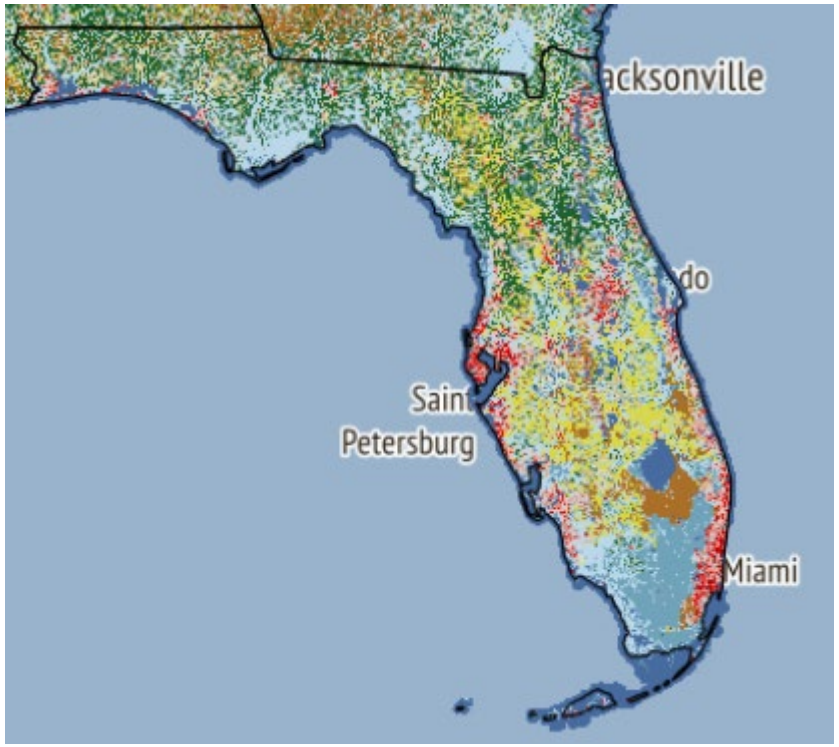
COMMON CENTS: ENCOURAGING GREEN INFRASTRUCTURE USE IN PINELLAS COUNTY

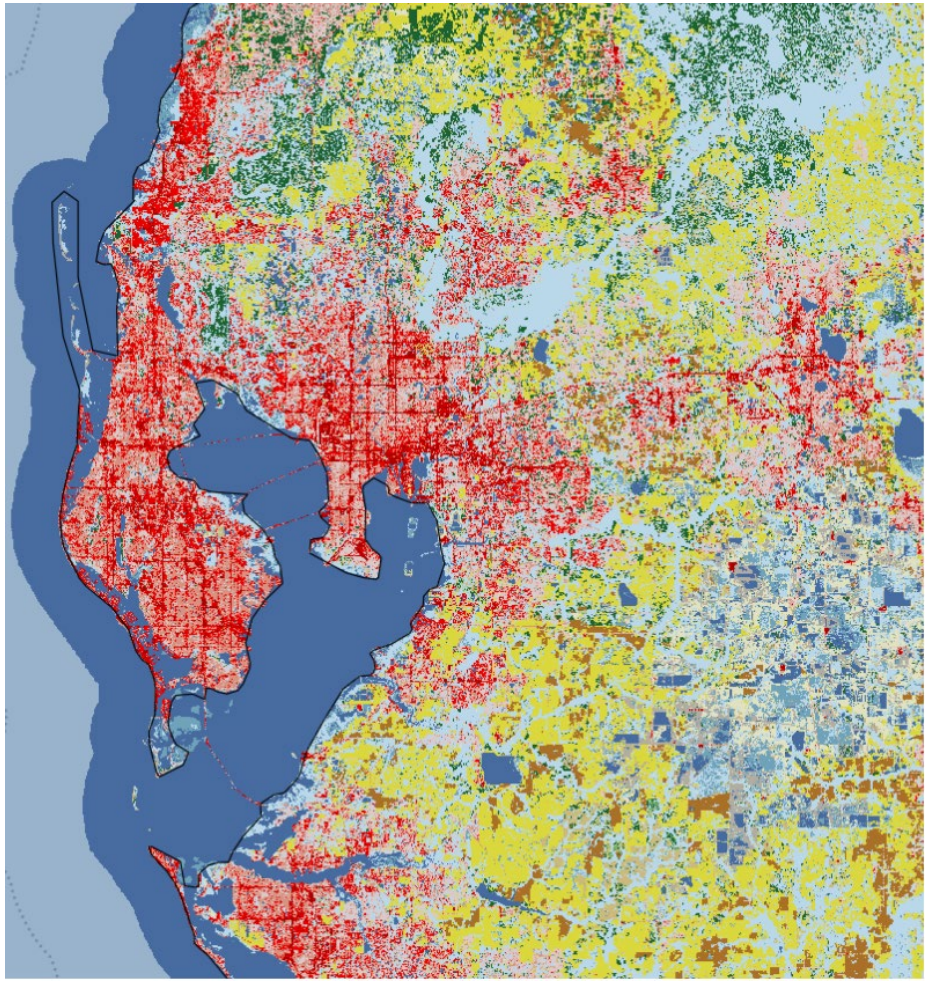
Josie Benwell, M.S., ENV SP
Project Coordinator
Pinellas County Public Works

Common Cents-Encouraging Green Infrastructure in Pinellas County

Pinellas County – Background Information



- Open Water (11)
- Perennial Ice/Snow/ (12)
- Developed, Open Space (21)
- Developed, Low Intensity (22)
- Developed, Medium Intensity (23)
- Developed, High Intensity (24)
- Barren Land (Rock/Sand/Clay) (31)
- Unconsolidated Shore (32)
- Deciduous Forest (41)
- Evergreen Forest (42)
- Mixed Forest (43)
- Dwarf Scrub(AK only) (51)
- Shrub/Scrub (52)
- Grasslands/Herbaceous (71)
- Sedge/Herbaceous(AK only) (72)
- Lichens (Ak only) (73)
- Moss (AK only) (74)
- Pasture/Hay (81)
- Cultivated Crops (82)
- Woody Wetlands (90)
- Emergent Herbaceous Wetlands (95)

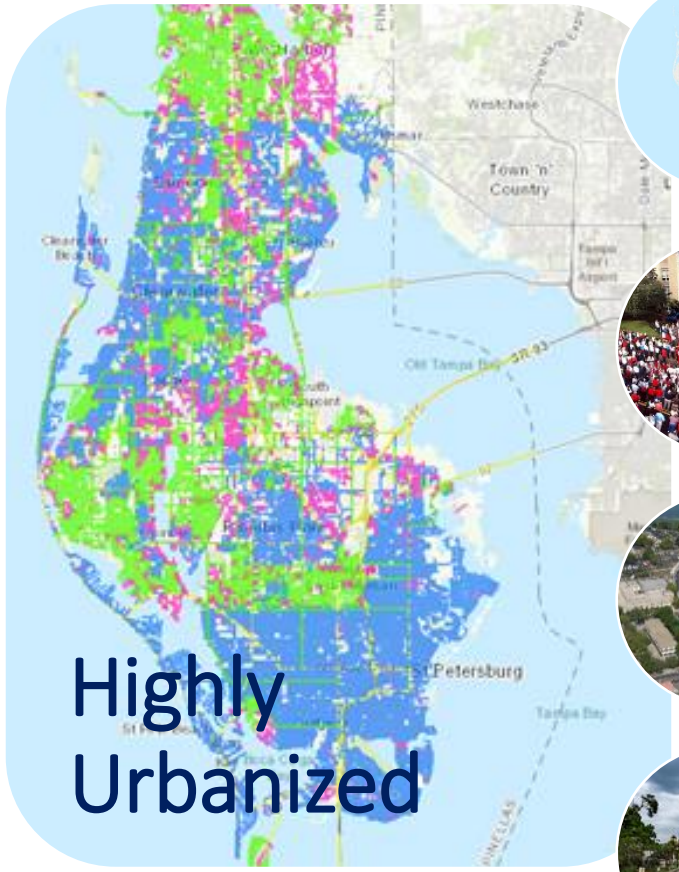


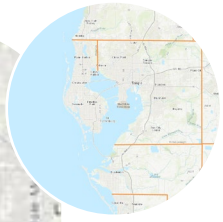
National Land Cover Database (2016)

https://www.mrlc.gov/viewer/

Common Cents-Encouraging Green Infrastructure in Pinellas County

Pinellas County – Fast Facts





2nd smallest County in FL at only 280 mi²

Most densely populated County in FL at 3,347 people/mi²

Limited open/vacant space

Extensively paved

- 4,521 mi of roads
- 1,072 mi of path
- 142 bridges

15,539,597 visitors in 2018

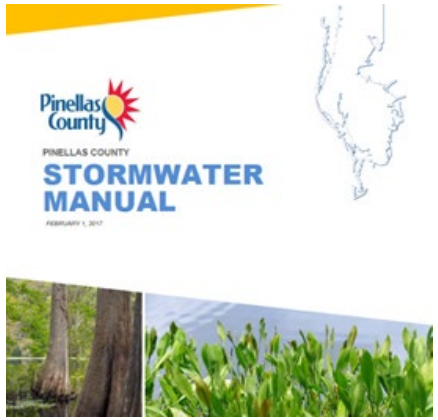
Economic impact of over $8 billion in 2018

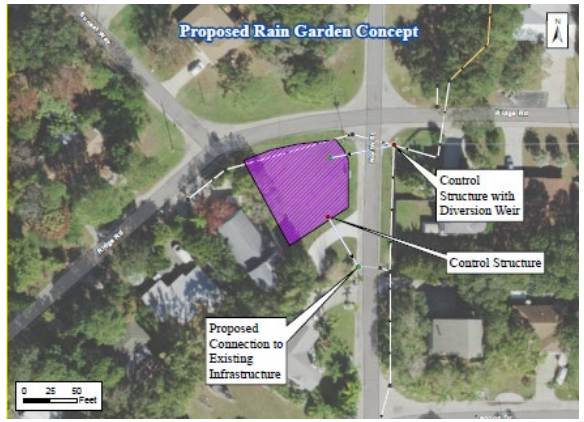
35 miles of beaches

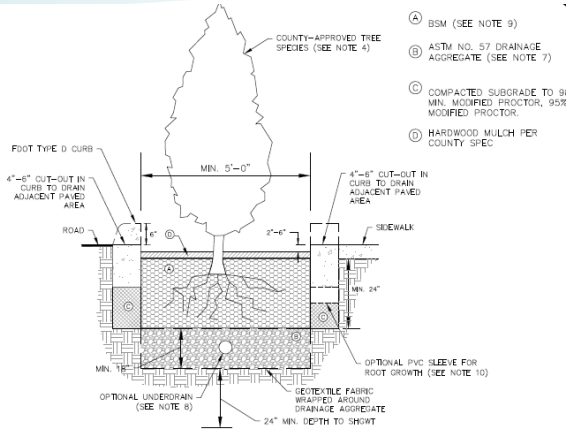
Sensitive habitat, impaired waters, seagrass

Common Cents-Encouraging Green Infrastructure in Pinellas County

Steps taken to Encourage the Use of Green Infrastructure







Set Standards

- Adopted Stormwater Manual in 2017
- Pollutant load-based standards
- Flexibility in BMPs

Improve Public Education

- Created educational flyer
- Discuss concept at public meetings

Construct GI on County property

- GIS siting tool - identified top GI projects
- Construct top 3 GI projects

Encourage GI- public & private projects

- GI design (CAD) templates
- Update/reorganize Stormwater Manual

Common Cents-Encouraging Green Infrastructure in Pinellas County

Feedback Received from Applicants

Unsure of how to effectively incorporate it into projects

Perception that it is cost prohibitive

FEEDBACK RECEIVED ABOUT GREEN INFRASTRUCURE

Thought that more maintenance will be required

Belief that it stymies development/redevelopment

Common Cents-Encouraging Green Infrastructure in Pinellas County

Strategies for encouraging the use of green infrastructure

Development of technical design aides

- Created green infrastructure CAD design templates
- Created a BAM supplemental specification
- Developed a list of suggested vegetation (searchable by attribute)

Stormwater manual updates

- Added new design templates
- Addressed feedback from stakeholders on technical items
- Reorganized manual and added live links to make it more user-friendly
- Included “social marketing” concepts
- Added a list of example project sites and case studies
- Referenced a cost estimator tool

Common Cents-Encouraging Green Infrastructure in Pinellas County

Triple Bottom Line

ENVIRONMENTAL

- ↑ water quality
- ↑ groundwater recharge
- ↓ air pollution
- ↓ erosion
- ↑ habitat
- ↓ urban heat island effect

SOCIAL

- ↓ flooding
- ↑ aesthetics
- ↑ public education
- ↑ rents/property values
- ↑ mental health
- ↑ recreation opportunity
- ↓ crime

ECONOMIC

- ↓ land acquisition $
- ↓ O&M $
- ↑ development intensity
- ↑ awards (LEED)
- ↑ SW fee/tax credits
- ↑ cost-benefit
- ↑ occupancy rates
- ↑ grants/ partnerships
- ↑ and faster sales
- ↑ marketability (by 10-15%)

Common Cents-Encouraging Green Infrastructure in Pinellas County

Summary of goals

Encourage the use of green infrastructure by:

- Improving the stormwater manual
- Providing "grab-and-go" CAD templates
- Making the use of BAM and plant selection easier
- Emphasizing that GI is desirable, garners positive attention and attracts buyers/patrons/tenants

Where would you rather be? (Palmetto street before and after revitalization using green infrastructure – design by Applied Sciences)

Which would you rather have in your neighborhood? (City of Denver; Conor Park in Palmetto, FL)

Common Cents-Encouraging Green Infrastructure in Pinellas County

Contact Information:

Josie Benwell, M.S., ENV SP
Project Coordinator
Pinellas County Public Works
Stormwater & Vegetation Division
jbenwell@pinellascounty.org

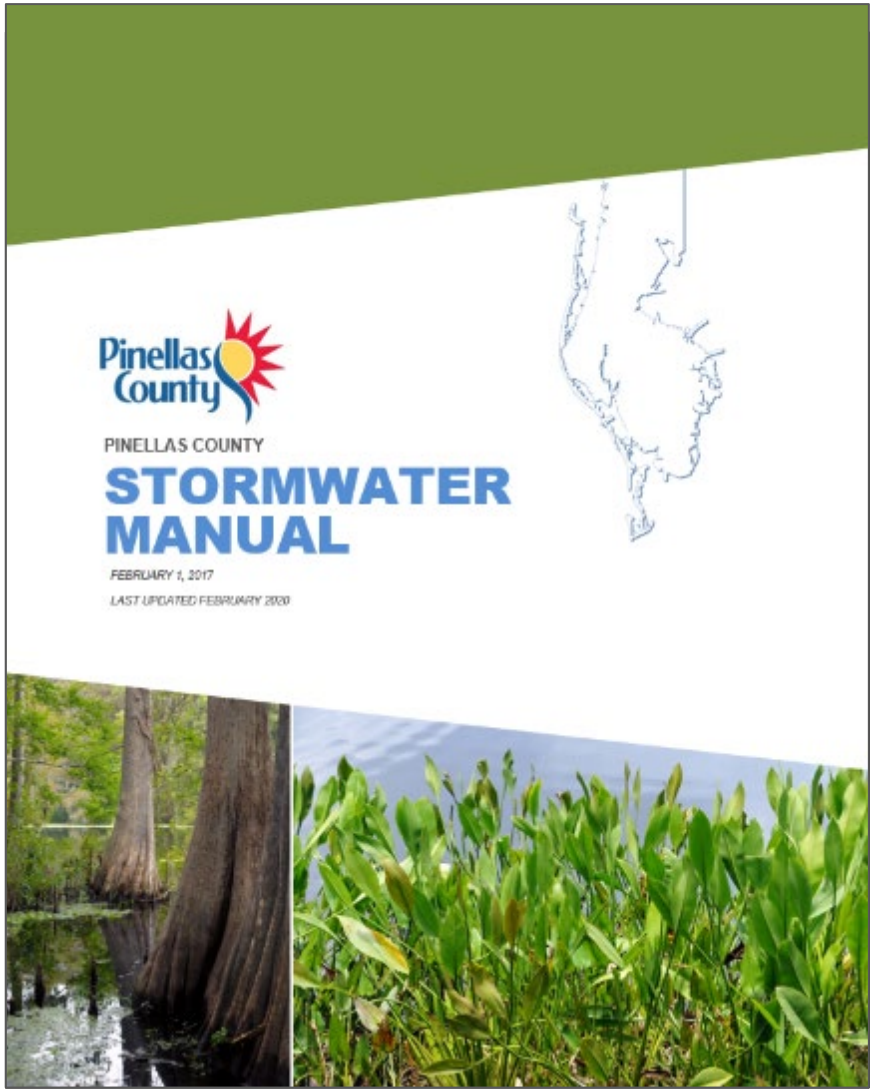
“Common Cents”: Encouraging Green Infrastructure in Pinellas County

June 23, 2021

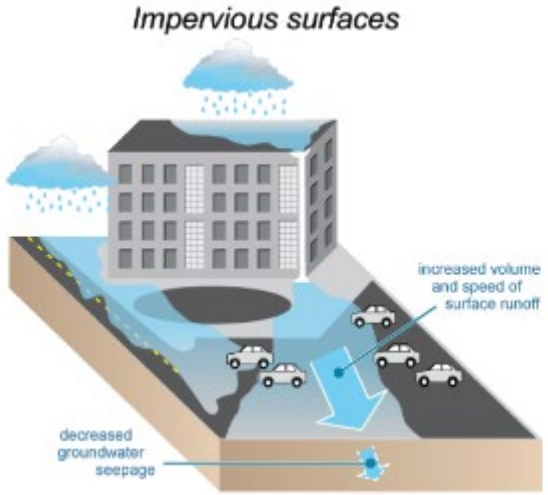
Pinellas County

APPLIED SCIENCES

Objective



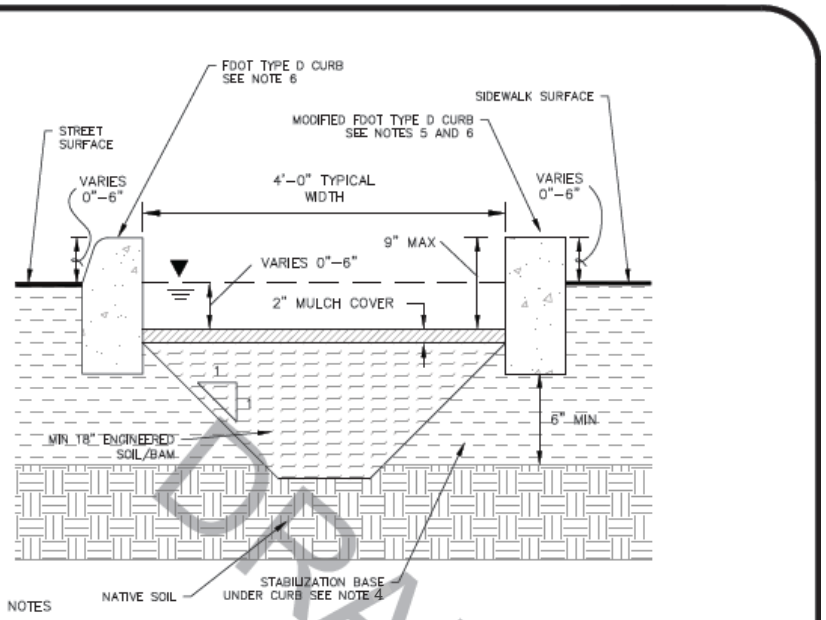
Available Online at: www.pinellascounty.org



Standard Details – Green Infrastructure Templates

1. Green Gutters
2. Bio-swales
3. Rain Gardens
4. Tree Wells
5. Exfiltration Trenches
6. Pervious Pavement

Green Gutters Template



DESIGN NOTES

1. FOR PUBLIC PROJECTS, ALL ELEMENTS MUST BE WITHIN THE RIGHT OF WAY OR APPROPRIATE EASEMENTS.
2. NO PRIVATE SYSTEMS SHALL BE PLACED IN THE PUBLIC RIGHT OF WAY.
3. ALL DIMENSIONS CAN BE MODIFIED TO FIT SITE CONSTRAINTS; WIDTHS LESS THAN 2' ARE NOT RECOMMENDED. MODIFICATIONS MUST BE DESIGNED BY LICENSED ENGINEER.
4. COMPACTED BASE TO 95% MIN. MODIFIED PROCTOR, 98% MAX. MODIFIED PROCTOR.
5. ANY TYPE D CURB MODIFICATIONS TO BE DESIGNED BY ENGINEER.
6. DRAINAGE INLET SLOT AND SPACING AS WELL AS OVERFLOW TO BE DESIGNED BY ENGINEER. TRAPEZOIDAL CURB OPENINGS ARE RECOMMENDED TO AVOID CLOGGING.
7. ENGINEERED SOIL SHOULD CONSIST OF 40% CLEAN SAND, 30% TOPSOIL, AND 30% COMPOST. SEE BSM AND BAM TECHNICAL SPECIFICATIONS.
8. HARDWOOD MULCH MATERIAL MUST BE USED PER PINELLAS COUNTY STORMWATER MANUAL SPECIFICATIONS.
9. VEGETATED SYSTEMS MUST BE ABLE TO RECOVER REQUIRED TREATMENT VOLUME IN 24 TO 36 HOURS TO PREVENT DAMAGE TO VEGETATION.
10. REQUIRED MIN. DISTANCE OF 24" FROM BOTTOM OF GREEN GUTTER TO SEASONAL HIGH GROUNDWATER TABLE (SHGWT).
11. UNDERDRAIN SYSTEM REQUIRED IF THE SEASONAL HIGH GROUNDWATER TABLE IS LESS THAN 24" BELOW THE BOTTOM OF THE ENGINEERED SOIL/BAM LAYER OR IF NATIVE SOIL INFILTRATION DOES NOT FACILITATE ADEQUATE INFILTRATION. UNDERDRAIN TO BE DESIGNED BY ENGINEER PER PINELLAS COUNTY DETAIL INDEX NUMBER 1290.
12. MINIMUM UTILITY SETBACKS AND PROTECTION MEASURES MUST CONFORM TO CURRENT PINELLAS COUNTY STANDARDS. COORDINATE WITH UTILITY OWNER IN THE EVENT OF UTILITY CROSSING AND UTILITY CONFLICTS.
13. DESIGN ENGINEER MUST ENSURE FINAL DESIGN ADHERES TO ALL APPLICABLE COUNTY CODES.

PINELLAS COUNTY

GREEN GUTTERS

DETAIL INDEX I.D.: ---

DATE: SEP/2020

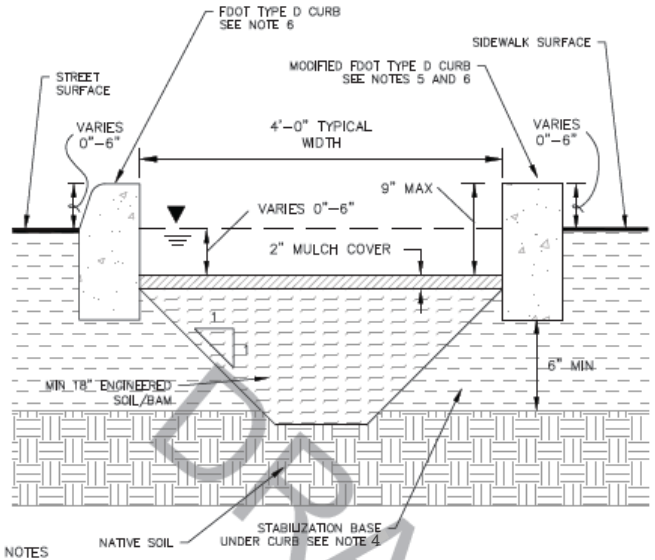
NOT TO SCALE

REVISION:

Highlights

- Typically located within right-of-way, between road curb and sidewalk.
- < 2 acre contributing drainage area
- Scalable length
- Available options:
  - Overflow structure
  - Underdrain vs. infiltration
  - Native plantings

Green Gutters Template – Design Notes Example



DESIGN NOTES

1. FOR PUBLIC PROJECTS, ALL ELEMENTS MUST BE WITHIN THE RIGHT OF WAY OR APPROPRIATE EASEMENTS.
2. NO PRIVATE SYSTEMS SHALL BE PLACED IN THE PUBLIC RIGHT OF WAY.
3. ALL DIMENSIONS CAN BE MODIFIED TO FIT SITE CONSTRAINTS; WIDTHS LESS THAN 2' ARE NOT RECOMMENDED. MODIFICATIONS MUST BE DESIGNED BY LICENSED ENGINEER.
4. COMPACTED BASE TO 95% MIN. MODIFIED PROCTOR, 98% MAX. MODIFIED PROCTOR.
5. ANY TYPE D CURB MODIFICATIONS TO BE DESIGNED BY ENGINEER.
6. DRAINAGE INLET SLOT AND SPACING AS WELL AS OVERFLOW TO BE DESIGNED BY ENGINEER. TRAPEZOIDAL CURB OPENINGS ARE RECOMMENDED TO AVOID CLOGGING.
7. ENGINEERED SOIL SHOULD CONSIST OF 40% CLEAN SAND, 30% TOPSOIL, AND 30% COMPOST. SEE BSM AND BAM TECHNICAL SPECIFICATIONS.
8. HARDWOOD MULCH MATERIAL MUST BE USED PER PINELLAS COUNTY STORMWATER MANUAL SPECIFICATIONS.
9. VEGETATED SYSTEMS MUST BE ABLE TO RECOVER REQUIRED TREATMENT VOLUME IN 24 TO 36 HOURS TO PREVENT DAMAGE TO VEGETATION.
10. REQUIRED MIN. DISTANCE OF 24" FROM BOTTOM OF GREEN GUTTER TO SEASONAL HIGH GROUNDWATER TABLE (SHGWT).
11. UNDERDRAIN SYSTEM REQUIRED IF THE SEASONAL HIGH GROUNDWATER TABLE IS LESS THAN 24" BELOW THE BOTTOM OF THE ENGINEERED SOIL/BAM LAYER OR IF NATIVE SOIL INFILTRATION DOES NOT FACILITATE ADEQUATE INFILTRATION. UNDERDRAIN TO BE DESIGNED BY ENGINEER PER PINELLAS COUNTY DETAIL INDEX NUMBER 1290.
12. MINIMUM UTILITY SETBACKS AND PROTECTION MEASURES MUST CONFORM TO CURRENT PINELLAS COUNTY STANDARDS. COORDINATE WITH UTILITY OWNER IN THE EVENT OF UTILITY CROSSING AND UTILITY CONFLICTS.
13. DESIGN ENGINEER MUST ENSURE FINAL DESIGN ADHERES TO ALL APPLICABLE COUNTY CODES.

PINELLAS COUNTY	DETAIL INDEX I.D.: ---
GREEN GUTTERS	DATE: SEP/2020
	NOT TO SCALE
	REVISION:

DESIGN NOTES

1. GREEN GUTTER PLANTINGS:
   a. GREEN GUTTERS SHOULD BE POPULATED WITH PLANTS NATIVE TO THE INSTALLATION LOCATION. NATIVE PLANTS, GRASSES AND FLOWERS ESTABLISH DEEPER ROOTS AND REMOVE MORE POLLUTANTS FROM RUNOFF.
   b. SELECT A MIXTURE OF NATIVE PLANTS BASED ON SITE CONDITIONS TO IMPROVE BIODIVERSITY AND AESTHETICS. SELECTED PLANTS SHOULD BE DROUGHT AND FLOOD TOLERANT. RECOMMENDED APPROACH INCLUDES 1/3 SEDGES, 1/3 FLOWERS, AND 1/3 GRASSES.
2. SCHEDULE PRE–INSTALLATION MEETING WITH THE DESIGN ENGINEER 72 HOURS IN ADVANCE OF GREEN INFRASTRUCTURE CONSTRUCTION.
3. VEGETATED SYSTEMS MUST BE ABLE TO RECOVER REQUIRED TREATMENT VOLUME IN 24 TO 36 HOURS TO PREVENT DAMAGE TO VEGETATION WITH A DESIGN SAFETY FACTOR OF 2.0.
4. AREAS IN AND AROUND GREEN INFRASTRUCTURE SHOULD BE PROTECTED DURING EARTH MOVING TO PREVENT COMPACTION THAT WOULD REDUCE INFILTRATION RATES. PROTECTION THROUGHOUT CONSTRUCTION FROM SEDIMENT TRANSPORT THAT WOULD CLOG THE INFILTRATION CAPACITY OF NATIVE AND ENGINEERED SOILS.
5. CONTRACTOR SHOULD RAKE OR ROTOTILL THE TOP SIX INCHES OF NATIVE SOIL AFTER EXCAVATION WHERE INFILTRATION WILL TAKE PLACE TO COUNTERACT THE EFFECTS OF COMPACTION AND CLOGGING.
6. MINIMIZE NATIVE SOIL DISTURBANCE WHILE INSTALLING OVERFLOW STRUCTURE.

ENGINEERED SOIL AND BAM SPECIFICATION

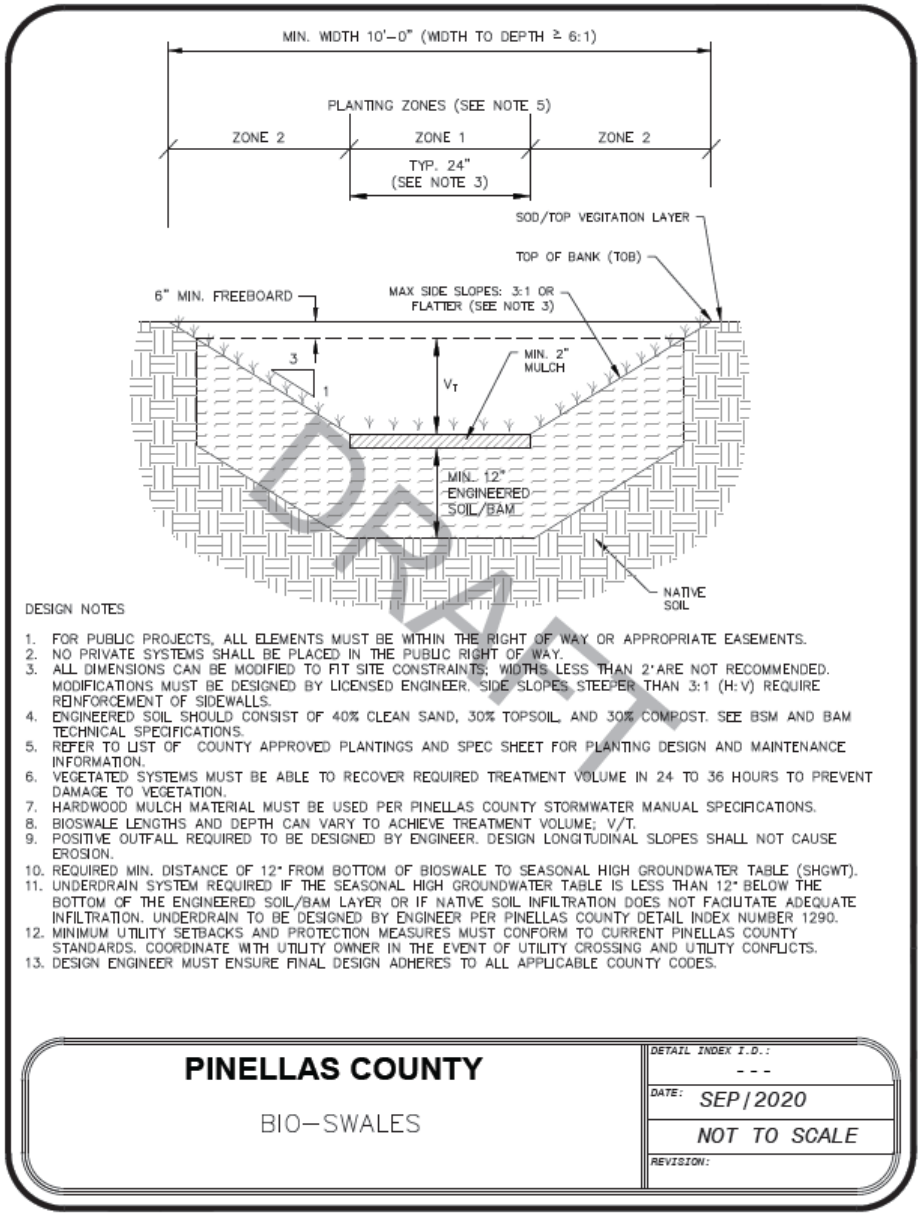
1. ENGINEERED SOIL WILL ADHERE TO THE FOLLOWING:
   a. 40% SAND, 30% TOPSOIL, AND 30% COMPOST (SEE TECHNICAL SPECIFICATIONS ENGINEERED SOILS).
   b. ORGANIC CONTENT MATTER FROM 8–10% BY WEIGHT
   c. LESS THAN 5% MINERAL FINES CONTENT (CLAY)
   d. MINIMUM THICKNESS OF 2 FEET.
   e. COMPACT TO 85% MAXIMUM DENSITY PER ASTM D 1557
   f. MINIMUM LONG–TERM HYDRAULIC CONDUCTIVITY OF 1 INCH/HOUR PER ASTM D2434.
   g. MAXIMUM IMMEDIATE HYDRAULIC CONDUCTIVITY OF 12 INCHES/HOUR
2. ENGINEERED SOIL MAY BE OBTAINED OFF SITE OR CREATED BY TESTING NATIVE SOILS AND MIXING WITH IMPORTED MATERIALS AS NEEDED TO ACHIEVE SPECIFICATIONS.
3. ENGINEERED SOIL SHOULD BE MIXED UNIFORMLY AND ONSITE CHARACTERISTICS SHOULD BE VERIFIED BY MATERIALS TESTING PRIOR TO PLACEMENT.
4. PLACE UNSATURATED SOIL IN 8 INCH LIFTS. DO NOT PLACE IF SATURATED.
5. TO PRESERVE INFILTRATION CAPACITY OF NATIVE SOIL, KEEP MACHINERY OUTSIDE OF GREEN INFRASTRUCTURE AREA.
6. AFTER PLACEMENT, COMPACT EACH LIFT TO 85% MAXIMUM DENSITY USING WATER UNTIL SATURATED OR BY WALKING ON THE SURFACE, DO NOT USE A VIBRATORY COMPACTOR.

MAINTENANCE GUIDELINES

1. WATER PLANTS THOROUGHLY FOLLOWING PLANTING TO SETTLE THE SOIL AROUND THE ROOTS UNTIL ESTABLISHMENT HAS TAKEN PLACE.
2. REMOVE DEBRIS AND RUBBISH ON A MONTHLY BASIS.
3. PERFORM SPRING MAINTENANCE TO REMOVE BUILT UP DEBRIS FROM WINTER, PROVIDE PRE–EMERGENT PLANT CARE AND INSTALL/REPLACE MULCH AS NECESSARY.
4. TRIM VEGETATION TO ENSURE SAFETY, AESTHETICS, PROPER OPERATION, OR TO SUPPRESS WEEDS AND INVASIVE VEGETATION.
5. CUT BACK PERENNIALS AND REMOVE LEAF DEBRIS AT END OF GROWING SEASON.
6. REPLACE UNSUCCESSFULLY ESTABLISHED PLANTS
7. INSPECT AND CORRECT EROSION PROBLEMS, DAMAGE TO VEGETATION, SEDIMENT AND DEBRIS ACCUMULATION AND POOLS OF STANDING WATER.
8. REMOVE ALL LABELS, WIRES, ETC, FROM PLANTS

PINELLAS COUNTY	DETAIL INDEX I.D.: ---
GREEN GUTTER NOTES	DATE: SEP/2020
	NOT TO SCALE
	REVISION:

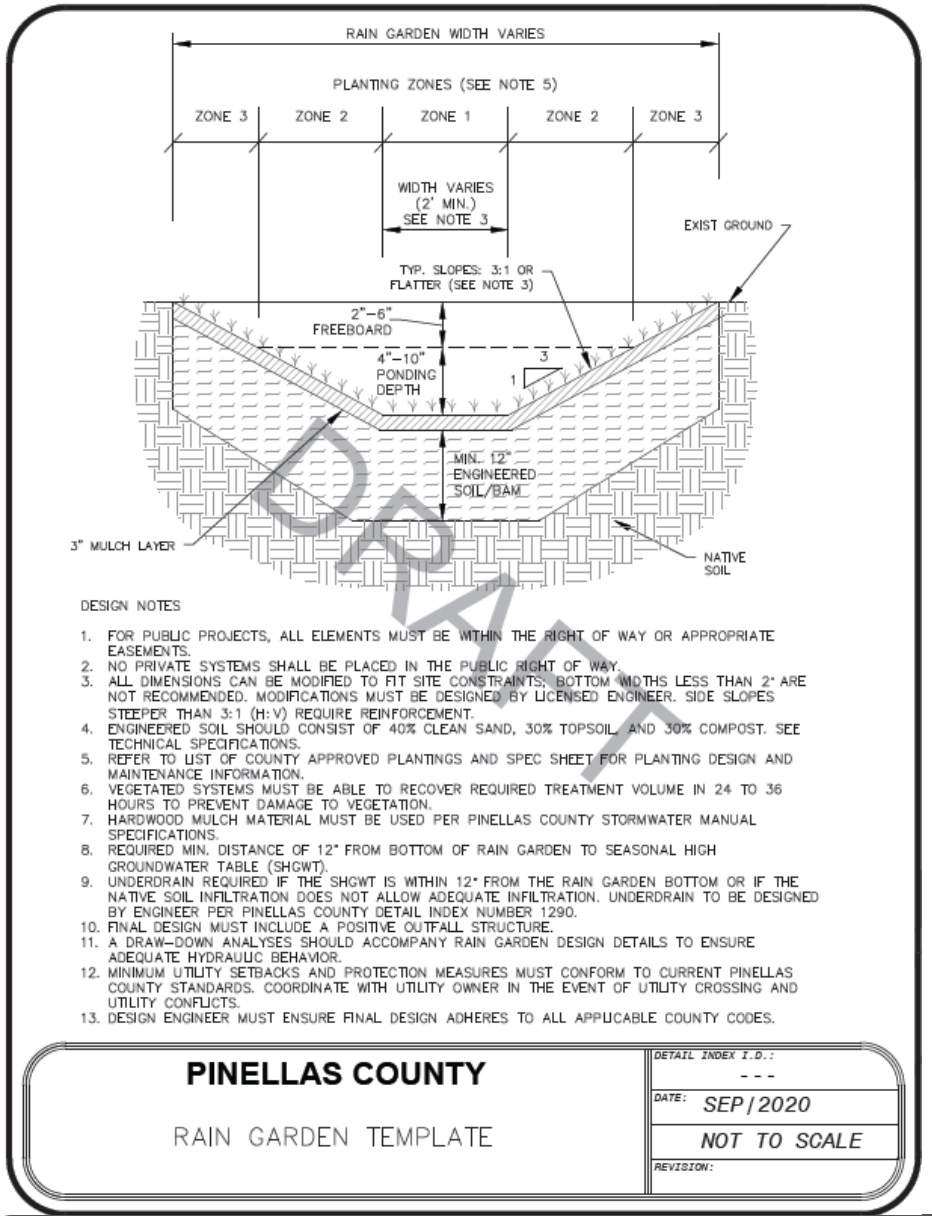
Bioswales Template



Highlights

- Typically located in parking lots, along right-of-way, and adjacent to buildings
- < 2 acre contributing drainage area
- Scalable length
- Available options:
  - Overflow structure
  - Underdrain vs. infiltration

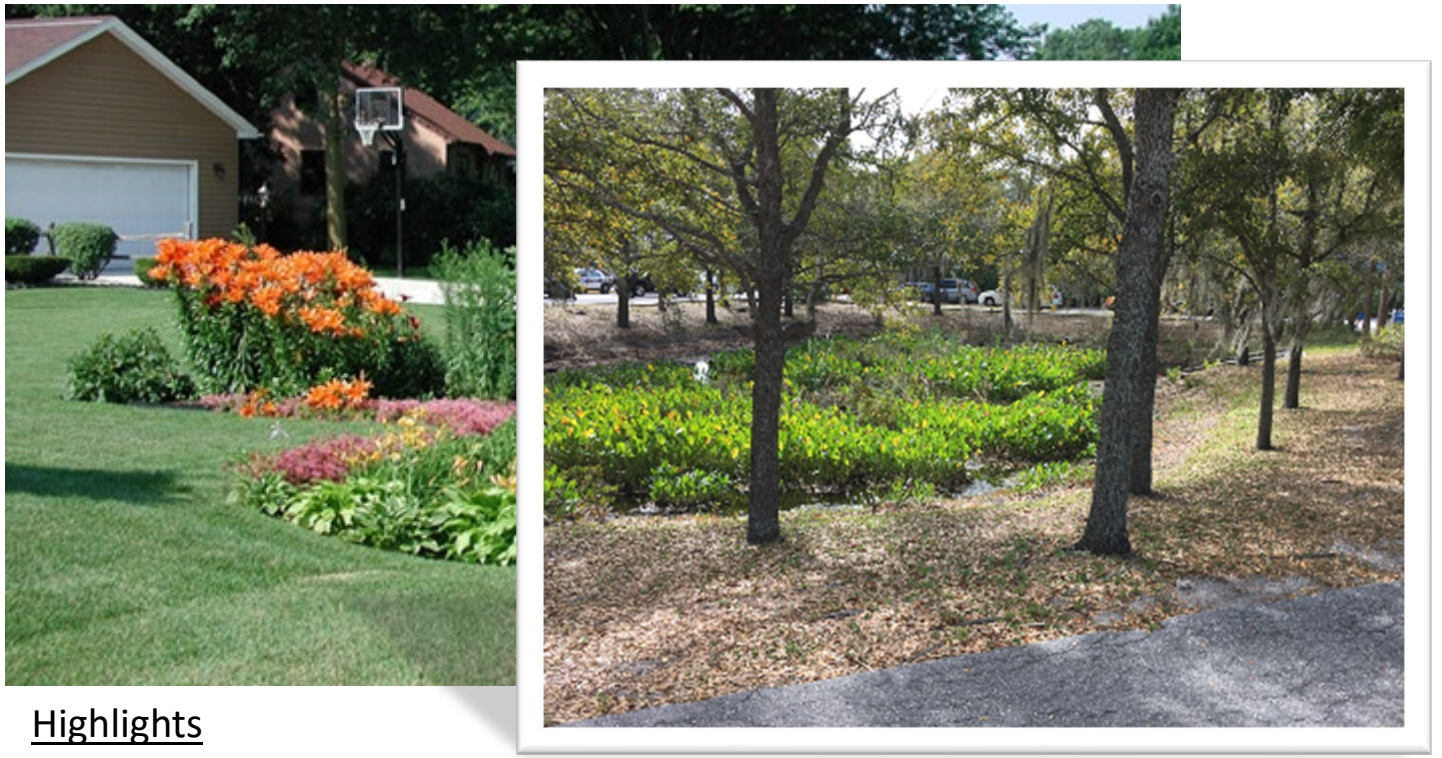
Rain Garden Template



DESIGN NOTES

1. FOR PUBLIC PROJECTS, ALL ELEMENTS MUST BE WITHIN THE RIGHT OF WAY OR APPROPRIATE EASEMENTS.
2. NO PRIVATE SYSTEMS SHALL BE PLACED IN THE PUBLIC RIGHT OF WAY.
3. ALL DIMENSIONS CAN BE MODIFIED TO FIT SITE CONSTRAINTS; BOTTOM WIDTHS LESS THAN 2' ARE NOT RECOMMENDED. MODIFICATIONS MUST BE DESIGNED BY LICENSED ENGINEER. SIDE SLOPES STEEPER THAN 3:1 (H:V) REQUIRE REINFORCEMENT.
4. ENGINEERED SOIL SHOULD CONSIST OF 40% CLEAN SAND, 30% TOPSOIL AND 30% COMPOST. SEE TECHNICAL SPECIFICATIONS.
5. REFER TO LIST OF COUNTY APPROVED PLANTINGS AND SPEC SHEET FOR PLANTING DESIGN AND MAINTENANCE INFORMATION.
6. VEGETATED SYSTEMS MUST BE ABLE TO RECOVER REQUIRED TREATMENT VOLUME IN 24 TO 36 HOURS TO PREVENT DAMAGE TO VEGETATION.
7. HARDWOOD MULCH MATERIAL MUST BE USED PER PINELLAS COUNTY STORMWATER MANUAL SPECIFICATIONS.
8. REQUIRED MIN. DISTANCE OF 12" FROM BOTTOM OF RAIN GARDEN TO SEASONAL HIGH GROUNDWATER TABLE (SHGWT).
9. UNDERDRAIN REQUIRED IF THE SHGWT IS WITHIN 12" FROM THE RAIN GARDEN BOTTOM OR IF THE NATIVE SOIL INFILTRATION DOES NOT ALLOW ADEQUATE INFILTRATION. UNDERDRAIN TO BE DESIGNED BY ENGINEER PER PINELLAS COUNTY DETAIL INDEX NUMBER 1290.
10. FINAL DESIGN MUST INCLUDE A POSITIVE OUTFALL STRUCTURE.
11. A DRAW–DOWN ANALYSES SHOULD ACCOMPANY RAIN GARDEN DESIGN DETAILS TO ENSURE ADEQUATE HYDRAULIC BEHAVIOR.
12. MINIMUM UTILITY SETBACKS AND PROTECTION MEASURES MUST CONFORM TO CURRENT PINELLAS COUNTY STANDARDS. COORDINATE WITH UTILITY OWNER IN THE EVENT OF UTILITY CROSSING AND UTILITY CONFLICTS.
13. DESIGN ENGINEER MUST ENSURE FINAL DESIGN ADHERES TO ALL APPLICABLE COUNTY CODES.

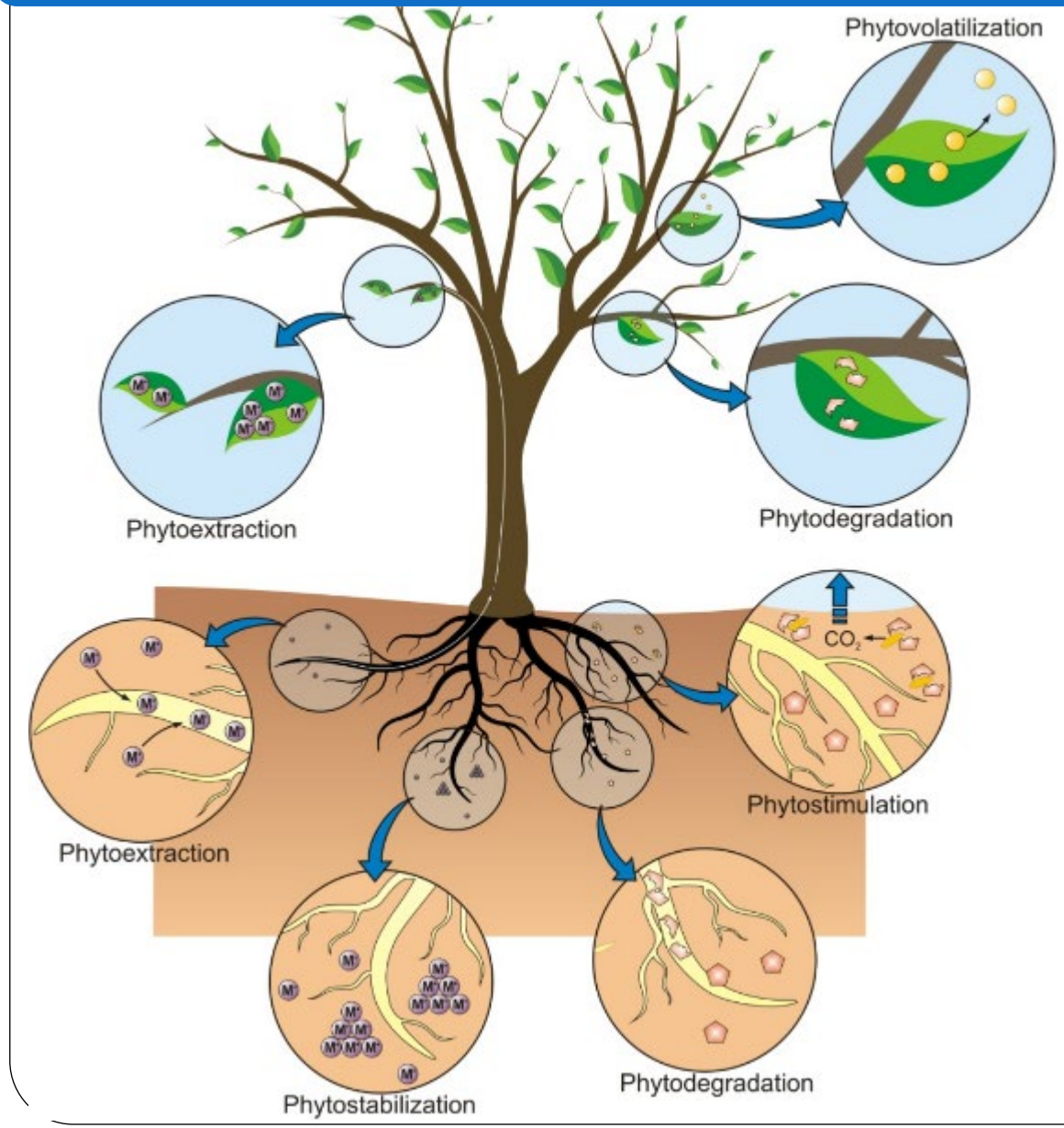
PINELLAS COUNTY	DETAIL INDEX I.D.: ---
RAIN GARDEN TEMPLATE	DATE: SEP/2020
	NOT TO SCALE
	REVISION:



Highlights

- Typically located in depression areas
- < 2 acre contributing drainage area
- Scalable length
- Available options:
  - Overflow structure
  - Underdrain
  - Native plantings to increase natural habitat area
- Highly adaptable

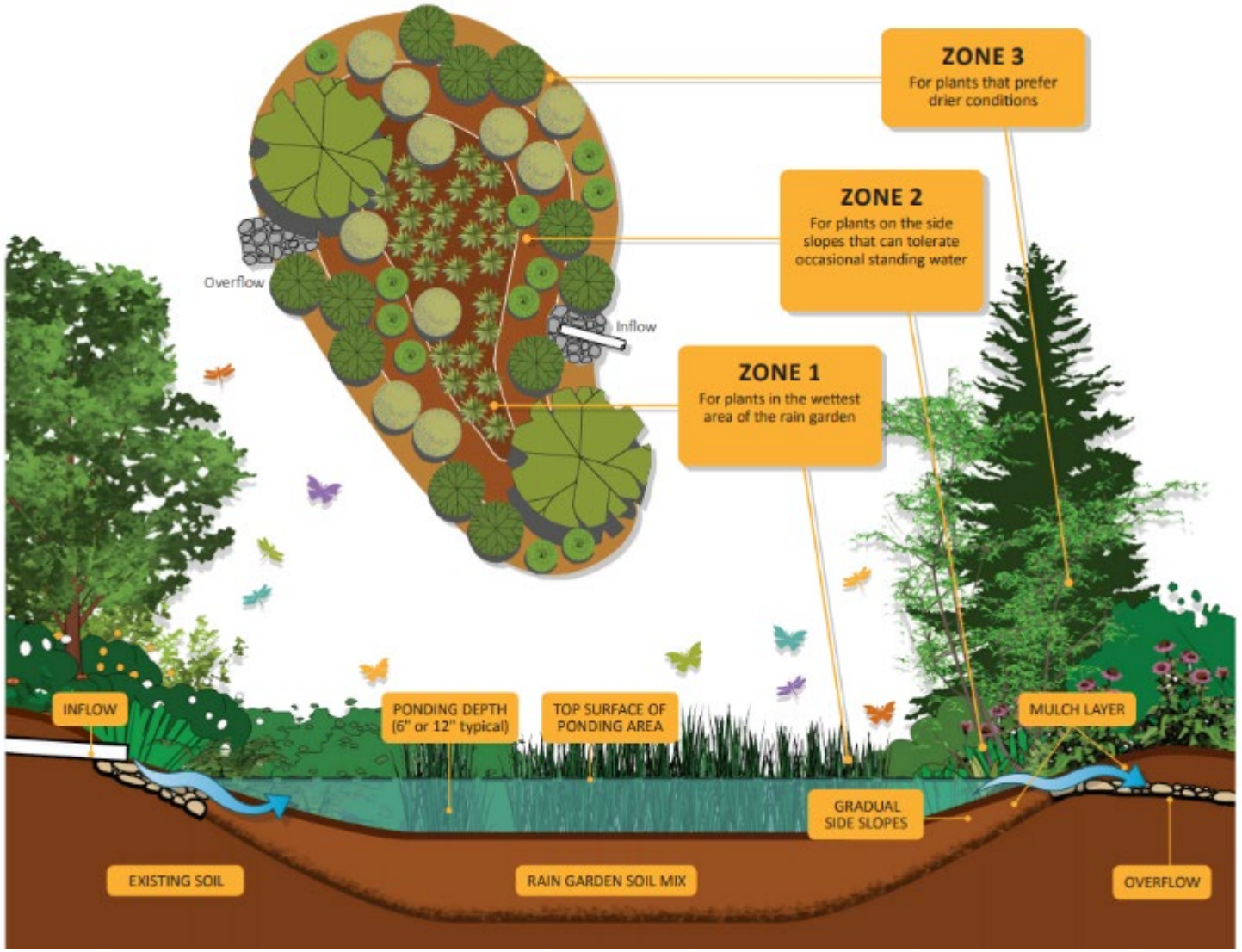
Green Infrastructure Vegetation



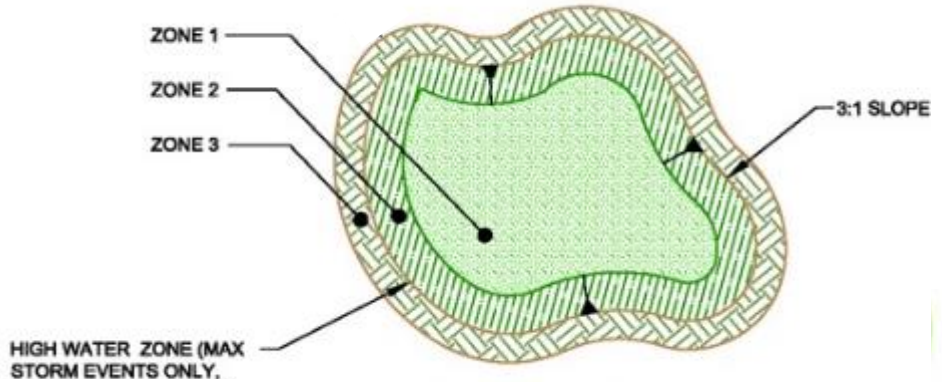
Plants are an Important System Component!

- Filter stormwater
- Remove soil contaminants
- Soil stabilization

Green Infrastructure Vegetation

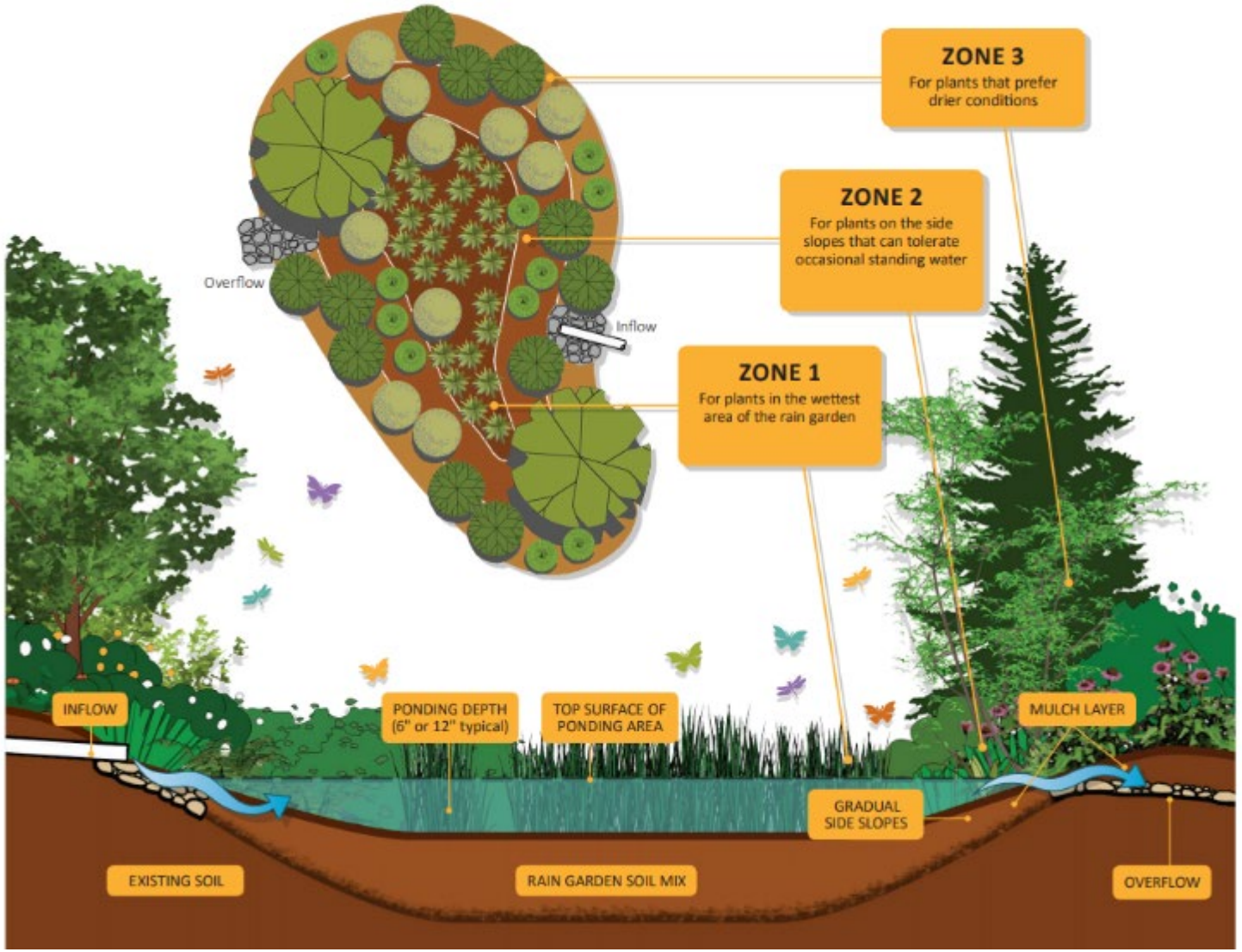


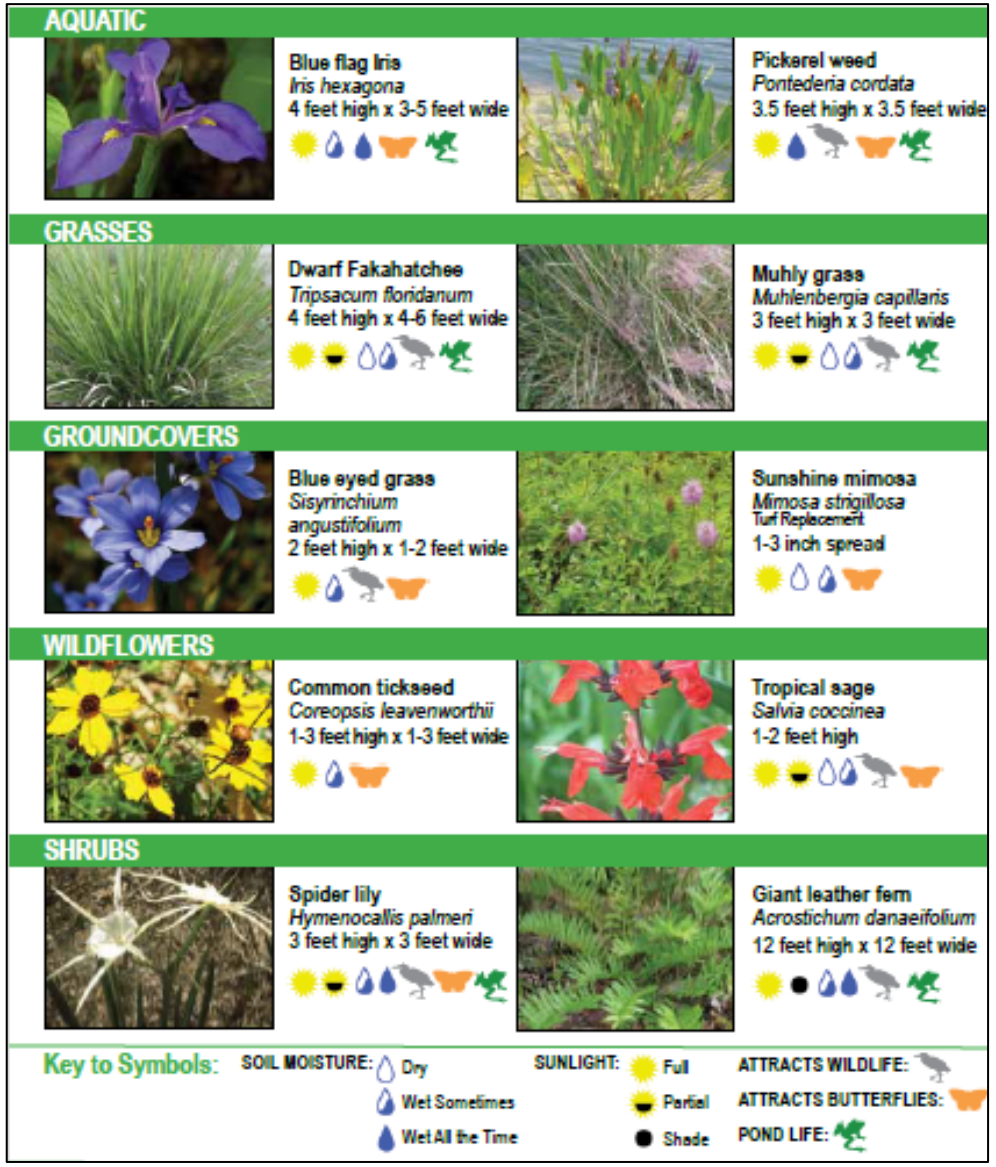
NATIVE PLANTING MAINTENANCE GUIDELINES		
TASK	FREQUENCY	TIMEFRAME
ESTABLISHMENT WATERING	3XWEEK	FIRST 4 WEEKS AFTER INSTALLATION
1ST YEAR WATERING	2XWEEK	THROUGH OCTOBER OF FIRST YEAR; SUBSEQUENT YEARS ONLY IN DROUGHT
WEEDING	2X MONTH	THROUGH 1ST YEAR
MULCHING	ANNUALLY	THROUGH 3 YEARS
MOWING/COMPLETE CUTBACK	ANNUALLY	THROUGH 3 YEARS
TRASH REMOVAL	1XMONTH	ONGOING
TRIM VEGETATION	AS NEEDED	ONGOING
REPLACE DEAD PLANTS	AS NEEDED	ONGOING



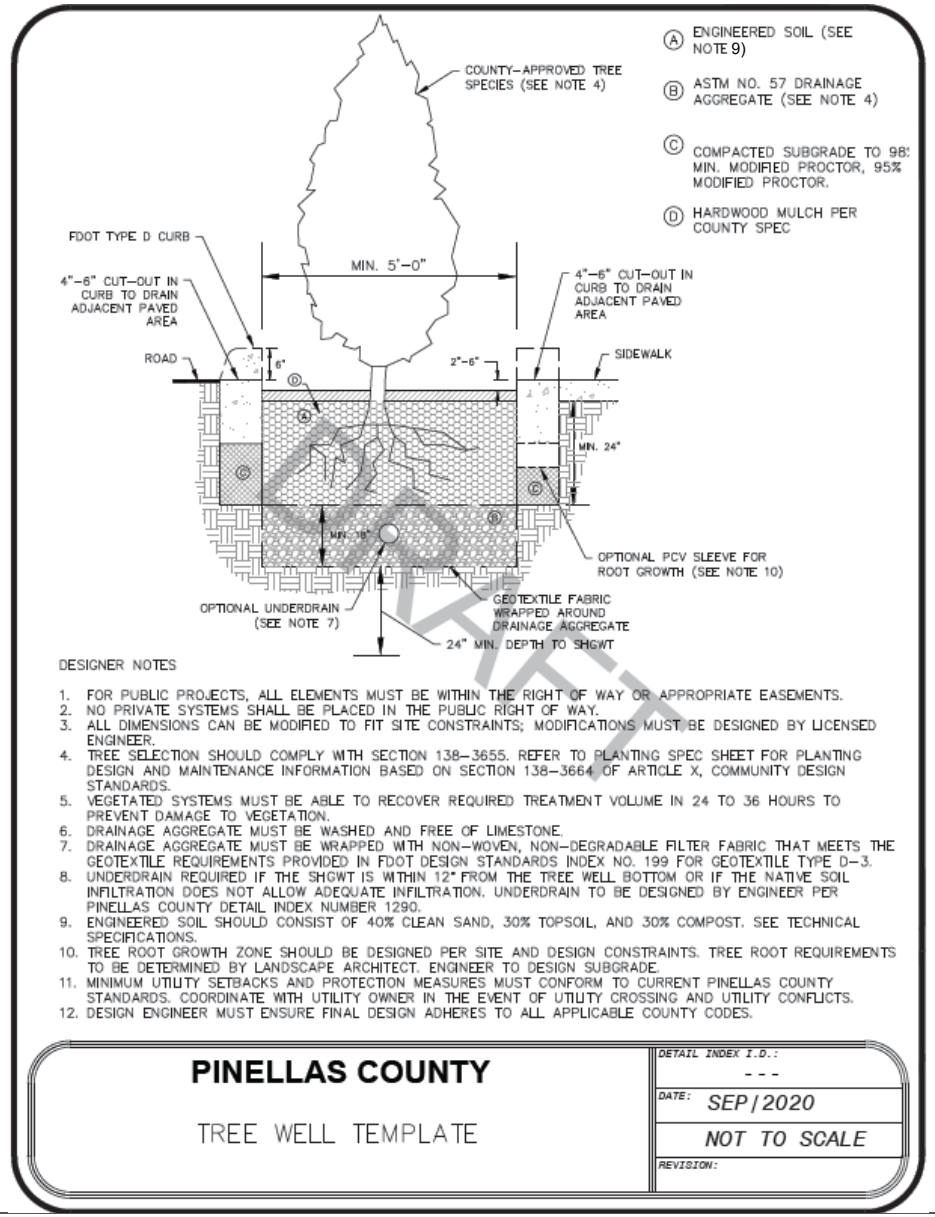
RAIN GARDEN PLAN VIEW

Green Infrastructure Vegetation





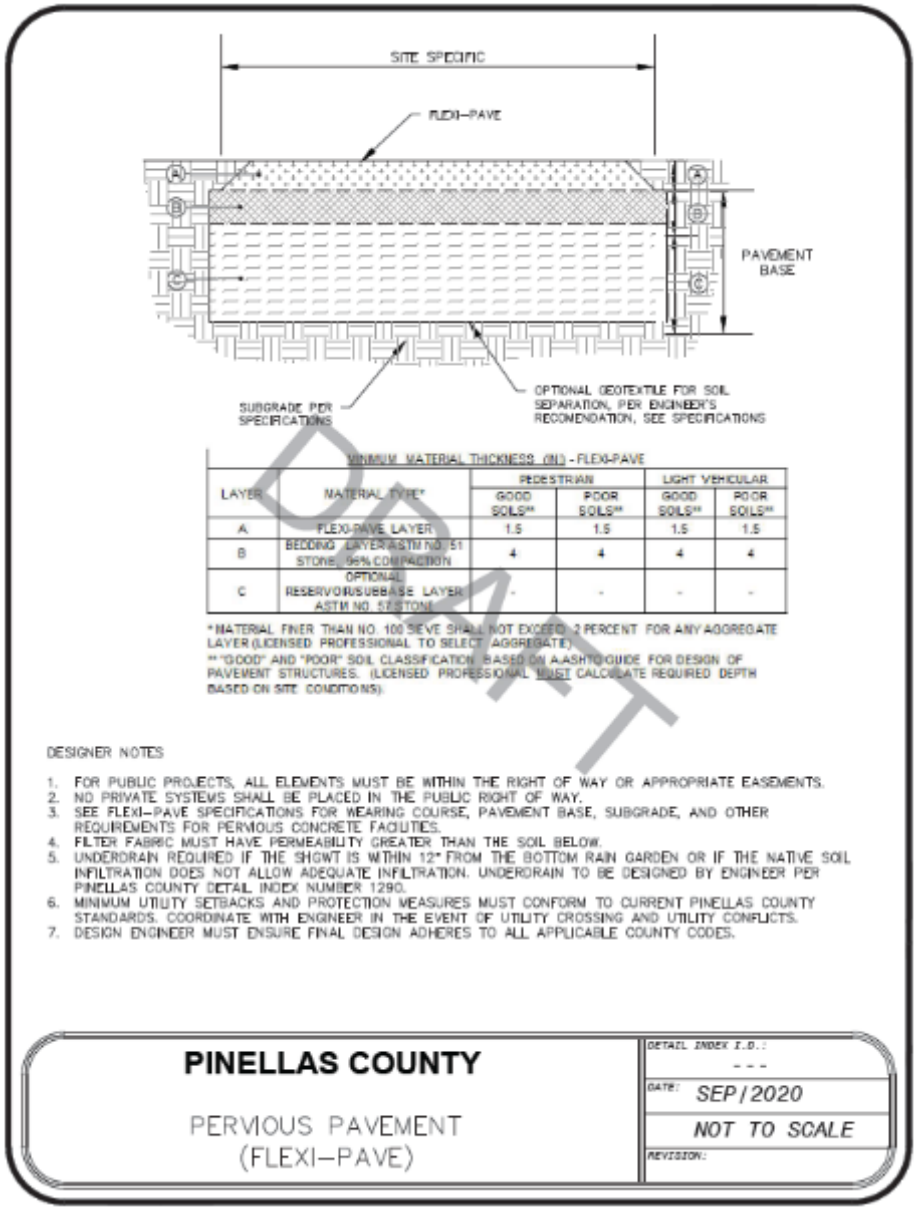
Tree Well Template



Highlights

- Typically located within right-of-way, between road curb and sidewalk.
- Small footprint
- Available options:
  - Underdrain vs. infiltration
  - Native plantings

Pervious Pavement – Permeable Asphalt “Flexi-Pave”



MINIMUM MATERIAL THICKNESS (IN) - FLEXI-PAVE

LAYER	MATERIAL TYPE*	PEDESTRIAN		LIGHT VEHICULAR	
		GOOD SOILS**	POOR SOILS**	GOOD SOILS**	POOR SOILS**
A	FLEXI-PAVE LAYER	1.5	1.5	1.5	1.5
B	BEDDING LAYER ASTM NO. 57 STONE, 98% COMPACTION	4	4	4	4
C	OPTIONAL RESERVOIR/SUBBASE LAYER ASTM NO. 57 STONE	-	-	-	-

*MATERIAL FINER THAN NO. 100 SIEVE SHALL NOT EXCEED 2 PERCENT FOR ANY AGGREGATE LAYER (LICENSED PROFESSIONAL TO SELECT AGGREGATE)

**"GOOD" AND "POOR" SOIL CLASSIFICATION BASED ON AASHTO GUIDE FOR DESIGN OF PAVEMENT STRUCTURES. (LICENSED PROFESSIONAL MUST CALCULATE REQUIRED DEPTH BASED ON SITE CONDITIONS)

DRAFT

DESIGNER NOTES

1. FOR PUBLIC PROJECTS, ALL ELEMENTS MUST BE WITHIN THE RIGHT OF WAY OR APPROPRIATE EASEMENTS.
2. NO PRIVATE SYSTEMS SHALL BE PLACED IN THE PUBLIC RIGHT OF WAY.
3. SEE FLEXI–PAVE SPECIFICATIONS FOR WEARING COURSE, PAVEMENT BASE, SUBGRADE, AND OTHER REQUIREMENTS FOR PERVIOUS CONCRETE FACILITIES.
4. FILTER FABRIC MUST HAVE PERMEABILITY GREATER THAN THE SOIL BELOW.
5. UNDERDRAIN REQUIRED IF THE SHGWT IS WITHIN 12" FROM THE BOTTOM RAIN GARDEN OR IF THE NATIVE SOIL INFILTRATION DOES NOT ALLOW ADEQUATE INFILTRATION. UNDERDRAIN TO BE DESIGNED BY ENGINEER PER PINELLAS COUNTY DETAIL INDEX NUMBER 1290.
6. MINIMUM UTILITY SETBACKS AND PROTECTION MEASURES MUST CONFORM TO CURRENT PINELLAS COUNTY STANDARDS. COORDINATE WITH ENGINEER IN THE EVENT OF UTILITY CROSSING AND UTILITY CONFLICTS.
7. DESIGN ENGINEER MUST ENSURE FINAL DESIGN ADHERES TO ALL APPLICABLE COUNTY CODES.

PINELLAS COUNTY

PERVIOUS PAVEMENT
(FLEXI–PAVE)

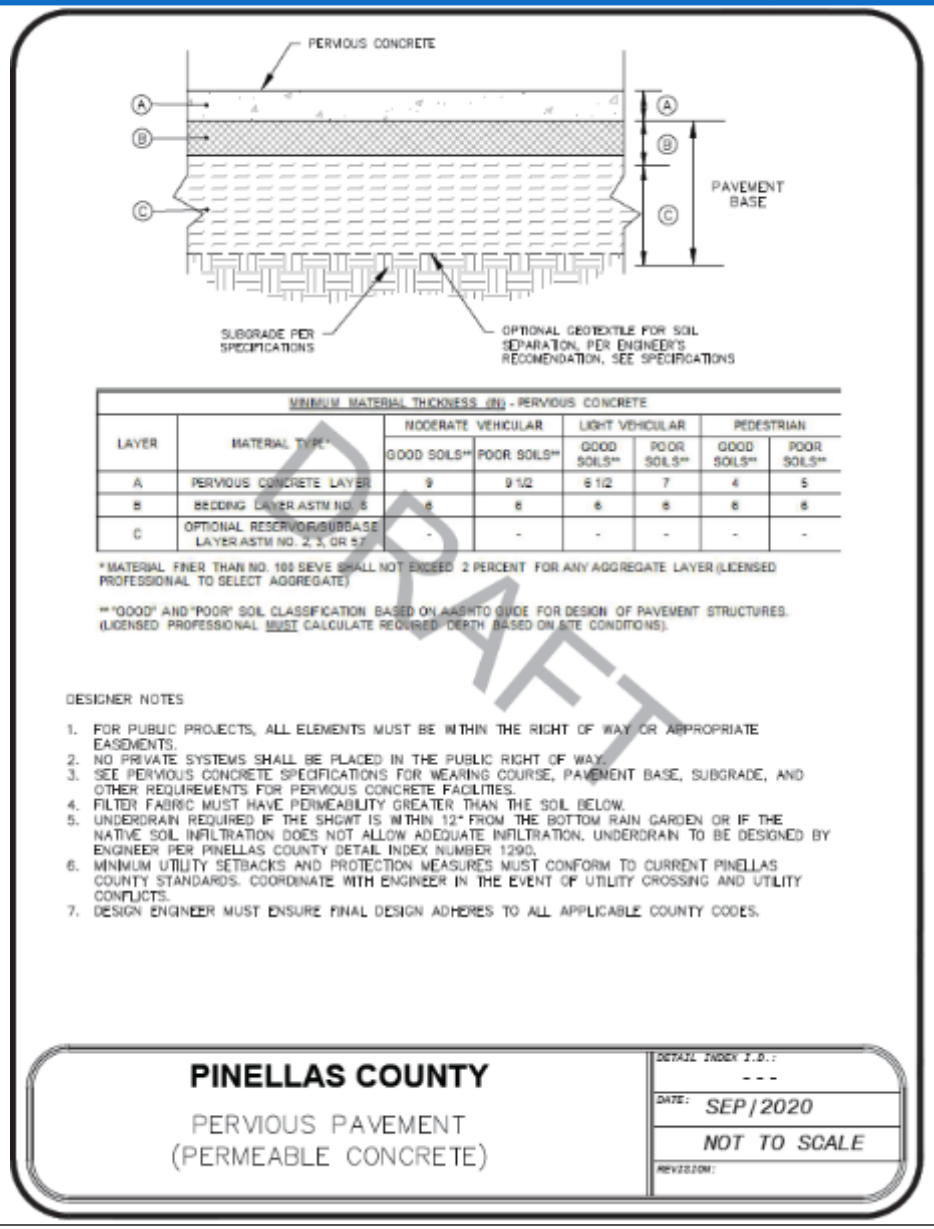
DETAIL INDEX I.D.: - - -
DATE: SEP/2020
NOT TO SCALE
REVISION:

Highlights

- Typically located along walking paths, along greenways
- Increasing accessibility
- LEED Certified and ADA Compliant
- Local Supplier located in Pinellas County

KBI Flexi®-Pave

Pervious Pavement – Permeable Concrete



MINIMUM MATERIAL THICKNESS (IN) - PERVIOUS CONCRETE

LAYER	MATERIAL TYPE*	MODERATE VEHICULAR		LIGHT VEHICULAR		PEDESTRIAN	
		GOOD SOILS**	POOR SOILS**	GOOD SOILS**	POOR SOILS**	GOOD SOILS**	POOR SOILS**
A	PERVIOUS CONCRETE LAYER	9	9 1/2	6 1/2	7	4	5
B	BEDDING LAYER ASTM NO. 8	6	6	6	6	6	6
C	OPTIONAL RESERVOIR/SUBBASE LAYER ASTM NO. 2, 3, OR 57	-	-	-	-	-	-

*MATERIAL FINER THAN NO. 100 SIEVE SHALL NOT EXCEED 2 PERCENT FOR ANY AGGREGATE LAYER (LICENSED PROFESSIONAL TO SELECT AGGREGATE)

**"GOOD" AND "POOR" SOIL CLASSIFICATION BASED ON AASHTO GUIDE FOR DESIGN OF PAVEMENT STRUCTURES. (LICENSED PROFESSIONAL MUST CALCULATE REQUIRED DEPTH BASED ON SITE CONDITIONS).

DRAFT

DESIGNER NOTES

1. FOR PUBLIC PROJECTS, ALL ELEMENTS MUST BE WITHIN THE RIGHT OF WAY OR APPROPRIATE EASEMENTS.
2. NO PRIVATE SYSTEMS SHALL BE PLACED IN THE PUBLIC RIGHT OF WAY.
3. SEE PERVIOUS CONCRETE SPECIFICATIONS FOR WEARING COURSE, PAVEMENT BASE, SUBGRADE, AND OTHER REQUIREMENTS FOR PERVIOUS CONCRETE FACILITIES.
4. FILTER FABRIC MUST HAVE PERMEABILITY GREATER THAN THE SOIL BELOW.
5. UNDERDRAIN REQUIRED IF THE SHGWT IS WITHIN 12" FROM THE BOTTOM RAIN GARDEN OR IF THE NATIVE SOIL INFILTRATION DOES NOT ALLOW ADEQUATE INFILTRATION. UNDERDRAIN TO BE DESIGNED BY ENGINEER PER PINELLAS COUNTY DETAIL INDEX NUMBER 1290.
6. MINIMUM UTILITY SETBACKS AND PROTECTION MEASURES MUST CONFORM TO CURRENT PINELLAS COUNTY STANDARDS. COORDINATE WITH ENGINEER IN THE EVENT OF UTILITY CROSSING AND UTILITY CONFLICTS.
7. DESIGN ENGINEER MUST ENSURE FINAL DESIGN ADHERES TO ALL APPLICABLE COUNTY CODES.

PINELLAS COUNTY

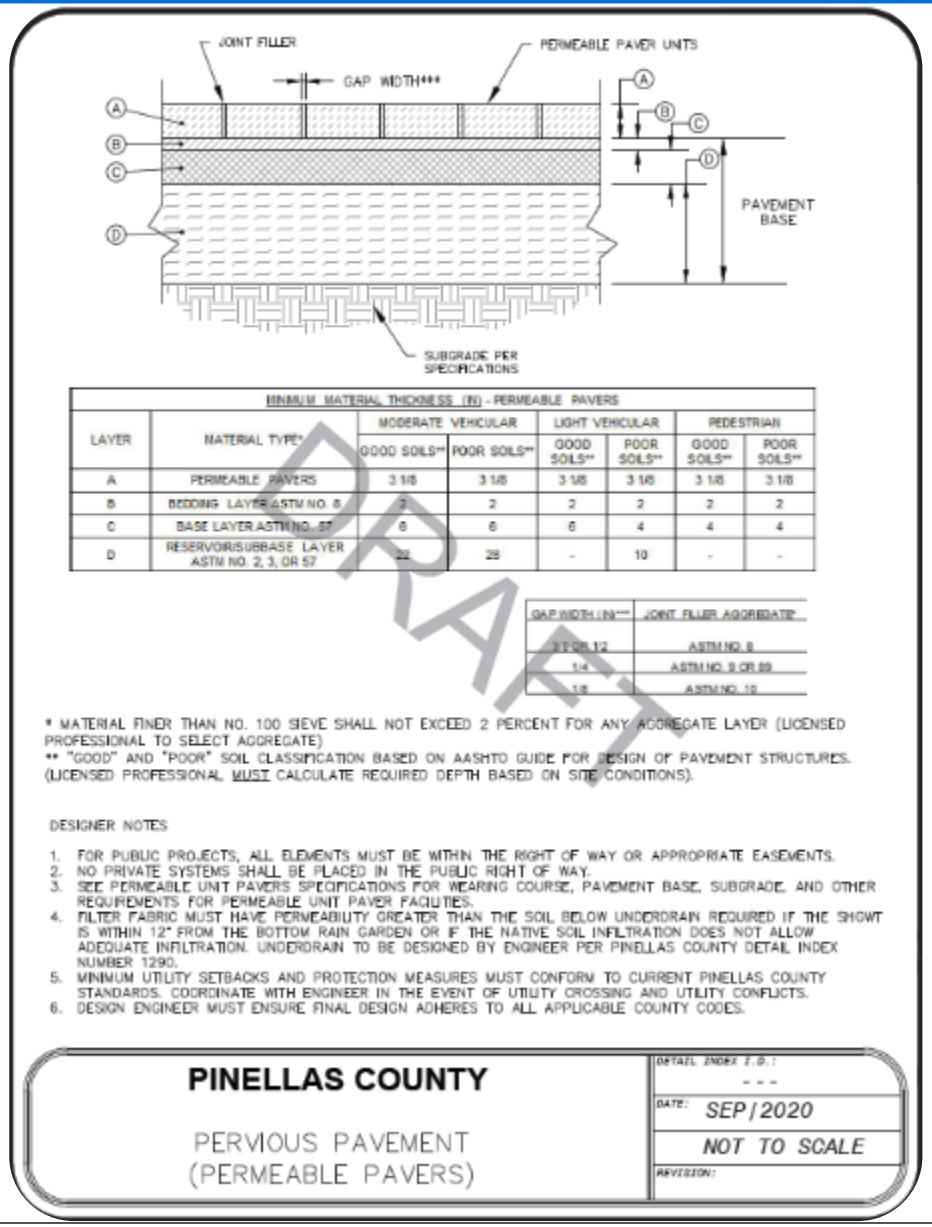
PERVIOUS PAVEMENT
(PERMEABLE CONCRETE)

DETAIL INDEX I.D.: ---
DATE: SEP/2020
NOT TO SCALE
REVISION:

Highlights

- Typically located in parallel parking lanes within right-of-way or in parking areas of a redevelopment
  - Limited wheel turning
- Contributing drainage area can vary
- Can facilitate infiltration or biofiltration

Pervious Pavement – Permeable Pavers



MINIMUM MATERIAL THICKNESS (IN) - PERMEABLE PAVERS

LAYER	MATERIAL TYPE*	MODERATE VEHICULAR		LIGHT VEHICULAR		PEDESTRIAN	
		GOOD SOILS**	POOR SOILS**	GOOD SOILS**	POOR SOILS**	GOOD SOILS**	POOR SOILS**
A	PERMEABLE PAVERS	3 1/8	3 1/8	3 1/8	3 1/8	3 1/8	3 1/8
B	BEDDING LAYER ASTM NO. 8	2	2	2	2	2	2
C	BASE LAYER ASTM NO. 57	6	6	6	4	4	4
D	RESERVOIR/SUBBASE LAYER ASTM NO. 2, 3, OR 57	22	28	-	10	-	-

GAP WIDTH (IN)***	JOINT FILLER AGGREGATE*
3/8 OR 1/2	ASTM NO. 8
1/4	ASTM NO. 9 OR 89
1/8	ASTM NO. 10

DRAFT

* MATERIAL FINER THAN NO. 100 SIEVE SHALL NOT EXCEED 2 PERCENT FOR ANY AGGREGATE LAYER (LICENSED PROFESSIONAL TO SELECT AGGREGATE)
** "GOOD" AND "POOR" SOIL CLASSIFICATION BASED ON AASHTO GUIDE FOR DESIGN OF PAVEMENT STRUCTURES. (LICENSED PROFESSIONAL MUST CALCULATE REQUIRED DEPTH BASED ON SITE CONDITIONS).

DESIGNER NOTES

1. FOR PUBLIC PROJECTS, ALL ELEMENTS MUST BE WITHIN THE RIGHT OF WAY OR APPROPRIATE EASEMENTS.
2. NO PRIVATE SYSTEMS SHALL BE PLACED IN THE PUBLIC RIGHT OF WAY.
3. SEE PERMEABLE UNIT PAVERS SPECIFICATIONS FOR WEARING COURSE, PAVEMENT BASE, SUBGRADE, AND OTHER REQUIREMENTS FOR PERMEABLE UNIT PAVER FACILITIES.
4. FILTER FABRIC MUST HAVE PERMEABILITY GREATER THAN THE SOIL BELOW UNDERDRAIN REQUIRED IF THE SHGWT IS WITHIN 12" FROM THE BOTTOM RAIN GARDEN OR IF THE NATIVE SOIL INFILTRATION DOES NOT ALLOW ADEQUATE INFILTRATION. UNDERDRAIN TO BE DESIGNED BY ENGINEER PER PINELLAS COUNTY DETAIL INDEX NUMBER 1290.
5. MINIMUM UTILITY SETBACKS AND PROTECTION MEASURES MUST CONFORM TO CURRENT PINELLAS COUNTY STANDARDS. COORDINATE WITH ENGINEER IN THE EVENT OF UTILITY CROSSING AND UTILITY CONFLICTS.
6. DESIGN ENGINEER MUST ENSURE FINAL DESIGN ADHERES TO ALL APPLICABLE COUNTY CODES.

PINELLAS COUNTY

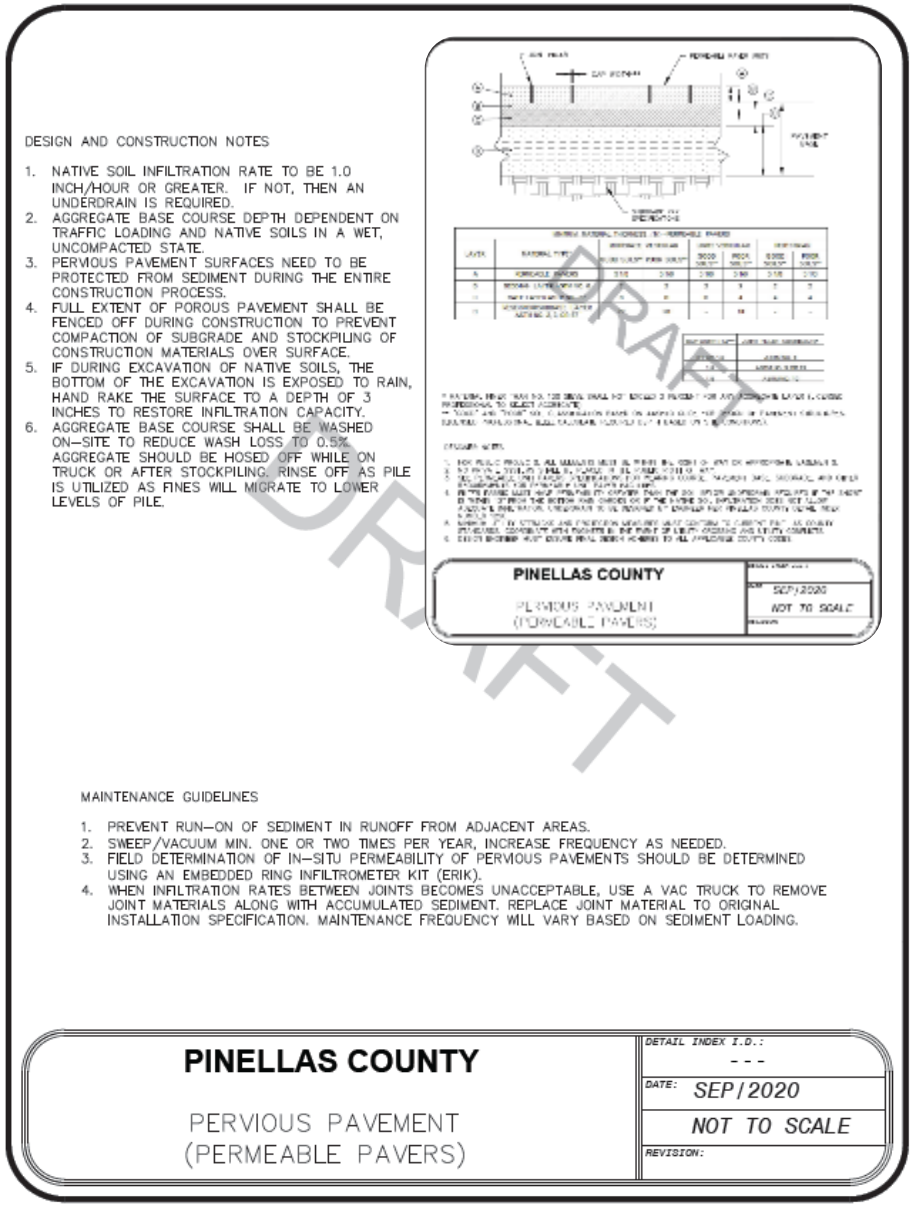
PERVIOUS PAVEMENT
(PERMEABLE PAVERS)

DETAIL INDEX I.D.: - - -
DATE: SEP/2020
NOT TO SCALE
REVISION:

Highlights

- Typically located in parallel parking lanes within right-of-way or in parking areas of a redevelopment
- Contributing drainage area can vary
- Can facilitate infiltration or biofiltration

Pervious Pavement – Design Considerations



DESIGN AND CONSTRUCTION NOTES

1. NATIVE SOIL INFILTRATION RATE TO BE 1.0 INCH/HOUR OR GREATER. IF NOT, THEN AN UNDERDRAIN IS REQUIRED.
2. AGGREGATE BASE COURSE DEPTH DEPENDENT ON TRAFFIC LOADING AND NATIVE SOILS IN A WET, UNCOMPACTED STATE.
3. PERVIOUS PAVEMENT SURFACES NEED TO BE PROTECTED FROM SEDIMENT DURING THE ENTIRE CONSTRUCTION PROCESS.
4. FULL EXTENT OF POROUS PAVEMENT SHALL BE FENCED OFF DURING CONSTRUCTION TO PREVENT COMPACTION OF SUBGRADE AND STOCKPILING OF CONSTRUCTION MATERIALS OVER SURFACE.
5. IF DURING EXCAVATION OF NATIVE SOILS, THE BOTTOM OF THE EXCAVATION IS EXPOSED TO RAIN, HAND RAKE THE SURFACE TO A DEPTH OF 3 INCHES TO RESTORE INFILTRATION CAPACITY.
6. AGGREGATE BASE COURSE SHALL BE WASHED ON-SITE TO REDUCE WASH LOSS TO 0.5%. AGGREGATE SHOULD BE HOSED OFF WHILE ON TRUCK OR AFTER STOCKPILING. RINSE OFF AS PILE IS UTILIZED AS FINES WILL MIGRATE TO LOWER LEVELS OF PILE.

MAINTENANCE GUIDELINES

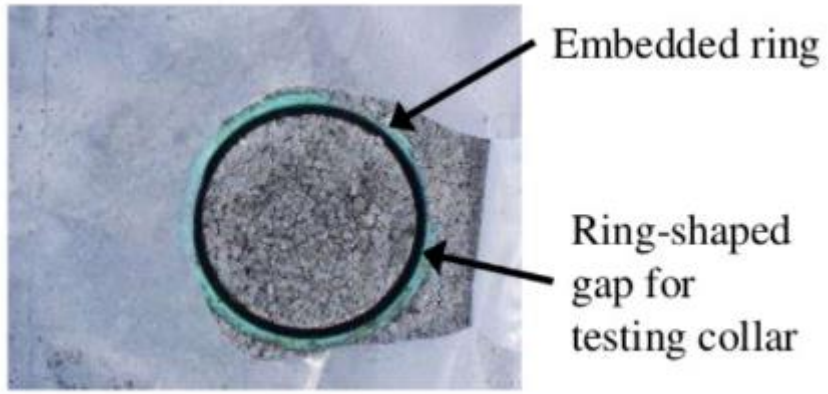
1. PREVENT RUN-ON OF SEDIMENT IN RUNOFF FROM ADJACENT AREAS.
2. SWEEP/VACUUM MIN. ONE OR TWO TIMES PER YEAR, INCREASE FREQUENCY AS NEEDED.
3. FIELD DETERMINATION OF IN-SITU PERMEABILITY OF PERVIOUS PAVEMENTS SHOULD BE DETERMINED USING AN EMBEDDED RING INFILTROMETER KIT (ERIK).
4. WHEN INFILTRATION RATES BETWEEN JOINTS BECOMES UNACCEPTABLE, USE A VAC TRUCK TO REMOVE JOINT MATERIALS ALONG WITH ACCUMULATED SEDIMENT. REPLACE JOINT MATERIAL TO ORIGINAL INSTALLATION SPECIFICATION. MAINTENANCE FREQUENCY WILL VARY BASED ON SEDIMENT LOADING.

PINELLAS COUNTY

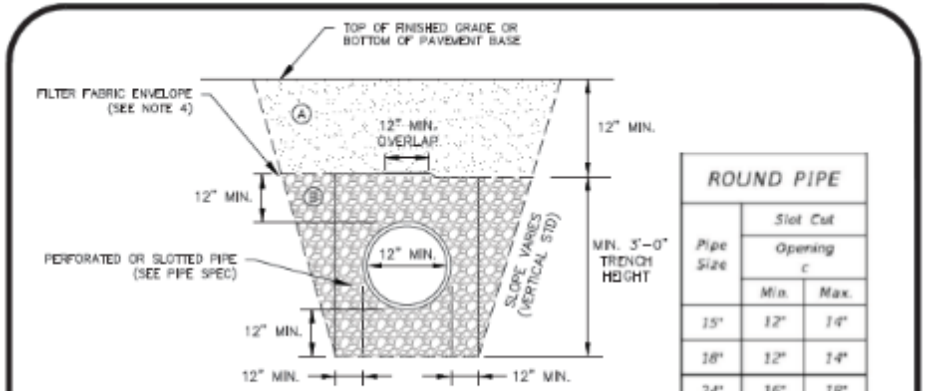
PERVIOUS PAVEMENT
(PERMEABLE PAVERS)

DETAIL INDEX I.D.: - - -
DATE: SEP/2020
NOT TO SCALE
REVISION:

- flat/minimal slope
- SHWT at least 24" below bottom
- Soil infiltration rate should be at least 1"/hr.
- Recovery of water storage capacity within 72 hours (safety factor of 2)
- Provide adequate edge treatment to avoid scour.
- Embedded Ring Infiltrometer Kit (ERIK)



Exfiltration Trench Template



ELLIPTICAL PIPE		
Pipe Size	Slot Cut Opening c	
	Min.	Max.
14"x23"	10"	12"
19"x30"	14"	16"
24"x38"	14"	16"
29"x45"	20"	22"
34"x53"	20"	22"
38"x60"	20"	22"

ROUND PIPE		
Pipe Size	Slot Cut Opening c	
	Min.	Max.
15"	12"	14"
18"	12"	14"
24"	16"	18"
30"	16"	18"
36"	22"	24"
42"	22"	24"
48"	22"	24"
54"	24"	26"
60"	24"	26"
66"	24"	26"
72"	24"	26"

DESIGNER NOTES

1. FOR PUBLIC PROJECTS, ALL ELEMENTS MUST BE WITHIN THE RIGHT OF WAY OR APPROPRIATE EASEMENTS.
2. NO PRIVATE SYSTEMS SHALL BE PLACED IN THE PUBLIC RIGHT OF WAY.
3. PERFORATED OR SLOTTED PIPES SHALL TERMINATE A MINIMUM OF TWO (2) FEET FROM THE END OF THE EXFILTATION TRENCH OR CONNECT TO ADDITIONAL INLETS OR MANHOLES.
4. DRAINAGE AGGREGATE MUST BE WRAPPED WITH NON-WOVEN, NON-DEGRADABLE FILTER FABRIC THAT MEETS THE GEOTEXTILE REQUIREMENTS PROVIDED IN FDOT DESIGN STANDARDS INDEX NO. 199 FOR GEOTEXTILE TYPE D-3.
5. DISTANCE FROM EXFILTATION TRENCH INVERT TO SEASONAL HIGH GROUNDWATER TABLE VARIES; 12" OR GREATER.
6. ENGINEER TO DESIGN FINAL EXFILTRATION TRENCH DIMENSIONS INCLUDING SLOPES OF SIDEWALLS IN ACCORDANCE WITH SITE AND SOIL CONDITIONS.
7. MINIMUM UTILITY SETBACKS AND PROTECTION MEASURES MUST CONFORM TO CURRENT PINELLAS COUNTY STANDARDS. COORDINATE WITH UTILITY OWNER IN THE EVENT OF UTILITY CROSSING AND UTILITY CONFLICTS.
8. DESIGN ENGINEER MUST ENSURE FINAL DESIGN ADHERES TO ALL APPLICABLE COUNTY CODES.

PINELLAS COUNTY

EXFILTRATION TRENCH

DETAIL INDEX I.D.: - - -

DATE: SEP/2020

NOT TO SCALE

REVISION:

Highlights

- Space efficient
- Contributing drainage area can vary
- Scalable length
- Directs flow to infiltration

Engineered Soil and BAM

- Engineered Soil
  - Facilitates infiltration
  - Supports plants growth
  - Maintains moisture
  - Typically composed of:
    - Sand - infiltration
    - Compost – contaminant removal

- Bio-Sorption Activated Media (BAM)
  - Enhanced removal of **nitrogen** and **phosphorus**
  - Removal of heavy metals
  - Applications
    - Landscaping with tree well
    - rain gardens
    - green gutters
    - bioswales
    - Pervious pavement
    - Regional retention basins with BAM added to the bottom

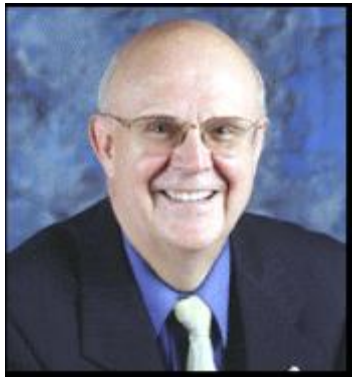
Evaluating GI Systems

BMP Trains 2020: a C++ and VB based model for estimating **annual** removal effectiveness.

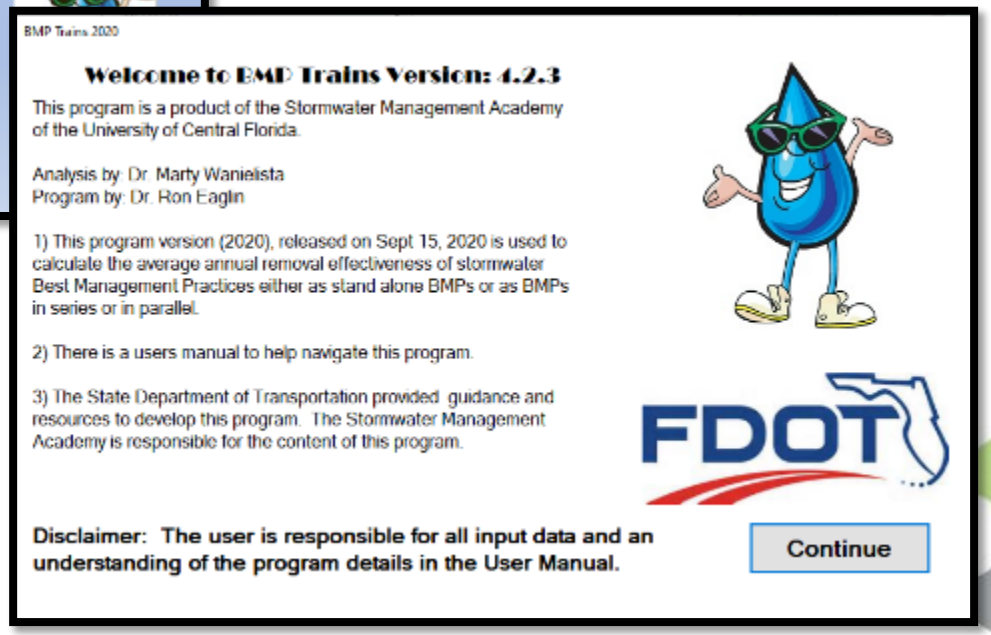
The acronym is derived for the analysis of stormwater BMPs in series
The model is used to evaluate **B**est **M**anagement **P**ractice **T**reatment options based on **R**emoval using **A**nnual loadings by those **I**nterested in **N**utrients in **S**tormwater.

Mailing list for updates:
https://stars.library.ucf.edu/bmptrains/announcements.html
2 Locations for the **manual** and the **program**:
http://www.stormwater.ucf.edu
https://stars.library.ucf.edu/bmptrains/

Credit and thanks for the programming and technical skills of: Dr. Ron Eaglin, Dr. Mike Hardin, Dr. Harvey Harper, Dr. Ikiensinma Gogo-Abite, Eric Livingston, Rich Magee and Chris Kuzlo



Marty Wanielista,
Professor Emeritus, UCF



(Adapted from Wanielista, M. (2020). *Virtual Learning Applications for Practicing Professionals*. [Online workshop])

Small Industrial Site – Case Study Example

Table 2.1.a Small Commercial Site Information with Retention BMP Options

Land Uses	Site Size (Acres)	Impervious Area	Directly Connected Imp Area (DCIA)	Non-DCIA Pervious Area	Soil Types	SHGWT
Existing: Light Industrial	1.79	1.66 acres 93% impervious	1.66 acres Project %DCIA = 93%	0.13 acres CN=80	HSG B	3' below land
Proposed: High Intensity Commercial	1.79	1.66 acres 93% impervious	1.66 acres Project % DCIA = 93%	0.13 acres CN=80	HSG B	

Reference: Pinellas County Stormwater Manual CASE STUDIES (2016)

Small Industrial Site – Case Study Example

Row #		TN Loadings (kg/year)	TP Loadings (kg/year)	TN % Reduction	TP % Reduction
(1)	Existing Land Use (pre)	8.72	1.89		
(2)	Proposed Land Use (post)	16.17	2.32		
(3)	Proposed Land Use (post) net improvement Existing rules – meet using Retention Basin	8.72	1.89	46	46
(4)	Proposed Land Use (post) **Target Load for Post = 10% reduction from Pre**	7.85	1.71	52	52
(5)	Proposed Land Use (post) **Target Load for 55%TN 80%TP reduction from Post**	7.28	0.46	55	80

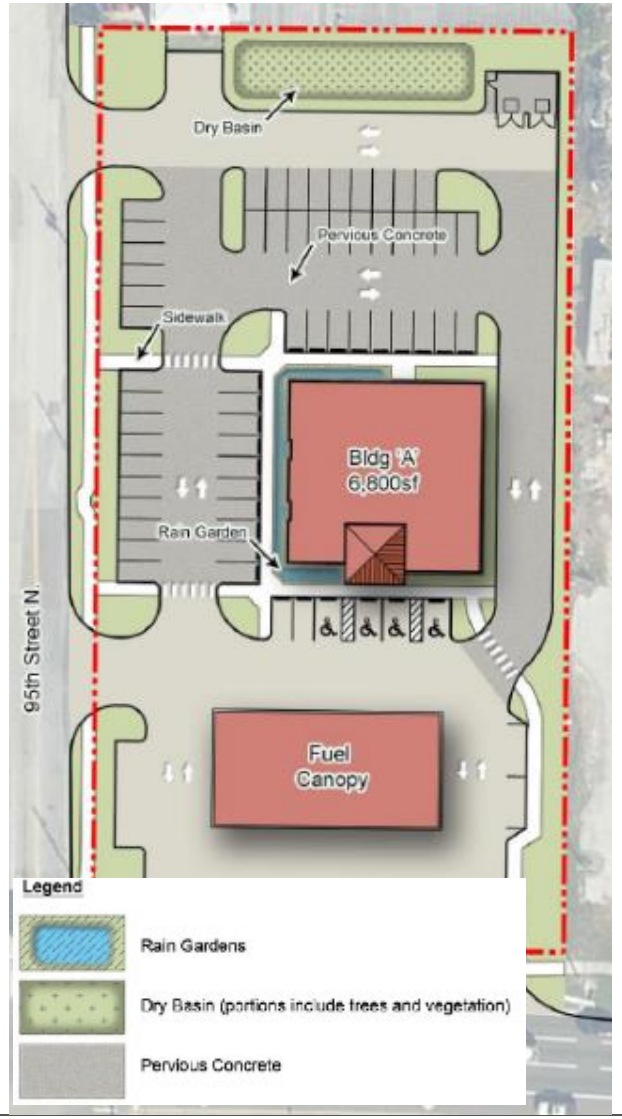
Pinellas Performance Standard: Designed to achieve the highest level of pollutant removal of the following performance standards:

Reduce the post-development annual average stormwater total nitrogen load by at least a 55% total phosphorus load by at least 80%,
-OR-
Reduce the post-development annual average stormwater total nitrogen and phosphorus loads level less than or equal to 90% of the loads currently discharged from the site.

Small Industrial Site – Example BMP Approach

Conventional Approach

GI Approach

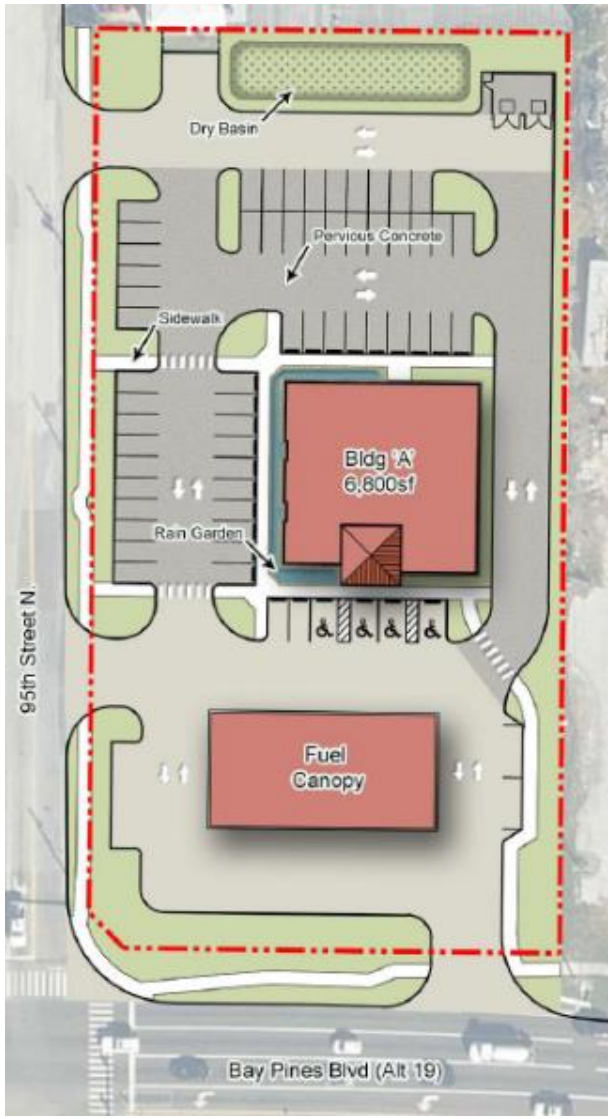


Site Statistics

Site Area:	1.8 ac. / 78,408 sf.
Floor Area Ratio:	0.09 FAR
Zoning:	CG, Commercial General
Building Area:	6,800 sf.
Paved Area:	1.38 ac. / 60,113 sf.
Building footprint:	0.16 ac. / 6,970 sf.
Parking:	1.15 ac. / 50,094 sf.
Sidewalk:	0.07 ac. / 3,049 sf.
Parking:	
Required:	min. 43 stalls / max. 63 stalls
	3,400sf Retail: 4.00 per 1,000sf = 14
	3,400sf Fast Food: 8.2 per 1,000sf = 28
	Max. is 150% of minimum parking.
Proposed:	63 stalls
Stormwater Management	
Rain Gardens:	0.01 ac. / 435.6 sf.
Pervious Concrete:	0.50 ac. / 21,780 sf.
Dry Retention:	0.044 ac. / 1,916 sf.

Note:
(1) Site plan is intended to be conceptual in nature. Designed for planning purposes only.
(2) Property data including boundaries and topograph based on GIS and aerial photography data. No land survey was used in preparation of this design.

Small Industrial Site – Treatment Summary



Row #		TN Loadings (kg/year)	TP Loadings (kg/year)	TN % Reduction	TP % Reduction
(1)	Existing Land Use (pre)	8.72	1.89		
(2)	Proposed Land Use (post)	16.17	2.32		
(3)	Proposed Land Use (post) net improvement Existing rules – meet using Retention Basin	8.72	1.89	46	46
(4)	Proposed Land Use (post) **Target Load for Post = 10% reduction from Pre**	7.85	1.71	52	52
(5)	Proposed Land Use (post) **Target Load for 55%TN 80%TP reduction from Post**	7.28	0.46	55	80
(6)	Proposed Land Use (post) **Manual Practices – Pervious Pavement, Rain Garden and Retention Basins**	3.29	0.46	80	80

Legend

Rain Gardens

Dry Basin (portions include trees and vegetation)

Pervious Concrete

Small Industrial Site – Example Cost Comparison

Conventional Stormwater Management System (Previous Stormwater Requirements)

Item No.	Description	Quantity	Unit	Unit Cost	Extended Cost
Conventional Stormwater Management System – meeting previously-approved stormwater methods					
CON-1	Regular Excavation (Retention Area)	441	CY	$5	$2,204
CON-2	Grade / Compact	441	CY	$9	$3,746
CON-3	15" RCP Storm Pipe	525	LF	$62	$32,550
CON-4	8" PVC Roof leader	402	LF	$25	$10,050
CON-5	8" PVC Clean Out	26	EA	$500	$13,000
CON-6	FDOT Type C Ditch Bottom Inlet, < 10'	7	EA	$2,600	$18,200
CON-7	Concrete Spillway	3	EA	$2,000	$6,000
CON-8	Sod, Retention Area	661	SY	$2	$1,421
				Total Cost:	$87,171
				Development Intensity (SF)	6,117
				Unit Cost (SF)	$14.25

LID Stormwater Management System (Meeting New Stormwater Requirements)

LID Stormwater Management Systems - meeting this stormwater manual methods					
LID-1	Rain Garden	435.6	SF	$12	$5,232
LID-2	Pervious Concrete (8")	21,780	SF	$3	$54,450
LID-3	Aggregate Base (9")	2,420	SY	$16	$38,720
LID-4	Filter Fabric	2,420	SY	$5	$10,890
LID-5	Regular Excavation (Retention Area)	142	CY	$5	$710
LID-6	Grade / Compact	142	CY	$9	$1,206
LID-7	Sod, Retention Area	213	SY	$2	$458
				Total Cost:	$111,666
				Development Intensity (SF)	6,800
				Unit Cost (SF)	$16.42

Results Summary

Pollutant	Required Reduction	Provided Reduction	Cost Effectiveness
Total Nitrogen:	55%	80%	**$130/lb Removed**
Total Phosphorus:	80%	80%	**$900/lb Removed**

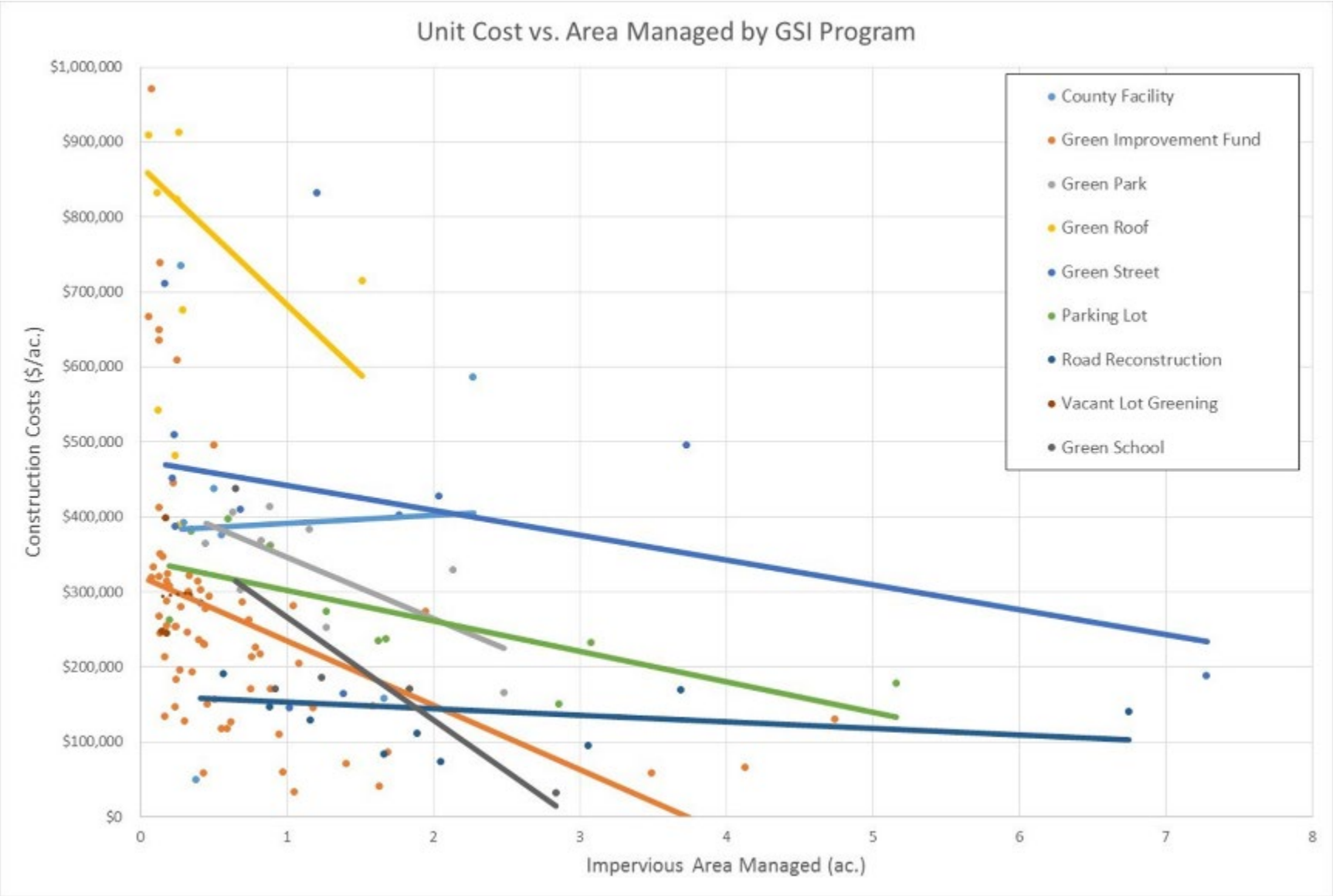
SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT

CFI Process Overview

METRICS FOR RANKING COST EFFECTIVENESS

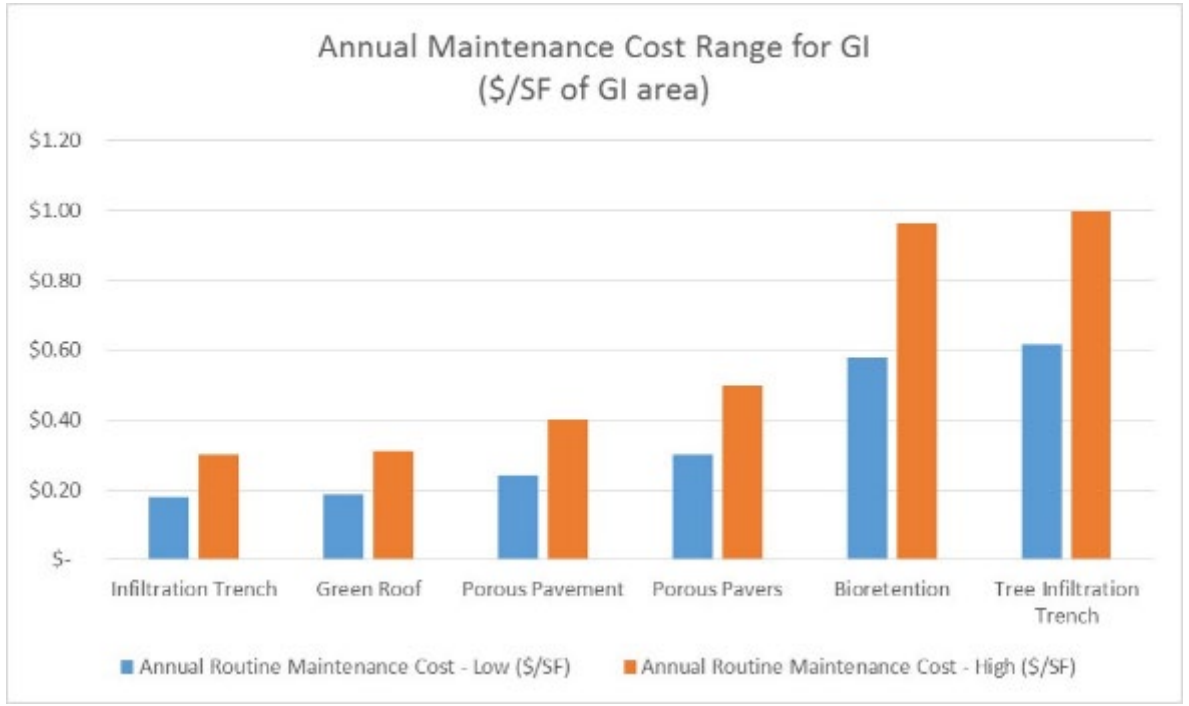
Water Quality Projects (cost/lb of pollutant removed)			
Project Type	**High**	**Medium**	**Low**
Total Nitrogen (cost/lb)	<$176	≥$176 ≤ $475	>$475
Total Phosphorus (cost/lb)	<$1498	≥$1498 ≤ $4152	>$4152

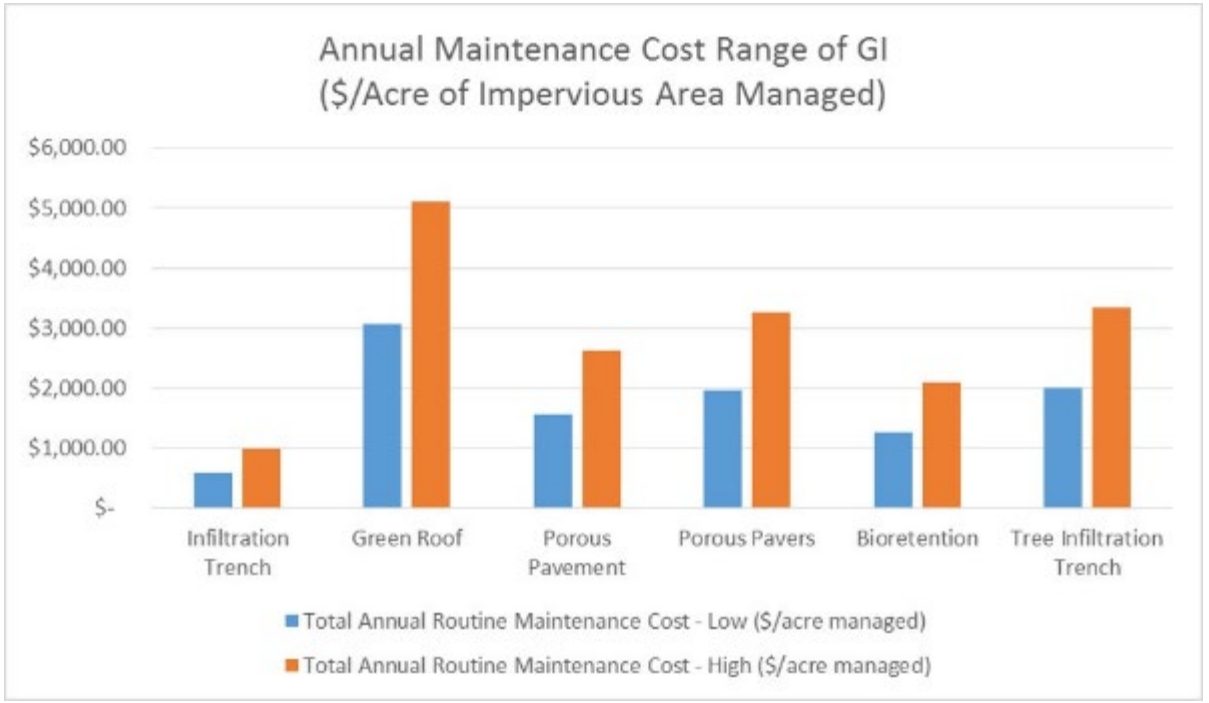
GI Construction Cost Data



Cost data from 127 green stormwater infrastructure projects in Onondaga County, N.Y., demonstrate the influence of both scale and implementation program. Graph by CH2M

GI Maintenance Cost Data





Typical annual maintenance cost-ranges for green stormwater infrastructure based on cost per square foot of green infrastructure (left) compared with maintenance costs based on square foot of impervious area managed (right). Graphs by CH2M

Questions:

Jorge Calabria, Ph.D., ENV SP
Applied Sciences Consulting, Inc.
Email: Jcalabria@appliedfl.com

APPLIED SCIENCES