TRIECA
Mississauga, Ontario

Implementing LID Techniques

March 27 and 28, 2012

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Plain City, Ohio

Outline

- Three Driving Forces
- Scott’s Version of LID Objectives
- Obstacles to LID
- Regulatory Criteria
- Project Examples
- Comments

Three Driving Forces

- Meeting Regulatory or PR Goals
- Owner Developer Goals
- Designer Priorities

Low Impact Design

- Minimize Impervious Impacts
- Maximize Flow Lengths
- Minimize Flow Velocities
- Maximize Infiltration
- Provide Water Quality Filtration
- Provide Controlled Flood Storage

Obstacles

- Cost - Owners
- Typical Design Solutions - Designers
- Regulatory Standards - Agencies
- Zoning Criteria – Local Gov’t
- Construction Standard Practices - Contractors

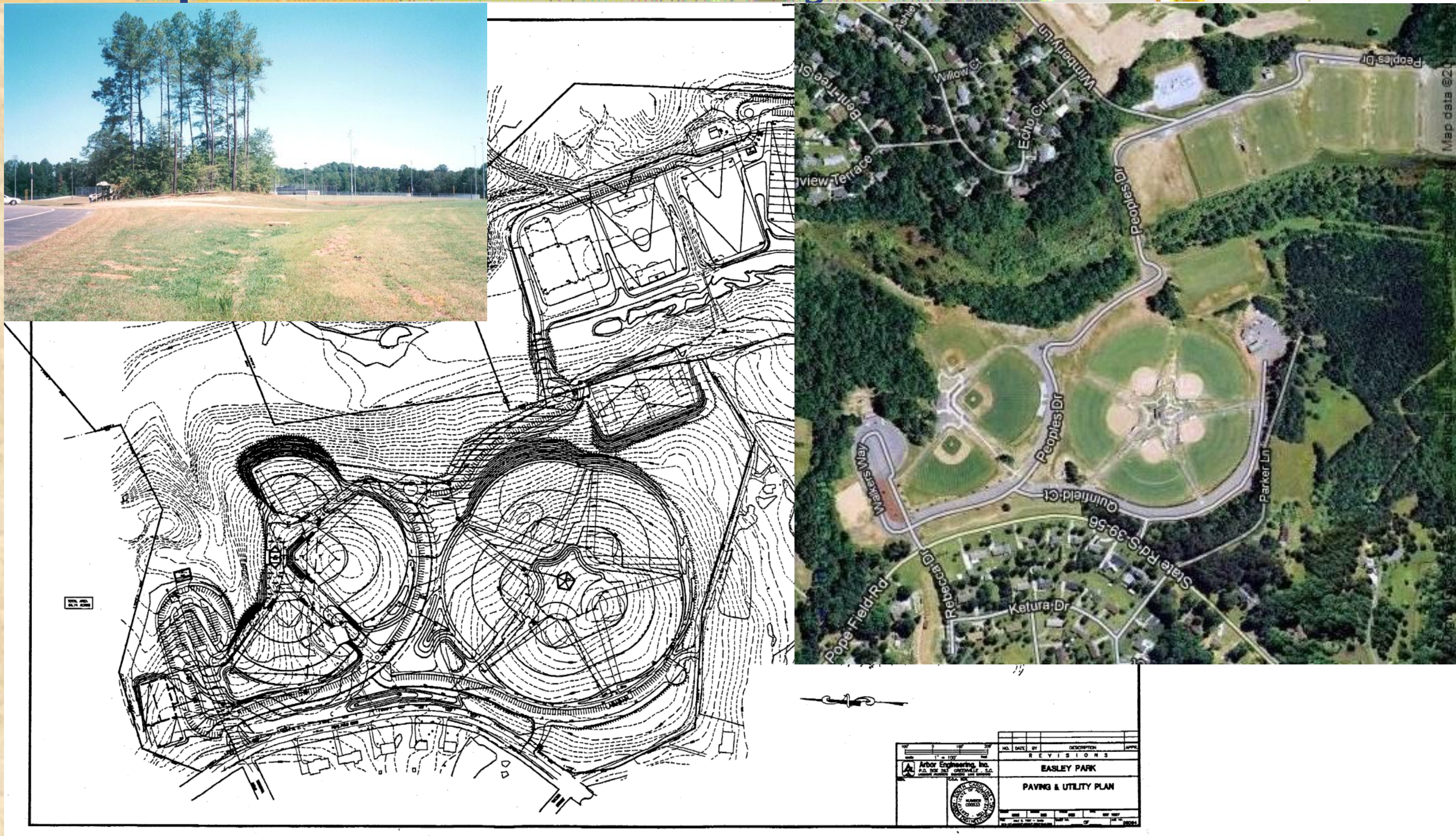
Stormwater Regulations

- Post < Pre Runoff Rate
- Flood Control
- Critical Storm 1-Yr Volume Increase
- NPDES Phase II Regulations
- Water Quality Criteria
- Infiltration/Volume Criteria

Citizen Park, Aiken, SC

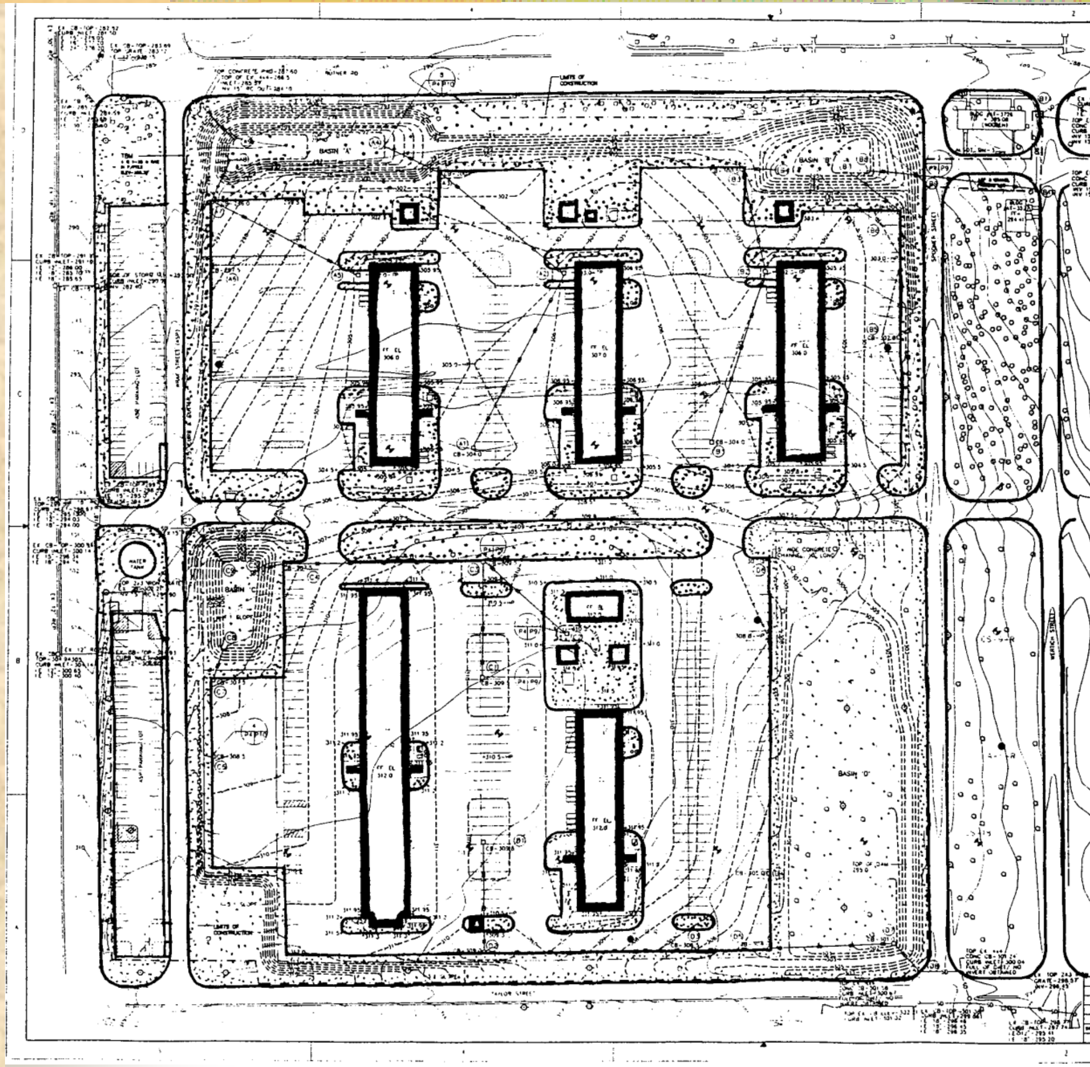
- Flood Control Regs
- Public Relations

Sports Park, Easley, SC



- Flood Control Regs
- Public Relations

Vehicle Maint, Ft Bragg, NC



VEHICLE MAINTENANCE COMPLEX / FORT BRAGG, N.C.

Original Corps Design

- 25 acres building and paving on a 26 acre site
- 420 parking spaces with no traffic islands or any planting areas around buildings
- 3300 lf of 24" to 36" storm drain pipe onsite and 2000 lf of 48" offsite storm drain pipe across a natural area to an existing creek with severe erosion problems
- Massive cut and fill to create a level site
- Eliminate all large existing onsite Pine trees which serve as habitat for endangered woodpeckers

Revised Layout

- Eliminate 5 acres of heavy duty concrete paving Save $823,000
- Provide 520 parking spaces by defining traffic flow using planted islands around buildings and parking areas
- Eliminate large onsite and all of offsite storm drain pipe with 4 onsite stormwater management basins with discharge into existing small storm drain systems Save $390,000
- Terrace building pads and parking areas to match existing grades and minimize earthwork Save $400,000
- Preserve large onsite existing Pine trees as migratory habitat

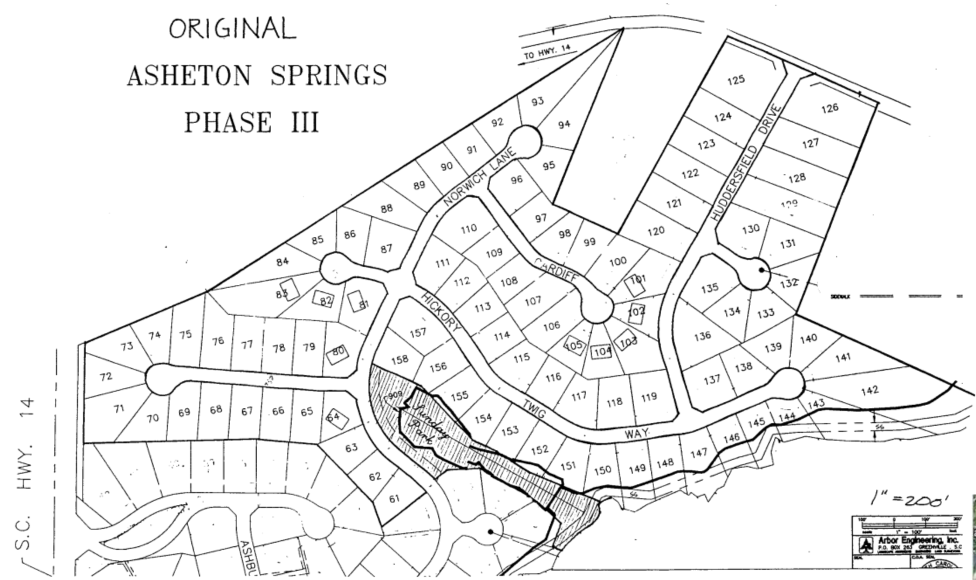
Total Savings $1,613,000

PUBLISHED IN: NATURAL RESOURCES DEFENSE COUNCIL

"STORMWATER STRATEGIES IN THE SOUTHEAST", 1998

- Existing Conditions
- Costs

Asheton Springs, Mauldin, SC



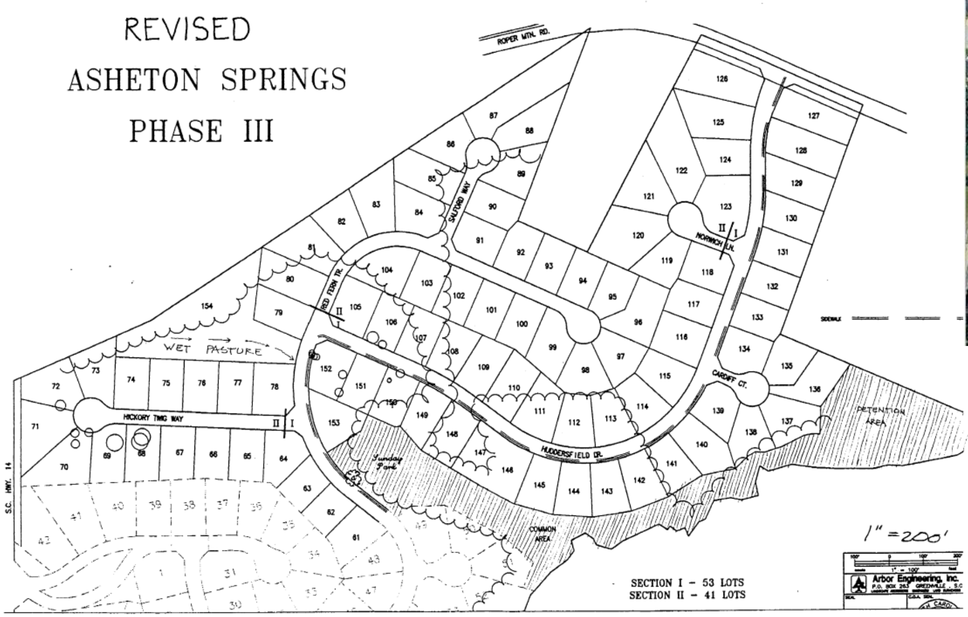
ASHETON SPRINGS - PHASE III

Original Design

- 97 lots
  - 7 environmentally unbuildable
  - 9 too small for desired house plans
  - 4 with wetland, floodplain or detention areas on lot
  - 77 good buildable lots
- 6400 lf of road
- $7300±/lot approximate construction costs - $704,000 approximate total
- $146,000± possible losses due to unbuildable lots

Revised Design

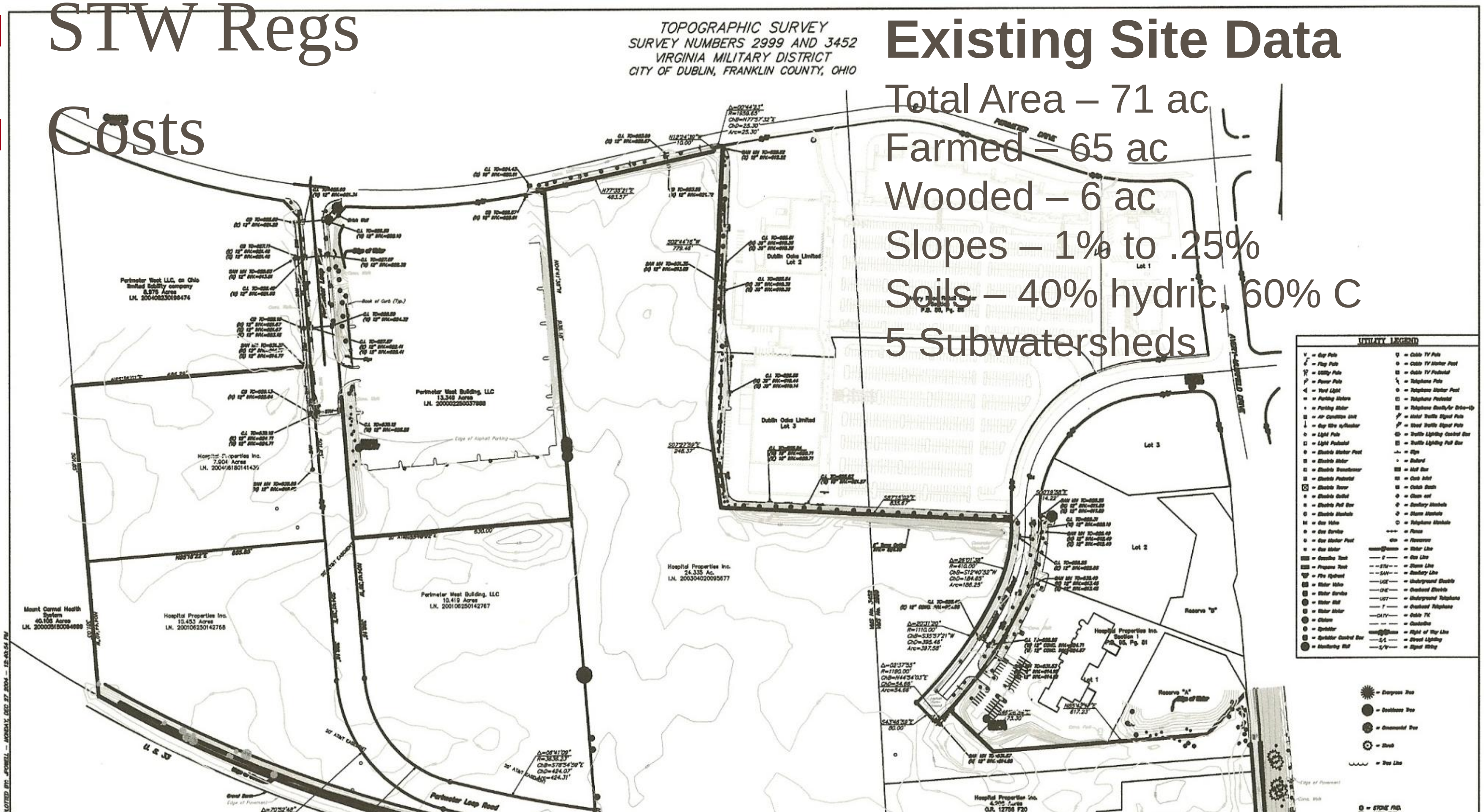
- 93 good buildable lots
- 5850 lf of road
- $6900±/lot approximate construction costs - $644,000 approximate total
- Saved $60,000 in road construction costs (4 extra lots cost $15,000/lot)
- Expanded park / greenway area
- Preserved wet pasture area
- Possible $320,000 in profits for 16 lots at $20,000 vs $146,000 in losses



- STW Regs
- Costs

Ex Hospital Site, Dublin, OH

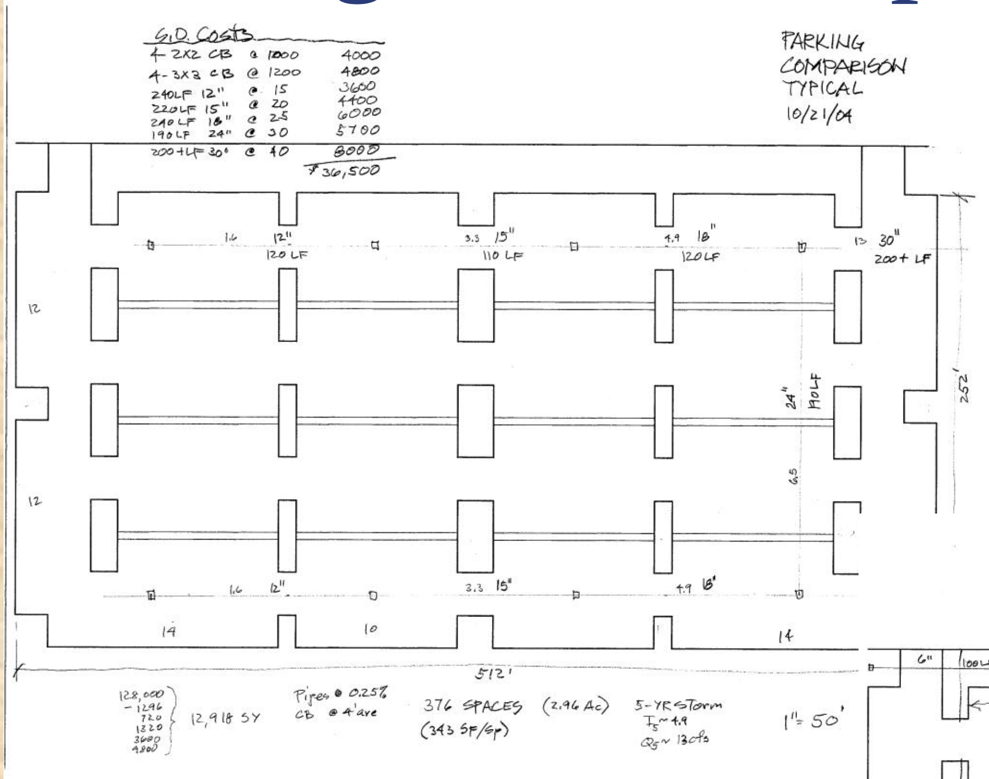
- STW Regs
- Costs



Existing Site Data

Total Area – 71 ac
Farmed – 65 ac
Wooded – 6 ac
Slopes – 1% to .25%
Soils – 40% hydric, 60% C
5 Subwatersheds

Parking Cost Comparison

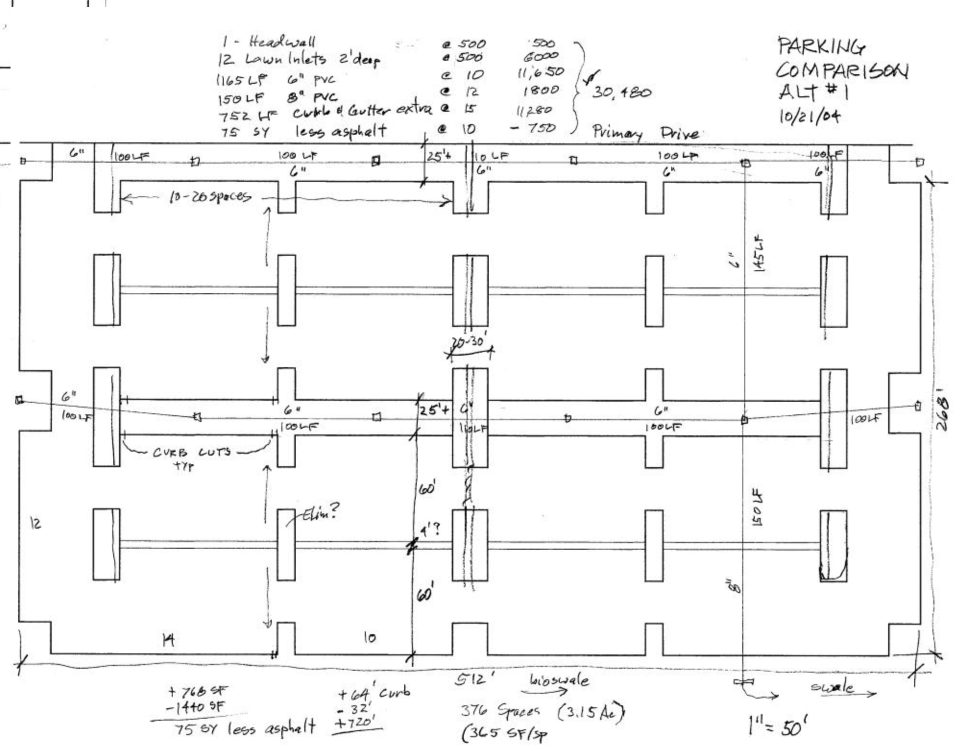


Traditional Parking

8 catch basins in pavement

1090 lf 15” to 30 “ pipe

$36,500



LID Parking

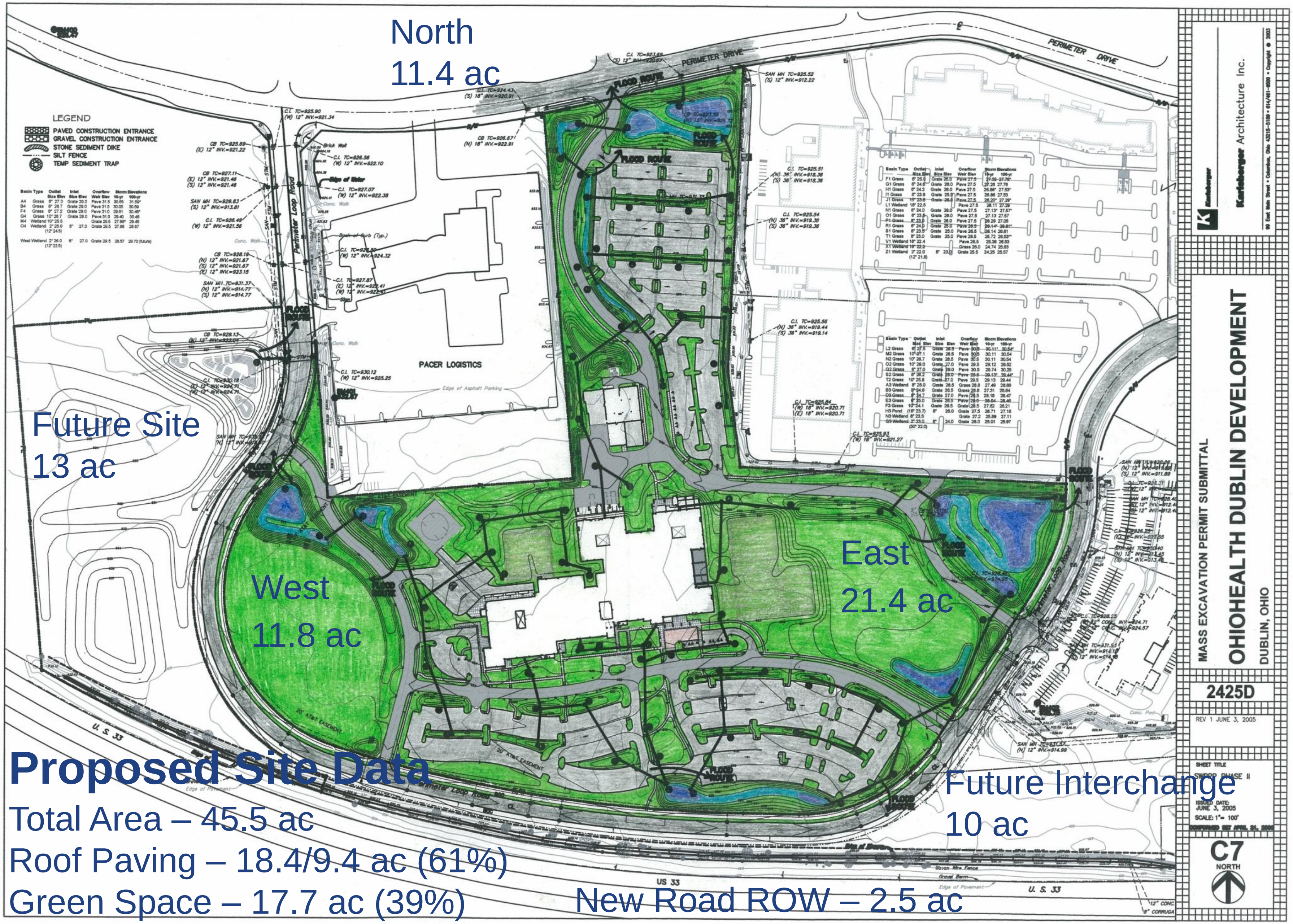
12 lawn inlets

1300 lf 6” to 8” pipe

750 lf extra curb

$30,500

Dublin Methodist Hospital



North
11.4 ac

Future Site
13 ac

West
11.8 ac

East
21.4 ac

Future Interchange
10 ac

Proposed Site Data

Total Area – 45.5 ac

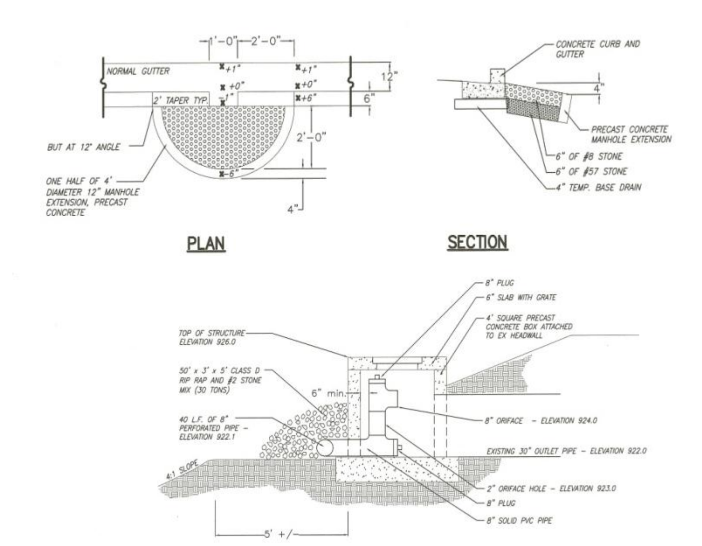
Roof Paving – 18.4/9.4 ac (61%)

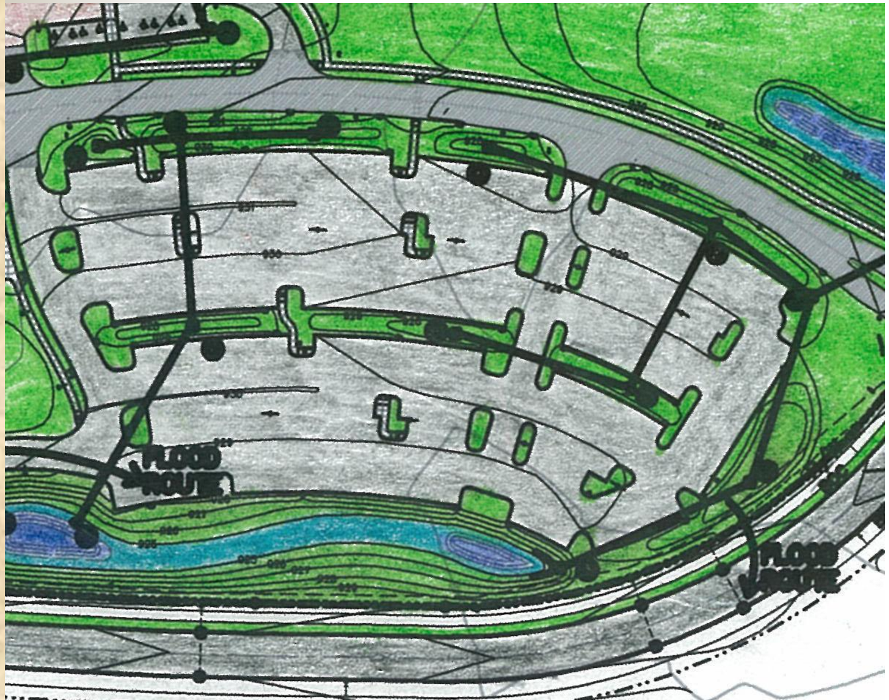
Green Space – 17.7 ac (39%)

New Road ROW – 2.5 ac

Proposed LID Measures

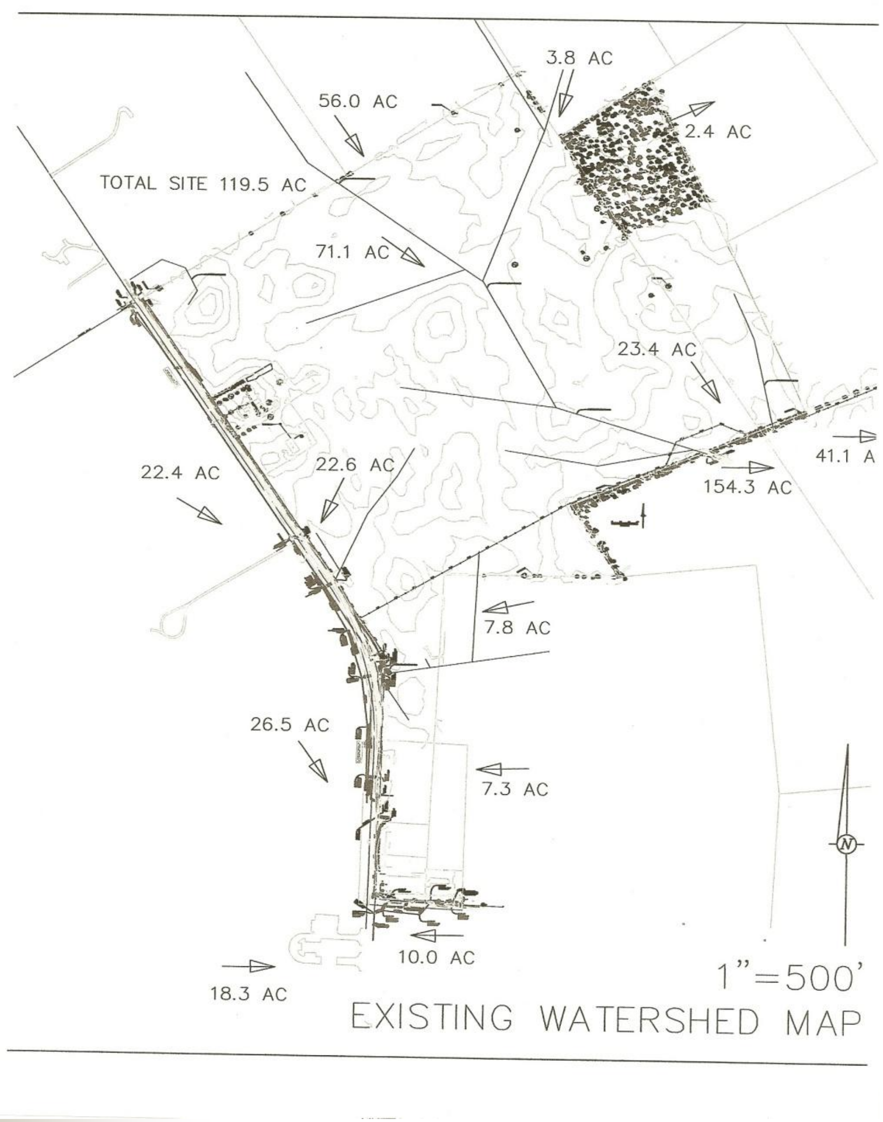
- Minimize Impervious Impacts with impervious runoff into 28 vegetated areas and 26 grassed basins
- Maximize Flow Lengths using sheet flow, curb cuts, grass swales, basins, wetland swales, and ponds
- Maximize Infiltration with 26 grass detention basins, 5 wetland swales, 5 wetland ponds > 4 days release duration
- Provide Water Quality Filtration with 3.5 ac ft WQ volume in grass basins, wetland swales, and wetland ponds
- Minimize Flow Velocities using wetland swales at 0.1% slopes and undersized storm drain pipes
- Provide Controlled Flood Storage within multiple basins throughout site provides > 18 acft storage

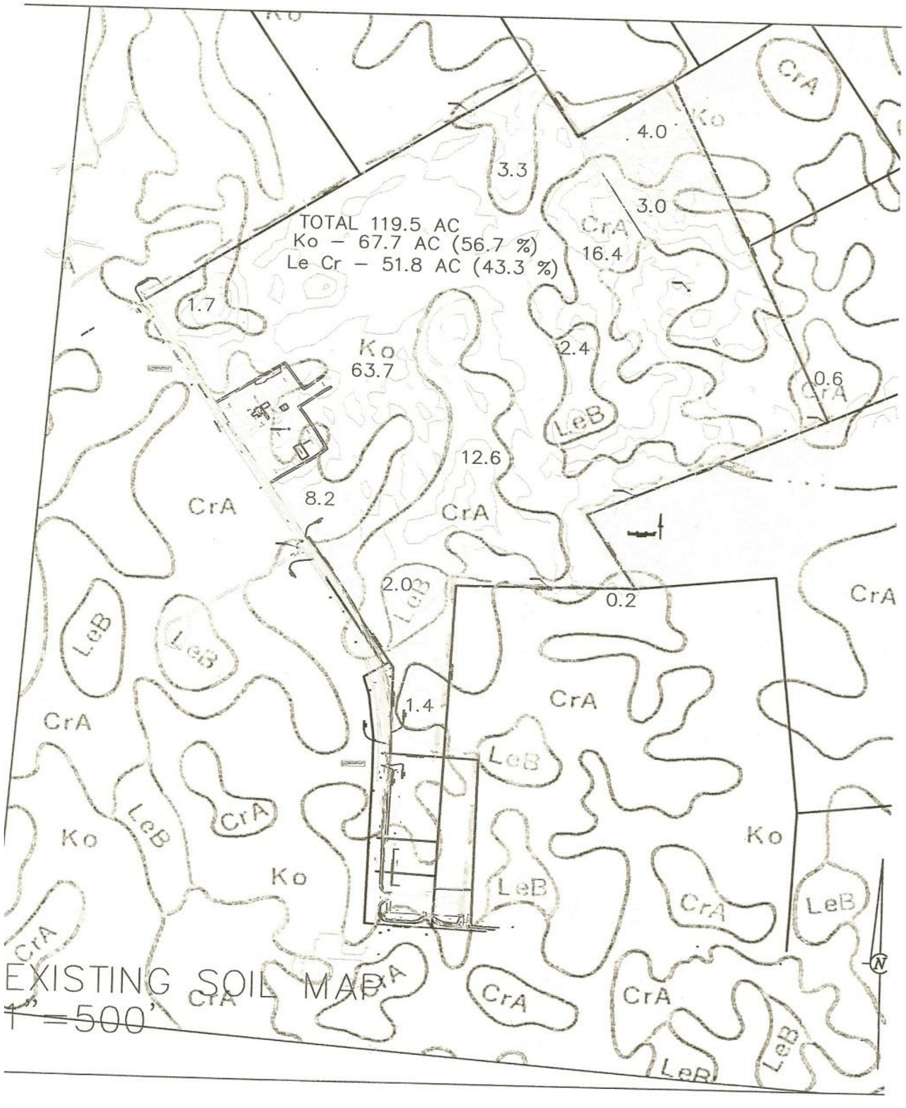




Dublin Methodist Hospital

New High School, Hilliard, OH





Big Darby Creek Stormwater Permit

General Permit OHC100001, 10/27/06

Difference

-Submit SWPPP with NOI 45 days prior and wait for letter

- Mandatory stream setbacks and mitigation for impacts (100’ min. and $W=133DA^{.43}$)

- No dry detention, stricter use of silt fence and sediment basins

- 134 cy/ac drainage area for sediment basins + 20% (100 ac site = 5’ max depth x 190’ x 380’ + 3’ depth x 150’ x 160’)

- TSS sampling at outlets for maximum 45 mg/l

- Groundwater recharge requirements annual post ≤ pre

Groundwater Recharge Criteria

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Ohio EPA Permit No.: OHC100001
Issuance Date: September 12, 2006

Part III.G.2.d.i

Table 1
Annual Average Expected Total Groundwater Recharge[3]

Land Use	Density (DU[1]/acre)	% Impervious	Recharge (inches) by Hydrologic Soil Group[2]			
			A	B	C	D
Wood / Forest	-	-	17.0	16.6	15.6	14.6
Brush	-	-	17.0	16.6	15.6	14.6
Meadow	-	-	17.0	16.5	15.4	14.4
Managed Wood	-	-	16.9	16.0	14.7	13.4
Pasture	-	-	16.5	15.9	14.4	13.0
Row Crop	-	-	15.8	14.2	11.9	8.1
Urban Grasses	-	-	15.7	15.7	14.2	12.7
Low Density Residential	0.5	12%	15.7	15.7	14.2	12.7
Low Density Residential	1	20%	14.8	14.8	13.7	12.2
Medium Density Residential	2	25%	11.5	11.5	11.5	11.5
Medium Density Residential	3	30%	11.2	11.2	11.2	11.2
Medium Density Residential	4	38%	9.6	9.6	9.6	9.6
High Density Residential	≥5	65%	7.3	7.3	7.3	7.3
Commercial	-	90%	4.3	4.3	4.3	4.3

[1]DU = Dwelling Units
[2]Hydrologic soil group designations of A/D, B/D, and C/D should be considered as D soils for this application
[3] These values apply when recharge of the aquifer is expected; recharge to the bedrock aquifer can be expected when the potentiometric head of the glacial aquifer is greater than the bedrock aquifer.

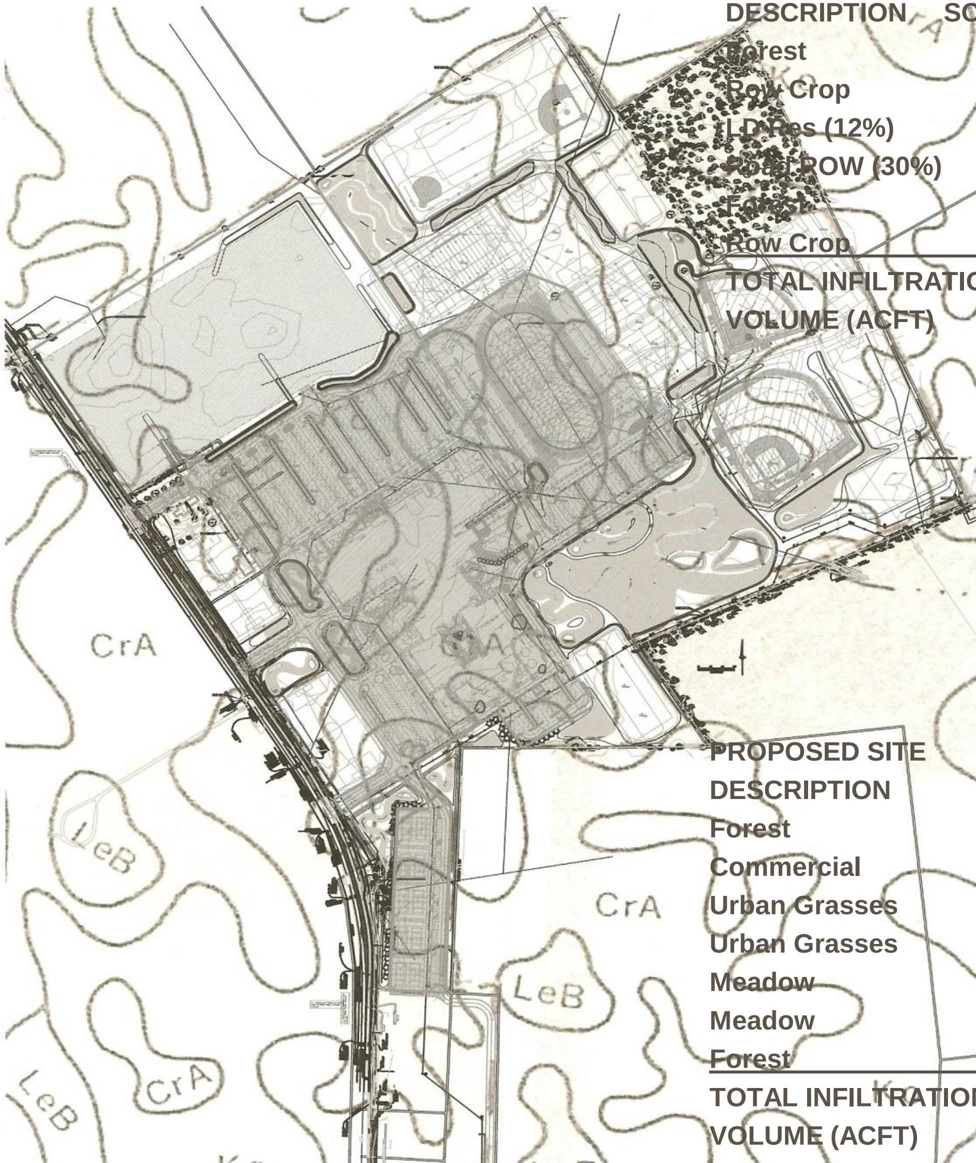
- Vre = AREA x Dre/12

- Calculate annual pre-dev and post-dev infiltration volumes

- Mitigation if post-dev < pre-dev

- Preferred mitigation convert ex land to higher recharge use or create onsite infiltration system

New Hilliard High School



EXISTING SITE 119.5 Total Acres

DESCRIPTION	SOIL TYPE	AREA	COEF	INF VOL
Forest	C	3.0	15.6	46.8
Row Crop	C	46.8	11.9	556.9
LD Res (12%)	C	1.0	14.2	14.2
Road ROW (30%)	C	1.0	11.2	11.2
Forest	D	4.0	14.6	58.4
Row Crop	D	63.7	8.1	516.0
TOTAL INFILTRATION VOLUME (INCHES)				1203.5
VOLUME (ACFT)				100.3

PROPOSED SITE

DESCRIPTION	SOIL TYPE	AREA	COEF	INF VOL
Forest	C	3.0	15.6	46.8
Commercial	C/D	55.0	4.3	236.5
Urban Grasses	C	21.0	14.2	298.2
Urban Grasses	D	20.5	12.7	260.3
Meadow	C	8.0	15.4	123.2
Meadow	D	8.0	14.4	115.2
Forest	D	4.0	14.6	58.4
TOTAL INFILTRATION VOLUME (INCHES)				1138.6
VOLUME (ACFT)				94.9
VOLUME DEFICIT				5.4
VOLUME PROVIDED (RECARGA)				21-35 ACFT

LID - Rain Gardens

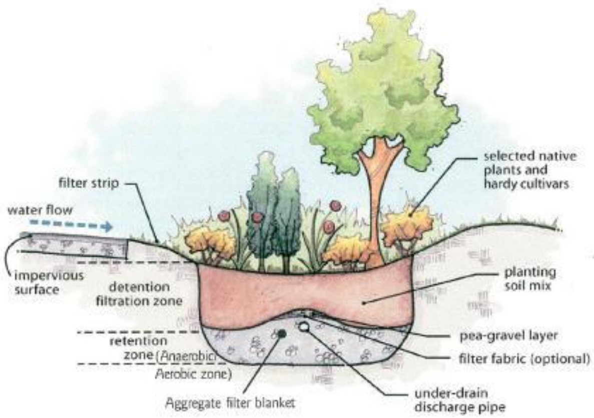


Figure 6.1.13 Bioretention with elevated under-drain.

Graphic by AHBL Engineering

Plant List

(Plants recommended for Missouri and Kansas)

Plant	Sun/Shade	Moisture*	Color	Height	Bloom Period
Flowers					
Aromatic Aster *Aster Oblongifolius*	Full Sun, Partial Shade	average to dry	blue/purple	1 - 3 ft.	Aug - Oct
Cardinal Flower *Lobelia cardinalis*	Full Sun, Partial Shade	wet to moist	red	2 - 4 ft.	July - Sept
Great Blue Lobelia *Lobelia siphilitica*	Full Sun, Partial Shade	wet to moist	blue	2 - 4 ft.	Aug - Sept
Marsh Milkweed *Asclepias incarnata*	Full Sun, Partial Shade	wet to moist	pink	4 - 5 ft.	July - Aug
Butterfly Milkweed *Asclepias tuberosa*	Full Sun, Partial Shade	moist to dry	orange	1 - 3 ft.	June - Aug
Prairie Blazing Star *Liatris pycnostachya*	Full Sun, Partial Shade	moist to dry	purple	2 - 5 ft.	July - Aug
Yellow Coneflower *Ratibida pinnata*	Full Sun, Partial Shade	moist to dry	yellow	3 - 4 ft.	June - Aug
Purple Coneflower *Echinacea purpurea*	Full Sun, Partial Shade	moist to dry	purple	2 - 4 ft.	June - Aug
Wild Geranium *Geranium maculatum*	Partial Shade, Full Shade	moist	pink	12 - 24 in.	April - May
Celandine Poppy *Stylophorum diphyllum*	Full Shade	moist	yellow	16 - 24 in.	April - May
Black-Eyed Susan *Rudbeckia fulgida 'Goldsturm'*	Full Sun	moist to average	yellow	2 - 3 ft.	July - Sept
Daylilies *Hemerocalis spp.*	Full Sun, Partial Shade	moist to average	various	1 - 3 ft.	May - Aug
Prairie Coreopsis *Coreopsis palmata*	Full Sun, Partial Shade	average to dry	yellow	1 1/2 - 2 ft.	June - July
Grasses & Sedges					
Fox Sedge *Carex vulpinoidea*	Full Sun, Partial Shade	saturated to wet	green leaves, brown in fall	2 - 3 ft.	May - July
Soft Rush *Juncus effusus*	Full Sun, Partial Shade	saturated to wet	green leaves,	2 - 4 ft.	June - Aug
Little Bluestem *Schizachyrium scoparium*	Full Sun	average to dry	blue-green, bronze in fall	2 - 4 ft.	Aug
Prairie Dropseed *Sporobolus heterolepis*	Full Sun, Partial Shade	average to dry	green leaves, copper in fall	1 1/2 - 2 ft.	Aug - Oct
Shrubs					
Red-twigged Dogwood *Cornus sericea*	Full Sun, Partial Shade	wet to dry	white flower, red bark	6 - 12 ft.	May - June
Blueberries, high bush var. *Vaccinium spp.*	Full Sun, Partial Shade	moist	red fall foliage	4 - 6 ft.	June - Aug Fruit
Black Chokeberry *Aronia melanocarpa*	Full Sun, Partial Shade	moist to dry	white flowers red fall foliage	3 - 6 ft.	May

Full Sun · Partial Shade · Full Shade

*Moisture: Locate plants that like wet conditions in the lowest part of the garden, average to moist conditions on the sides, and dry conditions on the top

Franklin Soil and Water Conservation District

Conservation Series

Rain Gardens

Rain gardens are attractive, landscaped areas planted with perennial native plants which don't mind getting "wet feet". Built in a bowl shape, the gardens are designed to increase infiltration allowing rain and snowmelt to seep naturally into the ground. Benefits of rain gardens are multiple; they recharge groundwater supply, prevent water quality problems, provide habitat for birds and butterflies, and are great looking landscape features.

History of the Rain Garden

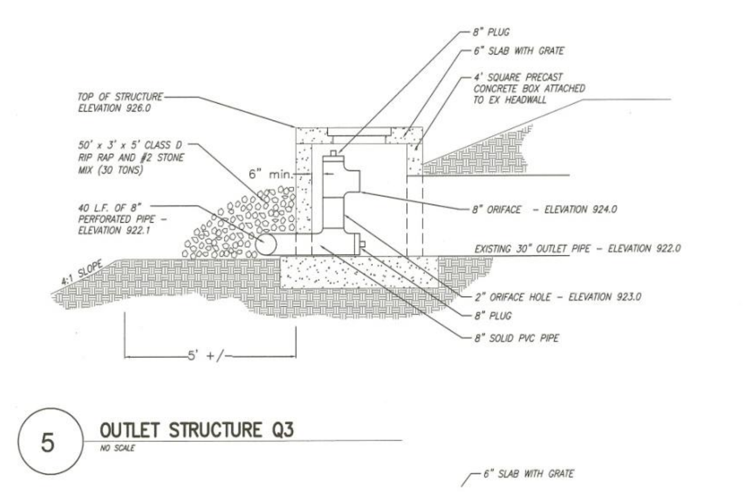
Rain gardens were first used in Maryland in the early 1990s to address pollution that was threatening the Chesapeake Bay. They were developed based on the idea of the bioretention basin. These basins were initially designed as a Best Management Practice (BMP) to minimize the impacts of development and storm water runoff. Bioretention basins are depressions which collect and hold storm water runoff. Slowing the flow of surface runoff allows time for pollutants to break down or settle out of the water before it slowly continues its flow to the nearest river or lake.

While detention basins are primarily used to contain water from a substantial drainage area, rain gardens are designed for use on smaller, residential lots, giving the homeowner the ability to reduce the amount of storm water runoff that flows from the yard.

Why Do We Need Rain Gardens?

As development increases, the ability of our environment to perform its natural processes decreases. This is because the natural landscape that was once able to absorb and clean storm water is covered by impervious surfaces. Impervious surfaces are simply surfaces that water is unable to penetrate, such as roads, rooftops, and driveways.

Increased impervious surfaces result in an increased amount of storm water runoff and an increased chance for pollution to enter our waterways through our storm sewer systems. Pollution that results



New Hilliard High School

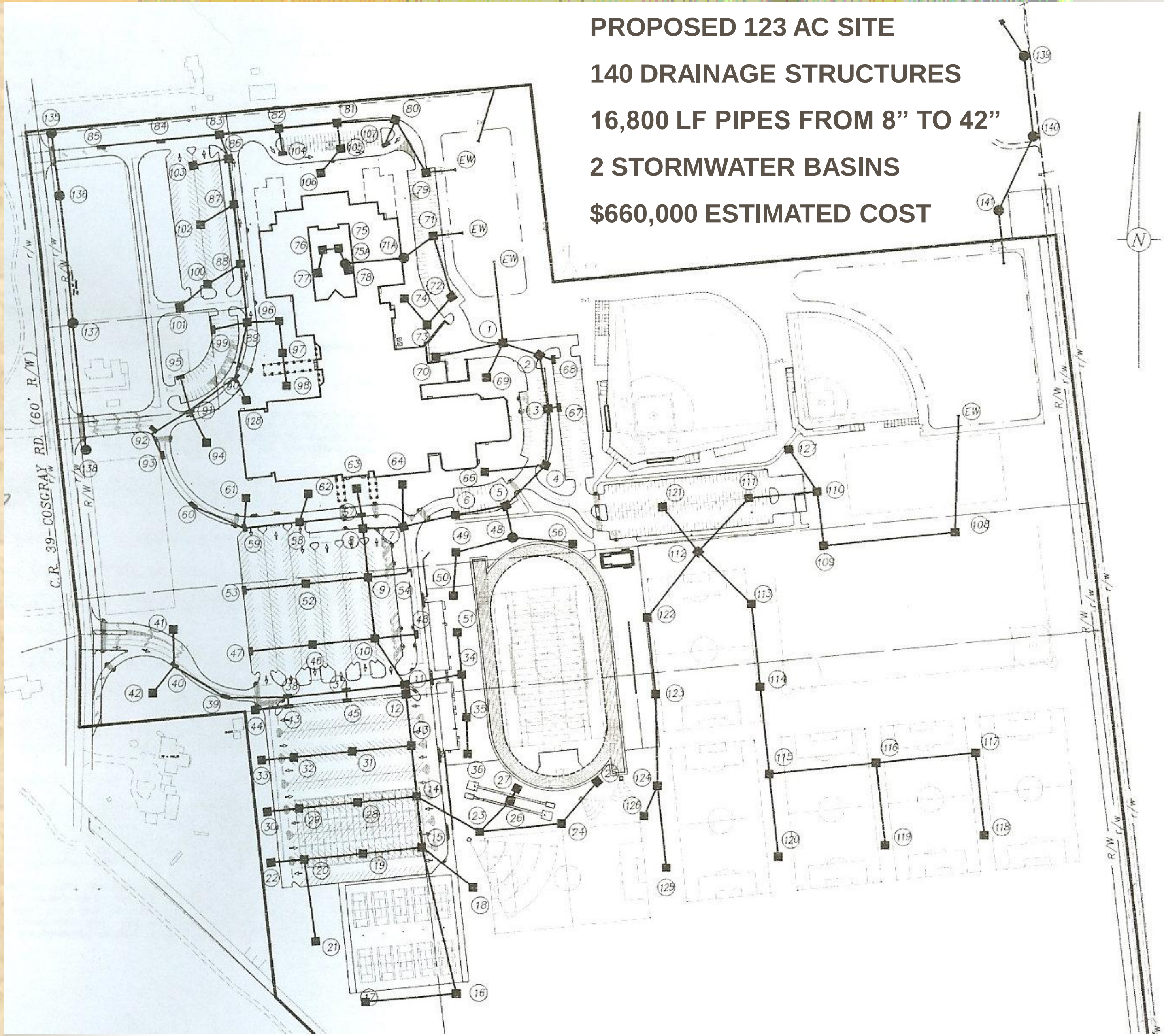
PROPOSED 123 AC SITE

140 DRAINAGE STRUCTURES

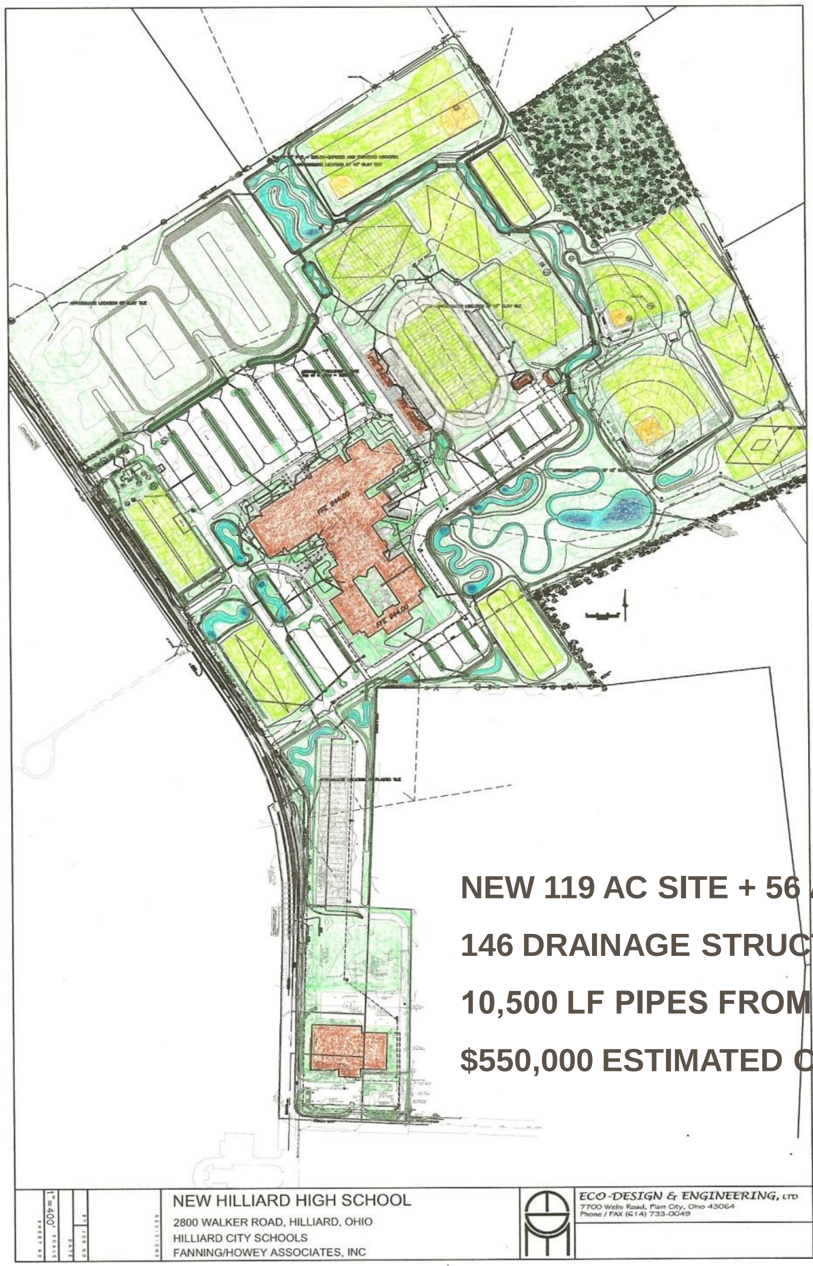
16,800 LF PIPES FROM 8” TO 42”

2 STORMWATER BASINS

$660,000 ESTIMATED COST



New Hilliard High School



NEW 119 AC SITE + 56 AC

146 DRAINAGE STRUCTURES

10,500 LF PIPES FROM 6" TO 36"

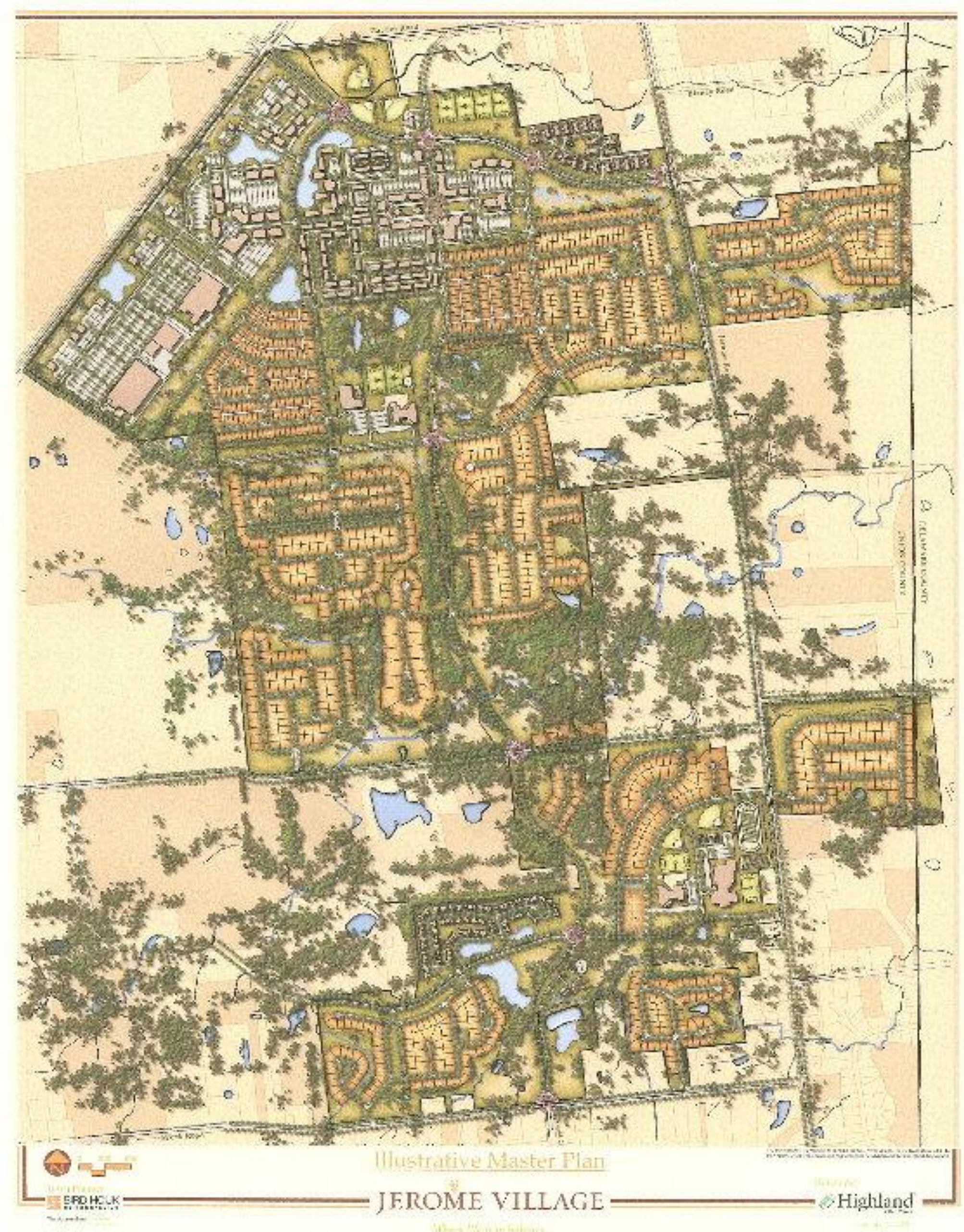
$550,000 ESTIMATED COST

Proposed Stormwater Management System

- Parking Island Rain Gardens-11
- Basin Rain Gardens - 11
- Water Quality Basins - 3
- Wetland Channel Systems – 9
- Vegetated Basins - 2
- Extended Wetland Detention – 1
- 20.5 Ac Greenspace for Stormwater
- 5.4 AcFt Water Quality Volume at 1'
- 48.4 AcFt Flood Storage at 4' ave
- Daylighting Farm Tiles – 3000 LF
- Open Channel Systems – 8000 LF
- 36 Basins and 59 Inlets (19 PD)
- 119.5 Ac Site, 60% Open Space
- SWPPP with 95% trap efficiency
- TSS Monitoring
- BMP Schedule

New Hilliard High School

Jerome Village – New Town Dev



1500 AC SITE

PHASE 1 - 2200 LF NEW PUBLIC ROADS

TRADITIONAL STORM DRAIN DESIGN

18 CURB INLETS, 7 INLETS, 9 MANHOLES, 4 CURB CUTS, 3445 LF PIPES FROM 12” TO 24”, 5 HEADWALLS, 2 BASINS, 420 LF SWALES

$189,000 ESTIMATED COST

LOW IMPACT DESIGN SYSTEM

14 CURB INLETS,10 INLETS, 1 MANHOLE, 8 CURB CUTS, 1820 LF PIPES FROM 12” TO 18”, 15 HEADWALLS, 9 BASINS, 400 LF SWALES

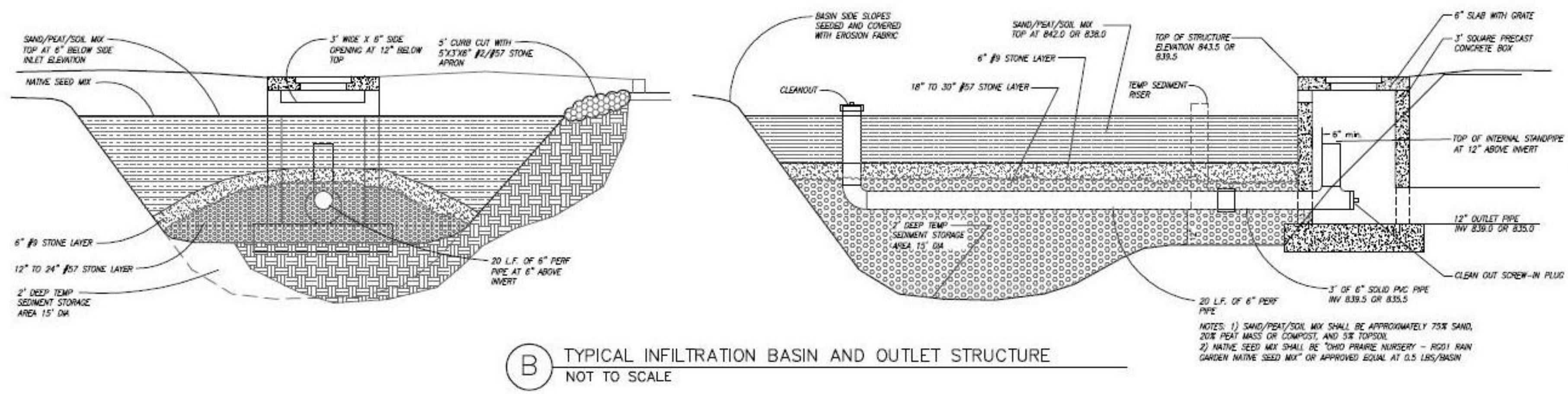
$125,000 ESTIMATED COST

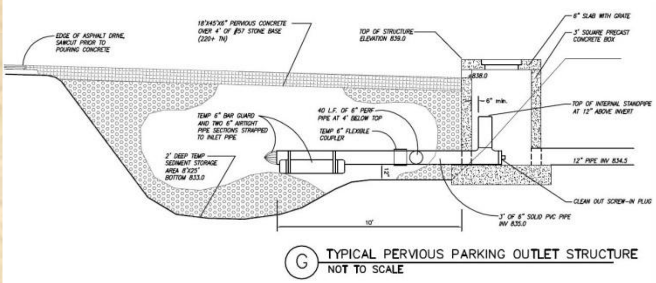
- STW Regs
- Costs
- Owner Change

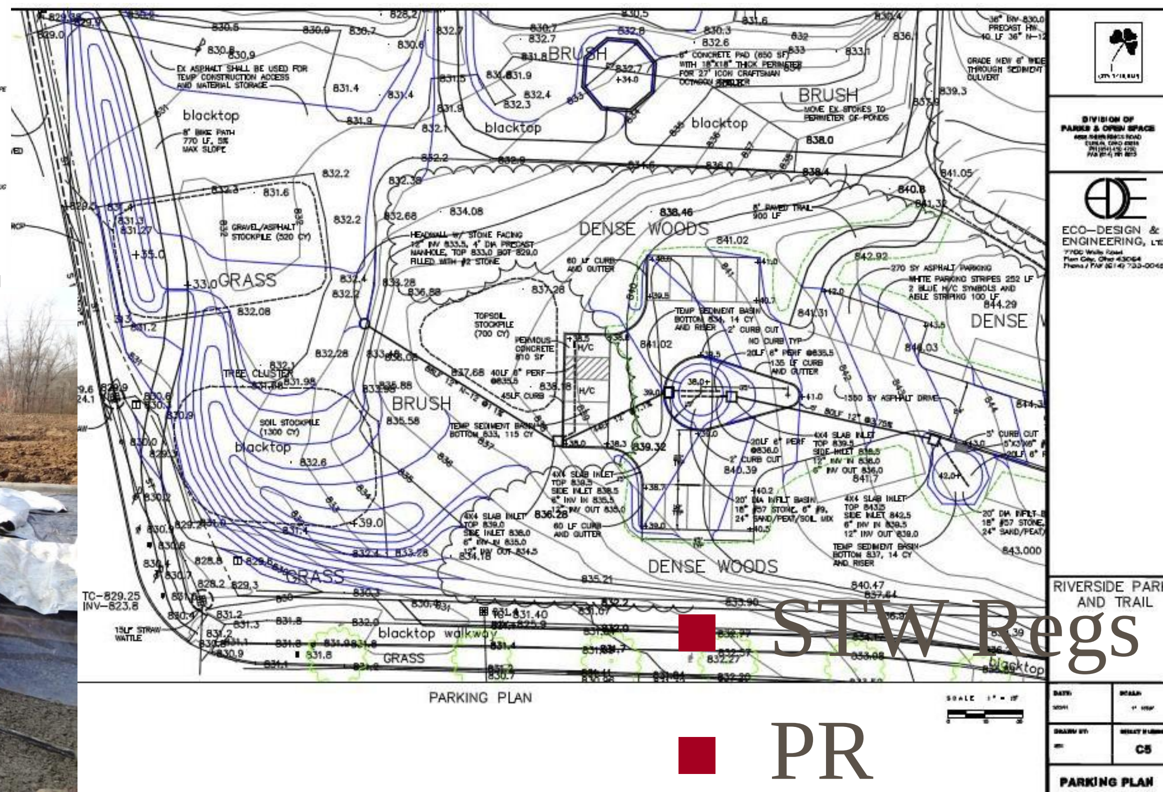
Springs Park, Dublin, OH

- Test Case
- PR

Riverside Park, Dublin, OH

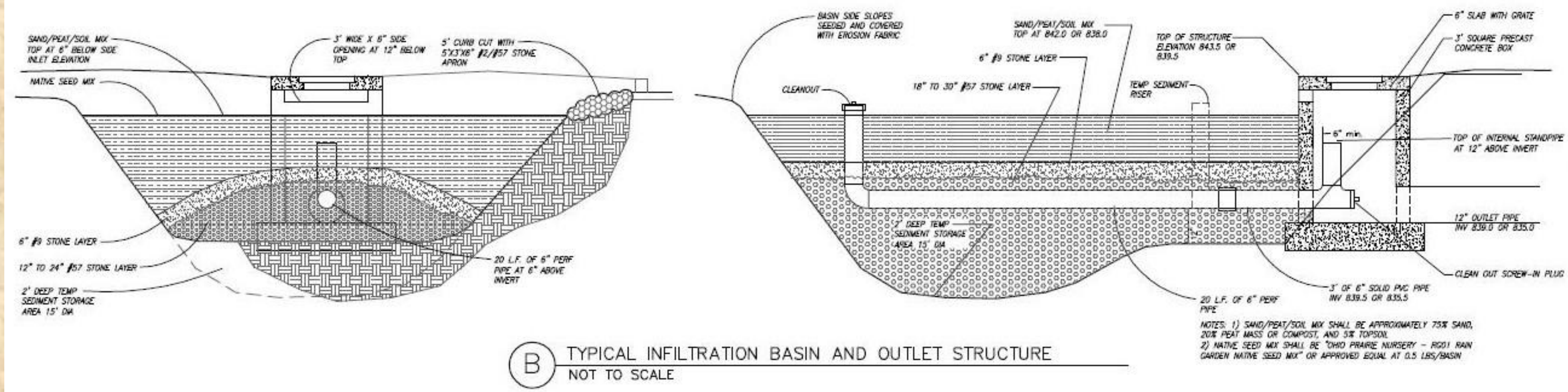


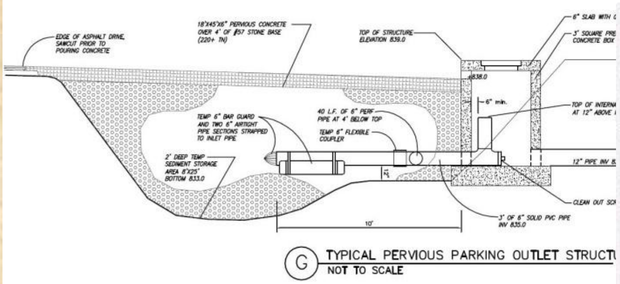


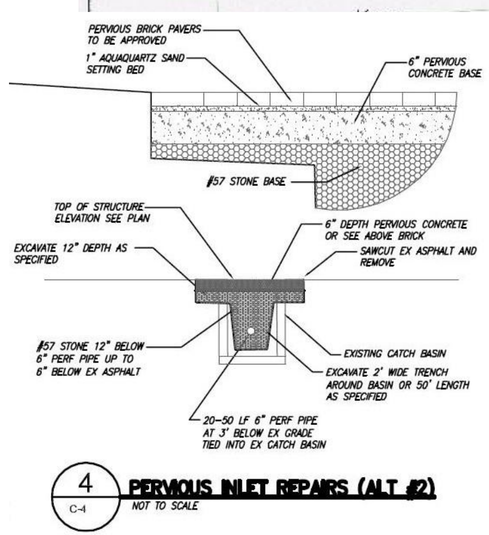


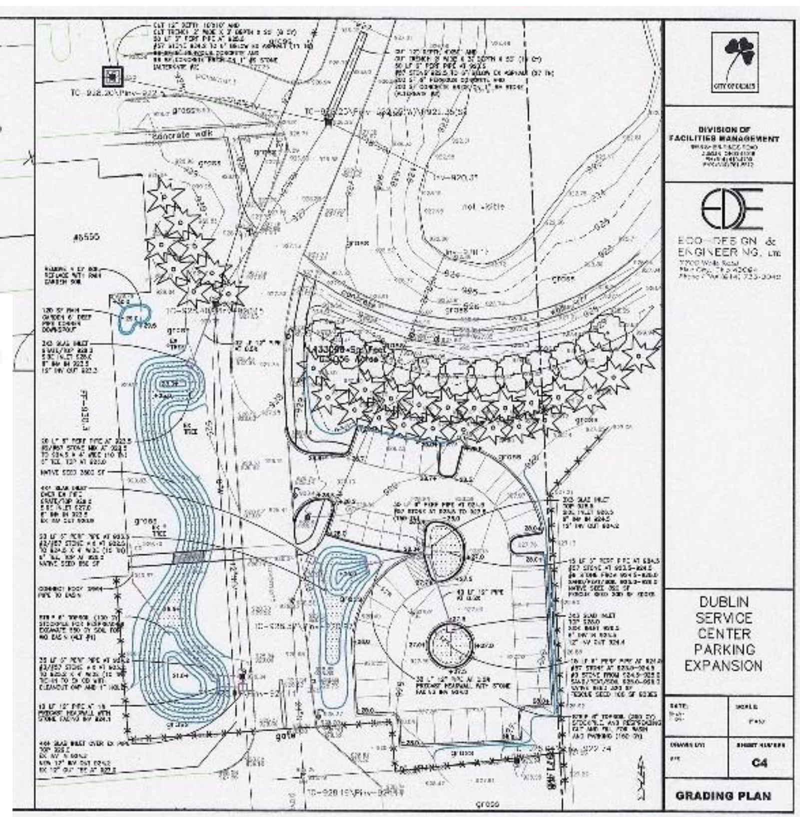
- STW Regs
- PR

Facilities Parking, Dublin, OH









- STW Regs
- PR

Random Thoughts for LID Success

- Reallocate green space
- Reverse vertical concepts
- Seek opportunities early
- Pursue Volume Based Design
- Protect Water Quality
- Improve profitability

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