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CONSULTING CIVIL ENGINEERS & LAND SURVEYORS
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PRELIMINARY STORMWATER CONTROL PLAN

For

Cliff & Bay
190 West Cliff Drive
Santa Cruz, CA 95060

February 9, 2018
Revised November 20, 2018

B&W Job No. 26202.01

BASIS OF DESIGN:

1. **City of Santa Cruz Storm Water Best Management Practices and Public Development Projects, March 2014**

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STORM WATER CONTROL PLAN
Dream Multi–Res, West Cliff Drive - Application No. CP18-0043

I. Project Data

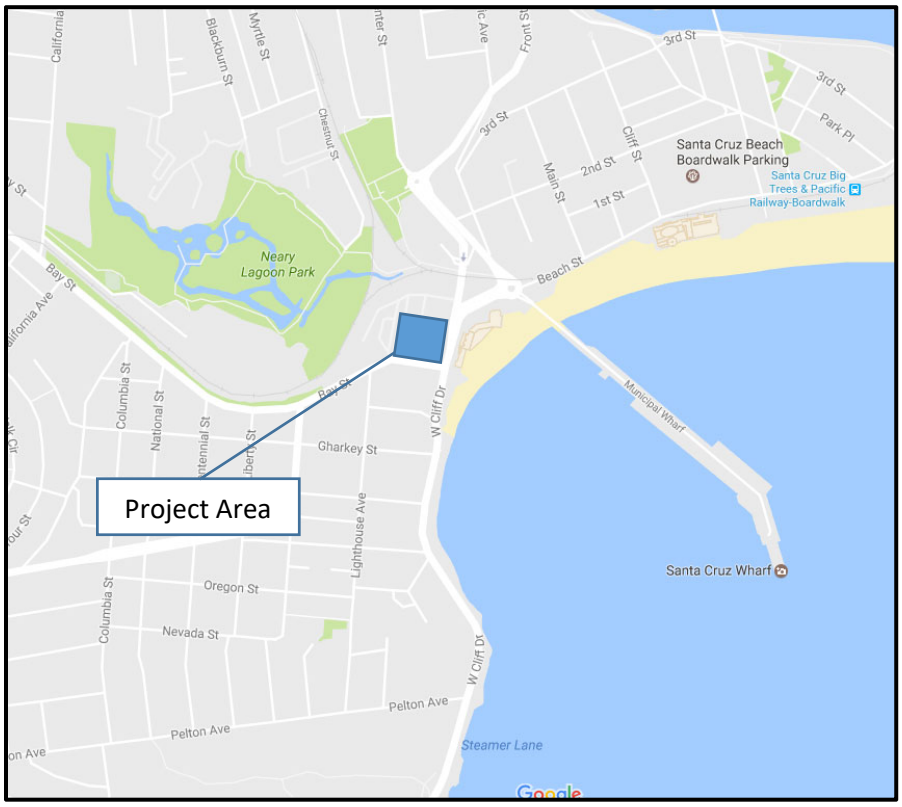
Project Name/Number	190 West Cliff Drive - Application No. CP18-0043
Application Submittal Date	TBD
Project Location	Cliff & Bay 190 West Cliff Drive West Cliff Drive, Santa Cruz, California
APN	004-081-12
Project Phase No.	NA
Project Type and Description	New mixed use, residential, beach club and retail project to be developed on an existing parking lot
Total Project Site Area (acres)	2.14
Total New Impervious Surface Area	861 sf
Total Replaced Impervious Surface Area	63,108 sf
Total Pre-Project Impervious Surface Area	72,657 sf
Total Post-Project Impervious Surface Area	63,969 sf
Net Impervious Area	63,969 sf
Watershed Management Zone(s)	4
Performance Tier	4
1. Site Design Measures	Yes. Measures will include Porous Pavement and Landscape features on the first, second and third levels.
2. Stormwater Treatment	Yes. Onsite retention of the 85th percentile 24 hr storm for DMA 1A, 1B, and 2. Additionally there will be a PerkFilter Treatment unit to treat overflow from the CUDO retention system, and the pavers.
3. Retention Runoff	Yes . Onsite retention of the 95th percentile 24 hr storm for the new impervious and 50% of the replaced impervious surface areas.
4. Peak Management	No, Runoff discharges to marine near shore waters

II. Setting

A. *Project Location and Description*

The Project will consist of a new mixed use, residential, beach club and hotel project to be developed on the existing Dream Inn Hotel parking lot.

Figure 1: Vicinity Map



The project is located on the North-West corner of West Cliff Drive and Bay Street.

B. *Existing Site Features and Conditions*

The site is an existing 2.14 acre parcel with an existing parking lot used by the Dream Inn. It is relatively flat, sloping from the North West to the south east and paved over 87%. See page 12, Pre Development Drainage Area Map.

The Santa Cruz County Geologic Map indicates the site is underlain by Lowest emergent coastal terrace deposits (Pleistocene), which is described as, semi consolidated, generally well-sorted sand with a few thin, relatively continuous layers of gravel.

According to the NRCS soil report, the restricting layer has a soil permeability of 0.57 in/hr, which is a moderately high capacity to transmit water. Since this rate is

considered feasible for runoff retention, SCMs will be sized to retain the 95th percentile 24-hour rainfall event.

C. *Hydrologic Considerations*

A portion of the existing site's storm water is collected by an on-site storm drain system which connects to the City Storm Drain system near the corner of West Cliff Drive and Bay Street. This runoff flows down the street through the storm drain system and discharges to Monterey Bay waters. The remainder of the site flows to West Cliff Drive at the northeast corner by way of through curb drain(s).

D. *Natural Areas*

There are various trees in the parking lot which will be removed. There is mature redwood and cedar trees bordering the south boundary of the parcel, and a large palm tree on West Cliff Drive which will remain.

E. *Opportunities and Constraints for Stormwater Control*

The roof runoff will be collected with underground storm drain pipes and directed to the on-site storm drainage system, then the project's proposed development area and storm water treatment measures. We understand that a factor of 0.5 is allowed to be applied to the replaced impervious area for retention calculations.

It is noted that the parking level P-1 is 11' floor to floor. This height has been provided to accommodate the slope of any long drainage runs to the treatment systems. The floor to floor height is determined by the architect and will be the responsibility of the design team to ensure that roof drains can be piped to the stormwater control measures within the ceilings of the garages without conflict during the construction documents. The architect also intends to take the drainage to the perimeter at the roof drop point to avoid long runs ay the parking level.

III. Low Impact Development Design Strategies

A. *Use of Permeable Pavements*

The driveway shall be constructed of porous pavement. A portion of the driveway shall be constructed out of porous pavement with a retaining rock bed beneath to minimize the impact upon the existing hydrology.

B. *Stormwater Control Measures*

<u>Tier 1 – Site Design and Runoff Reduction</u>

Site design and runoff reduction at the project will include self-retaining porous pavement areas, where feasible, to minimize storm water runoff. There are also planting areas on the first, second, and third levels.

Tier 2 – Water Quality Treatment

For DMA 1A there will be a CUDO Retention system which will treat the runoff produced by the 85th percentile 24hr storm event as well as a PerkFilter which shall be capable of treating the runoff from the entire DMA 1A area. For DMA 1B and DMA 2 the runoff from the impervious area will be treated using a retention based treatment system (Pervious Pavement). These pavers will treat the runoff produced by the 85th percentile 24hr storm event as well as a PerkFilter which shall be capable of treating the runoff from the entire DMA 1B and DMA 2 areas.

Tier 3 – Runoff Retention

The pervious pavement and CUDO retention system will be sized to provide onsite retention of the 95th percentile 24hr storm event. Sizing of the pervious pavement and CUDO system will meet the greater requirement of the Tier 2 and Tier 3 Stormwater Control Measures.

Tier 4 – Peak Management

This project is exempt from tier 4 requirements. Project runoff discharges to a continuous underground storm drain system that discharges to the marine nearshore waters of the Monterey Bay.

IV. Documentation of Drainage Design

The Stormwater Control Measures were sized using City of Santa Cruz Storm Water Best Management Practices and Public Development Projects Guide.

A. *Descriptions of each Drainage Management Area*

The project site has three drainage management areas for the purposes of design and calculations as shown in overall drainage map found in Attachments 2 & 3.

1. Table of Drainage Management Areas Calculations

DMA	New Impervious Area (sf)	Replaced Impervious Area (sf)	Landscape (sf)	Pervious Pavement (sf)	Overall Area (sf)
1A	2,038	10,207	398	0	12,643
1B	0	25,463	3,555	5,370	34,388
2	0	31,786	4,950	6,352	43,088
	2,038	67,456	8,903	11,722	90,119

2. Drainage Management Area Descriptions

The project site has three drainage management areas. Runoff from the impervious and pervious areas of the DMAs will be directed to the pervious pavement areas and CUDO treatment system for stormwater quality treatment.

B. *Tabulation and Sizing Calculations*

1. Information Summary for LID Facility Design

Porous pavement is provided in an effort to reduce runoff rates and pollutant loading.

DMA	Pervious Pavement Area Provided (sf)
1B	5,370
2	6,352

2. Self-Treating Areas

All unaltered and landscaped areas are self-treating.

3. Self-Retaining Areas

Porous pavement areas with the ability to collect and retain runoff in the aggregate drain rock are considered self-retaining.

4. Stormwater Treatment

Treatment for the project's runoff will be collected and directed towards in the case of DMA 1B and DMA 2 the pervious pavement area and, in the case of DMA 1A, CUDO retention system to be treated. DMA 1A and combined DMA 1B and 2 shall also be treated with a PerkFilter Treatment system. A volume based design using the 85th percentile 24hr storm event is used to calculate the amount of volume that is to be infiltrated for each DMA. The CUDO system in DMA 1A will be able to treat runoff at a volume of 608 cf. The pervious pavement area in DMA 1B will be able to treat runoff at a volume of 1,526 cf. The pervious pavement area in DMA 2 will be able to treat runoff at a volume of 1,794 cf. A flow based design using 0.2 in/hr is used to determine the treatment flow rate for each system. DMA 1A requires a treatment flow rate of 0.05 and DMAS 1B and 2 require a treatment flow rate of 0.27.

PerkFILTERs (Flow Based Treatment)					
DMA	Area (sf)	Area (ac)	Runoff Coefficient, C	Storm Intensity, i (in/hr)	Treatment Flow (CFS)
1A	12,245	0.28	0.90	0.20	0.05
1B & 2	68,971	1.59	0.85	0.20	0.27

Permeable Pavers (Volume Based Treatment)						
DMA	Pervious Pavement Retention Area (sf)	Soil Permeability (in/hr)	Treatment Flow (cfs)	Retention Depth Required (in)	Retention Volume Required (cf)	Retention Volume Provided (cf)
1B	3,816	0.57	0.050	10	1,246	1,526
2	4,486	0.57	0.059	11	1,547	1,794

CUDO System (Volume Based Treatment)						
DMA	CUDO Retention Area (sf)	Soil Permeability (in/hr)	Treatment Flow (cfs)	Retention Depth Required (in)	Retention Volume Required (cf)	Retention Volume Provided (cf)
1A	320	0.57	0.004	22	569	608

5. Retention Sizing

The NRCS soil permeability for the surface soil at the site is 0.57 in/hr at the most limiting layer. Therefore, DMA 1A, DMA 1B and DMA 2 will be sized to provide runoff retention of the 95th percentile 24hr storm event. Due to the site's Watershed Management Zone, a factor of 0.5 was applied to replaced impervious area to determine the retention requirement.

Permeable Pavers (Volume Based Treatment)						
DMA	Pervious Pavement Retention Area (sf)	Soil Permeability (in/hr)	Treatment Flow (cfs)	Retention Depth Required (in)	Retention Volume Required (cf)	Retention Volume Provided (cf)
1B	3,816	0.57	0.050	5	544	1,526
2	4,486	0.57	0.059	5	678	1,794
CUDO System (Volume Based Treatment)						
DMA	CUDO Retention Area (sf)	Soil Permeability (in/hr)	Treatment Flow (cfs)	Retention Depth Required (in)	Retention Volume Required (cf)	Retention Volume Provided (cf)
1A	320	0.57	0.004	17	444	608

The pervious pavement has been sized to provide the greater runoff retention volume which meets the runoff requirement from both the 85th and 95th percentile 24hr storm events. This will meet the necessary Tier 2 and Tier 3 requirements.

V. Source Control Measures

A. Site Activities and Potential Sources of Pollutants

The drain inlets are currently the only potential Source of runoff Pollutants.

B. Source Control Table

Potential Source of Runoff Pollutants	Permanent Source Control BMPs	Operational Source Control BMPs
On-site storm drain inlets (unauthorized non-storm water Discharges and accidental spills or leaks)	Mark all inlets with the words "No Dumping! Flows to Bay" or similar.	Maintain and periodically repaint or replace inlet markings.

VI. Stormwater Facility Maintenance

A. *Ownership and Responsibility for Maintenance in Perpetuity*

Owner accepts responsibility for interim operation and maintenance of stormwater treatment and flow-control facilities until such time as this responsibility is formally transferred to a subsequent owner. A signed maintenance agreement is provided with this plan and will be signed for any transference of ownership.

B. *Summary of Maintenance Requirements for Each Stormwater Facility*

The owner shall have an inspection done at all stormwater facilities bi-annually and following significant storms. We recommend that the inspections be done concurrently with the monthly landscaping operation. The inspections of the stormwater facilities include, but are not limited to cleanouts, catch basins, inlet risers, and structures. The inspections shall be conducted as follows:

- Visually inspect for structural function and integrity, and record any damaged occurred.
- Check for any accumulated sediments on and inside the drainage facilities.
- Check for any signs of erosion resulting from drainage overflow or failures.
- Record all completed inspections on 8.5x11 sheets, including a site plan.
- Maintenance shall be conducted for any deficiencies noted during inspection. Maintenance shall be provided per the guidelines in section VI.C.

C. *Short- and long-term maintenance requirements and recommended frequency:*

- Owner shall vacuum sweep all porous pavement every 2 years or as needed.
- Regular maintenance shall be provided, at least once before and after the winter season, on all stormwater facilities to maintain proper drainage.
- For catch basins, inlet risers, and treatment device, perform the following:
  - Remove any accumulation of sediments, litters, and debris.

- Repair any damages to pipes or structures.
- Repair or replenish rip rap rock at outfall structures.

VII. **Certification**

A. The conceptual design of stormwater treatment facilities and other stormwater pollution control measures in this plan are in accordance with the current edition of the City of Santa Cruz Storm Water Best Management Practices and Public Development Projects, March 2014.

Attachment 1:

BMP WORKSHEET

APPENDIX A
STORM WATER AND LOW-IMPACT DEVELOPMENT BMP REQUIREMENT WORKSHEET

How to Use This Worksheet

The City's Storm Water BMP requirements are based on project type, proposed impervious area, and location within the watershed. This worksheet was developed to help permit applicants determine and meet storm water BMP requirements applicable to a proposed development or redevelopment

1 - Download this fillable form online at **www.cityofsantacruz.com/LID**
2 - Fill out the Worksheet to determine what stormwater BMP requirements apply to a proposed project.
3 - Attach Worksheet and additional documentation required as listed in the City Storm Water Best Management Practices for Private and Public Development Projects to plans for review by the Department of Public Works
4 - Please contact the Public Works Environmental Project Analyst at 420-5160 if you have any questions on completing the worksheet.

Project Address: Cliff & Bay - 190 West Cliff Drive **Bldg Permit #:** CP18-0043

A - Project Type

Check project type that applies:

☐ Single Family Home ☑ Multi-family, Commercial, Industrial, Public facilities

Check development type that applies:

☐ New Development ☑ Redevelopment / Remodel

B - Proposed Development Area and Impervious Area:

Pre-project impervious surface area:	84,572	sq ft
Post-project impervious surface area:	79,320	sq ft
Amount of impervious surface area that will be **replaced**:	77,282	sq ft
Amount of new impervious surface area that will be **created**:	2,038	sq ft
Reduced Impervious Area Credit:	5252	sq ft
New and Replaced Impervious Area =	**79320**	**sq ft**
Net Impervious Area =	**74068**	**sq ft**

(Net Impervious Area = Impervious Area created + Impervious Area replaced - Reduced Impervious Area Credit)

C - Post-Construction BMP Tier requirement:

Check Project Type and Impervious Area (from calculations above) that applies.
BMP requirements are cumulative (e.g. a project subject to BMP Tier 3 is also subject to Tiers 1 and 2), permit review fees are not cumulative.
Projects requiring a Stormwater Control Plan will need to involve a civil engineer.

SINGLE-FAMILY HOMES	BMP TIER	Permit Review Fee	Stormwater Control Plan required?
☐ Single-family Home with Net Impervious Area **< 15,000 sf**, **please consult Chapter 6A, BMPs for Single-Family Homes on Small Lots**	**N/A**	$0	No
☐ Net Impervious Area **≥ 15,000 sf**; New and replaced impervious area **< 22,500 sf**	**3**	$330	Yes
☐ New and replaced impervious area **≥ 22,500 sf**	**4**	$550	Yes

MULTI-FAMILY, COMMERCIAL, INDUSTRIAL, PUBLIC FACILITIES	BMP TIER	Permit Review Fee	Stormwater Control Plan Required?
☐ New and Replaced Impervious Area **≥ 2,500 sf**; Net Impervious Area **< 5,000 sf**	**1**	$0	No
☐ Net Impervious Area **≥ 5,000 sf**; New and Replaced Impervious Area **< 15,000 sf**	**2**	$330	Yes
☐ New and Replaced Impervious Area **≥ 15,000 sf** but **< 22,500 sf**	**3**	$550	Yes
☑ New and replaced impervious area **≥ 22,500 sf**	**4**	$550	Yes

If the proposed project is only subject to BMP Tiers 1 or 2, skip to Step F.

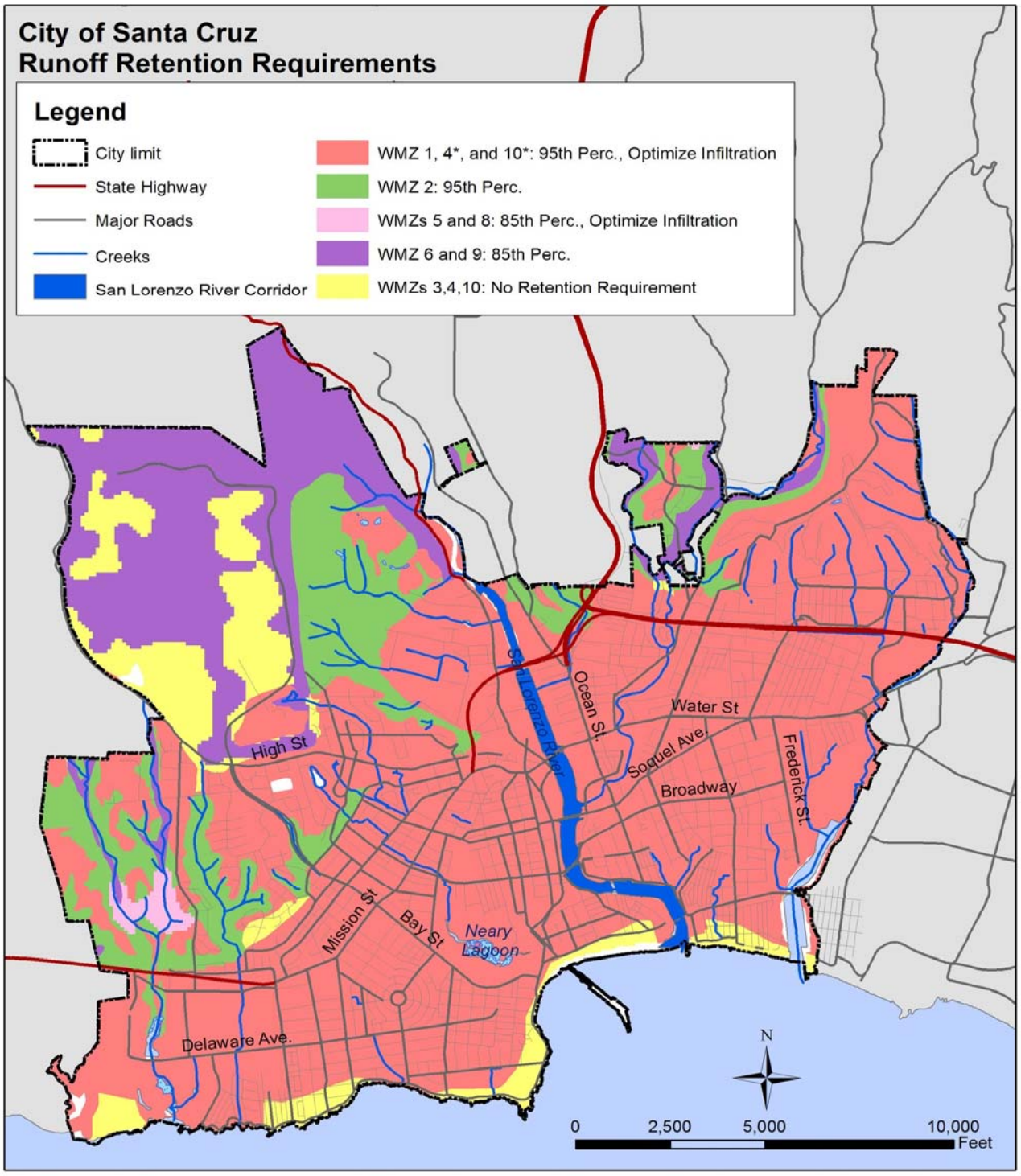
D - Watershed Management Zones - For projects subject to Tiers 3 Post-Construction BMP requirements only.

Watershed Management Zones are viewable online on the City of Santa Cruz GIS website at: http://gis.cityofsantacruz.com/gis/index.html

Watershed Management Zones and associated Tier 3 (Runoff Retention) Post-Construction BMP requirements

If Tier 3 BMP requirements are applicable to the project, check the watershed management zone area where the project is located.

- ☑ WMZ 1, and portions of 4, and 10 overlying groundwater basin
- ☐ WMZ 2
- ☐ WMZ 5 and 8
- ☐ WMZ 6 and 9
- ☐ WMZ 3, 4 and 10



E - Special Circumstances - For projects subject to Tiers 3 and 4 Post-Construction BMP requirements only.
Check if special circumstance applies to the project

- ☐ Highly Altered Channel and Intermediate Flow Control Facility
- ☐ Urban Sustainability Area

F - Additional Stormwater BMP Requirements for Multi-family, Commercial and Industrial projects
Check if additional BMP requirements apply to the project

a) State Construction Activities Storm Water General Permit

- ☑ Construction activity resulting in land disturbance of one acre or more, or part of a larger common plan of development

b) Additional Source Control BMP requirements for specific facilities

- ☑ Commercial or industrial facility
- ☐ Material Storage Areas
- ☐ Vehicle fueling, maintenance and wash areas
- ☐ Equipment and accessory wash areas
- ☑ Interior and parking garage floor drains
- ☑ Parking areas
- ☑ Pools, spas and other water features
- ☑ Trash Storage Areas
- ☑ Restaurants and food processing or manufacturing facilities
- ☐ Miscellaneous drain or wash water

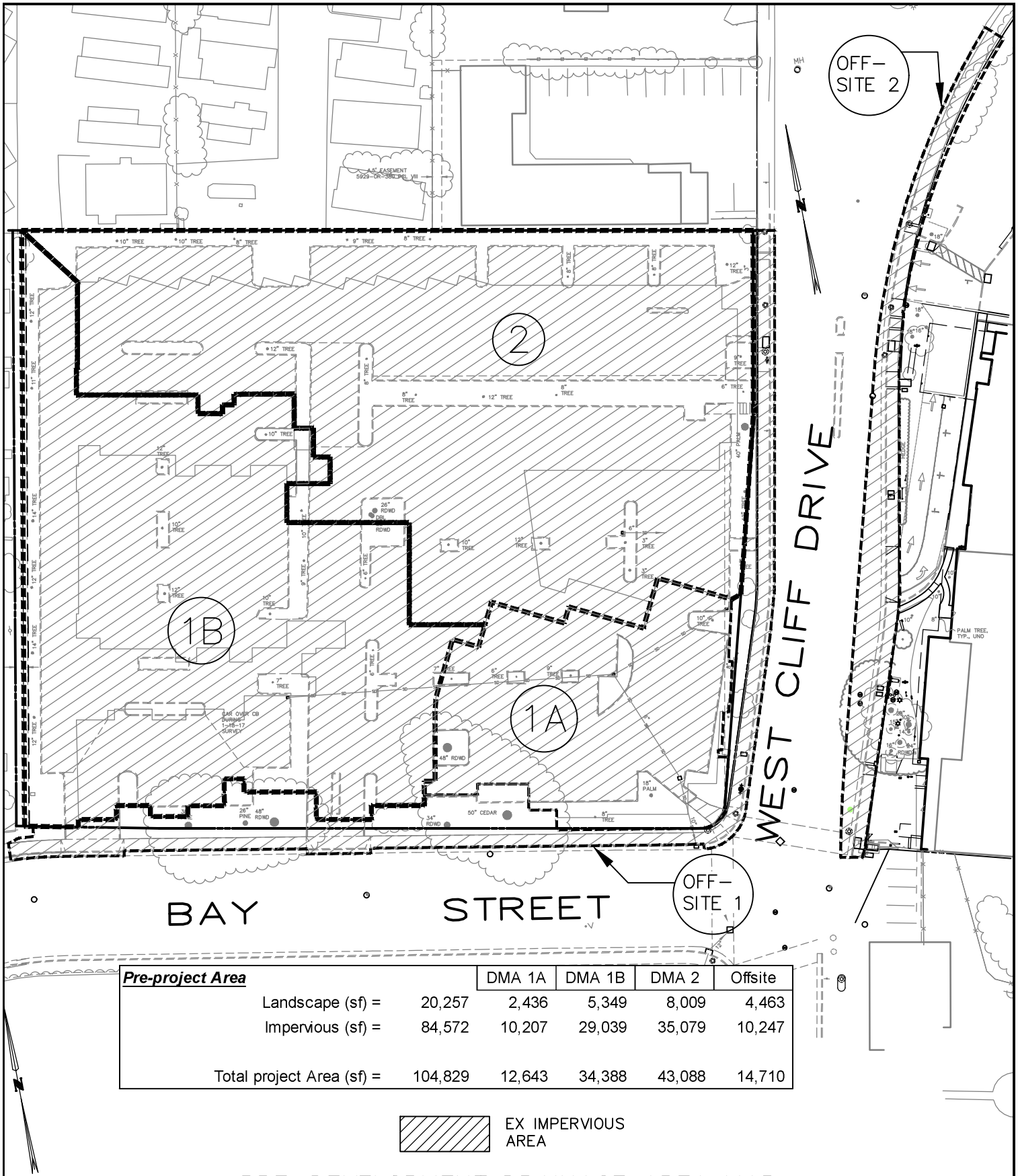
G - Complete if your project is <u>only</u> subject to Tier 1 Requirements - Site planning and LID design measures.
LID design measures shall be clearly marked on site plans

Check applicable boxes and provide short description of measure and location

- ☐ Conserve natural areas, riparian areas and wetlands
  Description: _____
- ☐ Concentrate improvements on the least-sensitive portions of the site and minimize grading
  Description: _____
- ☐ Direct roof runoff into cisterns or rain barrels
  Description: _____
- ☐ Direct roof downspouts to landscaped areas or rain gardens
  Description: _____
- ☐ Use pervious pavement (pervious concrete or asphalt, turf block, crushed aggregate, etc.)
  Description: _____
- ☐ Disperse runoff from paved areas to adjacent pervious areas
  Description: _____

Attachment 2:

PRE- DEVELOPMENT DRAINAGE AREA MAP



Pre-project Area		DMA 1A	DMA 1B	DMA 2	Offsite
Landscape (sf) =	20,257	2,436	5,349	8,009	4,463
Impervious (sf) =	84,572	10,207	29,039	35,079	10,247
Total project Area (sf) =	104,829	12,643	34,388	43,088	14,710

EX IMPERVIOUS AREA

PRE-DEVELOPMENT DRAINAGE AREA MAP

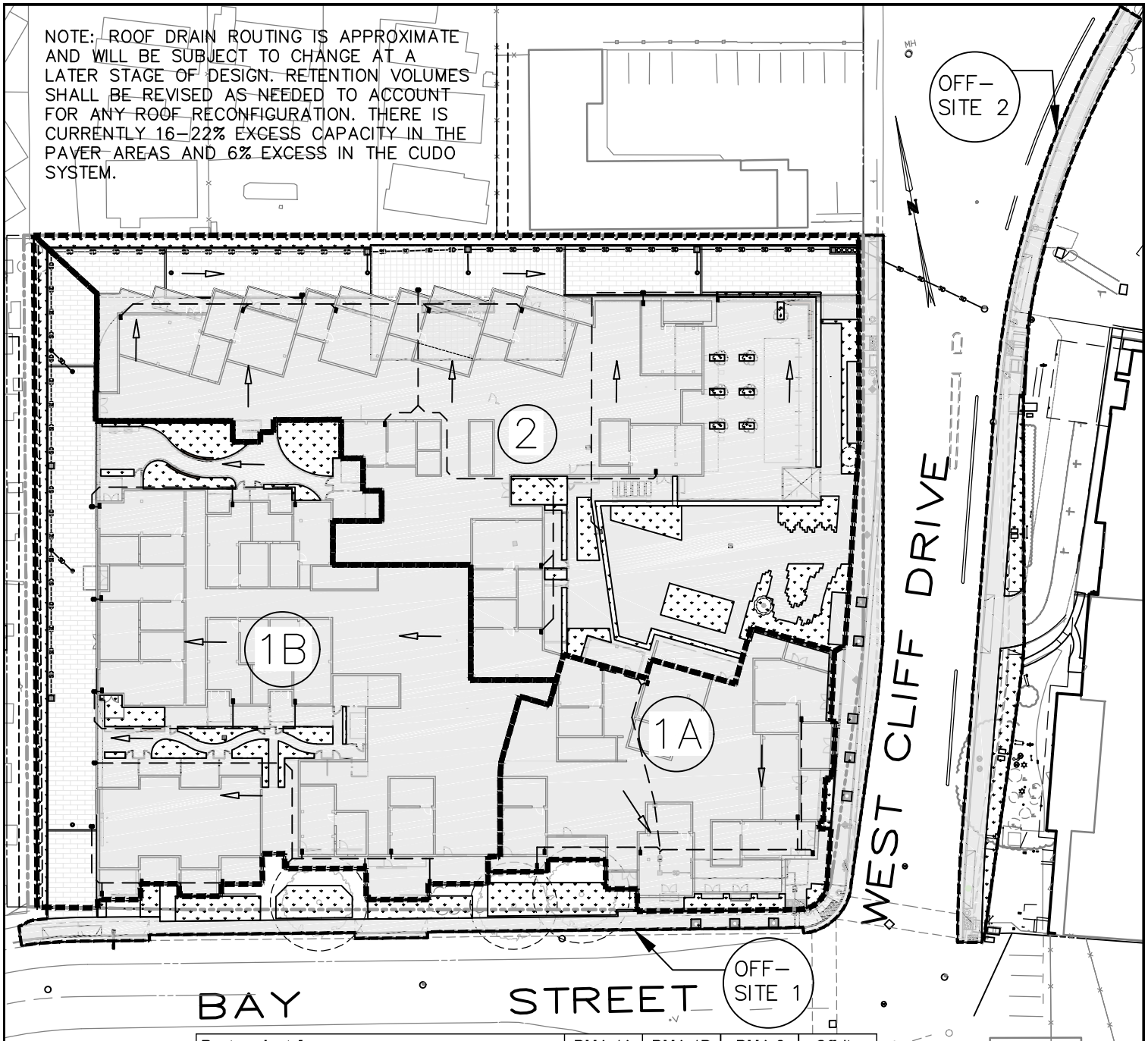
BOWMAN & WILLIAMS
CONSULTING CIVIL ENGINEERS
AND LAND SURVEYORS
3949 RESEARCH PARK CT., STE 100, SOQUEL CA 95073

SCALE 1"=60'	JOB NO. 26202
DATE MAY 15, 2018	DWG NAME
DRAWN ML	FILE NO. 26202

Attachment 3:

POST-DEVELOPMENT DRAINAGE AREA MAP

NOTE: ROOF DRAIN ROUTING IS APPROXIMATE AND WILL BE SUBJECT TO CHANGE AT A LATER STAGE OF DESIGN. RETENTION VOLUMES SHALL BE REVISED AS NEEDED TO ACCOUNT FOR ANY ROOF RECONFIGURATION. THERE IS CURRENTLY 16–22% EXCESS CAPACITY IN THE PAVER AREAS AND 6% EXCESS IN THE CUDO SYSTEM.



Post-project Area		DMA 1A	DMA 1B	DMA 2	Offsite
Pervious Pavement (sf) =	11,722	-	5,370	6,352	0
Replaced Impervious (sf)=	77,282	10,207	25,463	31,786	9,826
New Impervious (sf)=	2,038	2,038	-	-	0
Landscape (sf) =	13,787	398	3,555	4,950	4,884
Total SWCP Area (sf) =	90,119	12,643	34,388	43,088	0
To Offsite (sf)=	14,710				
Total project Area (sf) =	104,829				
1/2 replaced impervious (sf)	38,641	5,104	12,732	15,893	

IMPERVIOUS | LANDSCAPE | PERVIOUS PAVEMENT | DIRECTION OF SURFACE FLOW

POST–DEVELOPMENT DRAINAGE AREA MAP

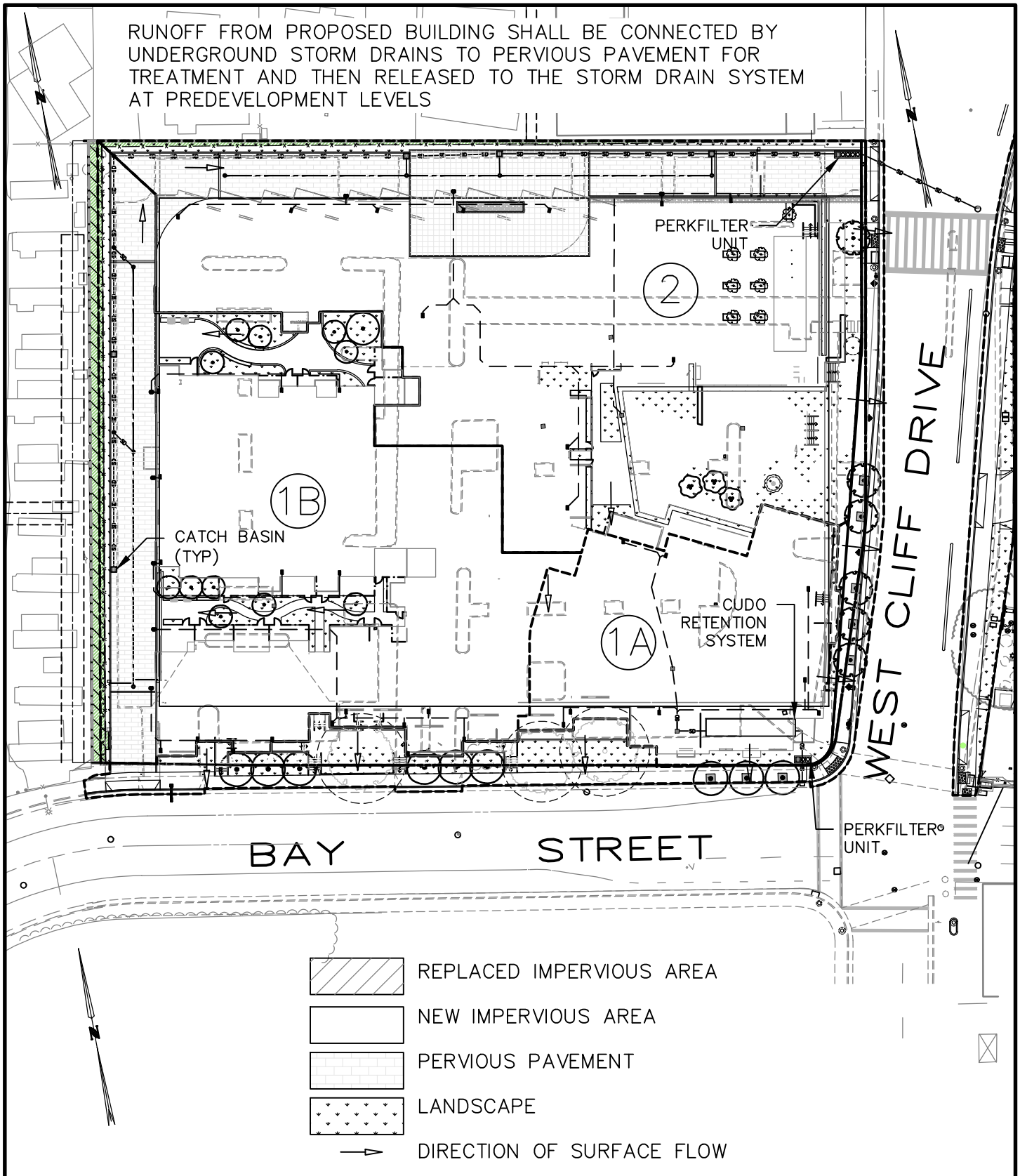
BOWMAN & WILLIAMS
CONSULTING CIVIL ENGINEERS
AND LAND SURVEYORS
3949 RESEARCH PARK CT., STE 100, SOQUEL CA 95073

SCALE 1"=60'	JOB NO. 26202
DATE NOVEMBER 20, 2018	DWG NAME
DRAWN ML	FILE NO. 26202

Attachment 4:

STORMWATER CONTROL MEASURE PLAN

RUNOFF FROM PROPOSED BUILDING SHALL BE CONNECTED BY UNDERGROUND STORM DRAINS TO PERVIOUS PAVEMENT FOR TREATMENT AND THEN RELEASED TO THE STORM DRAIN SYSTEM AT PREDEVELOPMENT LEVELS



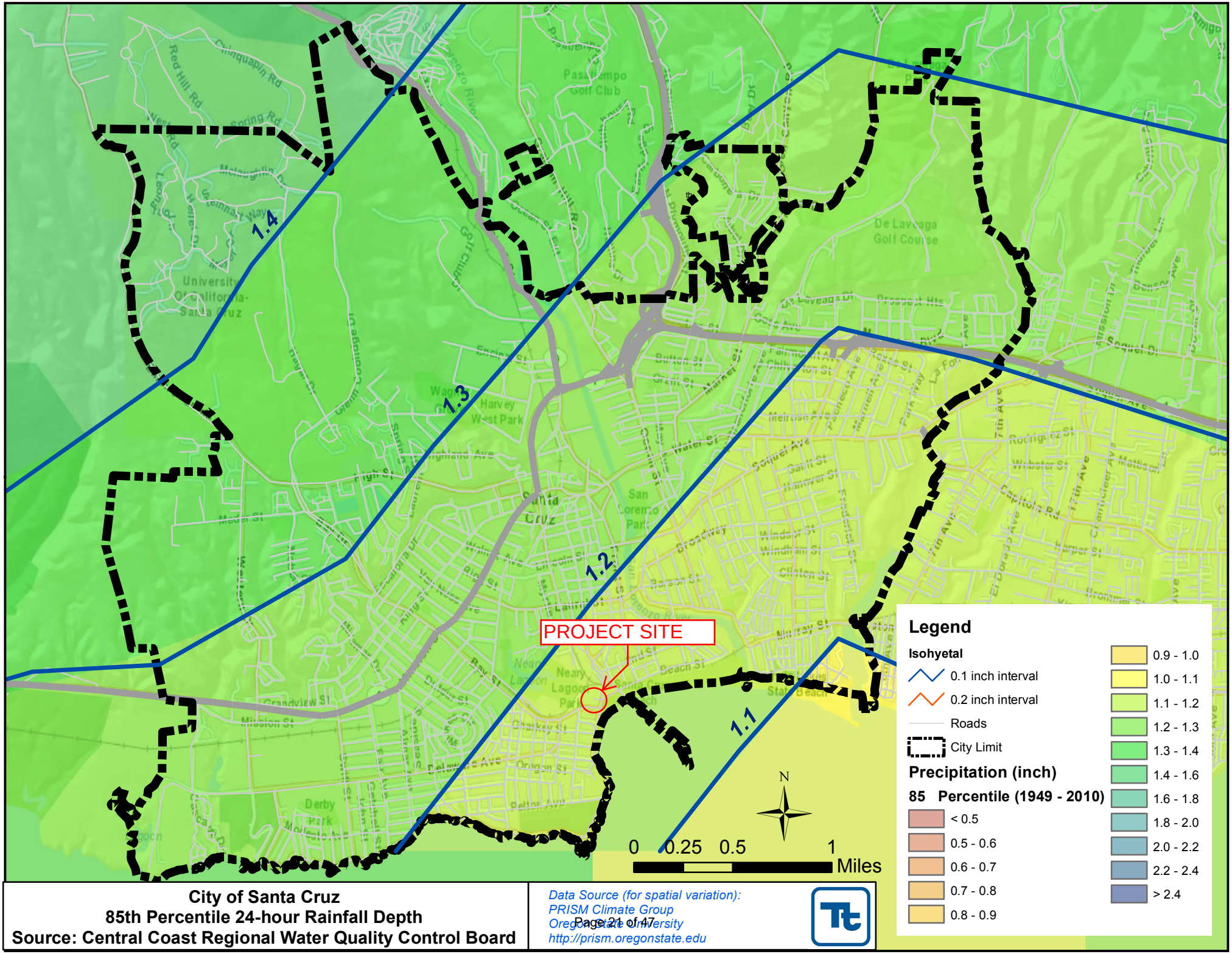
STORM WATER CONTROL MEASURE PLAN

BOWMAN & WILLIAMS
CONSULTING CIVIL ENGINEERS
AND LAND SURVEYORS
1011 CEDAR STREET SANTA CRUZ CA 426-3560

SCALE 1"=60'	JOB NO. 26202
DATE MAY 15, 2018	DWG NAME 26202 SCWM PLAN
DRAWN ML	FILE NO. 26202

Attachment 5:

CITY OF SANTA CRUZ 85TH PERCENTILE RAINFALL DEPTH



City of Santa Cruz
85th Percentile 24-hour Rainfall Depth
Source: Central Coast Regional Water Quality Control Board

Data Source (for spatial variation):
PRISM Climate Group
Oregon State University
http://prism.oregonstate.edu

Attachment 6:

STORMWATER TREATMENT CALCULATIONS

Storm Water Flow Conveyance Calculations
190 West Cliff Dr. - Application No. CP18-0043
SANTA CRUZ, CA
BOWMAN & WILLIAMS FILE: 26202
September 19, 2018

Project Data

PROJECT DEVELOPMENT AREA AND IMPERVIOUS AREA

Pre-project Area		DMA 1A	DMA 1B	DMA 2	Offsite
Landscape (sf) =	20,257	2,436	5,349	8,009	4,463
Impervious (sf) =	84,572	10,207	29,039	35,079	10,247
Total project Area (sf) =	104,829	12,643	34,388	43,088	14,710

Post-project Area		DMA 1A	DMA 1B	DMA 2	Offsite
Pervious Pavement (sf) =	11,722	-	5,370	6,352	0
Replaced Impervious (sf)=	77,282	10,207	25,463	31,786	9,826
New Impervious (sf)=	2,038	2,038	-	-	0
Landscape (sf) =	13,787	398	3,555	4,950	4,884
Total SWCP Area (sf) =	90,119	12,643	34,388	43,088	0
To Offsite (sf)=	14,710				
Total project Area (sf) =	104,829				
1/2 replaced impervious (sf)	38,641	5,104	12,732	15,893	

PROJECT POST CONSTRUCTION BMP REQUIREMENTS

New & Replaced Impervious Area (sf)=	79,320	12,245	25,463	31,786
Tier Requirement (sf)=	4			

Flow Rate Calculations

Area Description	Area (ft2)	Area (AC)	C	A*C
Permeable Pavers	11,722	0.27	0.60	0.16
Landscape	13,787	0.32	0.30	0.09
Impervious Surfaces	79,320	1.82	0.90	1.64
	Total:	2.41		1.90
	Weighted C=	0.79		

Intensity for Storm
10 Year: $I=10.6110T^{-0.5370}$
25 Year: $I=11.40110T^{-0.5384}$

Runoff Flow Calculations

Description	Area (ac)	C	C_a	T_c (min)	I (in/hr)	Q (cfs)
10 Year Return	2.41	0.79	1.00	10	3.081	**5.84**
25 Year Return	2.41	0.79	1.10	10	3.300	**6.88**

Storm Water Treatment Flow Based Calculations - DMA 1A

190 West Cliff Dr. - Application No. CP18-0043

SANTA CRUZ, CA
BOWMAN & WILLIAMS FILE: 26202
September 19, 2018

Project Data

PROJECT DEVELOPMENT AREA AND IMPERVIOUS AREA

Pre-project Area

Landscape =	2,436	sf
Impervious =	10,207	sf
Total =	12,643	sf

Post-project Area

Pervious Pavement =	0	sf
Replaced Impervious =	10,207	sf
New Impervious =	2,038	sf
Landscape =	398	sf
Total =	12,643	sf

1/2 replaced impervious	5,104	sf

PROJECT POST CONSTRUCTION BMP REQUIREMENTS

New & Replaced Impervious Area =	12,245	sf
Tier Requirement =	4	

Flow Rate Calculations

Area Description	Area (ft2)	Area (AC)	C	A*C
Permeable Pavers	0	0.00	0.60	0.00
Impervious Surfaces	12,245	0.28	0.90	0.25
	Total:	0.28		0.25
	Weighted C=	0.90		

Intensity for Storm

Non-retention based Treatment systems using a flow hydraulic design basis shall be sized to treat the flow of runoff produced by a rain event equal to at least 0.2 inches per hour intensity.

i = 0.2 in/hr

Runoff Flow Calculations

Description	Area (ac)	C	C_a	I (in/hr)	Q (cfs)
DMA 1A	0.28	0.90	1.00	0.20	**0.05**

Storm Water Treatment Flow Based Calculations - DMA 1B
190 West Cliff Dr. - Application No. CP18-0043
SANTA CRUZ, CA
BOWMAN & WILLIAMS FILE: 26202
September 19, 2018

Project Data

PROJECT DEVELOPMENT AREA AND IMPERVIOUS AREA

Pre-project Area

Landscape =	5,349	sf
Impervious =	29,039	sf
Total =	34,388	sf

Post-project Area

Pervious Pavement =	5,370	sf
Replaced Impervious =	25,463	sf
New Impervious =	0	sf
Landscape =	3,555	sf
Total =	34,388	sf
1/2 replaced impervious	12,732	sf

PROJECT POST CONSTRUCTION BMP REQUIREMENTS

Area To Be Treated =	30,833	sf
Tier Requirement =	4	

Flow Rate Calculations

Area Description	Area (ft2)	Area (AC)	C	A*C
Permeable Pavement	5,370	0.12	0.60	0.07
Impervious Surfaces	25,463	0.58	0.90	0.53
	Total:	0.71		0.60
	Weighted C=	0.85		

Intensity for Storm

Non-retention based Treatment systems using a flow hydraulic design basis shall be sized to treat the flow of runoff produced by a rain event equal to at least 0.2 inches per hour intensity.

i = 0.2 in/hr

Runoff Flow Calculations

Description	Area (ac)	C	C_a	I (in/hr)	Q (cfs)
DMA 1B	0.71	0.85	1.00	0.20	**0.12**

Storm Water Treatment Flow Based Calculations - DMA 2

190 West Cliff Dr. - Application No. CP18-0043

SANTA CRUZ, CA
BOWMAN & WILLIAMS FILE: 26202
September 19, 2018

Project Data

PROJECT DEVELOPMENT AREA AND IMPERVIOUS AREA

Pre-project Area

Landscape =	8,009	sf
Impervious =	35,079	sf
Total =	43,088	sf

Post-project Area

Pervious Pavement =	6,352	sf
Replaced Impervious =	31,786	sf
New Impervious =	0	sf
Landscape =	4,950	sf
Total =	43,088	sf
1/2 replaced impervious	15,893	sf

PROJECT POST CONSTRUCTION BMP REQUIREMENTS

Area To Be Treated =	38,138	sf
Tier Requirement =	4	

Flow Rate Calculations

Area Description	Area (ft2)	Area (AC)	C	A*C
Permeable Pavement	6,352	0.15	0.60	0.09
Impervious Surfaces	31,786	0.73	0.90	0.66
	Total:	0.88		0.74
	Weighted C=	0.85		

Intensity for Storm

Non-retention based Treatment systems using a flow hydraulic design basis shall be sized to treat the flow of runoff produced by a rain event equal to at least 0.2 inches per hour intensity.

i = 0.2 in/hr

Runoff Flow Calculations

Description	Area (ac)	C	C_a	I (in/hr)	Q (cfs)
DMA 2	0.88	0.85	1.00	0.20	**0.15**

Tier 2 Water Quality Calculations
190 West Cliff Dr. - Application No. CP18-0043
SANTA CRUZ, CA
BOWMAN & WILLIAMS FILE: 26202
September 19, 2018

RETENTION CALCULATIONS

DMA	RUNOFF COEFFICIENT, C	SCM TRIBUTARY DRAINAGE AREA (SF)	IMPERVIOUS AREA (SF)	IMPERVIOUS AREA FRACTION, i
1A	0.61	12,643	10,207	13/16
1B	0.53	34,388	25,463	12/16
2	0.53	43,088	31,786	12/16

DMA	85TH - 24 HR RAINFALL(IN)	TREATMENT VOLUME (CF)	OVERALL SCM AREA (SF)	ALLOWED AREA FOR INFILTRATION (SF)
1A	1.10	569	320	320
1B	1.10	1,246	3,816	3,816
2	1.10	1,547	4,486	4,486

SCM Drain Time Calculation

The NRCS soil permeability = 0.57 in/hr

SCM	MIN REQ'D DRAIN ROCK DEPTH (IN)*	CFS	TIME TO EMPTY (HOURS)
1A	22.0	0.004	40
1B	10.0	0.050	8
2	11.0	0.059	8

*Depth for SCM 1A is a chamber depth (not drain rock depth).

VOLUME SUMMARY

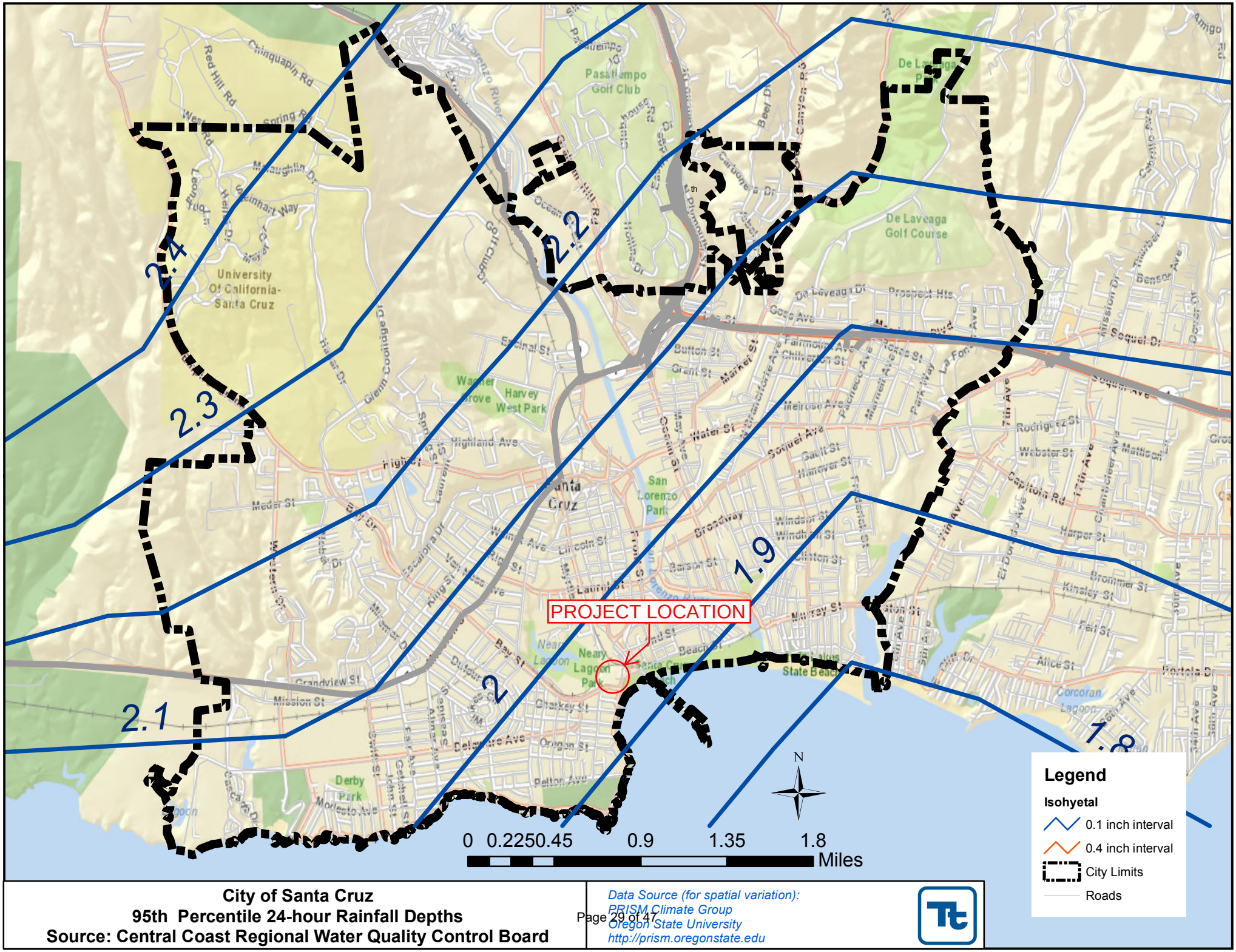
SCM	DEPTH PROVIDED (IN)	VOLUME INCLUDING ROCK (CF)**	ACTUAL VOLUME (CF)	EXCESS VOLUME (CF)
1A	24	NA	608	39
1B	12.0	3180	1526	280
2	12.0	4112	1794	247

**SCM 1A does not include drain rock

EXCESS VOLUME PROVIDED 567

Attachment 7:

CITY OF SANTA CRUZ 95TH PERCENTILE RAINFALL DEPTH



City of Santa Cruz
95th Percentile 24-hour Rainfall Depths
Source: Central Coast Regional Water Quality Control Board

Data Source (for spatial variation):
PRISM Climate Group
Oregon State University
http://prism.oregonstate.edu

Attachment 8:

STORMWATER RETENTION CALCULATIONS

Tier 3 - Storm Water Retention Calculations
190 West Cliff Dr. - Application No. CP18-0043
SANTA CRUZ, CA
BOWMAN & WILLIAMS FILE: 26202
September 19, 2018

RETENTION CALCULATIONS

DMA	RUNOFF COEFFICIENT, C*	SCM TRIBUTARY DRAINAGE AREA (SF)	NEW IMPERVIOUS + 50% REPLACED IMPERVIOUS AREA (SF)	IMPERVIOUS AREA FRACTION, i**
1A	0.38	12,643	7,142	9/16
1B	0.26	34,388	12,732	6/16
2	0.26	43,088	15,893	6/16

* $C = 0.858i^3 - 0.78i^2 + 0.774i + 0.04$
** i = the fraction of the DMA that is impervious

DMA	95TH - 24 HR RAINFALL(IN)	TREATMENT VOLUME (CF)	OVERALL SCM AREA (SF)	ALLOWED AREA FOR INFILTRATION (SF)
1A *	1.95	444	320	320
1B	1.95	544	3,816	3,816
2	1.95	678	4,486	4,486

* USE RETENTION STRUCTURE LIKE CUL 1,667

SCM Drain Time Calculation

The NRCS soil permeability = 0.57 in/hr

SCM	MIN REQ'D DRAIN ROCK DEPTH (IN)	CFS	TIME TO EMPTY (HOURS)
1A	N/A	0.004	40
1B	5.0	0.050	21
2	5.0	0.059	21

VOLUME SUMMARY

SCM	DEPTH PROVIDED (IN)	ACTUAL VOID VOLUME (CF)	ACTUAL VOLUME w/ ROCK IF OCCURS (CF)	EXCESS VOLUME (CF)
1A	N/A	608	608	164
1B	12.0	544	3,816	2,455
2	12.0	678	4,486	2,792

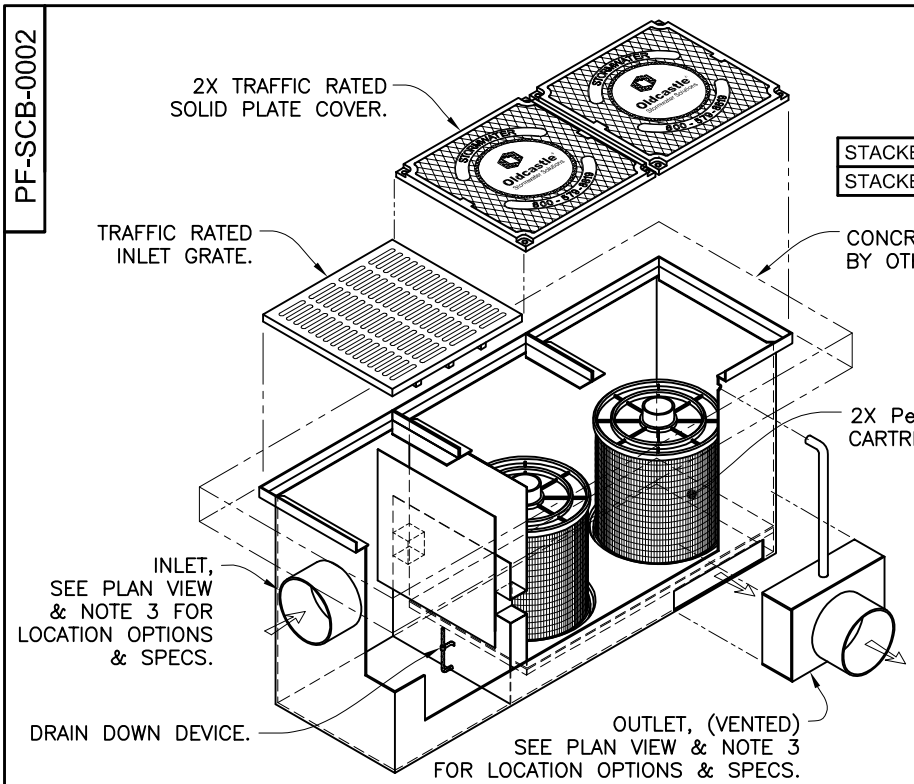
EXCESS VOLUME PROVIDED 8,910 5,410

Attachment 9:

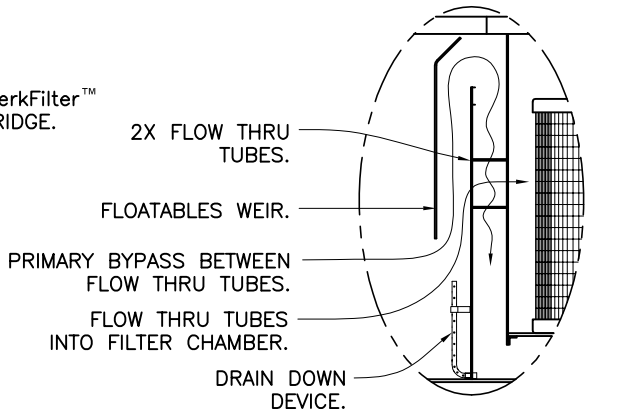
PERKFILTER TREATMENT UNITS

PF-SCB-0002

	CARTRIDGE SIZE	TREATMENT FLOW RATE GPM / CFS	TOTAL FLOW CAPACITY CFS	MINIMUM DEPTH (FEET)
	12.00"	24 / 0.05	1.3	1.80
	18.00"	36 / 0.08	1.3	2.34
STACKED	12.00" + 12.00"	48 / 0.11	1.3	3.08
STACKED	18.00" + 12.00"	60 / 0.13	1.3	3.67



ISOMETRIC VIEW

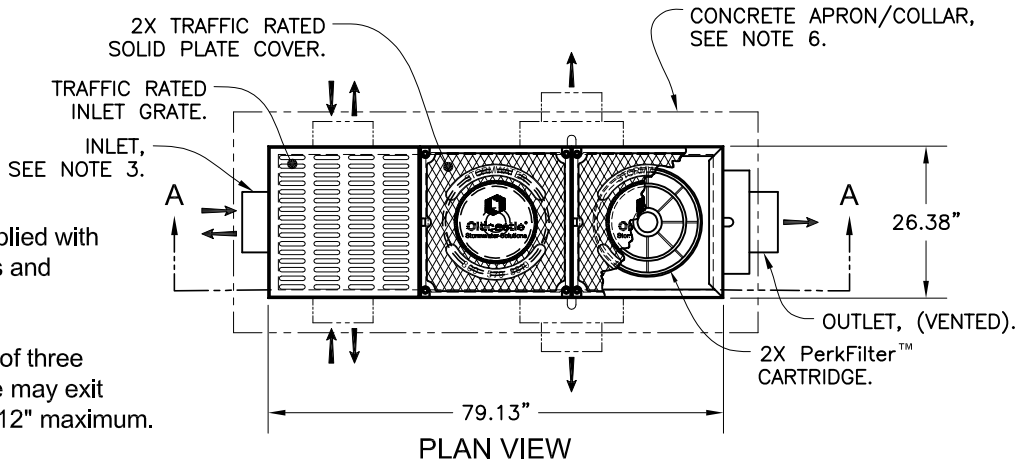


DETAIL A

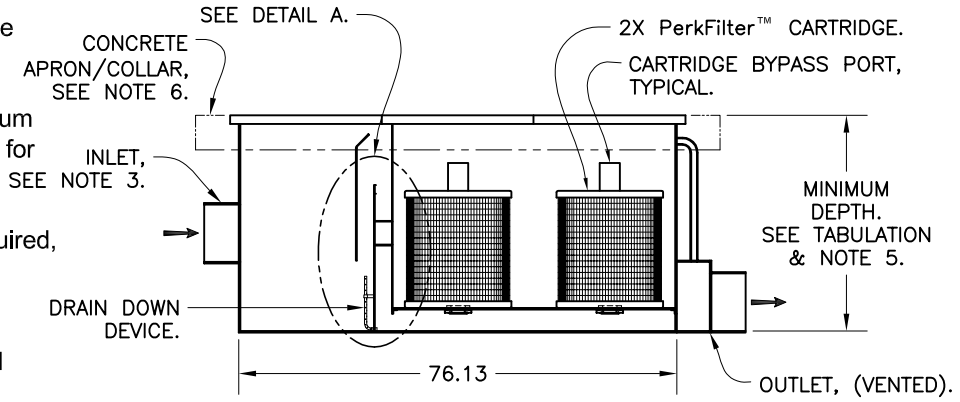
INLET / BYPASS ASSEMBLY & DRAIN DOWN SCALE: 1.5X

Notes:

1. All steel utilized in fabrication and shall be 1/4" plate per ASTM A36.
2. PerkFilter™ Catch basin shall be supplied with traffic rated (H20) bicycle-proof grates and solid plate cover.
3. Inlet pipe(s) may enter device on any of three sides of the inlet chamber. Outlet pipe may exit on any of all four sides. All pipe is Ø 12" maximum.
4. Inlet chamber shall be supplied with a DRAIN DOWN device designed to remove standing water between storm events.
5. For depths less than the specified minimum contact Oldcastle® Stormwater Solutions for engineering assistance.
6. Field poured Concrete Apron / Collar required, by others. Refer to PF-SCB-1000 for recommended configuration.
7. PerkFilter™ cartridge shall be maintained in accordance with manufacturer recommendations.



PLAN VIEW



SECTION A-A

Media Filtration

PerkFilter™

Steel Catch Basin

Double Cartridge

(End Grate Configuration)

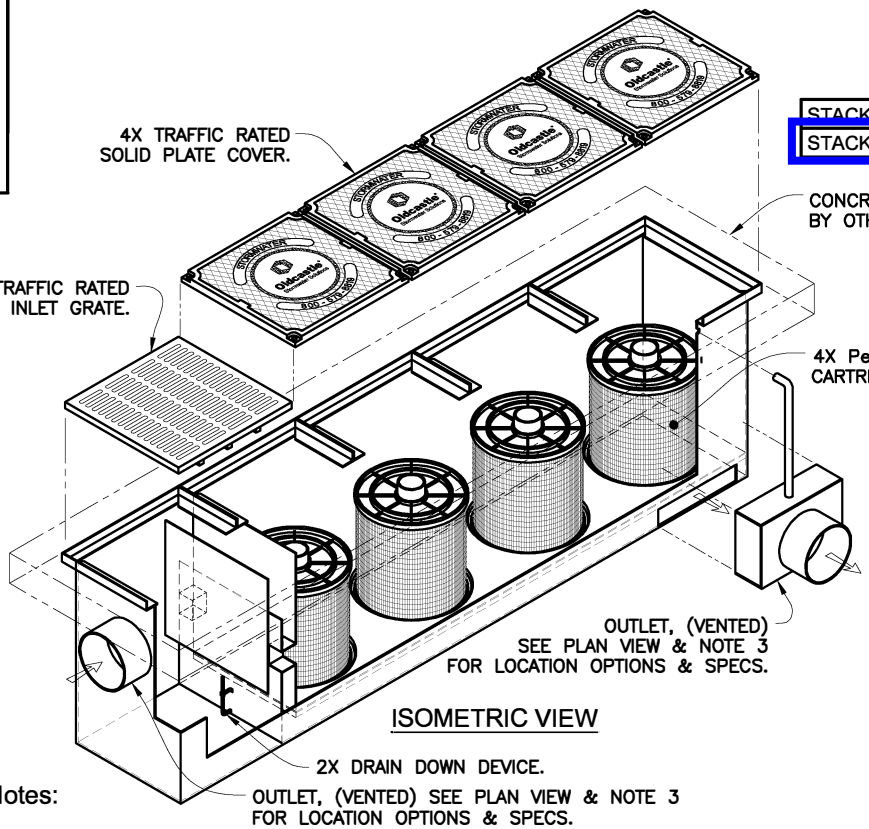
Oldcastle® Stormwater Solutions

7921 Southpark Plaza, Suite 200 | Littleton, CO | 80120 | Ph: 800.579.8819 | oldcastlestormwater.com

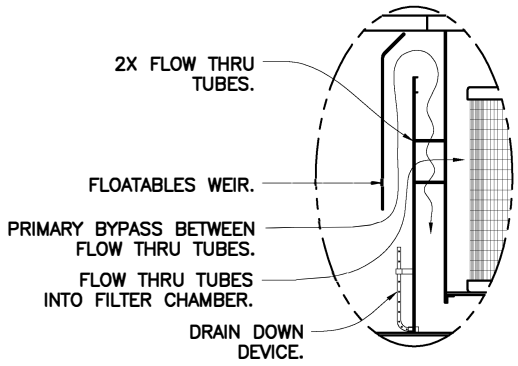
DRAWING NO.	REV	ECO	DATE	
PF-SCB-0002	NR	ECO-0143 NEW	JPR 12/2/16	SHEET 1 OF 1

PF-SCB-0006

	CARTRIDGE SIZE	TREATMENT FLOW RATE GPM / CFS	TOTAL FLOW CAPACITY CFS	MINIMUM DEPTH (FEET)
	12.00"	48 / 0.11	1.4	1.80
	18.00"	72 / 0.16	1.4	2.34
STACKED	12.00" + 12.00"	96 / 0.21	1.4	3.08
STACKED	18.00" + 12.00"	120 / 0.27	1.4	3.67



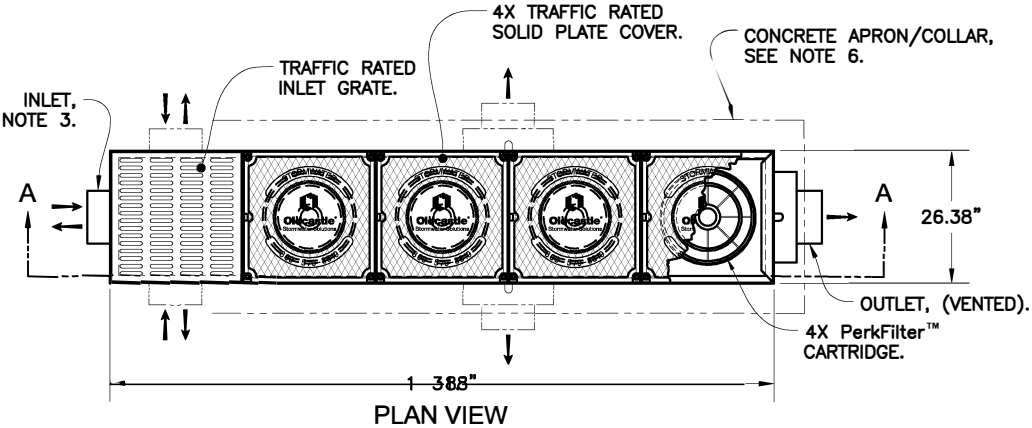
ISOMETRIC VIEW



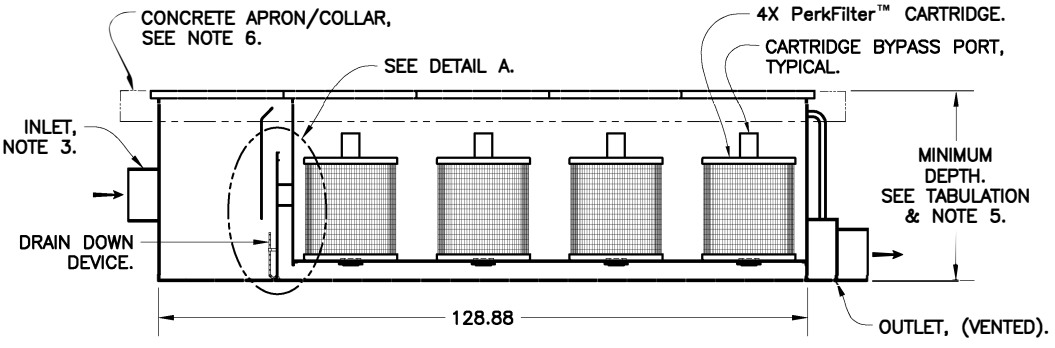
DETAIL A
INLET / BYPASS ASSEMBLY & DRAIN DOWN SCALE: 1.5X

Notes:

1. All steel utilized in fabrication and shall be 1/4" plate per ASTM A36.
2. PerkFilter™ Catch basin shall be supplied with traffic rated (H20) bicycle-proof grates and solid plate cover.
3. Inlet pipe(s) may enter device on any of three sides of the inlet chamber. Outlet pipe may exit on any of all four sides. All pipe is Ø 12" maximum
4. Inlet chamber shall be supplied with a DRAIN DOWN device designed to remove standing water between storm events..
5. For depths less than the specified minimum contact Oldcastle® Stormwater Solutions for engineering assistance.
6. Field poured Concrete Apron / Collar required, by others. Refer to PF-SCB-1000 for recommended configuration.
7. Perk Filter™ cartridge shall be maintained in accordance with manufacturer recommendations.



PLAN VIEW



SECTION A-A

Media Filtration

PerkFilter™
Steel Catch Basin
Four Cartridge
(End Grate Configuration)

Oldcastle® Stormwater Solutions
7921 Southpark Plaza, Suite 200 | Littleton, CO | 80120 | Ph: 800.579.8819 | oldcastlestormwater.com

DRAWING NO.	REV	ECO	DATE	SHEET
PF-SCB-0006	NR	ECO-0143 NEW	JPR 12/2/16	1 OF 1

Attachment 10:

PERKFILTER MAINTENANCE AND INSPECTION GUIDE

PERKFILTER™

Inspection and Maintenance Guide

Stormwater

PerkFilter™ Media Filtration System

Description

The PerkFilter is a stormwater treatment device used to remove pollutants from urban runoff. Impervious surfaces and other urban and suburban landscapes generate a variety of contaminants that can enter stormwater and pollute downstream receiving waters. The PerkFilter is a media-filled cartridge filtration device designed to capture and retain sediment, gross solids, metals, nutrients, hydrocarbons, and trash and debris. As with any stormwater treatment system, the PerkFilter requires periodic maintenance to sustain optimum system performance.

Function

The PerkFilter is a water quality treatment system consisting of three chambers: an inlet chamber, a filter cartridge treatment chamber, and an outlet chamber (Figure 1). Stormwater runoff enters the inlet chamber through an inlet pipe, curb opening, or grated inlet. Gross solids are settled out and floating trash and debris are trapped in the inlet chamber. Pretreated flow is then directed to the treatment chamber through an opening in the baffle wall between the inlet chamber and treatment chamber. The treatment chamber contains media-filled filter cartridges (Figure 2) that use physical and chemical processes to remove pollutants. During a storm event, runoff pools in the treatment chamber before passing radially through the cylindrical cartridges from the outside surface, through the media for treatment, and into the center of the cartridge. At the center of the cartridge is a center tube assembly designed to distribute the hydraulic load evenly across the surface of the filter cartridge and control the treatment flow rate. The center tube assembly discharges treated flow through the false floor and into the outlet chamber. A draindown feature built into each cartridge allows the treatment chamber to dewater between storm events.

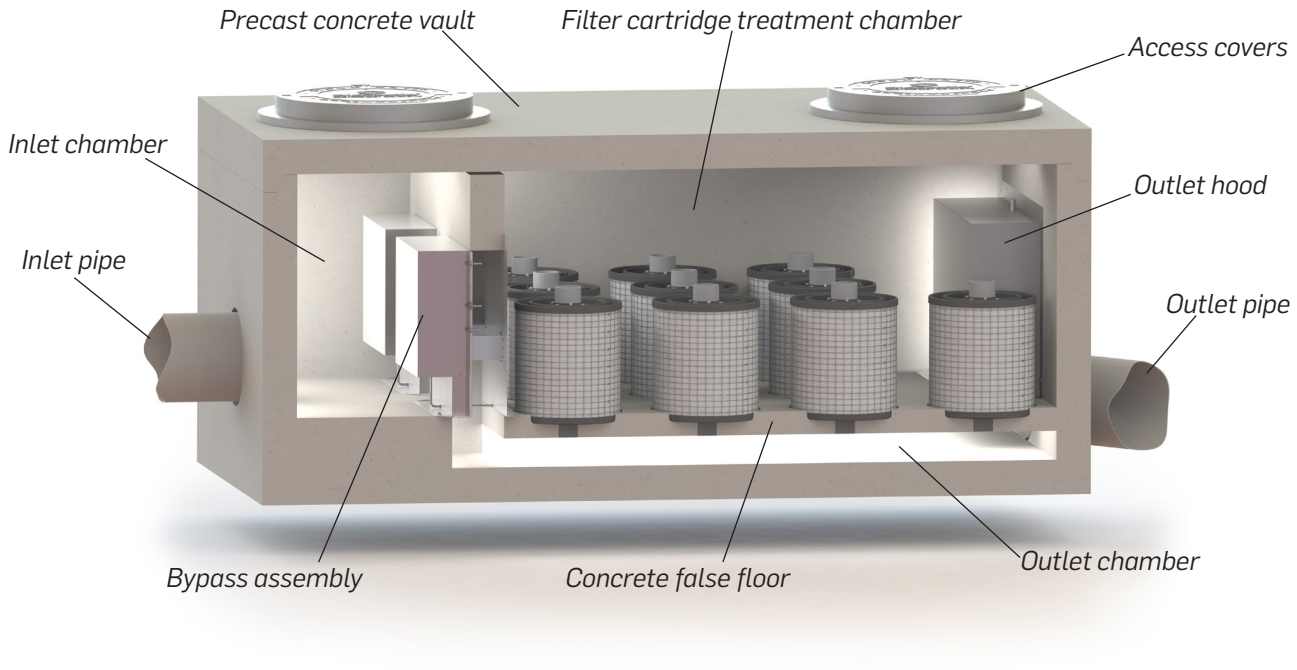
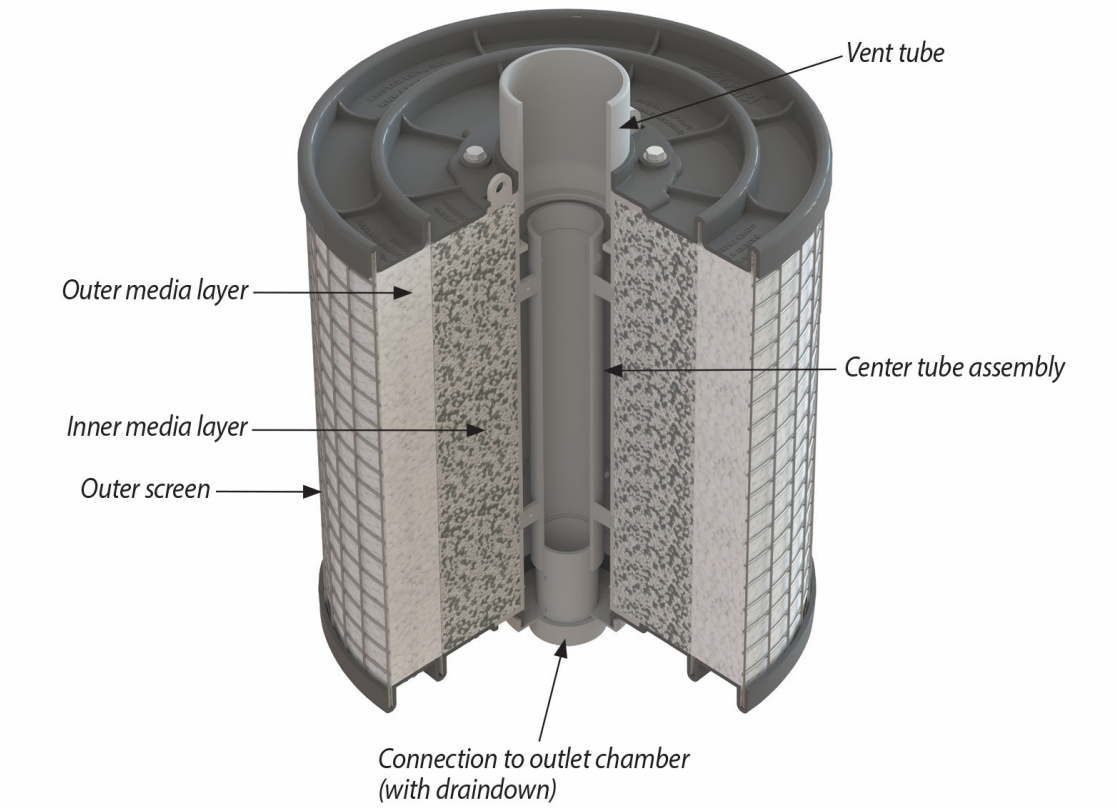


Figure 1. Schematic of the PerkFilter system.

All PerkFilter systems include a high flow bypass assembly to divert flow exceeding the treatment capacity of the filter cartridges around the treatment chamber. The bypass assembly routes peak flow from the inlet chamber directly to the outlet chamber, bypassing the treatment chamber to prevent sediment and other captured pollutants from being scoured and re-entrained by high flow. Treated flow and bypass flow merge in the outlet chamber for discharge by a single outlet pipe.



Configuration

The PerkFilter structure may consist of a vault, manhole, or catch basin configuration. Catch basin units may be fabricated from concrete or steel. Internal components including the PerkFilter cartridges are manufactured from durable plastic and stainless steel components and hardware. All cartridges are 18 inches in diameter and are available in two heights: 12-inch and 18-inch. Cartridges may be used alone or may be stacked (Figure 3) to provide 24-inch and 30-inch combinations. The capacity of each cartridge or cartridge combination is dictated by the allowable operating rate of the media and the outer surface area of the cartridge. Thus, taller cartridges have greater treatment capacity than shorter cartridges but they also require more hydraulic drop across the system. Cartridges may be filled with a wide variety of media but the standard mix is composed of zeolite, perlite and carbon (ZPC).

Access to an installed PerkFilter system is typically provided by ductile iron castings or hatch covers. The location and number of access appurtenances is dependent on the size and configuration of the system.

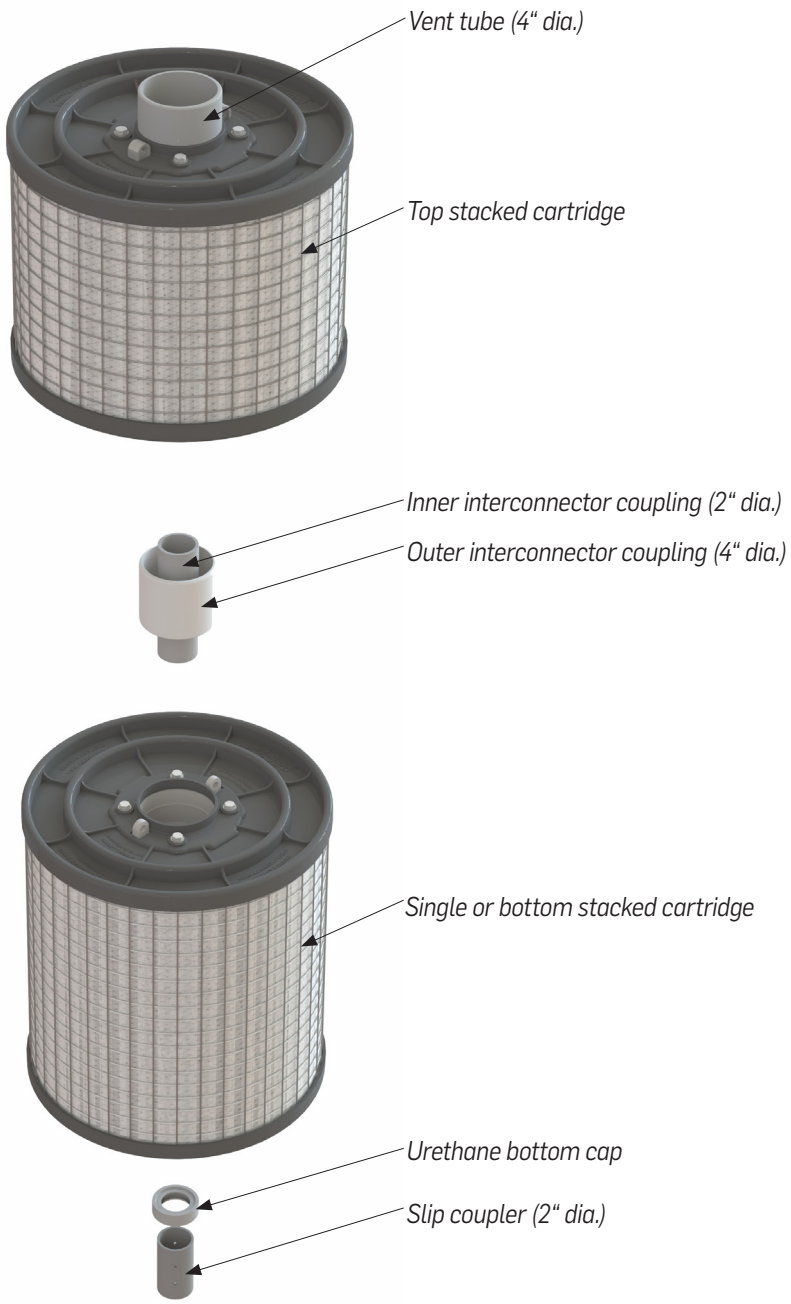


Figure 3. Schematic of stacked cartridges and connector components.

Maintenance Overview

State and local regulations require all stormwater management systems to be inspected on a periodic basis and maintained as necessary to ensure performance and protect downstream receiving waters. Maintenance prevents excessive pollutant buildup that can limit system performance by reducing the operating capacity and increasing the potential for scouring of pollutants during periods of high flow.

Inspection and Maintenance Frequency

The PerkFilter should be inspected on a periodic basis, typically twice per year, and maintained as required. Initially, inspections of a new system should be conducted more frequently to help establish an appropriate site-specific inspection frequency. The maintenance frequency will be driven by the amount of runoff and pollutant loading encountered by a given system. In most cases, the optimum maintenance interval will be one to three years. Inspection and maintenance activities should be performed only during dry weather periods.

Inspection Equipment

The following equipment is helpful when conducting PerkFilter inspections:

- Recording device (pen and paper form, voice recorder, iPad, etc.)
- Suitable clothing (appropriate footwear, gloves, hardhat, safety glasses, etc.)
- Traffic control equipment (cones, barricades, signage, flagging, etc.)
- Socket and wrench for bolt-down access covers
- Manhole hook or pry bar
- Flashlight
- Tape measure
- Measuring stick or sludge sampler
- Long-handled net (optional)

Inspection Procedures

PerkFilter inspections are visual and may be conducted from the ground surface without entering the unit. To complete an inspection, safety measures including traffic control should be deployed before the access covers are removed. Once the covers have been removed, the following items should be checked and recorded (see form provided at the end of this document) to determine whether maintenance is required:

- Inspect the internal components and note whether there are any broken or missing parts. In the unlikely event that internal parts are broken or missing, contact Oldcastle Stormwater at (800) 579-8819 to determine appropriate corrective action.
- Note whether the inlet pipe is blocked or obstructed. The outlet pipe is covered by a removable outlet hood and cannot be observed without entering the unit.
- Observe, quantify and record the accumulation of floating trash and debris in the inlet chamber. The significance of accumulated floating trash and debris is a matter of judgment. A long-handled net may be used to retrieve the bulk of trash and debris at the time of inspection if full maintenance due to accumulation of floating oils or settled sediment is not yet warranted.

- Observe, quantify and record the accumulation of oils in the inlet chamber. The significance of accumulated floating oils is a matter of judgment. However, if there is evidence of an oil or fuel spill, immediate maintenance by appropriate certified personnel is warranted.
- Observe, quantify and record the average accumulation of sediment in the inlet chamber and treatment chamber. A calibrated dipstick, tape measure, or sludge sampler may be used to determine the amount of accumulated sediment in each chamber. The depth of sediment may be determined by calculating the difference between the measurement from the rim of the PerkFilter to the top of the accumulated sediment and the measurement from the rim of the PerkFilter to the bottom of the PerkFilter structure. Finding the top of the accumulated sediment below standing water takes some practice and a light touch, but increased resistance as the measuring device is lowered toward the bottom of the unit indicates the top of the accumulated sediment.
- Finally, observe, quantify and record the amount of standing water in the treatment chamber around the cartridges. If standing water is present, do not include the depth of sediment that may have settled out below the standing water in the measurement.

Maintenance Triggers

Maintenance should be scheduled if any of the following conditions are identified during the inspection:

- Internal components are broken or missing.
- Inlet piping is obstructed.
- The accumulation of floating trash and debris that cannot be retrieved with a net and/or oil in the inlet chamber is significant.
- There is more than 6” of accumulated sediment in the inlet chamber.
- There is more than 4” of accumulated sediment in the treatment chamber.
- There is more than 4” of standing water in the treatment chamber more than 24 hours after end of rain event.
- A hazardous material release (e.g. automotive fluids) is observed or reported.
- The system has not been maintained for 3 years (wet climates) to 5 years (dry climates).

Maintenance Equipment

The following equipment is helpful when conducting PerkFilter maintenance:

- Suitable clothing (appropriate footwear, gloves, hardhat, safety glasses, etc.)
- Traffic control equipment (cones, barricades, signage, flagging, etc.)
- Socket and wrench for bolt-down access covers
- Manhole hook or pry bar
- Confined space entry equipment, if needed
- Flashlight
- Tape measure
- 9/16” socket and wrench to remove hold-down struts and filter cartridge tops
- Replacement filter cartridges
- Vacuum truck with water supply and water jet

Contact Oldcastle Stormwater at (800) 579-8819 for replacement filter cartridges. A lead time of four weeks is recommended.

Maintenance Procedures

Maintenance should be conducted during dry weather when no flow is entering the system. Confined space entry is necessary to maintain vault and manhole PerkFilter configurations. Only personnel that are OSHA Confined Space Entry trained and certified may enter underground structures. Confined space entry is not required for catch basin PerkFilter configurations. Once safety measures such as traffic control are deployed, the access covers may be removed and the following activities may be conducted to complete maintenance:

- Remove floating trash, debris and oils from the water surface in the inlet chamber using the extension nozzle on the end of the boom hose of the vacuum truck. Continue using the vacuum truck to completely dewater the inlet chamber and evacuate all accumulated sediment from the inlet chamber. Some jetting may be required to fully remove sediment. The inlet chamber does not need to be refilled with water after maintenance is complete. The system will fill with water when the next storm event occurs.
- Remove the hold-down strut from each row of filter cartridges and then remove the top of each cartridge (the top is held on by four 9/16" bolts) and use the vacuum truck to evacuate the spent media. When empty, the spent cartridges may be easily lifted off their slip couplers and removed from the vault. The couplers may be left inserted into couplings cast into the false floor to prevent sediment and debris from being washed into the outlet chamber during washdown.
- Once all the spent cartridges have been removed from the structure, the vacuum truck may be used to evacuate all accumulated sediment from the treatment chamber. Some jetting may be required to fully remove sediment. Take care not to wash sediment and debris through the openings in the false floor and into the outlet chamber. All material removed from the PerkFilter during maintenance including the spent media must be disposed of in accordance with local, state, and/or federal regulations. In most cases, the material may be handled in the same manner as disposal of material removed from sumped catch basins or manholes.
- Place a fresh cartridge in each cartridge position using the existing slip couplers and urethane bottom caps. If the vault is equipped with stacked cartridges, the existing outer and inner interconnector couplers must be used between the stacked cartridges to provide hydraulic connection. Transfer the existing vent tubes from the spent cartridges to the fresh cartridges. Finally, refit the struts to hold the fresh cartridges in place.
- Securely replace access covers, as appropriate.
- Make arrangements to return the empty spent cartridges to Oldcastle Stormwater.

PerkFilter
Inspection and Maintenance Log

Location _____

Structure Configuration and Size:

Inspection Date _____

☐ Vault _____feet x _____feet
☐ Manhole _____feet diameter
☐ Catch Basin _____feet x _____feet

Number and Height of Cartridge Stacks:

Count_____each ☐12" ☐18" ☐24" ☐30"

Media Type:

☐ ZPC ☐ Perlite ☐ Other_____

Condition of Internal Components ☐ Good ☐ Damaged ☐ Missing	Notes:
Inlet or Outlet Blockage or Obstruction ☐ Yes ☐ No	Notes:
Floating Trash and Debris ☐ Significant ☐ Not Significant	Notes:
Floating Oils ☐ Significant ☐ Not Significant ☐ Spill	Notes:
Sediment Depth in Inlet Chamber ☐ Inches of Sediment:_____	Notes:
Sediment Depth in Treatment Chamber ☐ Inches of Sediment:_____	Notes:
Standing Water in Treatment Chamber ☐ Inches of Standing Water:_____	Notes:

Maintenance Required

☐ **Yes - Schedule Maintenance** ☐ **No - Inspect Again in _____ Months**

PERKFILTER™

OUR MARKETS

BUILDING STRUCTURES

COMMUNICATIONS

WATER

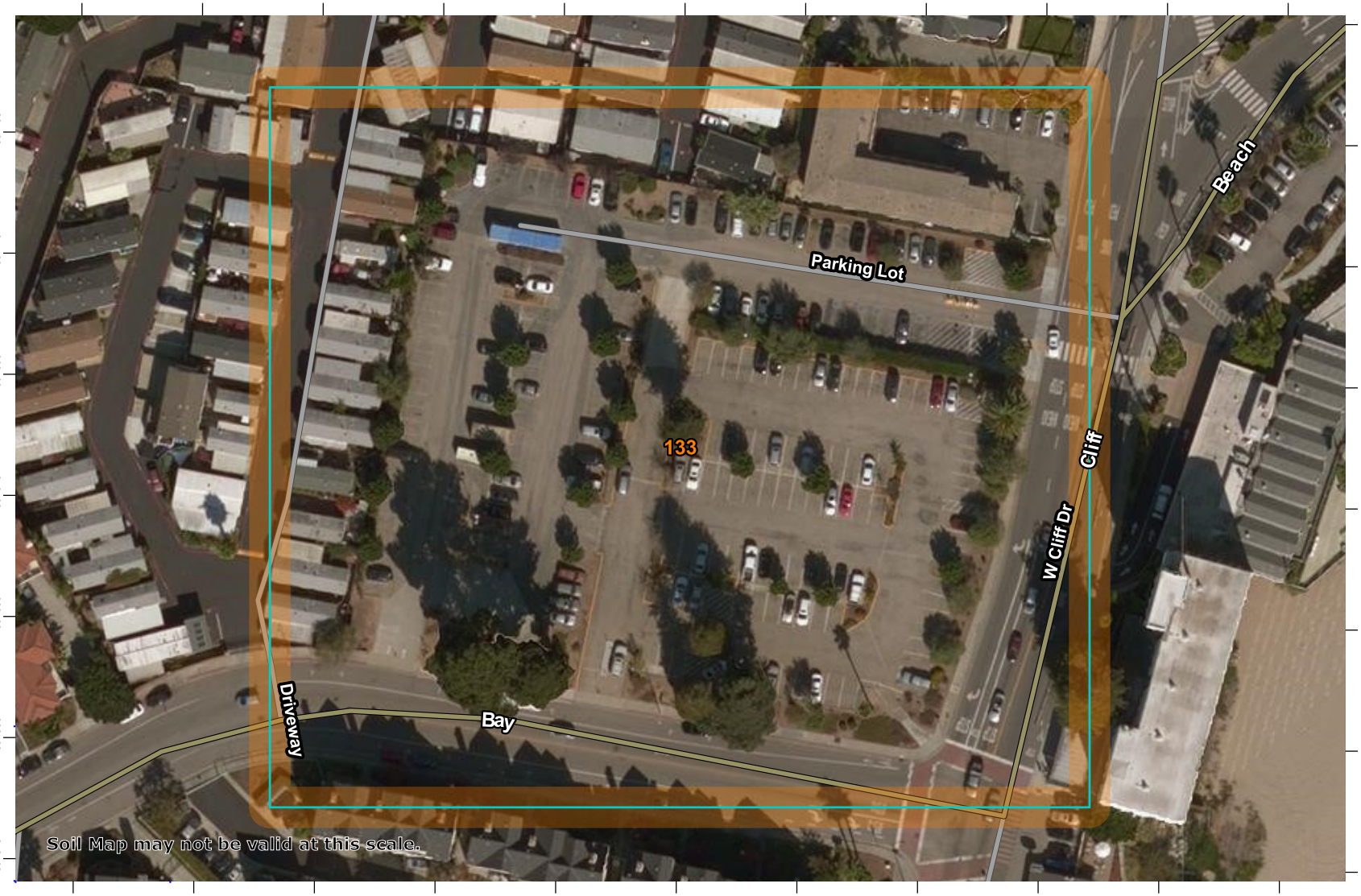
ENERGY

TRANSPORTATION

Attachment 11:

NRCS DATA

Custom Soil Resource Report
Soil Map



Map Scale: 1:1,010 if printed on A landscape (11" x 8.5") sheet.

N

Meters
0 10 20 40 60

Feet
0 45 90 180 270

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 10N WGS84

Santa Cruz County, California

133—Elkhorn sandy loam, 2 to 9 percent slopes

Map Unit Setting

National map unit symbol: h9dr
Elevation: 50 to 5,000 feet
Mean annual precipitation: 14 to 22 inches
Mean annual air temperature: 57 degrees F
Frost-free period: 245 to 275 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Elkhorn and similar soils: 85 percent
Minor components: 11 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Elkhorn

Setting

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

Typical profile

H1 - 0 to 21 inches: sandy loam
H2 - 21 to 61 inches: sandy clay loam, clay loam
H2 - 21 to 61 inches:

Properties and qualities

Slope: 2 to 9 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very high (about 15.8 inches)

Interpretive groups

Land capability classification (irrigated): 2e
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C
Ecological site: FINE LOAMY (R014XD034CA)
Hydric soil rating: No

Minor Components

Elder, sandy loam

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

Baywood, loamy sand
Percent of map unit: 2 percent
Hydric soil rating: No

Pinto, loam
Percent of map unit: 1 percent
Hydric soil rating: No

Elkhorn
Percent of map unit: 1 percent
Hydric soil rating: No

Soquel, loam
Percent of map unit: 1 percent
Hydric soil rating: No

Watsonville
Percent of map unit: 1 percent
Landform: Marine terraces
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread
Hydric soil rating: Yes