Eastham "Rain Garden" Workshop

Green Infrastructure

Function and Maintenance

- Eastham Public Library
- 05.02.18

APCC-logo-lo-res.tiff

APCC Association to Preserve Cape Cod

Horsley Witten Group

Town of Eastham Incorporated 1651

Eastham MASSACHUSETTS

United States Environmental Protection Agency

WHY IS THIS IMPORTANT?

OPERATION AND MAINTENANCE

REGULATIONS AND DESIGN MANUALS

STATE AND LOCAL AGENCIES

OWNERS & OPERATORS

DESIGNERS

CONTRACTORS

INSTALLATION

CONSTRUCTION DRAWINGS

GI - HOW DOES IT WORK?

1. "Collect" the water
2. "Move" to where you want it to go
3. "Remove" sediment and debris
4. **"Filter"** to clean the water
5. "Overflow" for larger storms


1
2


5
4
3

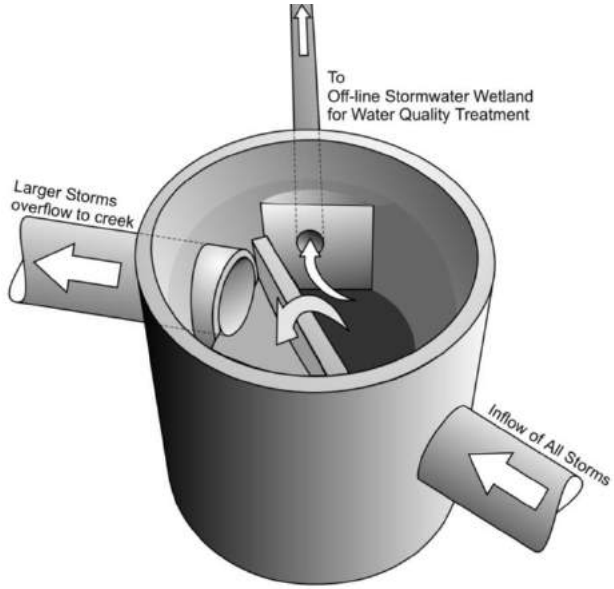

4
3
2
1

HOW CAN WE AVOID THIS?

1. Drainage Inlets
2. Swales
3. Sediment Collection
4. Treatment Areas
   (Bioswales/Raingardens)
5. Outlets & Spillways
6. Surrounding Area
   - Vegetation
   - Long-Term Maintenance

1 DRAINAGE INLETS

- Diversion struct.
- Pipe Inlets
- Trench grates
- Curb Cuts
- Paved inlet flumes
- Catch basins
- Roof downspouts



MAINTENANCE

- Clean sediment
- Remove leaf litter from inlets
- Watch for scouring

Inlet Clogging

LESSONS LEARNED

- Stone prone to clogging
- Ensure it is located at the low point and water can enter easily.
- Curbing increases side slope and depth
- When applicable zero curb
  - Allow for sheet flow

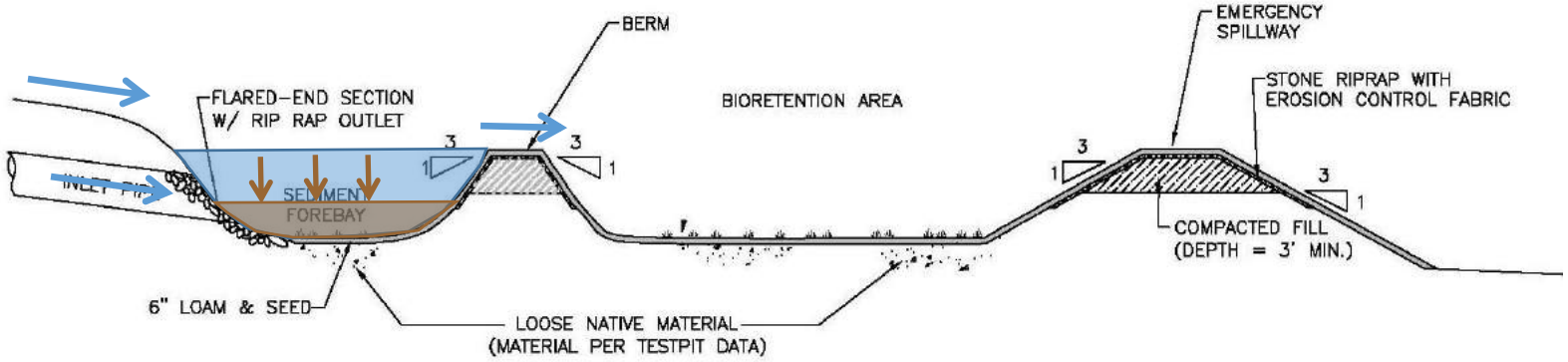
2 SWALES & CONVEYANCE

- Grass swales
- Vegetated swales
- Turf reinforced (TRM) swales
- Stone swales

MAINTENACE

- Debris Cleanout
- Sediment/Organic Debris Removal
- Check for areas of erosion/ gullies in the swale, particularly along the swale bottom.
- Repair/reseed as necessary

3 SEDIMENT COLLECTION



TYPICAL SECTION THROUGH BIORETENTION
NOT TO SCALE

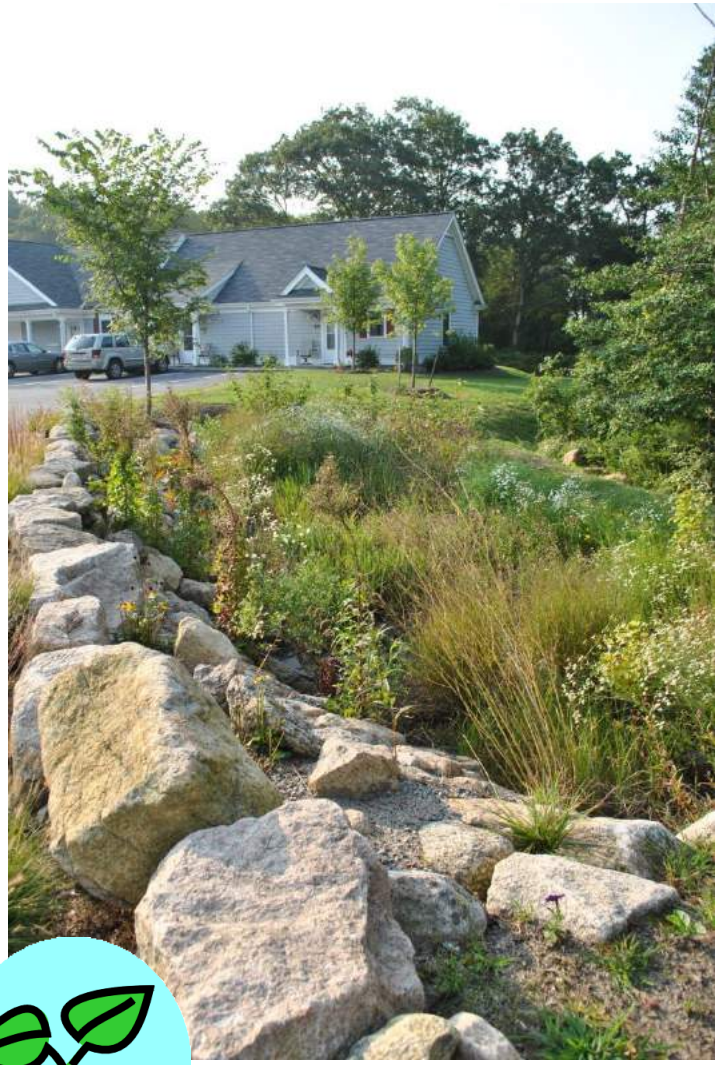
MAINTENANCE

- Remove trash and debris from the surface.
- Signs of erosion gullies. Repair as necessary.
- Remove sediment accumulation and properly dispose when accumulation is greater than or equal to 3 inches or you cannot see stones.*

LESSONS LEARNED

- Early Designs
  - Inlets & Sediment collection areas or “forebays” with rip/rap or stone
  - Sediment forebays large/difficult to clean
- Lessons Learned
  - Smaller forebay/more frequent cleaning
  - Use a hardscape smooth surface at the bottom

4 TREATMENT AREAS



MAINTENANCE

- Debris Cleanout
- Signs of erosion gullies, animal burrowing, overtopping or slumping
- Sediment/Organic Debris Removal
- Vegetation Maintenance & Replacement
- Water Draining properly
    - If standing water is observed for more than 48 hours after a storm event maintenance required

LESSONS LEARNED

- Early Designs
  - 6"-12" depth
  - Flat bottom – zero slope
  - Became too deep
  - Side slope stabilization
  - Curb and gutter systems
- Lessons Learned
  - Shallower depth has advantages
  - Use check dams
  - More cells
- Benefit
  - Aesthetics
  - Improved Function
  - Easier Maintenance

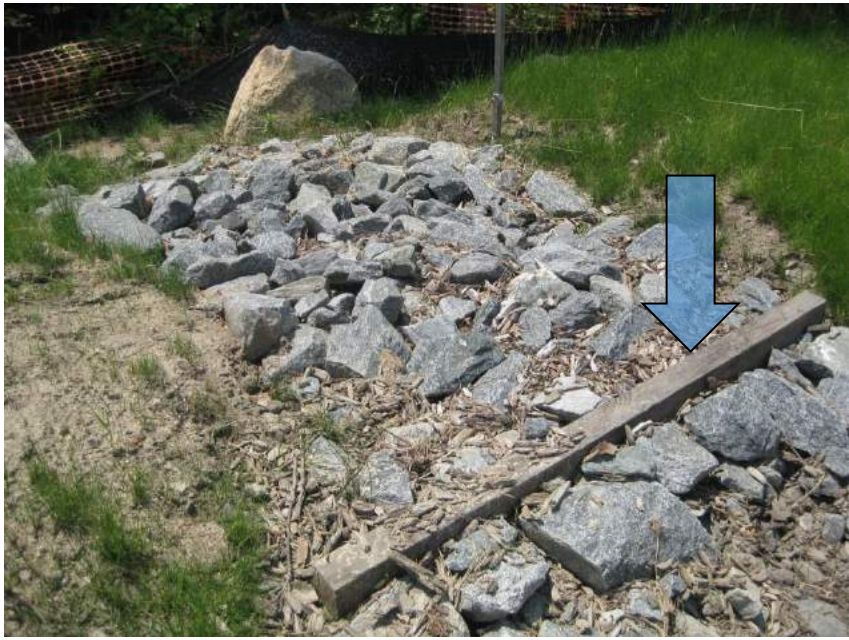
Source: Los Angeles Zoo designed by others

5 OUTLETS & SPILLWAYS

- Overflow/Outlet Structures
- Spillways

MAINTENANCE

- EMERGENCY SPILLWAYS
  - Check for settling gulling, erosion damage, settling & clogging
  - Repair as necessary and return to design grades



- OVERFLOW STRUCTURE
  - Check for sediment accumulation that impacts inflow. If sediment accumulation. Schedule cleaning
  - Check for leaf litter, debris and inlet clogging

6 SURROUNDING AREA

- Debris Removal
  - Remove trash from perimeter areas.
- Pavement Sweeping
  - Sweep parking lot minimum once a year after spring thaw.
- Drainage Network
  - Ensure proper operation.
- Contributing drainage area stabilized

VEGETATION

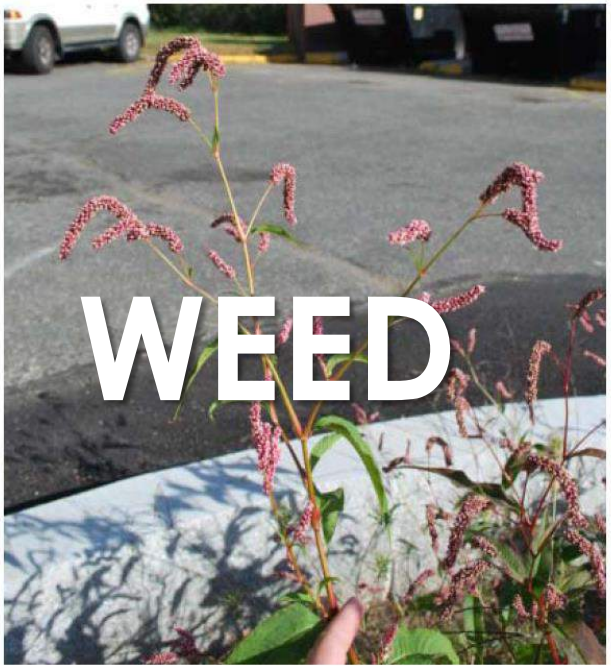
- **Pruning**
  - Why?
    - Maintain plant health and vigor
    - Removal of dead or broken wood
    - Encouragement of flowering and fruiting
    - Control of overgrowth of plant material
  - When?
    - Annually – Fall or Spring

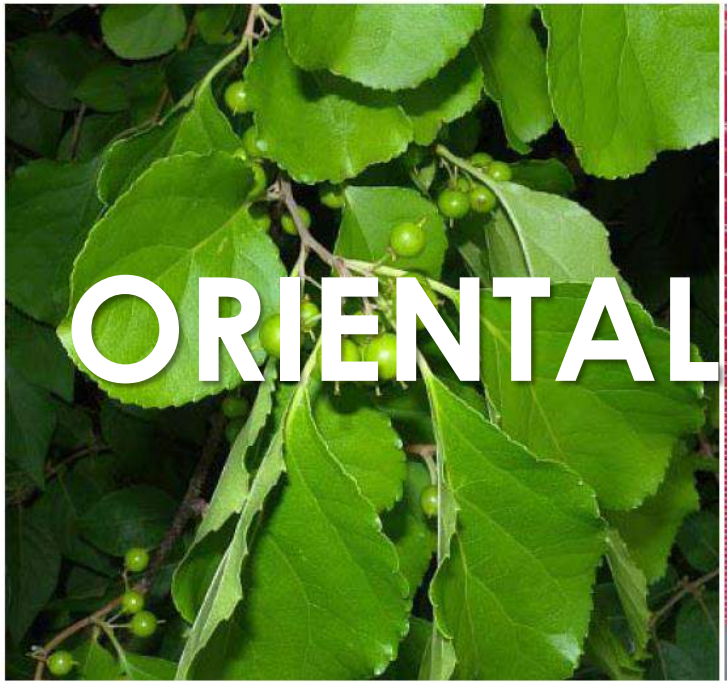
- **Weeding**
- Why?
  - Control invasive plants
  - Promote native non-invasive plant growth
- When?
  - Monthly
  - April thru October
- Do not use chemical herbicides
- Remove by hand


SMART

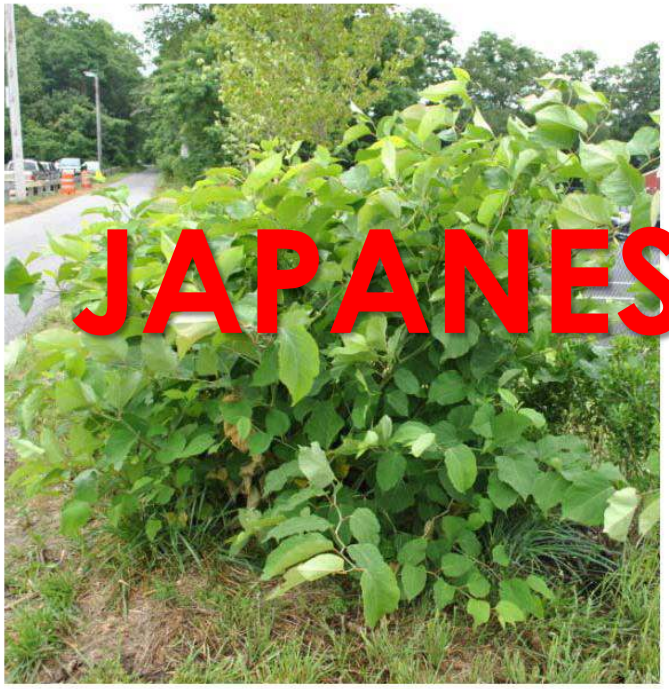

WEED


SMART


WEED



ORIENTAL BITTERSWEET



JAPANESE KNOTWEED

LESSONS LEARNED

- Early Designs
  - Ornamental/flowering "gardens"=MORE MAINTENANCE
  - Predominantly Native Plants
  - Included Larger shrubs
  - Trees often excluded

- Lessons Learned
  - Greater mix of plants
  - Grasses, Herbs and Forbs do well
  - Less manicured and ornamental more wild & natural "=LESS MAINTENANCE
  - **Work with Nature**

Cool Season Grasses:

Cool Season Grasses start their growth early in the spring and continue growth until the rain and cool weather ends. They go dormant during hot, dry months of summer, but resume growth in the fall when the rain returns.

Examples:

Deschampsia cespitosa	Tufted Hairgrass
Festuca Idahoensis "Siskyou Blue"	Fescue
Juncus patens "Elk's Blue"	Rush



Warm Season Grasses

Warm season grasses break dormancy in mid-spring and grow during the hot summer months. Because of their extensive root system, these plants conserve water and nutrients. These grasses have a low water requirement and remain green and growing during dry conditions.

Examples:

Schizachryrium scoparium	Little Bluestem
Panicum virgatum 'Heavy Metal'	Heavy Metal Switchgrass
Miscanthus sinensis "Gracillimus"	Maiden Grass



Herbs and Forbs

Herbs and Forbs may be annuals, biennials or perennials, but all are defined by the fact they do not form secondary woody growth. These plants all resprout or regrow from their roots.

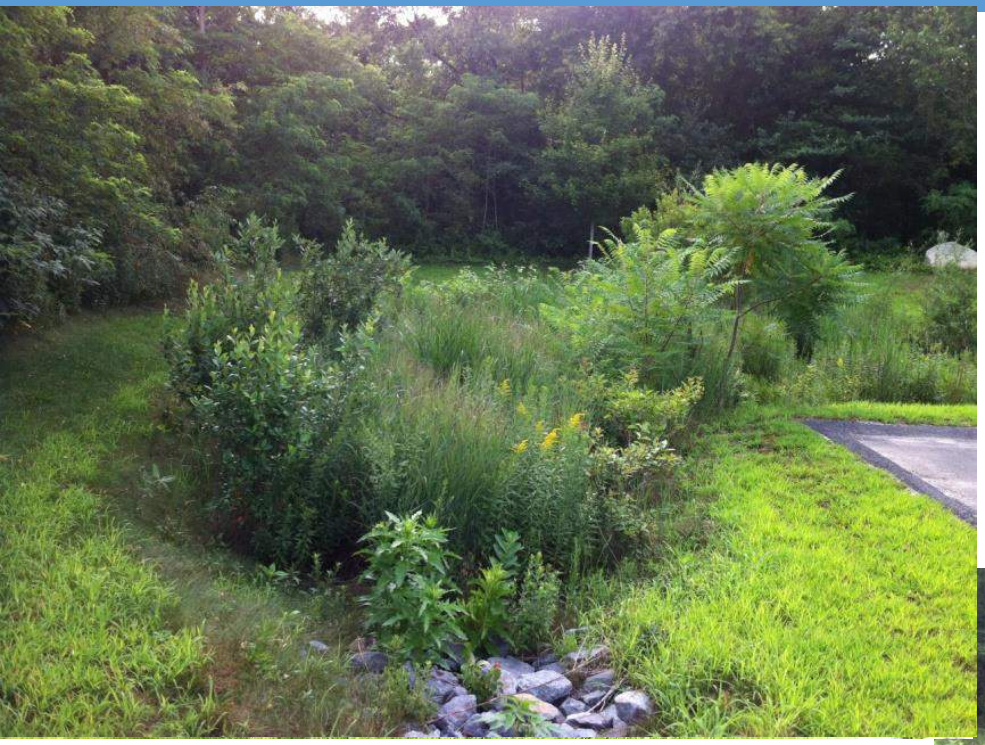
Examples:

Iris douglassiana	Douglas Iris
Polystichum munitum	Swordfern
Liriope sp.	Lilyturf



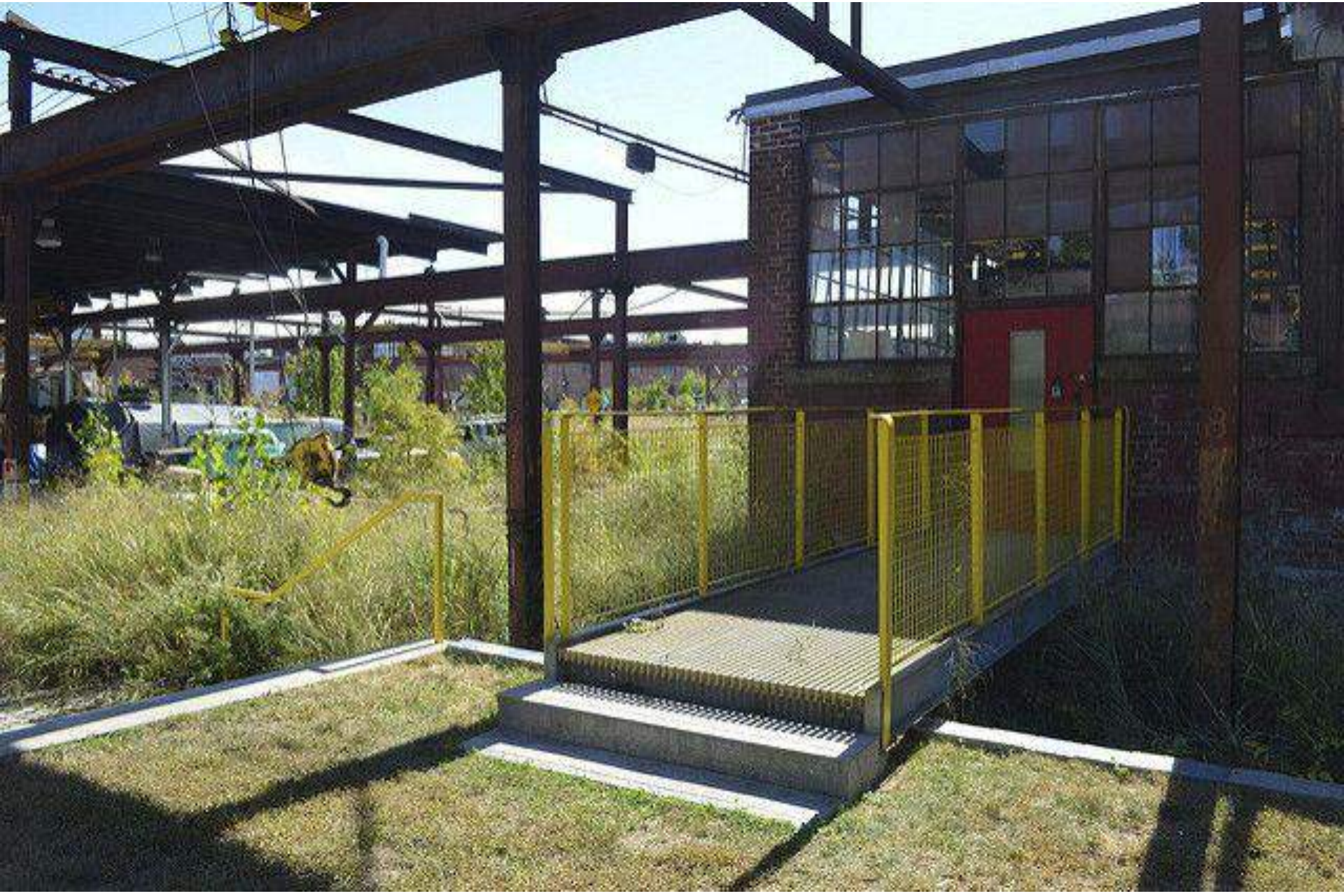
Source: SW Montgomery Green Street Plan by Nevue Ngan

VEGETATION



TO MOW OF NOT MOW?

IS THAT THE QUESTION ?



FERTILIZING

- Fertilization should not be necessary
  - Compromises pollutant reduction effectiveness
  - Leads to weak plant growth
  - Promotes disease and pests
  - Inhibits soil life

SHORT-TERM MAINTENANCE

- Why Inspect?
  - Ensure proper design function after construction
- When to inspect?
  - 6 months period after construction
  - Monthly during an immediately after construction
  - After rain events of 1" and greater

What to inspect?

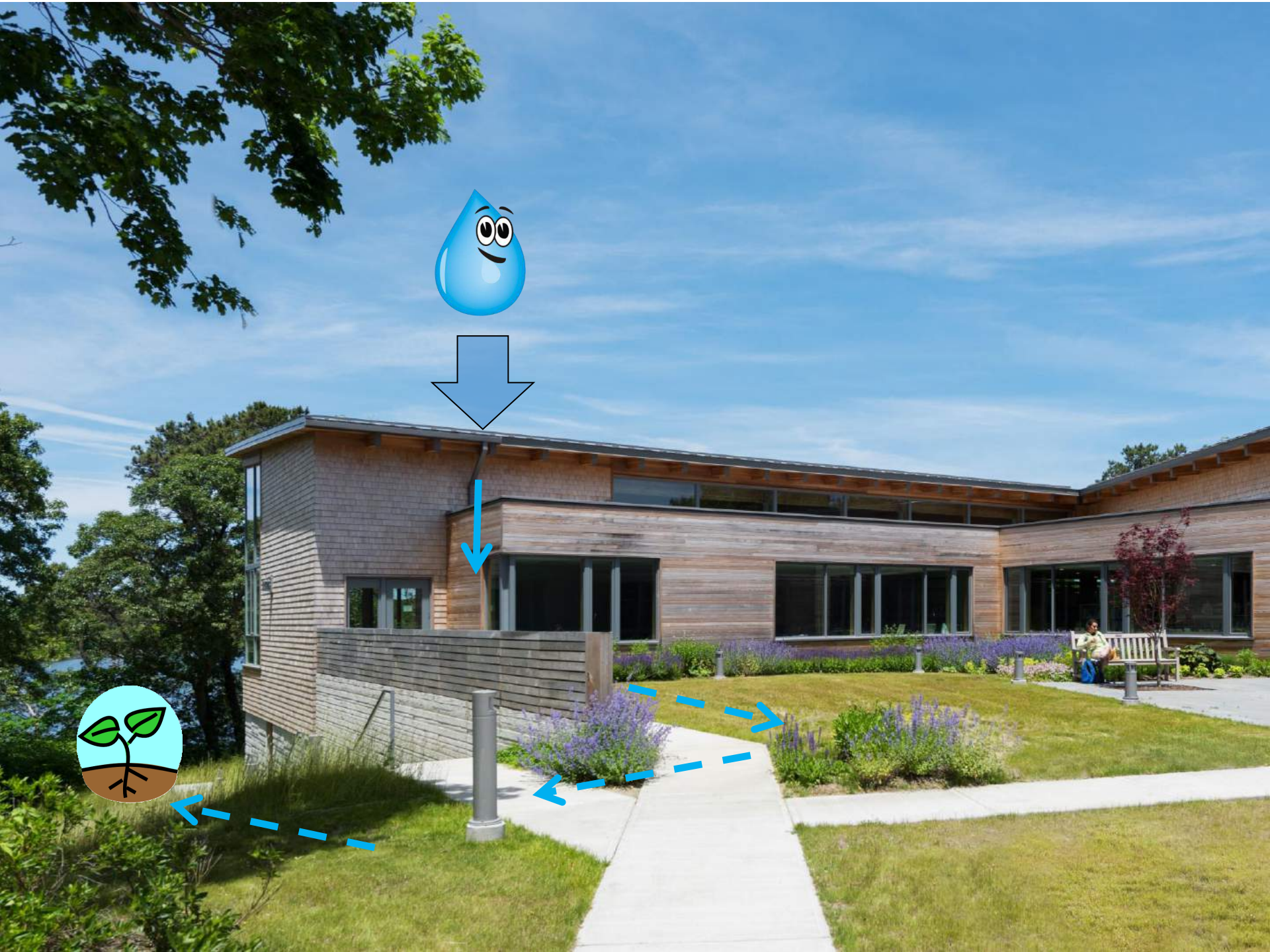
- Erosion and Gullying
- Grass/Plant growth
- Washouts Inlet flumes or pipes inlets
- Sediment forebay

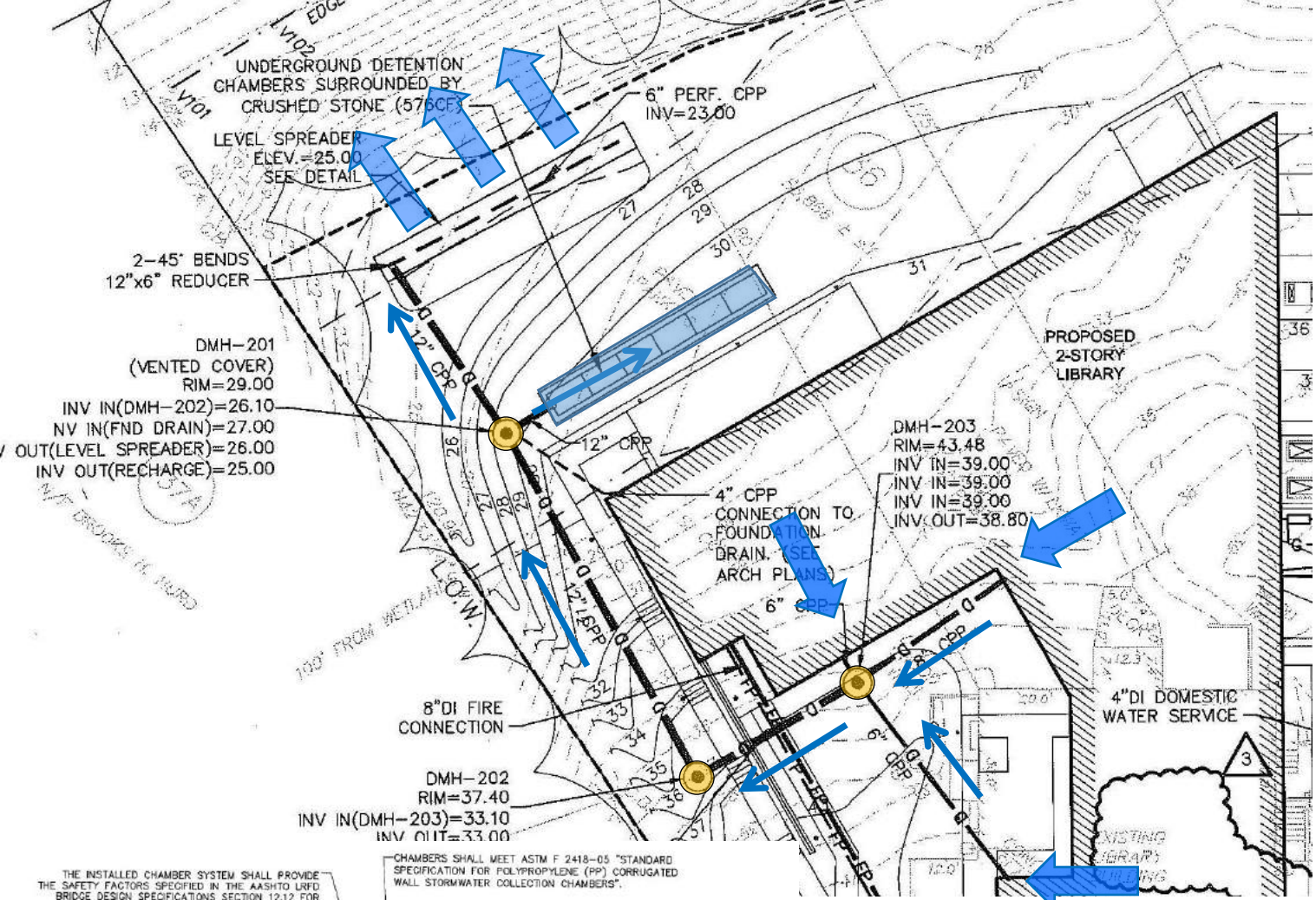
LONG-TERM MAINTENANCE

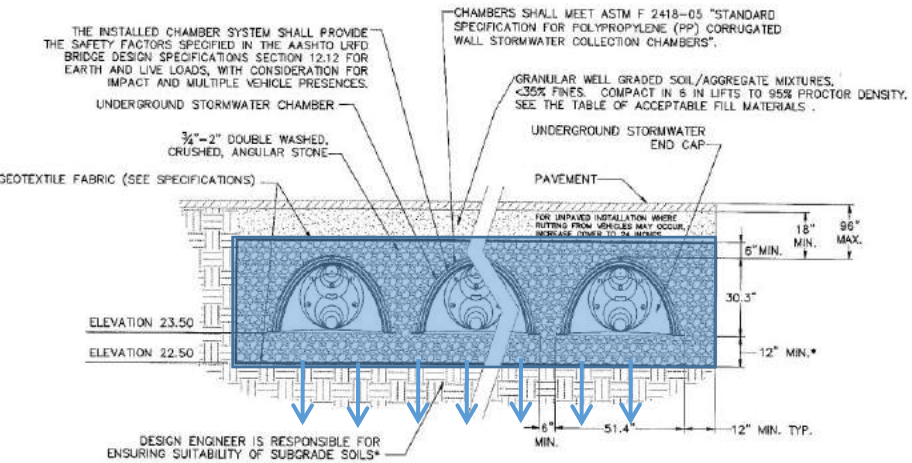
- When to inspect?
  - Spring thru fall
  - During the typical routine landscape maintenance:
  - Once per month
  - After large storm events
  - During other extreme weather events
- What to Inspect?
  - Debris Accumulation
  - Sediment build up
  - Weeds and invasive plants
  - Plant and grass health
  - Erosion/Gullying
  - Inlet/Outlet structure clogging

HANDS-ON MAINTENANCE EXERCISE

- **2:00 – 3:00pm Hands-on Maintenance Exercise**
  - Parking lot stormwater runoff treatment system
  - Roof runoff stormwater treatment system(s)

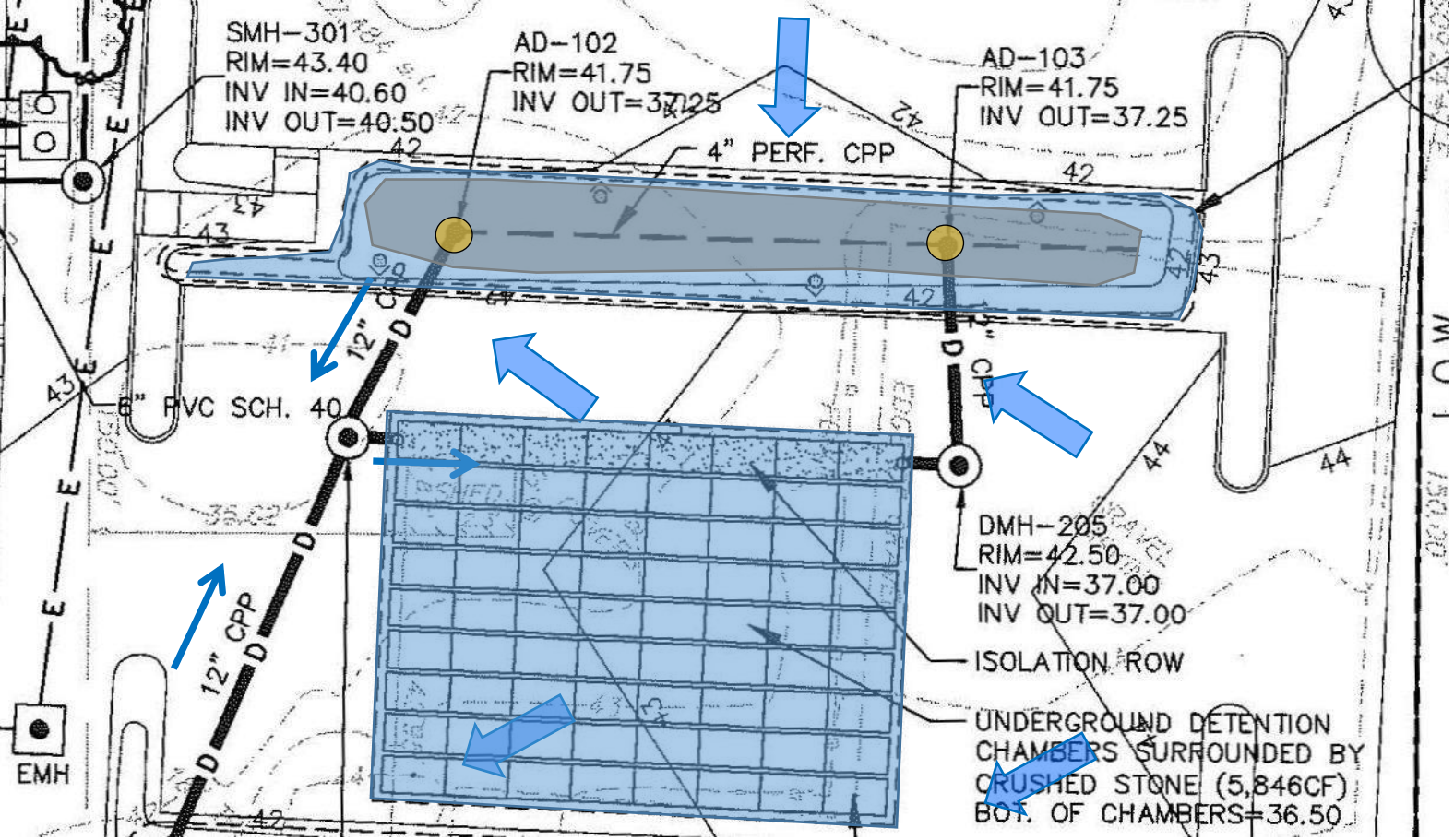


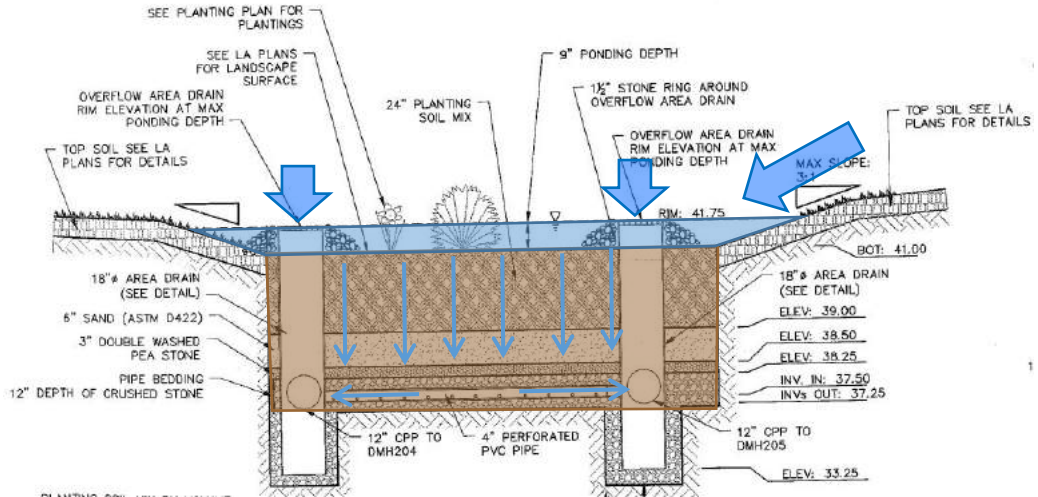

UNDERGROUND DETENTION CHAMBERS SURROUNDED BY CRUSHED STONE (576CF)
6" PERF. CPP INV=23.00
LEVEL SPREADER ELEV.=25.00 SEE DETAIL
2-45° BENDS 12"x6" REDUCER
DMH-201 (VENTED COVER) RIM=29.00
INV IN(DMH-202)=26.10
NV IN(FND DRAIN)=27.00
OUT(LEVEL SPREADER)=26.00
INV OUT(RECHARGE)=25.00
12" CPP
4" CPP CONNECTION TO FOUNDATION DRAIN. (SEE ARCH PLANS)
6" CPP
PROPOSED 2-STORY LIBRARY
DMH-203 RIM=43.48
INV IN=39.00
INV IN=39.00
INV IN=39.00
INV OUT=38.80
8"DI FIRE CONNECTION
DMH-202 RIM=37.40
INV IN(DMH-203)=33.10
4"DI DOMESTIC WATER SERVICE
L.O.W.
100' FROM WETLAND


THE INSTALLED CHAMBER SYSTEM SHALL PROVIDE THE SAFETY FACTORS SPECIFIED IN THE AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS SECTION 12.12 FOR EARTH AND LIVE LOADS, WITH CONSIDERATION FOR IMPACT AND MULTIPLE VEHICLE PRESENCES.
CHAMBERS SHALL MEET ASTM F 2418-05 "STANDARD SPECIFICATION FOR POLYPROPYLENE (PP) CORRUGATED WALL STORMWATER COLLECTION CHAMBERS".
GRANULAR WELL GRADED SOIL/AGGREGATE MIXTURES, <35% FINES. COMPACT IN 6 IN LIFTS TO 95% PROCTOR DENSITY. SEE THE TABLE OF ACCEPTABLE FILL MATERIALS .
UNDERGROUND STORMWATER CHAMBER
¾"-2" DOUBLE WASHED, CRUSHED, ANGULAR STONE
UNDERGROUND STORMWATER END CAP
GEOTEXTILE FABRIC (SEE SPECIFICATIONS)
PAVEMENT
FOR UNPAVED INSTALLATION WHERE RUTTING FROM VEHICLES MAY OCCUR, INCREASE COVER TO 24 INCHES
18" MIN.
96" MAX.
6" MIN.
30.3"
ELEVATION 23.50
ELEVATION 22.50
12" MIN.*
6" MIN.
51.4"
12" MIN. TYP.
DESIGN ENGINEER IS RESPONSIBLE FOR ENSURING SUITABILITY OF SUBGRADE SOILS*

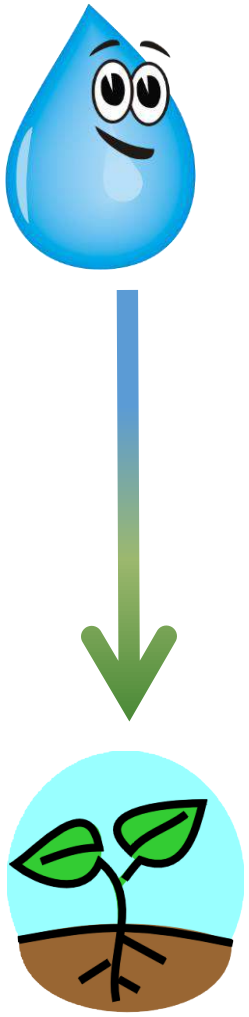
Bioswale

Bioswale


SMH-301
RIM=43.40
INV IN=40.60
INV OUT=40.50
AD-102
RIM=41.75
INV OUT=37.25
AD-103
RIM=41.75
INV OUT=37.25
4" PERF. CPP
12" CPP
6" PVC SCH. 40
12" CPP
EMH
DMH-205
RIM=42.50
INV IN=37.00
INV OUT=37.00
ISOLATION ROW
UNDERGROUND DETENTION CHAMBERS SURROUNDED BY CRUSHED STONE (5,846CF)
BOT. OF CHAMBERS=36.50


SEE PLANTING PLAN FOR PLANTINGS
SEE LA PLANS FOR LANDSCAPE SURFACE
OVERFLOW AREA DRAIN RIM ELEVATION AT MAX PONDING DEPTH
TOP SOIL SEE LA PLANS FOR DETAILS
24" PLANTING SOIL MIX
9" PONDING DEPTH
1½" STONE RING AROUND OVERFLOW AREA DRAIN
OVERFLOW AREA DRAIN RIM ELEVATION AT MAX PONDING DEPTH
MAX SLOPE: 3:1
TOP SOIL SEE LA PLANS FOR DETAILS
RIM: 41.75
BOT: 41.00
18"ø AREA DRAIN (SEE DETAIL)
6" SAND (ASTM D422)
3" DOUBLE WASHED PEA STONE
PIPE BEDDING
12" DEPTH OF CRUSHED STONE
12" CPP TO DMH204
4" PERFORATED PVC PIPE
18"ø AREA DRAIN (SEE DETAIL)
ELEV: 39.00
ELEV: 38.50
ELEV: 38.25
INV. IN: 37.50
INVs OUT: 37.25
12" CPP TO DMH205
ELEV: 33.25

RECAP



1. "Collect" - Drainage Inlets
2. "Move" - Swales
3. "Remove" - Sediment Collection
4. "Filter" Treatment Areas (Bioswales/Raingardens)
5. "Overflow" - Outlets & Spillways
6. Surrounding Area

Maintenance Checklist
Eastham Library – Bioretention/Bioswales

Date:

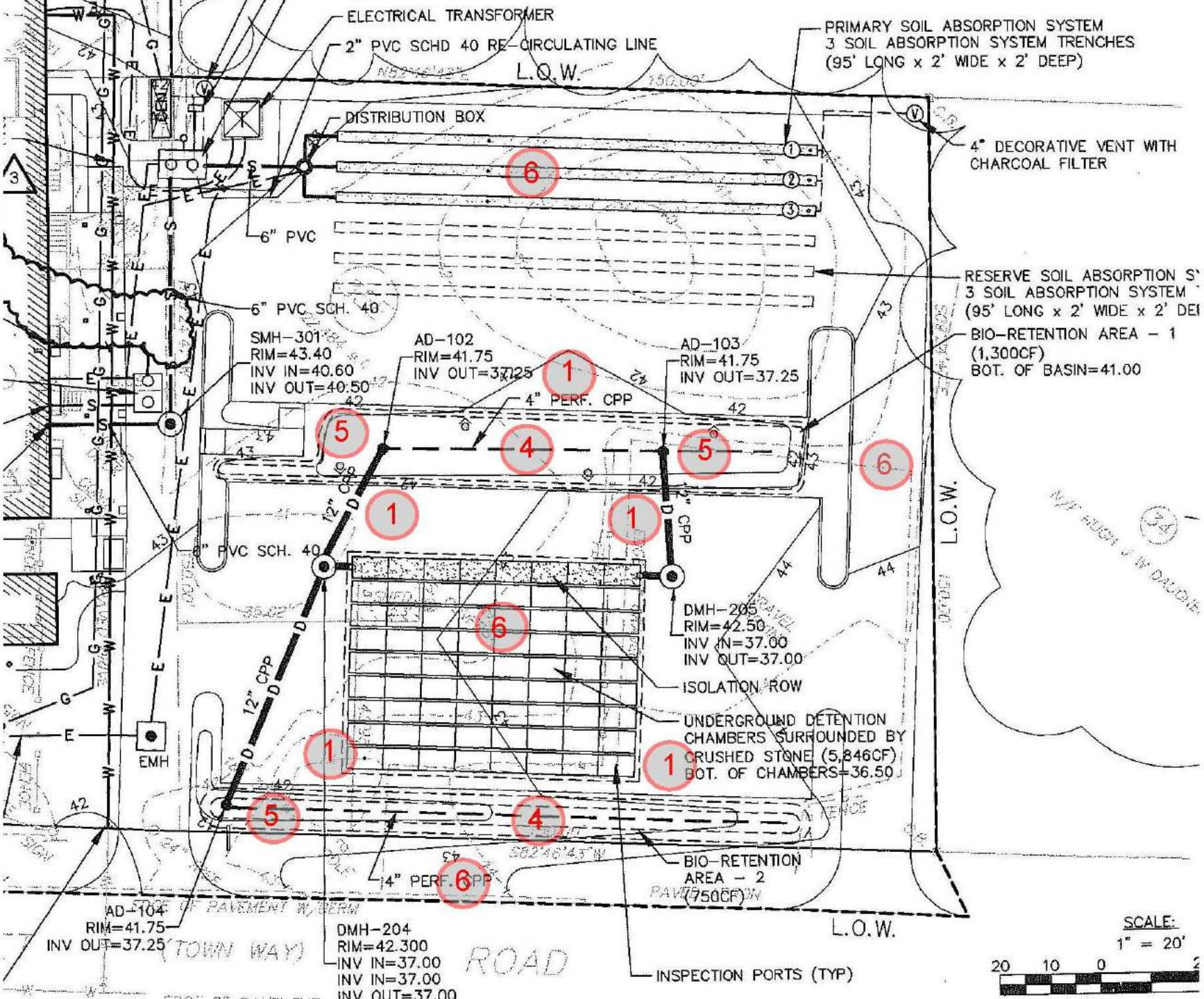
Time:

Inspector:

Maintenance Item	Description	Maintenance (Y/N)
1. Drainage Inlet: **Includes: Inlet Flumes, catch basins, diversion structure** **Inspect annually and after major storm events (2" of rain or greater)**		
Surface Debris Cleaning	Remove all trash, leaf litter and inlet clogging.	
Inlet Flumes	Check for clogging and sediment accumulation that impacts inflow. If sediment/debris accumulation	
Actions to be taken:		
2. Swales (if applicable) **Inspect annually and after major storm events (2" of rain or greater)**		
Debris Cleanout	Remove all trash and debris from the swale.	
Sediment/Organic Debris Removal	Removed and properly disposed of when build-up is greater than or equal to 3 inches.*	
Erosion	Check for areas of erosion/ gullies in the swale, particularly along the swale bottom. Repair/reseed as necessary	
Actions to be taken:		
2. Sediment Collection (if applicable): **Includes: Sediment Forebays, Structure/Deep Sumps** **Inspect bi-annually and after major storm events the first year.**		
Debris Cleanout	Remove trash and debris from the surface.	
Side Slopes	Signs of erosion gullies, animal burrowing, overtopping or slumping are observed. Repair as necessary.	
Sediment/Organic Debris Removal	Remove sediment accumulation and properly dispose when accumulation is greater than or equal to 3 inches or you cannot see stones.*	
Actions to be taken:		

Maintenance Item	Description	Maintenance (Y/N)
4. Treatment Area (Bioretention/Bioswale Area) **Inspect bi-annually and after major storm events the first year; then annually and after major storm events (2" of rain or greater)**		
Debris Cleanout	Remove trash and debris from the surface.	
Side Slopes	Signs of erosion gullies, animal burrowing, overtopping or slumping are observed. Repair as necessary.	
Sediment/Organic Debris Removal	Remove sediment accumulation and properly dispose when accumulation is greater than or equal to 3 inches or you cannot see stones.*	
Vegetation Maintenance Replacement	Area mowed twice per year minimum (12" grass height). Over seed bare or thin grass growth areas.	
Water Draining properly	If standing water is observed for more than 48 hours after a storm event, rototill or aerate the bottom 6 inches to breakup any hard-packed sediment, and replenished with mulch.*	
Actions to be taken:		
5. Outlet Structures/Spillways **Includes: Bio outlet structures and emergency/overflow spillways** **Inspect annually and after major storm events (2" of rain or greater)**		
Emergency Spillways	Check for settling gulling, erosion damage, settling & clogging. Repair as necessary and return to design grades.	
Spillway Overflow	Look for areas of erosion in the overflow swale between. Repair as necessary.	
Overflow Structure	Check for sediment accumulation that impacts inflow. If sediment accumulation. Schedule cleaning. Check for leaf litter, debris and inlet clogging.	
Actions to be taken:		
6. Surrounding Grounds Maintenance – Inspect frequently		
Debris Removal	Remove trash from perimeter areas.	
Pavement Sweeping	Sweep parking lot minimum once a year after spring thaw.	
Drainage Network	Ensure proper operation.	
Contributing drainage area	Contributing drainage area stabilized	
Actions to be taken:		

*Sediment shall be disposed of offsite in a pre-approved location.


ELECTRICAL TRANSFORMER
2" PVC SCHD 40 RE-CIRCULATING LINE
L.O.W.
PRIMARY SOIL ABSORPTION SYSTEM
3 SOIL ABSORPTION SYSTEM TRENCHES
(95' LONG x 2' WIDE x 2' DEEP)
DISTRIBUTION BOX
4" DECORATIVE VENT WITH
CHARCOAL FILTER
6" PVC
RESERVE SOIL ABSORPTION S
3 SOIL ABSORPTION SYSTEM
(95' LONG x 2' WIDE x 2' DEI
6" PVC SCH. 40
BIO-RETENTION AREA - 1
(1,300CF)
BOT. OF BASIN=41.00
SMH-301
RIM=43.40
INV IN=40.60
INV OUT=40.50
AD-102
RIM=41.75
INV OUT=37.25
AD-103
RIM=41.75
INV OUT=37.25
4" PERF. CPP
12" CPP
6" PVC SCH. 40
DMH-205
RIM=42.50
INV IN=37.00
INV OUT=37.00
ISOLATION ROW
UNDERGROUND DETENTION
CHAMBERS SURROUNDED BY
CRUSHED STONE (5,846CF)
BOT. OF CHAMBERS=36.50
EMH
BIO-RETENTION
AREA - 2
(750CF)
4" PERF. CPP
AD-104
RIM=41.75
INV OUT=37.25
DMH-204
RIM=42.300
INV IN=37.00
INV IN=37.00
INV OUT=37.00
INSPECTION PORTS (TYP)
L.O.W.
SCALE:
1" = 20'
20 10 0


THANK YOU!
QUESTIONS?