
INDIAN VALLEY

Single Family Residential Development

Preliminary Stormwater Control Plan

**Town of Moraga
California**

December, 2016

**Prepared for:
The Bruzzone Family**

Prepared by:

*P/A Design Resources, Inc.
3021 Citrus Circle
Suite 150
Walnut Creek, California 94598*

Job No. 01025-20-0104

A report prepared for:

The Bruzzone Family
899 Hope Lane
Concord, California 94548-5131

**Preliminary Stormwater Control Plan
Indian Valley
Single Family Residential Development
Town of Moraga, California**

P/A Design Resources, Inc. Job No. 01025-20-0104

Ross Avedian, PE, PLS
Principal/ Civil Engineer

David L. Perrings, PE
Civil Engineer

P/A Design Resources, Inc.
3021 Citrus Circle
Suite 150
Walnut Creek, California 94598
(925)-210-9300

December, 2016

TABLE OF CONTENTS

I. Project Settings.....	4
A. Project Name, Location, Description.....	4
B. Existing Site Features and Conditions	8
C. Opportunities and Constraints for Stormwater Control.....	11
1. <i>Opportunities</i>	11
2. <i>Constraints</i>	11
3. <i>Maximum Extent Practicable</i>	11
II. Measures to Limit Imperviousness.....	11
A. Measures Used to Limit Directly Connected Impervious Area.....	12
1. <i>Site Design Features</i>	12
2. <i>Pervious Pavements</i>	12
3. <i>Drainage Design</i>	12
III. Selection and Preliminary Design of Treatment BMP/IMPs.....	12
A. Selection of Appropriate BMP/IMPs.....	12
1. <i>Consideration of Infiltration BMP/IMPs</i>	12
2. <i>Treatment BMP/IMPs</i>	12
3. <i>Treatment Chain</i>	14
4. <i>Description of Drainage Areas and BMP/IMPs</i>	14
B. Locations and Elevations	16
C. Sizing Calculations and Table Summarizing Impervious Areas and BMP/IMPs	16
D. BMP/IMP Measures on Project Site Plan and General Information	33
IV. Source Control Measures	33
A. Description of Site Activities and Potential Sources of Pollutants.....	33
B. List of Operational Source Control BMP/IMPs.....	33
C. Table of Permanent and Operational Source Control Measures	34
V. Summary of Permitting and Code Compliance Issues.....	35
VI. BMP/IMP Operation and Maintenance Requirements.....	35
A. Ownership and Responsibility for Maintenance in Perpetuity.	35
1. <i>Commitment to Execute any Necessary Agreements.</i>	35

2. Statement Accepting Responsibility for Operation and Maintenance of BMP/IMPs Until that Responsibility is Formally Transferred.....	35
B. Summary of Maintenance Requirements for BMP/IMP.	35
VII. Construction Plan C.3 Checklist	36
VIII. Certification.....	37
References	38

LIST OF FIGURES

Figure 1: Vicinity Map	5
Figure 2: Preliminary Stormwater Control Plan.....	7
Figure 3: Existing Site Conditions.....	9
Figure 4: IMP - Bioretention Detail	13

LIST OF TABLES

Table 1: Description of BMP/IMP Treatment by Drainage Area.....	15
Table 2: Treatment BMP/IMP Sizing Worksheets.....	17
Table 3: Permanent and Operational Source Control Measures.....	34
Table 4: Construction Plan C.3. Checklist	36

*Preliminary Stormwater Control Plan
Indian Valley Single-Family Residential Development
Town of Moraga, California*

I. Project Settings

A. Project Name, Location, Description

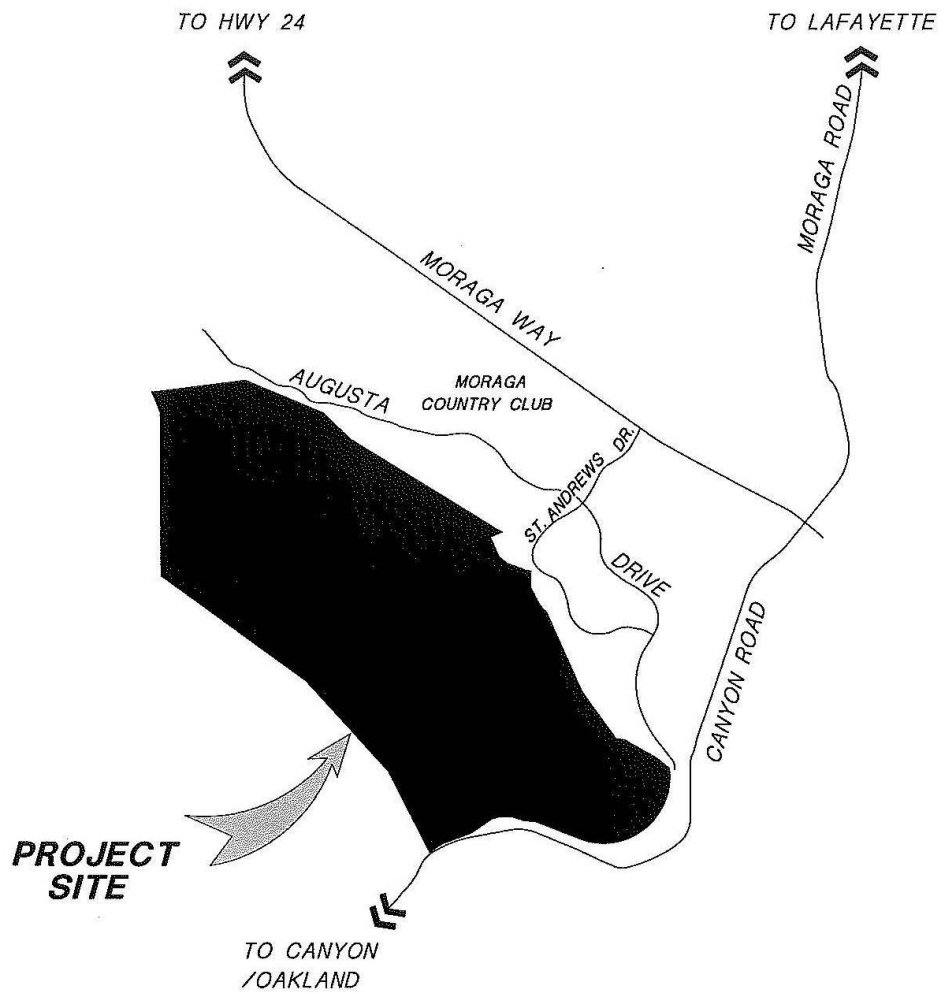
This report has been prepared to comply with the requirements of Contra Costa Clean Water Program's Stormwater C.3.Program (**Reference 1**) and the requirements of the Town of Moraga.

The Proposed Indian Valley Project is a proposed hillside residential community consisting of **71** homes on approximately **450** acres (140 acres of development and 310 acres of open space) located in the Town of Moraga, California, southwest of Moraga Way and north of Canyon Road in the lower valley of Indian Creek. The project is located above the north side of Indian Creek approximately one-half mile upstream from the confluence with San Leandro Creek. The existing project site is covered by grass and trees. The site is an alluvial valley that drains naturally to Indian Creek. The limits of the valley are defined by Gudde Ridge to the northeast and an unnamed ridge to the southwest. The site currently falls within multiple zoning districts of the Town of Moraga. The zoning districts are: 1.) Moraga Open Space Ordinance (M.O.S.O.) open space, 2.) Non-M.O.S.O. open space and 3.) 2 DUA Residential District. (see **Reference 3**).

The exiting principal roadways in the projects vicinity are Moraga Way and Canyon Road. The site will be serviced by a new roadway which will tee off of Canyon Road on the north side of Indian Creek. The project site will also include a Emergency Access Road across the lower portion of the project site adjacent to Indian Creek.

Indian Creek drains in a southeasterly direction to Canyon Road where it passes underneath the roadway in a culvert. The creek turns south and continues approximately 1000 ft to its confluence with San Leandro Creek then continues to the south east where it discharges into the Upper San Leandro Reservoir.

Figure 1: Vicinity Map



 **FIGURE 1**

The primary facilities located on the project site will consist of the following (**Reference 3**):

- 71 detached single family homes.
- Paved street area for vehicular access to the houses.
- Emergency Vehicular Access (EVA)
- Driveways.
- other paved areas
- Landscape areas.
- Drainage Swales along roadways
- Closed conduit storm drainage system.
- Detention Basins
- Bioretention Basins and swales. (note: both types of bioretention will be referred to as bioretention basins in the rest of this document)

The site layout for the project is shown on the following Preliminary Stormwater Control Plan.

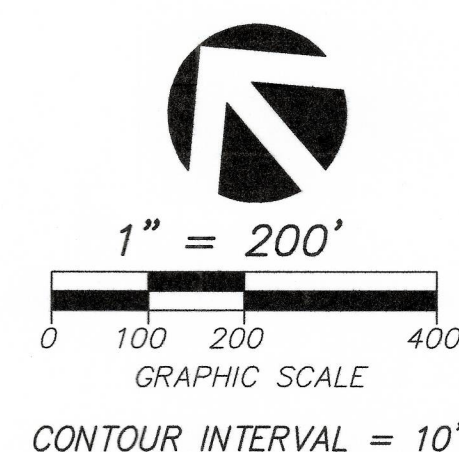
Figure 2: Preliminary Stormwater Control Plan

INDIAN VALLEY

TOWN OF MORAGA, CALIFORNIA

PRELIM. STORMWATER CONTROL PLAN

December 2016



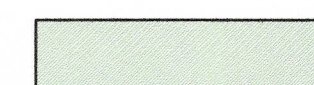
LEGEND



IMPERVIOUS AREAS DRAINING TO IMP



BIORETENTION AREA (IMP)



PERVIOUS AREAS DRAINING TO IMP



INDICATES DMA
(DRAINAGE MANAGEMENT AREA)

PA **Design Resources, Inc.**
Planning ■ Engineering ■ Surveying

3021 Citrus Circle, Suite 150
Walnut Creek, California 94598-2635

TEL (925) 210-9300

FIG.
2

This project will conform to the storm water quality requirements of the Town of Moraga and the Contra Costa County Clean Water Program's Stormwater C.3. Guidebook.

The C.3. program requirements for Stormwater Quality states:

"If the project creates or replaces more than 10,000 sq. ft of impervious area, a Stormwater Control Plan is required."

The total amount of impervious area (buildings and all other hardscape surfaces) being created and replaced is greater than 10,000 sf therefore a Stormwater Control Plan is required.

According to the Contra Costa County Clean Water Program's Stormwater C.3. Guidebook if a project creates more than 1 acre of impervious surface than Hydromodification (HMP), or flow control measures will also be required for this project.

B. Existing Site Features and Conditions

The existing site is covered with vegetation and trees. There are no man made structures on the site at this time.

Figure 3: Existing Site Conditions

(See Foldout on next Page)

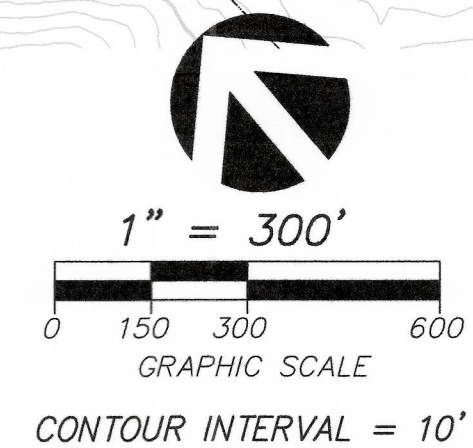
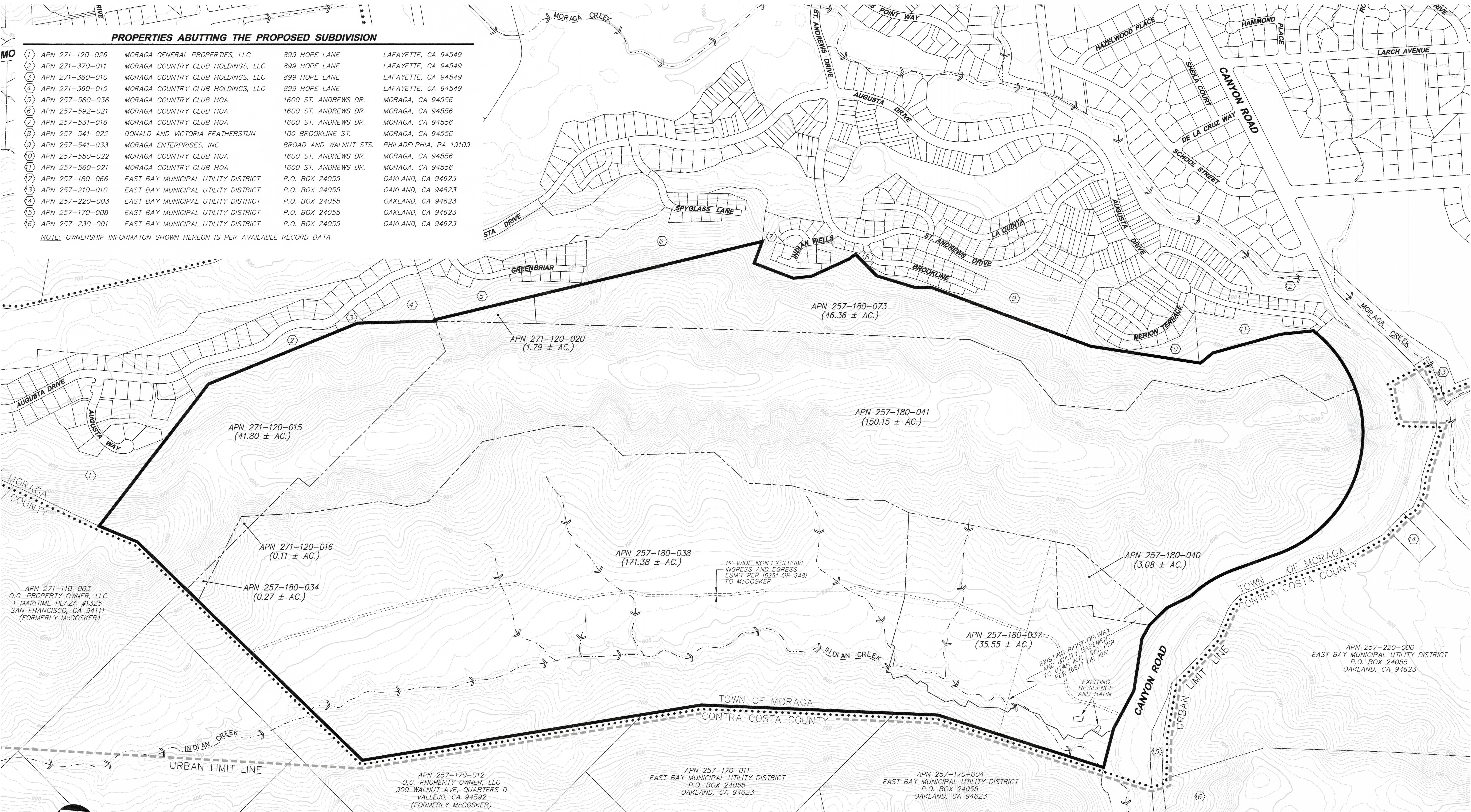
Figure 3: Existing Site Conditions

INDIAN VALLEY

TOWN OF MORAGA, CALIFORNIA

EXISTING SITE CONDITIONS

December 2016



PA Design Resources, Inc.
Planning ■ Engineering ■ Surveying

3021 Citrus Circle, Suite 150
Walnut Creek, California 94598-2635 TEL (925) 210-9300

FIG.
3

Existing Site Drainage

The project site is located along a ridge with Indian Creek located at the bottom. The site currently drains via overland flow to the Creek and is shown on **Figure 3**.

The project site is not subject to inundation and can be found on the FEMA Flood Insurance Rate Map (FIRM), Community – Panel Number 06013C0409F and located in an area designated as Zone A within the banks of Indian Creek and Zone X (500 yr floodplain) beyond the creek on the project site (see **Reference 10**).

Existing Vegetative Cover and Impervious Areas

The existing project site is covered in trees and vegetation. To date an Arborist Tree Report has not been prepared for the project site. In general the entire project site can be considered pervious since there is no development of any kind on the site.

Existing Climate Characteristics

The climate in the vicinity of the site reflects the Mediterranean climates of the central interior regions of California and is characterized by cool, wet winters and hot, dry summers. Long term data shown on the Contra Costa County Public Works Department Mean Seasonal Isohyets Map B-166 dated December 1977 (**Reference 4**) indicates that rainfall at the site averages approximately 30 inches per year.

Existing Geology, Soils and Groundwater

A Geotechnical Investigation was prepared for the Indian Valley Project by Engeo, Incorporated, dated October 7th, 2013, titled "**Updated Preliminary Geotechnical Report**" (see **Reference 5**). Groundwater was encountered in several borings on the site at depths of **40 ft** and **49 ft**, a perched groundwater was also encountered at a depth of 10 feet. Other boring sites indicated an average groundwater depth of 20 ft. Several natural springs with one being significant were also observed on the project site. Over time the groundwater levels on the project site are expected to fluctuate seasonally as well as over a period of years due to variations in precipitation, temperature, irrigation and other factors.

The existing soils on the project site are expansive clay soils. The upper 15 feet layer of soils on the site are the most expansive. These soils have a moderate to high expansion potential with a Plasticity Indices (PI) ranging from 17 to 39 over the site. The hydrologic soil classification for the soil is **Type D**.

The design of the water quality treatment bioretention basins along the northeastern side of the development area will need to account for the anticipated high clay content and density of the underlying soils, the near-surface site soils are not expected to have adequate permeability values to handle stormwater infiltration. Therefore, best management practices should assume that little stormwater infiltration will occur at the site.

Although infiltration rates are expected to be low, clayey soils can be weakened by water infiltration and saturation, which can cause problems for adjacent improvements. The bioretention basins should be designed with impermeable liners, subdrains, and their excavations should be situated outside a 1:1 line of projection extending downwards from

nearby improvements (such as curb, street, site wall, or house) unless retaining side walls are planned. Bioretention soil treatment mixes should be compacted to at least 85 percent relative compaction.

Biological Resources Analysis

Marylee Guinon LLC, with OLBERDING Environmental, Inc. is currently conducting field survey studies of the Indian Valley project area to assess the impact the project will have on these resources and to recommend necessary mitigation measures. These studies include Biological and Wetlands Assessment, Botanical Assessment and the California Red Legged Frog Focused Survey Report. In addition to the above three studies the U.S. Army Corps of Engineer's Jurisdictional Delineation for Indian Valley is also being prepared (see Reference 7)

C. Opportunities and Constraints for Stormwater Control

1. Opportunities

There is sufficient fall across the project site for gravity driven drainage since the site is located on a hillside. The existing site drains into Indian Creek located at the down hill side of the site. The site will continue to drain into Indian Creek after development.

The site is divided into a total of 19 Drainage Management Areas, DMA's for water quality treatment purposes. The DMA's will drain to the Integrated Management Practice, **IMP** for treatment. The IMP's for the site are bioretention basins covering a total combined area of **96,490 sf**. The bioretention basins will discharge downstream via closed conduit eventually discharging into Indian Creek. The bioretention basins are designed to treat the low flows from the project site in accordance with C.3 requirements. The is higher storm flows that do not require treatment will bypass the treatment element of the Bioretention basins.

2. Constraints

A large portion of the site is to remain undeveloped as open space this storm water runoff will be diverted around the developed portion of the site in order to eliminate the need for treatment.

Constraints include low-permeability soils (NRCS Hydrologic Soil Group D). Disposal of runoff to deep infiltration is not feasible due to the low permeability of the clay soils.

Due to the topography of the site the bioretention basins are primarily located at the lower portion of the site along side Indian Creek with some at higher elevations.

3. Maximum Extent Practicable

Stormwater controls are being proposed on the site to the maximum extent practicable. The total imperious area due to development will be treated. The bioretention basin will be located out in the open and accessible for inspection and maintenance purposes.

II. Measures to Limit Imperviousness

The proposed development is in conformance with the current zoning and designated land use for the property. The existing zoning designation shall remain for the developed

site. The limit unnecessary imperviousness the developed portion of the project site is being limited to 30% of the total site area with the remaining 70% being preserved open space.

A. Measures Used to Limit Directly Connected Impervious Area

1. Site Design Features

The bioretention basins will have the effect of causing a break in the flow from the impervious areas for the low flows which are to be treated. The higher storm flows will bypass the bioretention basins and flow directly into the storm drain system.

2. Pervious Pavements

Pervious pavement is not being purposed for this project site. Conventional pavement will be used.

3. Drainage Design

A closed conduit pipe system designed to drain the 10 and 100 yr design storm will serve the project site. The drainage system will pass thru both bioretention basins (for water quality treatment) and detention basins (for attenuation of the peak flood flows) prior to discharge into Indian Creek and continuing downstream of the project site. In addition to the bioretention basins, vegetated drainage swales will also be utilized along the on-site streets and EVA..

III. Selection and Preliminary Design of Treatment BMP/IMPs

A. Selection of Appropriate BMP/IMPs

Runoff from roofs, streets and pavement areas, driveways, sidewalks and other hardscape areas from each DMA will be collected and drained thru the bioretention basins.

The BMP/IMP bioretention Basin will be accessible for inspection and maintenance purposes. There is ample elevation relief across the site to provide sufficient hydraulic head to pass the water quality treatment and storm flows via gravity flow.

The requirements mentioned in the C.3 Manual to provide BMP/IMPs to mitigate peak flows and storm duration (hydro modification) shall be considered in the design of this project since this project shall generate more than one acres of new impervious surface and thus requires Hydrograph Modification Management.

1. Consideration of Infiltration BMP/IMPs

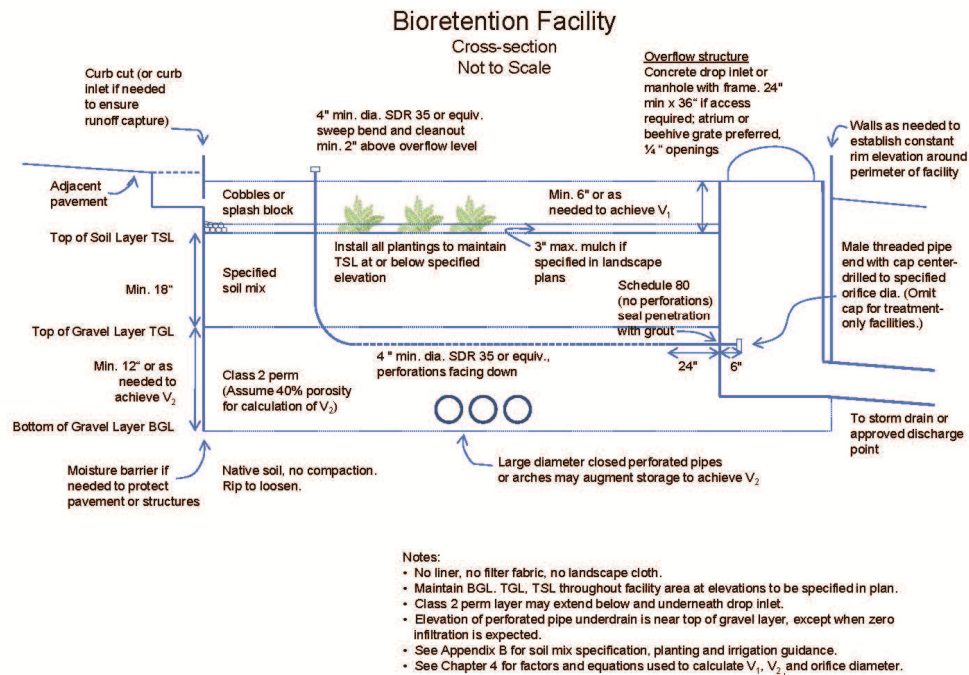
The existing site soil classification is D, rendering the use of direct infiltration BMP/IMP's impracticable.

2. Treatment BMP/IMPs

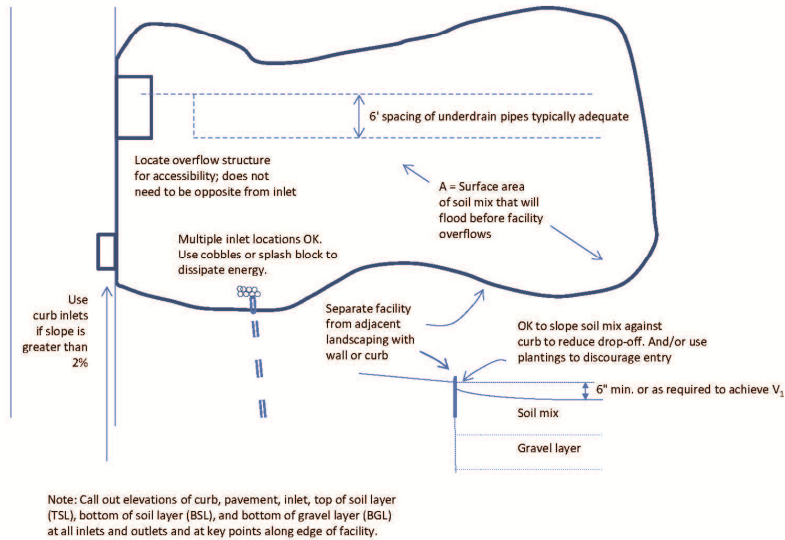
The primary treatment facility proposed is the bioretention basin for treatment of all the on-site area. These facilities will incorporate sub-drains and overflow outlet piping to insure positive drainage from the site. The ultimate outlet for both storm drainage and

water quality treatment is the existing Indian Creek. **Figure 4: IMP- Bioretention Detail and Reference 1).**

Figure 4: IMP - Bioretention Detail



Bioretention Facility Plan (Not to Scale)



6th Edition—February 15, 2012

77

3. Treatment Chain

The water quality treatment chain for the project site is designed to treat runoff from the impervious areas and the pervious areas. The treatment BMP/IMP is sized in accordance with criteria in the Contra Costa Clean Water Program *Stormwater C.3 Guidebook*.

4. Description of Drainage Areas and BMP/IMPs

The following Table provides a description of each of the treatment areas on the project site. This description augments what is shown on **Figures 2 :The Preliminary Storm Water Control Plan**. The area is designed to treat at low flows the stormwater runoff with a BMP/IMP. The areas are also designed to allow the storm water flood flows to pass thru the system without treatment of these larger flows. The Drainage Area ID's (example: DMA A-1) are also referred to as Drainage Maintenance Areas (DMA) see Table 1 on the following page.

Table 1: Description of BMP/IMP Treatment by Drainage Area

Drainage Area ID	Description of Surface to be Treated	BMP/IMP ID	Description of BMP/IMP
DMA A-1	Concrete or Asphalt = 94,643 sf Landscape = 242,258 sf	IMP A-1	Bioretention Basin Area =12,000 sf
DMA A-2	Concrete or Asphalt = 96,829 sf Landscape = 147,349 sf	IMP A-2	Bioretention Basin Area =8,000 sf
DMA A-4	Concrete or Asphalt = 26,310 sf Landscape = 73,910 sf	IMP A-4	Bioretention Basin Area =4,000 sf
DMA B-1	Concrete or Asphalt = 73,842 sf Landscape = 126,754 sf	IMP B-1	Bioretention Basin Area =7,000 sf
DMA B-2	Concrete or Asphalt = 7,393 sf Landscape = 23,722 sf	IMP B-2	Bioretention Basin Area =960 sf
DMA B-3	Concrete or Asphalt = 6,829 sf Landscape = 7,167 sf	IMP B-3	Bioretention Basin Area =850 sf
DMA B-4	Concrete or Asphalt = 36,203 sf Landscape = 127,360 sf	IMP B-4	Bioretention Basin Area =6,800 sf
DMA B-5	Concrete or Asphalt = 45,168 sf Landscape = 275,050 sf	IMP B-5	Bioretention Basin Area =11,100 sf
DMA B-6	Concrete or Asphalt = 137,763 sf Landscape = 194,283 sf	IMP B-6	Bioretention Basin Area =13,100 sf
DMA B-7	Concrete or Asphalt = 39,737 sf Landscape = 110,244 sf	IMP B-7	Bioretention Basin Area =6,100 sf
DMA C-1	Concrete or Asphalt = 23,082 sf Landscape = 55,432 sf	IMP C-1	Bioretention Basin Area =2,500 sf
DMA C-2	Concrete or Asphalt = 76,048 sf Landscape = 108,292 sf	IMP C-2	Bioretention Basin Area =6,700 sf
DMA C-3	Concrete or Asphalt = 59,477 sf Landscape = 162,986 sf	IMP C-3	Bioretention Basin Area =7,000 sf
DMA C-4	Concrete or Asphalt = 103,896 sf Landscape = 133,281 sf	IMP C-4	Bioretention Basin Area =8,000 sf
DMA C-5	Concrete or Asphalt = 34,522 sf	IMP C-5	Bioretention Basin

Drainage Area ID	Description of Surface to be Treated	BMP/IMP ID	Description of BMP/IMP
	Landscape =103,303 sf		Area =5,700 sf
DMA C-6	Concrete or Asphalt = 43,807 sf Landscape = 27,779 sf	IMP C-6	Bioretention Basin Area =2,800 sf

DMA A-3, B-8 and C-7 are considered "self treating areas".

B. Locations and Elevations

The projects BMP/IMP treatment device will be gravity based and pumping will not be required. The BMP/IMP has been incorporated into the overall landscaping design for aesthetics, ease of maintenance and accessibility purposes.

C. Sizing Calculations and Table Summarizing Impervious Areas and BMP/IMPs

The sizing requirements for water quality treatment were determined using the Contra Costa Clean Water Program's IMP Sizing Calculator (see Reference 2). IMP sizing results are presented in **Table 2** listed below. For each Drainage Management Area (DMA), the planned size of the IMP meets or exceeds the minimum size required for treatment.

Table 2: Treatment BMP/IMP Sizing Worksheets

Project Name: Indian Valley - TM
 Project Type: Treatment and Flow Control
 APN: various
 Drainage Area: 4,356,000
 Mean Annual Precipitation: 30.0

II. Self-Retaining Areas

Self-Retaining DMA	
DMA Name	Area (sq ft)
A-3 perv	95,242

IV. Areas Draining to IMPs

IMP Name: A-1
 IMP Type: Bioretention Facility
 Soil Group: A-1

DMA Name	Area (sq ft)	Post Project Surface Type	DMA Runoff Factor	DMA Area x Runoff Factor	IMP Sizing		
A-1 imp	94,643	Concrete or Asphalt	1.00	94,643	IMP Sizing Factor	Rain Adjustment Factor	Minimum Area or Volume
A-1 perv	242,258	Landscape	0.70	169,581	0.050	0.569	10,569*
Total				264,224	0.042	0.569	6,312
				Area	0.055	0.569	8,266
				Surface Volume			12,000
				Subsurface Volume			12,000
							Maximum Underdrain Flow (cfs)
							Orifice Diameter (in)
							7.11

* The product of the IMP Sizing Factor and the Rainfall Adjustment Factor was less than the minimum value of 0.04. The value of 0.04 was used to adjust the area instead.

IMP Name: A-2 (Soil Type: D)

IMP Type: Bioretention Facility

Soil Type: D

DMA Name	DMA Area (sq ft)	Post-Project Surface Type	DMA Runoff Factor	DMA Area x Runoff Factor
A-2 imp	96,829	Concrete or Asphalt	1.00	96,829
A-2 perv	147,349	Landscape	0.70	103,144
Total				199,973

Area

Surface Volume

Subsurface Volume

IMP Sizing			
IMP Sizing Factor	Rain Adjustment Factor	Minimum Area or Volume	Proposed Area or Volume
0.050	0.550	7,000*	0,000
0.042	0.509	4,777	8,000
0.035	0.509	0,250	8,000

Maximum Underdrain Flow (cfs)

Orifice Diameter (in)

* The product of the IMP Sizing Factor and the Rainfall Adjustment Factor was less than the minimum value of 0.04. The value of 0.04 was used to adjust the area instead.

IMP Name: A-4

IMP Type: Bioretention Facility

Soil Group: A-4

DMA Name	Area (sq ft)	Post Project Surface Type	DMA Runoff Factor	DMA Area x Runoff Factor	IMP Sizing			
A-4 imp	26,310	Concrete or Asphalt	1.00	26,310	IMP Sizing Factor	Rain Adjustment Factor	Minimum Area or Volume	Proposed Area or Volume
A-4 perv	73,910	Landscape	0.70	51,737				
Total				78,047				
				Area	0.050	0.569	3,122*	4,000
				Surface Volume	0.042	0.569	1,865	4,000
				Subsurface Volume	0.055	0.569	2,442	4,000
					Maximum Underdrain Flow (cfs)			
					Orifice Diameter (in)			
					3.88			

* The product of the IMP Sizing Factor and the Rainfall Adjustment Factor was less than the minimum value of 0.04. The value of 0.04 was used to adjust the area instead.

Project Name: Indian Valley - TM
 Project Type: Treatment and Flow Control
 APN: various
 Drainage Area: 4,356,000
 Mean Annual Precipitation: 30.0

II. Self-Retaining Areas

Self-Retaining DMA	
DMA Name	Area (sq ft)
B-8 perv	134,208

IV. Areas Draining to IMPs

IMP Name: B-1
 IMP Type: Bioretention Facility
 Soil Group: B-1

DMA Name	Area (sq ft)	Post Project Surface Type	DMA Runoff Factor	DMA Area x Runoff Factor	IMP Sizing Factor	Rain Adjustment Factor	Minimum Area or Volume	Proposed Area or Volume
B-1 imp	73,842	Concrete or Asphalt	1.00	73,842	0.050	0.569	6,503*	7,000
B-1 perv	126,754	Landscape	0.70	88,728	0.042	0.569	3,884	7,000
Total				162,570	0.055	0.569	5,086	7,000
				Area				0.61
				Surface Volume				Maximum Underdrain Flow (cfs)
				Subsurface Volume				Orifice Diameter (in)
								5.49

* The product of the IMP Sizing Factor and the Rainfall Adjustment Factor was less than the minimum value of 0.04. The value of 0.04 was used to adjust the area instead.

IMP Name: B-2 (Soil Type: D)

IMP Type: Bioretention Facility

Soil Type: D

DMA Name	DMA Area (sq ft)	Post-Project Surface Type	DMA Runoff Factor	DMA Area x Runoff Factor
B-2 imp	7,393	Concrete or Asphalt	1.00	7,393
B-2 perv	23,722	Landscape	0.70	16,605
Total				23,998

Area

Surface Volume

Subsurface Volume

IMP Sizing			
IMP Sizing Factor	Rain Adjustment Factor	Minimum Area or Volume	Proposed Area or Volume
0.050	0.569	960*	960
0.042	0.569	573	960
0.055	0.569	751	960

Maximum Underdrain Flow (cfs)

Orifice Diameter (in)

* The product of the IMP Sizing Factor and the Rainfall Adjustment Factor was less than the minimum value of 0.04. The value of 0.04 was used to adjust the area instead.

IMP Name: B-3
IMP Type: Bioretention Facility
Soil Group: B-3

DMA Name	Area (sq ft)	Post Project Surface Type	DMA Runoff Factor	DMA Area x Runoff Factor	IMP Sizing			
B-3 imp	6,829	Concrete or Asphalt	1.00	6,829	IMP Sizing Factor	Rain Adjustment Factor	Minimum Area or Volume	Proposed Area or Volume
B-3 perv	7,167	Landscape	0.70	5,017				
Total				11,846	0.050	0.569	474*	850
Surface Volume					0.042	0.569	283	850
Subsurface Volume					0.055	0.569	371	850
Maximum Underdrain Flow (cfs)							0.04	
Orifice Diameter (in)								1.45

* The product of the IMP Sizing Factor and the Rainfall Adjustment Factor was less than the minimum value of 0.04. The value of 0.04 was used to adjust the area instead.

IMP Name: B-4 (Soil Type: D)

IMP Type: Bioretention Facility

Soil Type: D

DMA Name	DMA Area (sq ft)	Post-Project Surface Type	DMA Runoff Factor	DMA Area x Runoff Factor
B-4 imp	38,203	Concrete or Asphalt	1.00	38,203
B-4 perv	127,360	Landscape	0.70	89,152
Total				125,355

Area
Surface Volume
Subsurface Volume

IMP Sizing			
IMP Sizing Factor	Rain Adjust-ment Factor	Minimum Area or Volume	Proposed Area or Volume
0.050	0.589	5,014*	8,800
0.042	0.589	2,995	8,800
0.055	0.589	3,922	8,800
Maximum Underdrain Flow (cfs)			0.50
Orifice Diameter (in)			4.95

* The product of the IMP Sizing Factor and the Rainfall Adjustment Factor was less than the minimum value of 0.04. The value of 0.04 was used to adjust the area instead.

IMP Name: B-5
IMP Type: Bioretention Facility
Soil Group: B-5

DMA Name	Area (sq ft)	Post Project Surface Type	DMA Runoff Factor	DMA Area x Runoff Factor	IMP Sizing			
B-5 imp	45,168	Concrete or Asphalt	1.00	45,168	IMP Sizing Factor	Rain Adjustment Factor	Minimum Area or Volume	Proposed Area or Volume
B-5 perv	275,050	Landscape	0.70	192,535	0.050	0.569	9,508*	11,100
Total				237,703	0.042	0.569	5,679	11,100
				Area	0.055	0.569	7,436	11,100
				Surface Volume	Maximum Underdrain Flow (cfs)			
				Subsurface Volume				
					Diameter (in)			
					Orifice			
					6.93			

* The product of the IMP Sizing Factor and the Rainfall Adjustment Factor was less than the minimum value of 0.04. The value of 0.04 was used to adjust the area instead.

IMP Name: B-6 (Soil Type: D)

IMP Type: Bioretention Facility

Soil Type: D

DMA Name	DMA Area (sq ft)	Post-Project Surface Type	DMA Runoff Factor	DMA Area x Runoff Factor
B-6 imp	137,763	Concrete or Asphalt	1.00	137,763
B-6 perv	194,283	Landscape	0.70	135,998
Total				273,761

Area
Surface Volume
Subsurface Volume

IMP Sizing			
IMP Sizing Factor	Rain Adjust-ment Factor	Minimum Area or Volume	Proposed Area or Volume
0.050	0.569	10,950*	13,100
0.042	0.569	8,540	13,100
0.055	0.569	8,564	13,100

Maximum Underdrain Flow (cfs)
Orifice Diameter (in)

1.01
7.06

* The product of the IMP Sizing Factor and the Rainfall Adjustment Factor was less than the minimum value of 0.04. The value of 0.04 was used to adjust the area instead.

IMP Name: B-7

IMP Type: Bioretention Facility

Soil Group: B-7

DMA Name	Area (sq ft)	Post Project Surface Type	DMA Runoff Factor	DMA Area x Runoff Factor	IMP Sizing		
B-7 imp	39,737	Concrete or Asphalt	1.00	39,737	IMP Sizing Factor	Rain Adjustment Factor	Minimum Area or Volume
B-7 perv	110,244	Landscape	0.70	77,171			
Total				116,908			
				Area	0.050	0.569	4,676*
				Surface Volume	0.042	0.569	2,793
				Subsurface Volume	0.055	0.569	3,657
				Maximum Underdrain Flow (cfs)			0.46
				Orifice Diameter (in)			4.74

* The product of the IMP Sizing Factor and the Rainfall Adjustment Factor was less than the minimum value of 0.04. The value of 0.04 was used to adjust the area instead.

Project Name: Indian Valley - TM
 Project Type: Treatment and Flow Control
 APN: various
 Drainage Area: 4,356,000
 Mean Annual Precipitation: 30.0

IV. Areas Draining to IMPs

IMP Name: C-1
 IMP Type: Bioretention Facility
 Soil Group: C-1

DMA Name	Area (sq ft)	Post Project Surface Type	DMA Runoff Factor	DMA Area x Runoff Factor	IMP Sizing Factor	Rain Adjustment Factor	Minimum Area or Volume	Proposed Area or Volume
C-1 imp	23,082	Concrete or Asphalt	1.00	23,082	0.050	0.569	2,475*	2,500
C-1 perv	55,432	Landscape	0.70	38,802	0.042	0.569	1,478	2,500
Total				61,884	0.055	0.569	1,936	2,500
				Area	Maximum			
				Surface Volume	Underdrain			
				Subsurface Volume	Flow (cfs)			
					Orifice			
					Diameter (in)			
					3.43			

* The product of the IMP Sizing Factor and the Rainfall Adjustment Factor was less than the minimum value of 0.04. The value of 0.04 was used to adjust the area instead.

IMP Name: C-2 (Soil Type: D)

IMP Type: Bioretention Facility

Soil Type: D

DMA Name	DMA Area (sq ft)	Post-Project Surface Type	DMA Runoff Factor	DMA Area x Runoff Factor
C-2 imp	76,048	Concrete or Asphalt	1.00	76,048
C-2 perv	108,292	Landscape	0.70	75,804
Total				151,852

Area

Surface Volume

Subsurface Volume

IMP Sizing			
IMP Sizing Factor	Rain Adjust-ment Factor	Minimum Area or Volume	Proposed Area or Volume
0.050	0.569	6,074*	6,700
0.042	0.569	3,628	6,700
0.055	0.569	4,751	6,700

Maximum Underdrain Flow (cfs)

Orifice Diameter (in)

* The product of the IMP Sizing Factor and the Rainfall Adjustment Factor was less than the minimum value of 0.04. The value of 0.04 was used to adjust the area instead.

IMP Name: C-3

IMP Type: Bioretention Facility

Soil Group: C-3

IMP Sizing				
DMA Name	Area (sq ft)	Post Project Surface Type	DMA Runoff Factor	DMA Area x Runoff Factor
C-3 imp	59,477	Concrete or Asphalt	1.00	59,477
C-3 perv	162,986	Landscape	0.70	114,090
			Total	173,567
				Area
				Surface Volume
				Subsurface Volume

IMP Name: C-4 (Soil Type: D)

IMP Type: Bioretention Facility

Soil Type: D

DMA Name	DMA Area (sq ft)	Post-Project Surface Type	DMA Runoff Factor	DMA Area x Runoff Factor
C-4 imp	103,896	Concrete or Asphalt	1.00	103,896
C-4 perv	133,281	Landscape	0.70	93,297
Total				197,193

Area

Surface Volume

Subsurface Volume

IMP Sizing			
IMP Sizing Factor	Rain Adjustment Factor	Minimum Area or Volume	Proposed Area or Volume
0.050	0.569	7,888*	8,000
0.042	0.569	4,711	8,000
0.055	0.569	6,169	8,000

Maximum Underdrain Flow (cfs)

Orifice Diameter (in)

* The product of the IMP Sizing Factor and the Rainfall Adjustment Factor was less than the minimum value of 0.04. The value of 0.04 was used to adjust the area instead.

IMP Name: C-5
IMP Type: Bioretention Facility
Soil Group: C-5

DMA Name	Area (sq ft)	Post Project Surface Type	DMA Runoff Factor	DMA Area x Runoff Factor	IMP Sizing Factor	Rain Adjustment Factor	Minimum Area or Volume	Proposed Area or Volume
C-5 imp	34,552	Concrete or Asphalt	1.00	34,552	0.050	0.569	4,275*	5,700
C-5 perv	103,303	Landscape	0.70	72,312	0.042	0.569	2,553	5,700
Total				106,864	0.055	0.569	3,343	5,700
				Area	Maximum Underdrain Flow (cfs)			
				Surface Volume	Diameter (in)			
				Subsurface Volume	Orifice			
					0.42			
					4.55			

* The product of the IMP Sizing Factor and the Rainfall Adjustment Factor was less than the minimum value of 0.04. The value of 0.04 was used to adjust the area instead.

IMP Name: C-6

IMP Type: Bioretention Facility

Soil Group: C-6

IMP Sizing				
DMA Name	Area (sq ft)	Post Project Surface Type	DMA Runoff Factor	DMA Area x Runoff Factor
C-6 imp	43,807	Concrete or Asphalt	1.00	43,807
C-6 perv	27,779	Landscape	0.70	19,445
Total				63,252
Area				
Surface Volume				
Subsurface Volume				
0.050				
0.042				
0.055				
0.569				
0.569				
0.569				
2,530*				
1,511				
1,979				
2,800				
2,800				
2,800				
0.22				
Maximum Underdrain Flow (cfs)				
Diameter (in)				
3.28				

* The product of the IMP Sizing Factor and the Rainfall Adjustment Factor was less than the minimum value of 0.04. The value of 0.04 was used to adjust the area instead.

D. BMP/IMP Measures on Project Site Plan and General Information

The existing site is shown on **Figure 3** while the proposed developed site plan with BMP/IMP's and drainage features is shown on **Figures 2**.

With the exception of any corrective grading as required by the geotechnical engineer the site is expected to balance. The compaction of on-site soils during construction will be preformed per the specification and requirements of the Geotechnical Engineer.

The project civil, landscape and architecture plans will be designed to provide adequate reveal (drop) between hardscape areas and vegetated areas to allow for positive flow without ponding along the edge of hardscape areas. The runoff from paved areas will sheet flow onto vegetated areas. The occurrence of concentrated flow from paved areas on to vegetated areas will be minimized to the maximum extent practicable.

On site soils will be compacted as specified on the improvement plans in such a manner as to maximize infiltration to the maximum extent practical. Measure will be taken to prevent over compaction due to on-site construction practices.

The drainage improvements include a conventional storm drain system with the bio-retention ponds. The storm drainage improvements for the project will drain the 10 year storm drainage flows through the project site as well as provide overland release for up to the 100 year storm. These drainage facilities are laid out so as not to interfere with the operation of the BMP/IMP's. Preliminary sizing calculations using the modified rational method and flood routing techniques have been perform for this storm drainage and bio-retention system to insure that adequate space is reserved on the site for these facilities.

Other specific information such as on-site plant selection, access and periodic maintenance requirements will be provided as part of the project design drawings.

IV. Source Control Measures

A. Description of Site Activities and Potential Sources of Pollutants

The proposed site use is single-family housing. Source Controls shall be used as part of the SWCP for the prevention of, or limitation of, pollutants being released into surface water as a result of storm water runoff. This is the preferred method of pollution control since it is aimed at keeping pollutant out of the storm water (**References 8 and 9**).

This project has the following potential sources of stormwater pollutants:

- Pesticides used for indoor or structural pest control;
- Fertilizers, pesticides and herbicides used for residential landscape maintenance;
- Nutrient loading from household pets;
- Vehicle washing;
- Other vehicle related pollutants such as heavy metals, oil and grease.

B. List of Operational Source Control BMP/IMPs

The source controls are discussed in the following table.

C. Table of Permanent and Operational Source Control Measures

The following table demonstrates that both types of source control measures have been considered to the maximum extent practicable.

Table 3: Permanent and Operational Source Control Measures

Potential Source	Permanent BMPs	Operational BMPs
Indoor and structural pest control		Provide Integrated Pest Management (IPM) information to homeowners, lessees and operators
Landscape and outdoor pesticides, herbicides, rodenticides, fungicides and fertilizers	Final Landscape Plans will: 1)Minimize irrigation and runoff and promote infiltration where appropriate 2)Minimize use of fertilizers and pesticides 3)Use pest-resistant plants, especially adjacent to hardscape when possible 4)Use plantings appropriate for the site soils, slopes, climate, sun, wind, land use, ecological consistency and plant interactions	Landscape will be maintained using minimum or no pesticides Landscape will be maintained using minimum fertilizer application especially adjacent to hardscape IPM information will be provided to homeowners
Vehicle washing		Stormwater pollution prevention information will be distributed to homeowners
On-Site drain Inlets	Stencil the storm drain inlets at the bio retention pond with “No Dumping, Drains to Creek” using thermoplastic tape	
Interior floor drains	Interior floor drains will be plumbed to sanitary sewer	
Need for future indoor and	Obtain a letter from the Project	

Potential Source	Permanent BMPs	Operational BMPs
structural pest control	Architect regarding the type of pest control that will be required for the type of building construction on the site.	

V. Summary of Permitting and Code Compliance Issues

The stormwater BMP/IMP's are consistent with Contra Costa County codes and development requirements.

VI. BMP/IMP Operation and Maintenance Requirements

A. Ownership and Responsibility for Maintenance in Perpetuity.

1. Commitment to Execute any Necessary Agreements.

The project owner agrees to provide Town of Moraga the necessary easements or rights of entry for the purpose of access and inspection of the stormwater BMP/IMP's.

2. Statement Accepting Responsibility for Operation and Maintenance of BMP/IMPs Until that Responsibility is Formally Transferred.

The project owner and applicant, accepts responsibility for maintenance and operation of the storm water BMP/IMP's associated with this Stormwater Control Plan until the responsibility is transferred to the site owners. The owner and applicant also agrees to annexation into an appropriate Assessment District that may be established to help fund the ongoing inspection and/or maintenance costs if the Town of Moraga were to take over these responsibilities in the future.

B. Summary of Maintenance Requirements for BMP/IMP.

The detailed maintenance requirements for the BMP/IMP's will be presented in an Operations and Maintenance Plan and Schedule which will be submitted to Town of Moraga with the project's application for building permits.

The general maintenance requirements for the proposed project IMP's are listed below. More specific requirements will be presented in the O&M Plan when it is submitted in the future.

Bioretention

These BMP/IMPs remove pollutants primarily by filtering runoff slowly through an active layer of soil. Routine maintenance is needed to ensure that flow is unobstructed, that erosion is prevented, and that plant roots hold soils together and are biologically active. Typical maintenance consists of the following:

- Inspect inlets for channels, exposure of soils, or other evidence of erosion. Clear any obstructions and remove any accumulation of sediment. Examine rock or other material used as a splash pad and replenish if necessary.

- Inspect outlets for erosion or plugging.
- Inspect side slopes for evidence of instability or erosion and correct as necessary.
- Observe soil at the bottom of the swale or filter for uniform percolation throughout. If portions of the swale or filter do not drain within 48 hours after the end of a storm, the soil should be tilled and replanted. Remove any debris or accumulations of sediment.
- Examine the vegetation to ensure that it is healthy and dense enough to provide filtering and to protect soils from erosion. Replenish mulch as necessary, remove fallen leaves and debris, prune large shrubs or trees, and mow turf areas. When mowing, remove no more than 1/3 height of grasses. Confirm that irrigation is adequate and not excessive. Replace dead plants and remove noxious and invasive vegetation.
- Abate any potential vectors by filling holes in the ground in and around the swales and bioretention and by insuring that there are no areas where water stands longer than 48 hours following a storm. If mosquito larvae are present and persistent, contact the Contra Costa Mosquito and Vector Control District for information and advice. Mosquito larvicides should be applied only when absolutely necessary and then only by a licensed individual or contractor.

VII. Construction Plan C.3 Checklist

A construction plan checklist listed below will be added at the time of improvement plans for the project. The last column which is intentionally left blank will be filled in when the table is added to the improvement plans. The checklist will also include the following note: The final grading plan shall conform to the delineation of the drainage areas in the Final SWCP.

Table 4: Construction Plan C.3. Checklist

Stormwater Control Plan Figure # Or Page #	BMP/IMP ID &Description	See Plan Sheet #s
Fig. 2	IMP A-1- Bioretention Area	
Fig. 2	IMP A-2- Bioretention Area	
Fig. 2	IMP A-4- Bioretention Area	
Fig. 2	IMP B-1- Bioretention Area	
Fig. 2	IMP B-2- Bioretention Area	
Fig. 2	IMP B-3- Bioretention Area	
Fig. 2	IMP B-4- Bioretention Area	
Fig. 2	IMP B-5- Bioretention Area	

Stormwater Control Plan Figure # Or Page #	BMP/IMP ID &Description	See Plan Sheet #s
Fig. 2	IMP B-6- Bioretention Area	
Fig. 2	IMP B-7- Bioretention Area	
Fig. 2	IMP C-1- Bioretention Area	
Fig. 2	IMP C-2- Bioretention Area	
Fig. 2	IMP C-3- Bioretention Area	
Fig. 2	IMP C-4- Bioretention Area	
Fig. 2	IMP C-5- Bioretention Area	
Fig. 2	IMP C-6- Bioretention Area	

VIII. Certification

The selections, size and preliminary design of treatment BMP's and other control measures in this plan meet the requirements of Regional Water Quality Control Board Order R2-2003-0022 and subsequent amendments.

References

1. Stormwater C.3 Guidebook, Contra Contra Costa Clean Water Program, 6th Edition, February 15, 2012.
2. Integrated Management Practices (IMP) Calculator, version 1.2.1.0; Contra Costa Clean Water Program, February, 2012.
3. Indian Valley - Conceptual Development Plan, Town of Moraga, California, 23 Sheets, Dated June 22, 2015 (Work in Progress), Prepared by P/A Design Resources, Inc..
4. Contra Costa County Public Works Department, Mean Seasonal Isohyets, Drawing Number B-166, dated December 1977.
5. Updated Preliminary Geotechnical Report, Indian Valley Project, Moraga, California; Engeo, Inc., Project No. 5900.200.000; Submitted to the Bruzzone Family Lafayette, California, 94549; October 7, 2013.
6. Preliminary Geotechnical Exploration, Indian Valley Project, Moraga, California; Engeo, Incorporated, Project # 5900.1.001.01, July 31, 2003.
7. Biological Resources Analysis Reports for the Indian Valley Project, Moraga, California are being prepared by Marylee Guinon LLC OLBERDING Environmental, Inc. Wetland Regulatory Consultants, 3170 Crow Canyon Place, Suite 260, San Ramon, California, 94583; June, 2015.
8. CASQA. 2003 California Stormwater Quality Association. California Stormwater BMP Handbooks, www.cabmphandbooks.org.
9. BASMAA. 1999. Bay Area Stormwater Management Agencies Association. Start at the Source: Design Guidance Manual for Stormwater Quality. Tom Richman and Associates. 154 pp. plus appendix.
www.cccleanwater.org/construction/nd.php#SATS
10. National Flood Insurance Program (NFIP), FIRM Flood Insurance Rate Map, Contra Costa County, California and Incorporated Areas, Panel 409 of 602, Map Number 06013C0409F, Effective Date June 16, 2009; Federal Emergency Management Agency (FEMA), U.S. Department of Homeland Security.