

** CONFLUENCE DATA **

STREAM	Q	Tc	Intensity	Fp(Fm)	Ap	Ae	
NUMBER	(CFS)	(MIN.)	(INCH/HR)	(INCH/HR)		(ACRES)	NODE
1	0.80	6.70	2.646	0.57(0.11)	0.20	0.3	
2	1.01	6.04	2.671	0.57(0.11)	0.20	0.4	
3	0.60	5.00	2.710	0.57(0.06)	0.10	0.2	

RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
 CONFLUENCE FORMULA USED FOR 3 STREAMS.

** PEAK FLOW RATE TABLE **

STREAM	Q	Tc	Intensity	Fp(Fm)	Ap	Ae	
NUMBER	(CFS)	(MIN.)	(INCH/HR)	(INCH/HR)		(ACRES)	NODE
1	2.06	5.00	2.710	0.57(0.10)	0.17	0.9	
2	2.33	6.04	2.671	0.57(0.10)	0.18	1.0	
3	2.38	6.70	2.646	0.57(0.10)	0.18	1.0	

COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
 PEAK FLOW RATE(CFS) = 2.38 Tc(MIN.) = 6.70
 EFFECTIVE AREA(ACRES) = 1.04 AREA-AVERAGED Fm(INCH/HR) = 0.10
 AREA-AVERAGED Fp(INCH/HR) = 0.57 AREA-AVERAGED $A_p = 0.18$
 TOTAL AREA(ACRES) = 1.0
 LONGEST FLOWPATH FROM NODE 10.00 TO NODE 11.00 = 275.00 FEET.

=====

END OF STUDY SUMMARY:
 TOTAL AREA(ACRES) = 1.0 TC(MIN.) = 6.70
 EFFECTIVE AREA(ACRES) = 1.04 AREA-AVERAGED Fm(INCH/HR) = 0.10
 AREA-AVERAGED Fp(INCH/HR) = 0.57 AREA-AVERAGED $A_p = 0.176$
 PEAK FLOW RATE(CFS) = 2.38

** PEAK FLOW RATE TABLE **

STREAM	Q	Tc	Intensity	Fp(Fm)	Ap	Ae	
NUMBER	(CFS)	(MIN.)	(INCH/HR)	(INCH/HR)		(ACRES)	NODE
1	2.06	5.00	2.710	0.57(0.10)	0.17	0.9	
2	2.33	6.04	2.671	0.57(0.10)	0.18	1.0	

10.00 3 2.38 6.70 2.646 0.57 (0.10) 0.18 1.0

=====

=====

END OF RATIONAL METHOD ANALYSIS

RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
(Reference: 1986 SAN BERNARDINO CO. HYDROLOGY CRITERION)
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Ver. 18.0 Release Date: 07/01/2011 License ID 1499

Analysis prepared by:

Kimley-Horn and Associates, Inc.
765 The City Drive
Suite 200
Orange, CA 92868

***** DESCRIPTION OF STUDY

* AUTOZONE VICTORVILL 100YR PROPOSED
*
* R.A. 7/22/21
*
* AZ10P
*

*

FILE NAME: AZV100P.DAT
TIME/DATE OF STUDY: 14:20 07/23/2021

=====
===

USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:

=====
===

--*TIME-OF-CONCENTRATION MODEL*--

USER SPECIFIED STORM EVENT(YEAR) = 100.00
SPECIFIED MINIMUM PIPE SIZE(INCH) = 8.00
SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE =
1.00

USER-DEFINED TABLED RAINFALL USED

NUMBER OF [TIME,INTENSITY] DATA PAIRS = 3

1) 5.00; 4.720
2) 60.00; 1.100
3) 180.00; 0.541

ANTECEDENT MOISTURE CONDITION (AMC) III ASSUMED FOR RATIONAL METHOD

*USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW
MODEL*

MANNING		HALF- CROWN TO	STREET-CROSSFALL:			CURB	GUTTER-GEOMETRIES:		
NO.	WIDTH (FT)	CROSSFALL (FT)	IN- SIDE	/ OUT- SIDE/	PARK- WAY	HEIGHT (FT)	WIDTH (FT)	LIP (FT)	HIKE (FT)
1	30.0	20.0	0.018	0.018	0.020	0.67	2.00	0.0313	0.167

0.0150

GLOBAL STREET FLOW-DEPTH CONSTRAINTS:

1. Relative Flow-Depth = 0.00 FEET
as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
 2. (Depth)*(Velocity) Constraint = 6.0 (FT*FT/S)
- *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
*USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

FLOW PROCESS FROM NODE 10.00 TO NODE 11.00 IS CODE = 21

>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
>>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<

=====

INITIAL SUBAREA FLOW-LENGTH (FEET) = 275.00
ELEVATION DATA: UPSTREAM (FEET) = 2939.11 DOWNSTREAM (FEET) = 2933.61

$$T_c = K * [(LENGTH ** 3.00) / (ELEVATION CHANGE)] ** 0.20$$

SUBAREA ANALYSIS USED MINIMUM T_c (MIN.) = 6.700

* 100 YEAR RAINFALL INTENSITY (INCH/HR) = 4.608

SUBAREA T_c AND LOSS RATE DATA (AMC III):

DEVELOPMENT TYPE/	SCS SOIL	AREA	F_p	A_p	SCS
LAND USE	GROUP	(ACRES)	(INCH/HR)	(DECIMAL)	CN
APARTMENTS	C	0.35	0.27	0.200	86

6.70

SUBAREA AVERAGE PERVIOUS LOSS RATE, F_p (INCH/HR) = 0.27

SUBAREA AVERAGE PERVIOUS AREA FRACTION, A_p = 0.200

SUBAREA RUNOFF (CFS) = 1.43

TOTAL AREA (ACRES) = 0.35 PEAK FLOW RATE (CFS) = 1.43

FLOW PROCESS FROM NODE 11.00 TO NODE 11.00 IS CODE = 1

```

-----
----
>>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<

=====
===
TOTAL NUMBER OF STREAMS = 3
CONFLUENCE VALUES USED FOR INDEPENDENT STREAM 1 ARE:
TIME OF CONCENTRATION(MIN.) = 6.70
RAINFALL INTENSITY(INCH/HR) = 4.61
AREA-AVERAGED Fm(INCH/HR) = 0.05
AREA-AVERAGED Fp(INCH/HR) = 0.27
AREA-AVERAGED Ap = 0.20
EFFECTIVE STREAM AREA(ACRES) = 0.35
TOTAL STREAM AREA(ACRES) = 0.35
PEAK FLOW RATE(CFS) AT CONFLUENCE = 1.43

*****
***
FLOW PROCESS FROM NODE 20.00 TO NODE 21.00 IS CODE = 21
-----
----
>>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
>>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<

=====
===
INITIAL SUBAREA FLOW-LENGTH(FEET) = 226.50
ELEVATION DATA: UPSTREAM(FEET) = 2938.78 DOWNSTREAM(FEET) =
2933.63

Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) = 6.043
* 100 YEAR RAINFALL INTENSITY(INCH/HR) = 4.651
SUBAREA Tc AND LOSS RATE DATA(AMC III):
DEVELOPMENT TYPE/ SCS SOIL AREA Fp Ap SCS
Tc
LAND USE GROUP (ACRES) (INCH/HR) (DECIMAL) CN
(MIN.)
APARTMENTS C 0.44 0.27 0.200 86
6.04
SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) = 0.27
SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap = 0.200
SUBAREA RUNOFF(CFS) = 1.82
TOTAL AREA(ACRES) = 0.44 PEAK FLOW RATE(CFS) = 1.82

*****
***
FLOW PROCESS FROM NODE 21.00 TO NODE 11.00 IS CODE = 1
-----
----
>>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<

```

```

=====
===
TOTAL NUMBER OF STREAMS = 3
CONFLUENCE VALUES USED FOR INDEPENDENT STREAM 2 ARE:
TIME OF CONCENTRATION(MIN.) = 6.04
RAINFALL INTENSITY(INCH/HR) = 4.65
AREA-AVERAGED Fm(INCH/HR) = 0.05
AREA-AVERAGED Fp(INCH/HR) = 0.27
AREA-AVERAGED Ap = 0.20
EFFECTIVE STREAM AREA(ACRES) = 0.44
TOTAL STREAM AREA(ACRES) = 0.44
PEAK FLOW RATE(CFS) AT CONFLUENCE = 1.82

*****
***
FLOW PROCESS FROM NODE 30.00 TO NODE 31.00 IS CODE = 22
-----
----
>>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
>>>>>USE SPECIFIED Tc VALUE FOR INITIAL SUBAREA<<<

=====
===
INITIAL SUBAREA FLOW-LENGTH(FEET) = 226.50
USER SPECIFIED Tc(MIN.) = 5.000
* 100 YEAR RAINFALL INTENSITY(INCH/HR) = 4.720
SUBAREA LOSS RATE DATA(AMC III):
DEVELOPMENT TYPE/ SCS SOIL AREA Fp Ap SCS
LAND USE GROUP (ACRES) (INCH/HR) (DECIMAL) CN
COMMERCIAL C 0.25 0.27 0.100 86
SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) = 0.27
SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap = 0.100
SUBAREA RUNOFF(CFS) = 1.06
TOTAL AREA(ACRES) = 0.25 PEAK FLOW RATE(CFS) = 1.06

*****
***
FLOW PROCESS FROM NODE 31.00 TO NODE 11.00 IS CODE = 1
-----
----
>>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
>>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<

=====
===
TOTAL NUMBER OF STREAMS = 3
CONFLUENCE VALUES USED FOR INDEPENDENT STREAM 3 ARE:
TIME OF CONCENTRATION(MIN.) = 5.00
RAINFALL INTENSITY(INCH/HR) = 4.72
AREA-AVERAGED Fm(INCH/HR) = 0.03
AREA-AVERAGED Fp(INCH/HR) = 0.27

```

```

AREA-AVERAGED Ap = 0.10
EFFECTIVE STREAM AREA(ACRES) = 0.25
TOTAL STREAM AREA(ACRES) = 0.25
PEAK FLOW RATE(CFS) AT CONFLUENCE = 1.06

```

** CONFLUENCE DATA **							
STREAM	Q	Tc	Intensity	Fp(Fm)	Ap	Ae	
HEADWATER							
NUMBER	(CFS)	(MIN.)	(INCH/HR)	(INCH/HR)		(ACRES)	NODE
1	1.43	6.70	4.608	0.27 (0.05)	0.20	0.3	
10.00							
2	1.82	6.04	4.651	0.27 (0.05)	0.20	0.4	
20.00							
3	1.06	5.00	4.720	0.27 (0.03)	0.10	0.2	
30.00							

RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
CONFLUENCE FORMULA USED FOR 3 STREAMS.

** PEAK FLOW RATE TABLE **							
STREAM	Q	Tc	Intensity	Fp(Fm)	Ap	Ae	
HEADWATER							
NUMBER	(CFS)	(MIN.)	(INCH/HR)	(INCH/HR)		(ACRES)	NODE
1	3.68	5.00	4.720	0.27 (0.05)	0.17	0.9	
30.00							
2	4.17	6.04	4.651	0.27 (0.05)	0.18	1.0	
20.00							
3	4.27	6.70	4.608	0.27 (0.05)	0.18	1.0	
10.00							

```

COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
PEAK FLOW RATE (CFS) =          4.27      Tc (MIN.) =          6.70
EFFECTIVE AREA (ACRES) =          1.04      AREA-AVERAGED Fm (INCH/HR) =    0.05
AREA-AVERAGED Fp (INCH/HR) =    0.27      AREA-AVERAGED Ap =    0.18
TOTAL AREA (ACRES) =          1.0
LONGEST FLOWPATH FROM NODE      10.00 TO NODE      11.00 =      275.00
FEET.

```

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END OF STUDY SUMMARY:

TOTAL AREA (ACRES)	=	1.0	TC (MIN.)	=	6.70
EFFECTIVE AREA (ACRES)	=	1.04	AREA-AVERAGED Fm (INCH/HR)	=	0.05
AREA-AVERAGED Fp (INCH/HR)	=	0.27	AREA-AVERAGED Ap	=	0.176
PEAK FLOW RATE (CFS)	=	4.27			

HEADWATER	NUMBER	PEAK FLOW RATE (CFS)	TABLE (MIN.)	Intensity (INCH/HR)	Fp(Fm) (INCH/HR)	Ap	Ae (ACRES)	NODE
30.00	1	3.68	5.00	4.720	0.27 (0.05)	0.17	0.9	
20.00	2	4.17	6.04	4.651	0.27 (0.05)	0.18	1.0	

10.00 3 4.27 6.70 4.608 0.27 (0.05) 0.18 1.0

=====

=====

END OF RATIONAL METHOD ANALYSIS

Operation and Maintenance Plan for Permanent BMPs for AutoZone -VICTORVILLE

Introduction

THE PROPOSED PROJECT IS IN VICTORVILLE, CA LOCATED ALONG MOJAVE DR AND EL EVADO RD

THE FOLLOWING BEST MANAGEMENT PRACTICES (BMPS) ARE PROPOSED FOR THE PROJECT AREA:

BMP 1, AN INFILTRATION BASIN.

THE PROPOSED GRADING AND DRAINAGE PLAN SHOWS THE LOCATION OF THE PROPOSED BMPS

Responsibility for Maintenance

a. General

AutoZone Inc. is the property owner and is also responsible for BMP maintenance; no access agreement or easement is necessary to maintain the BMPs. AutoZone Inc. will be solely responsible for the financing of operation and maintenance activities to maintain BMP functionality. The maintenance staff will receive the O&M plan and will be trained to maintain the BMPs and report to the City.

The responsible party shall serve or designate a corporate officer authorized to negotiate and execute any contracts that might be necessary for future changes to operation and maintenance of the LID BMPs or implement remedial measures if problems occur.

Employees or contractors who will report to the designated contact and are responsible for conducting Stormwater BMP operation and maintenance procedures within this document. All pertinent forms of educational materials for those personnel that will be maintaining the proposed BMPs have been included in Appendix 10.

Note: Updated contact information must be provided to the Permittee immediately whenever a property is sold or transferred and whenever designated individuals or contractors change.

Contact Information:

Mitch Bramlitt

AutoZone, Inc.

123 S. Front Street,

Memphis, TN 38103

Mitch.Bramlitt@Autozone.com

(901) 495-8714

Owner Signature

Mitch Bramlitt

b. **Maintenance Actions and Frequency**

Maintenance actions are generally grouped into two categories: **routine** and **intermittent**

i. **Routine Maintenance**

Bioretention:

Routine inspections of bioretention and cleanout structures are expected to be done monthly and after each storm event. During these inspections staff evaluate if there is significant accumulation of trash, debris, silt, or sediment that would need to be removed. Cleaning should occur on an as-needed basis, depending on the results of the inspections. The inspection frequency may be adjusted based on experience at the site (e.g., if inspections frequently find debris that needs to be cleaned out, the inspection frequency can be increased).

ii. **Intermittent Maintenance**

Intermittent maintenance activities include more substantial maintenance that is not required as frequently as routine maintenance. The mulch and engineering soil layers should be replaced in the bioretention swale to maintain treatment functionality. Depending on rainfall records, this should occur every 5-10 years. Maintain records of when intermittent maintenance activities occur.

BIORETENTION FACILITY BMP FACT SHEET

Underdrain Gravel and Pipes

An underdrain gravel layer and pipes shall be provided in accordance with Appendix B – Underdrains.



Figure 6: Incorrect Placement of an Overflow Inlet.

Inspection and Maintenance Schedule

The Bioretention Facility area shall be inspected for erosion, dead vegetation, soggy soils, or standing water. The use of fertilizers and pesticides on the plants inside the Bioretention Facility should be minimized.

Schedule	Activity
Ongoing	• Keep adjacent landscape areas maintained. Remove clippings from landscape maintenance activities. • Remove trash and debris • Replace damaged grass and/or plants • Replace surface mulch layer as needed to maintain a 2-3 inch soil cover.
After storm events	• Inspect areas for ponding*
Annually	• Inspect/clean inlets and outlets

*If ponding should occur, scarify and aerate soil. Check downstream storm drain line for clogs. If ponding persists, replace soil.

Routine Maintenance Checklist

☐	Trash and debris removed from basin area and cleanout structures.
☐	Silt and sediment removed from basin area and cleanout structures.
☐	Landscape clippings or other loose plant debris have been removed from basin area and adjacent landscaped areas.
☐	Grass and plants have been inspected and damaged areas and plants have been reported for replacement.
☐	Inspect mulch layer..If less than 2 inches, report for replenishment to maintain depth of 2-3 inches.



A Citizen's Guide to Understanding Stormwater



EPA 833-B-03-002
January 2003

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www.epa.gov/nps/stormwater
or visit
www.epa.gov/nps

After the Storm



What is stormwater runoff?



Stormwater runoff occurs when precipitation from rain or snowmelt flows over the ground. Impervious surfaces like driveways, sidewalks, and streets prevent stormwater from naturally soaking into the ground.

Why is stormwater runoff a problem?



Stormwater can pick up debris, chemicals, dirt, and other pollutants and flow into a storm sewer system or directly to a lake, stream, river, wetland, or coastal water. Anything that enters a storm sewer system is discharged untreated into the waterbodies we use for swimming, fishing, and providing drinking water.

The effects of pollution

Polluted stormwater runoff can have many adverse effects on plants, fish, animals, and people.

- ◆ Sediment can cloud the water and make it difficult or impossible for aquatic plants to grow. Sediment also can destroy aquatic habitats.
- ◆ Excess nutrients can cause algae blooms. When algae die, they sink to the bottom and decompose in a process that removes oxygen from the water. Fish and other aquatic organisms can't exist in water with low dissolved oxygen levels.
- ◆ Bacteria and other pathogens can wash into swimming areas and create health hazards, often making beach closures necessary.
- ◆ Debris—plastic bags, six-pack rings, bottles, and cigarette butts—washed into waterbodies can choke, suffocate, or disable aquatic life like ducks, fish, turtles, and birds.
- ◆ Household hazardous wastes like insecticides, pesticides, paint, solvents, used motor oil, and other auto fluids can poison aquatic life. Land animals and people can become sick or die from eating diseased fish and shellfish or ingesting polluted water.



- ◆ Polluted stormwater often affects drinking water sources. This, in turn, can affect human health and increase drinking water treatment costs.



Stormwater Pollution Solutions

Residential

Recycle or properly dispose of household products that contain chemicals, such as insecticides, pesticides, paint, solvents, and used motor oil and other auto fluids. Don't pour them onto the ground or into storm drains.

Lawn care

Excess fertilizers and pesticides applied to lawns and gardens wash off and pollute streams. In addition, yard clippings and leaves can wash into storm drains and contribute nutrients and organic matter to streams.

- ◆ Don't overwater your lawn. Consider using a soaker hose instead of a sprinkler.
- ◆ Use pesticides and fertilizers sparingly. When use is necessary, use these chemicals in the recommended amounts. Use organic mulch or safer pest control methods whenever possible.
- ◆ Compost or mulch yard waste. Don't leave it in the street or sweep it into storm drains or streams.
- ◆ Cover piles of dirt or mulch being used in landscaping projects.



Septic systems

Leaking and poorly maintained septic systems release nutrients and pathogens (bacteria and viruses) that can be picked up by stormwater and discharged into nearby waterbodies. Pathogens can cause public health problems and environmental concerns.

- ◆ Inspect your system every 3 years and pump your tank as necessary (every 3 to 5 years).
- ◆ Don't dispose of household hazardous waste in sinks or toilets.



Auto care

Washing your car and degreasing auto parts at home can send detergents and other contaminants through the storm sewer system. Dumping automotive fluids into storm drains has the same result as dumping the materials directly into a waterbody.

- ◆ Use a commercial car wash that treats or recycles its wastewater, or wash your car on your yard so the water infiltrates into the ground.
- ◆ Repair leaks and dispose of used auto fluids and batteries at designated drop-off or recycling locations.



Education is essential to changing people's behavior. Signs and markers near storm drains warn residents that pollutants entering the drains will be carried untreated into a local waterbody.

Residential landscaping

Permeable Pavement—Traditional concrete and asphalt don't allow water to soak into the ground. Instead these surfaces rely on storm drains to divert unwanted water. Permeable pavement systems allow rain and snowmelt to soak through, decreasing stormwater runoff.

Rain Barrels—You can collect rainwater from rooftops in mosquito-proof containers. The water can be used later on lawn or garden areas.

Rain Gardens and Grassy Swales—Specially designed areas planted with native plants can provide natural places for rainwater to collect and soak into the ground. Rain from rooftop areas or paved areas can be diverted into these areas rather than into storm drains.

Vegetated Filter Strips—Filter strips are areas of native grass or plants created along roadways or streams. They trap the pollutants stormwater picks up as it flows across driveways and streets.



Commercial

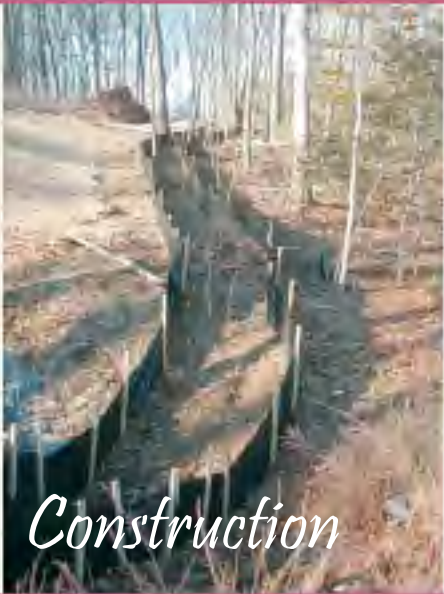
Dirt, oil, and debris that collect in parking lots and paved areas can be washed into the storm sewer system and eventually enter local waterbodies.

- ◆ Sweep up litter and debris from sidewalks, driveways and parking lots, especially around storm drains.
- ◆ Cover grease storage and dumpsters and keep them clean to avoid leaks.
- ◆ Report any chemical spill to the local hazardous waste cleanup team. They'll know the best way to keep spills from harming the environment.

Erosion controls that aren't maintained can cause excessive amounts of sediment and debris to be carried into the stormwater system. Construction vehicles can leak fuel, oil, and other harmful fluids that can be picked up by stormwater and deposited into local waterbodies.

- ◆ Divert stormwater away from disturbed or exposed areas of the construction site.
- ◆ Install silt fences, vehicle mud removal areas, vegetative cover, and other sediment and erosion controls and properly maintain them, especially after rainstorms.
- ◆ Prevent soil erosion by minimizing disturbed areas during construction projects, and seed and mulch bare areas as soon as possible.

Construction



Agriculture

Lack of vegetation on streambanks can lead to erosion. Overgrazed pastures can also contribute excessive amounts of sediment to local waterbodies. Excess fertilizers and pesticides can poison aquatic animals and lead to destructive algae blooms. Livestock in streams can contaminate waterways with bacteria, making them unsafe for human contact.

- ◆ Keep livestock away from streambanks and provide them a water source away from waterbodies.
- ◆ Store and apply manure away from waterbodies and in accordance with a nutrient management plan.
- ◆ Vegetate riparian areas along waterways.
- ◆ Rotate animal grazing to prevent soil erosion in fields.
- ◆ Apply fertilizers and pesticides according to label instructions to save money and minimize pollution.



Forestry

Improperly managed logging operations can result in erosion and sedimentation.

- ◆ Conduct preharvest planning to prevent erosion and lower costs.
- ◆ Use logging methods and equipment that minimize soil disturbance.
- ◆ Plan and design skid trails, yard areas, and truck access roads to minimize stream crossings and avoid disturbing the forest floor.
- ◆ Construct stream crossings so that they minimize erosion and physical changes to streams.
- ◆ Expedite revegetation of cleared areas.



Automotive Facilities



Uncovered fueling stations allow spills to be washed into storm drains. Cars waiting to be repaired can leak fuel, oil, and other harmful fluids that can be picked up by stormwater.

- ◆ Clean up spills immediately and properly dispose of cleanup materials.
- ◆ Provide cover over fueling stations and design or retrofit facilities for spill containment.
- ◆ Properly maintain fleet vehicles to prevent oil, gas, and other discharges from being washed into local waterbodies.
- ◆ Install and maintain oil/water separators.



Landscaping and garden maintenance activities can be major contributors to water pollution. Soils, yard wastes, over-watering and garden chemicals become part of the urban runoff mix that winds its way through streets, gutters and storm drains before entering lakes, rivers, streams, etc. Urban runoff pollution contaminates water and harms aquatic life!

In Riverside County, report illegal discharges into the storm drain, call
1-800-506-2555
"Only Rain Down the Storm Drain"

Important Links:

Riverside County Household Hazardous Waste Collection Information
1-800-304-2226 or www.rivcowm.org

Riverside County Backyard Composting Program
1-800-366-SAVE

Integrated Pest Management (IPM) Solutions
www.ipm.ucdavis.edu

California Master Gardener Programs
www.mastergardeners.org
www.camastergardeners.ucdavis.edu

California Native Plant Society
www.cnps.org

The Riverside County "Only Rain Down the Storm Drain" Pollution Prevention Program gratefully acknowledges Orange County's Storm Water Program for their contribution to this brochure.



...Only Rain Down ...the Storm Drain

*What you should know for...
Landscape and Gardening*

Best Management tips for:

- Professionals
- Novices
- Landscapers
- Gardeners
- Cultivators



Tips for Landscape & Gardening

This brochure will help you to get the most of your lawn and gardening efforts and keep our waterways clean. Clean waterways provide recreation, establish thriving fish habitats, secure safe sanctuaries for wildlife, and add beauty to our communities. NEVER allow gardening products or waste water to enter the street, gutter or storm drain.

General Landscaping Tips

- Protect stockpiles and materials from wind and rain by storing them under tarps or secured plastic sheeting.
- Prevent erosion of slopes by planting fast-growing, dense ground covering plants. These will shield and bind the soil.
- Plant native vegetation to reduce the amount of water, fertilizers and pesticides applied to the landscape.
- Never apply pesticides or fertilizers when rain is predicted within the next 48 hours.



Garden & Lawn Maintenance

- Do not overwater. Use irrigation practices such as drip irrigation, soaker hoses or micro-spray systems. Periodically inspect and fix leaks and misdirected sprinklers.

- Do not rake or blow leaves, clippings or pruning waste into the street, gutter or storm drain. Instead, dispose of green waste by composting, hauling it to a permitted landfill, or recycling it through your city's program.



- Consider recycling your green waste and adding "nature's own fertilizer" to your lawn or garden.
- Read labels and use only as directed. Do not over-apply pesticides or fertilizers. Apply to spots as needed, rather than blanketing an entire area.
- Store pesticides, fertilizers and other chemicals in a dry covered area to prevent exposure that may result in the deterioration of containers and packaging.
- Rinse empty pesticide containers and re-use rinse water as you would use the product. Do not dump rinse water down storm drains or sewers. Dispose of empty containers in the trash.
- When available, use non-toxic alternatives to traditional pesticides, and use pesticides specifically designed to control the pest you are targeting.

- Try natural long-term common sense solutions first. Integrated Pest Management (IPM) can provide landscaping guidance and solutions, such as:

- ◆ **Physical Controls** - Try hand picking, barriers, traps or caulking holes to control weeds and pests.
- ◆ **Biological Controls** - Use predatory insects to control harmful pests.
- ◆ **Chemical Controls** - Check out www.ipm.ucdavis.edu before using chemicals. Remember, all chemicals should be used cautiously and in moderation.

- If fertilizer is spilled, sweep up the spill before irrigating. If the spill is liquid, apply an absorbent material such as cat litter, and then sweep it up and dispose of it in the trash.
- Take unwanted pesticides to a Household Waste Collection Center to be recycled.
- *Dumping toxics into the street, gutter or storm drain is illegal!*

www.bewaterwise.com Great water conservation tips and drought tolerant garden designs.

www.ourwaterourworld.com Learn how to safely manage home and garden pests.

Additional information can also be found on the back of this brochure.

Helpful telephone numbers and links:

Riverside County Stormwater Protection Partners

Flood Control District	(951) 955-1200
County of Riverside	(951) 955-1000
City of Banning	(951) 922-3105
City of Beaumont	(951) 769-8520
City of Calimesa	(909) 795-9801
City of Canyon Lake	(951) 244-2955
Cathedral City	(760) 770-0327
City of Coachella	(760) 398-4978
City of Corona	(951) 736-2447
City of Desert Hot Springs	(760) 329-6411
City of Eastvale	(951) 361-0900
City of Hemet	(951) 765-2300
City of Indian Wells	(760) 346-2489
City of Indio	(760) 391-4000
City of Lake Elsinore	(951) 674-3124
City of La Quinta	(760) 777-7000
City of Menifee	(951) 672-6777
City of Moreno Valley	(951) 413-3000
City of Murrieta	(951) 304-2489
City of Norco	(951) 270-5607
City of Palm Desert	(760) 346-0611
City of Palm Springs	(760) 323-8299
City of Perris	(951) 943-6100
City of Rancho Mirage	(760) 324-4511
City of Riverside	(951) 361-0900
City of San Jacinto	(951) 654-7337
City of Temecula	(951) 694-6444
City of Wildomar	(951) 677-7751

REPORT ILLEGAL STORM DRAIN DISPOSAL

1-800-506-2555 or e-mail us at
fcnpdes@rcflood.org

- Riverside County Flood Control and Water Conservation District
www.rcflood.org

Online resources include:

- California Storm Water Quality Association
www.casqa.org
- State Water Resources Control Board
www.waterboards.ca.gov
- Power Washers of North America
www.thepwna.org

Stormwater Pollution

What you should know for...

Outdoor Cleaning Activities and Professional Mobile Service Providers



Storm drain pollution prevention information for:

- Car Washing / Mobile Detailers
- Window and Carpet Cleaners
- Power Washers
- Waterproofers / Street Sweepers
- Equipment cleaners or degreasers and all mobile service providers

Do you know where street flows actually go?

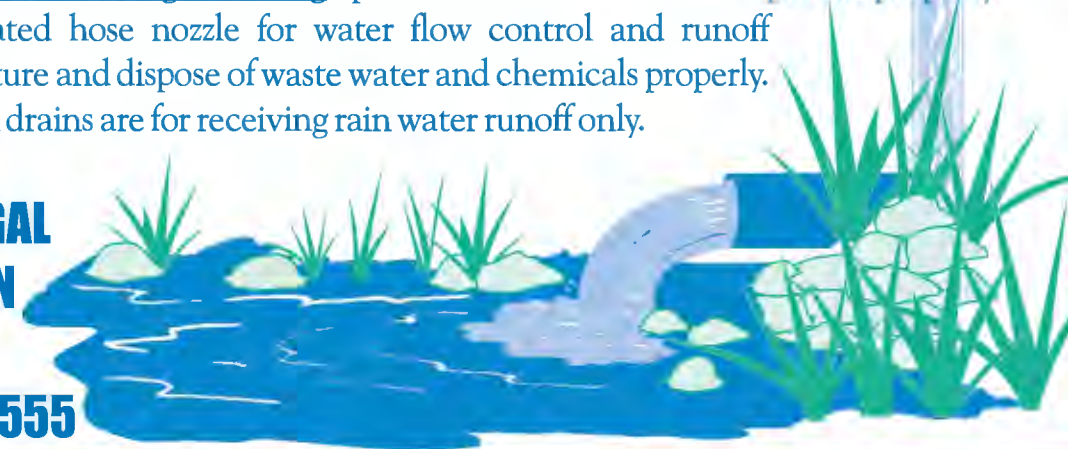
Storm drains are NOT connected to sanitary sewer systems and treatment plants!



The primary purpose of storm drains is to carry rain water away from developed areas to prevent flooding. Pollutants discharged to storm drains are transported directly into rivers, lakes and streams. Soaps, degreasers, automotive fluids, litter and a host of materials are washed off buildings, sidewalks, plazas and parking areas. Vehicles and equipment must be properly managed to prevent the pollution of local waterways.

Unintentional spills by mobile service operators can flow into storm drains and pollute our waterways. **Avoid mishaps.** Always have a **Spill Response Kit** on hand to clean up unintentional spills. Only emergency **Mechanical** repairs should be done in City streets, using drip pans for spills. **Plumbing** should be done on private property. Always store chemicals in a leak-proof container and keep covered when not in use. **Window/Power Washing** waste water shouldn't be released into the streets, but should be disposed of in a sanitary sewer, landscaped area or in the soil. Soiled **Carpet Cleaning** wash water should be filtered before being discharged into the sanitary sewer. Dispose of all filter debris properly. **Car Washing/Detailing** operators should wash cars on private property and use a regulated hose nozzle for water flow control and runoff prevention. Capture and dispose of waste water and chemicals properly. Remember, storm drains are for receiving rain water runoff only.

**REPORT ILLEGAL
STORM DRAIN
DISPOSAL
1-800-506-2555**



Help Protect Our Waterways!

Use these guidelines for Outdoor Cleaning Activities and Wash Water Disposal

Did you know that disposing of pollutants into the street, gutter, storm drain or body of water is **PROHIBITED** by law and can result in stiff penalties?

Best Management Practices

Waste wash water from Mechanics, Plumbers, Window/Power Washers, Carpet Cleaners, Car Washing and Mobile Detailing activities may contain significant quantities of motor oil, grease, chemicals, dirt, detergents, brake pad dust, litter and other materials.

Best Management Practices, or BMPs as they are known, are guides to prevent pollutants from entering the storm drains. *Each of us* can do our part to keep stormwater clean by using the suggested BMPs below:

Simple solutions for both light and heavy duty jobs:

Do...consider dry cleaning methods first such as a mop, broom, rag or wire brush. Always keep a spill response kit on site.

Do...prepare the work area before power cleaning by using sand bags, rubber mats, vacuum booms, containment pads or temporary berms to keep wash water away from the gutters and storm drains.

Do...use vacuums or other machines to remove and collect loose debris or litter before applying water.

Do...obtain the property owner's permission to dispose of *small amounts* of power washing waste water on to landscaped, gravel or unpaved surfaces.

Do...check your local sanitary sewer agency's policies on wash water disposal regulations before disposing of wash water into the sewer. (See list on reverse side)

Do...be aware that if discharging to landscape areas, soapy wash water may damage landscaping. Residual wash water may remain on paved surfaces to evaporate. Sweep up solid residuals and dispose of properly. Vacuum booms are another option for capturing and collecting wash water.

Do...check to see if local ordinances prevent certain activities.

Do not let...wash or waste water from sidewalk, plaza or building cleaning go into a street or storm drain.



Report illegal storm drain disposal
Call Toll Free
1-800-506-2555

Using Cleaning Agents

Try using biodegradable/phosphate-free products. They are easier on the environment, but don't confuse them with being toxic free. Soapy water entering the storm drain system can impact the delicate aquatic environment.



When cleaning surfaces with a *high-pressure washer* or *steam cleaner*, additional precautions should be taken to prevent the discharge of pollutants into the storm drain system. These two methods of surface cleaning can loosen additional material that can contaminate local waterways.

Think Water Conservation

Minimize water use by using high pressure, low volume nozzles. Be sure to check all hoses for leaks. Water is a precious resource, don't let it flow freely and be sure to shut it off in between uses.

Screening Wash Water

Conduct thorough dry cleanup before washing exterior surfaces, such as buildings and decks **with loose paint**, sidewalks or plaza areas. Keep debris from entering the storm drain after cleaning by first passing the wash water through a "20 mesh" or finer screen to catch the solid materials, then dispose of the mesh in a refuse container. Do not let the remaining wash water enter a street, gutter or storm drain.

Drain Inlet Protection & Collection of Wash Water

- Prior to any washing, block all storm drains with an impervious barrier such as sandbags or berms, or seal the storm drain with plugs or other appropriate materials.
- Create a containment area with berms and traps or take advantage of a low spot to keep wash water contained.
- Wash vehicles and equipment on grassy or gravel areas so that the wash water can seep into the ground.
- Pump or vacuum up all wash water in the contained area.

Concrete/Coring/Saw Cutting and Drilling Projects

Protect any down-gradient inlets by using dry activity techniques whenever possible. If water is used, minimize the amount of water used during the coring/drilling or saw cutting process. Place a barrier of sandbags and/or absorbent berms to protect the storm drain inlet or watercourse. Use a shovel or wet vacuum to remove the residue from the pavement. Do not wash residue or particulate matter into a storm drain inlet or watercourse.

Parking/Storage Area Maintenance SC-43



Description

Parking lots and storage areas can contribute a number of substances, such as trash, suspended solids, hydrocarbons, oil and grease, and heavy metals that can enter receiving waters through stormwater runoff or non-stormwater discharges. The following protocols are intended to prevent or reduce the discharge of pollutants from parking/storage areas and include using good housekeeping practices, following appropriate cleaning BMPs, and training employees.

Approach

Pollution Prevention

- Encourage alternative designs and maintenance strategies for impervious parking lots. (See New Development and Redevelopment BMP Handbook).
- Keep accurate maintenance logs to evaluate BMP implementation.

Suggested Protocols

General

- Keep the parking and storage areas clean and orderly. Remove debris in a timely fashion.
- Allow sheet runoff to flow into biofilters (vegetated strip and swale) and/or infiltration devices.
- Utilize sand filters or oleophilic collectors for oily waste in low concentrations.

Objectives

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

Targeted Constituents

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



SC-43 Parking/Storage Area Maintenance

- Arrange rooftop drains to prevent drainage directly onto paved surfaces.
- Design lot to include semi-permeable hardscape.

Controlling Litter

- Post “No Littering” signs and enforce anti-litter laws.
- Provide an adequate number of litter receptacles.
- Clean out and cover litter receptacles frequently to prevent spillage.
- Provide trash receptacles in parking lots to discourage litter.
- Routinely sweep, shovel and dispose of litter in the trash.

Surface cleaning

- Use dry cleaning methods (e.g. sweeping or vacuuming) to prevent the discharge of pollutants into the stormwater conveyance system.
- Establish frequency of public parking lot sweeping based on usage and field observations of waste accumulation.
- Sweep all parking lots at least once before the onset of the wet season.
- If water is used follow the procedures below:
 - Block the storm drain or contain runoff.
 - Wash water should be collected and pumped to the sanitary sewer or discharged to a pervious surface, do not allow wash water to enter storm drains.
 - Dispose of parking lot sweeping debris and dirt at a landfill.
- When cleaning heavy oily deposits:
 - Use absorbent materials on oily spots prior to sweeping or washing.
 - Dispose of used absorbents appropriately.

Surface Repair

- Pre-heat, transfer or load hot bituminous material away from storm drain inlets.
- Apply concrete, asphalt, and seal coat during dry weather to prevent contamination from contacting stormwater runoff.
- Cover and seal nearby storm drain inlets (with waterproof material or mesh) and manholes before applying seal coat, slurry seal, etc., where applicable. Leave covers in place until job is complete and until all water from emulsified oil sealants has drained or evaporated. Clean any debris from these covered manholes and drains for proper disposal.

Parking/Storage Area Maintenance SC-43

- Use only as much water as necessary for dust control, to avoid runoff.
- Catch drips from paving equipment that is not in use with pans or absorbent material placed under the machines. Dispose of collected material and absorbents properly.

Inspection

- Have designated personnel conduct inspections of the parking facilities and stormwater conveyance systems associated with them on a regular basis.
- Inspect cleaning equipment/sweepers for leaks on a regular basis.

Training

- Provide regular training to field employees and/or contractors regarding cleaning of paved areas and proper operation of equipment.
- Train employees and contractors in proper techniques for spill containment and cleanup.

Spill Response and Prevention

- Refer to SC-11, Spill Prevention, Control & Cleanup.
- Keep your Spill Prevention Control and countermeasure (SPCC) plan up-to-date, and implement accordingly.
- Have spill cleanup materials readily available and in a known location.
- Cleanup spills immediately and use dry methods if possible.
- Properly dispose of spill cleanup material.

Other Considerations

- Limitations related to sweeping activities at large parking facilities may include high equipment costs, the need for sweeper operator training, and the inability of current sweeper technology to remove oil and grease.

Requirements

Costs

Cleaning/sweeping costs can be quite large, construction and maintenance of stormwater structural controls can be quite expensive as well.

Maintenance

- Sweep parking lot to minimize cleaning with water.
- Clean out oil/water/sand separators regularly, especially after heavy storms.
- Clean parking facilities on a regular basis to prevent accumulated wastes and pollutants from being discharged into conveyance systems during rainy conditions.

SC-43 Parking/Storage Area Maintenance

Supplemental Information

Further Detail of the BMP

Surface Repair

Apply concrete, asphalt, and seal coat during dry weather to prevent contamination from contacting stormwater runoff. Where applicable, cover and seal nearby storm drain inlets (with waterproof material or mesh) and manholes before applying seal coat, slurry seal, etc. Leave covers in place until job is complete and until all water from emulsified oil sealants has drained or evaporated. Clean any debris from these covered manholes and drains for proper disposal. Use only as much water as necessary for dust control, to avoid runoff.

References and Resources

<http://www.stormwatercenter.net/>

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

Model Urban Runoff Program: A How-To Guide for Developing Urban Runoff Programs for Small Municipalities. Prepared by City of Monterey, City of Santa Cruz, California Coastal Commission, Monterey Bay National Marine Sanctuary, Association of Monterey Bay Area Governments, Woodward-Clyde, Central Coast Regional Water Quality control Board. July 1998 (Revised February 2002 by the California Coastal Commission).

Orange County Stormwater Program

http://www.ocwatersheds.com/StormWater/swp_introduction.asp

Oregon Association of Clean Water Agencies. Oregon Municipal Stormwater Toolbox for Maintenance Practices. June 1998.

Pollution from Surface Cleaning Folder. 1996. Bay Area Stormwater Management Agencies Association (BASMAA) <http://www.basma.org>

San Diego Stormwater Co-permittees Jurisdictional Urban Runoff Management Program (URMP)

<http://www.projectcleanwater.org/pdf/Model%20Program%20Municipal%20Facilities.pdf>



Description

Pollutants on sidewalks and other pedestrian traffic areas and plazas are typically due to littering and vehicle use. This fact sheet describes good housekeeping practices that can be incorporated into the municipality's existing cleaning and maintenance program.

Approach

Pollution Prevention

- Use dry cleaning methods whenever practical for surface cleaning activities.
- Use the least toxic materials available (e.g. water based paints, gels or sprays for graffiti removal).

Suggested Protocols

Surface Cleaning

- Regularly broom (dry) sweep sidewalk, plaza and parking lot areas to minimize cleaning with water.
- Dry cleanup first (sweep, collect, and dispose of debris and trash) when cleaning sidewalks or plazas, then wash with or without soap.
- Block the storm drain or contain runoff when cleaning with water. Discharge wash water to landscaping or collect water and pump to a tank or discharge to sanitary sewer if allowed. (Permission may be required from local sanitation district.)

Objectives

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

Targeted Constituents

Sediment	☒
Nutrients	☒
Trash	☒
Metals	☒
Bacteria	☒
Oil and Grease	☒
Organics	☒
Oxygen Demanding	☒



- Block the storm drain or contain runoff when washing parking areas, driveways or drive-throughs. Use absorbents to pick up oil; then dry sweep. Clean with or without soap. Collect water and pump to a tank or discharge to sanitary sewer if allowed. Street Repair and Maintenance.

Graffiti Removal

- Avoid graffiti abatement activities during rain events.
- Implement the procedures under Painting and Paint Removal in SC-70 Roads, Streets, and Highway Operation and Maintenance fact sheet when graffiti is removed by painting over.
- Direct runoff from sand blasting and high pressure washing (with no cleaning agents) into a dirt or landscaped area after treating with an appropriate filtering device.
- Plug nearby storm drain inlets and vacuum/pump wash water to the sanitary sewer if authorized to do so if a graffiti abatement method generates wash water containing a cleaning compound (such as high pressure washing with a cleaning compound). Ensure that a non-hazardous cleaning compound is used or dispose as hazardous waste, as appropriate.

Surface Removal and Repair

- Schedule surface removal activities for dry weather if possible.
- Avoid creating excess dust when breaking asphalt or concrete.
- Take measures to protect nearby storm drain inlets prior to breaking up asphalt or concrete (e.g. place hay bales or sand bags around inlets). Clean afterwards by sweeping up as much material as possible.
- Designate an area for clean up and proper disposal of excess materials.
- Remove and recycle as much of the broken pavement as possible to avoid contact with rainfall and stormwater runoff.
- When making saw cuts in pavement, use as little water as possible. Cover each storm drain inlet completely with filter fabric during the sawing operation and contain the slurry by placing straw bales, sandbags, or gravel dams around the inlets. After the liquid drains or evaporates, shovel or vacuum the slurry residue from the pavement or gutter and remove from site.
- Always dry sweep first to clean up tracked dirt. Use a street sweeper or vacuum truck. Do not dump vacuumed liquid in storm drains. Once dry sweeping is complete, the area may be hosed down if needed. Wash water should be directed to landscaping or collected and pumped to the sanitary sewer if allowed.

Concrete Installation and Repair

- Schedule asphalt and concrete activities for dry weather.

- Take measures to protect any nearby storm drain inlets and adjacent watercourses, prior to breaking up asphalt or concrete (e.g. place sand bags around inlets or work areas).
- Limit the amount of fresh concrete or cement mortar mixed, mix only what is needed for the job.
- Store concrete materials under cover, away from drainage areas. Secure bags of cement after they are open. Be sure to keep wind-blown cement powder away from streets, gutters, storm drains, rainfall, and runoff.
- Return leftover materials to the transit mixer. Dispose of small amounts of hardened excess concrete, grout, and mortar in the trash.
- Do not wash sweepings from exposed aggregate concrete into the street or storm drain. Collect and return sweepings to aggregate base stockpile, or dispose in the trash.
- Protect applications of fresh concrete from rainfall and runoff until the material has dried.
- Do not allow excess concrete to be dumped onsite, except in designated areas.
- Wash concrete trucks off site or in designated areas on site designed to preclude discharge of wash water to drainage system.

Controlling Litter

- Post “No Littering” signs and enforce anti-litter laws.
- Provide litter receptacles in busy, high pedestrian traffic areas of the community, at recreational facilities, and at community events.
- Cover litter receptacles and clean out frequently to prevent leaking/spillage or overflow.
- Clean parking lots on a regular basis with a street sweeper.

Training

- Provide regular training to field employees and/or contractors regarding surface cleaning and proper operation of equipment.
- Train employee and contractors in proper techniques for spill containment and cleanup.
- Use a training log or similar method to document training.

Spill Response and Prevention

- Refer to SC-11, Spill Prevention, Control & Cleanup.
- Have spill cleanup materials readily available and in a known location.
- Cleanup spills immediately and use dry methods if possible.
- Properly dispose of spill cleanup material.

Other Considerations

- Limitations related to sweeping activities at large parking facilities may include current sweeper technology to remove oil and grease.
- Surface cleaning activities that require discharges to the local sewerage agency will require coordination with the agency.
- Arrangements for disposal of the swept material collected must be made, as well as accurate tracking of the areas swept and the frequency of sweeping.

Requirements***Costs***

- The largest expenditures for sweeping and cleaning of sidewalks, plazas, and parking lots are in staffing and equipment. Sweeping of these areas should be incorporated into street sweeping programs to reduce costs.

Maintenance

Not applicable

Supplemental Information***Further Detail of the BMP***

Community education, such as informing residents about their options for recycling and waste disposal, as well as the consequences of littering, can instill a sense of citizen responsibility and potentially reduce the amount of maintenance required by the municipality.

Additional BMPs that should be considered for parking lot areas include:

- Allow sheet runoff to flow into biofilters (vegetated strip and swale) and infiltration devices.
- Utilize sand filters or oleophilic collectors for oily waste in low concentrations.
- Arrange rooftop drains to prevent drainage directly onto paved surfaces.
- Design lot to include semi-permeable hardscape.
- Structural BMPs such as storm drain inlet filters can be very effective in reducing the amount of pollutants discharged from parking facilities during periods of rain.

References and Resources

Bay Area Stormwater Management Agencies Association (BASMAA). 1996. Pollution From Surface Cleaning Folder <http://www.basmaa.org>

Model Urban Runoff Program: A How-To Guide for Developing Urban Runoff Programs for Small Municipalities. Prepared by City of Monterey, City of Santa Cruz, California Coastal Commission, Monterey Bay National Marine Sanctuary, Association of Monterey Bay Area Governments, Woodward-Clyde, Central Coast Regional Water Quality Control Board. July. 1998.

Oregon Association of Clean Water Agencies. Oregon Municipal Stormwater Toolbox for Maintenance Practices. June 1998.

Orange County Stormwater Program

http://www.ocwatersheds.com/stormwater/swp_introduction.asp

Santa Clara Valley Urban Runoff Pollution Prevention Program. 1997 Urban Runoff Management Plan. September 1997, updated October 2000.

Santa Clara Valley Urban Runoff Pollution Prevention Program. Maintenance Best Management Practices for the Construction Industry. Brochures: Landscaping, Gardening, and Pool; Roadwork and Paving; and Fresh Concrete and Mortar Application. June 2001.

San Diego Stormwater Co-permittees Jurisdictional Urban Runoff Management Plan. 2001. Municipal Activities Model Program Guidance. November.



Description

Landscape maintenance activities include vegetation removal; herbicide and insecticide application; fertilizer application; watering; and other gardening and lawn care practices. Vegetation control typically involves a combination of chemical (herbicide) application and mechanical methods. All of these maintenance practices have the potential to contribute pollutants to the storm drain system. The major objectives of this BMP are to minimize the discharge of pesticides, herbicides and fertilizers to the storm drain system and receiving waters; prevent the disposal of landscape waste into the storm drain system by collecting and properly disposing of clippings and cuttings, and educating employees and the public.

Approach

Pollution Prevention

- Implement an integrated pest management (IPM) program. IPM is a sustainable approach to managing pests by combining biological, cultural, physical, and chemical tools.
- Choose low water using flowers, trees, shrubs, and groundcover.
- Consider alternative landscaping techniques such as naturescaping and xeriscaping.
- Conduct appropriate maintenance (i.e. properly timed fertilizing, weeding, pest control, and pruning) to help preserve the landscapes water efficiency.

Objectives

- Contain
- Educate
- Reduce/Minimize
- Product Substitution

Targeted Constituents

Sediment	☒
Nutrients	☒
Trash	☒
Metals	
Bacteria	
Oil and Grease	
Organics	
Oxygen Demanding	☒



- Consider grass cycling (grass cycling is the natural recycling of grass by leaving the clippings on the lawn when mowing. Grass clippings decompose quickly and release valuable nutrients back into the lawn).

Suggested Protocols***Mowing, Trimming, and Weeding***

- Whenever possible use mechanical methods of vegetation removal (e.g mowing with tractor-type or push mowers, hand cutting with gas or electric powered weed trimmers) rather than applying herbicides. Use hand weeding where practical.
- Avoid loosening the soil when conducting mechanical or manual weed control, this could lead to erosion. Use mulch or other erosion control measures when soils are exposed.
- Performing mowing at optimal times. Mowing should not be performed if significant rain events are predicted.
- Mulching mowers may be recommended for certain flat areas. Other techniques may be employed to minimize mowing such as selective vegetative planting using low maintenance grasses and shrubs.
- Collect lawn and garden clippings, pruning waste, tree trimmings, and weeds. Chip if necessary, and compost or dispose of at a landfill (see waste management section of this fact sheet).
- Place temporarily stockpiled material away from watercourses, and berm or cover stockpiles to prevent material releases to storm drains.

Planting

- Determine existing native vegetation features (location, species, size, function, importance) and consider the feasibility of protecting them. Consider elements such as their effect on drainage and erosion, hardiness, maintenance requirements, and possible conflicts between preserving vegetation and the resulting maintenance needs.
- Retain and/or plant selected native vegetation whose features are determined to be beneficial, where feasible. Native vegetation usually requires less maintenance (e.g., irrigation, fertilizer) than planting new vegetation.
- Consider using low water use groundcovers when planting or replanting.

Waste Management

- Compost leaves, sticks, or other collected vegetation or dispose of at a permitted landfill. Do not dispose of collected vegetation into waterways or storm drainage systems.
- Place temporarily stockpiled material away from watercourses and storm drain inlets, and berm or cover stockpiles to prevent material releases to the storm drain system.
- Reduce the use of high nitrogen fertilizers that produce excess growth requiring more frequent mowing or trimming.

- Avoid landscape wastes in and around storm drain inlets by either using bagging equipment or by manually picking up the material.

Irrigation

- Where practical, use automatic timers to minimize runoff.
- Use popup sprinkler heads in areas with a lot of activity or where there is a chance the pipes may be broken. Consider the use of mechanisms that reduce water flow to sprinkler heads if broken.
- Ensure that there is no runoff from the landscaped area(s) if re-claimed water is used for irrigation.
- If bailing of muddy water is required (e.g. when repairing a water line leak), do not put it in the storm drain; pour over landscaped areas.
- Irrigate slowly or pulse irrigate to prevent runoff and then only irrigate as much as is needed.
- Apply water at rates that do not exceed the infiltration rate of the soil.

Fertilizer and Pesticide Management

- Utilize a comprehensive management system that incorporates integrated pest management (IPM) techniques. There are many methods and types of IPM, including the following:
 - Mulching can be used to prevent weeds where turf is absent, fencing installed to keep rodents out, and netting used to keep birds and insects away from leaves and fruit.
 - Visible insects can be removed by hand (with gloves or tweezers) and placed in soapy water or vegetable oil. Alternatively, insects can be sprayed off the plant with water or in some cases vacuumed off of larger plants.
 - Store-bought traps, such as species-specific, pheromone-based traps or colored sticky cards, can be used.
 - Slugs can be trapped in small cups filled with beer that are set in the ground so the slugs can get in easily.
 - In cases where microscopic parasites, such as bacteria and fungi, are causing damage to plants, the affected plant material can be removed and disposed of (pruning equipment should be disinfected with bleach to prevent spreading the disease organism).
 - Small mammals and birds can be excluded using fences, netting, tree trunk guards.
 - Beneficial organisms, such as bats, birds, green lacewings, ladybugs, praying mantis, ground beetles, parasitic nematodes, trichogramma wasps, seed head weevils, and spiders that prey on detrimental pest species can be promoted.
- Follow all federal, state, and local laws and regulations governing the use, storage, and disposal of fertilizers and pesticides and training of applicators and pest control advisors.

- Use pesticides only if there is an actual pest problem (not on a regular preventative schedule).
- Do not use pesticides if rain is expected. Apply pesticides only when wind speeds are low (less than 5 mph).
- Do not mix or prepare pesticides for application near storm drains.
- Prepare the minimum amount of pesticide needed for the job and use the lowest rate that will effectively control the pest.
- Employ techniques to minimize off-target application (e.g. spray drift) of pesticides, including consideration of alternative application techniques.
- Fertilizers should be worked into the soil rather than dumped or broadcast onto the surface.
- Calibrate fertilizer and pesticide application equipment to avoid excessive application.
- Periodically test soils for determining proper fertilizer use.
- Sweep pavement and sidewalk if fertilizer is spilled on these surfaces before applying irrigation water.
- Purchase only the amount of pesticide that you can reasonably use in a given time period (month or year depending on the product).
- Triple rinse containers, and use rinse water as product. Dispose of unused pesticide as hazardous waste.
- Dispose of empty pesticide containers according to the instructions on the container label.

Inspection

- Inspect irrigation system periodically to ensure that the right amount of water is being applied and that excessive runoff is not occurring. Minimize excess watering, and repair leaks in the irrigation system as soon as they are observed.
- Inspect pesticide/fertilizer equipment and transportation vehicles daily.

Training

- Educate and train employees on use of pesticides and in pesticide application techniques to prevent pollution. Pesticide application must be under the supervision of a California qualified pesticide applicator.
- Train/encourage municipal maintenance crews to use IPM techniques for managing public green areas.
- Annually train employees within departments responsible for pesticide application on the appropriate portions of the agency's IPM Policy, SOPs, and BMPs, and the latest IPM techniques.

- Employees who are not authorized and trained to apply pesticides should be periodically (at least annually) informed that they cannot use over-the-counter pesticides in or around the workplace.
- Use a training log or similar method to document training.

Spill Response and Prevention

- Refer to SC-11, Spill Prevention, Control & Cleanup
- Have spill cleanup materials readily available and in a known location
- Cleanup spills immediately and use dry methods if possible.
- Properly dispose of spill cleanup material.

Other Considerations

- The Federal Pesticide, Fungicide, and Rodenticide Act and California Title 3, Division 6, Pesticides and Pest Control Operations place strict controls over pesticide application and handling and specify training, annual refresher, and testing requirements. The regulations generally cover: a list of approved pesticides and selected uses, updated regularly; general application information; equipment use and maintenance procedures; and record keeping. The California Department of Pesticide Regulations and the County Agricultural Commission coordinate and maintain the licensing and certification programs. All public agency employees who apply pesticides and herbicides in “agricultural use” areas such as parks, golf courses, rights-of-way and recreation areas should be properly certified in accordance with state regulations. Contracts for landscape maintenance should include similar requirements.
- All employees who handle pesticides should be familiar with the most recent material safety data sheet (MSDS) files.
- Municipalities do not have the authority to regulate the use of pesticides by school districts, however the California Healthy Schools Act of 2000 (AB 2260) has imposed requirements on California school districts regarding pesticide use in schools. Posting of notification prior to the application of pesticides is now required, and IPM is stated as the preferred approach to pest management in schools.

Requirements

Costs

Additional training of municipal employees will be required to address IPM techniques and BMPs. IPM methods will likely increase labor cost for pest control which may be offset by lower chemical costs.

Maintenance

Not applicable

Supplemental Information***Further Detail of the BMP******Waste Management***

Composting is one of the better disposal alternatives if locally available. Most municipalities either have or are planning yard waste composting facilities as a means of reducing the amount of waste going to the landfill. Lawn clippings from municipal maintenance programs as well as private sources would probably be compatible with most composting facilities

Contractors and Other Pesticide Users

Municipal agencies should develop and implement a process to ensure that any contractor employed to conduct pest control and pesticide application on municipal property engages in pest control methods consistent with the IPM Policy adopted by the agency. Specifically, municipalities should require contractors to follow the agency's IPM policy, SOPs, and BMPs; provide evidence to the agency of having received training on current IPM techniques when feasible; provide documentation of pesticide use on agency property to the agency in a timely manner.

References and Resources

King County Stormwater Pollution Control Manual. Best Management Practices for Businesses. 1995. King County Surface Water Management. July. On-line:
<http://dnr.metrokc.gov/wlr/dss/spcm.htm>

Los Angeles County Stormwater Quality Model Programs. Public Agency Activities
http://ladpw.org/wmd/npdes/model_links.cfm

Model Urban Runoff Program: A How-To Guide for Developing Urban Runoff Programs for Small Municipalities. Prepared by City of Monterey, City of Santa Cruz, California Coastal Commission, Monterey Bay National Marine Sanctuary, Association of Monterey Bay Area Governments, Woodward-Clyde, Central Coast Regional Water Quality Control Board. July. 1998.

Orange County Stormwater Program
http://www.ocwatersheds.com/StormWater/swp_introduction.asp

Santa Clara Valley Urban Runoff Pollution Prevention Program. 1997 Urban Runoff Management Plan. September 1997, updated October 2000.

United States Environmental Protection Agency (USEPA). 2002. Pollution Prevention/Good Housekeeping for Municipal Operations Landscaping and Lawn Care. Office of Water. Office of Wastewater Management. On-line: http://www.epa.gov/npdes/menuofbmps/poll_8.htm

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.



SD-10 Site Design & Landscape Planning

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

Site Design & Landscape Planning SD-10

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.

SD-10 Site Design & Landscape Planning

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.



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



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 1/4 to 1/2 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



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.



- 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.

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.



- 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.

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: AutoZone Parts, Inc.

PROPERTY ADDRESS: 14394 Mojave Dr. Victorville, CA 92394

APN: a portion of APN 0394-031-36-0-000.

THIS AGREEMENT is made and entered into in

Victorville, California, this _____ day of

_____, by and between

AutoZone Parts, Inc., 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

AutoZone Store 4499 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:

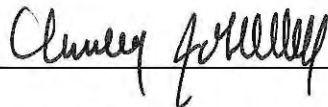
AutoZone Parts, Inc

123 South Front Street

Memphis, TN. 38103

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

OWNER:

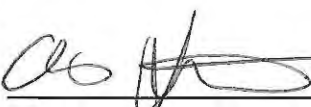
Signature: 

Name: Timothy J. Goddard

Title: Vice President

APPROVED, VERIFIED AND
PASSED FOR SIGNING
JP 

OWNER:

Signature: 

Name: Chris Hunter

Title: Vice President

NOTARIES ON FOLLOWING PAGE

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

ACCEPTED BY:

Brian W. Gengler., City Engineer for City of Victorville

Date:

Attachment: Standard Notary Acknowledgement

EXHIBIT A
(Legal Description)

EXHIBIT B
(Map/illustration)

STATE OF TENNESSEE)

COUNTY OF SHELBY)

On February 8, 2022, before me, Lori Smith (Notary Public) personally appeared Timothy J. Goddard, Vice President AutoZone Parts, Inc., and Chris Hunter, Vice President AutoZone Parts, Inc. who proved to me on the basis of satisfactory evidence to be the persons whose names are subscribed to the within instrument and acknowledged to me that they executed the same in their authorized capacities, and that by their signatures on the instrument the persons, or the entity upon behalf of which the persons acted, executed the instrument.

WITNESS my hand and official seal.

Lori Smith (SEAL)
Lori Smith

(Printed Name)

NOTARY PUBLIC IN AND
FOR SAID COUNTY AND STATE



My Commission Expires: **My Commision Expires**
November 09, 2025

Hydrology and Hydraulics Report

AUTOZONE VICTORVILLE

MOJAVE DR AND EL EVADO RD

VICTORVILLE, CA

February 2021

Revised: August, 2021

Revised: February, 2022

Revised: July, 2022

PREPARED FOR:

AutoZone Parts, Inc
123 S. Front Street, 3rd Floor
Memphis, TN 38103
901-495-8714

PREPARED BY:

Kimley-Horn and Associates, Inc.
1100 W Town and Country Road, Suite 700
Orange, CA 92868
(714) 705-1374
Attn: Jacob Glaze, P.E.

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Appendices

Appendix A: Site Data

- City Priority Check List
- NOAA Atlas Rainfall DEPTH
 - o 10yr, 24hr = 2.24 in/hr
 - o 100yr, 1hr = 3.70 in/hr
- Mojave River Watershed Map
- APN Map
 - o Note: Lot is currently going through a lot split/subdivision

Appendix B: Existing Hydrology

- Existing Hydrology Map/Plan
- Existing Drainage Area Hydrology Calculations (AES Models) 10yr & 100yr
 - o Rational method calculations

Appendix C: Proposed Hydrology

- Proposed Hydrology Map/Plan
- Proposed Drainage Area Hydrology Calculations (AES Models) 10yr & 100yr
 - o Hydrograph analysis
 - o Rational Method Calculations
- WQMP exhibit – provided for reference.

Appendix D: Reports

- Geotech report
 - o Addendum to the Geotech report for the additional testing for infiltration feasibility and percolation tests is provided.

1. Project Description

Kimley-Horn and Associates has been retained to prepare a Drainage Study for the proposed development near the intersection of Mojave Dr and El Evado Dr in the City of Victorville, California. The existing conditions at the site is an undeveloped/undisturbed property that will be subdivided into multiple parcels.

The purpose of this report is to provide information regarding the existing and proposed storm water discharge flow for the project. Due to the nature of the project, this report will be accompanied by a WQMP report as the project is a Priority Project. The proposed conditions will be compliant with the NPDES General Permit.

The project consists of a new AutoZone Parts commercial retail building, an associated parking lot for customers, landscaping, concrete hardscape, and asphalt paving. The associated improvements include, but are not limited to onsite grading, new utility services, connecting to neighboring utility stubs, and irrigation.

2. Site Discussion

The existing site is a predominantly pervious, undeveloped site with elevations ranging from 2938.25 to 2942 feet above mean sea level. Soil type of the existing site is C according to the San Bernardino Hydrology manual maps. Runoff from the drainage area sheet flows from the southwest to east, with no existing drainage structures on site. The site is part of a lot split that is being processed by the developer and is a portion of APN 039403136. The site is 45,378 sf (1.04 AC).

The proposed site lies within the Mojave Watershed and will generally maintain the existing drainage and flow volumes after the post construction BMPs are installed. Under proposed conditions, the site will be 66.3% impervious and 34.7% pervious with one major drainage area (DA). Runoff from DA-1 will ultimately be collected in an infiltration basin at the north end of the property. Runoff from the proposed building will outlet at-grade roof drain downspouts in landscaping that is considered self-treating. All other drainage to the northeast of the ridge line near the ease entrance will sheet flow to curb and gutter or to the valley gutter. The runoff in the valley gutter and curb and gutter will then be directed to a vegetated swale which will flow into the infiltration basin. Runoff to the west of the ridge line will flow to a curb and gutter, through a parkway drain and into a vegetated swale graded to the infiltration basin. Runoff not directly caught or directed to either curb and gutter or the valley gutter with sheet flow to the vegetated swale. The basin is designed to treat and infiltrate the runoff DCV. Refer to the WQMP for this project for DCV calculations. The basin is also designed with 1 foot of freeboard, allowing the basin to do both, handle the DCV volume and mitigate the proposed flows down to below the existing flows, 3.58 down to 3.56 CFS.

3. Hydrology and Methodology

The study will determine the amount of storm water flow generated by both the pre-existing and the post development conditions. The 10-year 24hr and 100-year 1-hour storms were developed using the rational method. The analyzed DA took into consideration impervious, coverage types, DA acreage, and time of concentration.

The drainage design for the proposed site meets the standards required and recommended by the city of Victorville Hydrology report guidance and County of San Bernardino Hydrology Manual. The difference between the pre-existing conditions and proposed conditions is provided below and shows the proposed conditions increase the runoff.

4. Conclusion

The 100 year storm and 10 year storm proposed increase in runoff will be mitigated through the proposed systems in place. Appendix D provides the study analysis of the proposed hydrographs for the 10yr and 100yr storms. The analysis shows that the 10year storm will be mitigated through the infiltration basin and its DCV. While 100yr storm will be mitigated through the weir outlet structure, releasing 3.53 CFS(existing is 3.58), which will ultimately outfall to the storm drain stub provided by the neighboring development. The stub will drain to El Evado where it will outlet the runoff at 3.53 cfs, which is less than the existing conditions 3.58 cfs. The proposed conditions will not create any adverse impacts on downstream routes. Under the proposed conditions for the drainage area, the infiltration basin and outlets structure will attenuate peak flows and provide water quality treatment.

Percolation and infiltration tests were completed at the site to verify the feasibility infiltration and to properly size the proposed basin. The percolation testing results show that the site has a design infiltration rate of 6.5 in/hr and a factor of 3. Please refer to the sites preliminary WQMP for the sizing calculations of the basin. The post construction BMPs on site will be the before mentioned infiltration basin.

Site Condition	Drainage Area	Q (cfs)	TC (min)
	DA-1 (AC)		
Existing Conditions-100 year, 1 hr	1.04	3.58	8.94
Proposed Conditions – 100 Year, 1 hr	1.04	4.27	6.70
Existing Conditions – 10yr, 24hr	1.04	1.87	8.94
Proposed Conditions -10yr, 24hr	1.04	2.38	6.70

Proposed Weir outlet flow -3.53 CFS for 100yr storm (mitigates to outlet less than existing)
Proposed Weir outlet flow -0 CFS for 10yr storm (mitigated in basin DCV)

Appendix A: Site Data

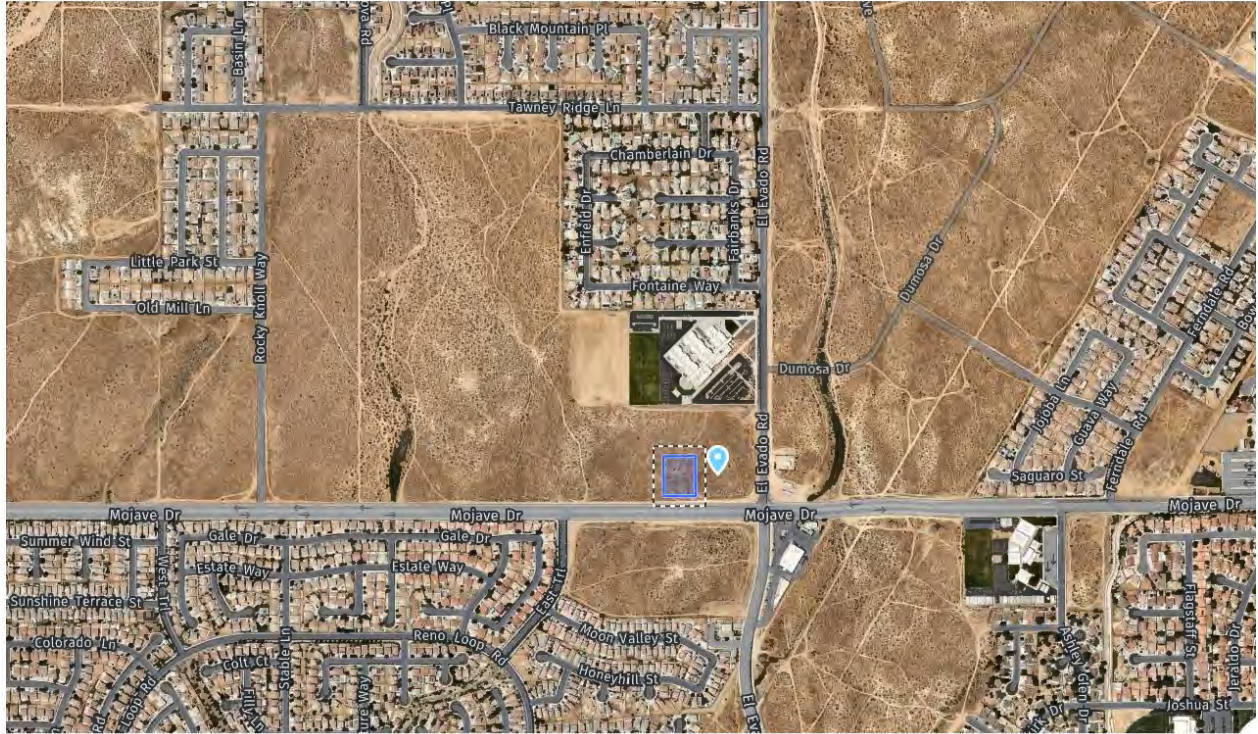
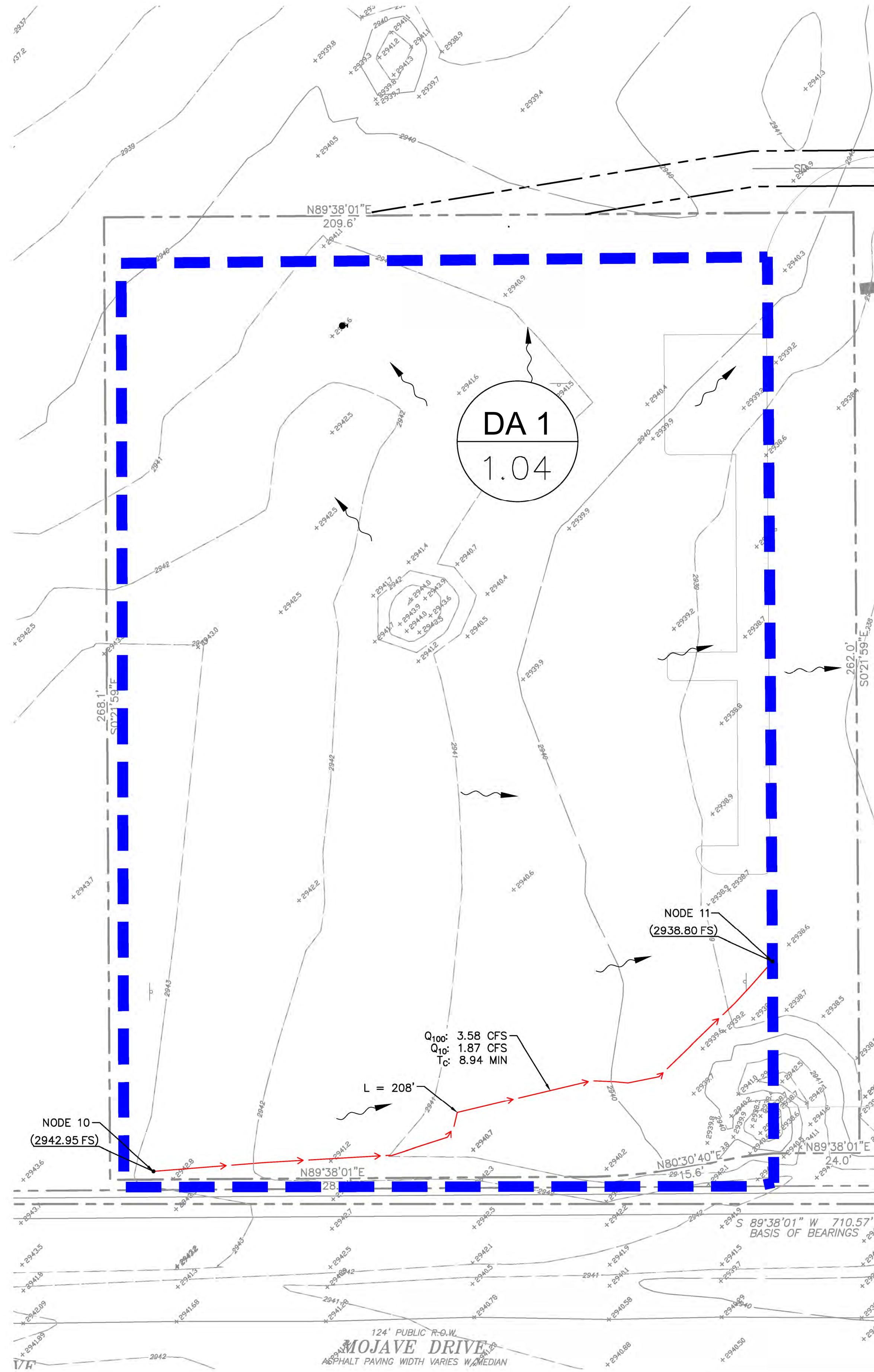


Image 1. Site location map

Appendix B: Existing Hydrology

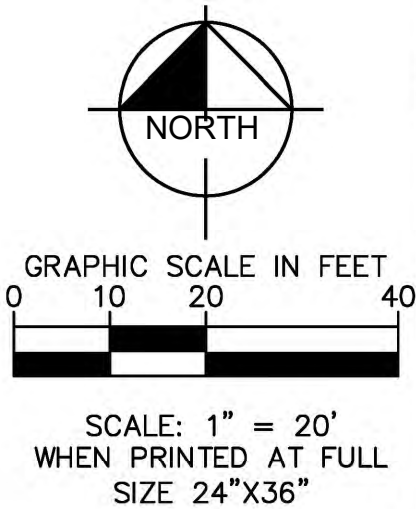


LEGEND

- PROPERTY LINE
- PROPOSED CONTOUR
- EXISTING CONTOUR
- EASEMENT LINE
- DRAINAGE AREA (DA)
- FLOW PATH
- DIRECTION OF FLOW
- DA NAME
- DA AREA (IN ACRES)

DATA SUMMARY

ADDRESS: NORTHWEST MOJAVE DR & EL EVADO RD
APN: 039403136
ZONING DISTRICT: C-2, GEN COMMERCIAL
FLOOD ZONE: ZONE X - AREA DETERMINED TO BE OUTSIDE OF .2% ANNUAL CHANCE FLOOD PLAN
TOTAL PROJECT AREA: 45,378 (1.04 AC)



BLDC21-00096

Kimley»Horn

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1100 TOWN AND COUNTRY RD, SUITE 700, ORANGE, CA 92668
PHONE: 714-938-1030 FAX: 714-938-9488
WWW.KIMLEY-HORN.COM



CITY OF VICTORVILLE
ENGINEERING DEPARTMENT
14343 Civic Drive, Victorville, Ca. 92392 (760) 955-5158

NO.	REVISION	BY	DATE

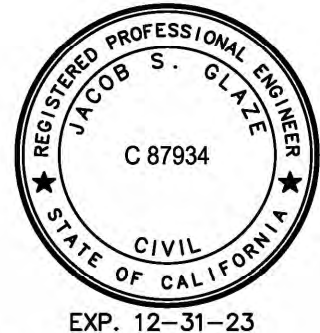
HYDROLOGY EXISTING CONDITIONS

FIELD BOOK NO. (S)
BENCH MARK:
CITY BENCHMARK:
#V-213; DESCRIPTION: "Mojave Dr. @ El Evado Rd., TO 2' West of SW BCR".
ELEVATION = 2937.86'
COV CONTROL #V-213

DESIGN BY: JO
DRAWN BY: JO
CHECKED BY: CF
DATE: 7/6/2022

SHEET NO.
OF

DRAWING No.
XX-00
PROJECT NO.
TBD



CITY CASE NO.

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

Approved By: Brian W. Gengler, RCE-C44730
City Engineer



RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
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Ver. 18.0 Release Date: 07/01/2011 License ID 1499

Analysis prepared by:

Kimley-Horn and Associates, Inc.
765 The City Drive
Suite 200
Orange, CA 92868

***** DESCRIPTION OF STUDY

* AUTOZONE VICTORVILLE 100YR EXISTING
*
* R.A. 7/22/21
*
* AZV100E.RES
*

*

FILE NAME: AZV100E.DAT
TIME/DATE OF STUDY: 13:45 07/23/2021

=====
===

USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:

=====
===

--*TIME-OF-CONCENTRATION MODEL*--

USER SPECIFIED STORM EVENT(YEAR) = 100.00
SPECIFIED MINIMUM PIPE SIZE(INCH) = 8.00
SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE =
1.00

USER-DEFINED TABLED RAINFALL USED

NUMBER OF [TIME,INTENSITY] DATA PAIRS = 3

1) 5.00; 4.720
2) 60.00; 1.100
3) 180.00; 0.541

ANTECEDENT MOISTURE CONDITION (AMC) III ASSUMED FOR RATIONAL METHOD

*USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW
MODEL*

MANNING		HALF- CROWN TO		STREET-CROSSFALL:		CURB GUTTER-GEOMETRIES:			
NO.	WIDTH (FT)	CROSSFALL (FT)	IN- SIDE	OUT- / SIDE/	PARK- WAY	HEIGHT (FT)	WIDTH (FT)	LIP (FT)	HIKE (FT)
1	30.0	20.0	0.018	0.018	0.020	0.67	2.00	0.0313	0.167

0.0150

GLOBAL STREET FLOW-DEPTH CONSTRAINTS:

1. Relative Flow-Depth = 0.00 FEET
as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
 2. (Depth)*(Velocity) Constraint = 6.0 (FT*FT/S)
- *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
*USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

FLOW PROCESS FROM NODE 10.00 TO NODE 11.00 IS CODE = 21

>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
>>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<

=====

INITIAL SUBAREA FLOW-LENGTH (FEET) = 208.00
ELEVATION DATA: UPSTREAM (FEET) = 2942.95 DOWNSTREAM (FEET) = 2938.80

$$T_c = K * [(LENGTH ** 3.00) / (ELEVATION CHANGE)] ** 0.20$$

SUBAREA ANALYSIS USED MINIMUM T_c (MIN.) = 8.937

* 100 YEAR RAINFALL INTENSITY (INCH/HR) = 4.461

SUBAREA T_c AND LOSS RATE DATA (AMC III):

DEVELOPMENT TYPE/	SCS SOIL	AREA	F_p	A_p	SCS
LAND USE	GROUP	(ACRES)	(INCH/HR)	(DECIMAL)	CN
PUBLIC PARK	C	1.00	0.27	0.850	86

8.94

SUBAREA AVERAGE PERVIOUS LOSS RATE, F_p (INCH/HR) = 0.27

SUBAREA AVERAGE PERVIOUS AREA FRACTION, A_p = 0.850

SUBAREA RUNOFF (CFS) = 3.81

TOTAL AREA (ACRES) = 1.00 PEAK FLOW RATE (CFS) = 3.81

=====

END OF STUDY SUMMARY:

TOTAL AREA (ACRES) = 1.00 T_c (MIN.) = 8.94
EFFECTIVE AREA (ACRES) = 1.00 AREA-AVERAGED F_m (INCH/HR) = 0.23

AREA-AVERAGED F_p (INCH/HR) = 0.27 AREA-AVERAGED A_p = 0.850
PEAK FLOW RATE (CFS) = 3.81

=====
===

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END OF RATIONAL METHOD ANALYSIS

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Analysis prepared by:

Kimley-Horn and Associates, Inc.
765 The City Drive
Suite 200
Orange, CA 92868

***** DESCRIPTION OF STUDY

* AUTOZONE VICTORVILLE 10YR 24HR EXISTING
*
* R.A. 7/22/21
*
* AZV1024E.RES
*

*

FILE NAME: AZV1024E.DAT
TIME/DATE OF STUDY: 13:26 07/27/2021

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USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:

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--*TIME-OF-CONCENTRATION MODEL*--

USER SPECIFIED STORM EVENT(YEAR) = 10.00
SPECIFIED MINIMUM PIPE SIZE(INCH) = 8.00
SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE =
1.00

USER-DEFINED TABLED RAINFALL USED
NUMBER OF [TIME,INTENSITY] DATA PAIRS = 3
1) 5.00; 2.710
2) 60.00; 0.632
3) 360.00; 0.215

ANTECEDENT MOISTURE CONDITION (AMC) II ASSUMED FOR RATIONAL METHOD

*USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW
MODEL*

MANNING		HALF- CROWN TO		STREET-CROSSFALL:		CURB GUTTER-GEOMETRIES:			
NO.	WIDTH (FT)	CROSSFALL (FT)	IN- SIDE	/ OUT- SIDE/	PARK- WAY	HEIGHT (FT)	WIDTH (FT)	LIP (FT)	HIKE (FT)
1	30.0	20.0	0.018	0.018	0.020	0.67	2.00	0.0313	0.167

0.0150

GLOBAL STREET FLOW-DEPTH CONSTRAINTS:

1. Relative Flow-Depth = 0.00 FEET
as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
 2. (Depth)*(Velocity) Constraint = 6.0 (FT*FT/S)
- *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
*USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

FLOW PROCESS FROM NODE 10.00 TO NODE 11.00 IS CODE = 21

>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
>>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<

=====

INITIAL SUBAREA FLOW-LENGTH (FEET) = 208.00
ELEVATION DATA: UPSTREAM (FEET) = 2942.95 DOWNSTREAM (FEET) = 2938.80

$$T_c = K * [(LENGTH ** 3.00) / (ELEVATION CHANGE)] ** 0.20$$

SUBAREA ANALYSIS USED MINIMUM T_c (MIN.) = 8.937

* 10 YEAR RAINFALL INTENSITY (INCH/HR) = 2.561

SUBAREA T_c AND LOSS RATE DATA (AMC II):

DEVELOPMENT TYPE/	SCS SOIL	AREA	F_p	A_p	SCS
LAND USE	GROUP	(ACRES)	(INCH/HR)	(DECIMAL)	CN

PUBLIC PARK	C	1.00	0.57	0.850	69
-------------	---	------	------	-------	----

8.94

SUBAREA AVERAGE PERVIOUS LOSS RATE, F_p (INCH/HR) = 0.57

SUBAREA AVERAGE PERVIOUS AREA FRACTION, A_p = 0.850

SUBAREA RUNOFF (CFS) = 1.87

TOTAL AREA (ACRES) = 1.00 PEAK FLOW RATE (CFS) = 1.87

=====

END OF STUDY SUMMARY:

TOTAL AREA (ACRES) = 1.00 T_c (MIN.) = 8.94
EFFECTIVE AREA (ACRES) = 1.00 AREA-AVERAGED F_m (INCH/HR) = 0.48

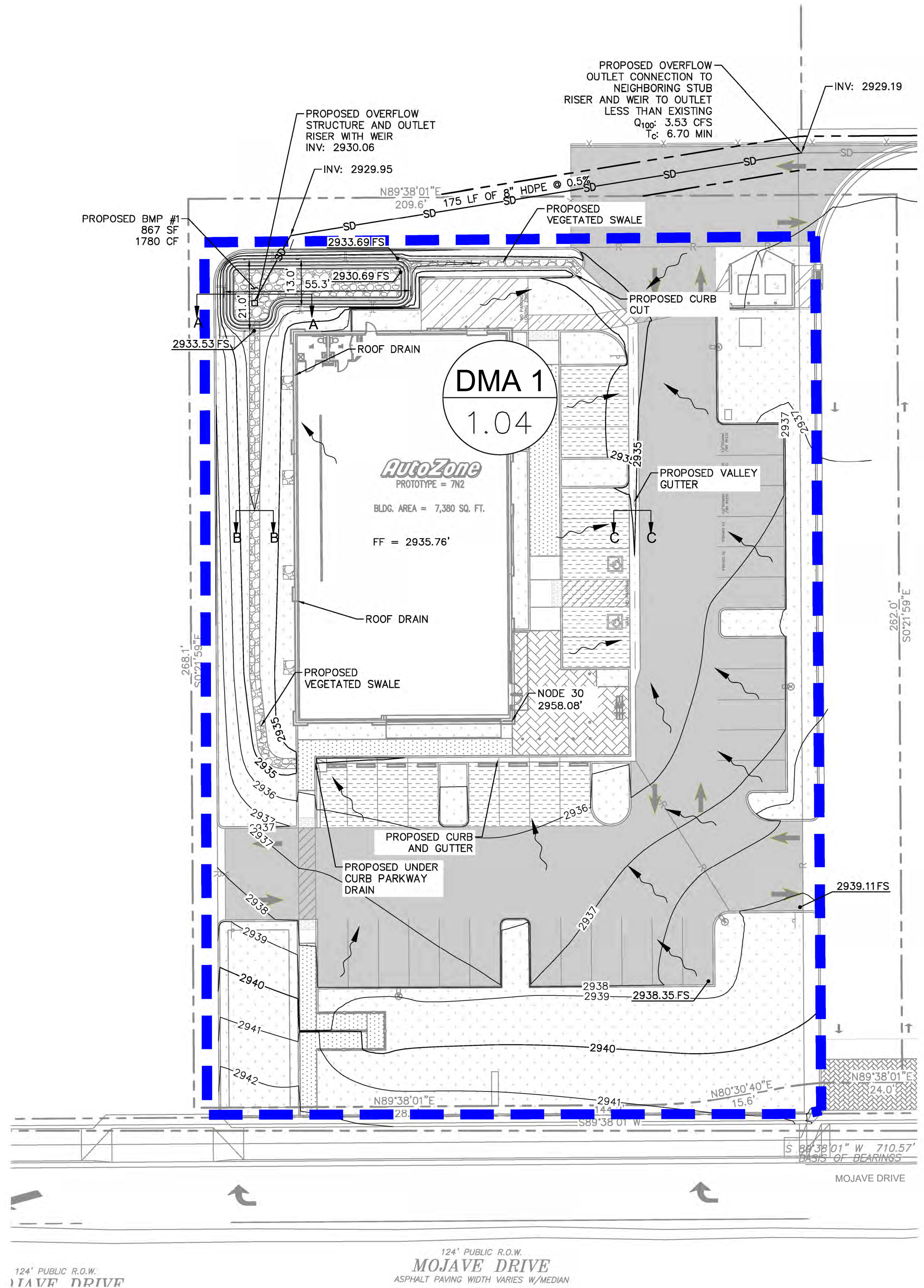
AREA-AVERAGED F_p (INCH/HR) = 0.57 AREA-AVERAGED A_p = 0.850
PEAK FLOW RATE (CFS) = 1.87

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END OF RATIONAL METHOD ANALYSIS

Appendix C: Proposed Hydrology



124' PUBLIC R.O.W.
MOJAVE DRIVE
ASPHALT PAVING WIDTH VARIES W/MEDIAN

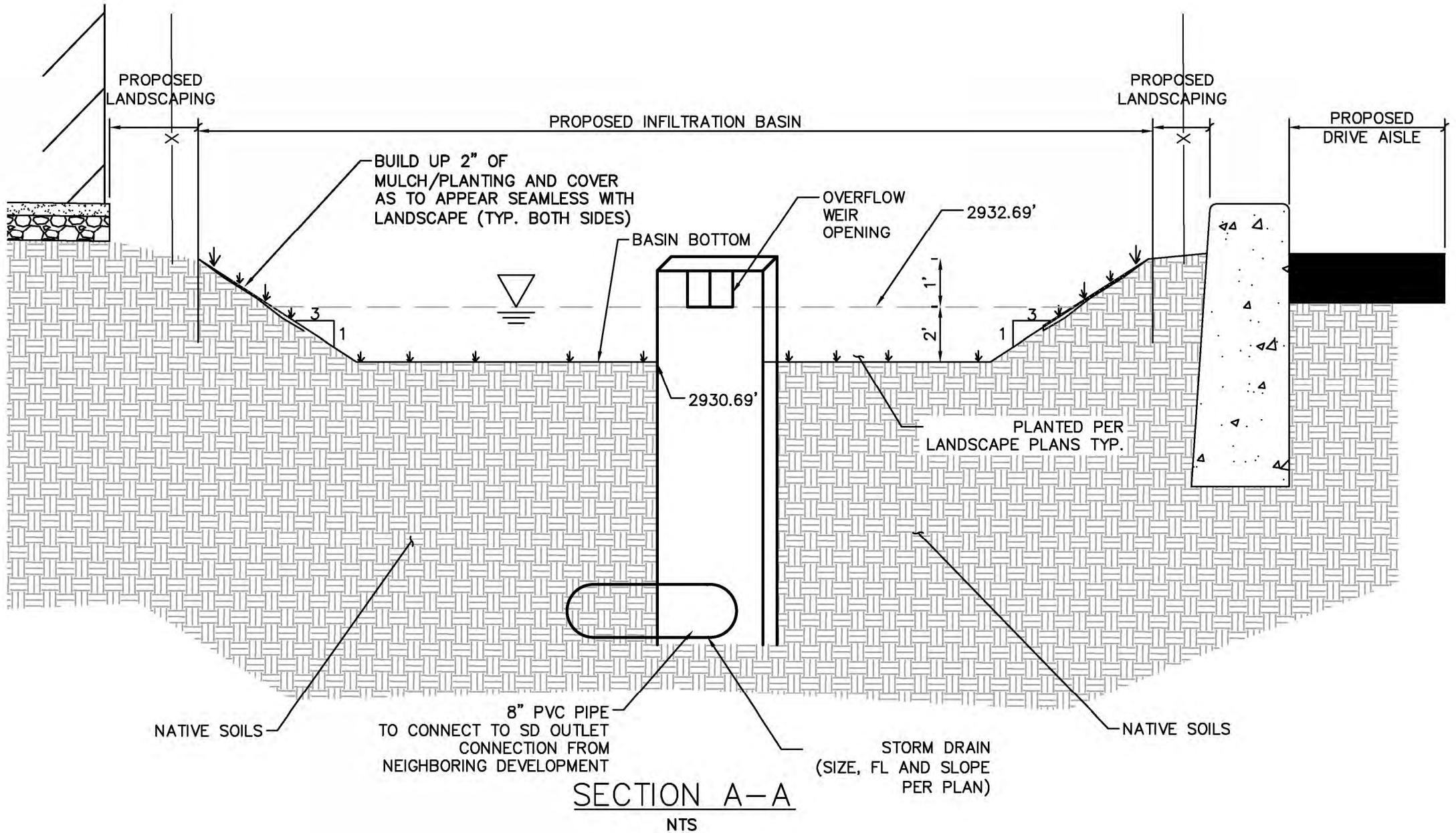
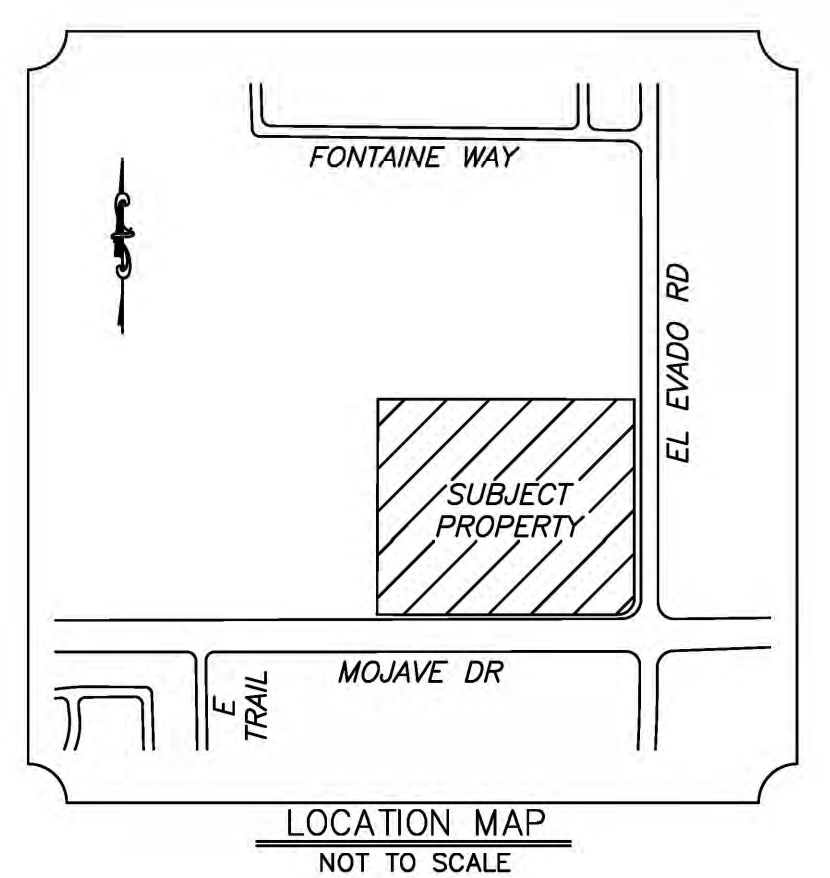
LEGEND

- PROPERTY LINE
- PROPOSED CONTOUR
- EXISTING CONTOUR
- EASEMENT LINE
- STREET CENTERLINE
- DRAINAGE MANAGEMENT AREA (DMA)
- DIRECTION OF FLOW
- DMA NAME
- DMA AREA (IN ACRES)

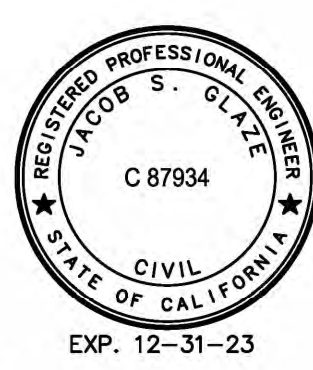
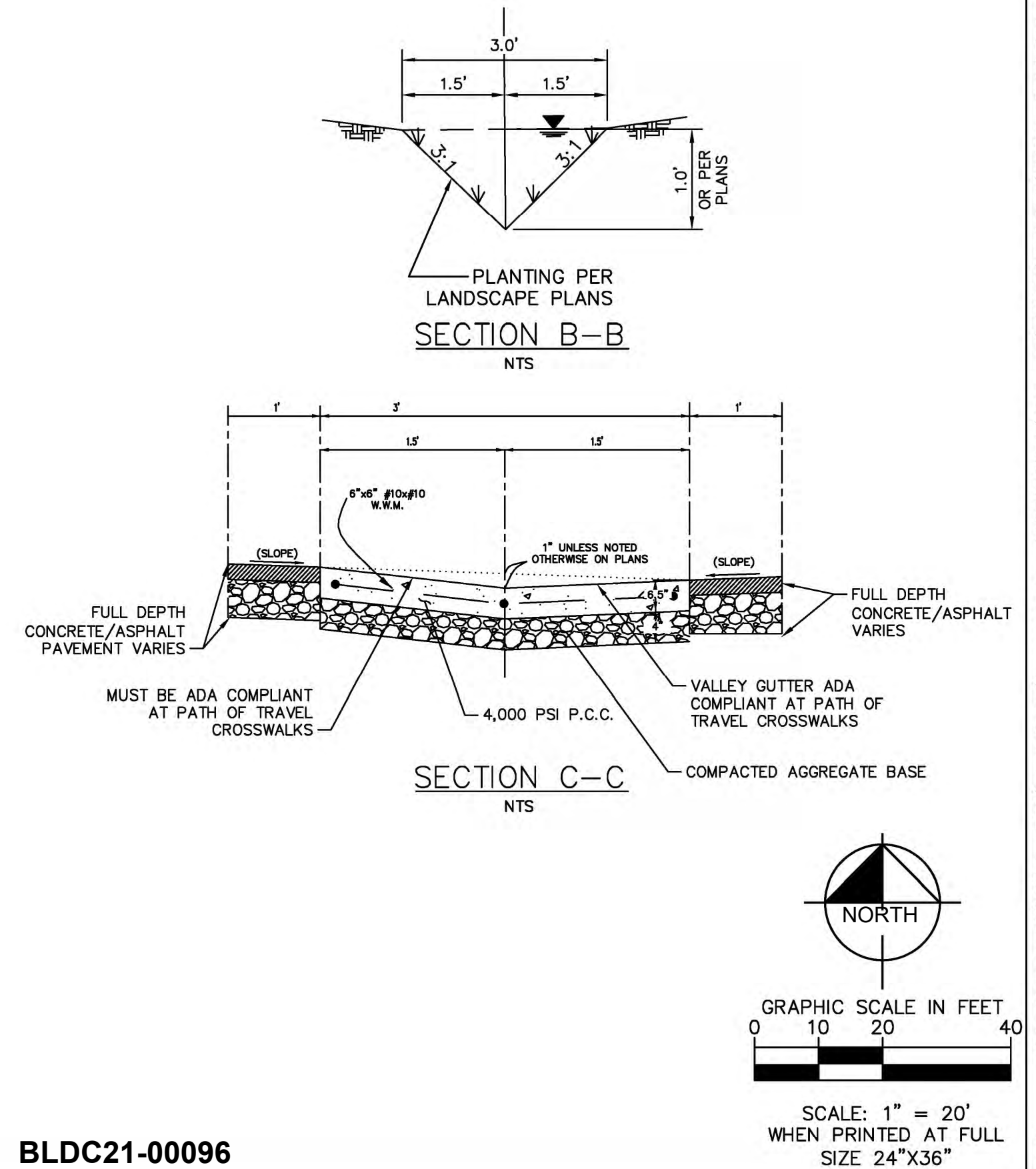
DATA SUMMARY

ADDRESS: NORTHWEST MOJAVE DR & EL EVADO RD
APN: 039403136
ZONING DISTRICT: C-2, GEN COMMERCIAL
FLOOD ZONE: ZONE X - AREA DETERMINED TO BE OUTSIDE OF .2% ANNUAL CHANCE FLOOD PLAN
TOTAL PROJECT AREA: 45,378 (1.04 AC)

DMA	SURFACE TYPE	AREA (SF)	AREA (AC)	(REQUIRED) DESIGN CAPTURE VOLUME FT ³	PROVIDED TREATMENT VOLUME FT ³
DMA TOTAL EXISTING	CONC./ASPH.	N/A	N/A		
	LANDSCAPING	45,378	1.04		
DMA TOTAL PROPOSED	CONC./ASPH.	30,160	0.69		
	LANDSCAPING	15,580	0.36		
DMA NET CHANGE	CONC./ASPH.	30,160	0.69	1549.0	1780.0
	LANDSCAPING	(29,798)	0.68		



TREATMENT CONTROL & SOURCE CONTROL BMP'S	
BMP ID	BMP DESCRIPTION
	MODULAR WETLANDS
SC-43	PARKING AREA MAINTENANCE
SC-44	DRAINAGE SYSTEM MAINTENANCE
SC-71	PLAZA & SIDEWALK CLEANING
SC-73	LANDSCAPE MAINTENANCE
SD-10	SITE DESIGN AND LANDSCAPE PLANNING
SD-11	ROOF RUNOFF CONTROL
SD-12	EFFICIENT IRRIGATION



BLDC21-00096

Kimley»Horn

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1100 TOWN AND COUNTRY RD, SUITE 700, ORANGE, CA 92668
PHONE: 714-939-1030 FAX: 714-938-9488
WWW.KIMLEY-HORN.COM

CITY OF VICTORVILLE
ENGINEERING DEPARTMENT
14343 Civic Drive, Victorville, Ca. 92392 (760) 955-5158

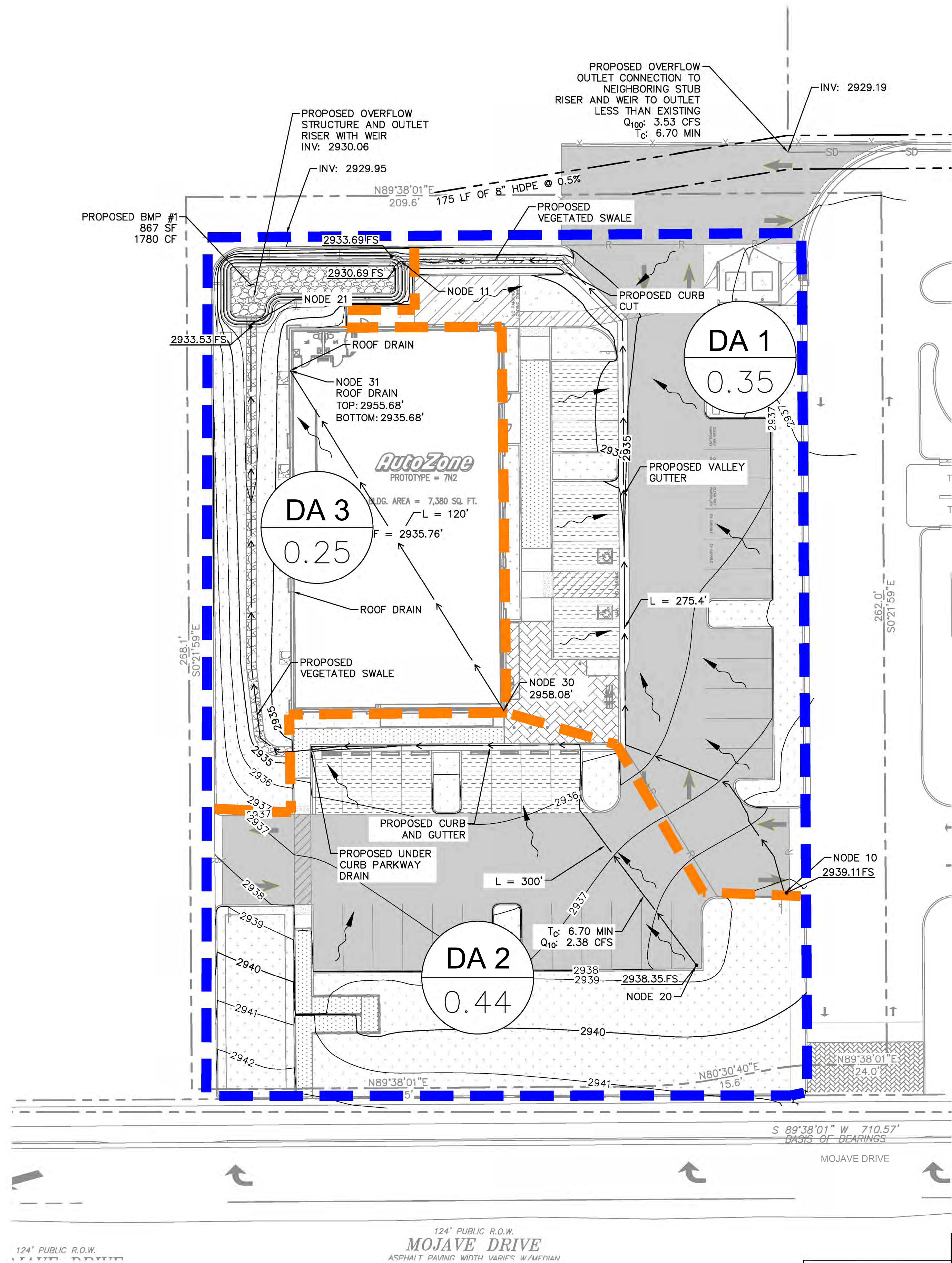
NO.	REVISION	BY	DATE
FIELD BOOK NO. (S)			
BENCH MARK: CITY BENCHMARK: #V-213; DESCRIPTION: "Mojave Dr. @ El Evado Rd., TO 2' West of SW BCR". ELEVATION = 2937.86' COV CONTROL #V-213			
DESIGN BY: JO		SHEET NO. OF	DRAWING No. XX-00
DRAWN BY: JO			
CHECKED BY: CF		PROJECT NO. TBD	
DATE: 7/6/2022			

CITY CASE NO.

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

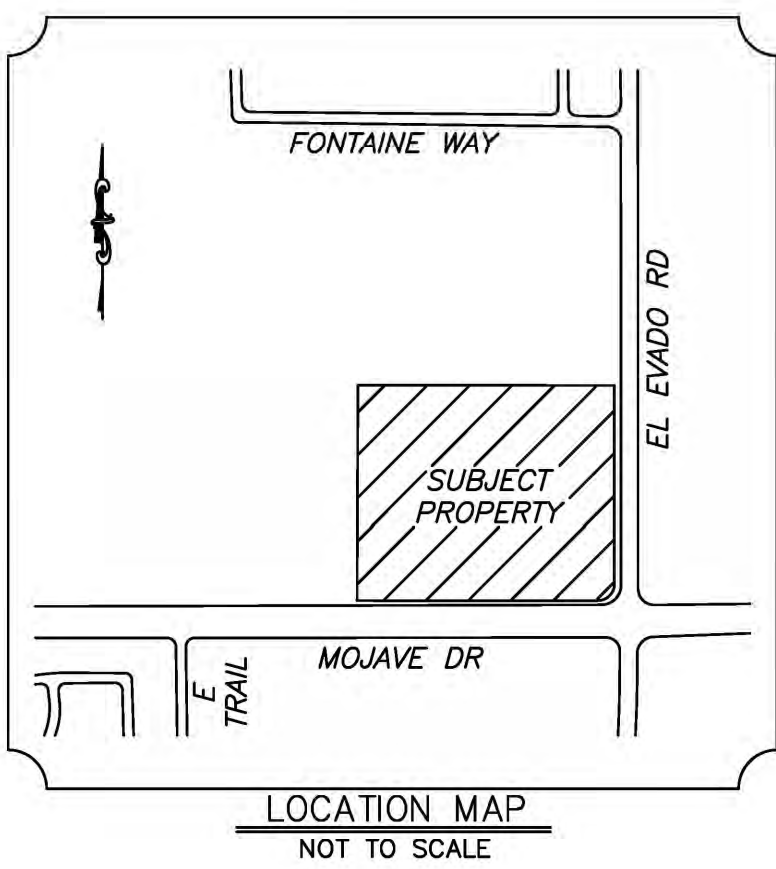
Approved By: Brian W. Gengler, RCE C44730
City Engineer

DATE



LEGEND

- PROPERTY LINE
- PROPOSED CONTOUR
- EXISTING CONTOUR
- EASEMENT LINE
- DRAINAGE MANAGEMENT AREA (DMA)
- DRAINAGE AREA (DA)
- FLOW PATH
- DIRECTION OF FLOW
- DA NAME
- DA AREA (IN ACRES)



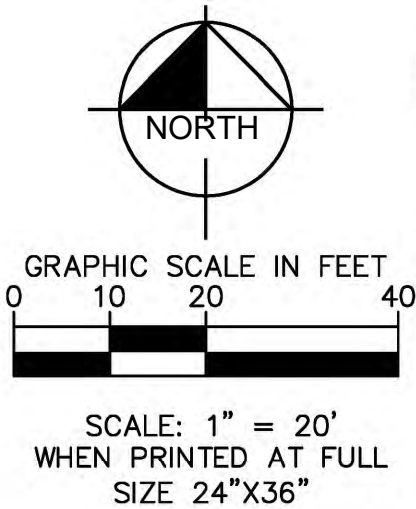
DATA SUMMARY

ADDRESS: NORTHWEST MOJAVE DR & EL EVADO RD
APN: 039403136
ZONING DISTRICT: C-2, GEN COMMERCIAL
FLOOD ZONE: ZONE X - AREA DETERMINED TO BE OUTSIDE OF .2% ANNUAL CHANCE FLOOD PLAN
TOTAL PROJECT AREA: 45,378 (1.04 AC)

DMA	SURFACE TYPE	AREA (SF)	AREA (AC)
DMA 1 0.35 AC	CONC./ASPH.	11,761	0.27
	LANDSCAPING	3,441	0.08
DMA 2 0.44	CONC./ASPH.	10,063	0.23
	LANDSCAPING	9,103	0.21
DMA 3 0.25	CONC./ASPH.	7405	0.17
	LANDSCAPING	3623	0.08

MITIGATION SUMMARY

Q₁₀ EXISTING: 3.58 CFS
Q₁₀ PROPOSED: 4.22 CFS
NOTE: OUTLET STRUCTURE RELEASES AT 3.53 CFS



BLDC21-00096

Kimley»Horn

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1100 TOWN AND COUNTRY RD, SUITE 700, ORANGE, CA 92668
PHONE: 714-939-1030 FAX: 714-938-9488
WWW.KIMLEY-HORN.COM



CITY OF VICTORVILLE
ENGINEERING DEPARTMENT
14343 Civic Drive, Victorville, Ca. 92392 (760) 955-5158

NO.	REVISION	BY	DATE

HYDROLOGY PROPOSED CONDITIONS

FIELD BOOK NO. (S)
BENCH MARK:
CITY BENCHMARK:
#V-213; DESCRIPTION: Mojave Dr. @ El Evado Rd., TO 2' West of SW BCR.
ELEVATION = 2937.86'
COV CONTROL #V-213

DESIGN BY: JO
DRAWN BY: JO
CHECKED BY: CF
DATE: 7/6/2022

SHEET NO. _____ OF _____
DRAWING No. XX-00
PROJECT No. TBD



CITY CASE NO.

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

Approved By: Brian W. Gengler, RCE C44730
City Engineer

DATE



RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
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Ver. 18.0 Release Date: 07/01/2011 License ID 1499

Analysis prepared by:

Kimley-Horn and Associates, Inc.
765 The City Drive
Suite 200
Orange, CA 92868

***** DESCRIPTION OF STUDY

* AUTOZONE VICTORVILL 100YR PROPOSED
*
* R.A. 7/22/21
*
* AZ10P
*

*

FILE NAME: AZV100P.DAT
TIME/DATE OF STUDY: 14:20 07/23/2021

=====
===

USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:

=====
===

--*TIME-OF-CONCENTRATION MODEL*--

USER SPECIFIED STORM EVENT(YEAR) = 100.00
SPECIFIED MINIMUM PIPE SIZE(INCH) = 8.00
SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE =
1.00

USER-DEFINED TABLED RAINFALL USED

NUMBER OF [TIME,INTENSITY] DATA PAIRS = 3

1) 5.00; 4.720
2) 60.00; 1.100
3) 180.00; 0.541

ANTECEDENT MOISTURE CONDITION (AMC) III ASSUMED FOR RATIONAL METHOD

*USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW
MODEL*

MANNING		HALF- CROWN TO	STREET-CROSSFALL:			CURB	GUTTER-GEOMETRIES:		
NO.	WIDTH (FT)	CROSSFALL (FT)	IN- SIDE	/ OUT- SIDE/	PARK- WAY	HEIGHT (FT)	WIDTH (FT)	LIP (FT)	HIKE (FT)
1	30.0	20.0	0.018	0.018	0.020	0.67	2.00	0.0313	0.167

0.0150

GLOBAL STREET FLOW-DEPTH CONSTRAINTS:

1. Relative Flow-Depth = 0.00 FEET
as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
 2. (Depth)*(Velocity) Constraint = 6.0 (FT*FT/S)
- *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
*USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

FLOW PROCESS FROM NODE 10.00 TO NODE 11.00 IS CODE = 21

>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<
>>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<

=====

INITIAL SUBAREA FLOW-LENGTH (FEET) = 275.00
ELEVATION DATA: UPSTREAM (FEET) = 2939.11 DOWNSTREAM (FEET) = 2933.61

$$T_c = K * [(LENGTH ** 3.00) / (ELEVATION CHANGE)] ** 0.20$$

SUBAREA ANALYSIS USED MINIMUM T_c (MIN.) = 6.700

* 100 YEAR RAINFALL INTENSITY (INCH/HR) = 4.608

SUBAREA T_c AND LOSS RATE DATA (AMC III):

DEVELOPMENT TYPE/	SCS SOIL	AREA	F_p	A_p	SCS
LAND USE	GROUP	(ACRES)	(INCH/HR)	(DECIMAL)	CN
APARTMENTS	C	0.35	0.27	0.200	86

6.70

SUBAREA AVERAGE PERVIOUS LOSS RATE, F_p (INCH/HR) = 0.27

SUBAREA AVERAGE PERVIOUS AREA FRACTION, A_p = 0.200

SUBAREA RUNOFF (CFS) = 1.43

TOTAL AREA (ACRES) = 0.35 PEAK FLOW RATE (CFS) = 1.43

FLOW PROCESS FROM NODE 11.00 TO NODE 11.00 IS CODE = 1

```

-----
----
>>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<

=====
===
TOTAL NUMBER OF STREAMS = 3
CONFLUENCE VALUES USED FOR INDEPENDENT STREAM 1 ARE:
TIME OF CONCENTRATION(MIN.) = 6.70
RAINFALL INTENSITY(INCH/HR) = 4.61
AREA-AVERAGED Fm(INCH/HR) = 0.05
AREA-AVERAGED Fp(INCH/HR) = 0.27
AREA-AVERAGED Ap = 0.20
EFFECTIVE STREAM AREA(ACRES) = 0.35
TOTAL STREAM AREA(ACRES) = 0.35
PEAK FLOW RATE(CFS) AT CONFLUENCE = 1.43

*****
***
FLOW PROCESS FROM NODE 20.00 TO NODE 21.00 IS CODE = 21
-----
----
>>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
>>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<

=====
===
INITIAL SUBAREA FLOW-LENGTH(FEET) = 226.50
ELEVATION DATA: UPSTREAM(FEET) = 2938.78 DOWNSTREAM(FEET) =
2933.63

Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) = 6.043
* 100 YEAR RAINFALL INTENSITY(INCH/HR) = 4.651
SUBAREA Tc AND LOSS RATE DATA(AMC III):
DEVELOPMENT TYPE/ SCS SOIL AREA Fp Ap SCS
Tc
LAND USE GROUP (ACRES) (INCH/HR) (DECIMAL) CN
(MIN.)
APARTMENTS C 0.44 0.27 0.200 86
6.04
SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) = 0.27
SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap = 0.200
SUBAREA RUNOFF(CFS) = 1.82
TOTAL AREA(ACRES) = 0.44 PEAK FLOW RATE(CFS) = 1.82

*****
***
FLOW PROCESS FROM NODE 21.00 TO NODE 11.00 IS CODE = 1
-----
----
>>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<

```

```

=====
===
TOTAL NUMBER OF STREAMS = 3
CONFLUENCE VALUES USED FOR INDEPENDENT STREAM 2 ARE:
TIME OF CONCENTRATION(MIN.) = 6.04
RAINFALL INTENSITY(INCH/HR) = 4.65
AREA-AVERAGED Fm(INCH/HR) = 0.05
AREA-AVERAGED Fp(INCH/HR) = 0.27
AREA-AVERAGED Ap = 0.20
EFFECTIVE STREAM AREA(ACRES) = 0.44
TOTAL STREAM AREA(ACRES) = 0.44
PEAK FLOW RATE(CFS) AT CONFLUENCE = 1.82

*****
***
FLOW PROCESS FROM NODE 30.00 TO NODE 31.00 IS CODE = 22
-----
----
>>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
>>>>>USE SPECIFIED Tc VALUE FOR INITIAL SUBAREA<<<

=====
===
INITIAL SUBAREA FLOW-LENGTH(FEET) = 226.50
USER SPECIFIED Tc(MIN.) = 5.000
* 100 YEAR RAINFALL INTENSITY(INCH/HR) = 4.720
SUBAREA LOSS RATE DATA(AMC III):
DEVELOPMENT TYPE/ SCS SOIL AREA Fp Ap SCS
LAND USE GROUP (ACRES) (INCH/HR) (DECIMAL) CN
COMMERCIAL C 0.25 0.27 0.100 86
SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) = 0.27
SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap = 0.100
SUBAREA RUNOFF(CFS) = 1.06
TOTAL AREA(ACRES) = 0.25 PEAK FLOW RATE(CFS) = 1.06

*****
***
FLOW PROCESS FROM NODE 31.00 TO NODE 11.00 IS CODE = 1
-----
----
>>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
>>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<

=====
===
TOTAL NUMBER OF STREAMS = 3
CONFLUENCE VALUES USED FOR INDEPENDENT STREAM 3 ARE:
TIME OF CONCENTRATION(MIN.) = 5.00
RAINFALL INTENSITY(INCH/HR) = 4.72
AREA-AVERAGED Fm(INCH/HR) = 0.03
AREA-AVERAGED Fp(INCH/HR) = 0.27

```

```

AREA-AVERAGED Ap = 0.10
EFFECTIVE STREAM AREA(ACRES) = 0.25
TOTAL STREAM AREA(ACRES) = 0.25
PEAK FLOW RATE(CFS) AT CONFLUENCE = 1.06

```

** CONFLUENCE DATA **

STREAM HEADWATER NUMBER	Q (CFS)	Tc (MIN.)	Intensity (INCH/HR)	Fp(Fm) (INCH/HR)	Ap	Ae (ACRES)	NODE
1	1.43	6.70	4.608	0.27 (0.05)	0.20	0.3	
10.00							
2	1.82	6.04	4.651	0.27 (0.05)	0.20	0.4	
20.00							
3	1.06	5.00	4.720	0.27 (0.03)	0.10	0.2	
30.00							

RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
CONFLUENCE FORMULA USED FOR 3 STREAMS.

** PEAK FLOW RATE TABLE **

STREAM HEADWATER NUMBER	Q (CFS)	Tc (MIN.)	Intensity (INCH/HR)	Fp(Fm) (INCH/HR)	Ap	Ae (ACRES)	NODE
1	3.68	5.00	4.720	0.27 (0.05)	0.17	0.9	
30.00							
2	4.17	6.04	4.651	0.27 (0.05)	0.18	1.0	
20.00							
3	4.27	6.70	4.608	0.27 (0.05)	0.18	1.0	
10.00							

COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:

```

PEAK FLOW RATE(CFS) =      4.27      Tc(MIN.) =      6.70
EFFECTIVE AREA(ACRES) =      1.04      AREA-AVERAGED Fm(INCH/HR) =  0.05
AREA-AVERAGED Fp(INCH/HR) =  0.27      AREA-AVERAGED Ap =  0.18
TOTAL AREA(ACRES) =      1.0
LONGEST FLOWPATH FROM NODE      10.00 TO NODE      11.00 =      275.00
ET.

```

END OF STUDY SUMMARY:

TOTAL AREA (ACRES)	=	1.0	TC (MIN.)	=	6.70
EFFECTIVE AREA (ACRES)	=	1.04	AREA-AVERAGED Fm (INCH/HR)	=	0.05
AREA-AVERAGED Fp (INCH/HR)	=	0.27	AREA-AVERAGED Ap	=	0.176
PEAK FLOW RATE (CFS)	=	4.27			

** PEAK FLOW RATE TABLE **

STREAM HEADWATER NUMBER	Q (CFS)	Tc (MIN.)	Intensity (INCH/HR)	Fp(Fm) (INCH/HR)	Ap	Ae (ACRES)	NODE
1 30.00	3.68	5.00	4.720	0.27 (0.05)	0.17	0.9	
2 20.00	4.17	6.04	4.651	0.27 (0.05)	0.18	1.0	

10.00 3 4.27 6.70 4.608 0.27 (0.05) 0.18 1.0

=====

=====

END OF RATIONAL METHOD ANALYSIS

RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
(Reference: 1986 SAN BERNARDINO CO. HYDROLOGY CRITERION)
(c) Copyright 1983-2011 Advanced Engineering Software (aes)
Ver. 18.0 Release Date: 07/01/2011 License ID 1499

Analysis prepared by:

Kimley-Horn and Associates, Inc.
765 The City Drive
Suite 200
Orange, CA 92868

***** DESCRIPTION OF STUDY

* AUTOZONE VICTORVILLE 10YR PROPOSED
*
* RA 8/3/2021
*
* AZ10P
*

*

FILE NAME: AZV10P.DAT
TIME/DATE OF STUDY: 13:36 08/03/2021

=====
===

USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:

=====
===

--*TIME-OF-CONCENTRATION MODEL*--

USER SPECIFIED STORM EVENT(YEAR) = 10.00
SPECIFIED MINIMUM PIPE SIZE(INCH) = 8.00
SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE =
1.00

USER-DEFINED TABLED RAINFALL USED

NUMBER OF [TIME,INTENSITY] DATA PAIRS = 3

1) 5.00; 2.710
2) 60.00; 0.632
3) 180.00; 0.322

ANTECEDENT MOISTURE CONDITION (AMC) II ASSUMED FOR RATIONAL METHOD

*USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW
MODEL*

MANNING		HALF- CROWN TO	STREET-CROSSFALL:			CURB	GUTTER-GEOMETRIES:		
NO.	WIDTH (FT)	CROSSFALL (FT)	IN- SIDE	OUT- / SIDE/	PARK- WAY	HEIGHT (FT)	WIDTH (FT)	LIP (FT)	HIKE (FT)
1	30.0	20.0	0.018	0.018	0.020	0.67	2.00	0.0313	0.167

0.0150

GLOBAL STREET FLOW-DEPTH CONSTRAINTS:

1. Relative Flow-Depth = 0.00 FEET
as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
 2. (Depth)*(Velocity) Constraint = 6.0 (FT*FT/S)
- *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
*USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

FLOW PROCESS FROM NODE 10.00 TO NODE 11.00 IS CODE = 21

>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
>>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<

=====

INITIAL SUBAREA FLOW-LENGTH (FEET) = 275.00
ELEVATION DATA: UPSTREAM (FEET) = 2939.11 DOWNSTREAM (FEET) = 2933.61

$T_c = K * [(LENGTH ** 3.00) / (ELEVATION CHANGE)] ** 0.20$
SUBAREA ANALYSIS USED MINIMUM T_c (MIN.) = 6.700
* 10 YEAR RAINFALL INTENSITY (INCH/HR) = 2.646
SUBAREA T_c AND LOSS RATE DATA (AMC II):

DEVELOPMENT TYPE/	SCS SOIL	AREA	F_p	A_p	SCS
LAND USE	GROUP	(ACRES)	(INCH/HR)	(DECIMAL)	CN
APARTMENTS	C	0.35	0.57	0.200	69

6.70

SUBAREA AVERAGE PERVIOUS LOSS RATE, F_p (INCH/HR) = 0.57
SUBAREA AVERAGE PERVIOUS AREA FRACTION, A_p = 0.200
SUBAREA RUNOFF (CFS) = 0.80
TOTAL AREA (ACRES) = 0.35 PEAK FLOW RATE (CFS) = 0.80

FLOW PROCESS FROM NODE 11.00 TO NODE 11.00 IS CODE = 1

```

-----
----
>>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<

=====
===
TOTAL NUMBER OF STREAMS = 3
CONFLUENCE VALUES USED FOR INDEPENDENT STREAM 1 ARE:
TIME OF CONCENTRATION(MIN.) = 6.70
RAINFALL INTENSITY(INCH/HR) = 2.65
AREA-AVERAGED Fm(INCH/HR) = 0.11
AREA-AVERAGED Fp(INCH/HR) = 0.57
AREA-AVERAGED Ap = 0.20
EFFECTIVE STREAM AREA(ACRES) = 0.35
TOTAL STREAM AREA(ACRES) = 0.35
PEAK FLOW RATE(CFS) AT CONFLUENCE = 0.80

*****
***
FLOW PROCESS FROM NODE 20.00 TO NODE 21.00 IS CODE = 21
-----
----
>>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
>>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<

=====
===
INITIAL SUBAREA FLOW-LENGTH(FEET) = 226.50
ELEVATION DATA: UPSTREAM(FEET) = 2938.78 DOWNSTREAM(FEET) =
2933.63

Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) = 6.043
* 10 YEAR RAINFALL INTENSITY(INCH/HR) = 2.671
SUBAREA Tc AND LOSS RATE DATA(AMC II):
DEVELOPMENT TYPE/ SCS SOIL AREA Fp Ap SCS
Tc
LAND USE GROUP (ACRES) (INCH/HR) (DECIMAL) CN
(MIN.)
APARTMENTS C 0.44 0.57 0.200 69
6.04
SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) = 0.57
SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap = 0.200
SUBAREA RUNOFF(CFS) = 1.01
TOTAL AREA(ACRES) = 0.44 PEAK FLOW RATE(CFS) = 1.01

*****
***
FLOW PROCESS FROM NODE 21.00 TO NODE 11.00 IS CODE = 1
-----
----
>>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<

```

```

=====
===
TOTAL NUMBER OF STREAMS = 3
CONFLUENCE VALUES USED FOR INDEPENDENT STREAM 2 ARE:
TIME OF CONCENTRATION(MIN.) = 6.04
RAINFALL INTENSITY(INCH/HR) = 2.67
AREA-AVERAGED Fm(INCH/HR) = 0.11
AREA-AVERAGED Fp(INCH/HR) = 0.57
AREA-AVERAGED Ap = 0.20
EFFECTIVE STREAM AREA(ACRES) = 0.44
TOTAL STREAM AREA(ACRES) = 0.44
PEAK FLOW RATE(CFS) AT CONFLUENCE = 1.01

*****
***
FLOW PROCESS FROM NODE 30.00 TO NODE 31.00 IS CODE = 22
-----
----
>>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
>>>>>USE SPECIFIED Tc VALUE FOR INITIAL SUBAREA<<<

=====
===
INITIAL SUBAREA FLOW-LENGTH(FEET) = 226.50
USER SPECIFIED Tc(MIN.) = 5.000
* 10 YEAR RAINFALL INTENSITY(INCH/HR) = 2.710
SUBAREA LOSS RATE DATA(AMC II):
DEVELOPMENT TYPE/ SCS SOIL AREA Fp Ap SCS
LAND USE GROUP (ACRES) (INCH/HR) (DECIMAL) CN
COMMERCIAL C 0.25 0.57 0.100 69
SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) = 0.57
SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap = 0.100
SUBAREA RUNOFF(CFS) = 0.60
TOTAL AREA(ACRES) = 0.25 PEAK FLOW RATE(CFS) = 0.60

*****
***
FLOW PROCESS FROM NODE 31.00 TO NODE 11.00 IS CODE = 1
-----
----
>>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
>>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<

=====
===
TOTAL NUMBER OF STREAMS = 3
CONFLUENCE VALUES USED FOR INDEPENDENT STREAM 3 ARE:
TIME OF CONCENTRATION(MIN.) = 5.00
RAINFALL INTENSITY(INCH/HR) = 2.71
AREA-AVERAGED Fm(INCH/HR) = 0.06
AREA-AVERAGED Fp(INCH/HR) = 0.57

```

AREA-AVERAGED $A_p = 0.10$
 EFFECTIVE STREAM AREA(ACRES) = 0.25
 TOTAL STREAM AREA(ACRES) = 0.25
 PEAK FLOW RATE(CFS) AT CONFLUENCE = 0.60

** CONFLUENCE DATA **

STREAM	Q	Tc	Intensity	Fp(Fm)	Ap	Ae	
NUMBER	(CFS)	(MIN.)	(INCH/HR)	(INCH/HR)		(ACRES)	NODE
1	0.80	6.70	2.646	0.57(0.11)	0.20	0.3	
2	1.01	6.04	2.671	0.57(0.11)	0.20	0.4	
3	0.60	5.00	2.710	0.57(0.06)	0.10	0.2	

RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
 CONFLUENCE FORMULA USED FOR 3 STREAMS.

** PEAK FLOW RATE TABLE **

STREAM	Q	Tc	Intensity	Fp(Fm)	Ap	Ae	
NUMBER	(CFS)	(MIN.)	(INCH/HR)	(INCH/HR)		(ACRES)	NODE
1	2.06	5.00	2.710	0.57(0.10)	0.17	0.9	
2	2.33	6.04	2.671	0.57(0.10)	0.18	1.0	
3	2.38	6.70	2.646	0.57(0.10)	0.18	1.0	

COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
 PEAK FLOW RATE(CFS) = 2.38 Tc(MIN.) = 6.70
 EFFECTIVE AREA(ACRES) = 1.04 AREA-AVERAGED Fm(INCH/HR) = 0.10
 AREA-AVERAGED Fp(INCH/HR) = 0.57 AREA-AVERAGED $A_p = 0.18$
 TOTAL AREA(ACRES) = 1.0
 LONGEST FLOWPATH FROM NODE 10.00 TO NODE 11.00 = 275.00 FEET.

=====

END OF STUDY SUMMARY:
 TOTAL AREA(ACRES) = 1.0 TC(MIN.) = 6.70
 EFFECTIVE AREA(ACRES) = 1.04 AREA-AVERAGED Fm(INCH/HR) = 0.10
 AREA-AVERAGED Fp(INCH/HR) = 0.57 AREA-AVERAGED $A_p = 0.176$
 PEAK FLOW RATE(CFS) = 2.38

** PEAK FLOW RATE TABLE **

STREAM	Q	Tc	Intensity	Fp(Fm)	Ap	Ae	
NUMBER	(CFS)	(MIN.)	(INCH/HR)	(INCH/HR)		(ACRES)	NODE
1	2.06	5.00	2.710	0.57(0.10)	0.17	0.9	
2	2.33	6.04	2.671	0.57(0.10)	0.18	1.0	

10.00 3 2.38 6.70 2.646 0.57 (0.10) 0.18 1.0

=====

=====

END OF RATIONAL METHOD ANALYSIS

Appendix D: Reports

Full Report

Project Summary

Title	AutoZone Victorville 100- year
Engineer	
Company	Kimley-Horn and Associates, Inc.
Date	8/2/2021

Notes

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Full Report

Subsection: User Notifications

User Notifications?	No user notifications generated.
---------------------	----------------------------------

Full Report

Subsection: Master Network Summary

Catchments Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ft ³)	Time to Peak (hours)	Peak Flow (ft ³ /s)
1	Base	0	12,349.000	14.400	4.29000

Node Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ft ³)	Time to Peak (hours)	Peak Flow (ft ³ /s)
O-7	Base	0	4,083.000	14.400	3.53452

Pond Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ft ³)	Time to Peak (hours)	Peak Flow (ft ³ /s)	Maximum Water Surface Elevation (ft)	Maximum Pond Storage (ft ³)
Det-1 (IN)	Base	0	12,229.000	14.400	4.29000	(N/A)	(N/A)
Det-1 (OUT)	Base	0	4,083.000	14.400	3.53452	2.489	1,561.000

Full Report

Subsection: Read Hydrograph
Label: 1

Scenario: Base

Peak Discharge	4.29000 ft ³ /s
Time to Peak	14.400 hours
Hydrograph Volume	12,349.455 ft ³

HYDROGRAPH ORDINATES (ft³/s)

Output Time Increment = 0.100 hours

Time on left represents time for first value in each row.

Time (hours)	Flow (ft ³ /s)	Flow (ft ³ /s)	Flow (ft ³ /s)	Flow (ft ³ /s)	Flow (ft ³ /s)
0.000	0.00000	0.04000	0.04000	0.04000	0.04000
0.500	0.04000	0.04000	0.04000	0.04000	0.05000
1.000	0.05000	0.05000	0.05000	0.05000	0.05000
1.500	0.05000	0.05000	0.05000	0.05000	0.05000
2.000	0.05000	0.05000	0.05000	0.05000	0.05000
2.500	0.05000	0.05000	0.05000	0.05000	0.05000
3.000	0.05000	0.05000	0.05000	0.05000	0.05000
3.500	0.05000	0.05000	0.05000	0.05000	0.05000
4.000	0.05000	0.05000	0.05000	0.05000	0.05000
4.500	0.05000	0.05000	0.05000	0.06000	0.06000
5.000	0.06000	0.06000	0.06000	0.06000	0.06000
5.500	0.06000	0.06000	0.06000	0.06000	0.06000
6.000	0.06000	0.06000	0.06000	0.06000	0.06000
6.500	0.06000	0.06000	0.06000	0.06000	0.06000
7.000	0.06000	0.07000	0.07000	0.07000	0.07000
7.500	0.07000	0.07000	0.07000	0.07000	0.07000
8.000	0.07000	0.07000	0.07000	0.07000	0.07000
8.500	0.07000	0.08000	0.08000	0.08000	0.08000
9.000	0.08000	0.08000	0.08000	0.08000	0.08000
9.500	0.08000	0.08000	0.08000	0.09000	0.09000
10.000	0.09000	0.09000	0.09000	0.09000	0.09000
10.500	0.10000	0.10000	0.10000	0.10000	0.10000
11.000	0.10000	0.10000	0.10000	0.11000	0.11000
11.500	0.11000	0.11000	0.12000	0.12000	0.12000
12.000	0.13000	0.13000	0.13000	0.13000	0.14000
12.500	0.14000	0.14000	0.14000	0.15000	0.15000
13.000	0.16000	0.17000	0.18000	0.19000	0.20000
13.500	0.21000	0.24000	0.25000	0.20000	0.21000
14.000	0.27000	0.47000	1.02000	1.47000	4.29000
14.500	0.79000	0.24000	0.27000	0.23000	0.20000
15.000	0.17000	0.16000	0.15000	0.15000	0.14000
15.500	0.13000	0.12000	0.12000	0.11000	0.11000
16.000	0.10000	0.10000	0.10000	0.10000	0.09000
16.500	0.09000	0.09000	0.09000	0.08000	0.08000
17.000	0.08000	0.08000	0.08000	0.07000	0.07000
17.500	0.07000	0.07000	0.07000	0.07000	0.07000
18.000	0.07000	0.06000	0.06000	0.06000	0.06000

Full Report

Subsection: Read Hydrograph

Scenario: Base

Label: 1

HYDROGRAPH ORDINATES (ft³/s)

Output Time Increment = 0.100 hours

Time on left represents time for first value in each row.

Time (hours)	Flow (ft ³ /s)	Flow (ft ³ /s)	Flow (ft ³ /s)	Flow (ft ³ /s)	Flow (ft ³ /s)
18.500	0.06000	0.06000	0.06000	0.06000	0.06000
19.000	0.06000	0.06000	0.06000	0.05000	0.05000
19.500	0.05000	0.05000	0.05000	0.05000	0.05000
20.000	0.05000	0.05000	0.05000	0.05000	0.05000
20.500	0.05000	0.05000	0.05000	0.05000	0.05000
21.000	0.05000	0.05000	0.04000	0.04000	0.04000
21.500	0.04000	0.00000	0.39528	0.38987	0.38987
22.000	0.38987	0.38445	0.37904	0.37904	0.37904
22.500	0.37362	0.36821	0.36279	0.35738	0.35738
23.000	0.35738	0.35196	0.34655	0.34655	0.34655
23.500	0.34655	0.34655	0.34113	0.33572	0.33572
24.000	0.33572	0.16786	0.00000	(N/A)	(N/A)

Full Report

Subsection: Time vs. Elevation

Scenario: Base

Label: Det-1 (IN)

Time vs. Elevation (ft)

Output Time increment = 0.050 hours

Time on left represents time for first value in each row.

Time (hours)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)
0.000	0.000	0.004	0.014	0.026	0.037
0.250	0.046	0.054	0.061	0.067	0.072
0.500	0.077	0.081	0.085	0.088	0.090
0.750	0.093	0.095	0.097	0.101	0.106
1.000	0.110	0.113	0.116	0.118	0.121
1.250	0.122	0.124	0.126	0.127	0.128
1.500	0.129	0.130	0.130	0.131	0.132
1.750	0.132	0.133	0.133	0.133	0.133
2.000	0.134	0.134	0.134	0.134	0.134
2.250	0.134	0.135	0.135	0.135	0.135
2.500	0.135	0.135	0.135	0.135	0.135
2.750	0.135	0.135	0.135	0.135	0.135
3.000	0.135	0.135	0.135	0.135	0.135
3.250	0.135	0.135	0.135	0.135	0.135
3.500	0.135	0.135	0.135	0.135	0.135
3.750	0.135	0.135	0.135	0.135	0.135
4.000	0.135	0.135	0.135	0.135	0.135
4.250	0.135	0.135	0.135	0.135	0.135
4.500	0.135	0.135	0.135	0.135	0.135
4.750	0.136	0.139	0.142	0.144	0.147
5.000	0.149	0.151	0.152	0.153	0.155
5.250	0.156	0.156	0.157	0.158	0.158
5.500	0.159	0.159	0.160	0.160	0.160
5.750	0.161	0.161	0.161	0.161	0.161
6.000	0.162	0.162	0.162	0.162	0.162
6.250	0.162	0.162	0.162	0.162	0.162
6.500	0.162	0.162	0.162	0.162	0.162
6.750	0.162	0.162	0.162	0.162	0.162
7.000	0.162	0.163	0.166	0.169	0.171
7.250	0.174	0.176	0.178	0.179	0.180
7.500	0.182	0.183	0.184	0.184	0.185
7.750	0.186	0.186	0.186	0.187	0.187
8.000	0.187	0.188	0.188	0.188	0.188
8.250	0.188	0.189	0.189	0.189	0.189
8.500	0.189	0.190	0.192	0.196	0.198
8.750	0.201	0.203	0.205	0.207	0.209
9.000	0.211	0.213	0.215	0.218	0.220
9.250	0.222	0.224	0.226	0.228	0.230
9.500	0.232	0.234	0.235	0.237	0.239
9.750	0.242	0.247	0.252	0.257	0.263
10.000	0.268	0.273	0.279	0.284	0.289

Full Report

Subsection: Time vs. Elevation

Scenario: Base

Label: Det-1 (IN)

Time vs. Elevation (ft)

Output Time increment = 0.050 hours

Time on left represents time for first value in each row.

Time (hours)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)
10.250	0.294	0.299	0.304	0.309	0.315
10.500	0.323	0.331	0.340	0.348	0.356
10.750	0.365	0.373	0.381	0.389	0.397
11.000	0.405	0.412	0.420	0.427	0.435
11.250	0.443	0.453	0.463	0.474	0.484
11.500	0.495	0.505	0.516	0.527	0.539
11.750	0.553	0.566	0.579	0.593	0.606
12.000	0.621	0.637	0.652	0.667	0.683
12.250	0.698	0.713	0.729	0.746	0.764
12.500	0.782	0.800	0.817	0.833	0.850
12.750	0.867	0.886	0.905	0.925	0.945
13.000	0.966	0.989	1.012	1.037	1.063
13.250	1.090	1.118	1.148	1.179	1.211
13.500	1.243	1.278	1.317	1.359	1.402
13.750	1.440	1.471	1.499	1.529	1.563
14.000	1.605	1.662	1.745	1.874	2.043
14.250	2.171	2.232	2.335	2.489	2.464
14.500	2.269	2.141	2.082	2.045	2.036
14.750	2.034	2.030	2.026	2.023	2.019
15.000	2.016	2.014	2.012	2.011	2.010
15.250	2.009	2.009	2.008	2.008	2.006
15.500	2.005	2.004	2.003	2.003	2.002
15.750	2.002	2.001	2.000	2.000	2.000
16.000	1.998	1.995	1.993	1.991	1.988
16.250	1.986	1.984	1.981	1.977	1.972
16.500	1.967	1.962	1.958	1.953	1.948
16.750	1.943	1.937	1.930	1.922	1.915
17.000	1.908	1.902	1.895	1.888	1.881
17.250	1.874	1.865	1.856	1.846	1.837
17.500	1.828	1.819	1.810	1.801	1.792
17.750	1.783	1.774	1.765	1.756	1.747
18.000	1.738	1.728	1.717	1.706	1.695
18.250	1.683	1.672	1.661	1.650	1.639
18.500	1.628	1.617	1.606	1.595	1.584
18.750	1.573	1.561	1.550	1.540	1.529
19.000	1.518	1.507	1.496	1.486	1.475
19.250	1.464	1.451	1.438	1.425	1.412
19.500	1.399	1.386	1.372	1.359	1.346
19.750	1.333	1.320	1.307	1.294	1.281
20.000	1.269	1.256	1.243	1.231	1.218
20.250	1.206	1.193	1.181	1.168	1.155

Full Report

Subsection: Time vs. Elevation

Scenario: Base

Label: Det-1 (IN)

Time vs. Elevation (ft)

Output Time increment = 0.050 hours

Time on left represents time for first value in each row.

Time (hours)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)
20.500	1.143	1.130	1.118	1.106	1.093
20.750	1.081	1.069	1.057	1.045	1.033
21.000	1.021	1.009	0.998	0.985	0.970
21.250	0.955	0.940	0.925	0.911	0.896
21.500	0.881	0.864	0.840	0.844	0.909
21.750	1.003	1.092	1.181	1.266	1.349
22.000	1.431	1.510	1.588	1.663	1.735
22.250	1.807	1.876	1.944	2.008	2.044
22.500	2.054	2.056	2.056	2.056	2.055
22.750	2.055	2.054	2.054	2.054	2.054
23.000	2.054	2.054	2.053	2.053	2.052
23.250	2.052	2.051	2.051	2.051	2.051
23.500	2.051	2.051	2.051	2.051	2.051
23.750	2.050	2.050	2.049	2.049	2.049
24.000	2.049	(N/A)	(N/A)	(N/A)	(N/A)

Full Report

Subsection: Time vs. Volume

Scenario: Base

Label: Det-1

Time vs. Volume (ft³)

Output Time increment = 0.050 hours

Time on left represents time for first value in each row.

Time (hours)	Volume (ft ³)	Volume (ft ³)	Volume (ft ³)	Volume (ft ³)	Volume (ft ³)
0.000	0.000	2.000	6.000	12.000	17.000
0.250	22.000	25.000	29.000	32.000	34.000
0.500	36.000	38.000	40.000	41.000	43.000
0.750	44.000	45.000	46.000	48.000	50.000
1.000	52.000	54.000	55.000	56.000	57.000
1.250	58.000	59.000	60.000	60.000	61.000
1.500	61.000	62.000	62.000	62.000	63.000
1.750	63.000	63.000	63.000	63.000	63.000
2.000	64.000	64.000	64.000	64.000	64.000
2.250	64.000	64.000	64.000	64.000	64.000
2.500	64.000	64.000	64.000	64.000	64.000
2.750	64.000	64.000	64.000	64.000	64.000
3.000	64.000	64.000	64.000	64.000	64.000
3.250	64.000	64.000	64.000	64.000	64.000
3.500	64.000	64.000	64.000	64.000	64.000
3.750	64.000	64.000	64.000	64.000	64.000
4.000	64.000	64.000	64.000	64.000	64.000
4.250	64.000	64.000	64.000	64.000	64.000
4.500	64.000	64.000	64.000	64.000	64.000
4.750	65.000	66.000	67.000	69.000	70.000
5.000	71.000	72.000	72.000	73.000	74.000
5.250	74.000	75.000	75.000	75.000	76.000
5.500	76.000	76.000	76.000	76.000	76.000
5.750	77.000	77.000	77.000	77.000	77.000
6.000	77.000	77.000	77.000	77.000	77.000
6.250	77.000	77.000	77.000	77.000	77.000
6.500	77.000	77.000	77.000	77.000	77.000
6.750	77.000	77.000	77.000	77.000	77.000
7.000	77.000	78.000	79.000	81.000	82.000
7.250	83.000	84.000	85.000	86.000	86.000
7.500	87.000	87.000	88.000	88.000	88.000
7.750	89.000	89.000	89.000	89.000	90.000
8.000	90.000	90.000	90.000	90.000	90.000
8.250	90.000	90.000	90.000	90.000	90.000
8.500	90.000	91.000	92.000	94.000	95.000
8.750	96.000	97.000	98.000	99.000	100.000
9.000	101.000	102.000	103.000	104.000	105.000
9.250	106.000	107.000	108.000	109.000	110.000
9.500	111.000	112.000	113.000	114.000	115.000
9.750	117.000	119.000	122.000	124.000	127.000
10.000	130.000	132.000	135.000	137.000	140.000

Full Report

Subsection: Time vs. Volume
Label: Det-1

Scenario: Base

Time vs. Volume (ft³)

Output Time increment = 0.050 hours

Time on left represents time for first value in each row.

Time (hours)	Volume (ft ³)	Volume (ft ³)	Volume (ft ³)	Volume (ft ³)	Volume (ft ³)
10.250	143.000	145.000	148.000	150.000	153.000
10.500	157.000	161.000	166.000	170.000	174.000
10.750	178.000	183.000	187.000	191.000	195.000
11.000	199.000	203.000	207.000	211.000	215.000
11.250	219.000	224.000	230.000	235.000	241.000
11.500	246.000	252.000	257.000	263.000	270.000
11.750	277.000	284.000	291.000	298.000	306.000
12.000	314.000	322.000	331.000	339.000	348.000
12.250	356.000	364.000	373.000	383.000	393.000
12.500	403.000	413.000	423.000	432.000	442.000
12.750	452.000	463.000	474.000	485.000	497.000
13.000	509.000	523.000	537.000	551.000	567.000
13.250	583.000	601.000	619.000	638.000	658.000
13.500	678.000	700.000	725.000	751.000	779.000
13.750	803.000	824.000	842.000	862.000	885.000
14.000	913.000	951.000	1,008.000	1,099.000	1,221.000
14.250	1,316.000	1,362.000	1,441.000	1,561.000	1,542.000
14.500	1,390.000	1,294.000	1,249.000	1,222.000	1,216.000
14.750	1,214.000	1,211.000	1,208.000	1,206.000	1,204.000
15.000	1,201.000	1,199.000	1,198.000	1,197.000	1,197.000
15.250	1,196.000	1,196.000	1,196.000	1,195.000	1,194.000
15.500	1,193.000	1,193.000	1,192.000	1,191.000	1,191.000
15.750	1,191.000	1,190.000	1,190.000	1,190.000	1,189.000
16.000	1,188.000	1,186.000	1,184.000	1,183.000	1,181.000
16.250	1,179.000	1,178.000	1,176.000	1,172.000	1,169.000
16.500	1,166.000	1,162.000	1,159.000	1,155.000	1,152.000
16.750	1,148.000	1,144.000	1,138.000	1,133.000	1,128.000
17.000	1,123.000	1,118.000	1,114.000	1,109.000	1,104.000
17.250	1,099.000	1,092.000	1,086.000	1,079.000	1,073.000
17.500	1,067.000	1,060.000	1,054.000	1,048.000	1,041.000
17.750	1,035.000	1,028.000	1,022.000	1,016.000	1,010.000
18.000	1,003.000	997.000	989.000	981.000	974.000
18.250	966.000	958.000	951.000	943.000	936.000
18.500	928.000	921.000	913.000	906.000	898.000
18.750	891.000	884.000	876.000	869.000	862.000
19.000	855.000	847.000	840.000	833.000	826.000
19.250	819.000	811.000	802.000	794.000	785.000
19.500	777.000	768.000	760.000	751.000	743.000
19.750	735.000	726.000	718.000	710.000	702.000
20.000	694.000	686.000	678.000	670.000	662.000
20.250	655.000	647.000	639.000	631.000	623.000

Full Report

Subsection: Time vs. Volume

Scenario: Base

Label: Det-1

Time vs. Volume (ft³)

Output Time increment = 0.050 hours

Time on left represents time for first value in each row.

Time (hours)	Volume (ft ³)	Volume (ft ³)	Volume (ft ³)	Volume (ft ³)	Volume (ft ³)
20.500	616.000	608.000	600.000	593.000	586.000
20.750	578.000	571.000	564.000	556.000	549.000
21.000	542.000	535.000	528.000	520.000	512.000
21.250	503.000	494.000	485.000	477.000	468.000
21.500	460.000	450.000	436.000	438.000	476.000
21.750	531.000	585.000	639.000	692.000	745.000
22.000	798.000	850.000	902.000	952.000	1,002.000
22.250	1,052.000	1,100.000	1,149.000	1,195.000	1,222.000
22.500	1,229.000	1,230.000	1,231.000	1,230.000	1,230.000
22.750	1,230.000	1,229.000	1,229.000	1,229.000	1,229.000
23.000	1,229.000	1,229.000	1,228.000	1,228.000	1,227.000
23.250	1,227.000	1,227.000	1,227.000	1,227.000	1,227.000
23.500	1,227.000	1,227.000	1,227.000	1,227.000	1,227.000
23.750	1,226.000	1,226.000	1,225.000	1,225.000	1,225.000
24.000	1,225.000	(N/A)	(N/A)	(N/A)	(N/A)

Full Report

Subsection: Outlet Input Data

Scenario: Base

Label: 1

Requested Pond Water Surface Elevations

Minimum (Headwater)	0.000 ft
Increment (Headwater)	0.200 ft
Maximum (Headwater)	3.000 ft

Outlet Connectivity

Structure Type	Outlet ID	Direction	Outfall	E1 (ft)	E2 (ft)
Orifice-Circular	Orifice - 1	Forward	TW	2.000	3.000
Rectangular Weir	Weir - 1	Forward	TW	2.000	3.000
Tailwater Settings	Tailwater			(N/A)	(N/A)

Full Report

Subsection: Outlet Input Data

Scenario: Base

Label: 1

Structure ID: Weir - 1	
Structure Type: Rectangular Weir	
Number of Openings	1
Elevation	2.000 ft
Weir Length	4.75 ft
Weir Coefficient	2.00 (ft ^{0.5})/s
Structure ID: Orifice - 1	
Structure Type: Orifice-Circular	
Number of Openings	1
Elevation	2.000 ft
Orifice Diameter	4.00 in
Orifice Coefficient	0.600
Structure ID: TW	
Structure Type: TW Setup, DS Channel	
Tailwater Type	Free Outfall
Convergence Tolerances	
Maximum Iterations	30
Tailwater Tolerance (Minimum)	0.010 ft
Tailwater Tolerance (Maximum)	0.500 ft
Headwater Tolerance (Minimum)	0.010 ft
Headwater Tolerance (Maximum)	0.500 ft
Flow Tolerance (Minimum)	0.001 ft ³ /s
Flow Tolerance (Maximum)	10.000 ft ³ /s

Full Report

Subsection: Elevation-Volume-Flow Table (Pond)

Scenario: Base

Label: Det-1

Infiltration	
Infiltration Method (Computed)	Average Infiltration Rate
Infiltration Rate (Average)	6.5000 in/h
Initial Conditions	
Elevation (Water Surface, Initial)	0.000 ft
Volume (Initial)	0.000 ft ³
Flow (Initial Outlet)	0.00000 ft ³ /s
Flow (Initial Infiltration)	0.00000 ft ³ /s
Flow (Initial, Total)	0.00000 ft ³ /s
Time Increment	0.050 hours

Elevation (ft)	Outflow (ft ³ /s)	Storage (ft ³)	Area (ft ²)	Infiltration (ft ³ /s)	Flow (Total) (ft ³ /s)	2S/t + O (ft ³ /s)
0.000	0.00000	0.000	467	0.00000	0.00000	0.00000
0.200	0.00000	95.817	491	0.07392	0.07392	1.13855
0.400	0.00000	196.549	516	0.07766	0.07766	2.26154
0.600	0.00000	302.320	542	0.08150	0.08150	3.44061
0.800	0.00000	413.252	568	0.08543	0.08543	4.67712
1.000	0.00000	529.469	595	0.08945	0.08945	5.97244
1.200	0.00000	650.917	620	0.09330	0.09330	7.32570
1.400	0.00000	777.531	646	0.09722	0.09722	8.73645
1.600	0.00000	909.419	673	0.10123	0.10123	10.20588
1.800	0.00000	1,046.689	700	0.10532	0.10532	11.73520
2.000	0.00000	1,189.448	728	0.10949	0.10949	13.32558
2.200	0.91803	1,337.668	755	0.11354	1.03156	15.89455
2.400	2.60622	1,491.314	782	0.11766	2.72387	19.29403
2.600	4.69169	1,650.484	810	0.12185	4.81354	23.15224
2.800	7.13191	1,815.274	838	0.12611	7.25802	27.42773
3.000	9.88342	1,985.782	867	0.13045	10.01387	32.07812

Full Report

Subsection: Pond Infiltration Calculations

Scenario: Base

Label: Det-1 (IN)

Average Infiltration Rating Table

Elevation (Water Surface) (ft)	Area (Total) (ft ²)	Flow (Infiltration) (ft ³ /s)
0.000	467.0	0.00000
0.200	491.3	0.07392
0.400	516.2	0.07766
0.600	541.7	0.08150
0.800	567.8	0.08543
1.000	594.5	0.08945
1.200	620.1	0.09330
1.400	646.2	0.09722
1.600	672.8	0.10123
1.800	700.0	0.10532
2.000	727.7	0.10949
2.200	754.6	0.11354
2.400	782.0	0.11766
2.600	809.8	0.12185
2.800	838.2	0.12611
3.000	867.0	0.13045

Full Report

Subsection: Level Pool Pond Routing Summary
Label: Det-1 (IN)

Scenario: Base

Infiltration				
Infiltration Method (Computed)		Average Infiltration Rate		
Infiltration Rate (Average)		6.5000 in/h		
Initial Conditions				
Elevation (Water Surface, Initial)		0.000 ft		
Volume (Initial)		0.000 ft³		
Flow (Initial Outlet)		0.00000 ft³/s		
Flow (Initial Infiltration)		0.00000 ft³/s		
Flow (Initial, Total)		0.00000 ft³/s		
Time Increment		0.050 hours		
Inflow/Outflow Hydrograph Summary				
Flow (Peak In)		4.29000 ft³/s	Time to Peak (Flow, In)	14.400 hours
Infiltration (Peak)		0.11952 ft³/s	Time to Peak (Infiltration)	14.400 hours
Flow (Peak Outlet)		3.53452 ft³/s	Time to Peak (Flow, Outlet)	14.400 hours
Peak Conditions				
Elevation (Water Surface, Peak)		2.489 ft		
Volume (Peak)		1,561.477 ft³		
Mass Balance (ft³)				
Volume (Initial)		0.000 ft³		
Volume (Total Inflow)		12,229.000 ft³		
Volume (Total Infiltration)		6,940.000 ft³		
Volume (Total Outlet Outflow)		4,083.000 ft³		
Volume (Retained)		1,186.000 ft³		
Volume (Unrouted)		-20.000 ft³		
Error (Mass Balance)		0.2 %		

Full Report

Subsection: Pond Inflow Summary

Scenario: Base

Label: Det-1 (IN)

Summary for Hydrograph Addition at 'Det-1'

Upstream Link	Upstream Node
<Catchment to Outflow Node>	1

Node Inflows

Inflow Type	Element	Volume (ft ³)	Time to Peak (hours)	Flow (Peak) (ft ³ /s)
Flow (From)	1	12,349.455	14.400	4.29000
Flow (In)	Det-1	12,228.596	14.400	4.29000

Full Report

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Scenario Calculation Summary

Scenario Summary	
ID	1
Label	Base
Notes	
Active Topology	Base Active Topology
Hydrology	Base Hydrology
Rainfall Runoff	Base Rainfall Runoff
Physical	Base Physical
Initial Condition	Base Initial Condition
Boundary Condition	Base Boundary Condition
Infiltration and Inflow	Base Infiltration and Inflow
Output	Base Output
User Data Extensions	Base User Data Extensions
PondPack Engine Calculation Options	Base Calculation Options

Output Summary			
Output Increment	0.050 hours	Duration	24.000 hours

Rainfall Summary			
Return Event Tag		Rainfall Type	(N/A)
Total Depth	(N/A) in	Storm Event	(N/A)

Executive Summary (Nodes)

Label	Scenario	Return Event (years)	Truncation	Hydrograph Volume (ft³)	Time to Peak (hours)	Peak Flow (ft³/s)	Maximum Water Surface Elevation (ft)	Maximum Pond Storage (ft³)
1	Base	0	None	12,349.000	14.400	4.29000	(N/A)	(N/A)
Det-1 (IN)	Base	0	None	12,229.000	14.400	4.29000	(N/A)	(N/A)
Det-1 (OUT)	Base	0	None	4,083.000	14.400	3.53452	2.489	1,561.000
O-7	Base	0	None	4,083.000	14.400	3.53452	(N/A)	(N/A)

Executive Summary (Links)

Label	Type	Location	Hydrograph Volume (ft³)	Peak Time (hours)	Peak Flow (ft³/s)	End Point	Node Flow Direction
Outlet-6	Pond Outlet	Upstream	12,229.000	14.400	4.29000	Det-1	Pond Inflow
Outlet-6	Pond Outlet	Outflow	4,083.000	14.400	3.53452	Det-1	Pond Outflow
Outlet-6	Pond Outlet	Link	4,083.000	14.400	3.53452		
Outlet-6	Pond Outlet	Downstream	4,083.000	14.400	3.53452	O-7	