LID Case Studies

Southeast Stormwater Association

Stormwater Solutions for Your Jurisdiction

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Study Concept

- Gain resolution on differences within land use types
- Are there internal differences big enough to consider?
- Swale vs Curb and Gutter appeared as a practical option
- Grassed conveyance swales are a common drainage feature in Sarasota County and are a LID practice

Versus

Sarasota County

ATKINS

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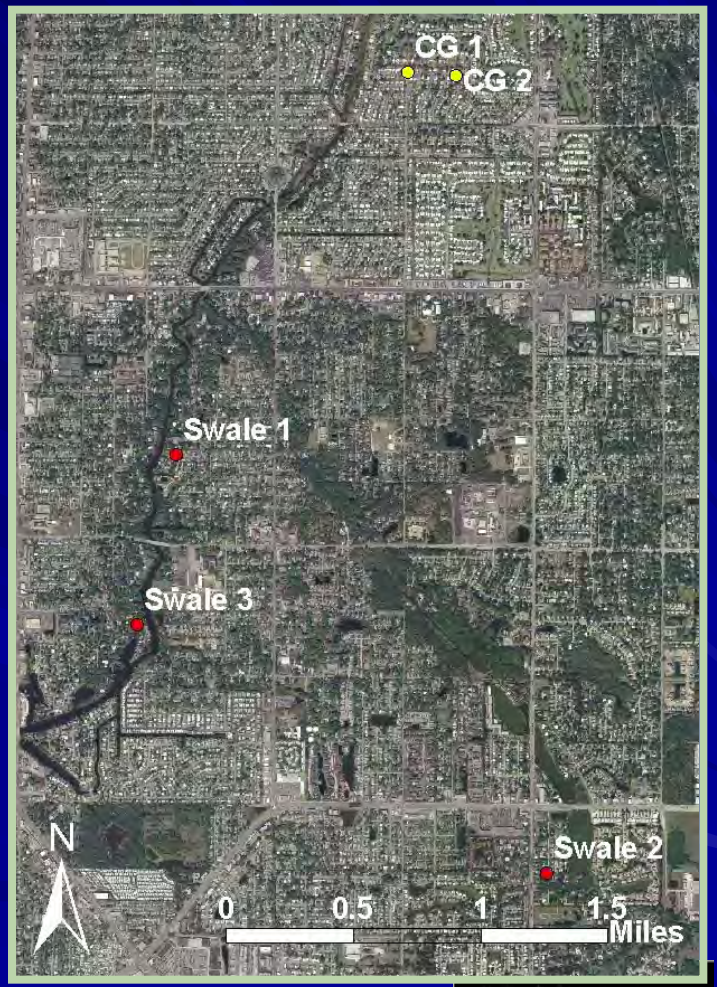
Southwest Florida Water Management District

Environmental Engineers & Consultants

Planning

- Site Characteristics:
  - other than drainage type, *all else equal* to extent possible, focus on land use
  - all sites within the Phillippi Creek basin
- Study period of 7 months or 40 total samples (even site distribution)



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Swale 1 - Nassau

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Curb and Gutter 1 - Dawson

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Field Methods

- Use ISCO Avalanche autosamplers to collect flow-weighted samples, monitor rainfall and discharge
- 0.2 inches of rain or more in less than 1 hour
- Adjust sample collection rates to match site specific conditions
- Followed all pertinent FDEP SOPs

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Results

- Physical removal of particulates drives concentration reductions
- Infiltration in swales drive volume reductions
- Pollutant loads are reduced by both mechanisms

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Concentration Results

Constituent	Swale Mean Conc. (mg/l)	Curb and Gutter Mean Conc. (mg/l)	Percent Difference in Mean
Total Nitrogen	1.98*	6.17*	68%
Total Kjeldahl Nitrogen	1.54	5.62	72%
Nitrate + Nitrite Nitrogen	0.43	0.55	22%
Total Phosphorus	0.77	0.99	22%
Ortho Phosphorus	0.44	0.52	15%
Total Suspended Solids	27.8	127.7	78%
Biochemical Oxygen Demand	4.45	15.35	71%

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* - Influenced by oak pollen event of record

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Runoff Results

- Average runoff coefficients were 58% lower at swale sites
- Three times as much rain without runoff at swale sites
- Annual runoff difference in total flow volume is approximately 5 times lower at swale sites

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Results: Pollutant Loads

- Observed 93% lower load of TN
  - 94% TKN and 81% NOx
- Observed 83% lower load of TP
  - 69% Ortho-Phosphorus
- Observed 95% lower load of TSS
- Observed 93% lower load of BOD

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Implications – Local Scale Matters

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Town of Melbourne Beach Challenges

- Lack of real estate for improvements
- Expensive cost of property acquisition
- Difficulty of regional projects due to outfall locations
- Typically older development
- Typically high directly connected impervious areas (DCIA)

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Town Needs

- Facing large pollutant load reduction goals (TMDLs)
- Will not be able to meet these goals with conventional and regional systems
- LID practices will be important for retrofits

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Basin 4: Sunset Blvd.

- 24 acre basin – Residential and SR A1A runoff
- Right-of-Way availability – crowned median
- Grassed edging - flows straight downhill to river
- Erosion problems

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Sunset Blvd Project Elements

- 1,000 LF median bioretention swale
- Use of curb and flumes to protect median
- Pervious pavers at median ends
- Required re-construction of roadway
- Native plants used, especially on west end with higher groundwater table
- Areas in front of lots graded for rain garden at resident's request
- $2,533 / lbs/yr

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Curb Application for Water Quality Benefit

- Off-line curb and flume system
- Prevents erosion
- Protects system (many of Town's swales filled in)
- Application for retrofitting older developed areas
- Curbs common beachside and on Merritt Island where regional and conventional treatment is not possible

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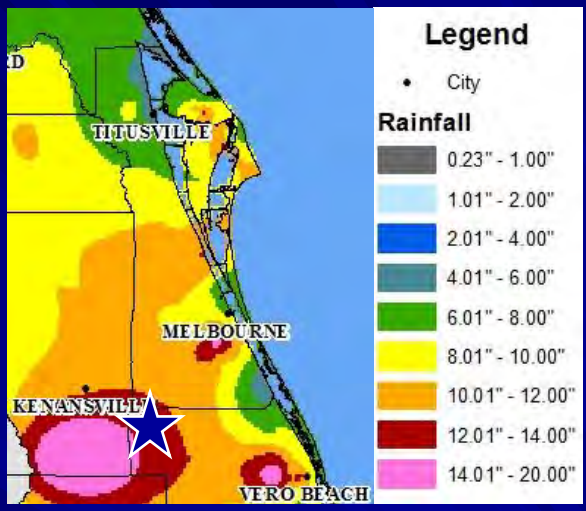
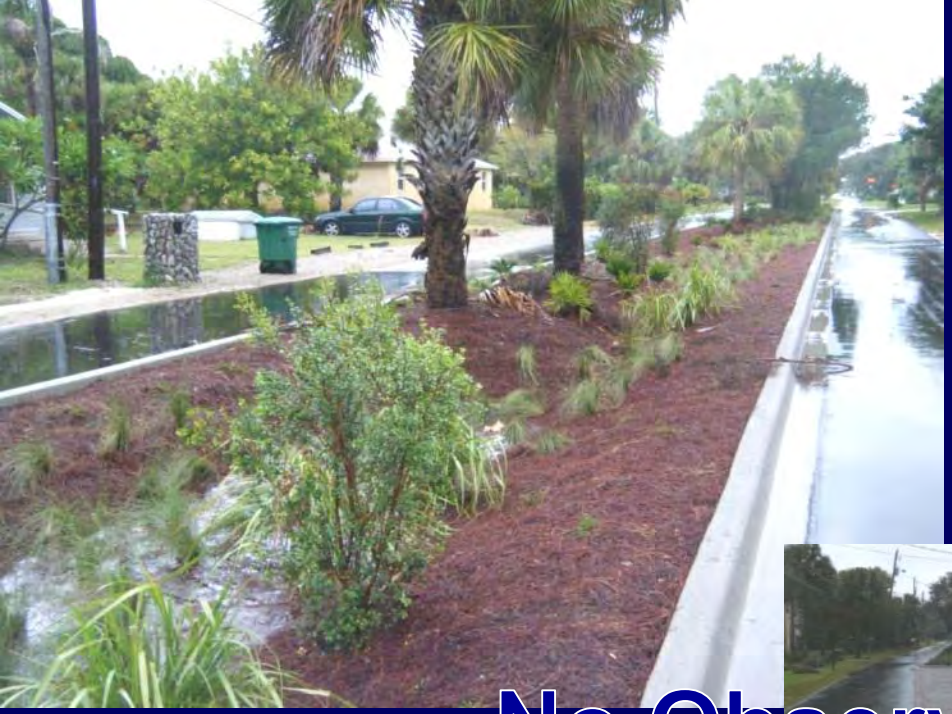
West End

Pre and Post Construction

Sunset Blvd Performance

- Town received approximately 8 inches of rainfall during October 7 - 9, 2011.
- Visual monitoring performed
- System exceeded expectations





No Observed Runoff

Retrofit of the Gwinnett County DWR Facility Using Low Impact Development Practices

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Project Objectives

- Determine if it is possible to infiltrate and store/reuse on-site the runoff from the 95th percentile storm event
- Determine effectiveness of different LID practices
- Determine construction and operation and maintenance requirements for infiltration and storage/reuse facilities
- Determine capital, O&M and life cycle costs for different types of LID practices
- Use constructed project to educate developers, engineers, and the public on the use of LID practices
- Promote the use of viable LID practices in Gwinnett County

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Project Site Aerial Photograph

~31 acres total,
18.5 acres impervious,
60% impervious.

Decided only the immediate site would be used for treatment; no off-site treatment.

Wanted to demonstrate LID can be used for any level of imperviousness allowed by County code; residential, commercial, or industrial.

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Completed Project Site Drainage Sub-Basin Delineation

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Developed Historical Annual Rainfall Probability Distribution for Atlanta

1.73 inch event = 95th %

Rainfall Event Range (inches)	Mean Rainfall Depth (inches)	Mean Rainfall Duration (hours)	Number of Annual Events in Range
0.11 - 0.20	0.151	3.69	16.43
0.21 - 0.30	0.254	4.73	10.17
0.31 - 0.40	0.353	5.21	7.97
0.41 - 0.50	0.45	5.74	6.58
0.51 -1.00	0.713	7.68	17.96
1.01 - 1.50	1.219	10.74	6.94
1.51 - 2.00	1.726	12.98	3.51
2.01 - 2.50	2.209	15.28	1.42
2.51 - 3.00	2.694	16.88	0.84
3.01 - 3.50	3.26	22.9	0.42
3.51 - 4.00	3.741	24.36	0.28
4.01 - 4.50	4.208	17.75	0.08
4.51 - 5.00	4.703	28.33	0.06
5.01 - 6.00	5.638	27.33	0.12
6.01 – 7.00	-	-	0.00
7.01 – 8.00	7.31	48	0.02
8.01 - 9.00	8.65	39	0.02
> 9.00	-	-	-

Total average annual rainfall = 49.6 inches.

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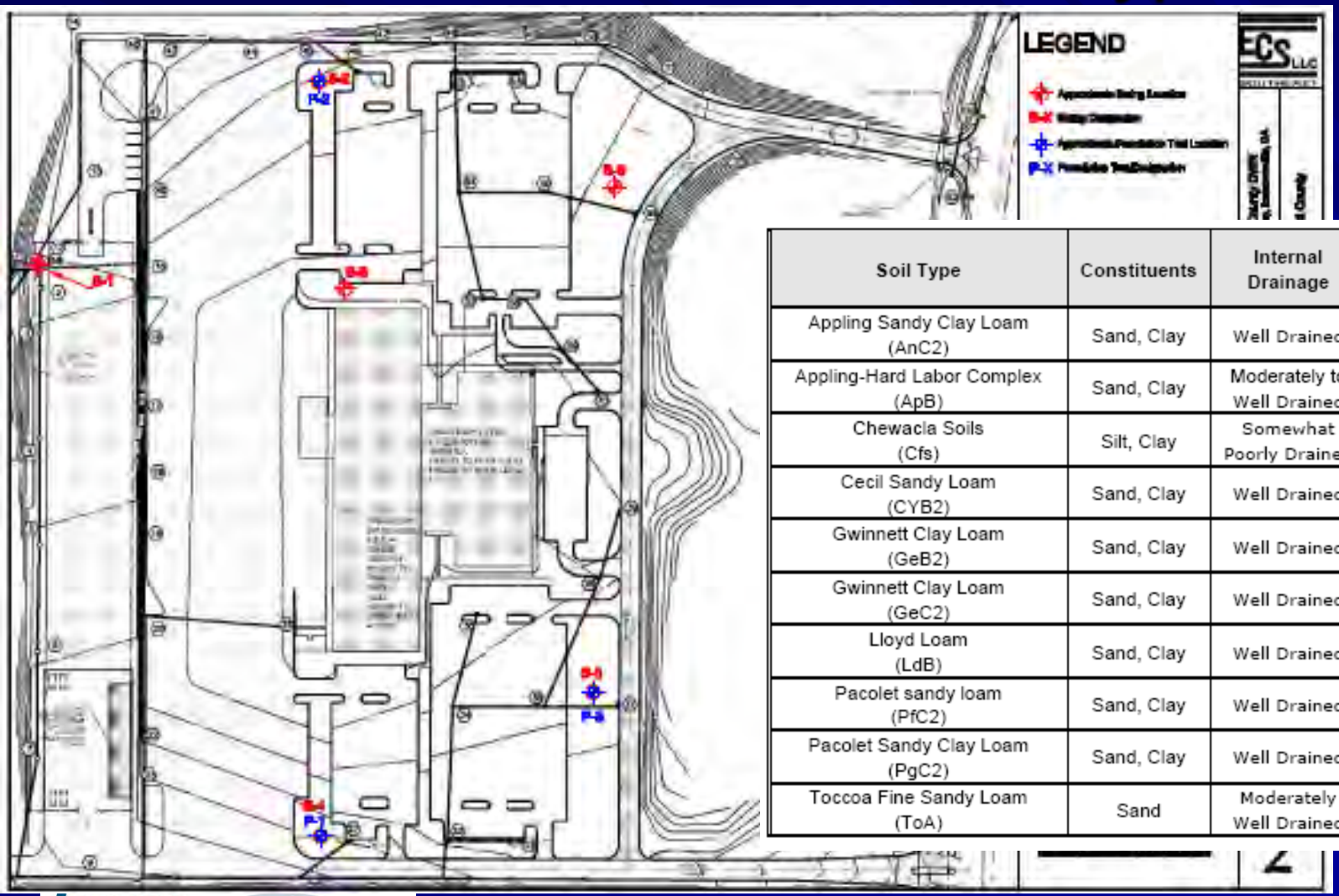
Performed Subsurface Testing and Evaluated Site Soil Types



Soil Type	Constituents	Internal Drainage	Seasonal High Water Table (inches)
Appling Sandy Clay Loam (AnC2)	Sand, Clay	Well Drained	More than 80 inches
Appling-Hard Labor Complex (ApB)	Sand, Clay	Moderately to Well Drained	More than 80 inches
Chewacla Soils (Cfs)	Silt, Clay	Somewhat Poorly Drained	About 6 to 18 inches
Cecil Sandy Loam (CYB2)	Sand, Clay	Well Drained	More than 80 inches
Gwinnett Clay Loam (GeB2)	Sand, Clay	Well Drained	More than 80 inches
Gwinnett Clay Loam (GeC2)	Sand, Clay	Well Drained	More than 80 inches
Lloyd Loam (LdB)	Sand, Clay	Well Drained	More than 80 inches
Pacolet sandy loam (PfC2)	Sand, Clay	Well Drained	More than 80 inches
Pacolet Sandy Clay Loam (PgC2)	Sand, Clay	Well Drained	More than 80 inches
Toccoa Fine Sandy Loam (ToA)	Sand	Moderately Well Drained	About 30 to 60 inches

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Completed In-Situ Infiltration Testing at Proposed Bottom of Engineered Soils

Interval #	Testing Time (min.)	Elapsed Duration (min.)	Depth to Water (in.)	Measured Decrease (in.)	Interval Percolation Rate (min./in.)
Start	1:35 PM	-	17.76	-	-
1	1:50 PM	15	19.08	1.32	11.4
2	2:05 PM	15	20.28	1.20	12.5
3	2:20 PM	15	21.60	1.32	11.4
4	2:35 PM	15	22.92	1.32	11.4
5	2:50 PM	15	24.24	1.32	11.4

Interval #	Testing Time (min.)	Elapsed Duration (min.)	Depth to Water (in.)	Measured Decrease (in.)	Interval Percolation Rate (min./in.)
Start	1:30 PM	-	11.16	-	-
1	1:45 PM	15	11.40	0.24	62.5
2	2:00 PM	15	11.76	0.36	41.7
3	2:15 PM	15	12.00	0.24	62.5
4	2:30 PM	15	12.24	0.24	62.5
5	2:45 PM	15	12.48	0.24	62.5

Measured infiltration rate = 1 to 6 inches per hour at 6-8 ft below existing grade; proposed bottom elevation of infiltration practices.

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Goal to Include at Least One of Each of These LID Practices in the Design

Low Impact Development Practice
Water Storage and Reuse (Cistern)
Tree Box Filter
Enhanced Tree Coverage
Bioretention Area
Grass Parking Spaces
Green Roof
Pervious Pavement or Pavers
Rain Garden*
Vegetated Swale
Engineered Wetland**

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Final Preliminary Plan

Met with all DWR Department Managers and incorporated comments.

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Estimated Runoff Volumes and Load Reductions for Sub-Basins and Project Site

Reduction of Runoff from LID Practices			
Drainage Area	Average Annual Runoff with LID (cu. ft.)	Average Annual Runoff (cu. ft.)	Percent Runoff Reduced by LID Practices
Prop-1	16,938	161,735	90%
Prop-2	78,594	592,068	87%
Prop-3	67,893	541,427	87%
Prop-4	29,414	368,192	92%
Prop-5	93,402	988,638	91%
Prop-6	31,768	226,155	86%
Prop-7	15,742	120,878	87%
Prop-8	30,242	378,347	92%
Prop-9	44,681	545,877	92%
Prop-10	22,459	246,852	91%
TOTAL	**431,133**	**4,170,169**	**90%**

Reduction in Pollutant Loading from LID Practices			
Pollutant	Pre LID (lb/yr)	Post LID (lb/yr)	Percent Reduction
Total N	465	48	90%
Total P	81	8	90%
BOD	2,494	258	90%
TSS	24,391	2,521	90%
FC*	23,617	2,442	90%

*Billion Counts/yr

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Moving Forward

- Estimated Construction Cost = $1,000,000
- Estimated Annual O&M cost = $90,000
- Submitted 319 (h) grant application to GA EPD; Requested $600,000 with $400,000 local match
- If grant approved, construction scheduled for late 2012
- Post construction monitoring proposed for each type of LID practice
- Construction of Phase I (bioretention area and roof rainwater harvesting system) completed in July 2011 using another 319 (h) grant

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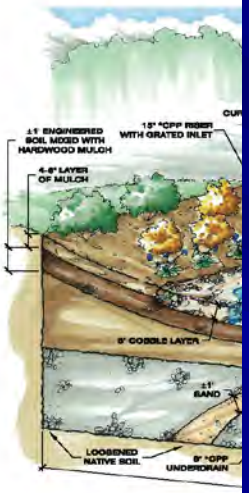
Phase I Construction – Completed in one month, July 2011

Gwinnett County Department
Bioretention Facility: Protecti

What is a Bioretention System?

- Designed to infiltrate pollutants into the soil before stormwater reaches a stream or detention pond
- Infiltration helps mitigate the high flows from impervious areas that can cause erosion in streams
- This bioretention area was constructed in a 2,600 square foot grass area and treats stormwater runoff from a 0.6 acre parking area



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Pre-Construction Site Area

Drainage area = 1 ac
Imperv. area = 0.7 ac (parking area)

Parking drains to one curb inlet.

0.3 acre raised grass area available.

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Excavation and Underdrain Installation

Excavated area for engineered soils (3-4 ft) and loosened soil to a depth 2 ft. below proposed bottom of engineered soils.

Installed 6-inch HDPE underdrain and gravel trench with 15-inch risers.

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Engineered Soils and Gravel Backfill

Installed engineer soils in 1 ft lifts and watered to consolidate.

Installed gravel trenches across area to aid in runoff distribution.

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Backfill Completion and Final Grading

Installed remaining engineered soils in 1 ft lifts and watered to consolidate.

Final surface grading 3-5H:1V slopes.

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Surface Treatment – Cobble, mulch, plants and sod

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Completed Project

3-inch tall curb around inlet; runoff overflows into curb inlet when pond is full.

Underdrain and risers have closed valve; Installed to be used only if pond does not infiltrate naturally.

Construction cost = $100,000
Primary cost was engineered soil purchase.

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Completed Project

Frequent watering was initially required due to sandy soils.

Installed a 6,000 gallon tank next to building and roof rainwater harvesting system in September for watering bioretention.
(1-inch rain = 1,000 gallons of water)

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