Introduce yourself

- Name
- Organization
- Role in land development design or review
- What you want to get out of today’s training
Motivations

Regulatory Compliance
- Mandate
- Client support
- Acceptance of costs
- Structure
- Schedule
- Accountability

Project Quality
- Enthusiasm
- Interest
- Energy
- Synergies
- Opportunities
- Elegance
Objectives for Today

- Become familiar with the Stormwater Technical Guide
- Become familiar with the Stormwater Control Measure Sizing Calculator
- Understand how to apply Low Impact Development design to achieve compliance
- Be ready to prepare or review a Stormwater Control Plan for a development site
- Share feedback
<table>
<thead>
<tr>
<th>Chapter</th>
<th>Time</th>
<th>Topic</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>8:30</td>
<td>Introductions and setting</td>
</tr>
<tr>
<td>1</td>
<td>8:50</td>
<td>About the Post-Construction Requirements and this project</td>
</tr>
<tr>
<td>1</td>
<td>8:55</td>
<td>Thresholds and requirements</td>
</tr>
<tr>
<td>2</td>
<td>9:15</td>
<td>Path to compliance</td>
</tr>
<tr>
<td>3</td>
<td>9:30</td>
<td>Preparing a Stormwater Control Plan</td>
</tr>
<tr>
<td>4</td>
<td>10:00</td>
<td>Preparing and documenting your LID design</td>
</tr>
<tr>
<td></td>
<td>10:15</td>
<td>BREAK</td>
</tr>
<tr>
<td>4</td>
<td>10:30</td>
<td>Technical and regulatory issues in LID design</td>
</tr>
<tr>
<td>4</td>
<td>10:45</td>
<td>Using the calculator to size Stormwater Control Measures</td>
</tr>
<tr>
<td>4</td>
<td>11:30</td>
<td>Designing and building bioretention and other LID facilities</td>
</tr>
<tr>
<td>5</td>
<td>11:50</td>
<td>Landscaping, operation, and maintenance of bioretention facilities</td>
</tr>
<tr>
<td></td>
<td>12:00</td>
<td>Adjourn</td>
</tr>
</tbody>
</table>
About the PCRs

- Over five years in the making
  - February 15, 2008 letter
  - Central Coast Joint Effort began 2009
  - PCRs adopted September 6, 2012
  - PCRs readopted July 12, 2013 to supersede statewide requirements
- Apply to first project approvals granted after March 6, 2014
About the *Guide*

- Santa Barbara *Guide* was model
  - Supported by SWRCB grant
  - Administered by County of Santa Barbara staff with participation by city staff
  - Issues discussed within Water Board staff’s Joint Effort Review Team (JERT)
- Adapted by MRSWMP
About the *Calculator*

- Developed to support the Santa Barbara *Stormwater Technical Guide*
- May be used throughout Central Coast Region
- Storm depth is the key geographic input variable
  - 85th or 95th percentile storm
  - Charts provided by Water Board
PCRs in a nutshell

- Site Design
- Runoff Treatment
- Runoff Retention
- Peak Runoff Controls
- Facility Maintenance
### Standards and Thresholds

<table>
<thead>
<tr>
<th>Threshold</th>
<th>Performance Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>≥ 2,500 SF</td>
<td>Design site drainage to minimize runoff</td>
</tr>
<tr>
<td>≥ 5,000 SF net</td>
<td>Treat runoff</td>
</tr>
<tr>
<td>≥ 15,000 SF</td>
<td>Retain specified runoff volume</td>
</tr>
<tr>
<td>≥ 22,500</td>
<td>Manage peak flows</td>
</tr>
</tbody>
</table>

**What does “net” mean?**

- **Pre-Project**
  - 10,000 SF

- **Post-Project**
  - 7,000 SF
  - 3,000 SF
MRSWMP Approach

- Emphasis on on-site compliance
- Step-by-step design procedure
- Low Impact Development design
- Drainage Management Areas
  - Delineate and tabulate
  - Segregate drainage impervious/pervious
  - Bioretention for treatment and retention
- Calculator for sizing bioretention/SCMs
Path to Compliance

1. Pre-application meeting
2. Follow the Guide.
3. Stormwater Control Plan
4. Draft O&M Plan
5. Detailed project design
6. Construction
7. Transfer maintenance responsibility
Development Review Process

Pre-Application Meeting → Completed Application → “Deemed Complete”

Planning Commission

Completed Application → Conditions of Approval

Conditions of Approval → CEQA Review

CEQA Review → Section Review

Section Review → Construction

Construction → "Deemed Complete"

Planning Commission

Completed Application

Conditions of Approval

CEQA Review

Construction

"Deemed Complete"
Development Review Process

Pre-Application Meeting
- Discuss design, O&M responsibility
- Lay out the site and stormwater facilities

Completed Application
- Planning Commission
- Incorporate facilities in plans and specifications

Conditions of Approval
- Detailed Design
- Laying out site and stormwater facilities
- Stormwater requirements are attached to COAs

“Deemed Complete”
- Construction Review
- Plan Set and Permit Application
- Prepare and submit a Stormwater Control Plan
- Respond to questions and revise plan

Respond to O&M responsibility
- Constructions
- Submit Final O&M Plan prior to end of construction
- Construct facilities
- Transfer Maintenance Responsibility
Level of Detail

“Plan and design your stormwater controls integrally with the site plan and landscaping for your project.”

- Drainage Management Areas
  - Grading and roof areas and slopes
- Locations/sizes of stormwater facilities
- Conceptual routing of drainage
Stormwater Control Plan

1. Project Information
2. Opportunities and Constraints
3. Conceptual Site Design
4. Calculations and Documentation
5. Design Details
6. Source Controls
7. Maintenance
8. Construction Checklist
Tools

- Stormwater Technical Guide
- Stormwater Control Plan Template
  - Small (Tier 1) projects
  - Tier 2 and Tier 3 projects
- Calculator
Small (Tier 1) Projects

PCRs require:
- Implement site design strategies
- Implement at least one runoff reduction measure

Stormwater Control Plan comprises:
1. Project Data Form
2. Site Plan or Sketch
3. Design criteria checklist(s) for runoff reduction measure(s) selected
1. Project Information

- Application Submittal Date
- Project Location
- Owner/Developer
- Type and Description
- Total Site Area
- Impervious Areas
  - Total New
  - Total Replaced
  - Total Pre-Project
  - Total Post-Project
- Runoff Reduction Measures Selected
  1. Disperse runoff to vegetated areas
  2. Pervious pavement
  3. Cisterns or rain barrels
  4. Bioretention facility or planter
2. Site Plan or Sketch

- Walkway
  4’ x 20’ = 80 SF
  permeable pavers on sand

- Driveway

- Approx. 200 SF

- Approx. 300 SF

- Downspouts will be directed to lawn area
3. Design Checklist

On the site plan, show:

- Each impervious area from which runoff will be directed, and its square footage.
- The vegetated areas that will receive runoff, and the approximate square footage of each.
- If necessary, explain in notes on the plan how runoff will be routed from impervious surfaces to vegetated areas.
3. Design Checklist

- Confirm the following standards are met:
  - Tributary impervious square footage in no instance exceeds twice the square footage of the receiving pervious area. On your sketch, show rough dimensions that will confirm this criterion is met.
  - Roof areas collect runoff and route it to the receiving pervious area via gutters and downspouts.
  - Paved areas are sloped so drainage is routed to the receiving pervious area.
  - Runoff is dispersed across the vegetated area (for example, with a splash block) to avoid erosion and promote infiltration.
  - Vegetated area has amended soils, vegetation, and irrigation as required to maintain soil stability and permeability.
  - Any area drains within the vegetated area have inlets at least 3 inches above surrounding grade.
Tier 2 and Tier 3 projects

Guidance in 4 formats:
1. Step-by-step instructions
2. Checklist
3. Template/table of contents
4. Example Stormwater Control Plans (to come)
Step by Step

1. Project Information

- New
- Replaced
- Pre-Project
- Post-Project
- Net

Net = New + Replaced – (Pre-Post)
1. Project Information

Watershed Management Zone(s)

- Design Storm Frequency and Depth
- Urban Sustainability Area

Google: “Central Coast Watershed Management Zone Maps”

Resolution R3-2013-0032 Adopted July 12, 2013, Approving Post-Construction Stormwater Management Requirements for Development Projects in the Central Coast

- Resolution No. R3-2013-0032
  - Resolution Attachment 1: Post Construction Requirements
  - Resolution Attachment 2: Technical Support Document for Post Construction Requirements
    - Technical Support Document, Attachment A: Summary of Stormwater Management Zone Maps (0.5 MB)
    - Technical Support Document, Attachment B: Case Study of Hydrologic Benefits of On-Site Retention in the Central Coast Region
    - Technical Support Document, Attachment C: Methods and Findings of the Joint Effort for Hydromodification Control in the Central Coast Region (2.8 MB)
    - Technical Support Document, Attachment D: Support for Selection of Criteria

85th and 95th Percentile Rainfall Depths

The Central Coast Post-Construction Requirements stipulate that municipalities must require Regulated Projects to use rainfall statistics provided by the Central Coast Water Board or to calculate site-specific rainfall depths determined from local rainfall data using USEPA’s methodology (see Post-Construction Requirements Provision B.4.c).

Rainfall Statistics Provided by the Central Coast Water Board:

- WARNING: Read instructions before downloading maps.
- 85th Percentile Rainfall Depth Maps (Adobe Reader, pdf)
- 95th Percentile Rainfall Depth Maps (Adobe Reader, pdf)

Shapefiles of 85th and 95th Percentile Rainfall Depth Maps (GIS Shape Files)

- Memo Explaining Process for Developing Rainfall Depth Maps
- Memo Documenting Confidence Interval Accuracy of Rainfall Depths

Directions for Using Local Rainfall Data to Develop Site-Specific Rainfall Depths:
- Directions for Using Local Rainfall Data to Develop Site-Specific Rainfall Depths

Spatial Data Coverages
2. Opportunities/Constraints

- Topography
- Unbuildable Areas
  - Setbacks from street or adjacent lots
  - Setbacks from watercourses
  - Odd-shaped areas
- Factors that facilitate or prevent infiltration
3. CONCEPTUAL SITE DESIGN
3 most common mistakes

1. Didn’t start early enough.
2. Planned to use less effective treatment facilities.
3. Postponed deciding who will operate and maintain...
LID Design Process

1. Analyze Project for LID
2. Develop and Document LID Drainage Design
3. Specify LID Preliminary Design Details

Coordinate with Site Design and Landscape Design
Analyze Your Project for LID

- Optimize the site layout
- Limit paving and roofs
- Use pervious surfaces
- Disperse runoff
- Drain to bioretention facilities or other infiltration facilities
Optimize the Site Layout

- Define the development envelope
- Minimize grading
- Set back from creeks, wetlands, and riparian areas
- Preserve significant trees
Optimize the Site Layout

- Limit roofs and paving
- Preserve and use permeable soils
- Detain and retain runoff throughout the site
- Use drainage as a design element
Use Pervious Surfaces

- Permeable pavements
- Green roofs
Disperse Runoff

- Sheet flow to soil
- Subsurface flow
- Infiltration
Direct Runoff to Facilities

Inflow

Sand/compost mix

Gravel

Infiltration

Underdrain
Landscape Treatments
Tips for Siting Facilities

- Require 4% - 10% of tributary area
- Flat sites
  - Limit drainage runs
  - Small facilities distributed throughout site
- Sloped sites
  - May work to collect runoff and pipe down hill
  - Use the head from roof downspouts
- Consider future ownership and access
4. Calcs and Documentation
5. Design of LID Facilities
6. Source Controls

- Identify sources from checklist in Appendix A
- Complete table in format of Table 3-1
- Narrative to explain special features, materials, or methods of construction

<table>
<thead>
<tr>
<th>Potential Source of Runoff Pollutants</th>
<th>Permanent/Structural Source Control BMPs</th>
<th>Operational/Pollution Prevention BMPs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
7. Maintenance of Facilities

- Operation and maintenance plan required (Chapter 5)
- O&M Plan is referenced in an agreement that “runs with the land”
- Stormwater Control Plan must:
  - Acknowledge and summarize maintenance requirements
  - Include a statement accepting maintenance responsibility
- Most significant for subdivisions
8. Construction Checklist

- Device to alert plan checker to stormwater requirements and to facilitate review

<table>
<thead>
<tr>
<th>Stormwater Control Plan Page #</th>
<th>BMP Description</th>
<th>See Plan Sheet #s</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
9. Certification

“The preliminary design of stormwater treatment facilities and other stormwater pollution control measures in this plan are in accordance with the current edition of the Monterey Regional Stormwater Management Program’s Stormwater Technical Guide.”
DOCUMENTING YOUR LID DESIGN
Drainage Management Areas

- Follow roof ridges and grade breaks
- Different DMA for each surface type
DMA Types

- **Pervious DMAs**
  - Self-treating
  - Self-retaining

- **Impervious DMAs**
  - Drains to self-retaining
    - Max 2:1 ratio impervious:pervious
  - Drains to LID facility

Use a curb to avoid run-on from self-treating areas

Grade self-retaining areas to drain inward. Set any area drains to pond 3”-4”

To storm drain
Example

<table>
<thead>
<tr>
<th>DMA</th>
<th>Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>DMA-1</td>
<td>3200</td>
</tr>
<tr>
<td>DMA-2</td>
<td>3200</td>
</tr>
<tr>
<td>DMA-3</td>
<td>3700</td>
</tr>
<tr>
<td>DMA-4</td>
<td>12400</td>
</tr>
<tr>
<td>DMA-5</td>
<td>500</td>
</tr>
<tr>
<td>DMA-6</td>
<td>8500</td>
</tr>
<tr>
<td>DMA-7</td>
<td>4200</td>
</tr>
<tr>
<td>Total</td>
<td>35700</td>
</tr>
</tbody>
</table>

1225 SF Existing Impervious Area
# Sizing – Treatment Only

<table>
<thead>
<tr>
<th>DMA Name</th>
<th>DMA Area (SF)</th>
<th>Post-project surface type</th>
<th>DMA Runoff factor</th>
<th>DMA Area × runoff factor</th>
<th>Facility Name</th>
<th>Minimum Facility Size</th>
<th>Proposed Facility Size</th>
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</thead>
<tbody>
<tr>
<td>DMA-1</td>
<td>3200</td>
<td>Roof</td>
<td>1.0</td>
<td>3200</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DMA-2</td>
<td>3200</td>
<td>Roof</td>
<td>1.0</td>
<td>3200</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DMA-4</td>
<td>12400</td>
<td>Paved</td>
<td>1.0</td>
<td>12400</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total&gt;</td>
<td></td>
<td></td>
<td></td>
<td>18800</td>
<td>752</td>
<td></td>
<td>900</td>
</tr>
</tbody>
</table>

## Diagram

![Diagram showing DMA areas and runoff factors.](image)

<table>
<thead>
<tr>
<th>DMA Name</th>
<th>Size (SF)</th>
</tr>
</thead>
<tbody>
<tr>
<td>DMA-1</td>
<td>3200</td>
</tr>
<tr>
<td>DMA-2</td>
<td>3200</td>
</tr>
<tr>
<td>DMA-3</td>
<td>3700</td>
</tr>
<tr>
<td>DMA-4</td>
<td>12400</td>
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<tr>
<td>DMA-5</td>
<td>500</td>
</tr>
<tr>
<td>DMA-6</td>
<td>8500</td>
</tr>
<tr>
<td>DMA-7</td>
<td>4200</td>
</tr>
<tr>
<td>Total</td>
<td>35700</td>
</tr>
</tbody>
</table>
Technical & Regulatory Issues

- Rationale for bioretention
  - LID principles and ancillary benefits
  - Simplicity and low costs
  - Advantages/disadvantages of underdrains
Technical & Regulatory Issues

- Sizing approaches
  - Flow
    - Treatment
    - Rates and durations
  - Design
  - Volume

- Calculating facility volume
  - Simple method
  - Routing method
    - Santa Barbara Unit Hydrograph
Technical & Regulatory Issues

■ Estimating infiltration rates and sizing factors
  ■ In infiltrative soils
    • Safety factor for direct infiltration
  ■ In clayey soils
Non-LID Facilities

- Issue for treatment only (Tier 2)
- PCRs state only an order of preference
- *Stormwater Technical Guide* adopts language from statewide permit
- Facilities:
  - Tree-box-type biofilters
  - Vault-based media filters
- Site Criteria
- Design criteria for facilities are in Appendix C
### Central Coast Region
Stormwater Control Measure
Sizing Calculator

**Version: 3/26/2014**

#### 1. Project Information

<table>
<thead>
<tr>
<th>Tier 3/Tier 3</th>
<th>Design rainfall depth (in)</th>
<th>Tier 3 - Retention</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

| Total project area (ft²): | 35700 |
| Total new impervious area (ft²): | 21775 |
| Total replaced impervious within a USA (ft²): | 125 |
| Total replaced impervious not in a USA (ft²): | 12700 |

#### 2. DMA Characterization

<table>
<thead>
<tr>
<th>Name</th>
<th>DMA Type</th>
<th>Area (ft²)</th>
<th>Surface Type</th>
<th>New, Replaced?</th>
<th>Connection</th>
</tr>
</thead>
<tbody>
<tr>
<td>DMA-1</td>
<td>Drains to SCM</td>
<td>300</td>
<td>Roof</td>
<td>New</td>
<td>SCM-1</td>
</tr>
<tr>
<td>DMA-2</td>
<td>Drains to SCM</td>
<td>3200</td>
<td>Roof</td>
<td>New</td>
<td>SCM-1</td>
</tr>
<tr>
<td>DMA-3</td>
<td>Drains to Self-Retaining</td>
<td>3700</td>
<td>Concrete or asphalt</td>
<td>New</td>
<td>SCM-1</td>
</tr>
<tr>
<td>DMA-4-A</td>
<td>Drains to SCM</td>
<td>1175</td>
<td>Concrete or asphalt</td>
<td>New</td>
<td>SCM-1</td>
</tr>
<tr>
<td>DMA-4-B</td>
<td>Drains to SCM</td>
<td>125</td>
<td>Concrete or asphalt</td>
<td>Replaced</td>
<td>SCM-1</td>
</tr>
<tr>
<td>DMA-5</td>
<td>Drains to SCM</td>
<td>500</td>
<td>Concrete or asphalt</td>
<td>New</td>
<td>SCM-1</td>
</tr>
<tr>
<td>DMA-6</td>
<td>Self-Retaining</td>
<td>9500</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DMA-7</td>
<td>Self-Treating</td>
<td>4200</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**DMA Summary Area**

| Total project impervious area (ft²): | 33470 |
| New impervious area (ft²): | 3075 |
| Replaced impervious within a USA (ft²): | 0 |
| Replaced impervious not in a USA (ft²): | 125 |
| Total pervious/landscape area (ft²): | 0 |

#### 3. SCM Characterization

<table>
<thead>
<tr>
<th>Name</th>
<th>SCM Type</th>
<th>Safety Factor</th>
<th>SCM Soil Type</th>
<th>Infilt. Rate (in/hr)</th>
<th>Area (ft²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCM-1</td>
<td>Biotenent</td>
<td>1</td>
<td>HSG O.D</td>
<td>0.25</td>
<td>2500</td>
</tr>
</tbody>
</table>

#### 4. Run SIBH Model

- [Launch Model](#)

#### 5. SCM Minimum Sizing Requirements
Rainfall Depths

- Identify Watershed Management Zone
- Designated Groundwater Basins (Zones 4, 7, and 10)
- 85th or 95th percentile
- Use isohyets to determine rainfall depth
After each step, launch the model and note the difference in depth required and drain time.

- Change soil type to C/D
- Increase the area of SCM-1 to take up more of the available area
- Make DMA-4B new instead of impervious
- Connect DMA-3 to SCM-1
- Connect DMA-1 to SCM-1
- Create SCM-2 in the left setback and direct some drainage there.
Calculator Exercises

After each step, launch the model and note the difference in depth required and drain time.

- Change soil type to C/D
- Increase the area of SCM-1 to take up more of the available area
- Make DMA-4B new instead of impervious
- Connect DMA-3 to SCM-1
- Connect DMA-1 to SCM-1
- Create SCM-2 in the left setback and direct some drainage there.
Ten Percent Adjustment

- Dedicate a minimum 10% of site’s “Equivalent Impervious Surface Area” to Stormwater Control Measures
- PCRls specify method of calculating EISA
  - Use “correction factors” in Table 4-6
- Requires demonstration of infeasibility
BIORETENTION DESIGN
DMAs are as intended

Delineate DMAs using a screened grading plan or grading plan + roof plan.
Make This Happen

- Bioretention facilities are level so they “fill up like a bathtub.”
Bioretention Facility

Cross-section
Not to Scale

Overflow structure
Concrete drop inlet or manhole with frame,
24” min x 36” min. if access required; atrium or
beehive grate preferred, ¼” openings

Walls as needed to establish constant rim elevation around perimeter of facility

To storm drain or approved discharge point

Notes:
• No liner, no filter fabric, no landscape cloth.
• Maintain BGL, TGL, TSL throughout facility area at elevations to be specified in plan.
• Class 2 permeable material layer may extend below and underneath drop inlet.
• Elevation of underdrain discharge is at top of gravel layer.
• See Chapter 4 for instructions on facility sizing and additional specifications.
Call out elevations

Outlet structure
- Top of overflow grate
- Underdrain connection

Inlet
- Flow line at inlet
- Top of curb
- Top of adjacent paving

Soil layers
- Top of soil layer
- Bottom of gravel layer
- Bottom of soil layer
Outlets

Overflow

elevation

Overflow structure
24" min x 36" min.
crude drop inlet
or manhole with
frame and atrium
or beehive grate
1/4" openings

24"

6"

To storm drain or
approved discharge

Schedule 80
(no perforations)
seal penetration
with grout

mulch if
in landscape

s as

rach V1
Bioretention Edges

- Separate facility from adjacent landscaping with wall or curb.
- OK to slope soil mix against curb to reduce drop-off. And/or use plantings to discourage entry.
- 6" min. or as required to achieve $V_1$

Soil mix

Gravel layer
Gravel and Underdrain

- Class 2 permeable
  - Caltrans spec 68-2.02(F)(3)
- No filter fabric
- Underdrain
  - Discharge elevation at top of gravel layer
  - PVC SDR 35 or equivalent; holes facing down
  - Solid pipe for 2' closest to outlet structure
  - Cleanout
Planting Soil

- 60-70% Sand
  - ASTM C33 for fine aggregate
- 30-40% Compost
  - Certified through US Composting Council Seal of Testing Assurance Program

- Install in 8”-12” lifts
- Do not compact
- Do not overfill
- Leave room for mulch
Landscaping

- Select plants for fast-draining soils
- Select for facility location
- Avoid problem conditions
  - Overly dense plantings
  - Aggressive roots
  - Invasive weeds
  - Need for irrigation or fertilization
Landscaping—O&M issues

- No fertilizer
- No pesticides
- Clean up as needed and annually
- Add mulch if needed annually
  - Compost mulch (aged mulch) recommended
- Avoid filling in or regrading
Avoid design conflicts

- Elevations consistent with grading and architectural plans
- Facilities do not interfere with parking or pedestrian circulation
- Utilities are located elsewhere
- Protection of adjacent paving and structures has been considered
Construction Checklist

- Layout
- Excavation
- Overflow/connection to storm drain
- Underdrain
- Gravel layer
- Soil mix
- Irrigation
- Planting
- Final inspection
DISCUSSION