Storm Water
Low Impact Development (LID)

For real application of LID construction, maintenance, and inspection compliance
We are hoping you find this training incredibly helpful! ....
What is Low Impact Development?

LID features are small scale, infiltration based, landscape features that aim to mimic undeveloped site conditions.

Features are designed in various ways using different components but always aim to achieve the same core principles:

- Treat and capture storm water
Storm Water - why we care

We want to keep our waterways clean!

......and it's required...
Common Acronyms

- **LID = Low Impact Development** (Designing new development to not impact water quality or volume)
- **BMP= Best Management Practice** (features that make up LID)
- **NPDES= National Pollution Discharge Elimination System** (Through Federal power of the Clean Water Act, issues our City MS4 Permit. Just think Permit)
- **MS4= Municipal Separate Storm Sewer System** (the gutters, storm drains, and creeks. Everything that drains stormwater)

"Bayer Park LID has 12 BMP’s in compliance with our NPDES lowering its impact on the MS4."

...OMG IDK. WYM?
Impervious Surfaces

- Areas modified to where storm water percolation into underlying soils is either reduced or eliminated.
- LID was created out of the necessity to offset the negative impacts of impervious surfaces.
Municipal MS4 Storm Water Permit

- Adopted by the North Coast Regional Water Quality Control Board.

- Effective January 6, 2016.

- Includes Santa Rosa, Sonoma County, Sonoma Water, Cotati, Cloverdale, Healdsburg, Rohnert Park, Sebastopol, Windsor, and Ukiah.
STORM WATER

Problem or Solution

Pave it | Slow it
Pipe it or Spread it
Pollute it | Sink it

By Jim Coleman
Benefits of LID

- Volume capture
- Lengthen hold time
- Decrease intensity (slope)
- Flow attenuation
- Reduce hydromodification
- Decrease erosion
- Decrease flood risk

Run-off Hydrograph

Quantitative measure over time.
The necessity of flow attenuation
Santa Rosa Neighbors Blame City After Creek Overflows, Flooding Homes, Forcing Evacuations

Torrential rain, wind lashes the North Bay, bringing flooding, power outages and rescues

Live blog: Storm forces school closures in Sonoma County

Sonoma County storm updates: Thousands still without power in Sonoma County

An abandoned vehicle sits in high water at the intersection of Highway 121 and Highway 12 in Schellville on Sunday, October 24, 2021. (Christopher Chung / The Press Democrat)

ANDREW GRAHAM AND COLIN ATAGI
A bulldozer clears debris as water from Lomadell Creek washes over Taoshee Drive, near Nicasio Avenue, in Santa Rosa on Sunday, October 24, 2021. (Christopher Chung / The Press Democrat)

A Santa Rosa firefighter convinces a resident to evacuate after being trapped by floodwaters on Nicasio Ave. in Santa Rosa, Calif. Sunday. Ethan Sopp/CP

Flooding was reported across the San Francisco Bay Area, closing streets in Berkeley:

Santa Rosa firefighters check for residents trapped by floodwaters on Roost Road in Santa Rosa, Calif., Sunday Oct. 24.
All Throughout the City

- Parking lots
- Parks
- Housing Developments
- Schools
- Shopping Centers
- City Facilities
- Businesses
- Private Property
LID Can be obvious

1. Bioretention with a high flow bypass drop inlet

2. Vegetated swale with rock pad, high infiltration structural soil

3. Curb cut leading to bioretention with high flow bypass drop inlet
...Or totally inconspicuous

- 1. Porous Pavement
- 2. Permeable concrete gutter pan
- 3. Trash capture vortex unit
- 4. Cudo infiltration/detention basins

Unvegetated LID features must be paired with a vegetated BMP to receive credit. This is part of a prescriptive treatment train.
When must LID be Installed?

- Areas which fall under the NPDES MS4 Permit Order No. R1-2015-0030
- If project is creating or replacing over 10,000 square feet of impervious surfaces
  - Impervious surfaces are modified surfaces where percolation of storm water to underlying soils is reduced or eliminated.
- There are exemptions such as routine maintenance activities, emergency development activities, stand alone trails or bike paths, pothole repairs
- Subject to change with permit revisions or amendments
LID Manual

- The guiding document for Storm Water LID.

- Development must follow requirements from current LID manual version at time of discretionary or ministerial approval.
Storm Water Calculator

- Allows developers to determine sizing of BMP's that must be installed to offset installation of impervious surfaces for all tributary areas
- Water treatment, volume capture, and trash capture are priorities of LID installation
- Required for all LID submittals

**Design Goal: 100% Volume Capture**
Capture (infiltration and/or reuse) of 100% of the volume of runoff generated by the 86th percentile 24 hour storm event.

**Formulas:**

\[ S = \frac{1000 - 10}{\text{CN}} \]

Where:

- \( S \) = Potential maximum retention after runoff (in)
- \( \text{CN} \) = Curve Number

\[ Q = \left( \frac{8.92 \times 0.2 - \text{SI}^{2}}{(0.92 \times 0.8 - 0.2) \times \text{In}} \right) \]

Where:

- \( Q \) = Runoff depth (ft)
- \( \text{SI} \) = Precipitation (in)
- \( \text{In} \) = Seasonal Precipitation Factor

\[ V = (0)(A) \]

Where:

- \( V \) = Volume of Storm Water to be Retained (ft³)
- \( A \) = Reduced Tributary Area Including credit for Pollution Prevention Measures (ft²)

**Input:** (pick data from drop down lists or enter calculated values)

- \( A_1 = 10,000 \text{ ft}^2 \)
- \( \text{In} = 1 \text{ ft} \)

**Solution:**

**Volume of storm water - Post Development**

\[ S_{\text{POST}} = \frac{1.11 \text{ in}}{90} \]

\[ Q_{\text{POST}} = (0.92 \times 1.00 + 0.2 \times 1.11) \times 12 \text{ in} \]

\[ V_{\text{GOAL}} = 225 \text{ ft}^3 \]

Where:

- \( S_{\text{POST}} \) = Post development potential maximum retention after runoff (in).
- \( Q_{\text{POST}} \) = Runoff in feet as defined by the "Urban Hydrology For Small Watersheds" TR-55 Manual.
- \( V_{\text{GOAL}} \) = Post Development Volume of Storm Water to be Retained (ft³)

NOTE: Entering a calculated composite CN will override selections made from the pull down menu above. Calculation worksheet should be used for all composite calculations and included with submittal.
Improvement Plans

IMPROVEMENT PLANS FOR
LANTANA HOMES SUBDIVISION
IN THE CITY OF SANTA ROSA
2979 DUTTON MEADOW
FILE NO. PRJ8-030
APN 043-121-013
JULY 30, 2019
TYPICAL SECTION

NOTE:
1. ALL PLANTING SOIL SHALL MEET STANDARDS SET FORTH IN THE CITY OF SANTA ROSA LOW IMPACT DEVELOPMENT TECHNICAL DESIGN MANUAL, APPENDIX F.
2. BIORETENTION AREAS SHALL BE PLANTED WITH PLANTS FROM THE APPROVED CITY OF SANTA ROSA LOW IMPACT DEVELOPMENT DESIGN MANUAL, APPENDIX E AND SHALL BE PLANTED TO ACHIEVE 50% COVERAGE.
3. TOP OF 6" PERFORATED PIPE TO BE SET 6" MIN BELOW BOTTOM OF ROAD STRUCTURAL SECTION.

TYPICAL ROADSIDE

BIORETENTION DETAIL

NO SCALE
STORM WATER MITIGATION PLAN

FOR

LANTANA SUBDIVISION

Southwest Corner of Dutton Meadow and Mojave Avenue
Santa Rosa, CA

APN 043-121-018

May 10, 2019

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DECLARATION OF COVENANTS REGARDING MAINTENANCE OF STORM WATER BMP FACILITIES

This Declaration of Covenants Regarding Maintenance of Storm Water BMP Facilities ("Declaration") is made on this ___ day of October, 20___, by ___________________________ ("Landowner") ___________________________.

RE bât E T A L S

A. Landowner is the fee simple owner of certain real property located in the City of Santa Rosa ("City"), Sonoma County, California, and more fully described in Exhibit A to this Declaration ("Property").

B. The City's National Pollutant Discharge Elimination System ("NPDES") Municipal Separate Storm Sewer System ("MS4") Permit, Order number R1-2009-0050, issued by the North Coast Regional Water Quality Control Board, requires the City to implement and enforce specific requirements for the construction and maintenance of onsite storm water management facilities/best management practices (collectively, "BMP") for development, redevelopment, and other applicable projects with the goal of mitigating impacts to storm water quality and runoff volume discharges into the MS4.

C. Provisions of Chapter 17-12 and other applicable sections of the Santa Rosa City Code shall apply to the construction, inspection and maintenance of BMP facilities and the enforcement of MS4 Permit requirements.

D. (Signature of person acting on behalf of Landowner) approved this Declaration on ___________________________, 20___.
- 100% Treatment and Volume capture of 1" storm event.
- Calculated by average annual precipitation amount and average number of annual rain events.
Question 3
BMP Selection

- According to LID Manual “Prioritization needs to be given to small scale landscaped based infiltration BMP’s closest to the source as possible”

- Offset programs are strongly discouraged and often not accepted.
Types of Features You May See

**Green** = Priority treatment features
**Black** = must be part of treatment train

- Bioretention Planter
- Detention Basin
- Rain Garden
- Roadside Bioretention
- Structural Soil
- Interceptor Tree
- Porous Pavement
- Permeable pavers
- Stormwater Interceptor
- Tree pod Biofilter

- Vegetated Swale
- Trash Capture
  - Vortechs Unit
  - Baysaver
  - Contech
  - Cudo
- Debris Catch Basin (trash capture)
- Retention Pond
- Infiltration Trench
How it works:

Storm water is directed into landscape from impervious surfaces.

Storm water is allowed to infiltrate and is filtered through the vegetation and soil.

Designs for features remains adaptive as LID is an ever-evolving practice.

High flows overflow to the bypass inlet and discharge to storm drain.
Respect the Zone

THE RIGHT PLANTS IN THE RIGHT PLACES

Here are a few favorite species from the Approved Plant List. To increase habitat value and curb appeal in your U.D. feature, try using a variety of species including flowering plants. Plants in the low zone do most of the filtering, so you'll want to make sure plantings are detailed there. Find the Approved Plant List here: [link to the list].

LOW ZONE
- Cynodon dactylon (Kikuyu grass)
- Dianthus barbatus (Sweet William)
- Eschscholzia californica (California poppy)
- Monarda didyma ( Oswego tea)

MID ZONE
- Iris pseudacorus (Yellow flag)
- Leontodon taraxacoides (Sticky monkey flower)
- Eschscholzia californica (California poppy)
- Artemisia tridentata (Denver bluebells)

HIGH ZONE
- Fragaria chiloensis (Dune strawberry)
- Adenophora latifolia (CA native yarrow)
- Arctostaphylos uva-ursi (Bearberry)
- Eucalyptus camaldulensis (CA tea tree)

MOISTURE LEVELS
- DRY
- MODERATE
- WET
- MODERATE
- DRY

TYPICAL FLOOD DEPTH
- 0.0

ZONE
- HIGH
- MID
- LOW

POSITION OF FEATURING
- NEW
Common Plant Species in LID

- Native perennials
- Emergent plants - Rushes, sedges, and bunch grasses
- Riparian shrubs
- Riparian trees
- Drought tolerant species
Rushes

- Common saying is “rushes are round”

- Perennial, wetland specific herbaceous plants

- Juncus patents- grey rush
- Juncus effusus – soft rush
- Juncus balticus- baltic rush
- Juncus xiphiodes- iris leaved rush
Sedges

- Common saying is “sedges have edges”
- All sedges are perennial, grass like, herbaceous plants
- Commonly found in wetland environments but can be drought tolerant. Vigorous grower creating dense mats
- Carex barbarae – basket sedge
- Carex obnupta – slough sedge
- Carex pansa – meadow sedge
Grasses

- Very similar to sedge in appearance, however grasses have “joints”

- Native grasses are often (but not always) bunch grasses

- LID incorporates perennial, wetland specific grasses, and drought tolerant bunch grasses

- *Elymus glaucus*- blue wild rye

- *Nasella pulchra*- purple needle grass

- *Muhlenbergia rigens*- deer grass
Common Invasive Species

- **Harding grass** - Phalarus aquatica
- **Slender Oat** - Avena barbata
- **Italian rye** - Lolium multiflorum
- **Ripgut brome** - Bromus diandrus
- **Foxtail** - Hordeum murinum
- **Himalayan blackberry** - Rubus armeniacus
- **Curly dock** - Rumex crispus
- **Cocklebur** - Xanthium strumarium
- **Teasel** - Dipsacus sativus
- **Field mustard** - Brassica rapa
- **Yellow star thistle** - Centaurea solstitialis
- **Scotch broom** - Cytisus scoparius
- **Bristly ox tongue** - Helminthotheca echioides
Phalarus aquaticus - Harding grass

Avena barbata - slender oat
Bromus diandrus- ripgut brome

Hordeum marinum- foxtail barley
Rumex crispus - curly dock

Dipsacus sativus - teasel
Cytisus scoparius- scotch broom  Helminthrotheca echioides- bristly ox tongue
Soil Medium

Infiltration rate determines growing medium within an LID features

Poor infiltration sites may require changes to soils

Soil is a recipe; contractor must test infiltration rate prior to construction of feature

- Structural Soil
- Amended Soil
- Native Soil
- Compost as an additive
- Sand as an additive
Vegetated Bio-retention Planter (rain gardens, bioretention cells)

- One of most common features
- Small Scale
- 12” – 18” minimum of native soil or amended soil
- Native perennial vegetation
- Often stormwater enters through curb cuts along gutters
- Eliminate all surface water within 72 hours of dry weather
- High flow bypass for storms larger than 1” design storm event.
Vegetated Bioretention Planters
- Thriving vegetation; well above 50% threshold
- Clean gutter line, no sediment accumulation
- Unobstructed curb cut allows for storm water infiltration
- Aesthetically pleasing

Vegetated Bioretention Planters
Thriving vegetation

- *Juncus patens* - grey rush
- *Muhlenbergia rigens* - deer grass
- *Epilobium canum* - California fuschia
Grass field vacant lot
- Pervious surface
- Conversion of pervious vacant lot to over 10,000 sq feet impervious surfaces triggers LID
- Successfully implemented, LID can virtually negate negative impacts of impervious surfaces to stormwater quality and volume

Vegetated Bioretention Planters
Vegetated Bioretention Planters
Vegetated Bioretention Planters
Rock pad allows for dissipation of energy/decrease erosion
Vegetated Bioretention Planters
Mid-Construction

- Structural soil base
- Overflow inlet pipe
- Impermeable liner for something that is supposed to allow infiltration?

Vegetated Bioretention Planters
Mid-Construction Issues

- Features should go in last, however, are often put in first to help with temporary storm water measures.
- Common issues we observe are rain gardens being utilized as detention basins during construction.
- Lead to sedimentation and clogging before LID feature is every used.
- Soil compaction from construction activities.
- Two inlets accept flow from adjacent street gutters
- Water surface flowing into feature bringing sediment, decreasing structural soil porosity
Mid Construction Issues

- Blowout of detention pond used to store stormwater during construction
- LID features were inundated with water and sediment
- Silt layer now alter infiltration rates, increase turbidity runoff.
- Feature must be re-installed
Coffey Park LID

Vegetated Bioretention Planters
Vegetated Bioretention Planters
- Juncus patens (grey rush)
- Carex praegracilis (field sedge)
- Infiltration/growing medium
- Overflow drop inlet
- Juncus patens (grey rush)
- Carex praegracilis (field sedge)
- Infiltration medium
- Overflow drop inlet
- Sheet flow from impervious surfaces into feature
Things to Look for ...

Vegetated Bioretention Planters
Vegetated Bioretention Planters

- Juncus patens (grey rush)
- Rosa californica (California rose)
- Juglans californica (Black walnut)
- Curb cut opening
- Curb cut to drain impervious surface parking lot
- Overflow drop inlet
- Dense mix of invasive species and some native vegetation

Vegetated Bioretention Planters
- Bare, exposed soils in some places
- Overly vegetated with invasive species in other areas
- Almost completely blocked overflow inlet
Overgrown with invasive species.....is that really a bad thing if we require vegetation?

Overflow inlet almost completely blocked
Native Perennial Grasses

- Native perennial grasses have roots that are much deeper than annual invasive grasses
- Adapted to our climate: winter flooding, summer drought
- Higher absorption rates
- Increased erosion control/stabilization of soils
- In LID, it's not just having vegetation, but having the right type
Vegetated Bioretention Planters
LID requires ongoing annual maintenance! These are living, breathing features!

Vegetated Bioretention Planters
Question 4
Vegetated Bioretention Maintenance Requirements

- Sedimentation issues
  - Remove blockages at inlets/outlets or where you see settling within the feature

- Standing water well after a rain event or in dry weather
  - Inspect inlets/outlets, soil compaction issues?

- Inlet/outlet blockages
  - Remove debris

- Survivorship of planted natives
  - Replanting if necessary

- Invasive species or weeds taking over
  - Remove, understand seasonal variation

- Trash and debris
  - Remove on an as need basis, more frequently in wet weather

Vegetated Bioretention Planters
What's wrong?

- Where does water enter the feature?
- Does it allow for vegetation to interact with water?
- Is there enough vegetation?
- Potential sediment issues?
Vegetated Bioretention Planters
Vegetated Bioretention Planters

What's Wrong?
What's Wrong?
What's Wrong?

Vegetated Bioretention Planters
What's Wrong?

Vegetated Bioretention Planters
What's Wrong?

Vegetated Bioretention Planters
What's Wrong?

Vegetated Bioretention Planters
What's Wrong?
Vegetated Swales

- Open, shallow channels
- Vegetation covering side slopes
- Function as a soil and plant based filtration/infiltration unit
- Trap suspended solids/trace metals, promote infiltration, reduce storm water runoff intensity
- Mini-creek
- 190 foot swale
- Native grasses along both banks
- Provides filtration and drainage for almost the entire park
Vegetated Swales
- Connects directly to Piner Creek
- Water from entire back parking lot feeds into LID feature
- Treated through approved vegetation
- Enters storm drain near airway drive
Vegetated Swale Maintenance Requirements

- Mow and irrigate during dry weather to keep vegetation alive
- Remove obstructions at outlet
- Ensure inlet is properly functioning and diverting water correctly
- Bank stability, erosion, incision
- Remove trash which may accumulate
- Ensure water is draining within 72 hours after rain event
- Never use fertilizers or pesticides
### Ideal Season(s)

#### Activity Notes

<table>
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<th>Notes</th>
<th>How Often?</th>
<th>Ideal Season(s)</th>
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<td><strong>Remove trash and debris</strong></td>
<td>Wear gloves to clean out any trash that may have accumulated. Put trash in garbage and any leaves or dead plant material into the compost.</td>
<td>monthly and after every major storm</td>
<td>Spring</td>
</tr>
<tr>
<td><strong>Remove accumulated sediment</strong></td>
<td>Use a shovel or wet/dry vac to remove any accumulated sediment at the inlets or bottom of feature. If sedimentation is severe, coordinate with City to help identify potential sources. If clogged with sediment, top layer of planting media may need to be replaced to maintain drainage.</td>
<td>when sediment reaches 2” in depth, or once a year</td>
<td>Spring</td>
</tr>
<tr>
<td><strong>Water plants</strong></td>
<td>Ensure irrigation timer is working and properly programmed for weather conditions. Run system to check for leaks or breaks and repair. Hand water regularly if there is no irrigation system.</td>
<td>dry season, especially when plants are young</td>
<td>Spring</td>
</tr>
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<td><strong>Remove weeds</strong></td>
<td>Hand pull weeds, making sure to remove the root. Avoid using herbicides. It is easiest to pull weeds while young. See LID Plant Identification guide to help identify common weeds.</td>
<td>monthly in growing season, ideally before weeds make seeds</td>
<td>Spring</td>
</tr>
<tr>
<td><strong>Replace plants that have not done well</strong></td>
<td>If survival falls below 50%, replace plants that have died with plants from the original approved planting plan or equivalents from the City LID Approved Plant List.</td>
<td>as needed, inspect once per year</td>
<td>Spring</td>
</tr>
<tr>
<td><strong>Inspect and maintain structures such as inlets and overflow drain</strong></td>
<td>Clear any plants that have grown into the inlets/drains. Remove any leaves, sediment, or other debris that may be clogging inlets/drains/splash pads. Make sure drainage grates are in place and in good repair.</td>
<td>as needed, inspect once per year</td>
<td>Spring</td>
</tr>
<tr>
<td><strong>Check plastic liner</strong></td>
<td>If there is a plastic liner, check that it is still attached to the sidewalls of the planters. If it is not attached, it will need repair because water can flow underneath the liner and cause problems.</td>
<td>as needed, inspect once per year</td>
<td>Spring</td>
</tr>
<tr>
<td><strong>Clean up grasses and grass-like plants</strong></td>
<td>Rake out dead material from grasses/sedges/rushes, and if needed, cut back to 6-8” tall. Do not cut too short or often.</td>
<td>as needed, inspect once per year</td>
<td>Spring</td>
</tr>
<tr>
<td><strong>Prune trees and shrubs</strong></td>
<td>Prune up lower branches of trees to maintain sidewalk clearance. Deadhead or lightly trim shrubs, thinning if needed to maintain sunlight to understory plants.</td>
<td>as needed, inspect once per year</td>
<td>Spring</td>
</tr>
<tr>
<td><strong>Add non-floatable mulch</strong></td>
<td>If soil looks bare, add 2-3” of non-floatable mulch such as arbor mulch. Avoid evenly cut wood chip mulch, which floats/can cause clogging. Make sure mulch is pulled 2-3” away from plant stems.</td>
<td>as needed, inspect once per year</td>
<td>Spring</td>
</tr>
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Detention Basin

- Stormwater flow collects from impervious surfaces
- Biofiltration through vegetation and soil media
- Then discharged to Nagasawa Creek
- Detention vs Retention
Extended Dry Basin

- Inflow pipe and forebay
- Energy dissipator (boulders or approved equivalent)
- Planting (per design guidelines)
- Flat bottom
- Jute matting
- Top soil
- Sub grade

- 4' Maximum Basin Depth
- 12" Topsoil
- 3:1 max. side slope
- 4' Min. Bottom Width

Detention Basins
Inlet

Detention Basins
Detention Basin

Detention Basins
Detention Basins
Detention Basins
Detention Basin Maintenance Requirements

- Remove trash/debris
- Limit invasive species cover
- Check for obstructions to inlet/outlet
- Vector control- gopher holes
- Observe for dead, dying, or diseased trees
- Excessive vegetation; fire risk
- Erosion causing excess sediment
What's wrong?

- Vegetation?
- Sediment?
Filter Strips

- Allow storm water to infiltrate sheet flow from adjacent impervious surfaces
- Allow settling of sediment and other pollutants
- Often an emphasis on herbaceous vegetation (grasses) and not trees or woody shrubs
- Best for low infiltration soils
- Larger features require check dams to slow water velocity
- Surface flow from impervious parking lot
- Dense planting of deer grass, grey rush
- Well vegetated
- Free of trash/debris
Vegetated Filter Strip

- Adjacent impermeable surface
- Gravel trench & level set grade board (if required)
- Evenly distributed sheet flow of stormwater through vegetation
- Jute matting
- Check dam or berm every 10’ for slopes greater than 20H:1V

18" Growing Medium
Slope (0.5-6%)
(existing subgrade)

Photo courtesy of www.cleanwaterservices.org
- Useful on sloped areas near impervious surfaces such as sloped parking lots, roads, or driveways
- Focuses on sheet flowing
- Can be placed along impervious surface pathways, parking lots, roadways, within public right of way
- Can be implemented in a variety of soil conditions
- Water may sheet flow and infiltrate to MS4 or be held in underlying soils
- Larger features may require check dams to decrease stormwater velocity
Filter Strip Maintenance Requirements

- Mow grass as needed
- Remove dead or dying vegetation
- Never use fertilizers or pesticides
- Removal of trash, especially filter strips which run along parking lots or roadways
- Observe for no ponding 72 hours after end of rain event
What's Wrong?

- Trash/debris
- 50% vegetation
- Sediment issues
- Irrigation issues?
What's wrong?

- Trash/debris
- 50% vegetation
- Sediment issues
- Irrigation issues
What's Wrong?

- No filtering
- Turbidity increase
- Erosion
Flow Through Planter

- Utilized where soils drain poorly
- Often places alongside buildings or structures which requires impervious lining
- Best where space is limited
- Lack full delta capture, used as treatment train
- Extremely useful in treating rooftop drainage
Flow Through Planters

- Generally smaller features
- Can place them in high abundance along buildings and structures
- Useful in areas with steep slopes where other features may not function properly
- Water collects in perforated pipe beneath permeable soils and then flows into storm drain system
- Because often along buildings, an impermeable liner is required
Flow Through Planter Maintenance Requirements

- Check for ponded water, if present grading or soil replacement may be necessary
- High flow inlet should be free of obstructions
- No pesticide or fertilizers should be used
- Plants pruned, weeds removed
- Check downspout splash block is in proper locations
- Check mulch/soil levels around plantings
Question 5
Treatment Trains and Runoff Reduction Measures
Treatment Train Features

- Using a variety of features in series to achieve stormwater quality improvement
- Typical features include
  - One element shall be vegetated
  - Trash capture devices
  - Porous pavement
  - Interceptor Trees
  - Infiltration trenches
  - Filter inserts
  - Treepod biofilters
Porous Pavement

- Load bearing, durable surface which allows for infiltration to controlled outlet
- Permeable aggregate or impermeable blocks with space
- Non vegetated = must be part of treatment train

Maintenance requirements
- Keep surface clean from debris/fine sediment
- Sweep on regular basis
- Ensure there is effective infiltration
Advantages

- Remove soluble and fine particulate pollutants
- High level of applicability
- Unobtrusive, easily take place of sidewalks or pathways
Limitations

- Can become clogged which virtually takes away any volume capture potential
- Parking lot, leaking vehicles?
- Infiltration tests
- Wet weather inspection
Permeable Concrete/Infiltration Planter treatment train

- Permeable concrete allows for initial infiltration of parking lot
- Runoff flows into Infiltration planter
- High flows go directly into catch basin and MS4
Treatment Train

- Porous Pavement
- Flow through planter
- Do you see any maintenance issues?
What maintenance requirements do you see here?

- Leaf litter/debris decreasing infiltration of permeable concrete
What maintenance requirements do you see here?
- Leaf litter/debris
- Sediment issues
- Curb cut inlet blockage
- Drop inlet blockage
### ANNUAL MAINTENANCE RECOMMENDATIONS

#### PERMEABLE HARDSCAPING

<table>
<thead>
<tr>
<th>Activity</th>
<th>Notes</th>
<th>How Often?</th>
<th>Spring</th>
<th>Summer</th>
<th>Fall</th>
<th>Winter</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Check adjacent landscaping for washout potential</strong></td>
<td>If any bare spots or eroded areas are observed within nearby planted areas, they should be replanted/mulched/stabilized ASAP. If any washout does occur it should be cleaned off the pavement immediately to prevent further clogging of the pores.</td>
<td>as needed</td>
<td>☀️</td>
<td>☀️</td>
<td>☃️</td>
<td>☄️</td>
</tr>
<tr>
<td><strong>Use a wet/dry vac (such as a shop vac) for quick cleanups</strong></td>
<td>If you notice small amounts of sediment or leaves have been deposited on your permeable pavement, a quick cleanup using a household wet/dry vac can prevent bigger cleanups later.</td>
<td>as needed</td>
<td>☀️</td>
<td>☀️</td>
<td>☃️</td>
<td>☄️</td>
</tr>
<tr>
<td><strong>Remove weeds</strong></td>
<td>It is easiest to remove any weeds growing in the joints or pore spaces of your permeable hardscaping while they are still small.</td>
<td>2x/year</td>
<td>☀️</td>
<td>☀️</td>
<td>☃️</td>
<td>☄️</td>
</tr>
<tr>
<td><strong>Remove deeper sediment with a commercial vacuum sweeper</strong></td>
<td>For large areas, hire a commercial vacuum sweeper truck. For small areas, walk-behind vacuum sweepers are available for rent at some local equipment rental companies. Ensure that your machine uses vacuum action, not high-pressure air or water as this can drive sediment deeper. Grid pavers with large open spaces do not require vac sweeping.</td>
<td>1x/year for low traffic areas&lt;br&gt;2x/year for high traffic areas</td>
<td>☀️</td>
<td>☀️</td>
<td>☃️</td>
<td>☄️</td>
</tr>
<tr>
<td><strong>Inspect/clean inlet structures draining to the infiltration beds</strong></td>
<td>If there are curb cuts or pipes that bring water to your permeable hardscaping, check that they are clean. This will help prevent sediment buildup and save on cleaning later.</td>
<td>2x/year</td>
<td>☀️</td>
<td>☀️</td>
<td>☃️</td>
<td>☄️</td>
</tr>
<tr>
<td><strong>Inspect/clean subdrain outlets (if applicable)</strong></td>
<td>If your structure has subdrains, find the outlets and make sure they are not blocked.</td>
<td>1x/year</td>
<td>☀️</td>
<td>☀️</td>
<td>☃️</td>
<td>☄️</td>
</tr>
<tr>
<td><strong>Test for permeability</strong></td>
<td>Check for ponding after rain storms or water flowing across permeable pavement during low intensity storms. This is an indication that it’s time for a deep clean.</td>
<td>1x/year</td>
<td>☀️</td>
<td>☀️</td>
<td>☃️</td>
<td>☄️</td>
</tr>
</tbody>
</table>
Rain Catchment

- Reduction in storm water runoff
- Flow attenuation
- Reduce hydromodification
- Reuse for irrigation water
- Rain Harvester
- Porous Pavement
- Vegetated Swale
Trash Capture Devices

- Cannot be stand alone LID
- Must be part of a “Treatment Train”
- Annual maintenance is vital to function correctly
- Vortex Units
- Baysaver Units
- Catch Basin Units
- High Velocity Stormwater Interceptor
- Capture solids, trash, debris, oils
- Reduction in velocity allows sediment and other materials to settle between chambers
- Hanging baffles remove floatables such as trash and oil/grease
- Must be serviced annually
Interceptor Trees

- New or existing trees in 25 foot proximity to impervious surface
- Intercept rainwater
- Allow evaporation
- Rainwater can run down trunk into soil
- Reduce peak flow by slowing rainwater
- Must be part of treatment train
### Inspection Checklist

- Annually inspect all LID feature in City
- Drainage, Erosion, Vegetation
- Determine what maintenance requirements are necessary for landowner
- Lack Enforcement power

---

#### Form A
Storm Water Quality Feature Maintenance Check List
- **Standard Conditions**

**Date:** 11/2/2020  
**Start Time:** 07:40  
**Stop Time:** 08:15  
**Project:** 70 - Santa Rosa Memorial Hospital  
**Address:** 1165 Montgomery Dr

Are there any special conditions and/or maintenance requirements noted for BMP(s)? Y N (Circle one)

---

### Table

<table>
<thead>
<tr>
<th>BMP ID</th>
<th>Drainage</th>
<th>Erosion</th>
<th>Vegetation</th>
<th>General</th>
</tr>
</thead>
<tbody>
<tr>
<td>70-BP-01</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>70-BP-02</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>70-BP-03</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>70-IT-00</td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

**Inspection Status Codes:**
- **S** = Satisfactory
- **D** = Deficient
- **H** = Refer to Form B (Specials)
- **N** = Refer to Form C (Notes)

---

**Office Use:**
- Complete: Issues Corrective Action: Re-inspection Required:

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**Page** page of **Page**.
Top 10 Maintenance Problems

1. Desirable vegetation Overgrowth
   - Prune trees/shrubs in fall, trim grasses
2. Erosion/channelization in feature
   - Fill eroded area with approved materials (soils, mulch, etc.)
3. Sedimentation
   - Remove to reestablish design elevation
4. Obstructed inlets/outlets
   - Clear debris inside and outside structures
5. Low plant density
   - Determine reason for failure, decide on appropriate replant species
6. Invasive vegetation (weeds)
   - Manual, Mechanical, Chemical
7. Trash and debris
   - Remove and dispose of properly
8. Standing/ponded water
   - Remove sediment or dead plant biomass causing lack of infiltration
9. Damage to inlet/outlet structure
   - Replace structures if possible
10. Damage to inlet pipes
    - Cut broken pipe and replace as necessary
General Calendar Inspection List

**Spring**
- Inspection
- Remove trash
- Fix erosion
- Remove sediment
- Remove weeds
- Re-plant
- Prune grasses
- Check irrigation

**Summer**
- Inspection
- Remove trash
- Fix erosion
- Remove sediment
- Water plants (if needed)
- Remove weeds
- Check irrigation

**Fall**
- Inspection
- Remove trash
- Fix erosion
- Remove sediment
- Remove weeds
- Plant
- Prune grasses
- Drain irrigation
- Inspect and maintain structures

**Winter**
- Inspection
- Remove trash
- Fix erosion
- Remove sediment
- Prune trees and shrubs
Maintenance Hazards

- Trips/falls
- Safe access
  - Traffic control
- Utilities
- Chemical spills
- Biohazards
- Animals/insects
- Poisonous plants
And knowing is half the battle

- By understanding the intended function of LID you can identify areas with maintenance needs
- Being trained allows for you to be the eyes and ears
- When in doubt, call it out. Never hesitate to contact SW&C
- Observe a feature during a rain event
Storm Water’s Role

- Tracking - document all new LID features within the entire City limits as they are constructed
- Inspection - conduct annual inspections on all features for status and maintenance requirements
- Enforcement - enforce on responsible party to perform maintenance tasks
Required Documents

Upon completion contractor must submit to City:

- Maintenance Declaration
- Final LID Submittal
- As-built

These are vital to the success of future inspections of LID features
Summary

- LID helps lower the impact of impervious surfaces by treating water and capturing water
- LID is a living, breathing component to new development.
- Requires ongoing maintenance
- Treatment and capture can be achieved through a variety of features and designs
- LID is the future
Additional Resources

LID MANUAL & APPROVED PLANT LIST
www.srcity.org/Low-Impact-Development

STREETS TO CREEKS LID FEATURE FACTSHEETS
www.streetstocreeks.org/commercial/low-impact-dev/

E.P.A. GENERAL LID INFORMATION
www.epa.gov/nps/urban-runoff-low-impact-development

WEEKLY WATERING RECOMMENDATIONS
srcity.org/WateringRecommendations
A brief survey will be emailed to everyone in this training. This will help inform us on best ways to develop future presentations.

Look out for an email from:
Andrew Stricklin
astricklin@cityofukiah.com
THANK YOU!

Nick Sudano | Senior Environmental Specialist
Storm Water and Creeks
Santa Rosa Water – Environmental Services
69 Stony Circle | Santa Rosa, CA 95401
Tel (707) 543-4538
NSudano@srcity.org

Aaron Nunez | Environmental Specialist
Storm Water & Creeks
Santa Rosa Water – Environmental Services
69 Stony Circle | Santa Rosa, CA 95401
Tel. (707) 543-4525
ARNunez@srcity.org