Appendix E

Hydrology Memorandum

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To: Andrew Simmons | City Engineer | City of Coachella

From: Alta Planning + Design

Date: January 16, 2024

Re: Connecting Coachella Hydrology Memorandum

Abbreviations and Acronyms

Throughout the content of this memo and for the project duration, there are several acronyms and abbreviations that are used. They are as follows:

ADA	Americans with Disabilities Act
A_S	Minimum permeable pavement surface area required
A_{IMP}	Impervious Area
A_T	Tributary Area
BMPs	Best Management Practices
b_{TH}	Minimum reservoir layer depth
City	City of Coachella
CV	Coachella Valley
CWA	Clean Water Act
I_f	Effective Impervious Fraction
LID	Low Impact Development
LID Design Handbook	Riverside County Flood Control Water Conservation District Whitewater River Region Stormwater Quality Best Management Practice Design Handbook for Low Impact Development (2014)
MS4	Municipal Separate Storm Sewer System
POC	Pollutants of Concern
PPOC	Potential Project Pollutants of Concern
SRA	Self-Retaining Areas
STA	Self-Treating Areas
V_{BMP}	Design Capture Volume (or water quality stormwater volume)
WQMP	Water Quality Management Plan
WWR WQMP	Whitewater River Region Water Quality Management Plan Guidance Document (2014, Revised 2015)

Introduction and Project Goals

Connecting Coachella is a 7.6-mile project located in the city of Coachella in Riverside County and is funded by the California Drought, Water, Parks, Climate, Coastal Protection, and Outdoor Access for Act of 2018 - Proposition 68 Grant Program. This project aims to enhance the surrounding communities and tribal areas, by providing safer non-motorized opportunities for users to circulate withing the city. The project will create 3.6 miles of a Class I multi-modal path, 2.6 miles (5.2 lane miles) of Class II bike lanes, 1.4 miles of concrete sidewalk, as well as connect the CV Link path users from the Avenue 54/Whitewater River Trailhead through the City to the proposed Arts and Music Line Path. Safety enhancements include:

- ADA curb ramp upgrades

- Enhanced traffic signals
- High visibility crosswalks
- Landscape buffers
- Lighted bollards
- Shade trees
- Shade Structures

Additional corridor amenities that will be incorporated include benches, drinking fountains, bicycle repair kiosks, waste receptacles, and artistic installations along the new pathway.

The purpose of this memorandum is to identify mitigation opportunities for water quality impacts of the proposed Class I multimodal path along Grapefruit Boulevard and to make recommendations for BMP implementation.

Existing Conditions

Topography & Hydrology

The project vicinity is an urbanized area with a population of approximately forty-two thousand. Although the area is urbanized, a significant portion of the land on which the corridor is being built is undeveloped. The remaining segment of the corridor runs adjacent to a mixture of industrial and commercial facilities.

This project is located within the Whitewater River watershed which consists of mountains, desert, and agricultural lands, with urbanized areas spanning the valley from Palm Springs to Coachella and Banning to Indio along State Highway 111 and Interstate 10, respectively. The Whitewater River runs from Mount San Gorgonio to the Salton Sea and is fed by several tributaries. These tributaries are San Gorgonio River and the Snow, Chino Canyon, Tahquitz, Palm Canyon, Deep Canyon, Mission, Big Morongo, and Little Morongo Creeks.

The general lay of the land in Coachella is relatively flat and slopes southeast towards the Salton Sea. The project corridor, Grapefruit Boulevard from Avenue 48 to Avenue 54, runs parallel to the Whitewater River before it crosses State Highway 111 and eventually discharges into the Salton Sea. Contours from survey shows that runoff from rainfall generally flows from the center of the roadway to the east into adjacent ditches that lead to shallow drainage culverts that run parallel to Grapefruit Boulevard. In some instances, the runoff sheet flows into depressed areas of the undeveloped land between Grapefruit Boulevard and the railroad tracks. Other sections of the corridor convey runoff via concrete curb and gutter and eventually discharges into the undeveloped land. There are no visible catch basins along the east side of the corridor to catch concentrated runoff flow.

The project area generally experiences low precipitation. However, heavy single event storms and prolonged precipitation during the spring months can cause flooding when heavy rains combine with the melting of the snowpack. In addition, thunderstorms that generally occur during the warmer months can produce short bursts of precipitation resulting in flooding.

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Project Analysis

Project Design Standards and Guidelines

Located in the Whitewater Watershed, this project utilizes the 2014 *River County Stormwater Quality Best Management Practice Design Handbook for Low Impact Development (LID Design Handbook)*. The purpose of the LID Design Handbook is to provide guidance for selecting and designing stormwater Best Manage Practices (BMPs) for Priority Development Projects (PDPs) and is to be used in conjunction with the *Whitewater River Region Water Quality Management Plan Guidance Document (2014, Revised 2015)* (WWR WQMP) and the 2013 MS4 Permit. However, this project is not categorized as a PDP in the WWR WQMP and is therefore, exempt from PDP requirements, including but not limited to the preparation of a project-specific WQMP. For the purpose of this memorandum, this project will be regarded and treated as a PDP throughout the entirety of this document.

Per Table 4 in section 6.1 of the LID Design Handbook, our project's location is subject to a local onsite retention requirement, which would require 100% retention of 100-yr, 24-hr storm event and no additional LID/site design or treatment control BMPs would be required. However, per section 3.5.1.2 of the WWR WQMP, our project is exempt from said onsite retention of urban runoff, because the project is located adjacent to an existing MS4 facility. Hence, the project will adhere to the LID Design Handbook guidance for selecting and designing the appropriate BMPs to address Potential Project Pollutants of Concern (PPOC).

BMP Selection

The selection of BMPs for this project were based on the potential pollutants generated from the project site, how impactful the potential pollutants are to the receiving waters and the BMPs' effectiveness in addressing the potential pollutants. Table 1 in Appendix A was used to identify the potential pollutants generated by land use. Although this project does not fit the land use categories listed in the table, given the nature of the project, all potential pollutants were considered.

The WWR WQMP identifies this project's receiving water as the Coachella Valley Stormwater Channel as seen in Appendix B and C. Section 3.3 of the LID Design Handbook states that where the Potential Project Pollutants of Concern (PPPOC) is the same as a Pollutant Impairing Receiving Waters, then the pollutant must be addressed with an LID/site design BMP that has a medium to high removal efficiency. This was determined using the BMP selection Matrix in Table 2 of section 3.4 of the LID Design Handbook (see Appendix D). The infiltration BMPs Bioretention Filtration and Permeable Pavement BMPs were determined to be the appropriate BMPs to implement along the project's class I multimodal path.

Permeable Pavement BMP (STA. 10+34 to STA. 76+75)

Permeable pavements are surfaces that are made up of porous material (permeable concrete, asphalt, or modular block) that allows water to infiltrate into a stone reservoir layer below. This reservoir temporarily stores the water quality stormwater volume or design capture volume (V_{BMP}), allowing it to slowly infiltrate into the underlying soil, provided that the soil can accept infiltration. For optimal functionality, permeable pavement surfaces are best suited for flat or gently sloping areas, generally with profile grades less than 3% in accordance with the LID Design Handbook. If the multi-modal path profile grades exceed the recommended standards and the native soil has poor infiltration capacity, as determined by a geotechnical engineer, then permeable pavements should not be used. Below is a list of considerations for choosing a permeable pavement BMP for this location:

- It addresses Potential Project Pollutants of Concern (PPOC) with high removal efficiency (except for Trash & Debris)
- The existing gently sloped
- Soil groups in project area are high in infiltration
- Impervious surface is designed to sheet flow runoff directly off site and not into a landscaped buffer

This BMP is a suitable BMP for treating the runoff from the impervious surface. However, portions of the multi-modal path are designed to be placed on newly compacted fill soil, therefore a professional geotechnical engineer should be consulted before being implemented.

Bioretention BMP (STA. 111+83 to STA. 206+18)

Bioretention facilities are shallow landscaped basins with engineered soil media beneath. The bottom of a bioretention facility is usually unlined, which allows for infiltration to the extent that the underlying soil can accommodate. If the infiltration rate of the underlying soil is exceeded, then the excess runoff is drained out through underdrains. The soil type in the project location is of hydraulic soil groups A and B (see Appendix E). These soil groups have high infiltration rates which is best for infiltration facilities. This BMP will be implemented in areas where landscape was scheduled to be incorporated into the project. Below is a list of considerations for choosing a Bioretention BMP for this location:

- It addresses all Potential Project Pollutants of Concern (PPOC)
- The Removal Efficiency is medium to high for all PPOC
- The project area is relatively flat
- Soil groups in project area are high in infiltration
- Landscape buffer is incorporated into this section of the project design
- Impervious surface (multi-modal path) is designed to drain runoff directly into the landscape area
- Majority of the landscape area is wide enough to accommodate the minimum width of the BMP

BMP Design

The project's BMPs should be designed to manage runoff consistent with the design sizing requirements, QBMP and/or VBMP, as specified in 2013 MS4 Permit Sections F.1.c.v.4.b.i and F.1.c.v.4.a.ii (See table 3 below), and as described in the LID Design Handbook. The design criteria described in the Table 1 below is incorporated in the LID Design Handbook worksheets used to size the bioretention facility. The WWR WQMP recommends using a volume design basis for bioretention and permeable pavement facilities. This information can be found in Table 7 of section 3.5.1.5 (see Appendix F).

Table 1. 2013 MS4 Permit Design Sizing Requirements for $V_{BMP\ and}$ Q_{BMP} (sourced NPDES Permit No. CAS617002)

2013 MS4 Permit Sections		
Section	Design Basis	Design Criteria
F.1.c.v.4.b.i	Flow-Based BMP	The maximum flow rate of runoff produced from a rainfall intensity of 0.2 inch of rainfall per hour, for each hour of a storm event.
F.1.c.v.4.a.ii	Volume Treatment Control BMP	The volume of annual runoff based on unit basin storage water quality volume, to achieve 80% or more volume treatment by the method recommended in California Stormwater Best Management Practices Handbook – Industrial/Commercial (2003).

This project utilizes a flow-based design basis. The sizing and design of the BMPs are a function of the tributary drainage area. If the project BMP is determined to be a Self-Retaining Areas (SRA) or a Self-Treating Areas (STA), the LID Design Handbook recommends removing those areas from the total tributary area used to size the BMPs. However, the areas removed is still accounted for as project area and is counted towards the LID/site design measurable goal as described in Section 3.5.1. of the WWR WQMP.

Sections 2.1 and 2.2 of the LID Design Handbook describes an SRA as an “area within a PDP that has been designed to capture and retain the volume of runoff requiring treatment from that area” and an STA as an “area within a PDP site that does not drain to a BMP, but drains directly offsite or to the MS4, rather than having its runoff comingle with runoff from the project’s impervious surfaces.” By these definitions, the project bioretention facility is considered a Self-Retaining Area and the permeable pavement facility is considered a Self-Treating Area.

Permeable Pavement BMP Design

The most critical parameters for sizing a permeable pavement reservoir are drawdown times and infiltration rates. As shown in Table 4., the maximum drawdown time for permeable pavement is 48 hours, which is sufficient time for treatment without creating vector issues. Per section 4.2.1 of the LID Design Handbook, “the infiltration rate will govern depth in which the BMP can still drawdown within 48 hours. This is calculated by applying a safety factor to the infiltration rate to achieve the design infiltration rate. The safety factor applied is based on the type of information known about the soils and the type of infiltration testing performed.” Since no infiltration tests have been performed, a factor of safety was determined from the infiltration testing requirements in the Infiltration Testing Guidelines section of the LID Design Handbook. It states that, “the final report shall present a recommended design infiltration rate that includes a factor of safety that is no less than the factor of safety shown in Table 1,” the Infiltration Testing Requirements table in Appendix G. The final WQMP shows a minimum factor of safety of 3. This yields the design factor of safety as shown below,

$$\text{Design Infiltration Rate} = \frac{\text{Infiltration Rate}}{3\ (\text{factor of safety})}$$

Therefore,

*Max. Reservoir Depth (inches) = Design Infiltration Rate * Max. Drawdown Time 48 hrs*

A feasibility assessment of utilizing permeable pavement will need to be conducted for infiltration rate, groundwater, underground utility conflicts, etc. The existing slope of the land is relatively flat, and the natural soil as identified earlier in this memo, is high in infiltration which is ideal for permeable pavements.

Table 4 illustrates the various design parameters for permeable pavement design identified from the Design Handbook for LID BMPs. These parameters are inputted into the design worksheets provided by the LID Design Handbook (see Appendix H).

Table 4. Requirements for Permeable Pavement (sourced from the Design Handbook for LID BMPs Section A.6)

Design Parameters	Permeable Pavement
Maximum slope of permeable pavement	3%
Maximum contributing area slope	5%
Maximum reservoir layer depth	12”
Drawdown time	48-hr
Vertical separation	5’ min. above impermeable layer 10’ above historic high groundwater mark
Maximum Drainage Area	10 ac.

Other recommendations, requirements and considerations for permeable pavement can be found in Section A.6 of the LID Design Handbook.

Bioretention BMP Design

Bioretention facilities provides the opportunity for rainfall to infiltrate into the ground. Impervious surfaces do not provide any infiltration for rainfall, therefore the imperviousness of the tributary area to a BMP is critical in determining how big the BMP needs to be. Determining the imperviousness of the tributary area of the BMP is as follows:

$$I_f = \frac{A_{IMP}\ (\text{Impervious Area})}{A_T\ (\text{Total Tributary Area})}$$

where I_f is the Impervious Ratio. Sections 4.1 of the LID Design Handbook recommends removing the SRA from the total tributary drainage area used to size the BMP, before calculating the impervious ratio. Table 2 illustrates the various design parameters for bioretention facility design. These parameters are then inputted into the design worksheets provided by the LID Design Handbook (see Appendix I).

Table 2. Bioretention Facility Design Criteria (sourced from the LID Design Handbook Section A.3.3)

Design Parameters	Bioretention Basin
Design Flow	V_{BMP} cfs
Max. Tributary Area	10 acres
Min. Width	6 ft
Max. Side Slope	4:1
Max. Ponding Depth	6 inches
Minimum Side-Slope Width (Maximum Ponding Depth X Maximum Side-slope)	2 ft
Minimum Depth of Engineered Soil Media	18 inches
Minimum Depth of Gravel Layer	12 inches
Vegetation	Desert appropriate landscaping suitable for this BMP with 2-3-inch layer of mulch
Engineered Soil Media	85% mineral and 15% organic by volume. The mineral component must meet the range specified in Table 3 below, the organic component must be nitrogen stabilized compost

Table 3. Mineral Component Range Requirements (sourced from the LID Deign Handbook Section A.3.3)

Percent Range	Component
70-80	Sand
15-20	Silt
5-10	Clay

The recommended cross-section necessary for a bioretention facility is below *(source: LID Design Handbook Section A.3.3)*:

- Landscaped area
- 18” minimum depth of engineered soil media
- 12” minimum gravel layer depth with 6' perforated pipes (added flow control features such as orifice plates may be required to mitigate for HCOC conditions)

Other recommendations, requirements and considerations for Bioretention Facilities can be found in Section A.3 of the LID Design Handbook.

Conclusion and Recommendations

It is recommended that permeable pavement be used for the Class I multi-modal path from station 10+34 to station 76+75. One of the concerns with using this BMP is that the fill slopes may present a challenge to the infiltration surface. Where the infiltration surface of the BMP extends into the natural soil, the soil should be tested at the design elevation before the fill is placed. In some cases, it may not be feasible to extend the BMP down to natural soil. In such situations, another BMP should be chosen instead. A landscaped swale (or vegetative swales) could be a viable alternative for this segment. The LID Design Handbook defines a landscaped swale as a "wide, shallow, landscaped channel that treats stormwater runoff as it is slowly conveyed into a downstream system." Treatment occurs through plant uptake of pollutants, sediment removal and infiltration. This BMP has one of the lowest removal efficiencies of all the BMP options provided in the LID Design Handbook, and as such, is recommended to be used in combination with other BMPs. One of the factors that makes this a viable option, is that the existing topography is flat, which means that high-flow velocity is unlikely to occur. Other factors that need to be considered for a properly functioning landscape swales are vegetative cover and the proximity to natural channels.

A bioretention infiltration basin is recommended for use between station 111+83 to station 206+18, where feasible and should be used where landscaping was scheduled to be incorporated into the design. The bioretention infiltration basin requires a minimum width of 6 feet. The landscape buffer areas that cannot accommodate the 6-foot width requirement can be utilized as a standard landscape buffer with the appropriate plant palette. It is also recommended that side slopes be used for the bioretention basin as a pedestrian safety measure. At this time underdrain pipes for the bioretention basin does not seem necessary given the soil type in the project area and the flatness of the existing profile slope. However, this decision should not be determined until a geotechnical professional has done an assessment.

Additional project information such as tributary drainage areas, impervious areas, etc., that were used in the design worksheets can be found in Appendix J.

Appendix A: Table 1 – Potential Pollutants Generated by Land Use Type

Table 1: Potential Pollutants Generated by Land Use Type

Type of Development (Land Use)	General Pollutant Categories						
	Sediment/ Turbidity	Nutrients	Toxic Organic Compounds	Trash & Debris	Bacteria & Viruses (also: Pathogens)	Oil & Grease	Heavy Metals
Detached Residential Development	P	P	N	P	P	P	N
Attached Residential Development	P	P	N	P	P	P(2)	N
Commercial/ Industrial Development	P	P(1)	P(5)	P	P(3)	P	P(6)
Automotive Repair Shops	N	N	P(4,5)	P	N	P	P
Restaurants	N	N	N	P	P	P	N
Hillside Development	P	P	N	P	P	P	N
Parking Lots	P	P(1)	P(4)	P	P	P	P
Retail Gasoline Outlets	N	N	P(4)	P	N	P	P

Abbreviations: P = Potential N = Not potential

Notes:

(1) A potential Pollutant if non-native landscaping exists or is proposed onsite; otherwise not expected.
(2) A potential Pollutant if the project includes uncovered parking areas; otherwise not expected.
(3) A potential Pollutant if land use involves food or animal waste products.
(4) Specifically, petroleum hydrocarbons.
(5) Specifically, solvents; however, this Pollutant is not expected at commercial office or commercial retail sites, unless said retail is vehicle related.
(6) A potential Pollutant if the project includes outdoor storage or metal roofs; otherwise not expected.

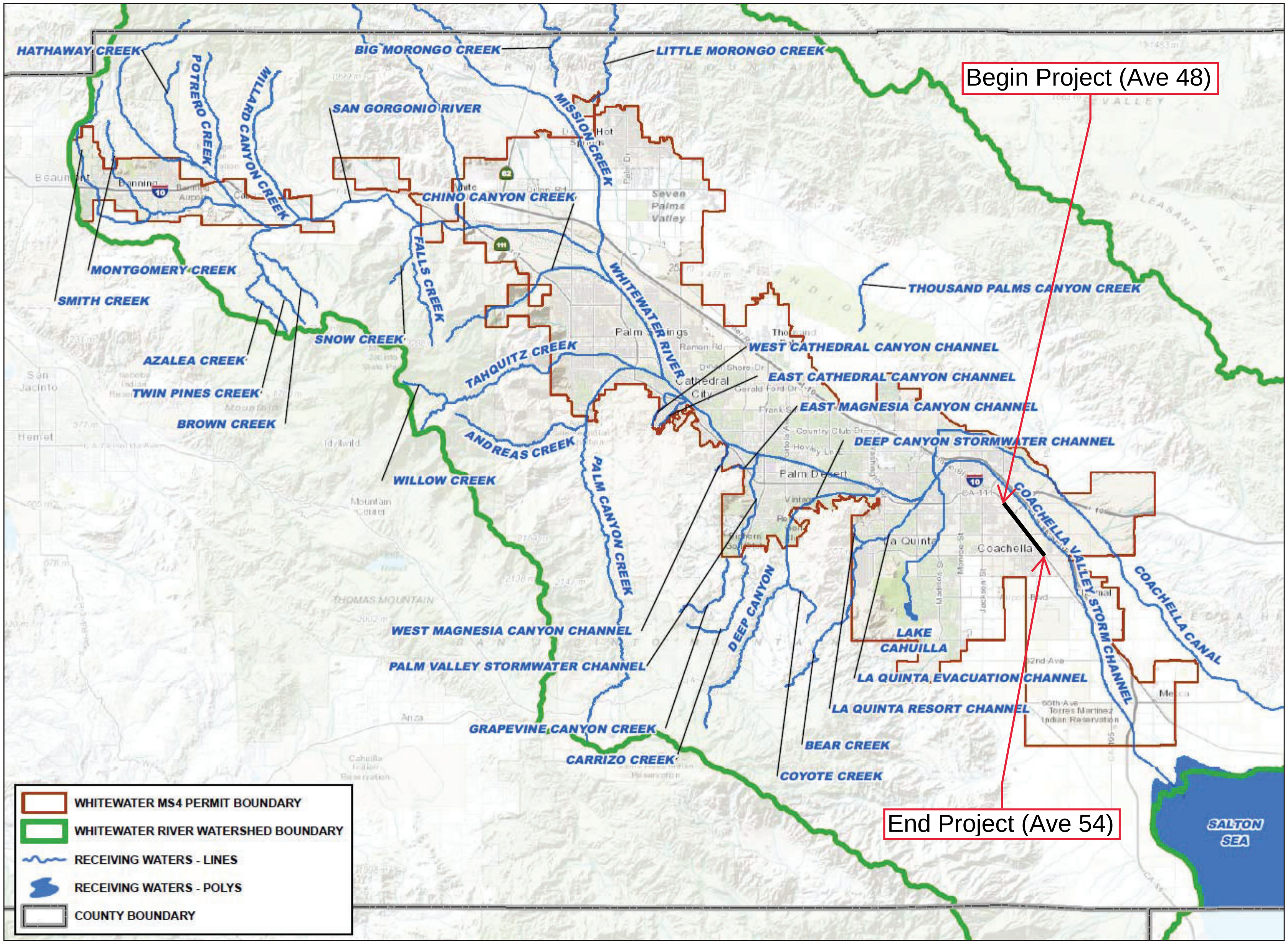
Appendix B: Table 2 – List of Receiving Waters

Table 2. List of Sub-Watersheds/Receiving Waters in Whitewater River Watershed

Drains or Streams [a]	Washes [b]
Coachella Valley Stormwater Channel	Bear Creek
Little Morongo Creek	Deep Canyon Stormwater Channel
Mission Creek	East Cathedral Canyon Channel
Palm Canyon Creek	East Magnesia Canyon Channel
San Gorgonio River	La Quinta Evacuation Channel
Tahquitz Creek	La Quinta Resort Channel
Whitewater River	Montgomery Creek
	Palm Valley Stormwater Channel
	Smith Creek
	West Cathedral Canyon Channel
	West Magnesia Canyon Channel
	Whitewater River from recharge basins to the Coachella Valley Stormwater Channel
Notes: a. Colorado River Basin Regional Water Quality Control Board Order No. R7-2013-0011, Finding 33. b. Colorado River Basin Regional Water Quality Control Board Order No. R7-2013-0011, Finding 32.	

Appendix C: Figure 2 – Receiving Waters

Figure 2. Whitewater River Region Receiving Waters Map



Appendix D: Table 2 – BMP Selection Matrix Based on POC Removal Efficiency

Table 2: BMP Selection Matrix Based Upon Pollutant of Concern Removal Efficiency [(1)]

(Sources: Riverside County Flood Control & Water Conservation District's *Design Handbook for Low Impact Development Best Management Practices* (September 2011), the Orange County *Technical Guidance Document for Water Quality Management Plans* (May 19, 2011), and the Caltrans *Treatment BMP Technology Reports* (April 2010 and April 2008)

Pollutant of Concern	Landscape Swale[2]	Landscape Strip[2]	Biofiltration (with Underdrain)[2, 3]	Extended Detention Basin[2]	Sand Filter Basin[2]	Infiltration Basin[2]	Infiltration Trench[2]	Permeable Pavement[2]	Bioretention (w/o Underdrain)[2, 3]	Other BMPs Including Proprietary BMPs[4, 6]
Sediment & Turbidity	M	M	H	M	H	H	H	H	H	Varies by Product[5]
Nutrients	L/M	L/M	M	L/M	L/M	H	H	H	H	
Toxic Organic Compounds	M/H	M/H	M/H	L	L/M	H	H	H	H	
Trash & Debris	L	L	H	H	H	H	H	L	H	
Bacteria & Viruses (also: Pathogens)	L	M	H	L	M	H	H	H	H	
Oil & Grease	M	M	H	M	H	H	H	H	H	
Heavy Metals	M	M/H	M/H	L/M	M	H	H	H	H	

<u>Abbreviations:</u>

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

<u>Notes:</u>

(1) Periodic performance assessment and updating of the guidance provided by this table may be necessary.

(2) Expected performance when designed in accordance with the most current edition of the document, *Riverside County, Whitewater River Region Stormwater Quality Best Management Practice Design Handbook for Low Impact Development*.

(3) Performance dependent upon design which includes implementation of thick vegetative cover. Local water conservation and/or landscaping requirements should be considered; approval is based on the discretion of the local land use authority.

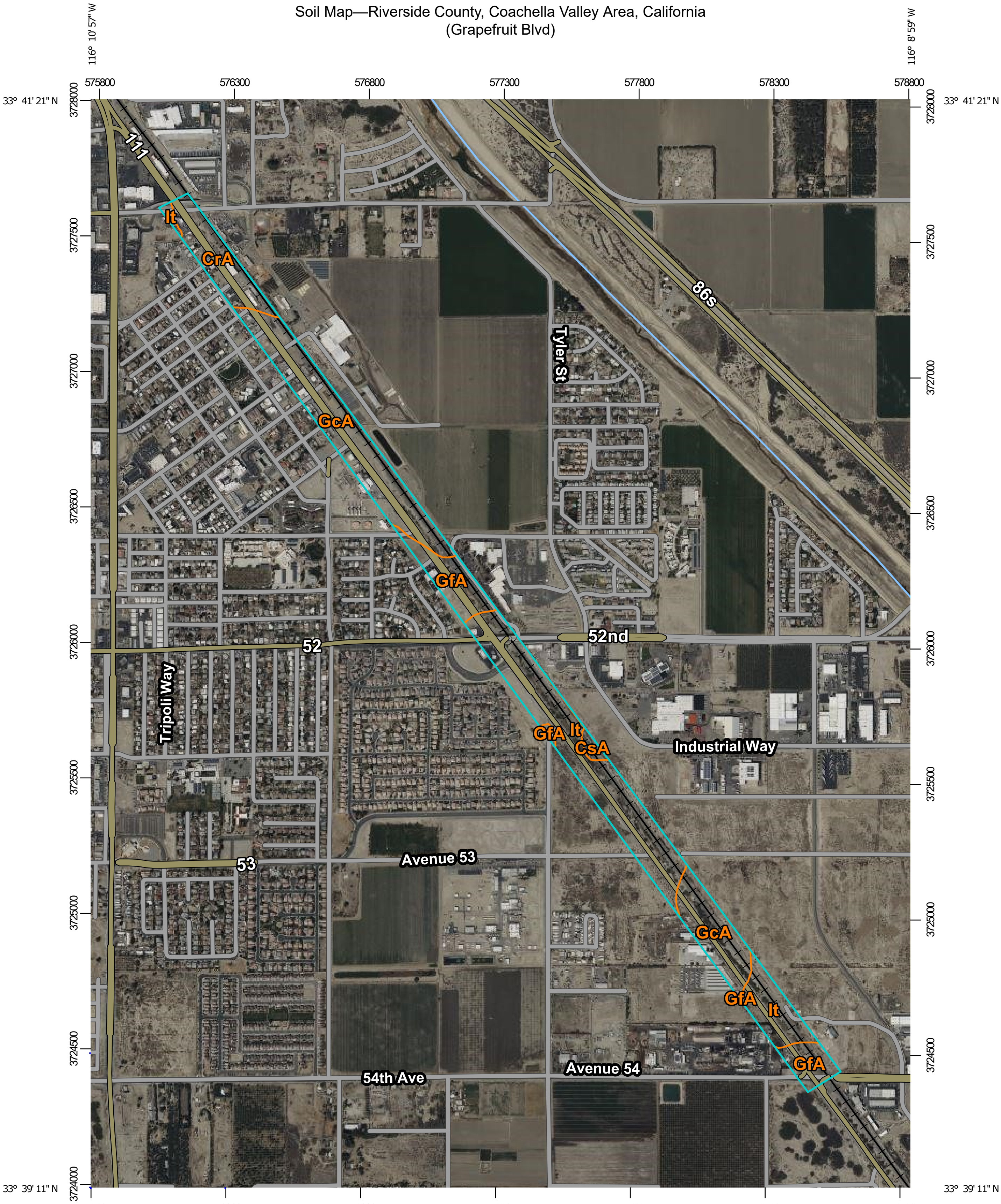
(4) Includes proprietary stormwater treatment devices as listed in the CASQA Stormwater Best Management Practices Handbooks, other stormwater treatment BMPs not specifically listed in this WQMP (including proprietary filters, hydrodynamic separators, inserts, etc.), or newly developed/emerging stormwater treatment technologies.

(5) Expected performance should be based on evaluation of the unit processes used by the BMP and available BMP testing data. Approval is based on the discretion of the local land use authority.

(6) When used for primary treatment as opposed to pre-treatment, requires site-specific approval by the local land use authority.

Appendix E: Soil Map

Soil Map—Riverside County, Coachella Valley Area, California
(Grapefruit Blvd)



Map Scale: 1:19,600 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0, 250, 500, 1000, 1500

Feet: 0, 500, 1000, 2000, 3000

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 11N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Map Unit Polygons

Soil Map Unit Lines

Soil Map Unit Points

Special Point Features

Blowout

Borrow Pit

Clay Spot

Closed Depression

Gravel Pit

Gravelly Spot

Landfill

Lava Flow

Marsh or swamp

Mine or Quarry

Miscellaneous Water

Perennial Water

Rock Outcrop

Saline Spot

Sandy Spot

Severely Eroded Spot

Sinkhole

Slide or Slip

Sodic Spot

Spoil Area

Stony Spot

Very Stony Spot

Wet Spot

Other

Special Line Features

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

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

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

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

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

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

Soil Survey Area: Riverside County, Coachella Valley Area, California
Survey Area Data: Version 15, Aug 30, 2023

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

Date(s) aerial images were photographed: Mar 15, 2022—May 28, 2022

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

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
CrA	Coachella fine sand, wet, 0 to 2 percent slopes	14.1	10.8%
CsA	Coachella fine sandy loam, 0 to 2 percent slopes	1.4	1.1%
GcA	Gilman fine sandy loam, wet, 0 to 2 percent slopes	47.5	36.4%
GfA	Gilman silt loam, wet, 0 to 2 percent slopes	16.6	12.7%
It	Indio very fine sandy loam, wet	50.6	38.8%
Totals for Area of Interest		**130.3**	**100.0%**

Riverside County, Coachella Valley Area, California

CrA—Coachella fine sand, wet, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: hkvf
Elevation: 40 feet
Mean annual precipitation: 2 to 4 inches
Mean annual air temperature: 72 degrees F
Frost-free period: 270 to 320 days
Farmland classification: Prime farmland if irrigated and drained

Map Unit Composition

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

Description of Coachella

Setting

Landform: Alluvial fans
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from igneous rock

Typical profile

H1 - 0 to 11 inches: fine sand
H2 - 11 to 60 inches: stratified sand to loamy fine sand

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Moderately well drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: About 36 to 60 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 1 percent
Maximum salinity: Nonsaline to slightly saline (0.0 to 4.0 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 5.3 inches)

Interpretive groups

Land capability classification (irrigated): 3w
Land capability classification (nonirrigated): 7w
Hydrologic Soil Group: A

Ecological site: R040XD007CA - Lacustrine Basin and Large RIver Floodplain
Hydric soil rating: No

Minor Components

Myoma
Percent of map unit: 5 percent
Hydric soil rating: No

Gilman
Percent of map unit: 5 percent
Hydric soil rating: No

Indio
Percent of map unit: 5 percent
Hydric soil rating: No

Data Source Information

Soil Survey Area: Riverside County, Coachella Valley Area, California
Survey Area Data: Version 15, Aug 30, 2023

Riverside County, Coachella Valley Area, California

CsA—Coachella fine sandy loam, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: hkvg
Elevation: 40 feet
Mean annual precipitation: 2 to 4 inches
Mean annual air temperature: 72 degrees F
Frost-free period: 270 to 320 days
Farmland classification: Prime farmland if irrigated

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Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from igneous rock

Typical profile

H1 - 0 to 10 inches: fine sandy loam
H2 - 10 to 40 inches: sand
H3 - 40 to 60 inches: loamy sand

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 1 percent
Maximum salinity: Nonsaline to slightly saline (0.0 to 4.0 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 3.6 inches)

Interpretive groups

Land capability classification (irrigated): 2e
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: A

Ecological site: R040XD007CA - Lacustrine Basin and Large RIver Floodplain
Hydric soil rating: No

Minor Components

Gilman
Percent of map unit: 5 percent
Hydric soil rating: No

Myoma
Percent of map unit: 5 percent
Hydric soil rating: No

Indio
Percent of map unit: 5 percent
Hydric soil rating: No

Data Source Information

Soil Survey Area: Riverside County, Coachella Valley Area, California
Survey Area Data: Version 15, Aug 30, 2023

Riverside County, Coachella Valley Area, California

GcA—Gilman fine sandy loam, wet, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: hkvn
Elevation: 400 feet
Mean annual precipitation: 4 inches
Mean annual air temperature: 72 degrees F
Frost-free period: 250 to 350 days
Farmland classification: Prime farmland if irrigated and drained

Map Unit Composition

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

Description of Gilman

Setting

Landform: Alluvial fans
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium

Typical profile

H1 - 0 to 8 inches: fine sandy loam
H2 - 8 to 60 inches: stratified loamy sand to silty clay loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Moderately well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: About 36 to 60 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 1 percent
Maximum salinity: Nonsaline to slightly saline (0.0 to 4.0 mmhos/cm)
Available water supply, 0 to 60 inches: High (about 10.2 inches)

Interpretive groups

Land capability classification (irrigated): 2w
Land capability classification (nonirrigated): 7w
Hydrologic Soil Group: B

Ecological site: R040XD007CA - Lacustrine Basin and Large RIver Floodplain
Hydric soil rating: No

Minor Components

Coachella
Percent of map unit: 5 percent
Hydric soil rating: No

Unnamed, sandy surface
Percent of map unit: 5 percent
Hydric soil rating: No

Indio
Percent of map unit: 3 percent
Hydric soil rating: No

Salton
Percent of map unit: 2 percent
Hydric soil rating: No

Data Source Information

Soil Survey Area: Riverside County, Coachella Valley Area, California
Survey Area Data: Version 15, Aug 30, 2023

Riverside County, Coachella Valley Area, California

GfA—Gilman silt loam, wet, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: hkvr
Elevation: 400 feet
Mean annual precipitation: 4 inches
Mean annual air temperature: 72 degrees F
Frost-free period: 250 to 350 days
Farmland classification: Prime farmland if irrigated and drained

Map Unit Composition

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

Description of Gilman

Setting

Landform: Alluvial fans
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium

Typical profile

H1 - 0 to 8 inches: silt loam
H2 - 8 to 60 inches: stratified loamy sand to silty clay loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Moderately well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: About 36 to 60 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 1 percent
Maximum salinity: Nonsaline to slightly saline (0.0 to 4.0 mmhos/cm)
Available water supply, 0 to 60 inches: High (about 10.2 inches)

Interpretive groups

Land capability classification (irrigated): 2w
Land capability classification (nonirrigated): 7w
Hydrologic Soil Group: B

Ecological site: R040XD007CA - Lacustrine Basin and Large RIver Floodplain
Hydric soil rating: No

Minor Components

Indio
Percent of map unit: 8 percent
Hydric soil rating: No

Salton
Percent of map unit: 4 percent
Hydric soil rating: No

Coachella
Percent of map unit: 3 percent
Hydric soil rating: No

Data Source Information

Soil Survey Area: Riverside County, Coachella Valley Area, California
Survey Area Data: Version 15, Aug 30, 2023

Riverside County, Coachella Valley Area, California

It—Indio very fine sandy loam, wet

Map Unit Setting

National map unit symbol: hkw1
Elevation: 300 feet
Mean annual precipitation: 4 inches
Mean annual air temperature: 72 degrees F
Frost-free period: 270 to 320 days
Farmland classification: Prime farmland if irrigated and drained

Map Unit Composition

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

Description of Indio

Setting

Landform: Alluvial fans
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium

Typical profile

H1 - 0 to 10 inches: very fine sandy loam
H2 - 10 to 60 inches: very fine sandy loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Moderately well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: About 36 to 60 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 5 percent
Maximum salinity: Nonsaline to slightly saline (0.0 to 4.0 mmhos/cm)
Available water supply, 0 to 60 inches: High (about 10.4 inches)

Interpretive groups

Land capability classification (irrigated): 2w
Land capability classification (nonirrigated): 7w
Hydrologic Soil Group: B

Ecological site: R040XD007CA - Lacustrine Basin and Large RIver Floodplain
Hydric soil rating: No

Minor Components

Gilman
Percent of map unit: 5 percent
Hydric soil rating: No

Salton
Percent of map unit: 5 percent
Hydric soil rating: No

Coachella
Percent of map unit: 5 percent
Hydric soil rating: No

Data Source Information

Soil Survey Area: Riverside County, Coachella Valley Area, California
Survey Area Data: Version 15, Aug 30, 2023

Appendix F: Table 7 – Design Basis for BMPs

LID/Site Design or Treatment Control BMP	**Design Basis**
Landscaped Filter Strips	Q_{BMP}
Landscaped Swales	
Biofiltration (with underdrain)	V_{BMP}
Bioretention (w/o underdrain)	
Extended Detention Basin	
Sand Filter Basin	
Permeable Pavement	
Infiltration Basin	
Infiltration Trench	
Other BMPs	Q_{BMP} or V_{BMP} on case-specific basis, as approved by the local land use authority

Appendix G: Table 7 – Table 1 – Infiltration Testing Requirements

Table 1 - Infiltration Testing Requirements							
WQMP Stage	Testing Options	Ring Infiltrometer Tests[1]	Percolation Test[2]	Test Pits or Boring Logs[3]	Final Report[4]	Hydrology Manual[5]	Factor of Safety
Preliminary WQMP	Option 1▶	two tests minimum with at least one per BMP location[6]	-	one boring or test pit per BMP location	Required	-	FS ≥ 3
	Option 2▶	-	four tests min. with at least two per BMP location[6]	one boring or test pit per BMP location	Required	-	FS ≥ 3
	Option 3[7]▶	-	-	one boring or test pit per BMP location	Required	-	FS ≥ 6
	Option 4[7]▶	-	-	one *representative* boring or test pit per site	-	Only	FS ≥ 10
Final WQMP	Option 1▶	two tests minimum with at least one per BMP location[6]	-	one boring or test pit per BMP location	Required	-	FS ≥ 3
	Option 2▶	-	four tests minimum with at least two per BMP location[6]	one boring or test pit per BMP location	Required	-	FS ≥ 3

Table Footnotes:

(1) Ring infiltrometer tests per Section 2.2

(2) Percolation tests per Section 2.3 and well permeameter test per Section 2.4

(3) Test pits or boring logs per Section 2.5

(4) Final Report per Section 1.6

(5) See Plate E-6.2 of the District's Hydrology Manual

(6) For BMPs with a wetted footprint in excess of 10,000 ft^2, provide one (1) ring infiltrometer test or two (2) percolation tests for each additional 10,000 ft^2

(7) This option is limited to BMPs with a tributary drainage area ≤ five acres.

Appendix H: Permeable Pavement – Design Volume (V_{BMP}) Calculations & Design Procedure (A1 thru A4)

Whitewater Watershed

BMP Design Volume, V_{BMP} (Rev. 06-2014)

Legend: Required Entries; Calculated Cells

Company Name	Alta Planning + Design	Date	1/12/2024
Designed by	Racquel Lee	County/City Case No	Riverside
Company Project Number/Name	2023-072/Connecting Coachella		
Drainage Area Number/Name	A1 (STA. 10+34 TO STA. 42+83)		

Enter the Area Tributary to this Feature (A_{TRIB}) A_{TRIB} = 4.4 acres

Determine the Impervious Area Ratio

Determine the Impervious Area within A_{TRIB} (A_{IMP}) A_{IMP} = 0.70 acres

Calculate Impervious Area Ratio (I_f) I_f = 0.16

$I_f = A_{IMP}/A_{TRIB}$

Calculate the composite Runoff Coefficient, C for the BMP Tributary Area

Use the following equation based on the WEF/ASCE Method

$C_{BMP} = 0.858I_f^3 - 0.78I_f^2 + 0.774I_f + 0.04$ C_{BMP} = 0.15

Determine Design Storage Volume, V_{BMP}

Calculate V_U, the 80% Unit Storage Volume $V_U = 0.40 \times C_{BMP}$ V_u = 0.06 (in*ac)/ac

Calculate the design storage volume of the BMP, V_{BMP}.

$$V_{BMP}\ (ft^3) = \frac{V_U\ (in\text{-}ac/ac) \times A_T\ (ac) \times 43{,}560\ (ft^2/ac)}{12\ (in/ft)}$$

V_{BMP} = 958 ft^3

Notes:

Whitewater Watershed

BMP Design Volume, V_{BMP} (Rev. 06-2014)

Legend: Required Entries; Calculated Cells

Company Name	Alta Planning + Design	Date	1/12/2024
Designed by	Racquel Lee	County/City Case No	Riverside
Company Project Number/Name	2023-072/Connecting Coachella		
Drainage Area Number/Name	A2 (STA. 42+83 TO STA. 52+36)		

Enter the Area Tributary to this Feature (A_{TRIB}) A_{TRIB} = 1.2 acres

Determine the Impervious Area Ratio

Determine the Impervious Area within A_{TRIB} (A_{IMP}) A_{IMP} = 0.20 acres

Calculate Impervious Area Ratio (I_f) I_f = 0.17

$I_f = A_{IMP}/A_{TRIB}$

Calculate the composite Runoff Coefficient, C for the BMP Tributary Area

Use the following equation based on the WEF/ASCE Method

$C_{BMP} = 0.858I_f^3 - 0.78I_f^2 + 0.774I_f + 0.04$ C_{BMP} = 0.15

Determine Design Storage Volume, V_{BMP}

Calculate V_U, the 80% Unit Storage Volume $V_U = 0.40 \times C_{BMP}$ V_u = 0.06 (in*ac)/ac

Calculate the design storage volume of the BMP, V_{BMP}.

$$V_{BMP}\ (ft^3) = \frac{V_U\ (in\text{-}ac/ac) \times A_T\ (ac) \times 43{,}560\ (ft^2/ac)}{12\ (in/ft)}$$

V_{BMP} = 261 ft^3

Notes:

Whitewater Watershed

BMP Design Volume, V_{BMP} (Rev. 06-2014)

Legend: Required Entries | Calculated Cells

Company Name	Alta Planning + Design	Date	1/12/2024
Designed by	Racquel Lee	County/City Case No	Riverside
Company Project Number/Name	2023-072/Connecting Coachella		
Drainage Area Number/Name	A3 (STA. 52+36 TO STA. 65+59)		

Enter the Area Tributary to this Feature (A_{TRIB}) A_{TRIB} = 1.6 acres

Determine the Impervious Area Ratio

Determine the Impervious Area within A_{TRIB} (A_{IMP}) A_{IMP} = 0.40 acres

Calculate Impervious Area Ratio (I_f) I_f = 0.25

$I_f = A_{IMP}/A_{TRIB}$

Calculate the composite Runoff Coefficient, C for the BMP Tributary Area

Use the following equation based on the WEF/ASCE Method

$C_{BMP} = 0.858I_f^3 - 0.78I_f^2 + 0.774I_f + 0.04$ C_{BMP} = 0.20

Determine Design Storage Volume, V_{BMP}

Calculate V_U, the 80% Unit Storage Volume $V_U = 0.40 \times C_{BMP}$ V_u = 0.08 (in*ac)/ac

Calculate the design storage volume of the BMP, V_{BMP}.

$$V_{BMP}\ (ft^3) = \frac{V_U\ (in\text{-}ac/ac) \times A_T\ (ac) \times 43{,}560\ (ft^2/ac)}{12\ (in/ft)}$$

V_{BMP} = 465 ft^3

Notes:

Whitewater Watershed

BMP Design Volume, V_{BMP} (Rev. 06-2014)

Legend: Required Entries | Calculated Cells

Company Name	Alta Planning + Design	Date	1/12/2024
Designed by	Racquel Lee	County/City Case No	Riverside
Company Project Number/Name	2023-072/Connecting Coachella		
Drainage Area Number/Name	A4 (STA. 65+59 TO STA. 76+75)		

Enter the Area Tributary to this Feature (A_{TRIB}) A_{TRIB} = 3.5 acres

Determine the Impervious Area Ratio

Determine the Impervious Area within A_{TRIB} (A_{IMP}) A_{IMP} = 0.30 acres

Calculate Impervious Area Ratio (I_f) I_f = 0.09

$I_f = A_{IMP}/A_{TRIB}$

Calculate the composite Runoff Coefficient, C for the BMP Tributary Area

Use the following equation based on the WEF/ASCE Method

$C_{BMP} = 0.858I_f^3 - 0.78I_f^2 + 0.774I_f + 0.04$ C_{BMP} = 0.10

Determine Design Storage Volume, V_{BMP}

Calculate V_U, the 80% Unit Storage Volume $V_U = 0.40 \times C_{BMP}$ V_u = 0.04 (in*ac)/ac

Calculate the design storage volume of the BMP, V_{BMP}.

$$V_{BMP}\ (ft^3) = \frac{V_U\ (in\text{-}ac/ac) \times A_T\ (ac) \times 43{,}560\ (ft^2/ac)}{12\ (in/ft)}$$

V_{BMP} = 508 ft^3

Notes:

Permeable Pavement - Design Procedure (Rev. 06-2014)	BMP ID	Legend:	Required Entries
	A1		Calculated Cells

Company Name: Alta Planning + Design — Date: 1/12/2024

Designed by: Racquel Lee — County/City Case No.: Riverside

Design Volume

Enter the area tributary to this feature — A_{TRIB}= 4.4 acres

Enter V_{BMP} determines from Section 4.3 of this Handbook — V_{BMP}= 958 ft^3

Permeable Pavement Surface Area

Reservoir Layer Depth, b_{TH} — b_{TH}= 9 inches

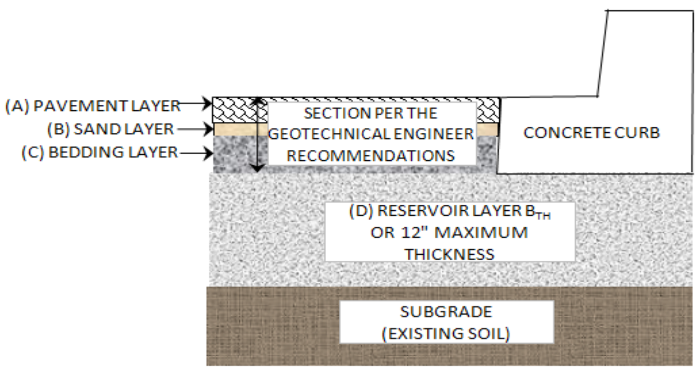
Minimum Surface Area Required, A_S

$$A_S\,(ft) = \frac{V_{BMP}\,(ft^3)}{(0.4 \times b_{TH}\,(in)) / 12(in/ft)}$$

A_S= 3,194 ft^2

Proposed Surface Area = 32,661 ft^2

Permeable Pavement Cross Section



Per the Geotechnical	(A)		in
Engineer's	(B)		in
Recommendations	(C)		in
Reservoir Layer	(D)	9	in
Total Permeable Pavement Section			in
Slope of Permeable Pavement		0	%

Sediment Control Provided? (Use pulldown)

Geotechnical report attached? (Use pulldown)

Describe Surrounding Landscaping:

Notes: ATRIB is overall total tributary drainage area minus the self-treating area. Permeable pavement slope is (

If the Permeable Pavement has been designed correctly, there should be no error messages on the spreadsheet.

Permeable Pavement - Design Procedure (Rev. 06-2014)	BMP ID	Legend:	Required Entries
	A2		Calculated Cells

Company Name:	Alta Planning + Design	Date:	1/12/2024
Designed by:	Racquel Lee	County/City Case No.:	Riverside

Design Volume

Enter the area tributary to this feature A_{TRIB}= 1.2 acres

Enter V_{BMP} determines from Section 4.3 of this Handbook V_{BMP}= 261 ft^3

Permeable Pavement Surface Area

Reservoir Layer Depth, b_{TH} b_{TH}= 9 inches

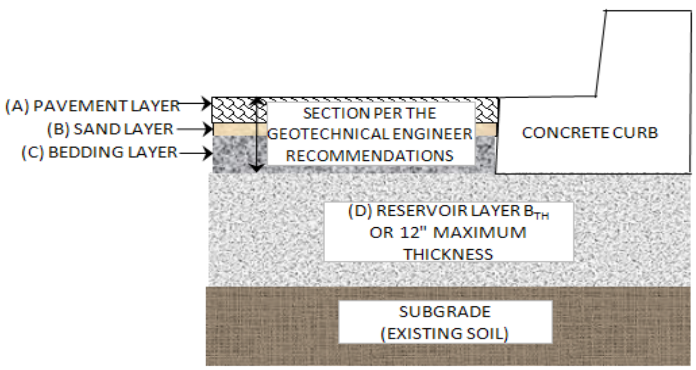
Minimum Surface Area Required, A_S

$$A_S\,(ft) = \frac{V_{BMP}\,(ft^3)}{(0.4 \text{ x } b_{TH}\,(in)) / 12(in/ft)}$$

A_S= 871 ft^2

Proposed Surface Area = 9,722 ft^2

Permeable Pavement Cross Section



Per the Geotechnical	(A)		in
Engineer's	(B)		in
Recommendations	(C)		in
Reservoir Layer	(D)	9	in
Total Permeable Pavement Section			in
Slope of Permeable Pavement		0	%

Sediment Control Provided? (Use pulldown)

Geotechnical report attached? (Use pulldown)

Describe Surrounding Landscaping:

Notes: ATRIB is overall total tributary drainage area minus the self-treating area. Permeable pavement slope is (

If the Permeable Pavement has been designed correctly, there should be no error messages on the spreadsheet.

Permeable Pavement - Design Procedure (Rev. 06-2014)	BMP ID	Legend:	Required Entries
	A3		Calculated Cells

Company Name:	Alta Planning + Design	Date:	1/12/2024
Designed by:	Racquel Lee	County/City Case No.:	Riverside

Design Volume

Enter the area tributary to this feature — A_{TRIB}= 1.6 acres

Enter V_{BMP} determines from Section 4.3 of this Handbook — V_{BMP}= 465 ft^3

Permeable Pavement Surface Area

Reservoir Layer Depth, b_{TH} — b_{TH}= 9 inches

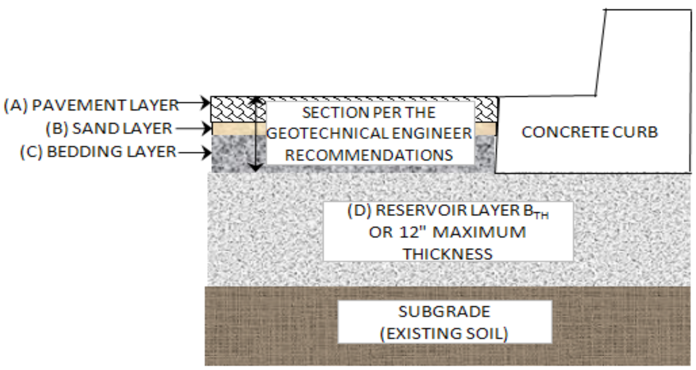
Minimum Surface Area Required, A_S

$$A_S\,(ft) = \frac{V_{BMP}\,(ft^3)}{(0.4 \times b_{TH}\,(in)) / 12(in/ft)}$$

A_S= 1,549 ft^2

Proposed Surface Area = 13,433 ft^2

Permeable Pavement Cross Section



Per the Geotechnical	(A)		in
Engineer's	(B)		in
Recommendations	(C)		in
Reservoir Layer	(D)	9	in
Total Permeable Pavement Section			in
Slope of Permeable Pavement		0	%

Sediment Control Provided? (Use pulldown)

Geotechnical report attached? (Use pulldown)

Describe Surrounding Landscaping:

Notes: ATRIB is overall total tributary drainage area minus the self-treating area. Permeable pavement slope is (

If the Permeable Pavement has been designed correctly, there should be no error messages on the spreadsheet.

Permeable Pavement - Design Procedure (Rev. 06-2014)	BMP ID	Legend:	Required Entries
	A4		Calculated Cells

Company Name: Alta Planning + Design — Date: 1/12/2024

Designed by: Racquel Lee — County/City Case No.: Riverside

Design Volume

Enter the area tributary to this feature — A_{TRIB}= 3.5 acres

Enter V_{BMP} determines from Section 4.3 of this Handbook — V_{BMP}= 508 ft^3

Permeable Pavement Surface Area

Reservoir Layer Depth, b_{TH} — b_{TH}= 9 inches

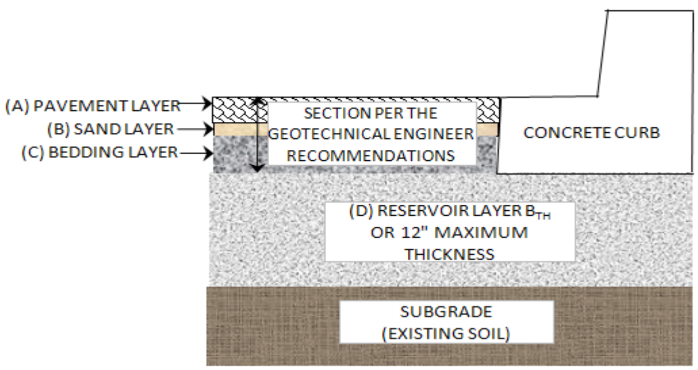
Minimum Surface Area Required, A_S

$$A_S\,(ft) = \frac{V_{BMP}\,(ft^3)}{(0.4 \times b_{TH}\,(in)) / 12(in/ft)}$$

A_S= 1,694 ft^2

Proposed Surface Area = 11,190 ft^2

Permeable Pavement Cross Section



Per the Geotechnical Engineer's Recommendations	(A)		in
	(B)		in
	(C)		in
Reservoir Layer	(D)	9	in
Total Permeable Pavement Section			in
Slope of Permeable Pavement		0	%

Sediment Control Provided? (Use pulldown)

Geotechnical report attached? (Use pulldown)

Describe Surrounding Landscaping:

Notes: ATRIB is overall total tributary drainage area minus the self-treating area. Permeable pavement slope is (

If the Permeable Pavement has been designed correctly, there should be no error messages on the spreadsheet.

Appendix I: Bioretention Infiltration Basin – Design Volume (V_{BMP}) Calculations & Design Procedure (B1 thru B5)

Whitewater Watershed

BMP Design Volume, V_{BMP} (Rev. 06-2014)

Legend: Required Entries / Calculated Cells

Company Name	Alta Planning + Design	Date	1/12/2024
Designed by	Racquel Lee	County/City Case No	Riverside
Company Project Number/Name	2023-072/Connecting Coachella		
Drainage Area Number/Name	B1 (STA. 111+83 TO STA. 119+29)		

Enter the Area Tributary to this Feature (A_{TRIB}) A_{TRIB} = 0.9 acres

Determine the Impervious Area Ratio

Determine the Impervious Area within A_{TRIB} (A_{IMP}) A_{IMP} = 0.20 acres

Calculate Impervious Area Ratio (I_f) I_f = 0.22

$I_f = A_{IMP}/A_{TRIB}$

Calculate the composite Runoff Coefficient, C for the BMP Tributary Area

Use the following equation based on the WEF/ASCE Method

$C_{BMP} = 0.858I_f^3 - 0.78I_f^2 + 0.774I_f + 0.04$ C_{BMP} = 0.18

Determine Design Storage Volume, V_{BMP}

Calculate V_U, the 80% Unit Storage Volume $V_U = 0.40 \times C_{BMP}$ V_u = 0.07 (in*ac)/ac

Calculate the design storage volume of the BMP, V_{BMP}.

$$V_{BMP}\,(ft^3) = \frac{V_U\,(in\text{-}ac/ac) \times A_T\,(ac) \times 43{,}560\,(ft^2/ac)}{12\,(in/ft)}$$

V_{BMP} = 229 ft^3

Notes:

Whitewater Watershed

BMP Design Volume, V_{BMP} (Rev. 06-2014)

Legend: Required Entries; Calculated Cells

Company Name	Alta Planning + Design	Date	1/12/2024
Designed by	Racquel Lee	County/City Case No	Riverside
Company Project Number/Name	2023-072/Connecting Coachella		
Drainage Area Number/Name	B2 (STA. 119+29 TO STA. 143+67)		

Enter the Area Tributary to this Feature (A_{TRIB}) A_{TRIB} = 2.1 acres

Determine the Impervious Area Ratio

Determine the Impervious Area within A_{TRIB} (A_{IMP}) A_{IMP} = 0.70 acres

Calculate Impervious Area Ratio (I_f) I_f = 0.33

$I_f = A_{IMP}/A_{TRIB}$

Calculate the composite Runoff Coefficient, C for the BMP Tributary Area

Use the following equation based on the WEF/ASCE Method

$C_{BMP} = 0.858I_f^3 - 0.78I_f^2 + 0.774I_f + 0.04$ C_{BMP} = 0.24

Determine Design Storage Volume, V_{BMP}

Calculate V_U, the 80% Unit Storage Volume $V_U = 0.40 \times C_{BMP}$ V_u = 0.10 (in*ac)/ac

Calculate the design storage volume of the BMP, V_{BMP}.

$$V_{BMP}\ (ft^3) = \frac{V_U\ (in\text{-}ac/ac) \times A_T\ (ac) \times 43{,}560\ (ft^2/ac)}{12\ (in/ft)}$$

V_{BMP} = 762 ft^3

Notes:

Whitewater Watershed

BMP Design Volume, V_{BMP} (Rev. 06-2014)

Legend: Required Entries / Calculated Cells

Company Name	Alta Planning + Design	Date	1/12/2024
Designed by	Racquel Lee	County/City Case No	Riverside
Company Project Number/Name	2023-072/Connecting Coachella		
Drainage Area Number/Name	B3 (STA. 143+67 TO STA. 156+72)		

Enter the Area Tributary to this Feature (A_{TRIB}) A_{TRIB} = 1.1 acres

Determine the Impervious Area Ratio

Determine the Impervious Area within A_{TRIB} (A_{IMP}) A_{IMP} = 0.40 acres

Calculate Impervious Area Ratio (I_f) I_f = 0.36

$I_f = A_{IMP}/A_{TRIB}$

Calculate the composite Runoff Coefficient, C for the BMP Tributary Area

Use the following equation based on the WEF/ASCE Method

$C_{BMP} = 0.858I_f^3 - 0.78I_f^2 + 0.774I_f + 0.04$ C_{BMP} = 0.26

Determine Design Storage Volume, V_{BMP}

Calculate V_U, the 80% Unit Storage Volume $V_U = 0.40 \times C_{BMP}$ V_u = 0.10 (in*ac)/ac

Calculate the design storage volume of the BMP, V_{BMP}.

$$V_{BMP}\ (ft^3) = \frac{V_U\ (in\text{-}ac/ac) \times A_T\ (ac) \times 43{,}560\ (ft^2/ac)}{12\ (in/ft)}$$

V_{BMP} = 399 ft^3

Notes:

Whitewater Watershed

BMP Design Volume, V_{BMP} (Rev. 06-2014)

Legend: Required Entries / Calculated Cells

Company Name	Alta Planning + Design	Date	1/12/2024
Designed by	Racquel Lee	County/City Case No	Riverside
Company Project Number/Name	2023-072/Connecting Coachella		
Drainage Area Number/Name	B4 (STA. 156+72 TO STA. 205+18)		

Enter the Area Tributary to this Feature (A_{TRIB}) A_{TRIB} = 2.9 acres

Determine the Impervious Area Ratio

Determine the Impervious Area within A_{TRIB} (A_{IMP}) A_{IMP} = 1.10 acres

Calculate Impervious Area Ratio (I_f) I_f = 0.38

$I_f = A_{IMP}/A_{TRIB}$

Calculate the composite Runoff Coefficient, C for the BMP Tributary Area

Use the following equation based on the WEF/ASCE Method

$C_{BMP} = 0.858I_f^3 - 0.78I_f^2 + 0.774I_f + 0.04$ C_{BMP} = 0.27

Determine Design Storage Volume, V_{BMP}

Calculate V_U, the 80% Unit Storage Volume $V_U = 0.40 \times C_{BMP}$ V_u = 0.11 (in*ac)/ac

Calculate the design storage volume of the BMP, V_{BMP}.

$$V_{BMP}\ (ft^3) = \frac{V_U\ (in\text{-}ac/ac) \times A_T\ (ac) \times 43{,}560\ (ft^2/ac)}{12\ (in/ft)}$$

V_{BMP} = 1,158 ft^3

Notes:

Whitewater Watershed

BMP Design Volume, V_{BMP} (Rev. 06-2014)

Legend: Required Entries; Calculated Cells

Company Name	Alta Planning + Design	Date	1/12/2024
Designed by	Racquel Lee	County/City Case No	Riverside
Company Project Number/Name	2023-072/Connecting Coachella		
Drainage Area Number/Name	B5 (STA. 208+18 TO STA. 206+18)		

Enter the Area Tributary to this Feature (A_{TRIB}) A_{TRIB} = 0.2 acres

Determine the Impervious Area Ratio

Determine the Impervious Area within A_{TRIB} (A_{IMP}) A_{IMP} = 0.00 acres

Calculate Impervious Area Ratio (I_f) I_f = 0.00

$I_f = A_{IMP}/A_{TRIB}$

Calculate the composite Runoff Coefficient, C for the BMP Tributary Area

Use the following equation based on the WEF/ASCE Method

$C_{BMP} = 0.858I_f^3 - 0.78I_f^2 + 0.774I_f + 0.04$ C_{BMP} = 0.04

Determine Design Storage Volume, V_{BMP}

Calculate V_U, the 80% Unit Storage Volume $V_U = 0.40 \times C_{BMP}$ V_u = 0.02 (in*ac)/ac

Calculate the design storage volume of the BMP, V_{BMP}.

$$V_{BMP}\,(ft^3) = \frac{V_U\,(in\text{-}ac/ac) \times A_T\,(ac) \times 43{,}560\,(ft^2/ac)}{12\,(in/ft)}$$

V_{BMP} = 15 ft^3

Notes:

Bioretention Facility - Design Procedure (Rev. 06-2014)	BMP ID	Legend:	Required Entries
	B1		Calculated Cells

Company Name:	Alta Planning + Design	Date:	1/12/2024
Designed by:	Racquel Lee	County/City Case No.:	Riverside

Design Volume

Enter the area tributary to this feature	A_{TRIB}=	0.9	acres
Enter V_{BMP} determined from Section 4.3 of this Handbook	V_{BMP}=	229	ft^3

Type of Bioretention Facility Design

- (●) Side slopes required (parallel to parking spaces or adjacent to walkways)
- ( ) No side slopes required (perpendicular to parking space or Planter Boxes)

Bioretention Facility Surface Area

Depth of Soil Filter Media Layer	d_S =	3.0	ft
Top Width of Bioretention Facility, excluding curb	w_T =	6.0	ft
Total Effective Depth, d_E $d_E = (0.3) \times d_S + (0.4) \times 1 - (0.7/w_T) + 0.5$	d_E =	1.68	ft
Minimum Surface Area, A_m $A_M\ (ft^2) = \frac{V_{BMP}\ (ft^3)}{d_E\ (ft)}$	A_M =	136	ft^2
Proposed Surface Area	A=	3,564	ft^2

Bioretention Facility Properties

Side Slopes in Bioretention Facility	z =	4	:1
Diameter of Underdrain			inches
Longitudinal Slope of Site (3% maximum)			%
6" Check Dam Spacing			feet

Describe Landscaping:

Notes:

Bioretention Facility - Design Procedure (Rev. 06-2014)	BMP ID	Legend:	Required Entries
	B2		Calculated Cells

Company Name:	Alta Planning + Design	Date:	1/12/2024
Designed by:	Racquel Lee	County/City Case No.:	Riverside

Design Volume

Enter the area tributary to this feature	A_{TRIB}=	0.9	acres
Enter V_{BMP} determined from Section 4.3 of this Handbook	V_{BMP}=	762	ft^3

Type of Bioretention Facility Design

- ◉ Side slopes required (parallel to parking spaces or adjacent to walkways)
- ○ No side slopes required (perpendicular to parking space or Planter Boxes)

Bioretention Facility Surface Area

Depth of Soil Filter Media Layer	d_S =	3.0	ft
Top Width of Bioretention Facility, excluding curb	w_T =	10.0	ft
Total Effective Depth, d_E $d_E = (0.3) \times d_S + (0.4) \times 1 - (0.7/w_T) + 0.5$	d_E =	1.73	ft
Minimum Surface Area, A_m $A_M (ft^2) = \frac{V_{BMP} (ft^3)}{d_E (ft)}$	A_M =	441	ft^2
Proposed Surface Area	A=	16,210	ft^2

Bioretention Facility Properties

Side Slopes in Bioretention Facility	z =	4	:1
Diameter of Underdrain			inches
Longitudinal Slope of Site (3% maximum)			%
6" Check Dam Spacing			feet

Describe Landscaping:

Notes:

Bioretention Facility - Design Procedure (Rev. 06-2014)	BMP ID	Legend:	Required Entries
	B3		Calculated Cells

Company Name:	Alta Planning + Design	Date:	1/12/2024
Designed by:	Racquel Lee	County/City Case No.:	Riverside

Design Volume

Enter the area tributary to this feature	A_{TRIB}=	1.1	acres
Enter V_{BMP} determined from Section 4.3 of this Handbook	V_{BMP}=	958	ft^3

Type of Bioretention Facility Design

◉ Side slopes required (parallel to parking spaces or adjacent to walkways)

○ No side slopes required (perpendicular to parking space or Planter Boxes)

Bioretention Facility Surface Area

Depth of Soil Filter Media Layer	d_S =	3.0	ft
Top Width of Bioretention Facility, excluding curb	w_T =	8.0	ft

Total Effective Depth, d_E

$d_E = (0.3) \times d_S + (0.4) \times 1 - (0.7/w_T) + 0.5$ — d_E = 1.71 ft

Minimum Surface Area, A_m

$$A_M\,(ft^2) = \frac{V_{BMP}\,(ft^3)}{d_E\,(ft)}$$

A_M = 560 ft^2

Proposed Surface Area — A= 10,440 ft^2

Bioretention Facility Properties

Side Slopes in Bioretention Facility	z =	4	:1
Diameter of Underdrain			inches
Longitudinal Slope of Site (3% maximum)			%
6" Check Dam Spacing			feet

Describe Landscaping:

Notes:

Bioretention Facility - Design Procedure (Rev. 06-2014)	BMP ID	Legend:	Required Entries
	B4		Calculated Cells

Company Name:	Alta Planning + Design	Date:	1/12/2024
Designed by:	Racquel Lee	County/City Case No.:	Riverside

Design Volume

Enter the area tributary to this feature	A_{TRIB}=	2.9	acres
Enter V_{BMP} determined from Section 4.3 of this Handbook	V_{BMP}=	229	ft^3

Type of Bioretention Facility Design

◉ Side slopes required (parallel to parking spaces or adjacent to walkways)

○ No side slopes required (perpendicular to parking space or Planter Boxes)

Bioretention Facility Surface Area

Depth of Soil Filter Media Layer	d_S =	3.0	ft
Top Width of Bioretention Facility, excluding curb	w_T =	20.0	ft
Total Effective Depth, d_E $d_E = (0.3) \times d_S + (0.4) \times 1 - (0.7/w_T) + 0.5$	d_E =	1.77	ft
Minimum Surface Area, A_m $A_M\ (ft^2) = \dfrac{V_{BMP}\ (ft^3)}{d_E\ (ft)}$	A_M =	130	ft^2
Proposed Surface Area	A=	96,960	ft^2

Bioretention Facility Properties

Side Slopes in Bioretention Facility	z =	4	:1
Diameter of Underdrain			inches
Longitudinal Slope of Site (3% maximum)			%
6" Check Dam Spacing			feet
Describe Landscaping:			

Notes:

Bioretention Facility - Design Procedure (Rev. 06-2014)	BMP ID	Legend:	Required Entries
	B5		Calculated Cells

Company Name: Alta Planning + Design — Date: 1/12/2024

Designed by: Racquel Lee — County/City Case No.: Riverside

Design Volume

Enter the area tributary to this feature	A_{TRIB}=	0.2	acres
Enter V_{BMP} determined from Section 4.3 of this Handbook	V_{BMP}=	762	ft^3

Type of Bioretention Facility Design

- ◉ Side slopes required (parallel to parking spaces or adjacent to walkways)
- ○ No side slopes required (perpendicular to parking space or Planter Boxes)

Bioretention Facility Surface Area

Depth of Soil Filter Media Layer	d_S =	3.0	ft
Top Width of Bioretention Facility, excluding curb	w_T =	14.0	ft
Total Effective Depth, d_E $d_E = (0.3) \times d_S + (0.4) \times 1 - (0.7/w_T) + 0.5$	d_E =	1.75	ft
Minimum Surface Area, A_m $A_M (ft^2) = \frac{V_{BMP} (ft^3)}{d_E (ft)}$	A_M =	436	ft^2
Proposed Surface Area	A=	1,316	ft^2

Bioretention Facility Properties

Side Slopes in Bioretention Facility	z =	4	:1
Diameter of Underdrain			inches
Longitudinal Slope of Site (3% maximum)			%
6" Check Dam Spacing			feet

Describe Landscaping:

Notes:

Appendix J: Drainage Area Summary for BMPs

Permeable Pavement Data Summary

Areas	Size of Overall Drainage Areas (A_T) (ac)	Impervious Areas within (A_T) (ac)	Self-Treating Areas (ac)	Size of Drainage Areas (A_T) without STAs (ac)	Design Volume Storage (V_{BMP}) (ft^3)	Reservoir Layer Depth b_{TH} (in)	Minimum Surface Area Required (A_M) (ft^2)	Slope of Permeable Pavement (%)	Proposed Permeable Surface Area (ft^2)	Pavement Section (in.)	Notes
A1 (STA. 10+34 TO STA. 42+83)	5.1	0.7	0.7	4.4	958	9	3,194	0.3	32,661	6" Pervious Concrete 9" #57 Stone over Prepared Subgrade	In areas where permeable pavement is placed on a fill soil, a professional geotechnical engineer should test if the compacted soil will be stable when saturated.
A2 (STA. 42+83 TO STA. 52+36)	1.4	0.2	0.2	1.2	261	9	871	0.3	9,722	6" Pervious Concrete 9" #57 Stone over Prepared Subgrade	In areas where permeable pavement is placed on a fill soil, a professional geotechnical engineer should test if the compacted soil will be stable when saturated.
A3 (STA. 52+36 TO STA. 65+59)	1.9	0.4	0.3	1.6	465	9	1,549	0.4	13,433	6" Pervious Concrete 9" #57 Stone over Prepared Subgrade	In areas where permeable pavement is placed on a fill soil, a professional geotechnical engineer should test if the compacted soil will be stable when saturated.
A4 (STA. 65+59 TO STA. 76+75)	3.8	0.3	0.3	3.5	508	9	1,694	0.3	11,190	6" Pervious Concrete 9" #57 Stone over Prepared Subgrade	In areas where permeable pavement is placed on a fill soil, a professional geotechnical engineer should test if the compacted soil will be stable when saturated.

Bioretention Facility Summary

Areas	Size of Overall Drainage Areas (A_T) (ac)	Impervious Areas within (A_T) (ac)	Self-Retaining Areas (ac)	Size of Drainage Areas (A_T) without SRAs (ac)	Design Volume Storage (V_{BMP}) (ft^3)	Engineered Soil Media Depth d_s (ft)	Minimum Surface Area Required (A_M) (ft^2)	Proposed Length of Bioretention Facility (ft)	Proposed Width of Bioretention Facility (ft)	Proposed Bioretention Facility Surface Area (ft^2)	Pavement Section (in.)	Constraints Prohibiting the Use of Bioretention Facility
B1 (STA. 111+83 TO STA. 119+29)	1	0.2	0.1	0.9	229	3	136	594	6	3,564	Landscape Area 36" Engineered Soil Media 12" Gravel Layer	None
B2 (STA. 119+29 TO STA. 143+67)	2.5	0.7	0.4	2.1	762	3	441	1621	10	16,210	Landscape Area 36" Engineered Soil Media 12" Gravel Layer	None
B3 (STA. 143+67 TO STA. 156+72)	1.5	0.4	0.4	1.1	399	3	560	1305	8	10,440	Landscape Area 36" Engineered Soil Media 12" Gravel Layer	None
B4 (STA. 156+72 TO STA. 205+18)	5.3	1.1	2.4	2.9	1,158	3	136	4848	20	96,960	Landscape Area 36" Engineered Soil Media 12" Gravel Layer	None
B5 (STA. 208+18 TO STA. 206+18)	0.2	0	0	0.2	15	3	136	94	14	1,316	Landscape Area 36" Engineered Soil Media 12" Gravel Layer	None