

# Increasing Climate Resilience throughout the Royce Brook Watershed



**RUTGERS**  
New Jersey Agricultural  
Experiment Station



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## **Project Goal is to Reduce Flooding in Hillsborough and Manville (supported by NFWF Coastal Resiliency Fund)**

- Design stormwater management systems that will manage the 100-year storm from existing development
- Prioritize nature-based solutions
- Design retrofits to manage the increase in rainfall due to climate change for sites that already have stormwater management

<b>Condition (100-yr Design Storm)</b>	<b>24-hour rainfall total (in)</b>
2000 Rainfall Total	8.21
2020 Rainfall Total	8.95
2100 Rainfall Total	12.15

# Types of Nature-Based Solutions (FEMA, 2021)

- **WATERSHED OR LANDSCAPE SCALE:** Interconnected systems of natural areas and open space. These are large-scale practices that require long-term planning and coordination.
- **NEIGHBORHOOD OR SITE SCALE:** Distributed stormwater management practices that manage rainwater where it falls. These practices can often be built into a site, corridor, or neighborhood without requiring additional space.
- **COASTAL AREAS:** Nature-based solutions that stabilize the shoreline, reducing erosion and buffering the coast from storm impacts. While many watershed and neighborhood-scale solutions work in coastal areas, these systems are designed to support coastal resilience.

# WATERSHED SCALE

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### LAND CONSERVATION

Land conservation is one way of preserving interconnected systems of open space that sustain healthy communities. Land conservation projects begin by prioritizing areas of land for acquisition. Land or conservation easements can be bought or acquired through donation.



### GREENWAYS

Greenways are corridors of protected open space managed for both conservation and recreation. Greenways often follow rivers or other natural features. They link habitats and provide networks of open space for people to explore and enjoy.



### FLOODPLAIN RESTORATION

Undisturbed floodplains help keep waterways healthy by storing floodwaters, reducing erosion, filtering water pollution, and providing habitat. Floodplain restoration rebuilds some of these natural functions by reconnecting the floodplain to its waterway.



### WETLAND RESTORATION AND PROTECTION

Restoring and protecting wetlands can improve water quality and reduce flooding. Healthy wetlands filter, absorb, and slow runoff. Wetlands also sustain healthy ecosystems by recharging groundwater and providing habitat for fish and wildlife.



### STORMWATER PARKS

Stormwater parks are recreational spaces that are designed to flood during extreme events and to withstand flooding. By storing and treating floodwaters, stormwater parks can reduce flooding elsewhere and improve water quality.

# NEIGHBORHOOD OR SITE SCALE

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## RAIN GARDENS

A rain garden is a shallow, vegetated basin that collects and absorbs runoff from rooftops, sidewalks, and streets.

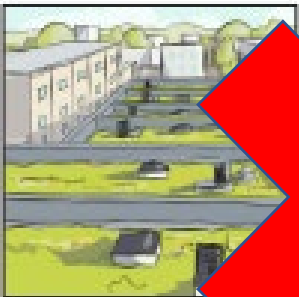
Rain gardens can be added around homes and businesses to reduce and treat stormwater runoff.



## VEGETATED SWALES

A vegetated swale is a channel holding plants or mulch that treats and absorbs stormwater as it flows down a slope.

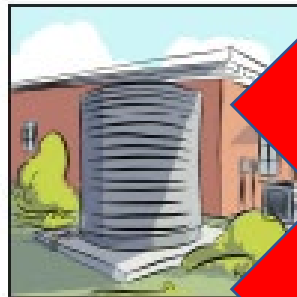
Vegetated swales can be placed along streets and in parking lots to soak up and treat their runoff, improving water quality.



## GREEN ROOFS

A green roof is fitted with a planting medium and vegetation. A green roof can help soak up rainfall, reduce energy costs for the building.

Green roofs, which have deeper soil, are more common on commercial buildings. Intensive green roofs, which have shallower soil, are more common on residential buildings.



## RAINWATER HARVESTING

Rainwater harvesting systems collect and store rainwater for later use. They can reduce the need for potable water.

Systems include rain barrels that store gallons of rainwater and cisterns that store hundreds or thousands of gallons.



### PERMEABLE PAVEMENT

Permeable pavements allow more rainfall to soak into the ground. Common types include pervious concrete, porous asphalt, and interlocking pavers.

Permeable pavements are most commonly used for parking lots and roadway shoulders.



### TREE TRENCHES

A stormwater tree trench is a row of trees planted in an underground infiltration structure made to store and filter stormwater.

Tree trenches can be added to streets and parking lots with limited space to manage stormwater.



### TREE CANOPIES

Tree canopies reduce stormwater runoff by intercepting rainfall on leaves and increasing evaporation. By keeping streets cooler in the summer, tree canopies also reduce the "urban heat island effect."

Because of trees' many benefits, many cities have set urban tree canopy goals.

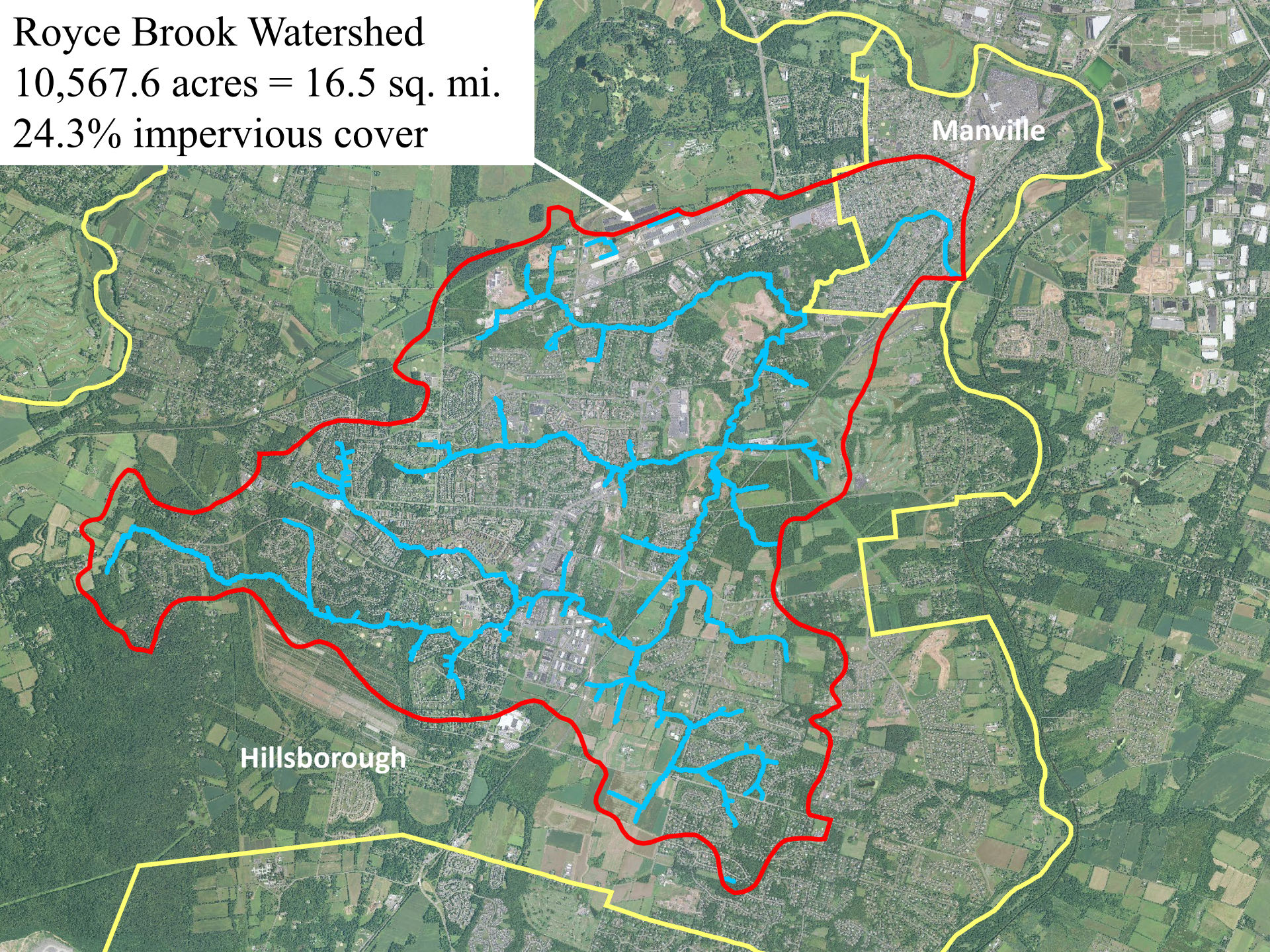


### GREEN STREETS

Green streets use a suite of green infrastructure practices to manage stormwater runoff and improve water quality.

Adding green infrastructure features to a street corridor can also contribute to a safer and more attractive environment for walking and biking.

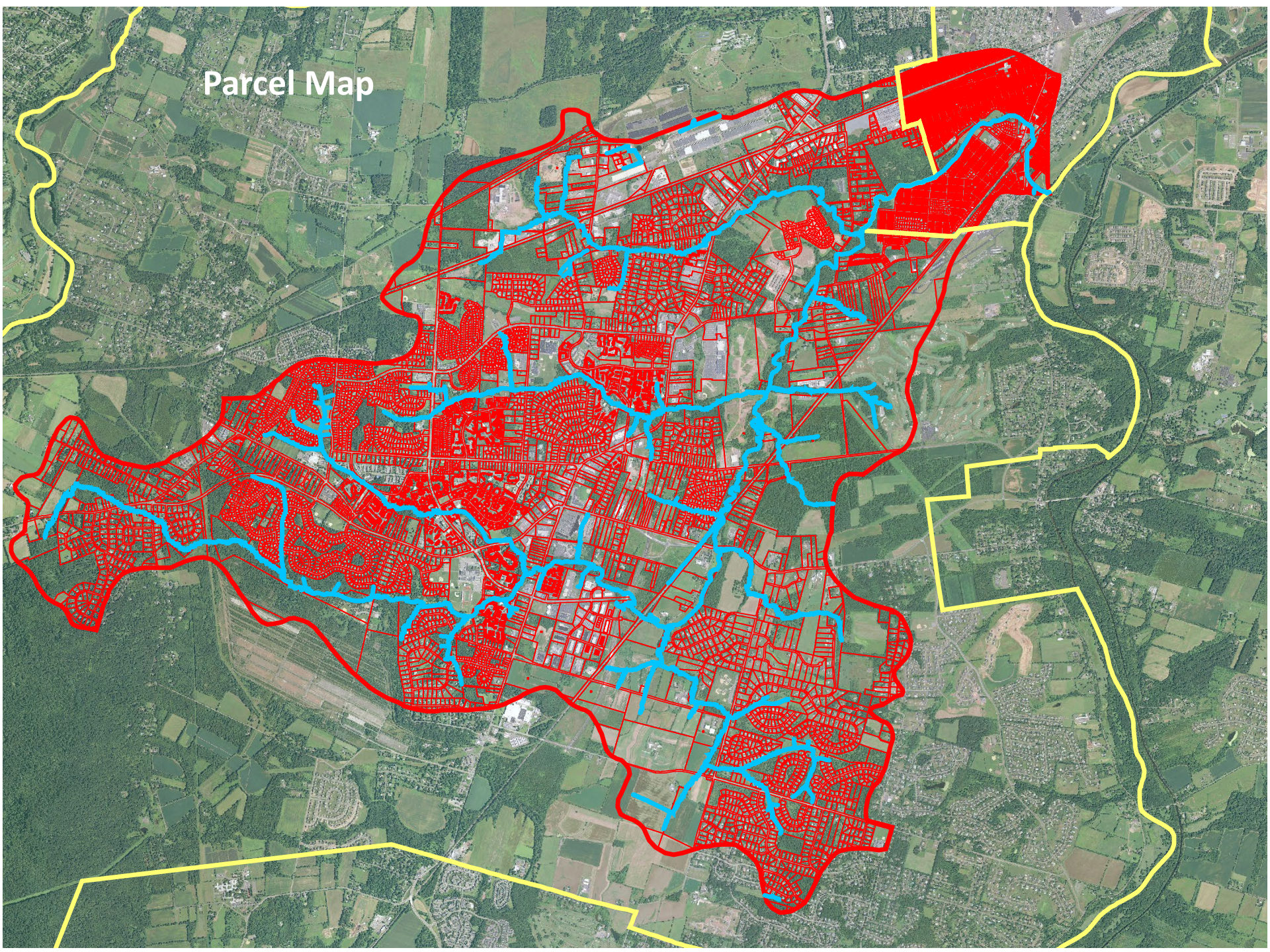
Royce Brook Watershed  
10,567.6 acres = 16.5 sq. mi.  
24.3% impervious cover



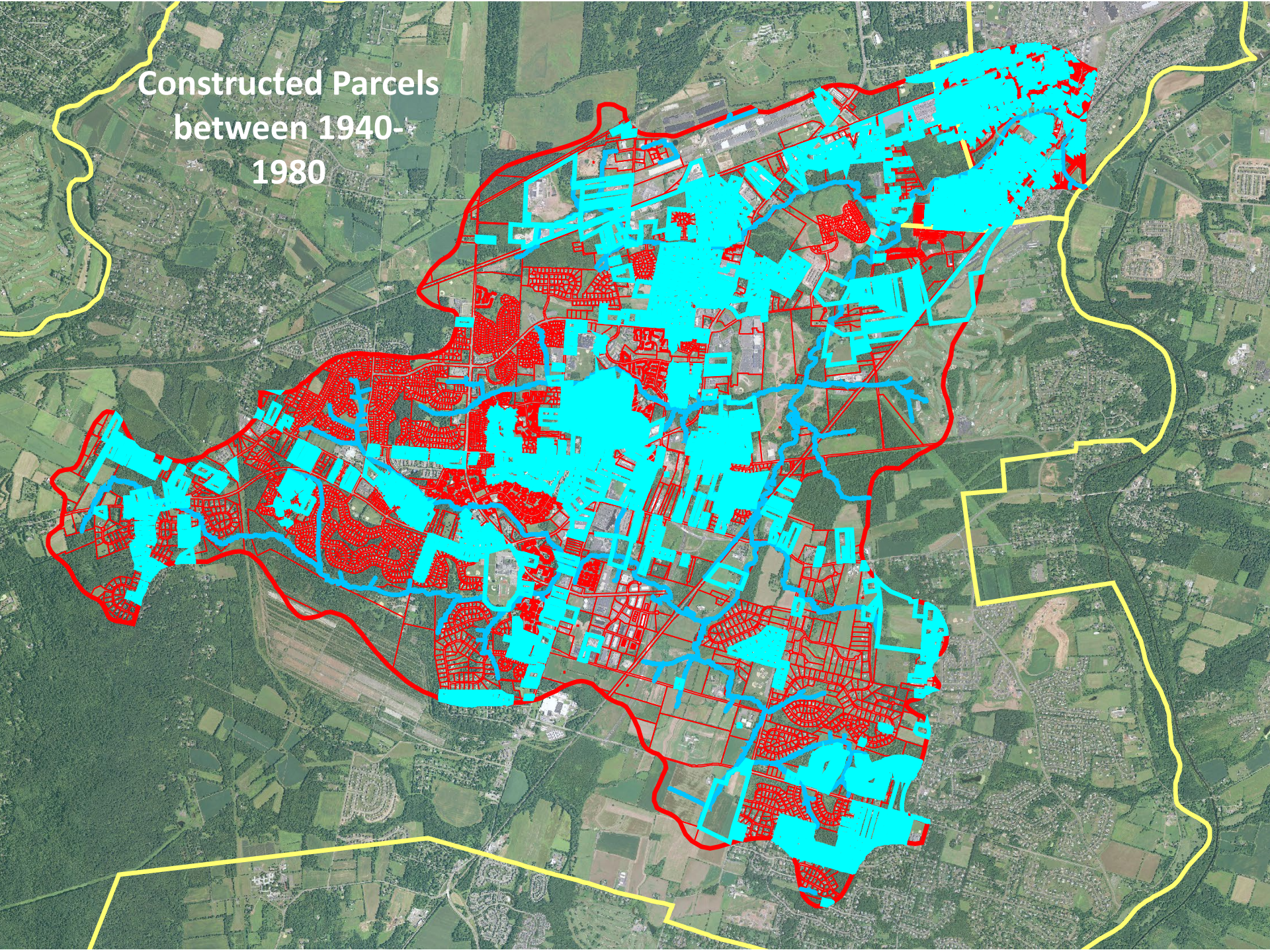
Manville

Hillsborough

# Parcel Map



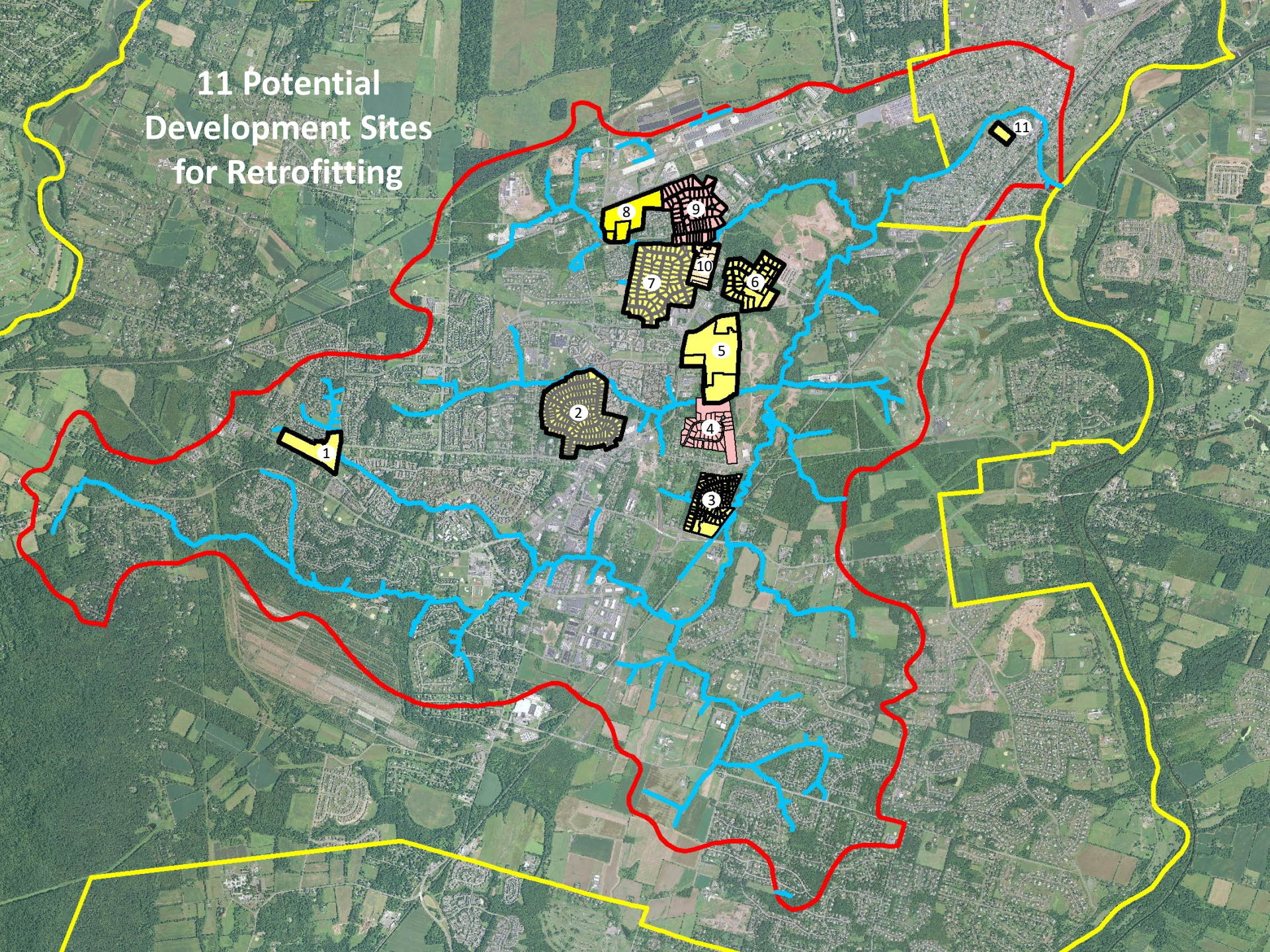
Constructed Parcels  
between 1940-  
1980



# 11 Potential Development Sites for Retrofitting

- 673.4 acres = 1.05 sq. mi.
- Six residential developments
- Three commercial sites (one with some stormwater management)
- One municipal site
- One public school
- Possible solutions
  - Constructed wetlands
  - Bioretention
  - Permeable pavement
  - Roadside rain gardens
  - Homeowner rain gardens

# 11 Potential Development Sites for Retrofitting

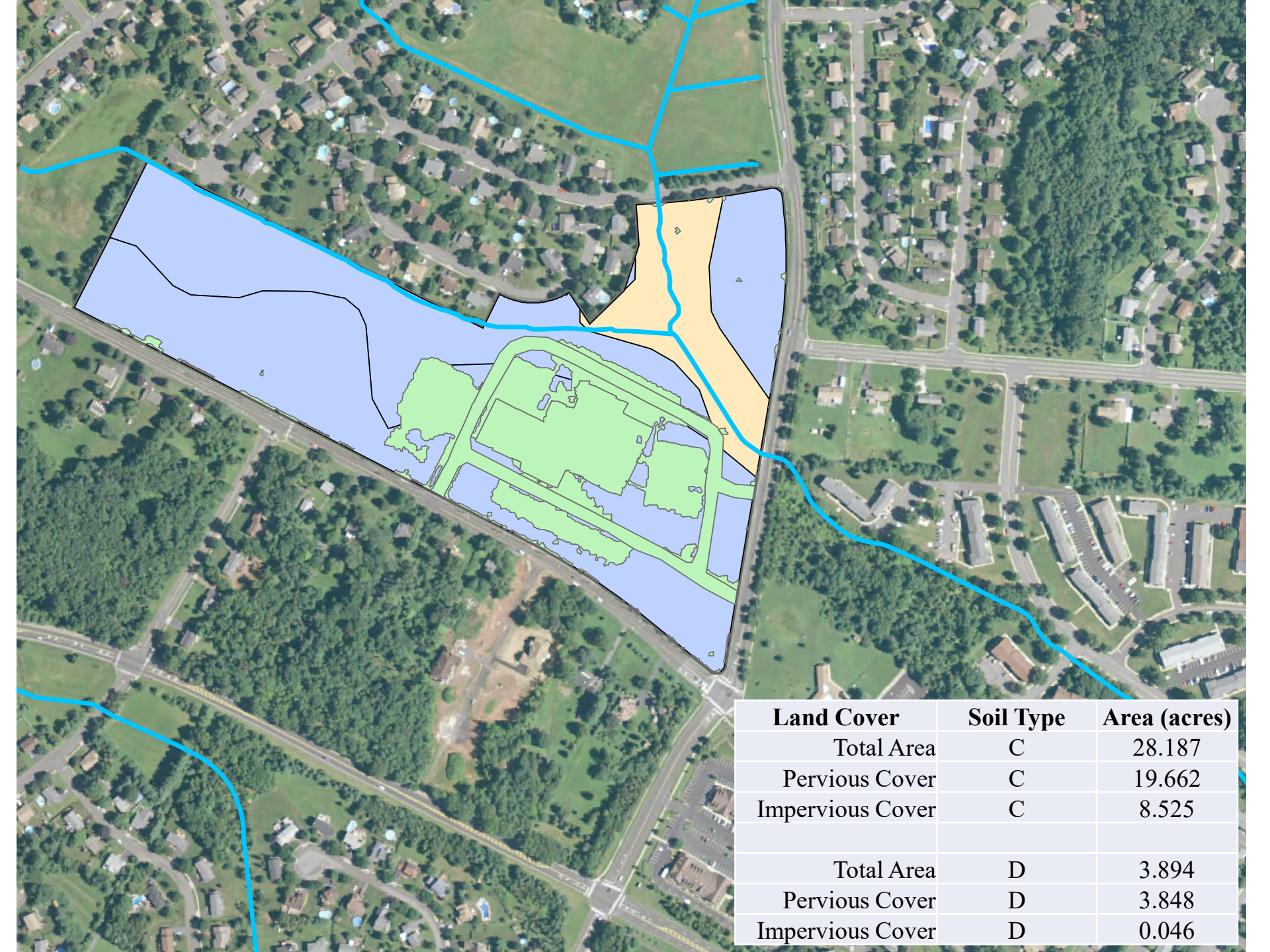


**Site 1 – Hillsborough Municipal Complex**

Total Area = 1,397,450 sq. ft. = 32.1 acres

Impervious Surface = 373,369.2 sq. ft. = 8.6 acres



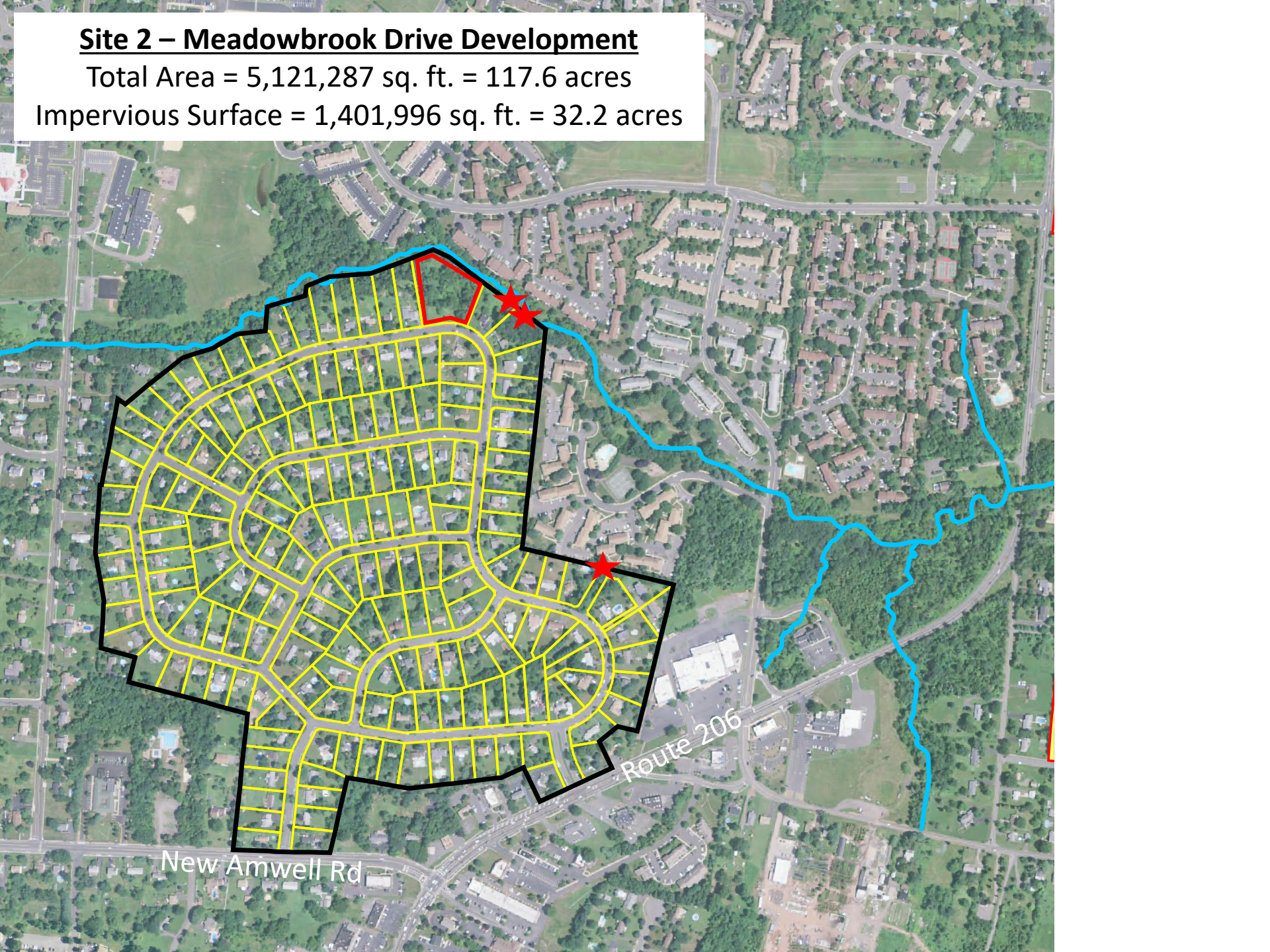


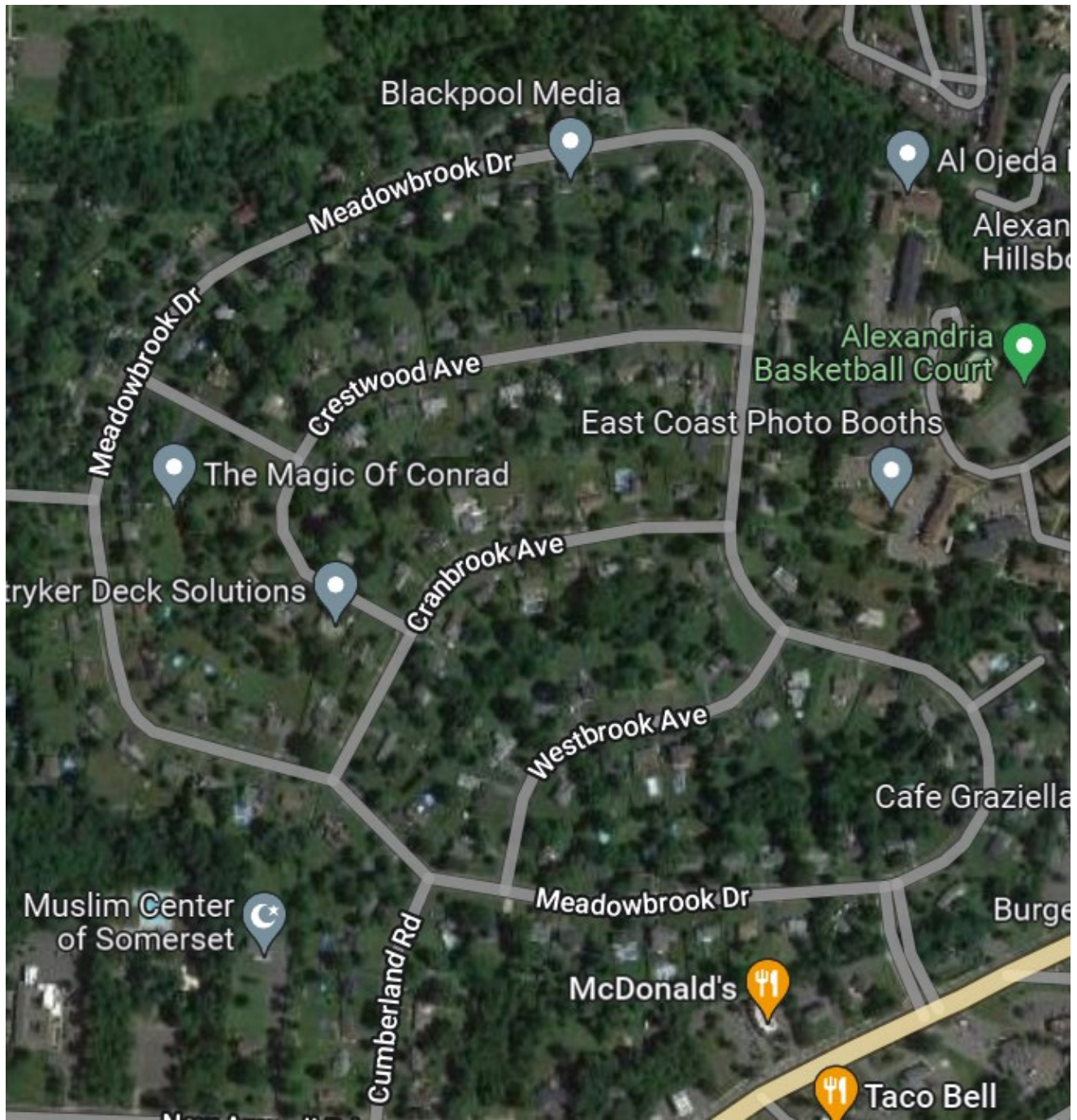
Land Cover	Soil Type	Area (acres)
Total Area	C	28.187
Pervious Cover	C	19.662
Impervious Cover	C	8.525
Total Area	D	3.894
Pervious Cover	D	3.848
Impervious Cover	D	0.046

**Site 2 – Meadowbrook Drive Development**

Total Area = 5,121,287 sq. ft. = 117.6 acres

Impervious Surface = 1,401,996 sq. ft. = 32.2 acres





Blackpool Media

Meadowbrook Dr

Al Ojeda  
Alexan  
Hillsbo

Meadowbrook Dr

Crestwood Ave

Alexandria  
Basketball Court

The Magic Of Conrad

East Coast Photo Booths

tryker Deck Solutions

Cranbrook Ave

Westbrook Ave

Cafe Graziella

Muslim Center  
of Somerset

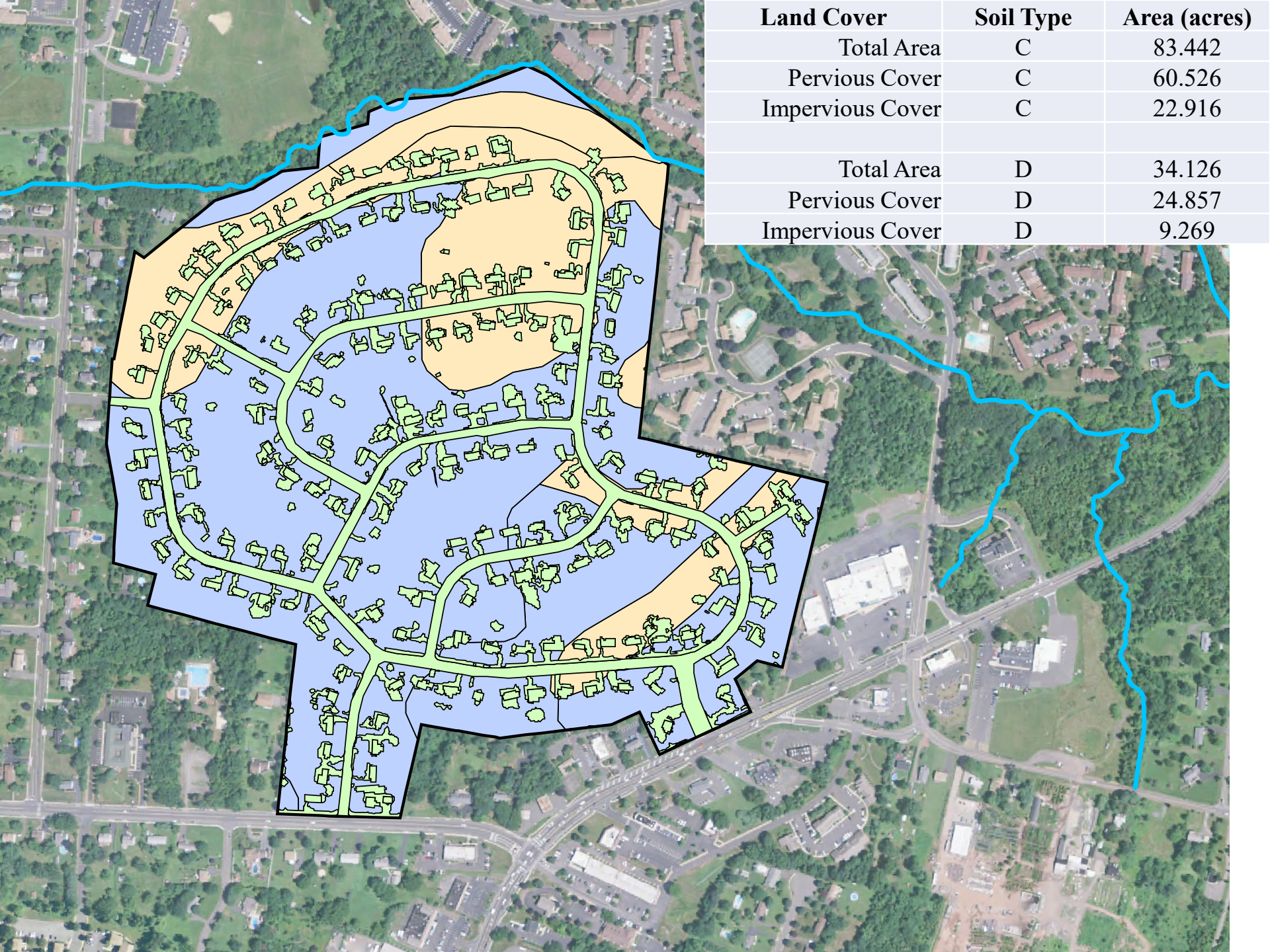
Meadowbrook Dr

Burge

McDonald's

Cumberland Rd

Taco Bell

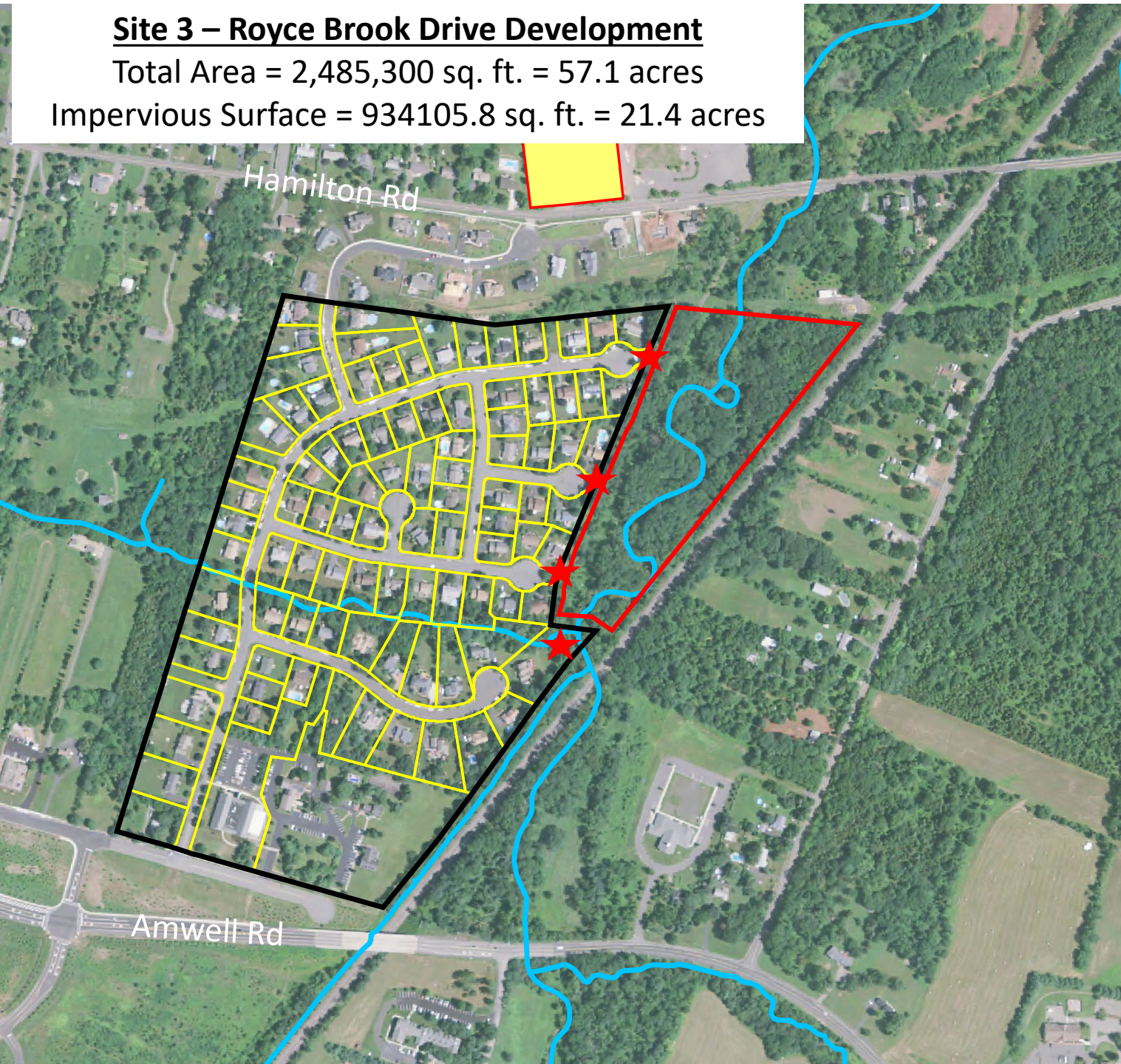


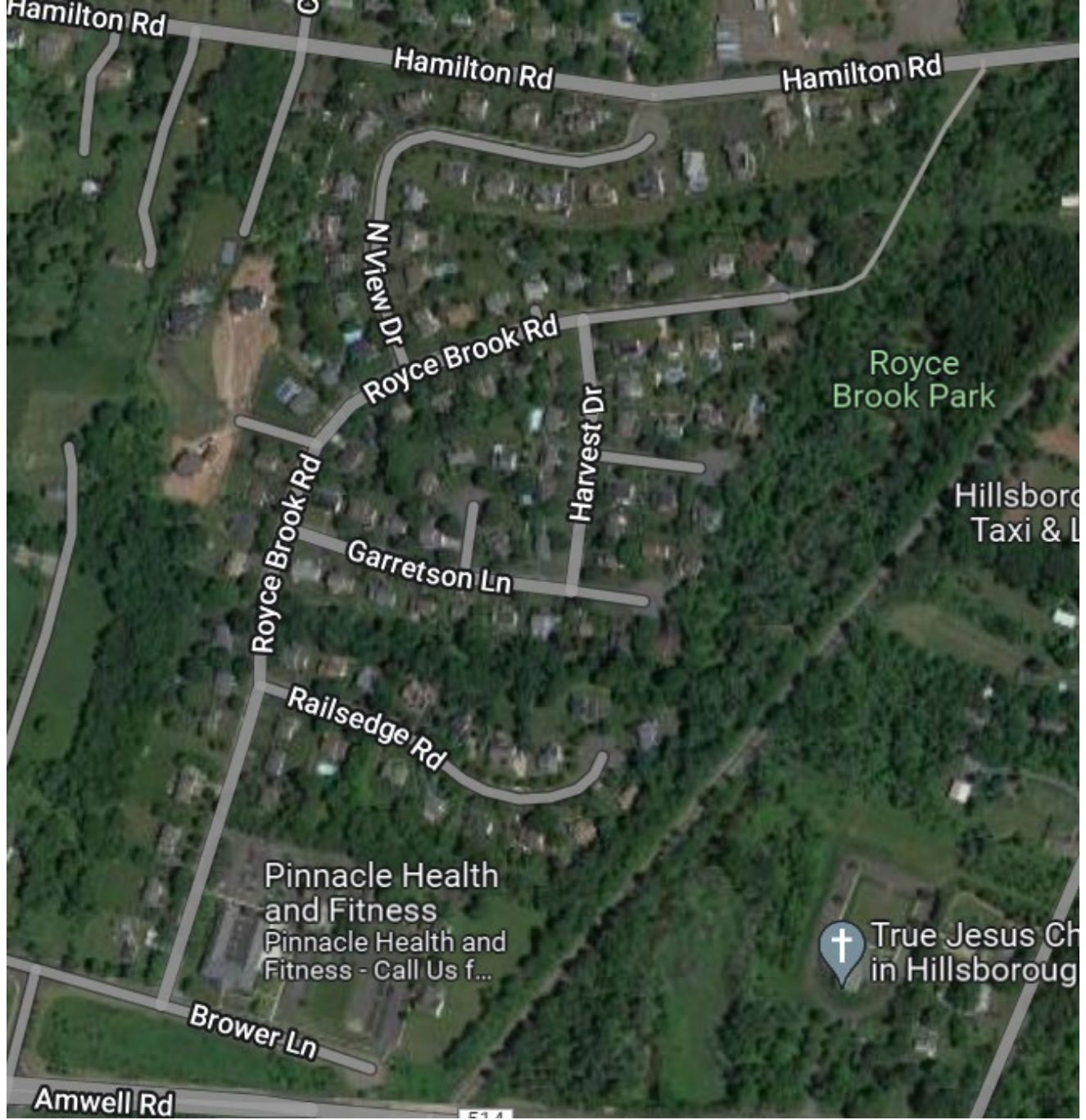
Land Cover	Soil Type	Area (acres)
Total Area	C	83.442
Pervious Cover	C	60.526
Impervious Cover	C	22.916
Total Area	D	34.126
Pervious Cover	D	24.857
Impervious Cover	D	9.269

**Site 3 – Royce Brook Drive Development**

Total Area = 2,485,300 sq. ft. = 57.1 acres

Impervious Surface = 934105.8 sq. ft. = 21.4 acres





Hamilton Rd

Hamilton Rd

Hamilton Rd

N View Dr

Royce Brook Rd

Harvest Dr

Royce Brook Park

Hillsboro Taxi & L

Garretson Ln

Royce Brook Rd

Rallsedge Rd

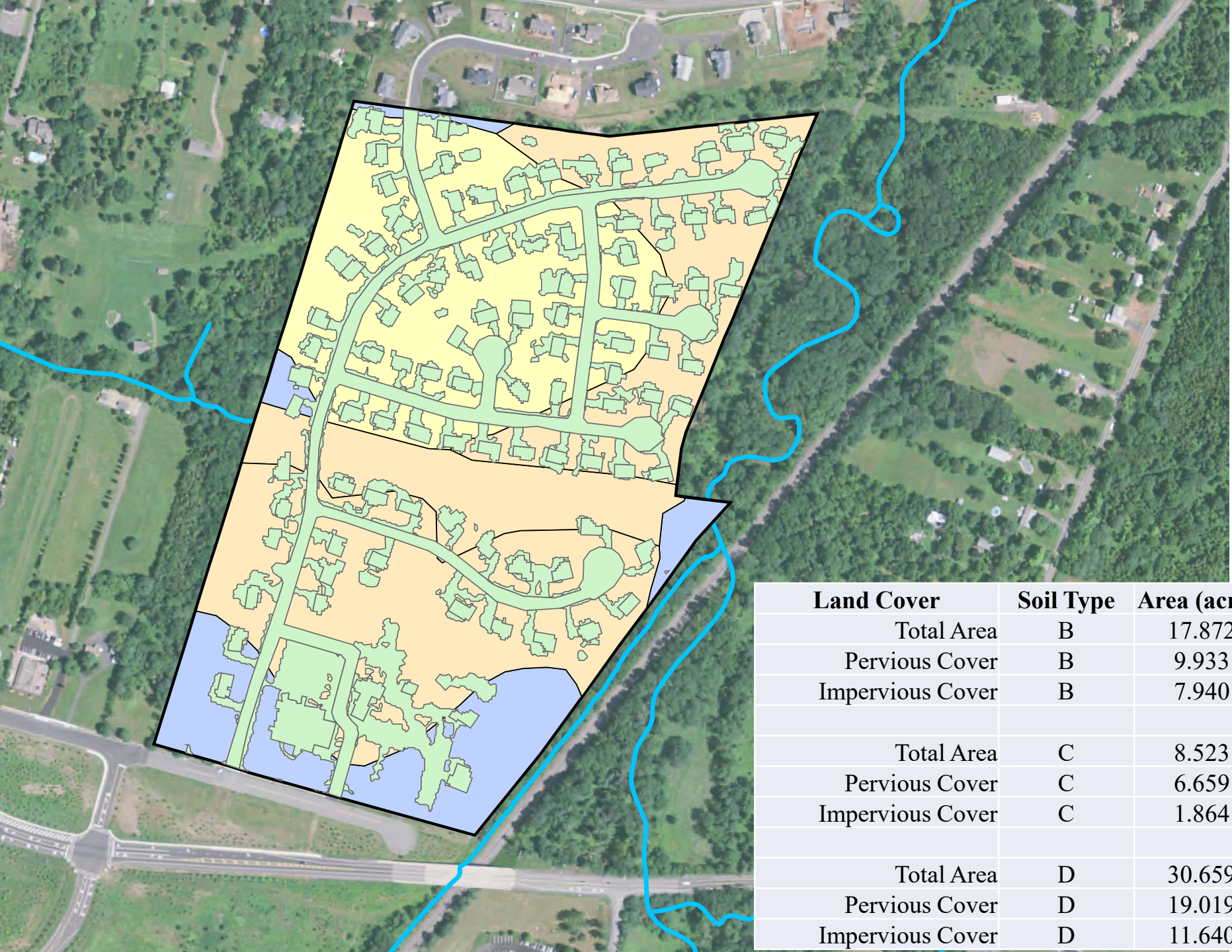
Pinnacle Health and Fitness  
Pinnacle Health and Fitness - Call Us f...

True Jesus Ch in Hillsboroug

Brower Ln

Amwell Rd

514

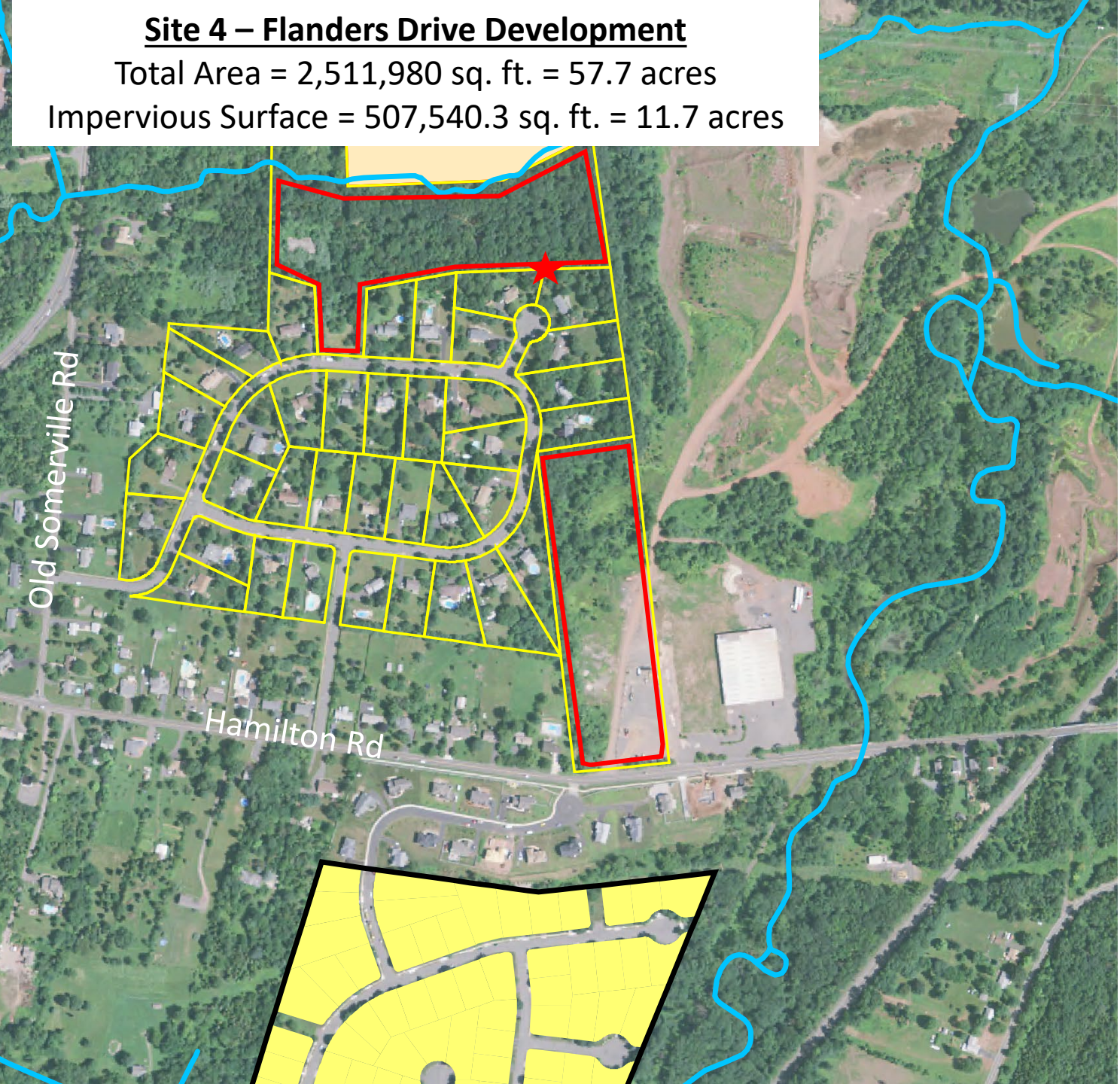


Land Cover	Soil Type	Area (acres)
Total Area	B	17.872
Pervious Cover	B	9.933
Impervious Cover	B	7.940
Total Area	C	8.523
Pervious Cover	C	6.659
Impervious Cover	C	1.864
Total Area	D	30.659
Pervious Cover	D	19.019
Impervious Cover	D	11.640

**Site 4 – Flanders Drive Development**

Total Area = 2,511,980 sq. ft. = 57.7 acres

Impervious Surface = 507,540.3 sq. ft. = 11.7 acres



American Assisted  
at Hillsborough



Site #3 on  
Flanders Ct

206

Flanders Dr  
Flanders Dr  
Flanders Dr  
Flanders Dr

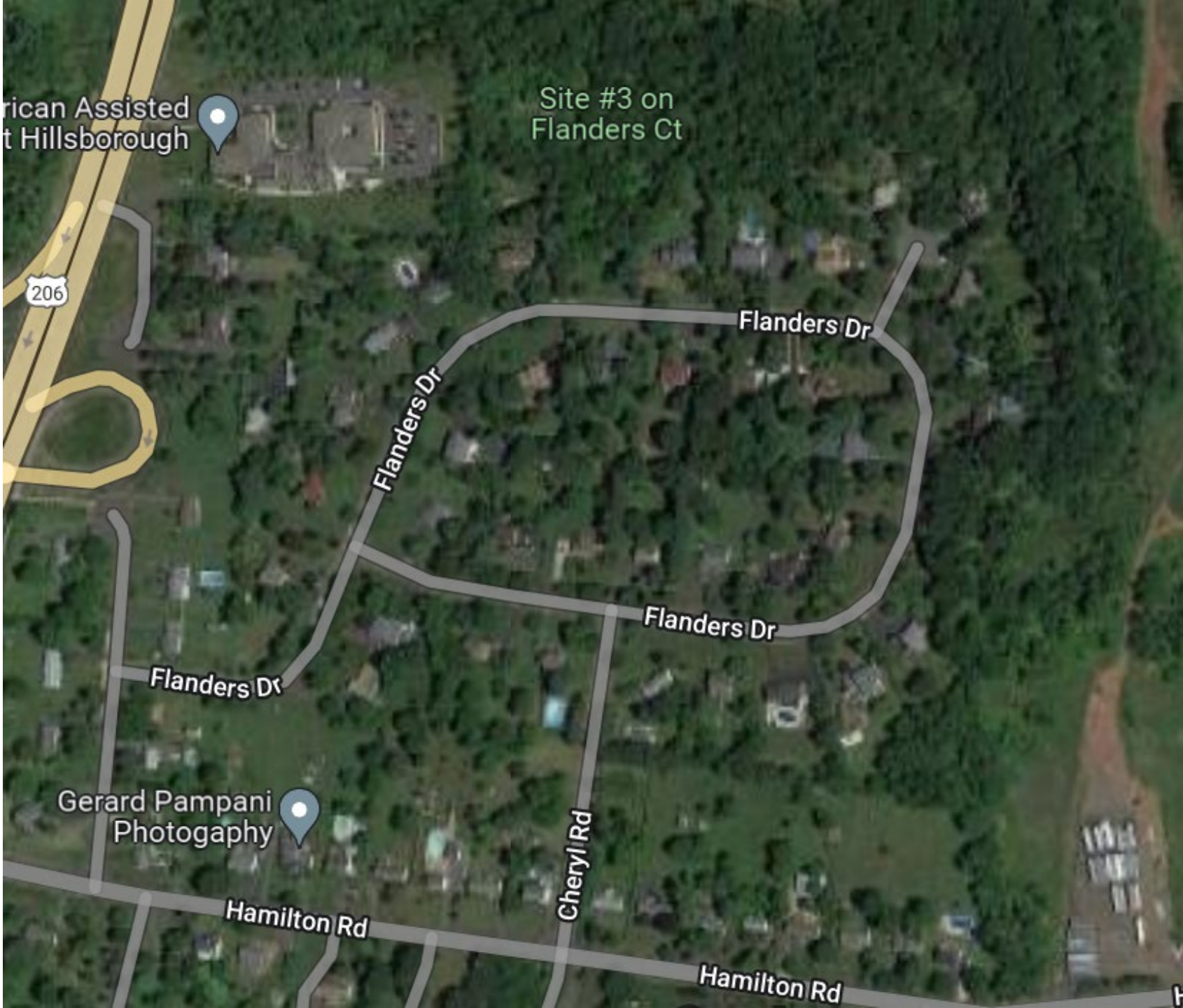
Gerard Pampani  
Photography

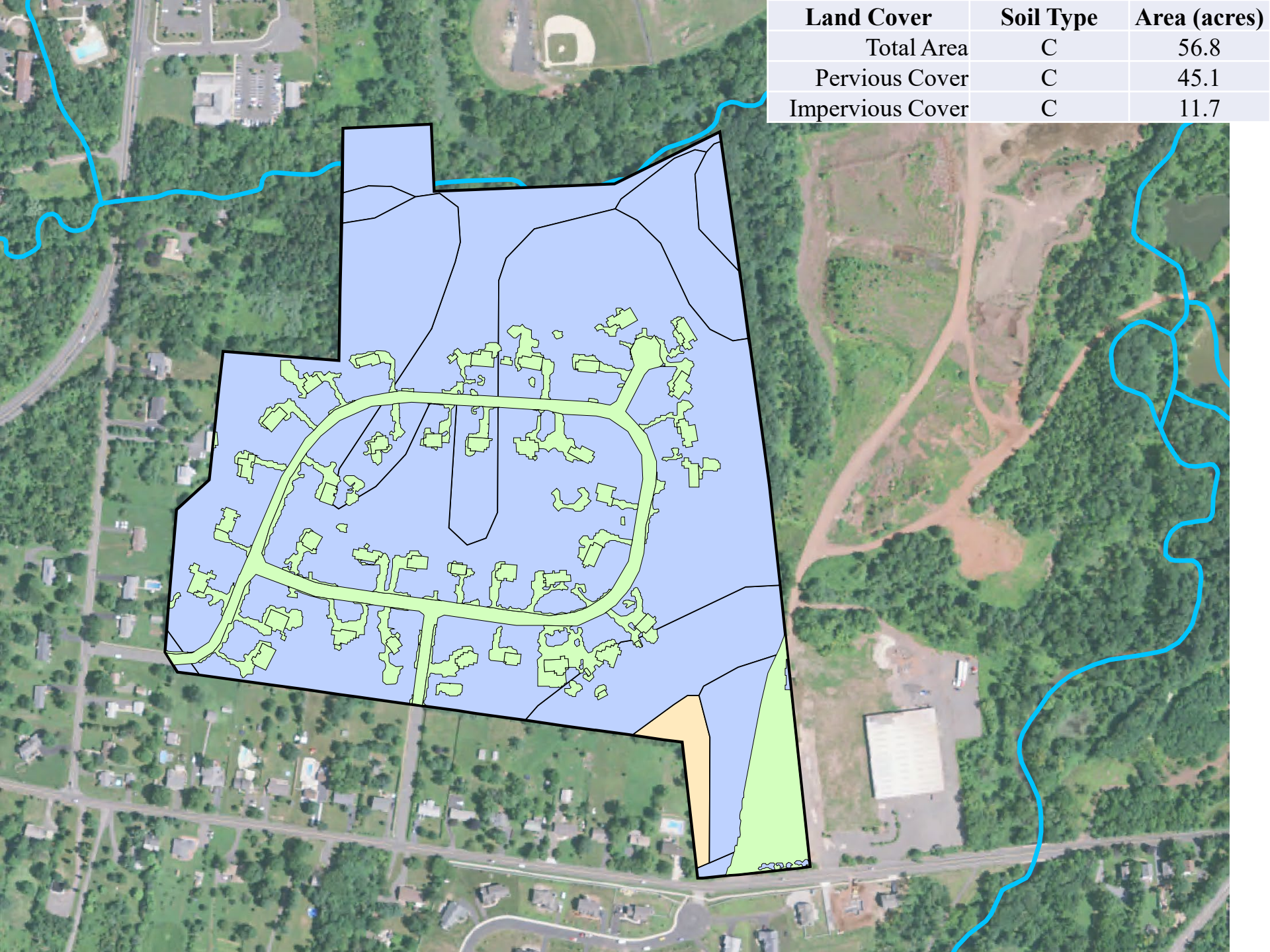


Hamilton Rd

Cheryl Rd

Hamilton Rd



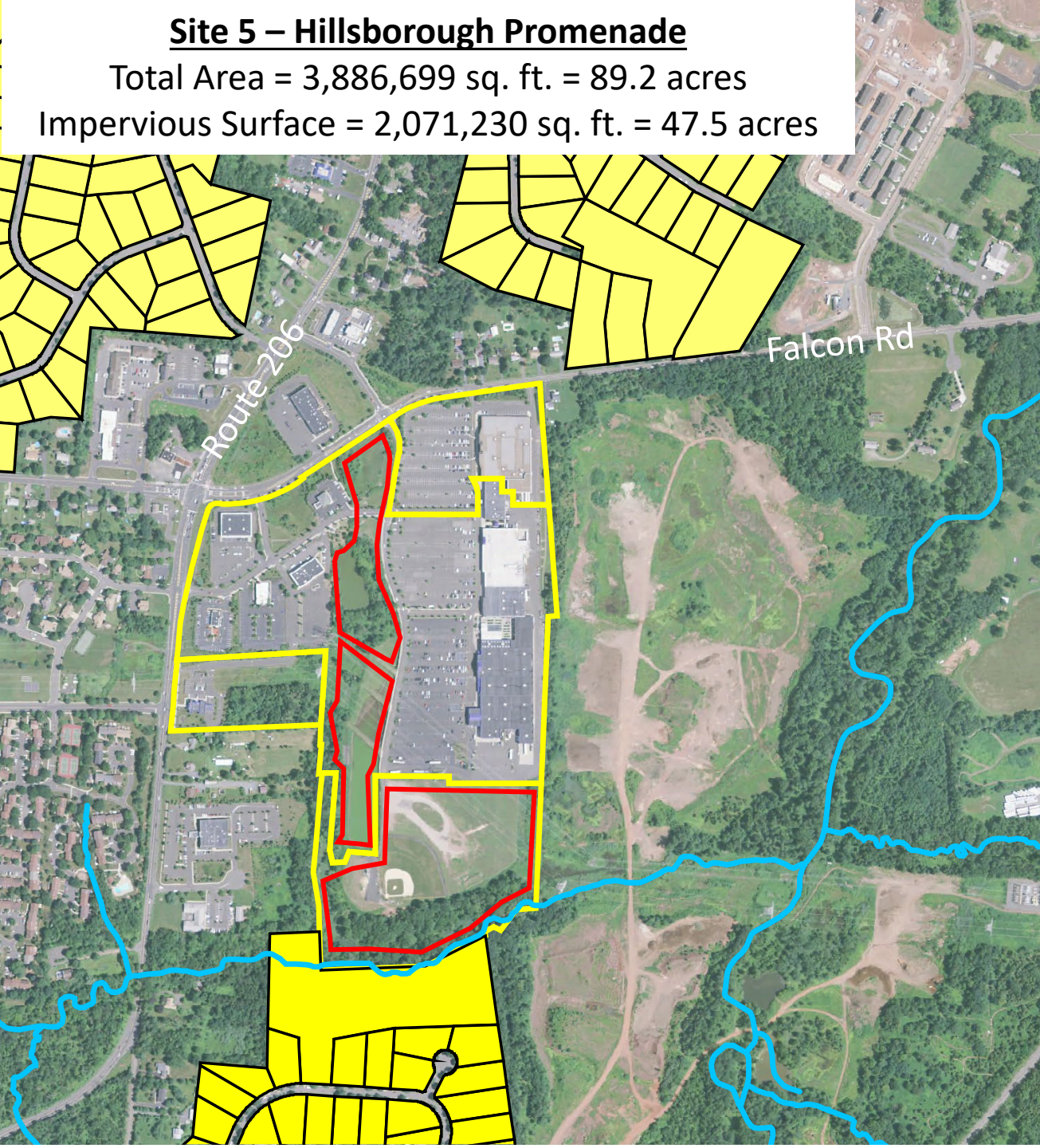


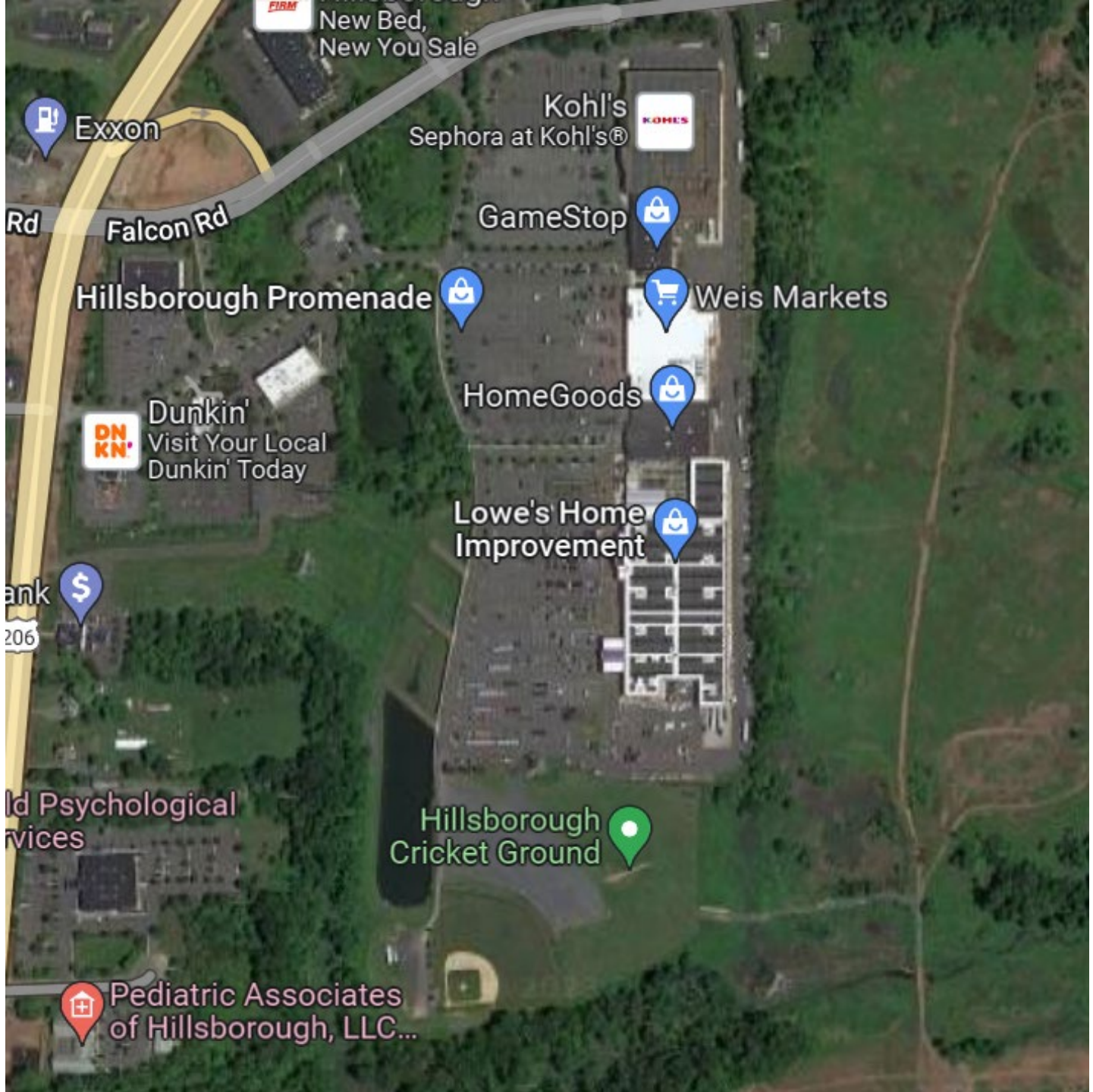
Land Cover	Soil Type	Area (acres)
Total Area	C	56.8
Pervious Cover	C	45.1
Impervious Cover	C	11.7

# Site 5 – Hillsborough Promenade

Total Area = 3,886,699 sq. ft. = 89.2 acres

Impervious Surface = 2,071,230 sq. ft. = 47.5 acres





New Bed,  
New You Sale

Exxon

Kohl's  
Sephora at Kohl's®

Rd  
Falcon Rd

GameStop

Hillsborough Promenade

Weis Markets

Dunkin'  
Visit Your Local  
Dunkin' Today

HomeGoods

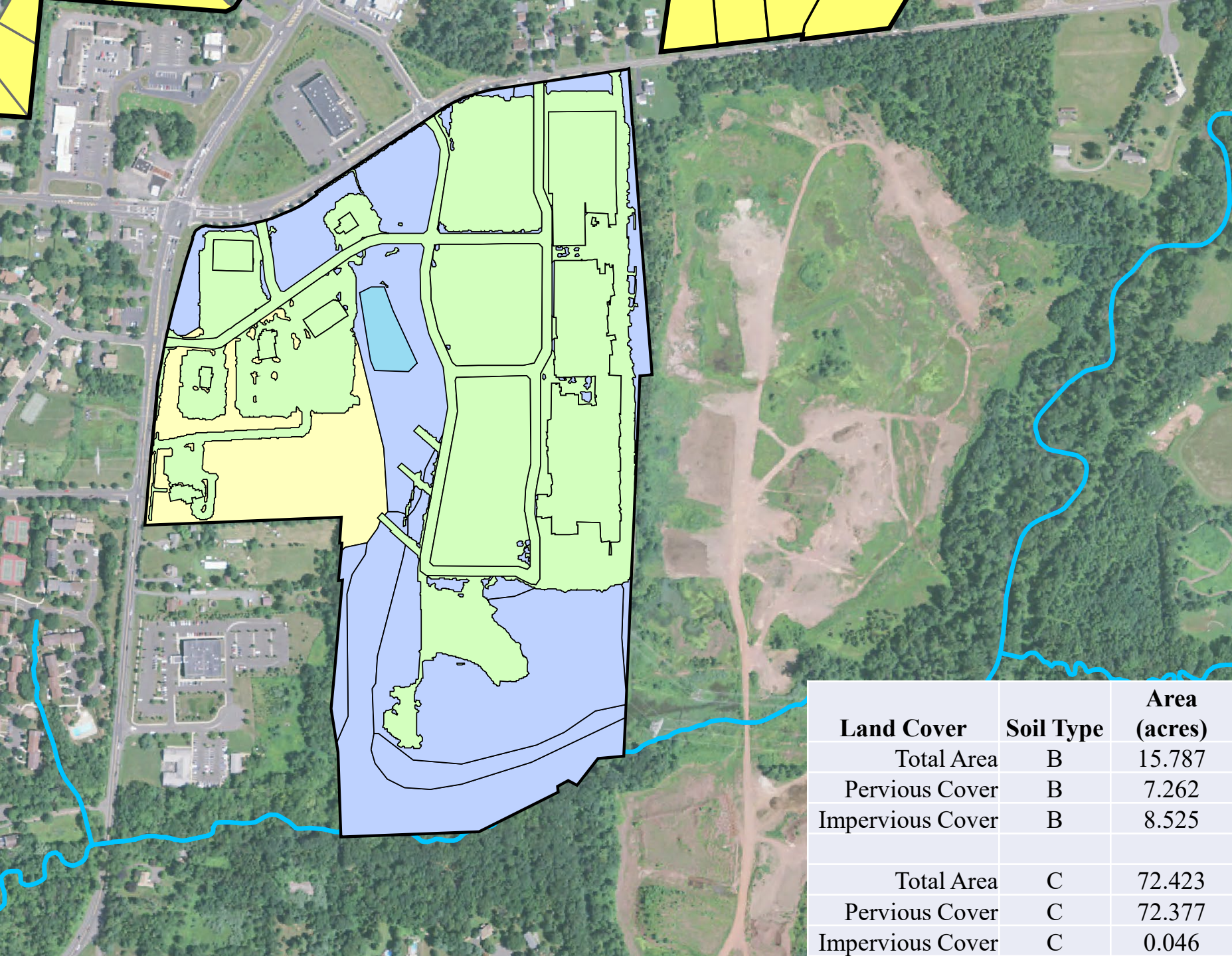
Lowe's Home  
Improvement

Bank  
206

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Hillsborough  
Cricket Ground

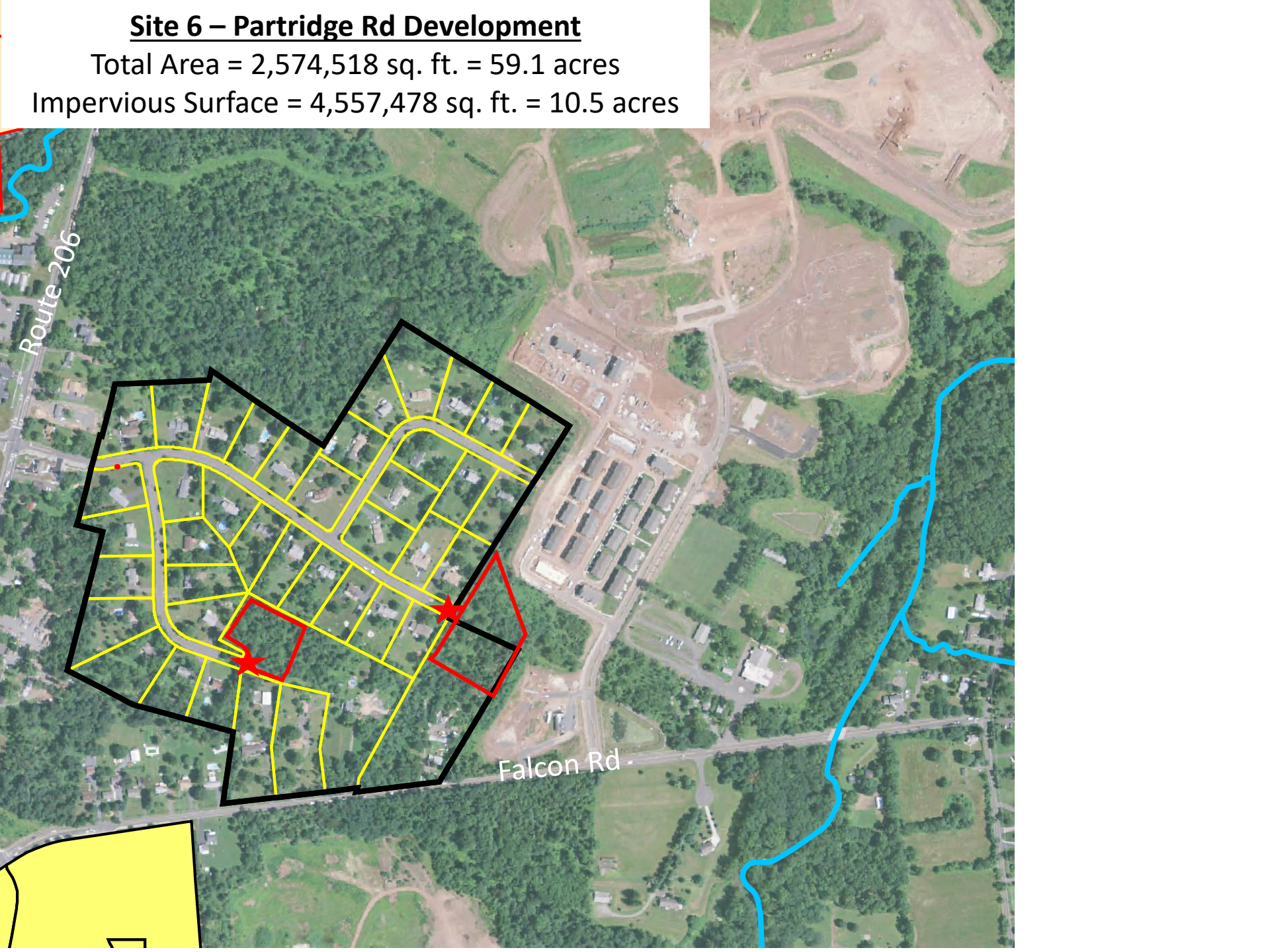
Pediatric Associates  
of Hillsborough, LLC...



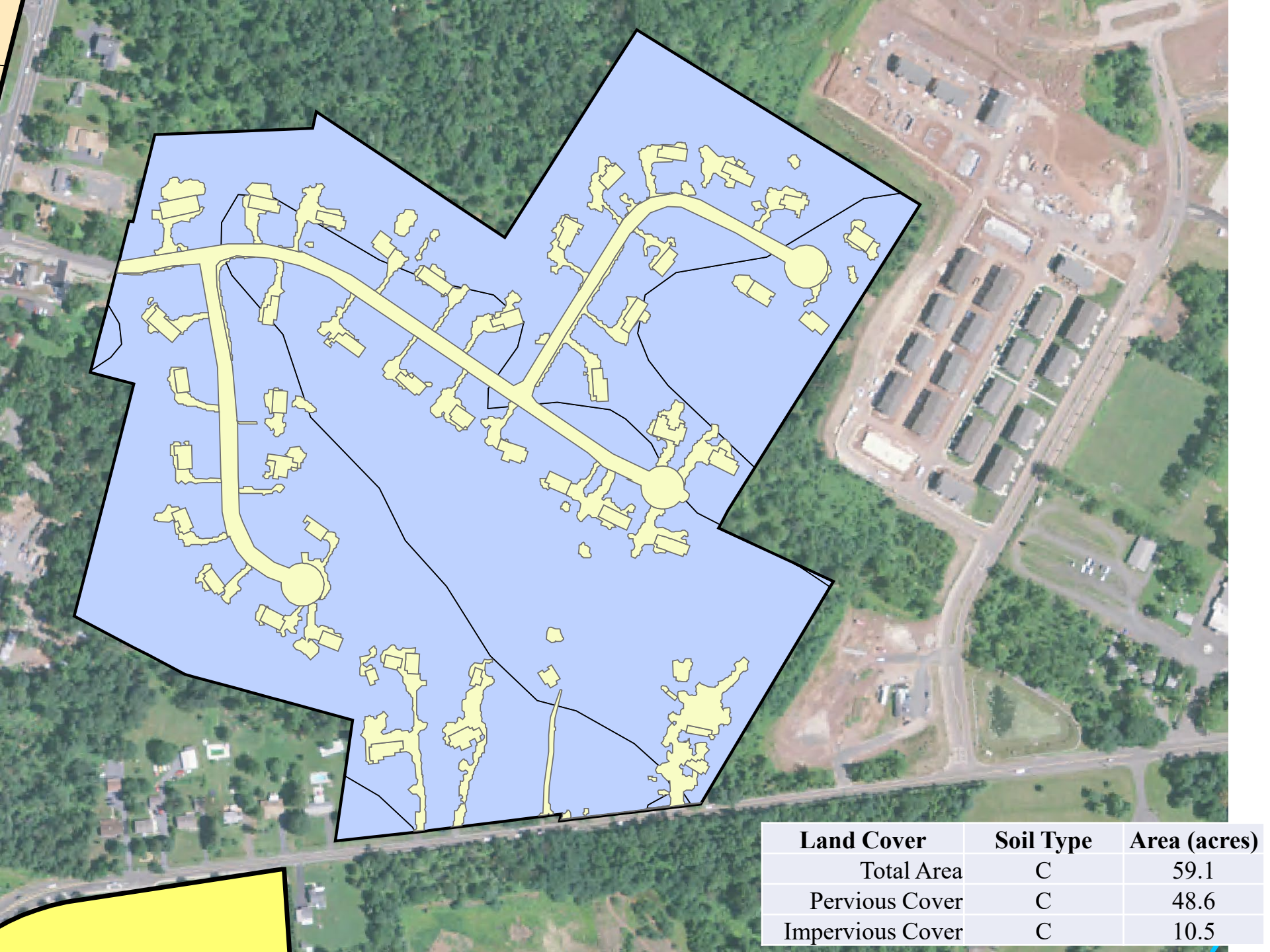
# Site 6 – Partridge Rd Development

Total Area = 2,574,518 sq. ft. = 59.1 acres

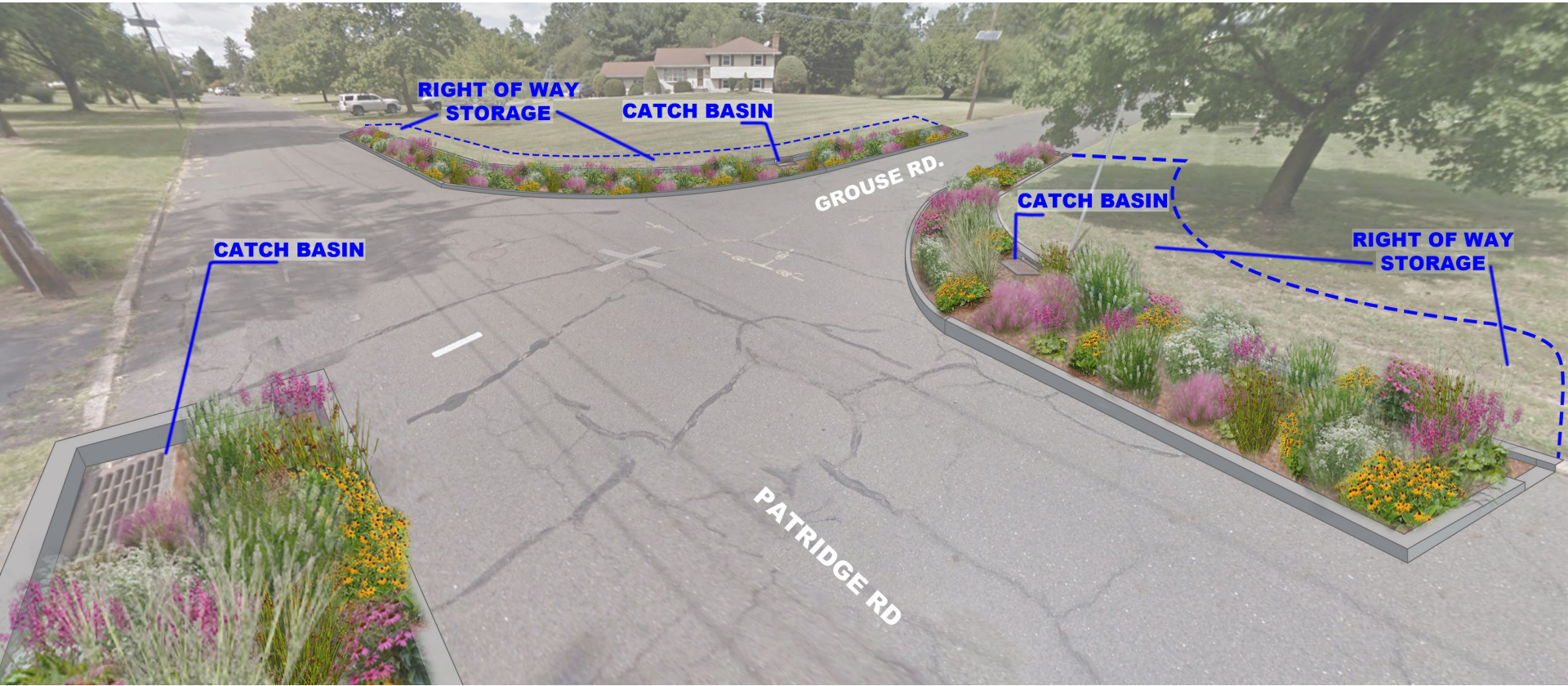
Impervious Surface = 4,557,478 sq. ft. = 10.5 acres

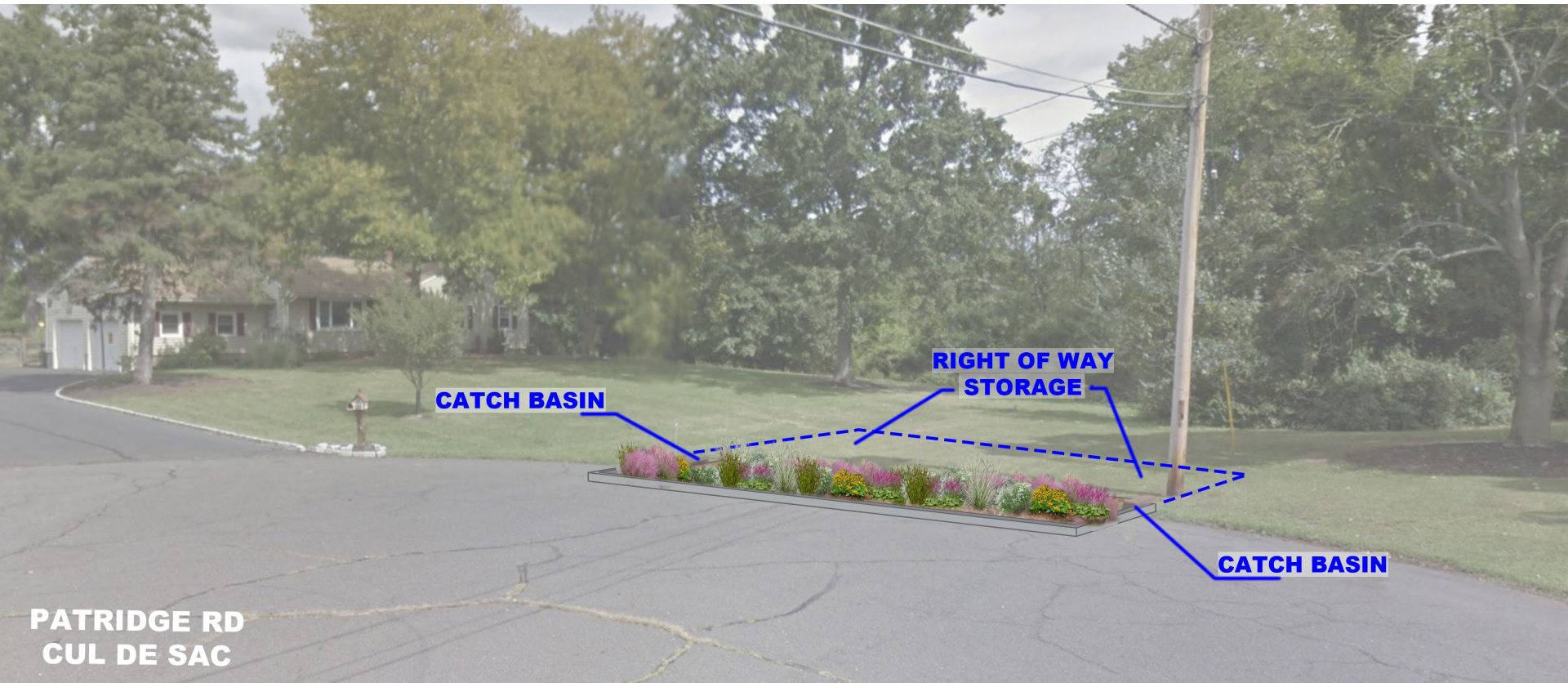






Land Cover	Soil Type	Area (acres)
Total Area	C	59.1
Pervious Cover	C	48.6
Impervious Cover	C	10.5



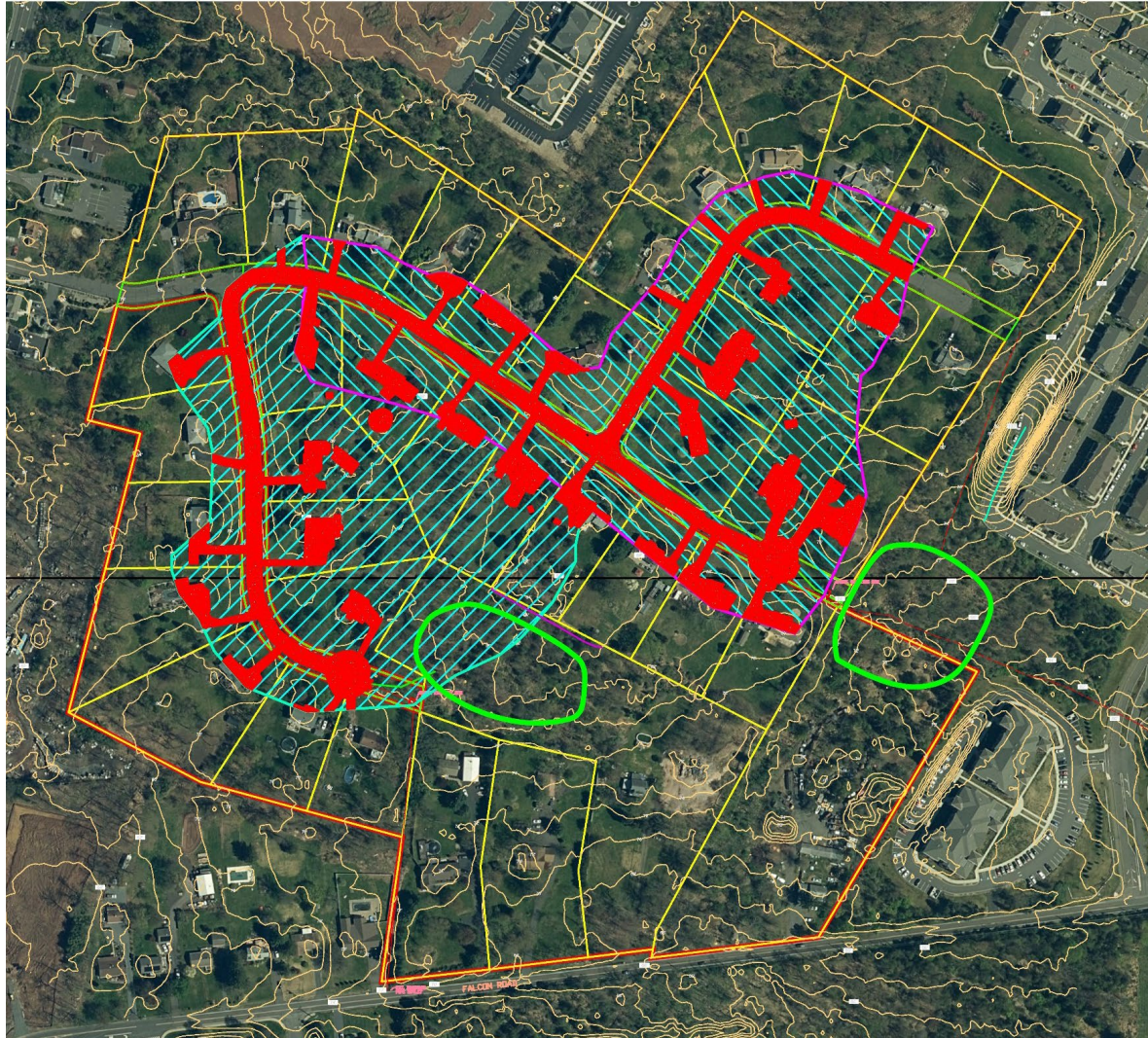


**PATRIDGE RD  
CUL DE SAC**

**CATCH BASIN**

**RIGHT OF WAY  
STORAGE**

**CATCH BASIN**



Two bioretention systems can capture 40.3% of the drainage area including 51.4% of the impervious cover.



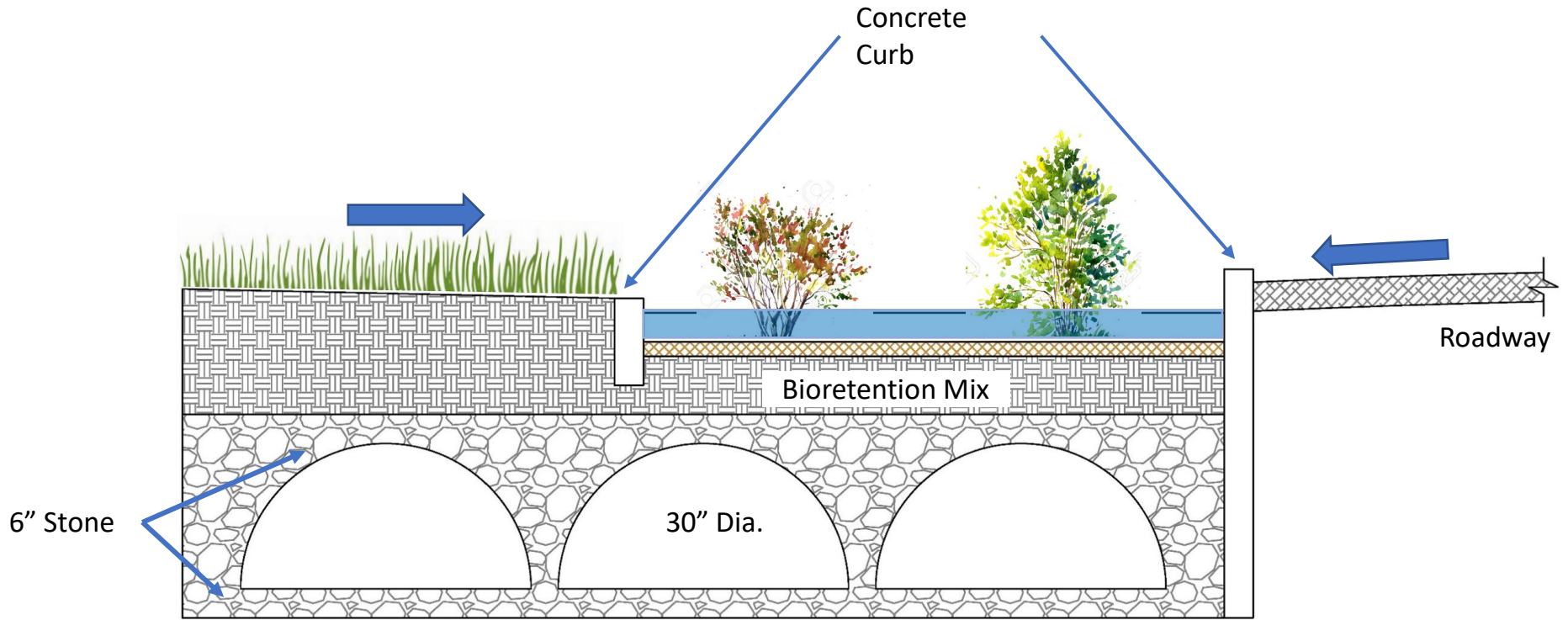
23 Bioswales = 47,375 cu. ft. storage

**Bioswales capture and treat runoff for first 2" of rainfall**

Basin 1 =  
233,464 cu. ft. storage

Basin 2 =  
266,220 cu. ft. storage

Total Storage =  
547,059 cu. ft.



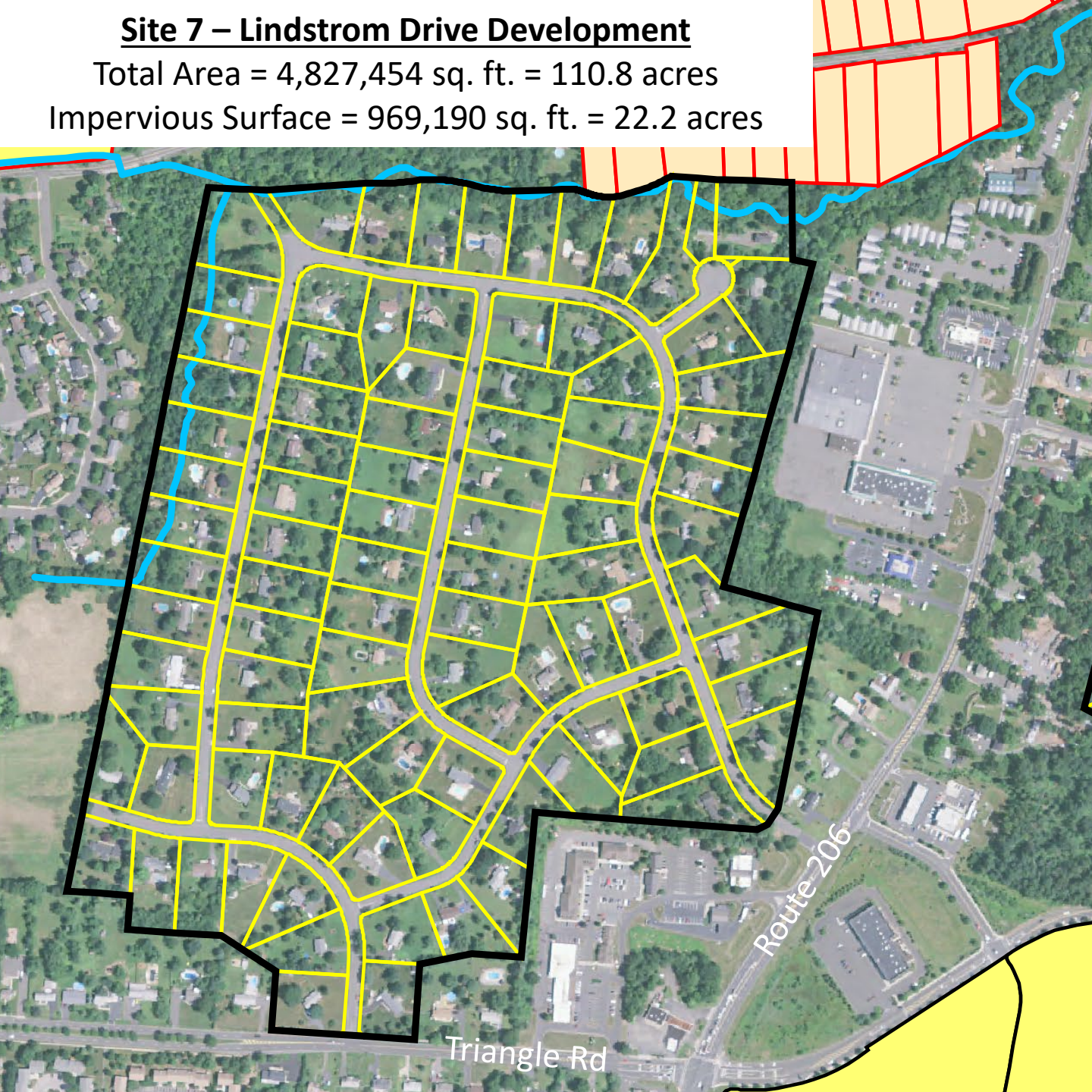
## Preliminary Design Results

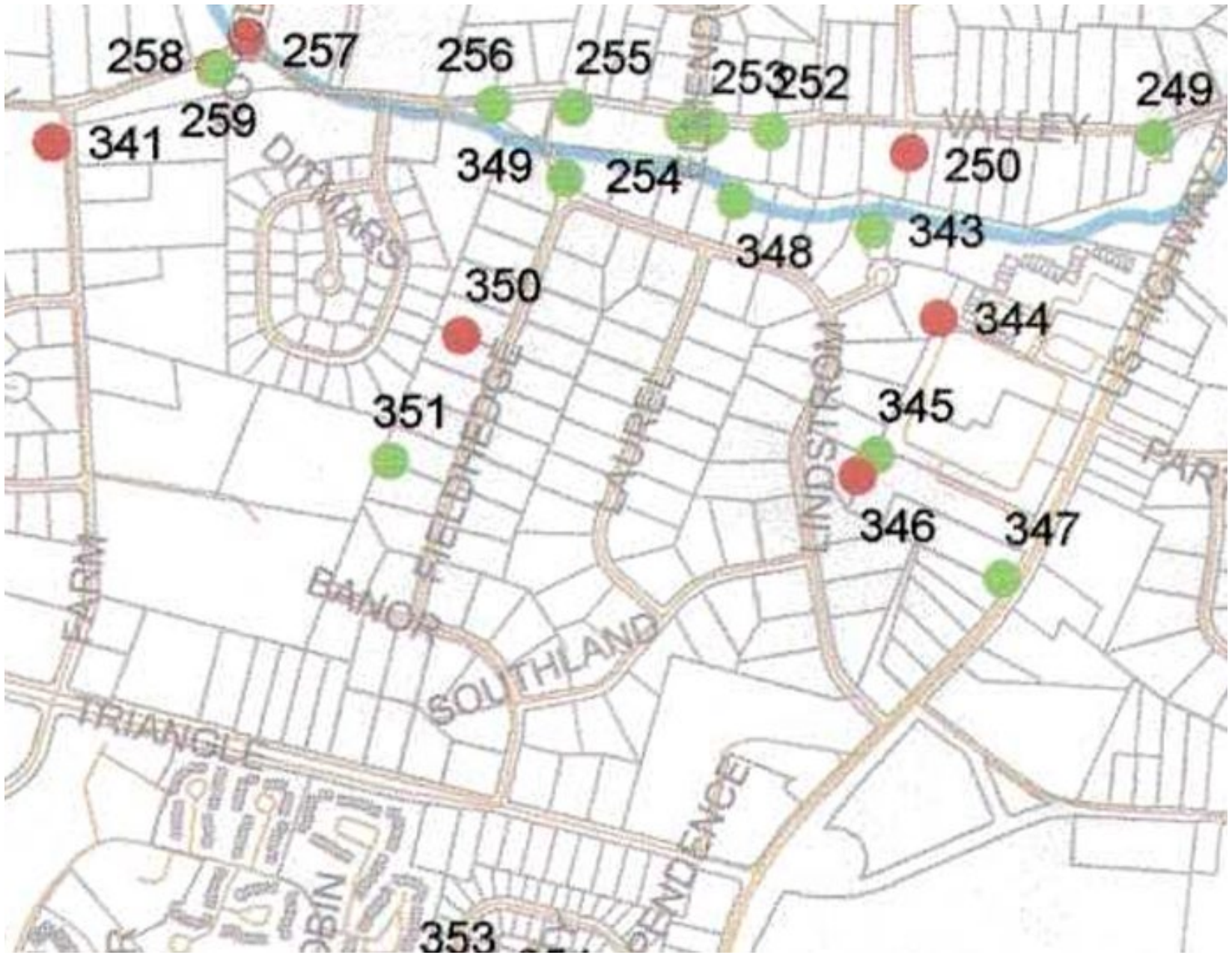
100-year Storm	Rainfall (in)	Volume (cu. Ft.)	Volume Managed (%)
2000	8.21	510,868	107.1%
2020	8.95	572,362	95.6%
2100	12.15	839,248	65.2%

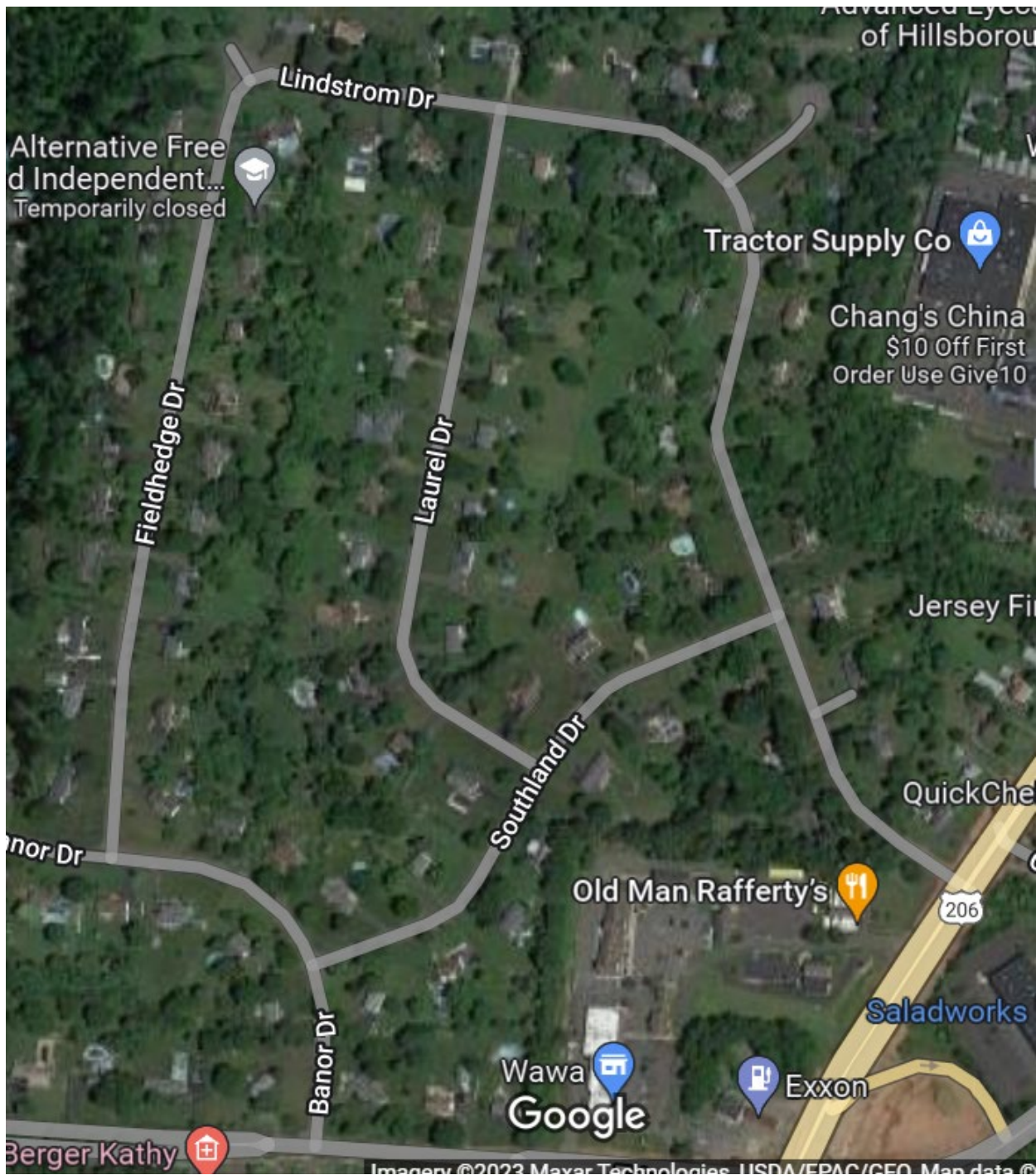
# Site 7 – Lindstrom Drive Development

Total Area = 4,827,454 sq. ft. = 110.8 acres

Impervious Surface = 969,190 sq. ft. = 22.2 acres







Alternative Free  
d Independent...  
Temporarily closed



Tractor Supply Co



Chang's China  
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Jersey Fi

QuickChe

Old Man Rafferty's



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Saladworks

Wawa

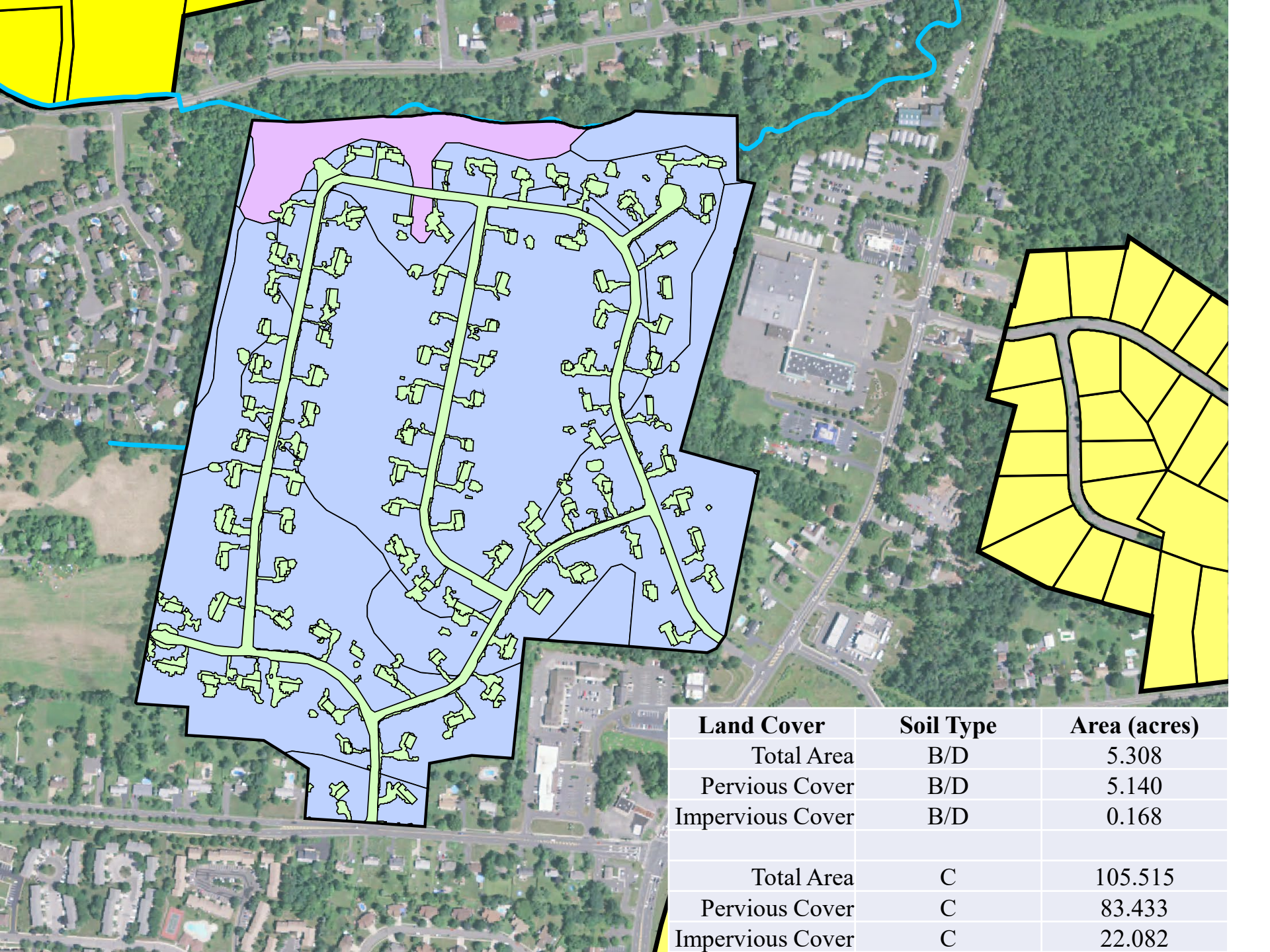


Exxon

Google

Berger Kathy



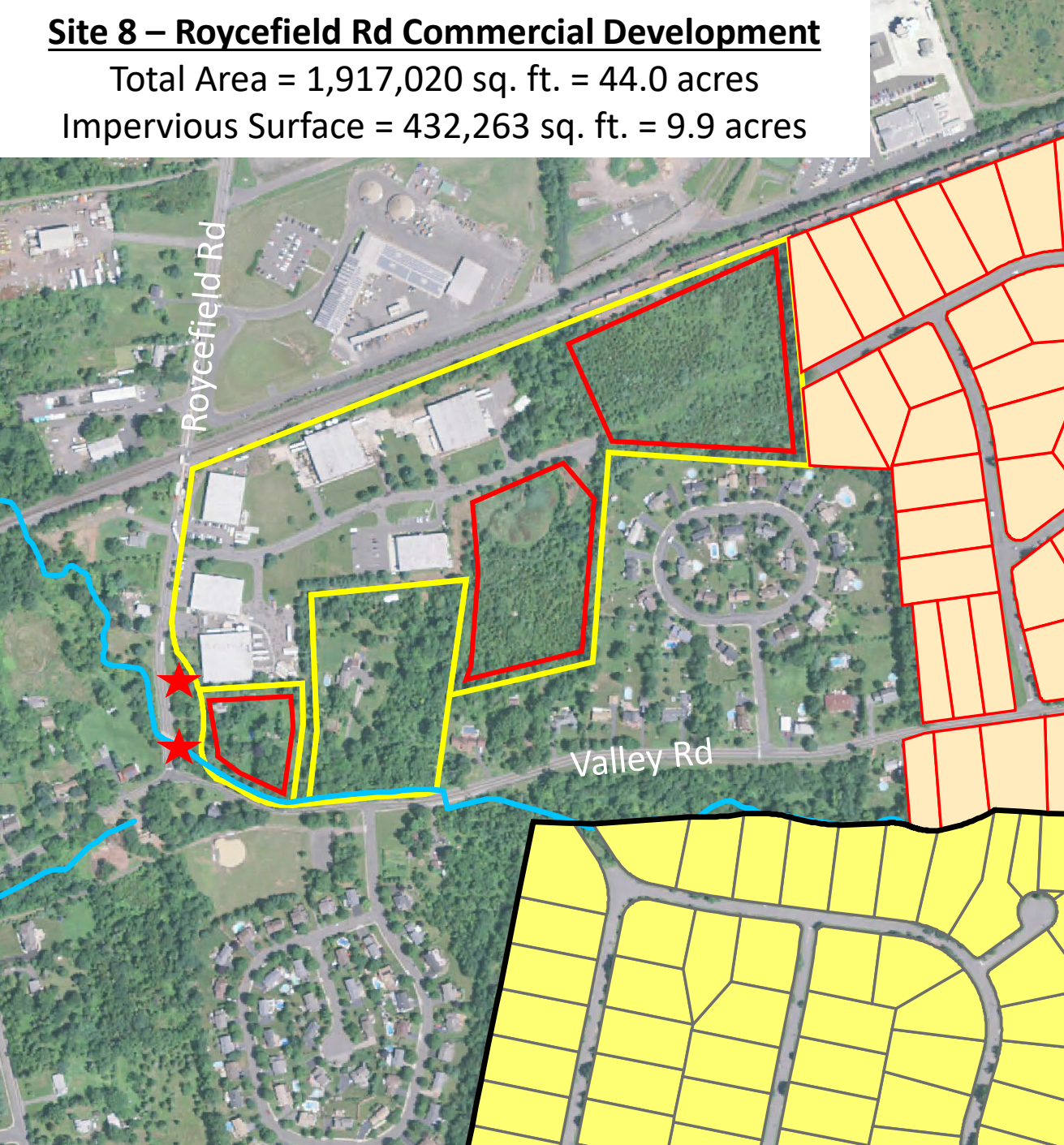


Land Cover	Soil Type	Area (acres)
Total Area	B/D	5.308
Pervious Cover	B/D	5.140
Impervious Cover	B/D	0.168
Total Area	C	105.515
Pervious Cover	C	83.433
Impervious Cover	C	22.082

# Site 8 – Roycefield Rd Commercial Development

Total Area = 1,917,020 sq. ft. = 44.0 acres

Impervious Surface = 432,263 sq. ft. = 9.9 acres



Kennedy Culvert & Supply



Tri-Delta Plastics



P 39.6



Roycefield Rd

Cougar Ct

Cougar Ct

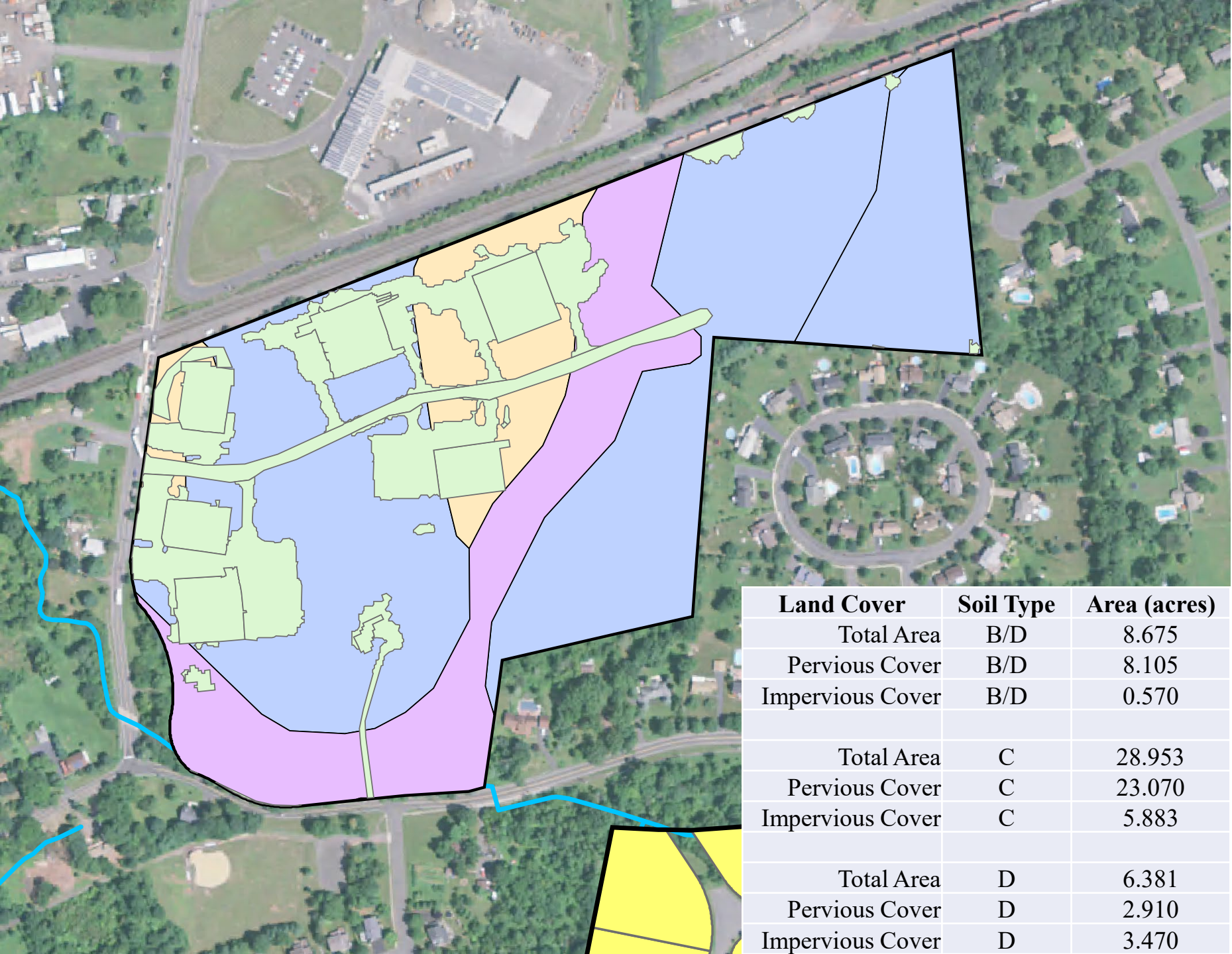
Roycefield Rd

Roger's Paving & Contracting



ing Towing  
ery Agency

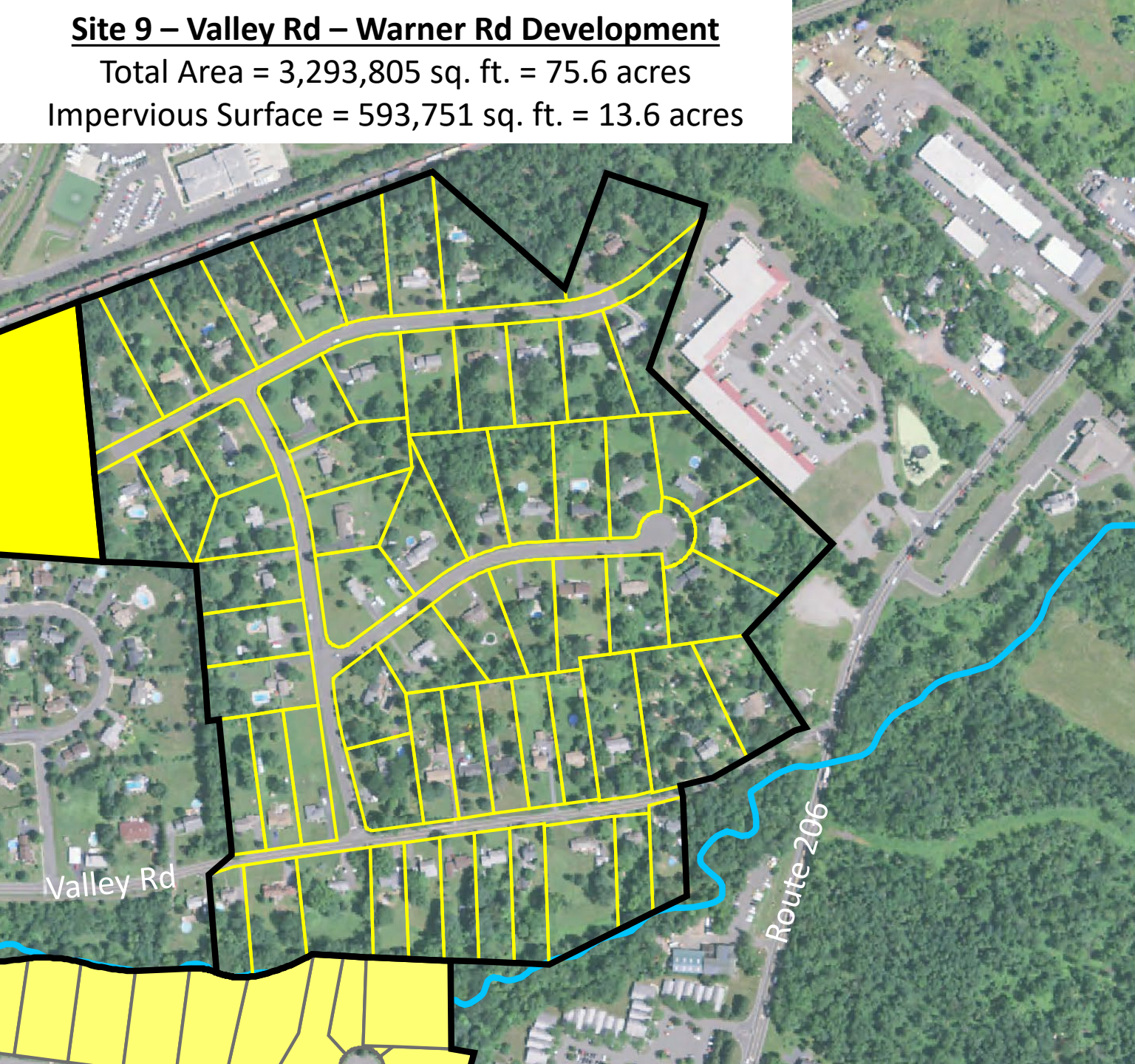
Valley Rd

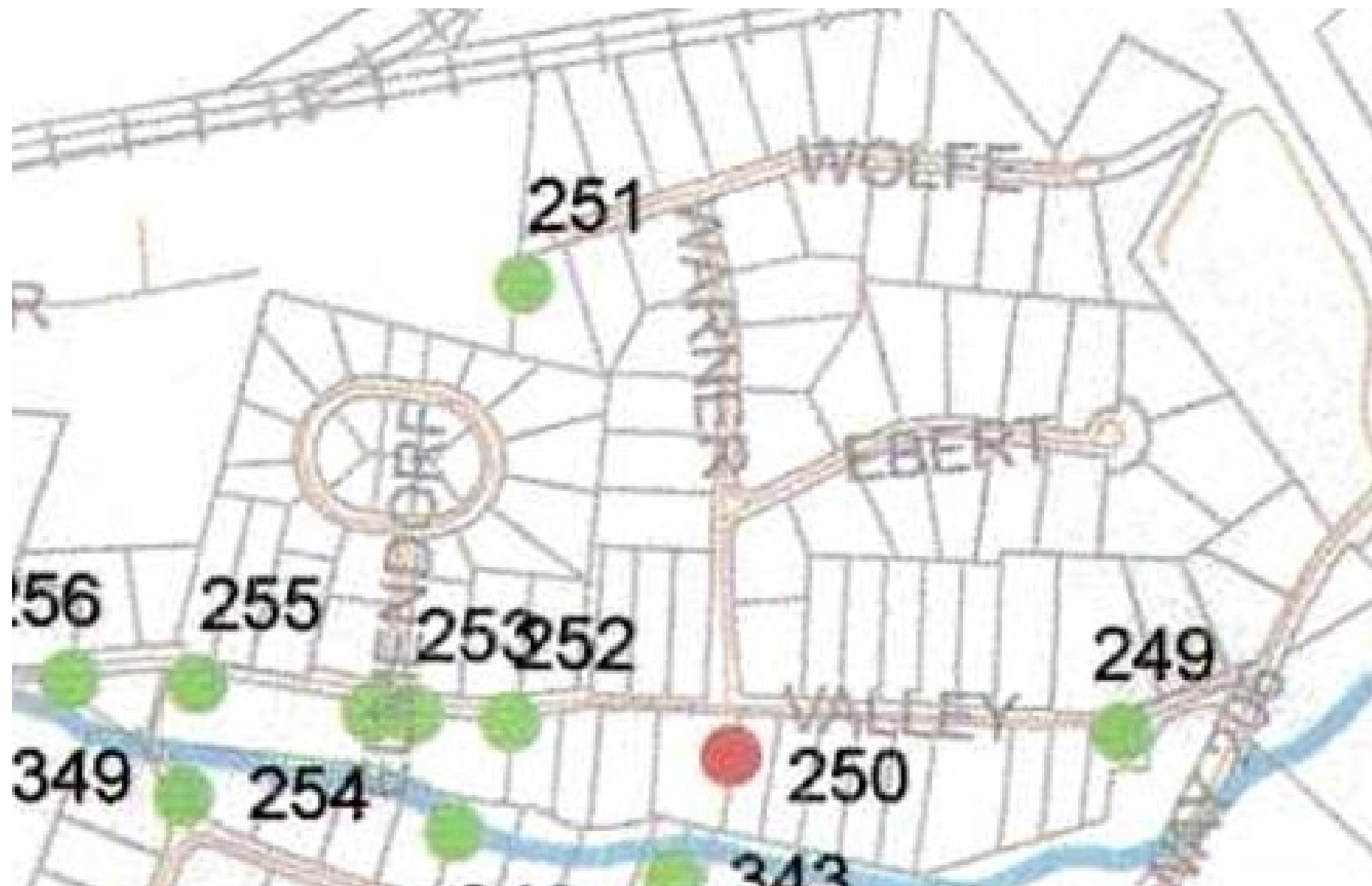


**Site 9 – Valley Rd – Warner Rd Development**

Total Area = 3,293,805 sq. ft. = 75.6 acres

Impervious Surface = 593,751 sq. ft. = 13.6 acres







E. Mueller  
Plumbing & HVAC

Chel's Clothes Closet

Ma  
Tra

Wolfe Dr

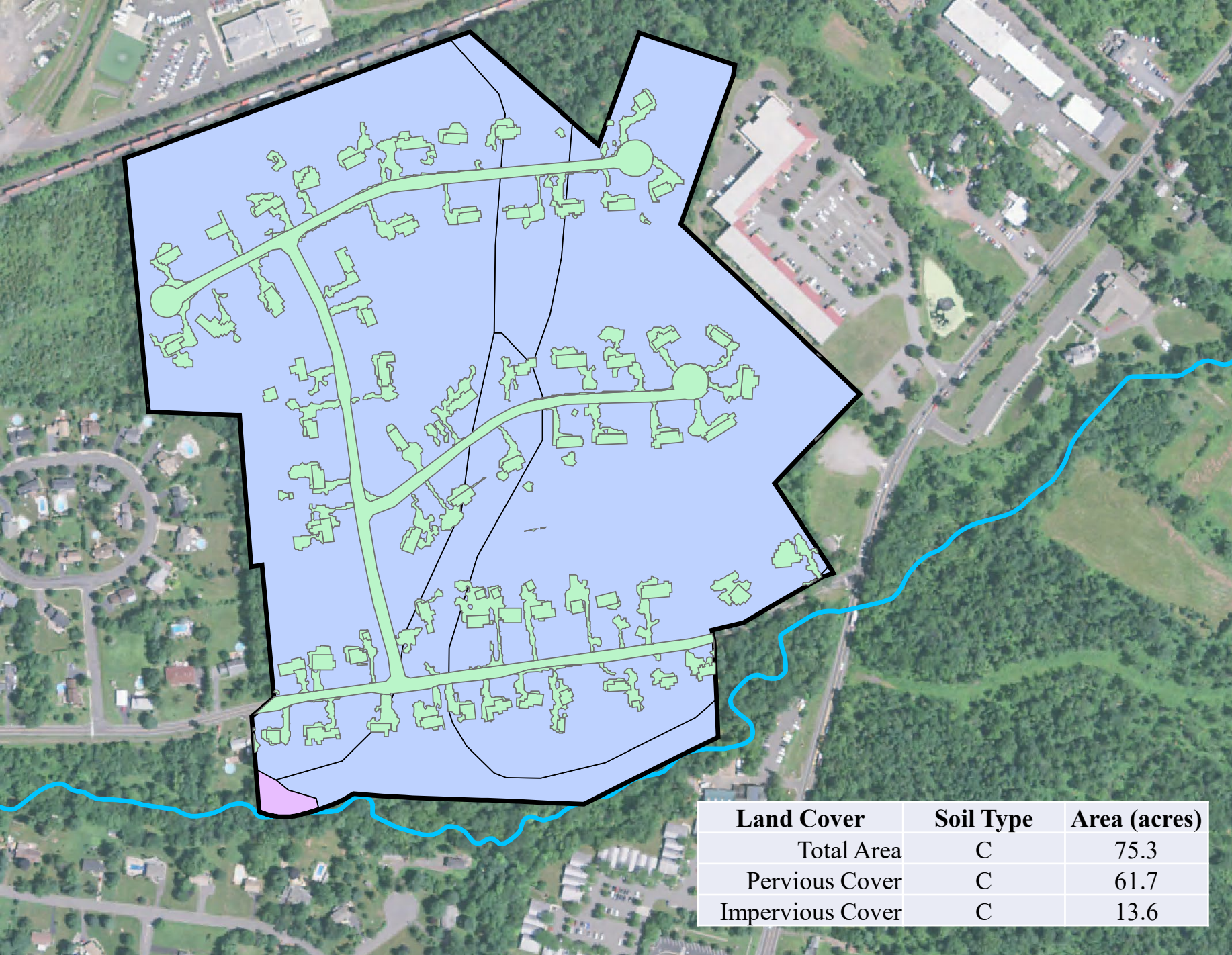
Ebert Dr

Warner Dr

Valley Rd

Valley Rd

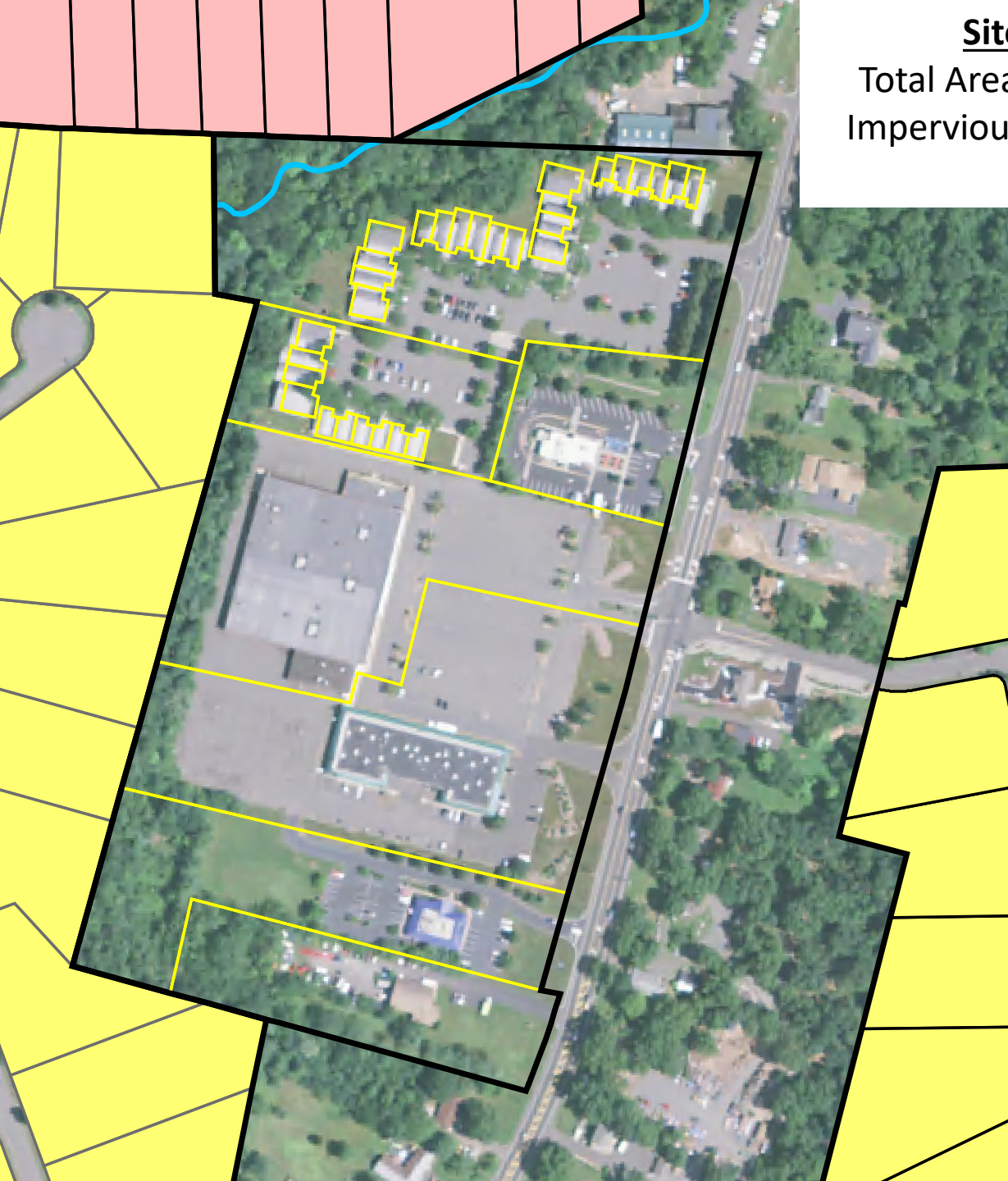
Randolph Cir



Land Cover	Soil Type	Area (acres)
Total Area	C	75.3
Pervious Cover	C	61.7
Impervious Cover	C	13.6

**Site 10 – Hillsborough Plaza**

Total Area = 1,036,600 sq. ft. = 23.8 acres  
Impervious Surface = 626,500 sq. ft. = 14.4  
acres



Advanced Eyecare  
of Hillsborough

Wendy's

Tractor Supply Co

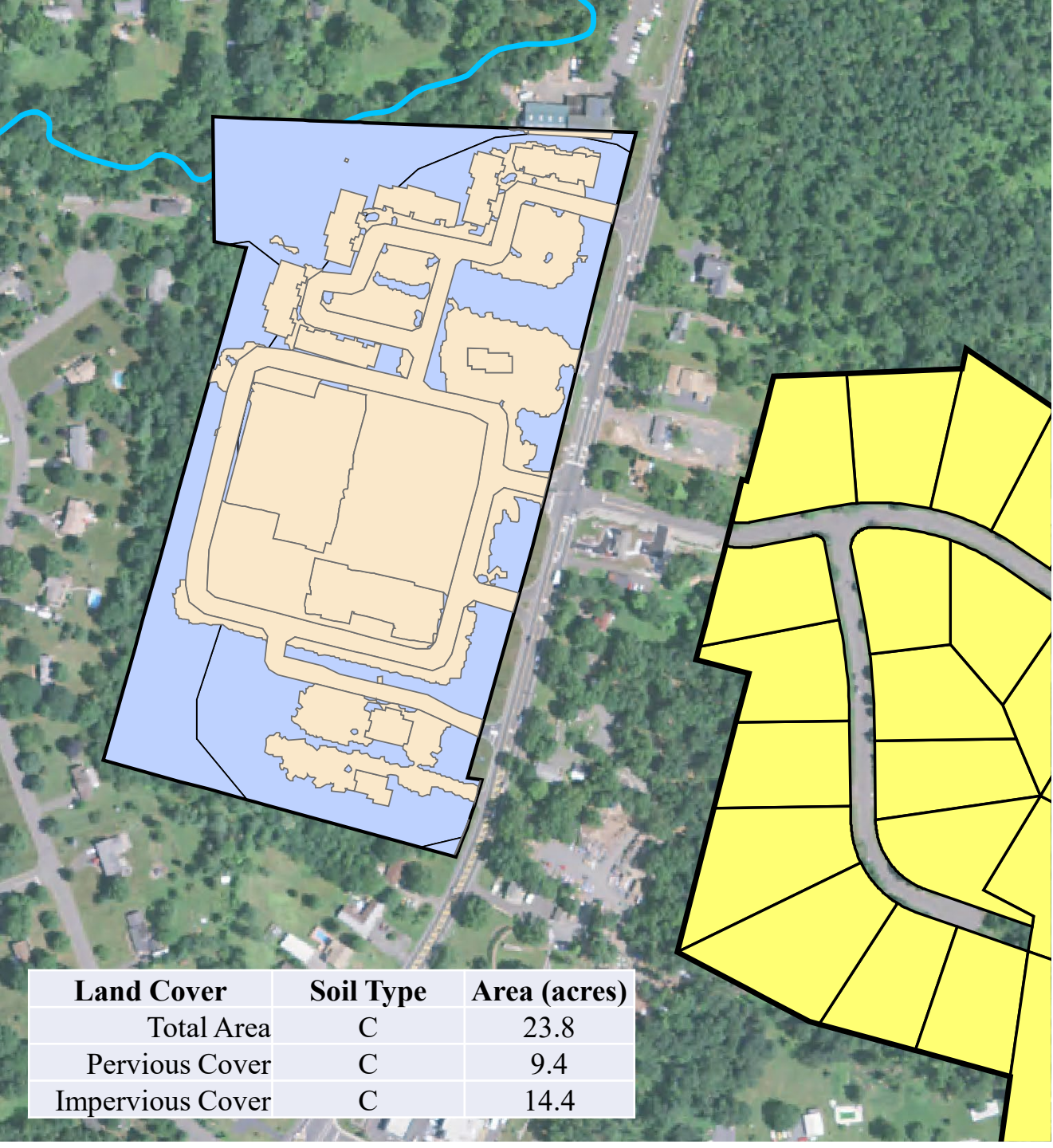
Chang's China

IHOP

206

Partric

Google



Land Cover	Soil Type	Area (acres)
Total Area	C	23.8
Pervious Cover	C	9.4
Impervious Cover	C	14.4

# HILLSBOROUGH PLAZA

## GREEN INFRASTRUCTURE IMPLEMENTATION PROJECT

### 256 US-206, HILLSBOROUGH CITY] SOMERSET COUNTY, NEW JERSEY

#### PROJECT DESCRIPTION:

GREEN INFRASTRUCTURE DEMONSTRATION PROJECT WILL BE INSTALLED IN 256 US-206 PLAZA.

1. ISLANDS OF PARKING LOT WILL BE DE-PAVED AND RE-INSTALLED TO BE RAIN GARDENS, TO CAPTURE, INFILTRATE THE STORMWATER RUNOFF FROM THE ROAD.
2. RAIN GARDENS WILL BE INSTALLED ON THE GRASS AREA AROUND THE PLAZA, TO CAPTURE, INFILTRATE THE STORMWATER RUNOFF FROM THE ROAD.
3. PARKING LOT AT THE SOUTH SIDE OF PLANET FITNESS WILL BE REPLACED WITH PERVIOUS CONCRETE TO CAPTURE THE STORMWATER RUNOFF FROM THE ROAD AND THE ROOF.
4. UNDERGROUND STORAGE TANK WILL BE INSTALLED UNDER THE PARKING LOT TO INCREASE THE CAPACITY OF GREEN INFRASTRUCTURES.

THE PROJECT WILL SERVE AS A DEMONSTRATION FOR CITIZEN TO LEARN ABOUT SUSTAINABLE STORMWATER MANAGEMENT AND LOCAL POLLINATOR ECOLOGY.

#### LIST OF DRAWINGS:

SHEET NAME	TITLE
COVER	COVER SHEET
P-1	EXISTING CONDITIONS AND DEMOLITION PLAN
P-2	PROPOSED SITE PLAN
DT-1	DETAILS
DT-2	DETAILS 2
DT-3	DETAILS 3
DT-4	DETAILS 4

#### GENERAL NOTES:

1. SURVEY CONDUCTED BY RUTGERS COOPERATIVE EXTENSION WATER RESOURCES PROGRAM. ALL ELEVATIONS ARE RELATIVE TO THE 100.00' BENCHMARK POINT. (OR ELEVATION DATA OBTAINED FROM [INSERT DATA SOURCE HERE, TYP NOAA DIGITAL COASTAL LIDAR]. ELEVATION ARE HEIGHT ABOVE MEAN SEA LEVEL SET BY NAVD 1988).
2. EXISTING SOILS ARE PENN SILT LOAM WHICH ARE CLASSIFIED AS HYDROLOGIC SOIL GROUP C WHICH HAVE LOW INFILTRATION RATES BASED ON THE NRCS WEB SOIL SURVEY ([websoilsurvey.sc.egov.usda.gov](http://websoilsurvey.sc.egov.usda.gov)).
3. ANY OVERHEAD AND UNDERGROUND UTILITIES SHOWN ARE FROM FIELD OBSERVATIONS AND ARE NOT A COMPLETE REPRESENTATION. A UTILITY MARKOUT NEEDS TO BE CONDUCTED PRIOR TO MOBILIZATION BY THOSE RESPONSIBLE FOR EXCAVATION. NJ ONE CALL: 811 OR 800-272-1000

#### LOCATION MAP (N.T.S):

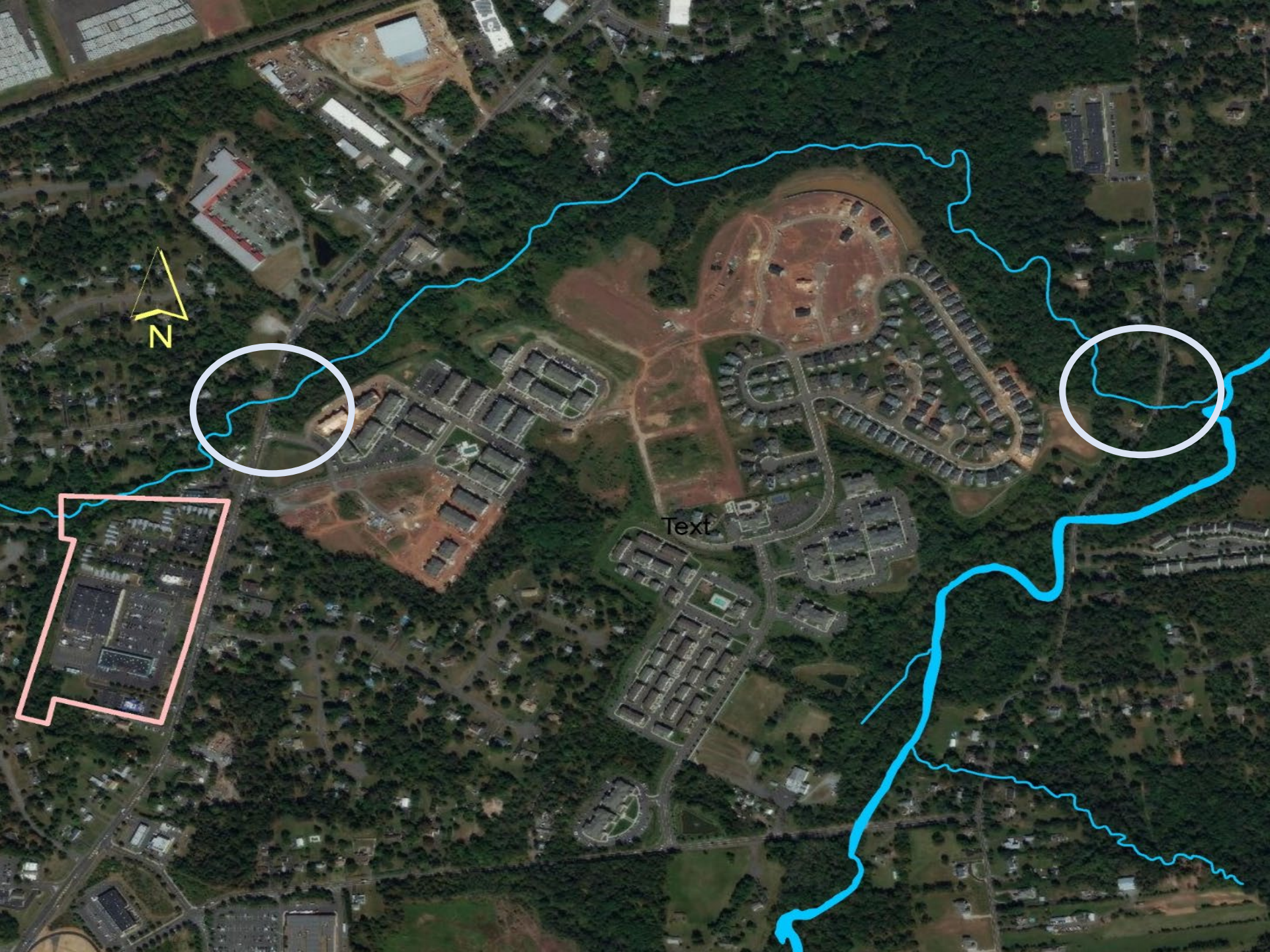


#### LEGEND:

	EXISTING DRAINAGE AREA
	EDGE OF PAVEMENT
	EXISTING CENTERLINE
	EXISTING TREELINE
	EXISTING TREE/SHRUB
	EXISTING BUILDING
	EXISTING LIGHT POLE
	AREA TO BE DEPAVED
	PROPOSED GREEN INFRASTRUCTURE
	PROPOSED POROUS ASPHALT
	PROPOSED TOP OF BERM

PLAN REVISIONS		
REV. DATE	REV. SUMMARY	REV. SHEETS



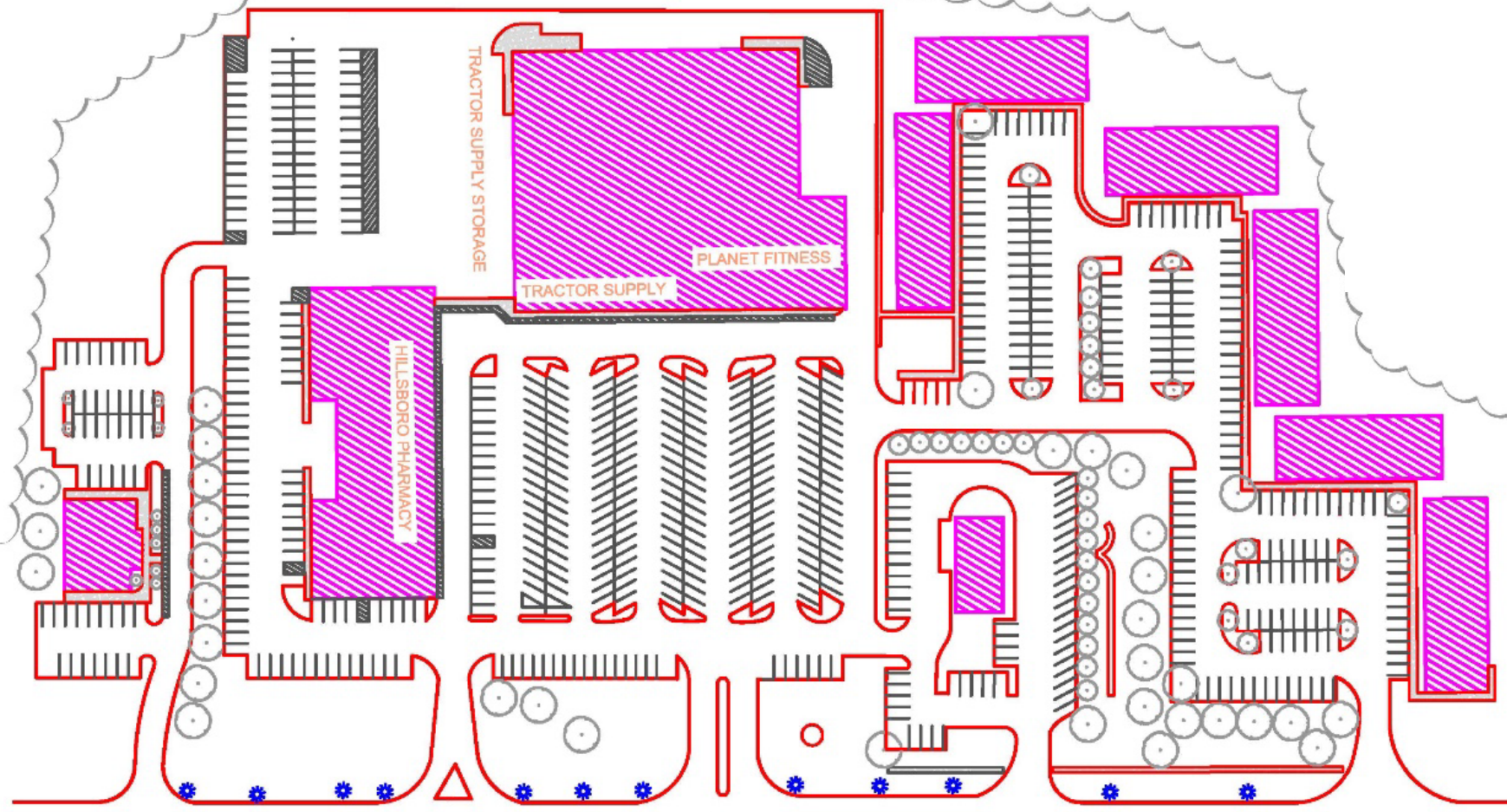


Text



**Hillsborough Plaza**  
**256 Route 206**  
**Hillsborough, New Jersey**

EXISTING TREE LINE

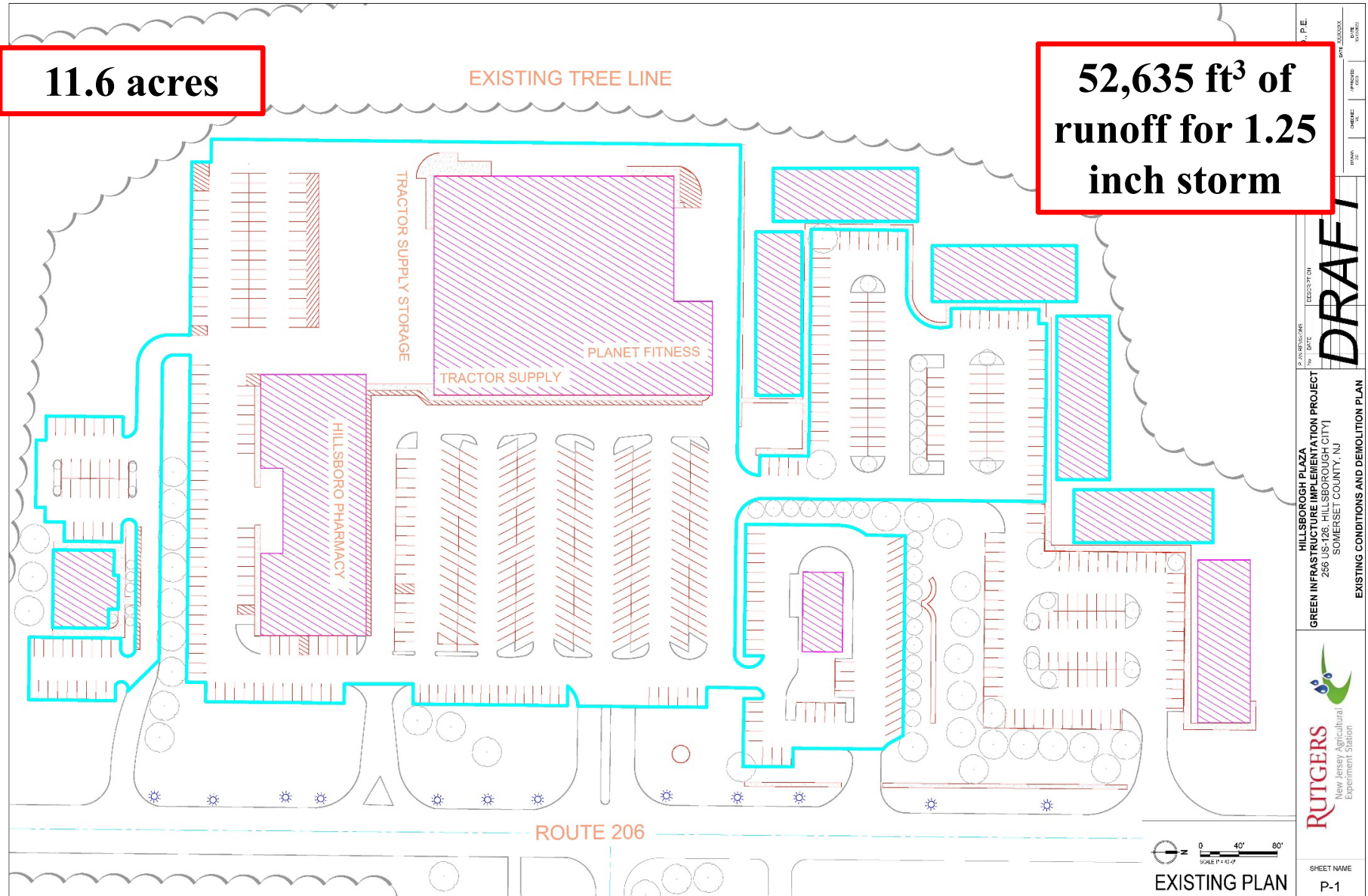


ROUTE 206

# Water Quality Storm Analysis (1.25 inches)

11.6 acres

52,635 ft<sup>3</sup> of runoff for 1.25 inch storm



11.6 acres

52,635 ft<sup>3</sup> of runoff for 1.25 inch storm

EXISTING TREE LINE

TRACTOR SUPPLY STORAGE

PLANET FITNESS

TRACTOR SUPPLY

HILLSBORO PHARMACY

ROUTE 206

SCALE 1" = 40'

EXISTING PLAN

P.E.

DATE

PROJECT

NO. 2022

11.6 acres

52,635 ft<sup>3</sup> of runoff for 1.25 inch storm

HILLSBOROUGH PLAZA

GREEN INFRASTRUCTURE IMPLEMENTATION PROJECT

266 US-126, HILLSBOROUGH CITY

SOMERSET COUNTY, NJ

EXISTING CONDITIONS AND DEMOLITION PLAN

RUTGERS

New Jersey Agricultural Experiment Station

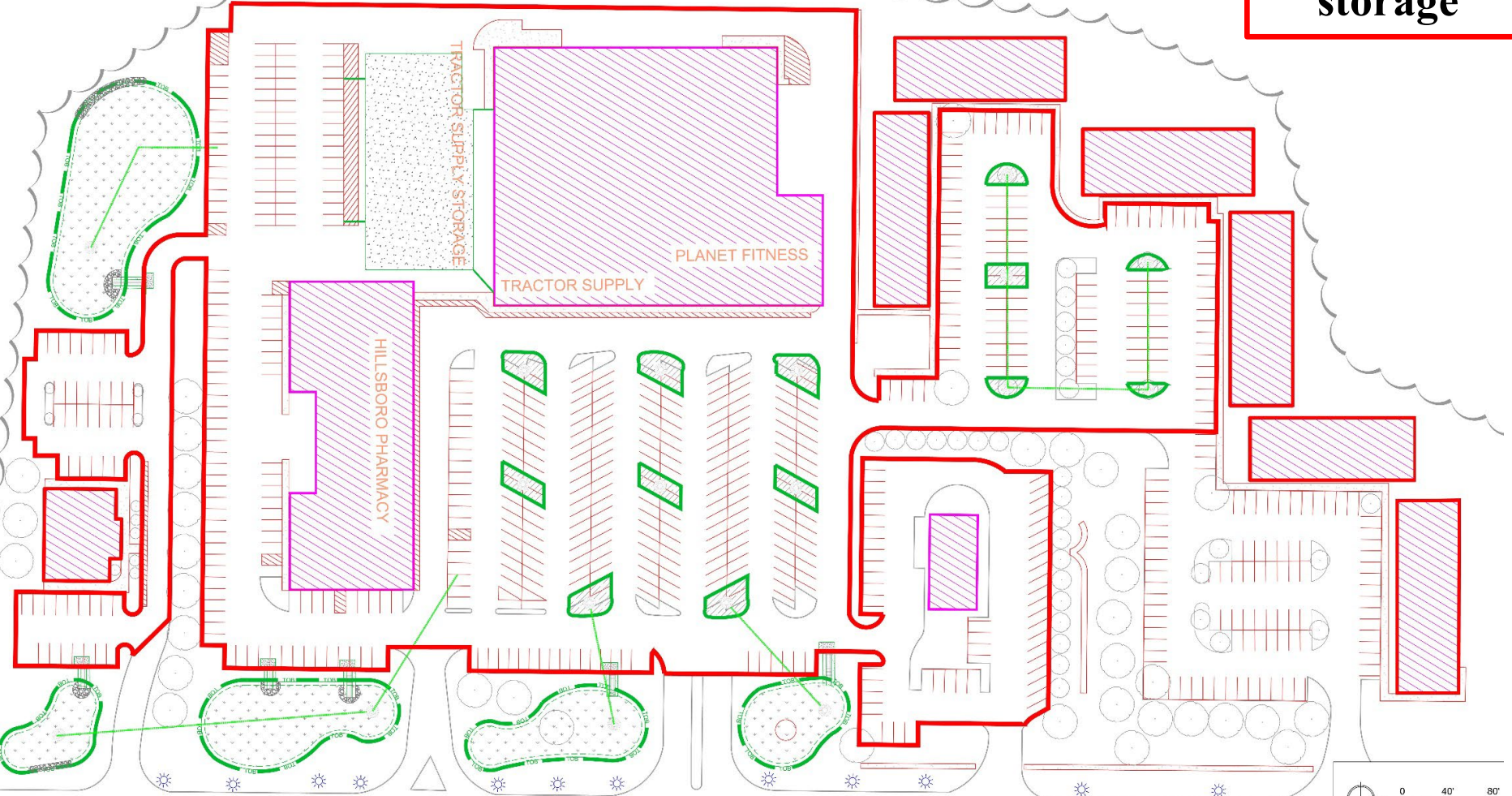
SHEET NAME

P-1

DRAFT

**1.23 acres of  
rain gardens  
provides  
45,611 ft<sup>3</sup> of  
storage**

EXISTING TREE LINE



ROUTE 206

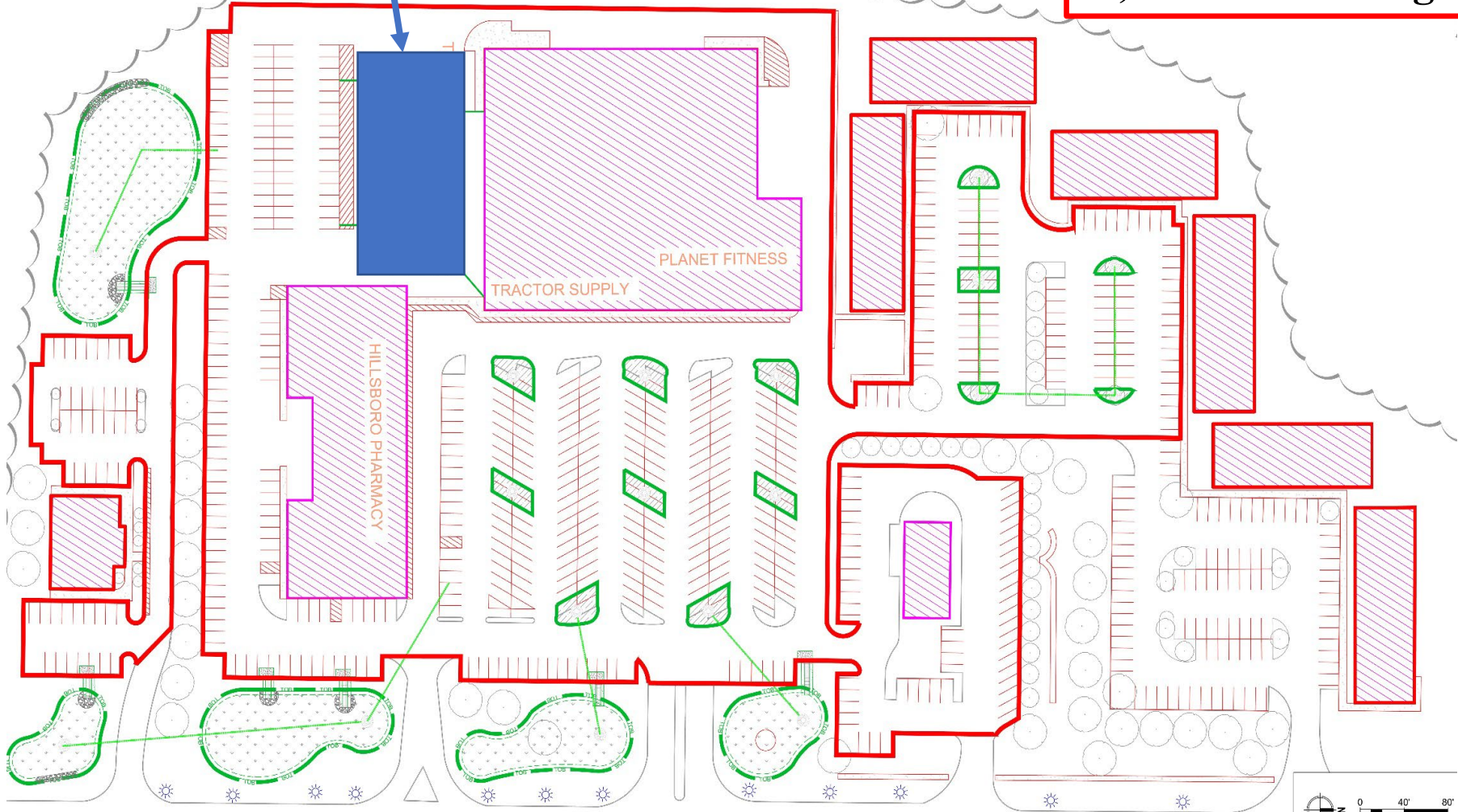


SITE PLAN

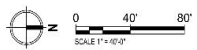
**17,560 ft<sup>2</sup> of  
pervious concrete  
provides  
7,024 ft<sup>3</sup> of storage**

Pervious Concrete

EXISTING TREE LINE



ROUTE 206

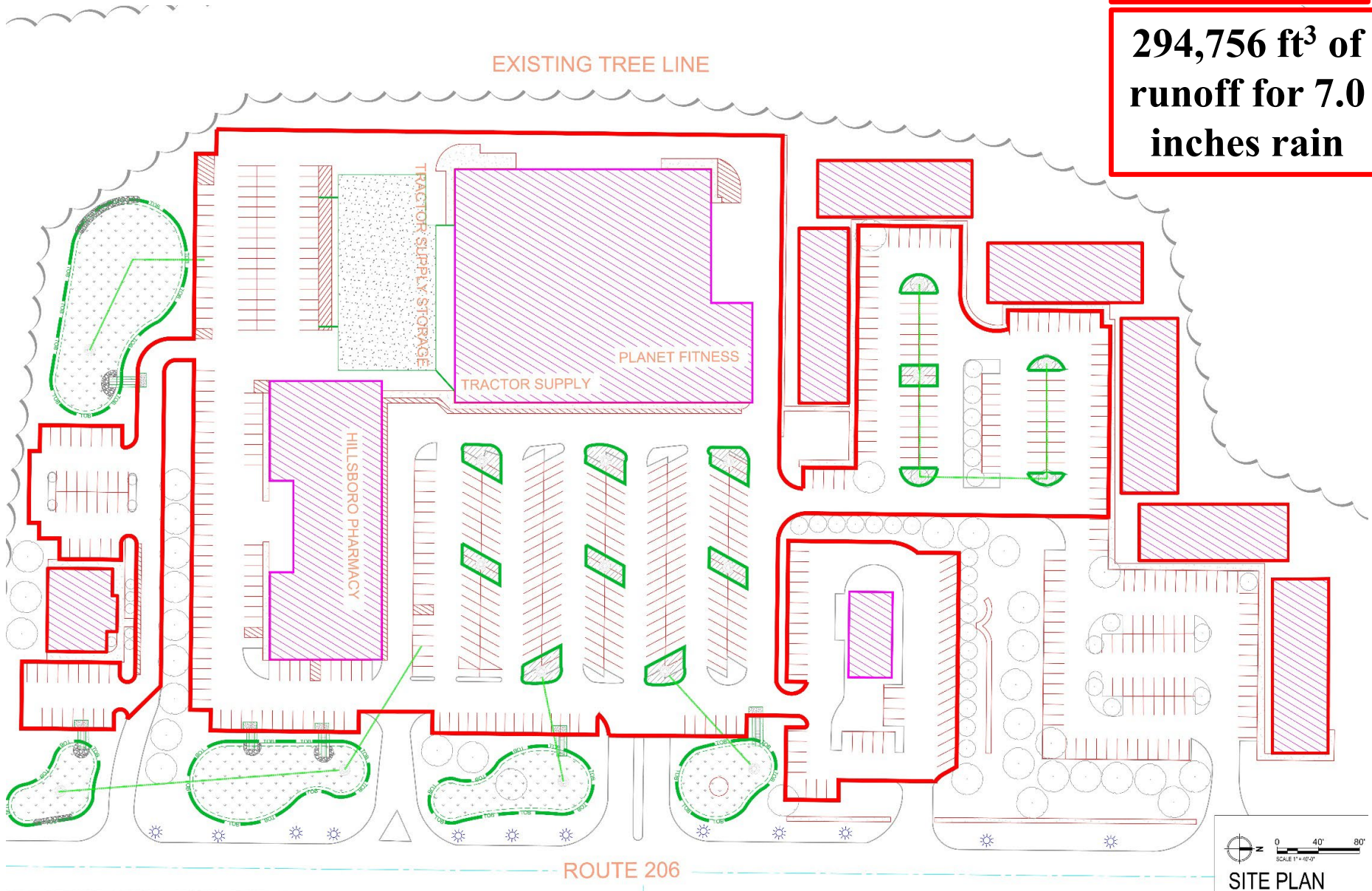


SITE PLAN

# 100-Year Storm Analysis 8.25 inches

11.6 acres

294,756 ft<sup>3</sup> of runoff for 7.0 inches rain

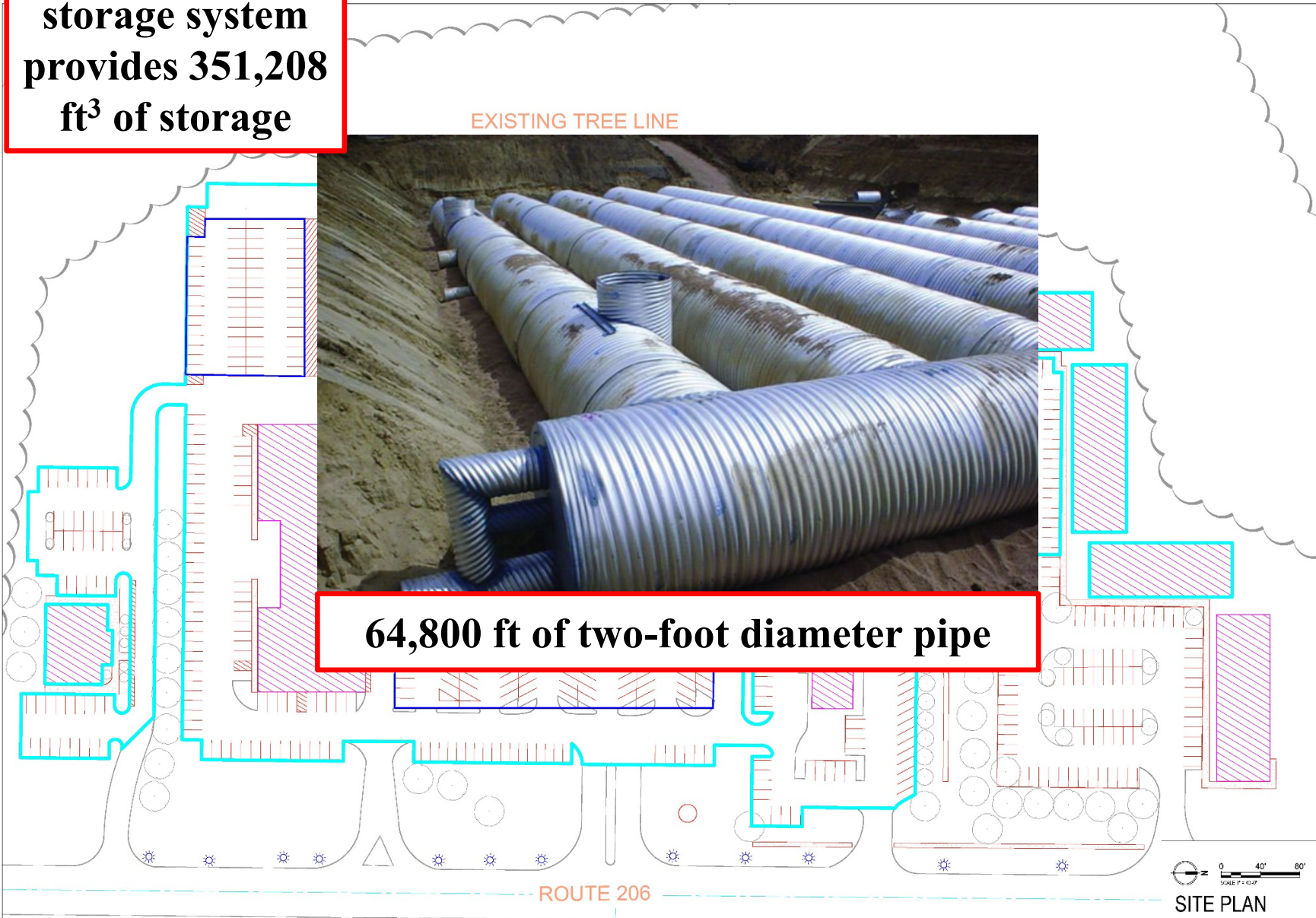


SITE PLAN

**2.4 acres of  
underground  
storage system  
provides 351,208  
ft<sup>3</sup> of storage**

EXISTING TREE LINE

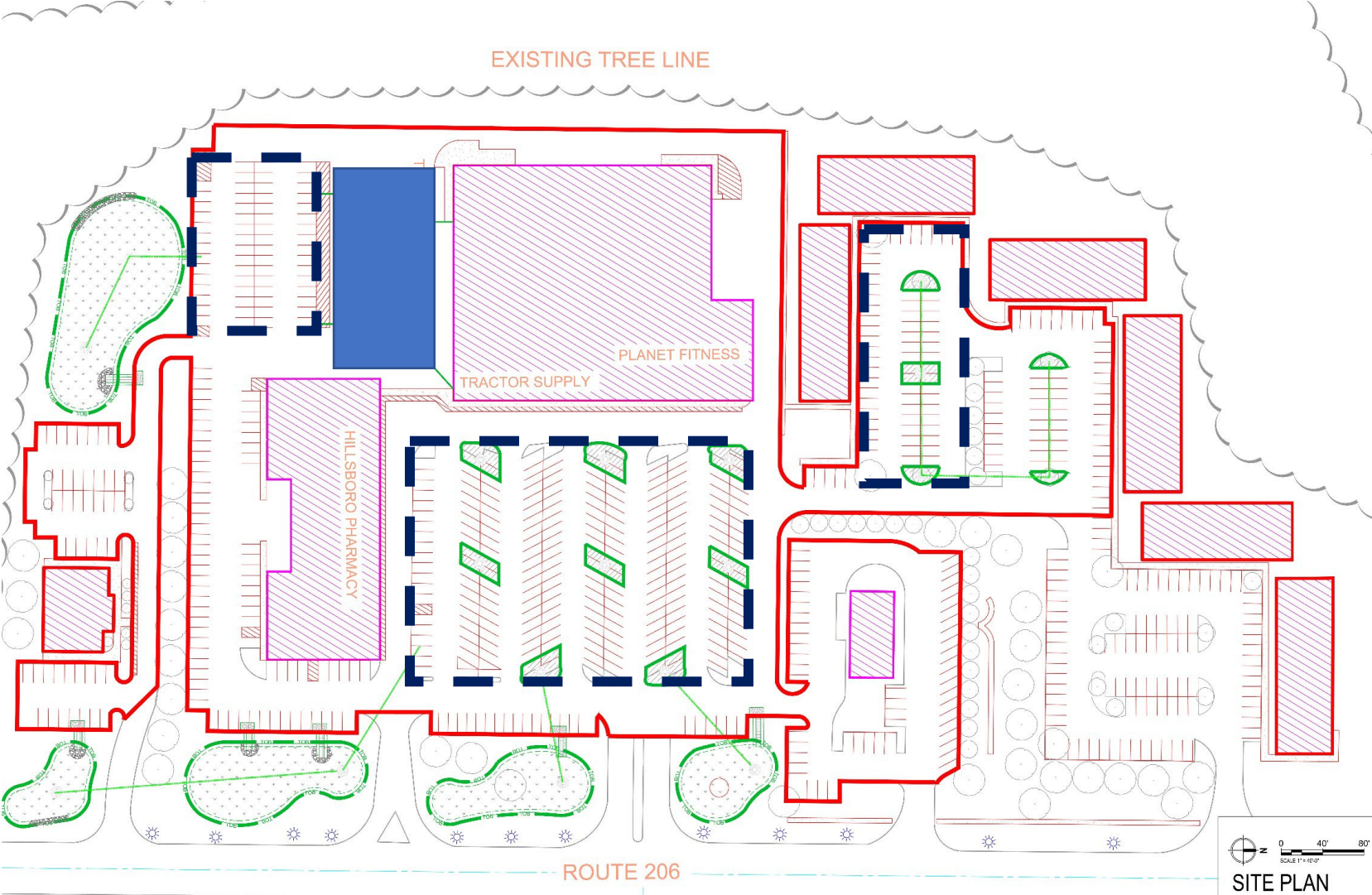
**64,800 ft of two-foot diameter pipe**



<b>RUTGERS</b> New Jersey Agricultural Experiment Station		<b>HILLSBOROUGH PLAZA GREEN INFRASTRUCTURE IMPLEMENTATION PROJECT</b> 266 US-126, HILLSBOROUGH CITY, SOMERSET COUNTY, NJ		<b>PROPOSED SITE PLAN</b>	
		DATE	DESCRIPTION	DATE	ISSUED
				<b>DRAFT</b>	
		CHRISTOPHER C. OBROPTA, Ph.D., P.E. PROFESSOR OF CIVIL ENGINEERING, JUNE 2008-2012			
		PROJECT NO.		DATE	
		DRAWN BY		CHECKED BY	
		SCALE		DATE	



# Green and Gray Infrastructure Practices



## Site 11 – Weston Elementary School

Total Area = 278,826 sq. ft. = 6.4 acres

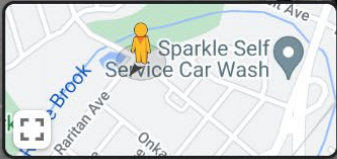
Impervious Surface = 121,707.4 sq. ft. = 2.8 acres



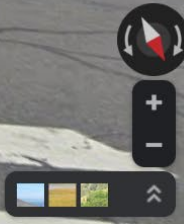
349 Whalen St  
Manville, New Jersey



Street View - Aug 2021



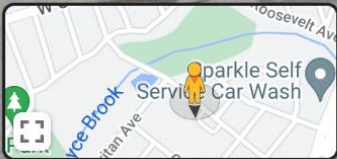
Google



312 Whalen St  
Manville, New Jersey

Google

Street View - Aug 2021



Google

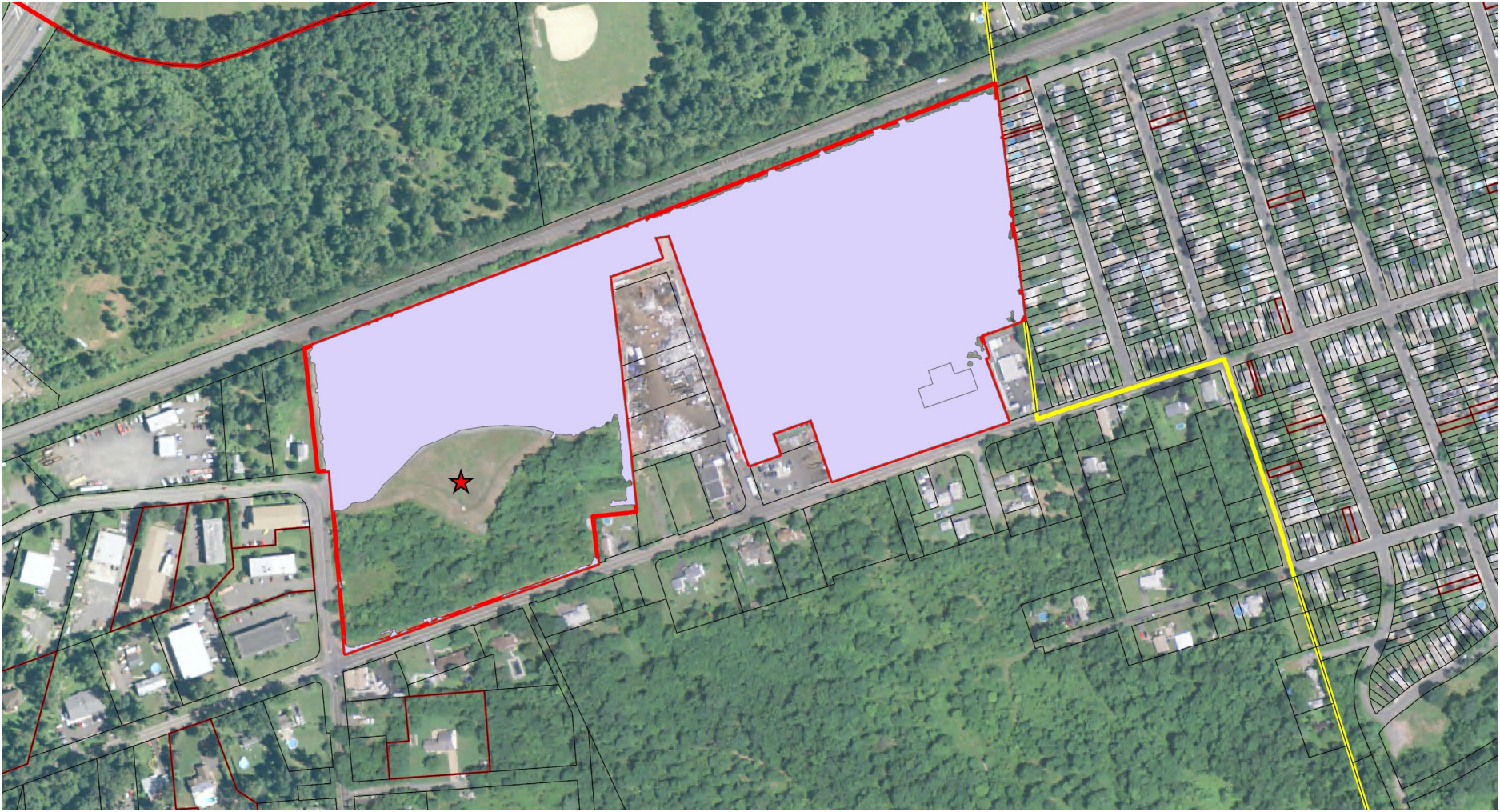


## Site 12 – Copart

Total Area = 32.16 acres

Impervious Surface = 24.40 acres





## Site 13 – Royce Brook Floodway in Manville ?

