FUSS & O'NEILL

NEWEA
Annual Conference

January 26, 2015

You Want to Put What? Where? – Old Saybrook's Decentralized Hybrid Approach For Their Shorefront Community

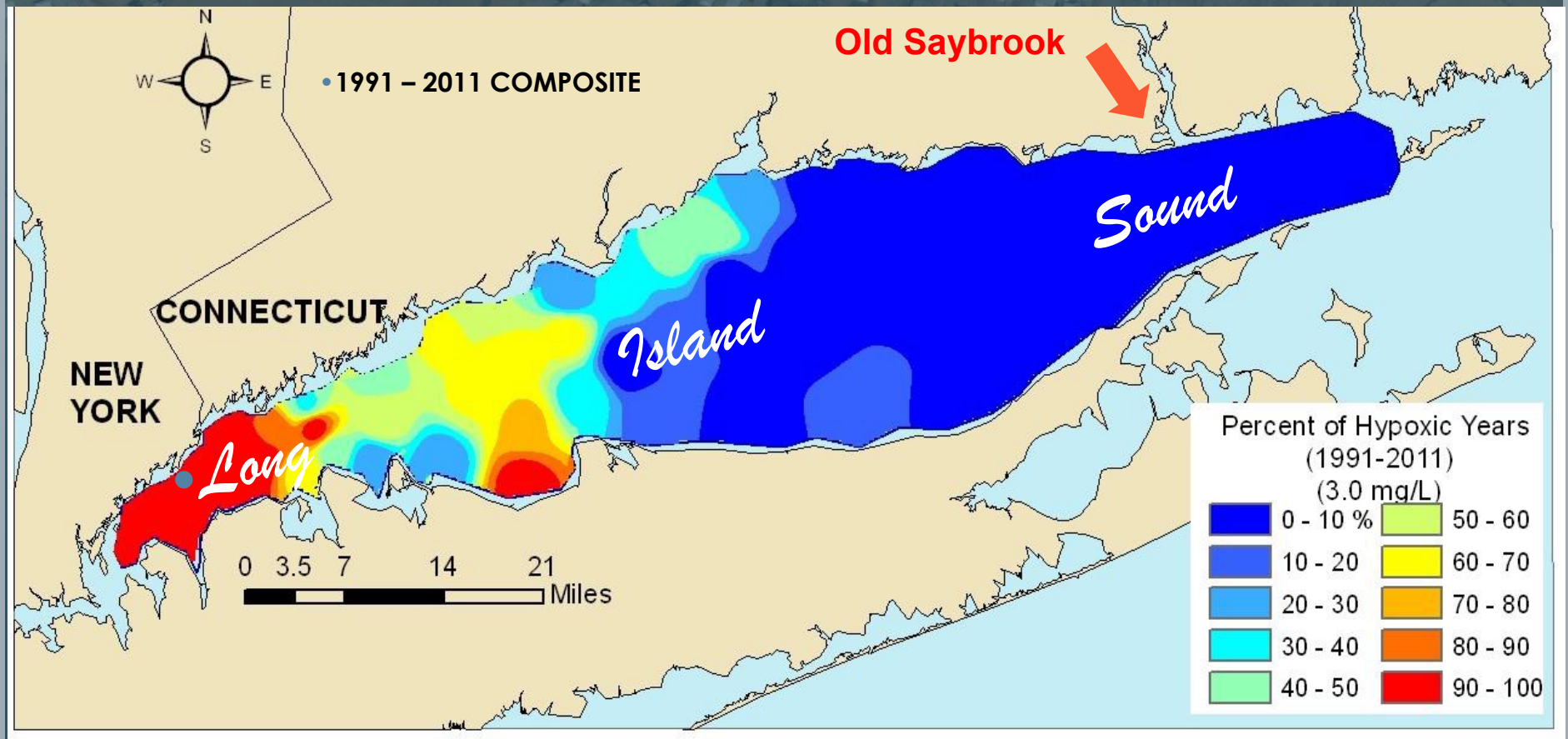
Outline

- Background
- Regulatory Requirements
- Program Status
- AT Challenges
- Cluster System Evaluations
- Community System Evaluations
- What's Next

Background

- Wastewater Issues
  - TMDL for nitrogen into Long Island Sound
- High Density Development
  - 4 to 8 homes per acre
- Older systems (50+ years old) built prior to current Public Health Code (PHC)
- High groundwater table
- Highly permeable or unsuitable soils

The Frequency of Hypoxia in Long Island Sound Bottom Waters*



*Courtesy of CT Department of Energy and Environmental Protection 2013

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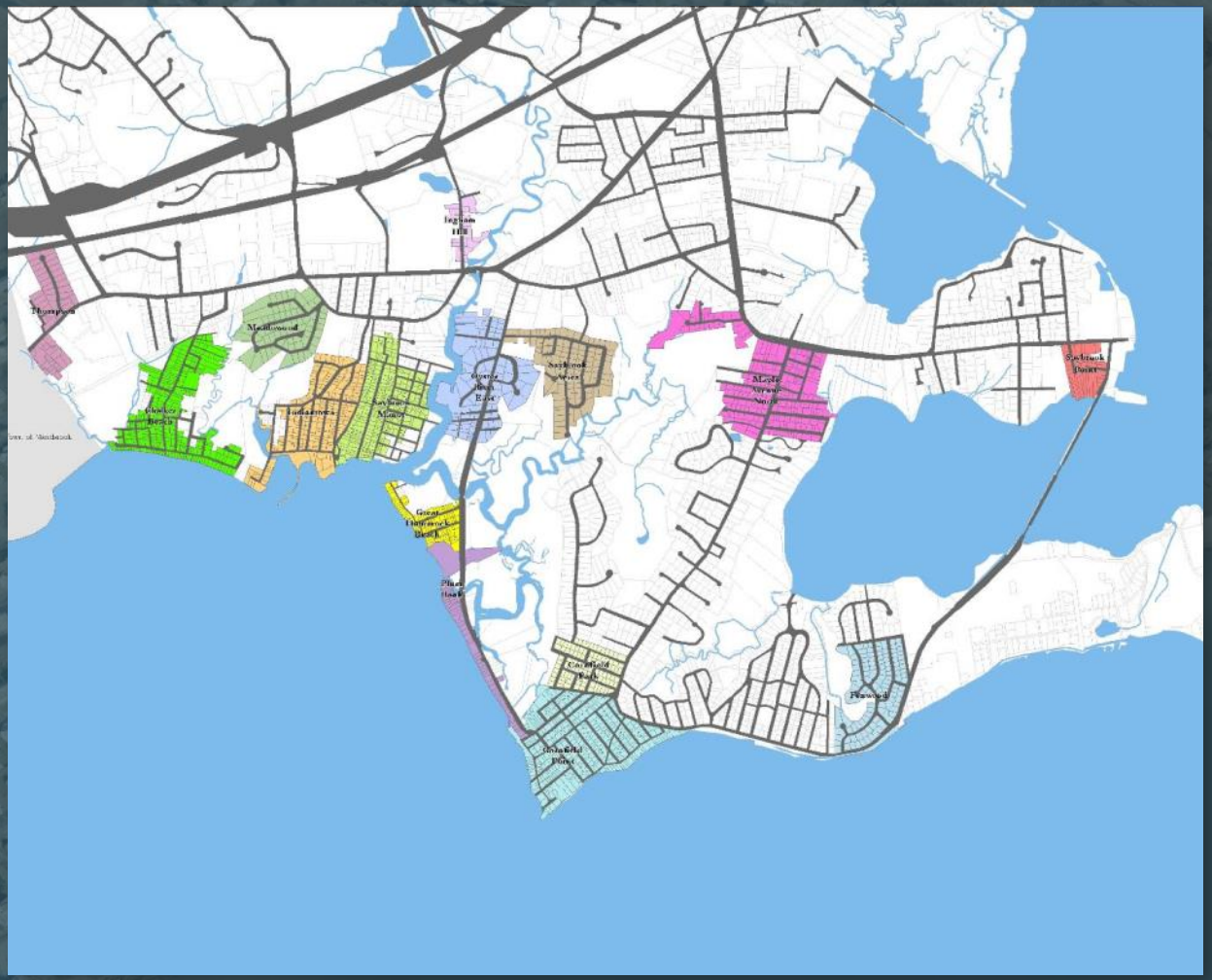
Background

Wastewater Management District Established

15 Focus Areas
1,900 Properties



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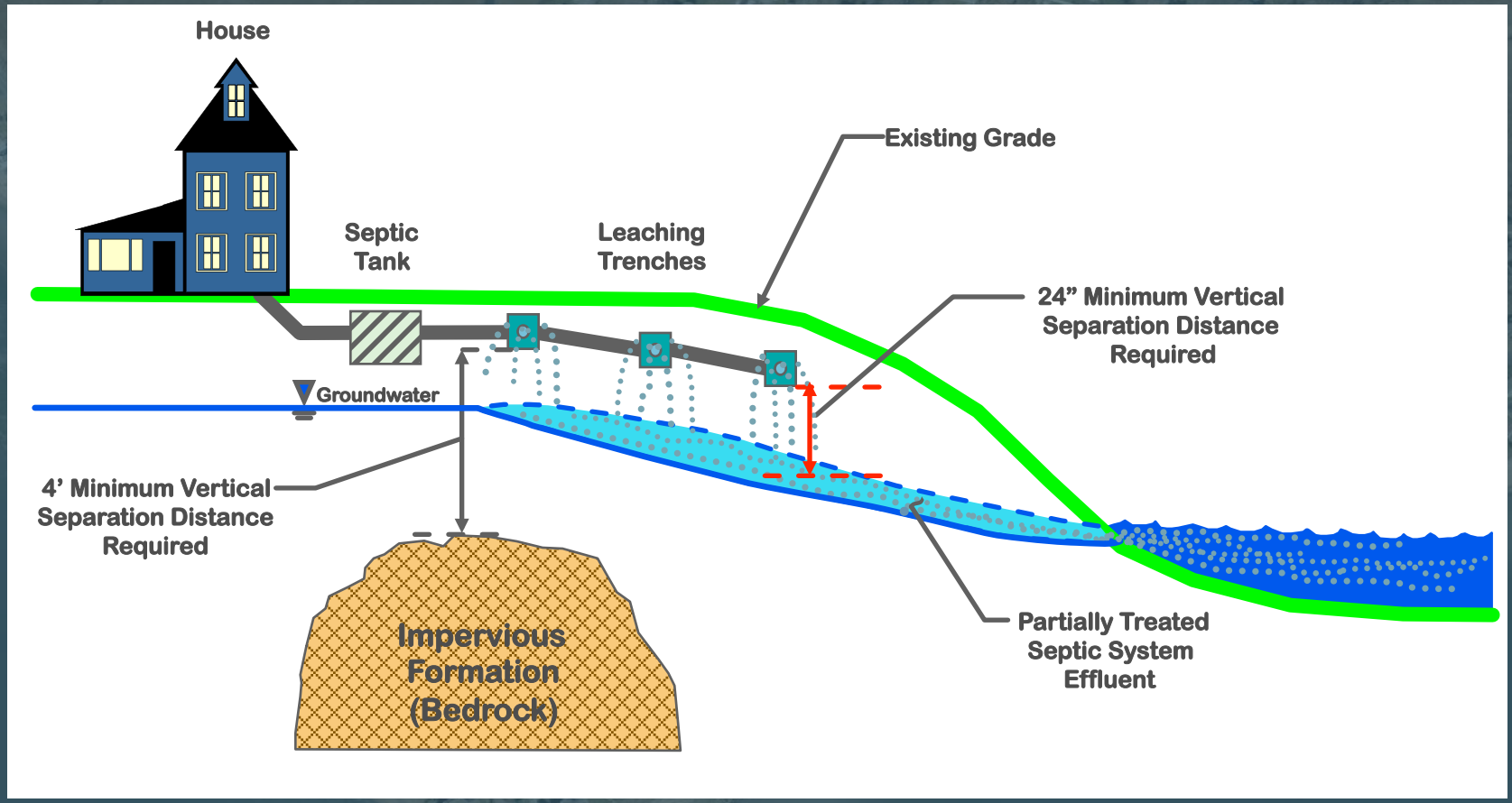
Background

- August 2009 - Citizens Approve Decentralized Referendum
  - $41M program (vs $72M centralized "Big Pipe" program)
  - 8 Year duration
  - Adopted Wastewater Management District Ordinance

Conventional Shorefront Septic System Problems



The Treatment Occurs In The Unsaturated Soil!

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Regulatory Requirements Within the WWMD

- Cesspools removed and replaced
- Septic tanks upgraded to PHC; add effluent filters
- Leaching systems upgraded to extent possible:
  - Between 2/3 and 100% of area required by PHC
  - Replace deep drywells with shallower systems
- Alternative Technology (AT) required for N removal:
  - All "Water Proximity" lots
  - When leaching field can not be upgraded to 2/3 PHC area

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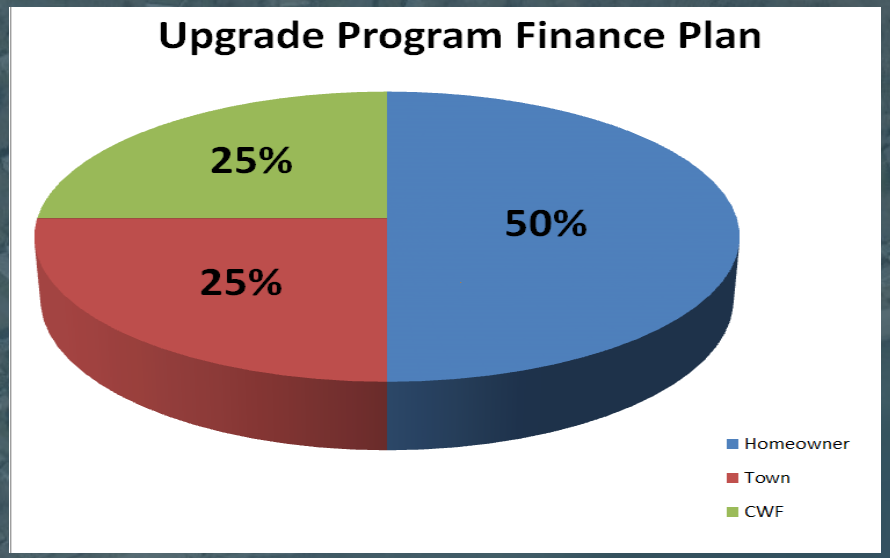
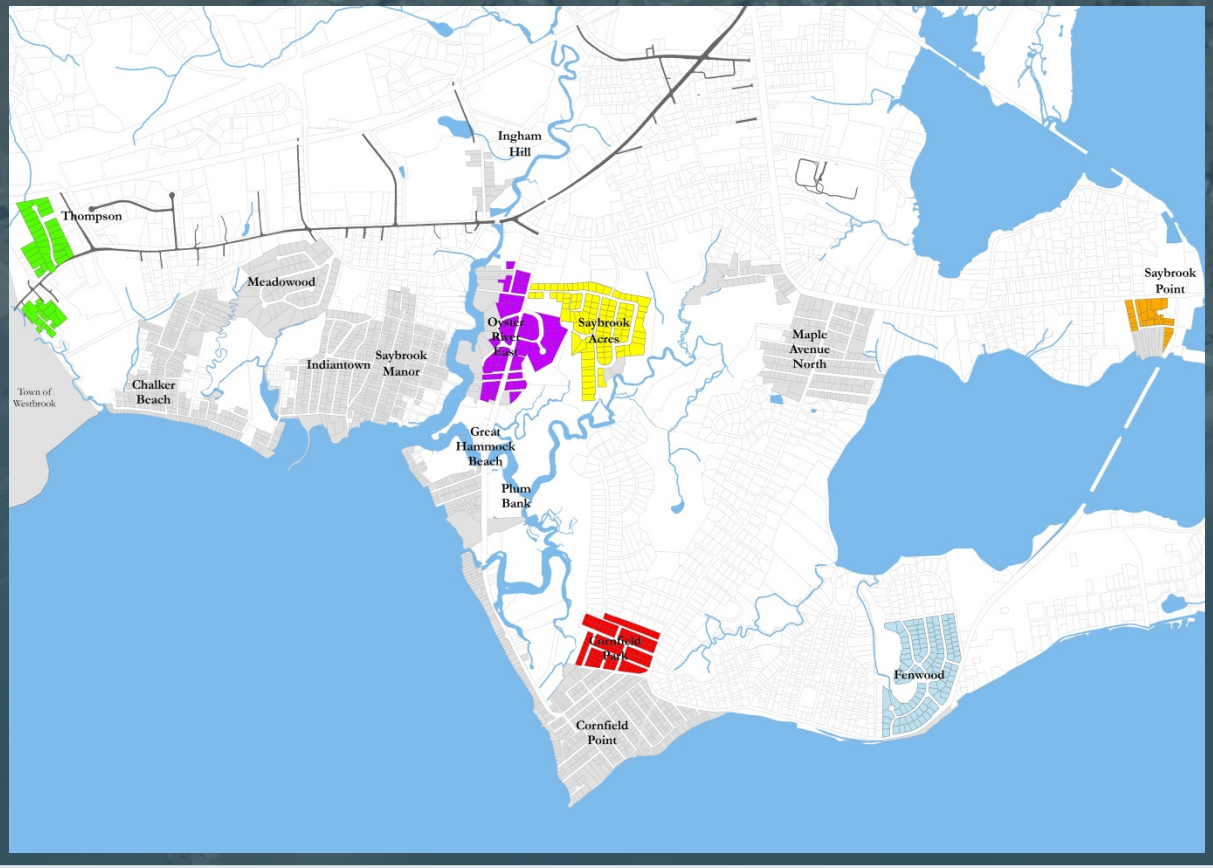
Old Saybrook WWMD Program - Financing

- Financial
  - 25% Clean Water Fund (CWF) Grant, 75% Loan Project
  - 25% Local Contributions
  - 50% Benefit Assessments to End Users



Program Status

- Phase I – Conventional Systems Portion
  - 13 Contracts have been awarded – 285 lots in 6 Focus Areas
  - AT Implementation Proceeding



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AT Systems for Water Proximity Lots

- CTDEEP Finalizing AT Delegation Document
  - Review and approval authority for AT systems to OSWPCA - currently resembles NPDES permit
  - AT Equipment Preselection – No Pre-approved "Black Boxes"
  - AT Management Policies
    - *Corrective Action Triggers*
      - *19 mg/l median or 38 mg/l discrete sample*
    - *Responsibility for Maintenance*

Challenges to AT Systems

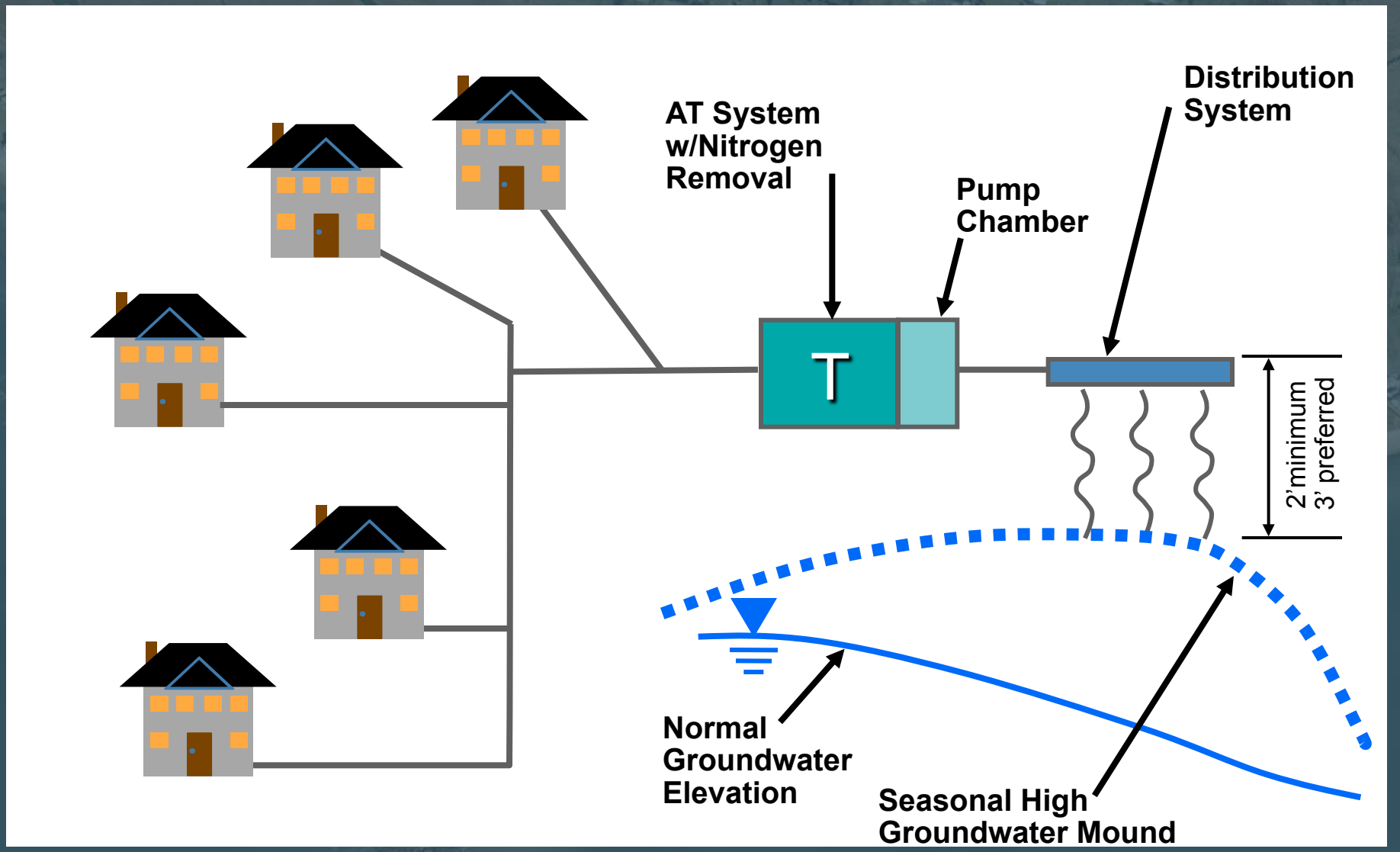
- More Challenging Lots
  - Increased Cost/Lot
  - Climate Change and Sea Level Rise
  - Individual Lot Testing/ Design
- Multiple Agency Reviews (local &DEEP)
- Aesthetics
- Seasonal Occupation

"Goodbye Sandy, Goodnight Irene"

What Are Some Alternatives?

- Cluster and/or Community Systems
  - DEEP Regulated
    - *21 Day Travel Time*
      - *No credit for UV Disinfection*
    - *Mounding Analysis*
      - *Unsaturated depth min. 3 feet*
    - *N-Removal (10 mg/l at Point of Env. Concern)*
    - *1.2 gpd/sf Loading Rate with Pretreatment*
    - *P-Removal Soil Capacity (6 months)*
    - *Individual Permits*

Wastewater Systems – Cluster / Community



NOTE: 21 Day Travel Time to Nearest Sensitive Receptor Required

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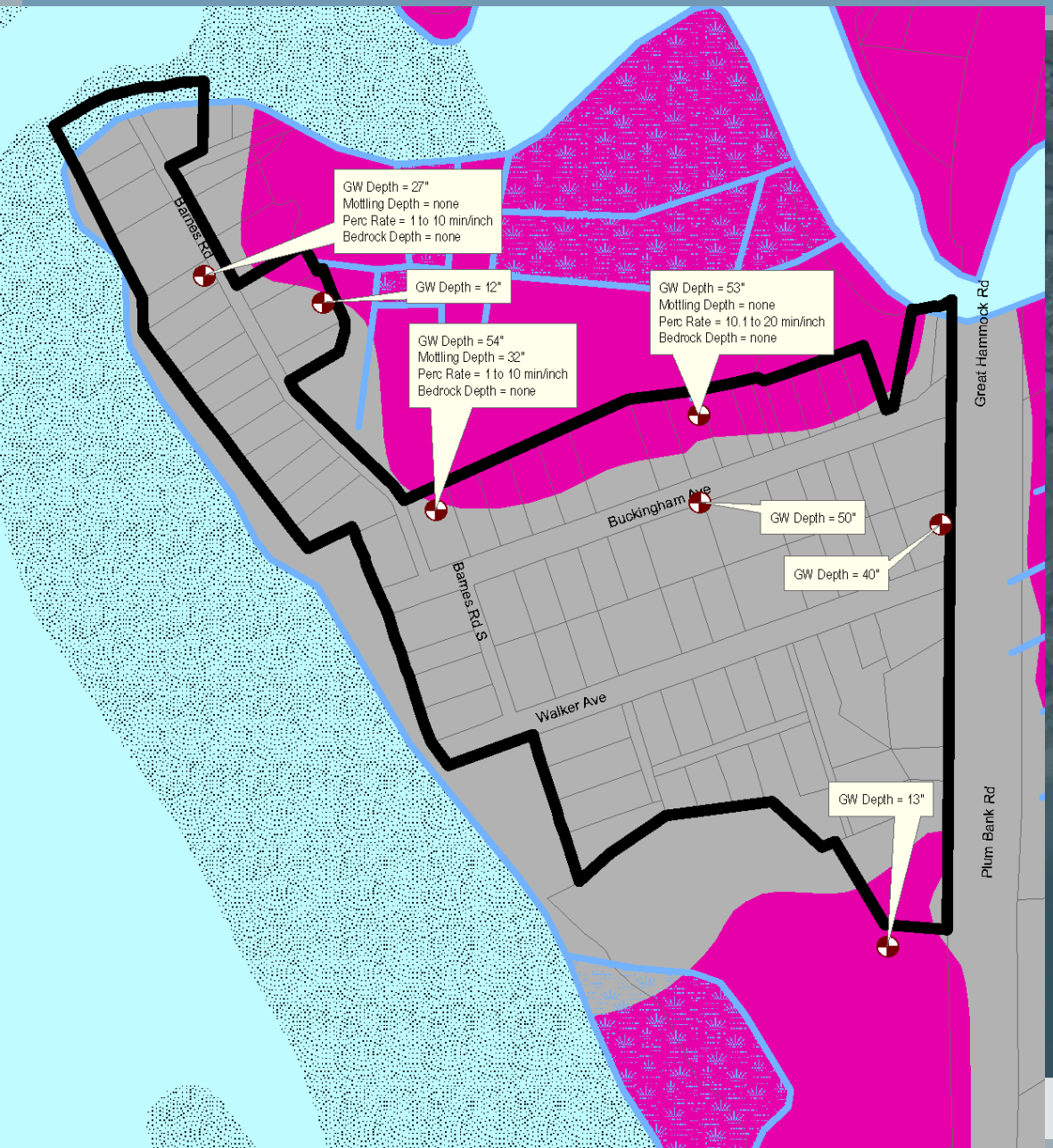
Step 1 – Clusters Within/Adjacent to Focus Areas

- Desktop Evaluation of Phase II Areas
  - Great Hammock Beach
  - Indiantown
  - Ingham Hill
  - Meadowood

Great Hammock Beach



SUBSURFACE CONDITIONS

- Subsurface Data Point
- Study Area Boundary

Subsurface Sewage Disposal Potential

- High Potential
- Medium Potential
- Low Potential
- Very Low Potential
- Extremely Low Potential
- Fill Soils - Not Rated

- Subsurface data points from:
- 1) CRAHD on-site test pit records
- 2) Spring 2002 GW Monitoring report by Cummins Envirotech, Inc.

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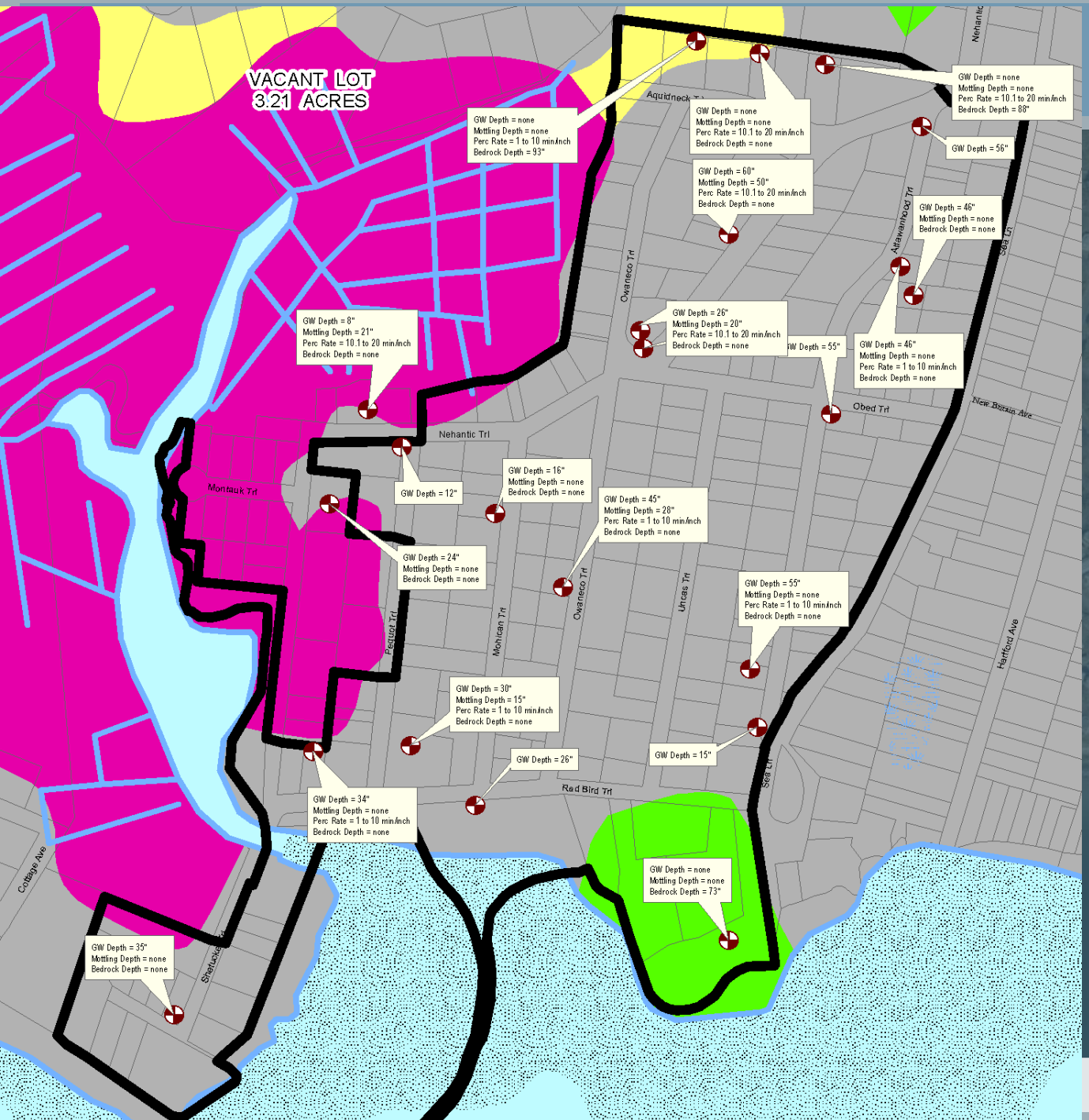
Indiantown



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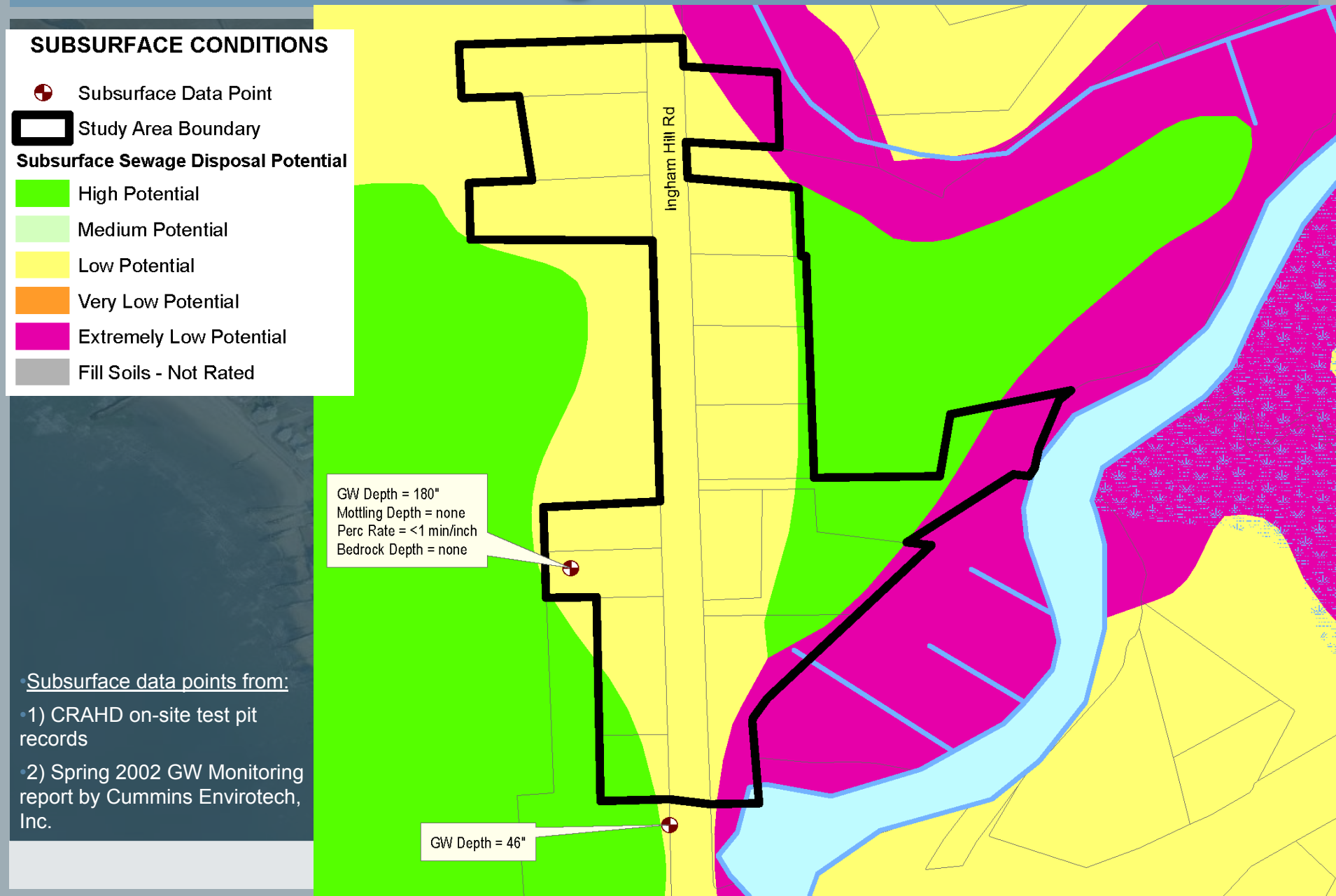
Ingham Hill



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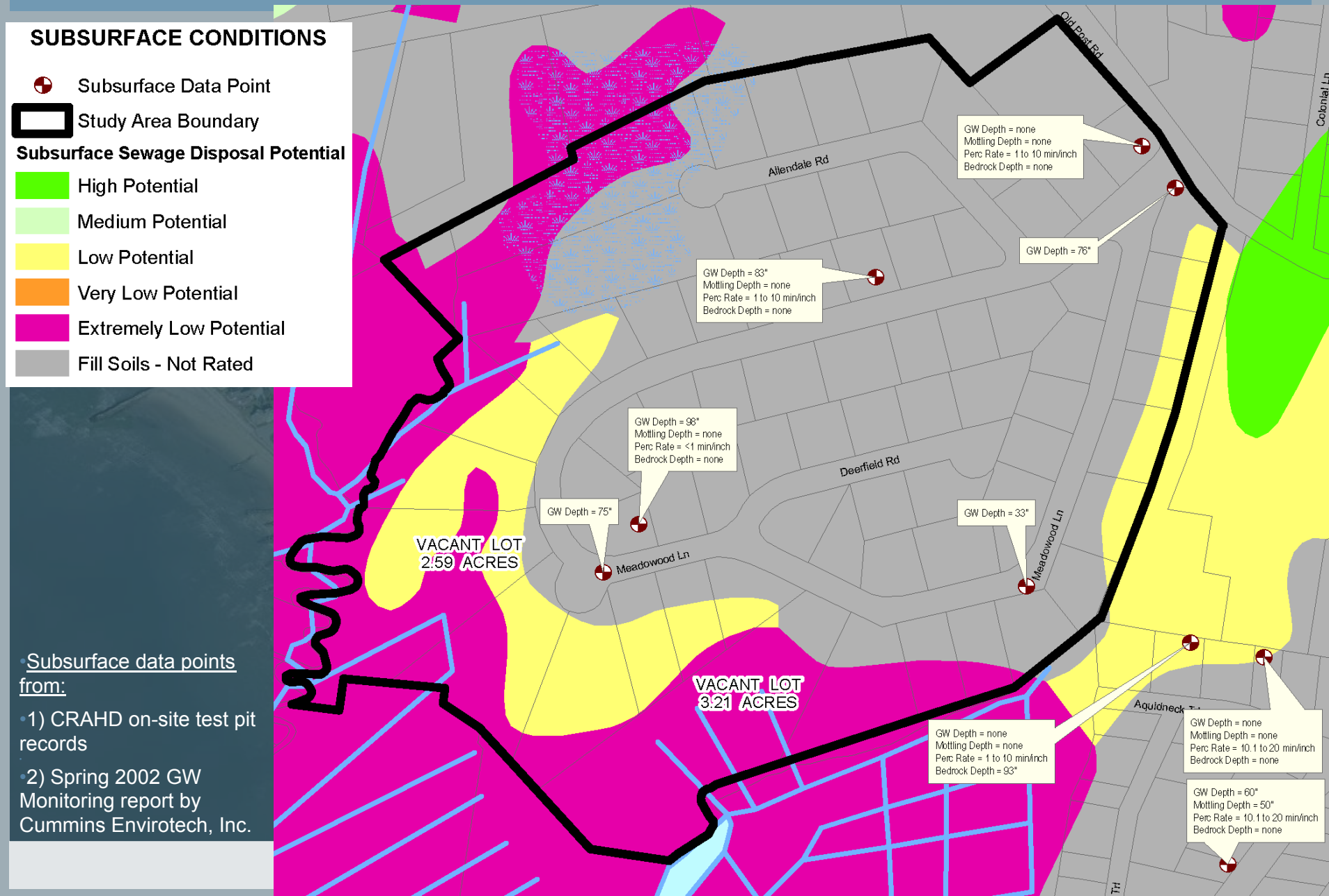
Meadowood



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Great Hammock Beach – Evaluated Sites

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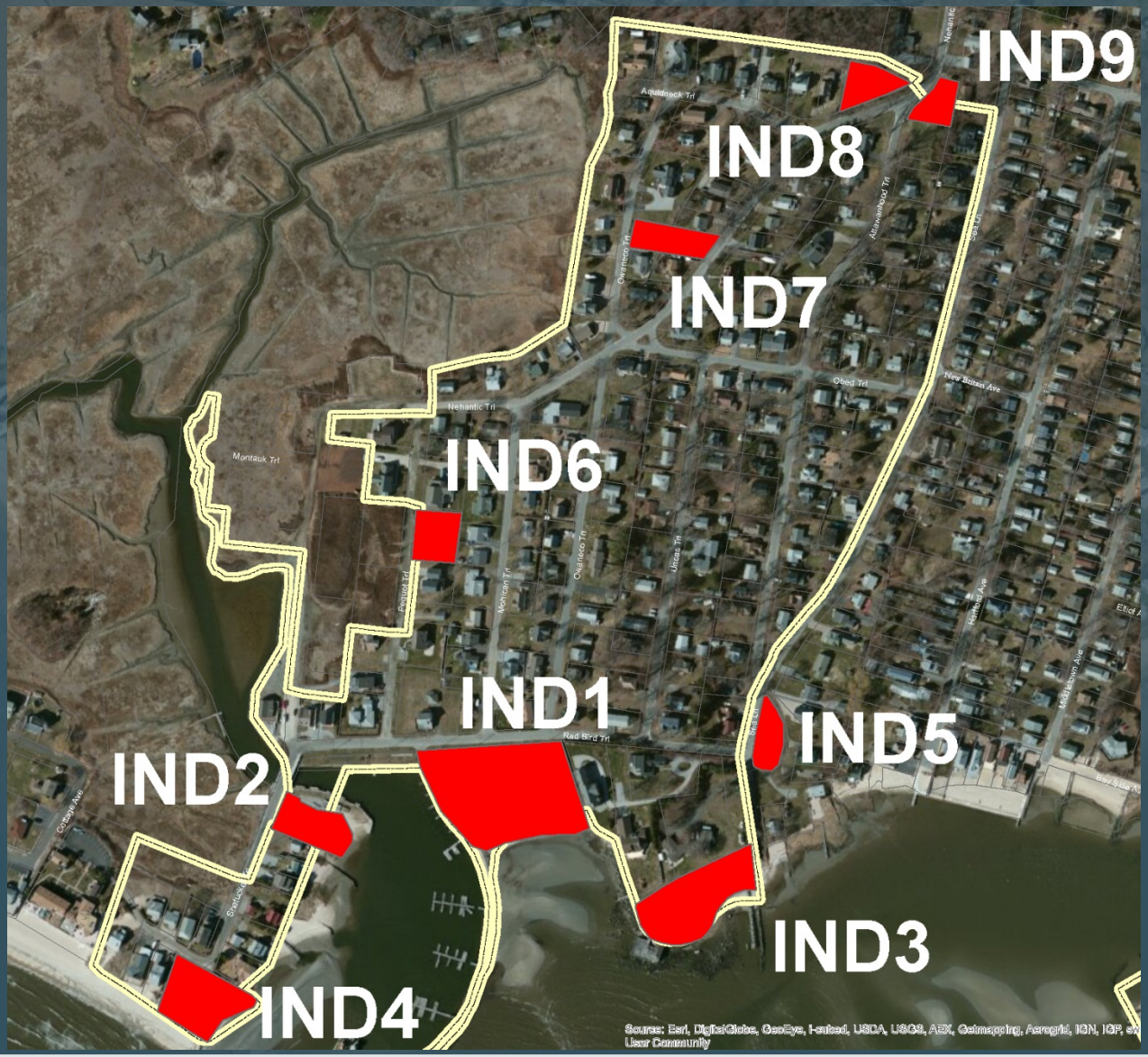
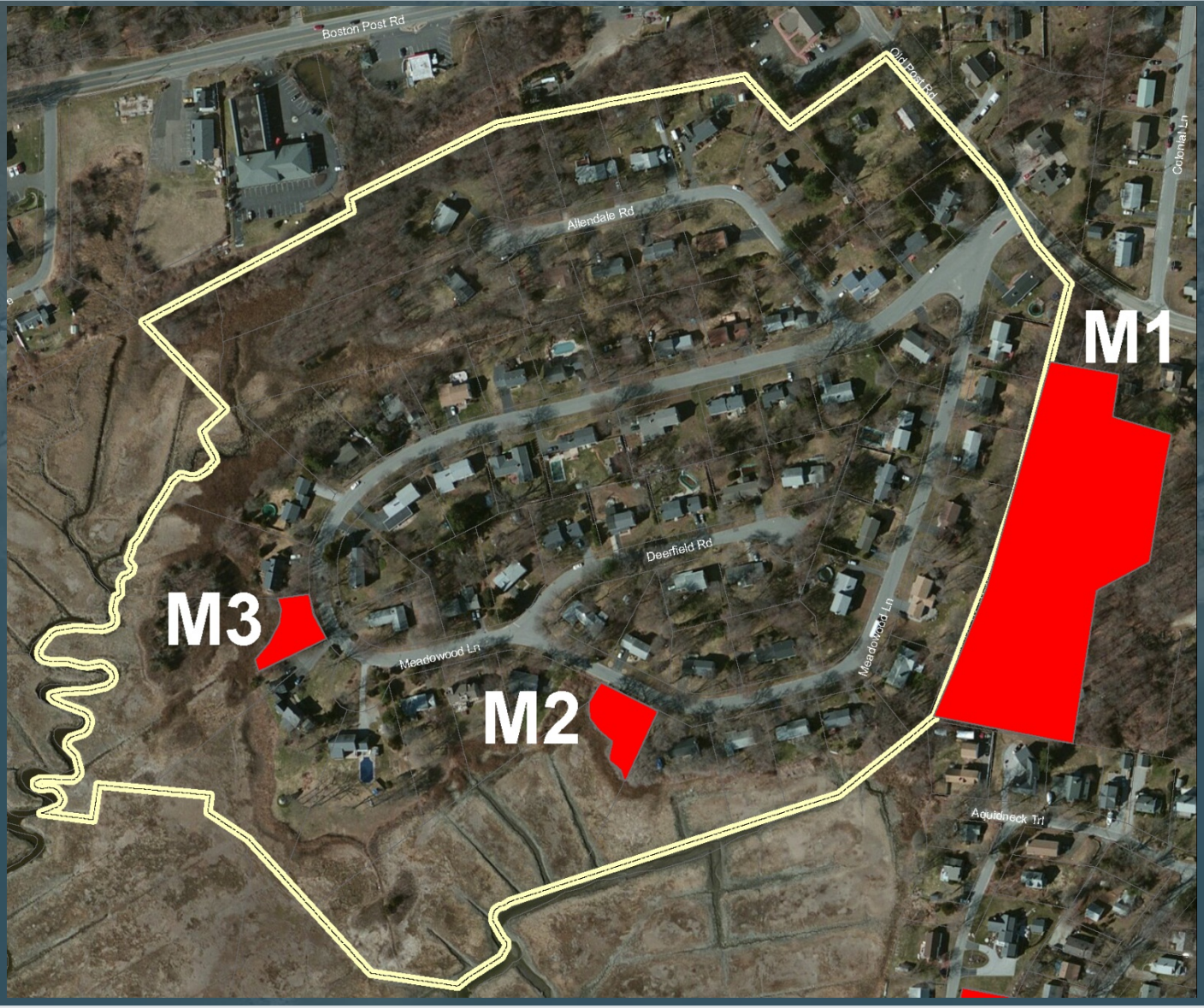
Indiantown – Evaluated Sites



Ingham Hill – Evaluated Sites

Meadowood – Evaluated Sites



Ingham Hill – Site ING1

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Ingham Hill – Site ING1

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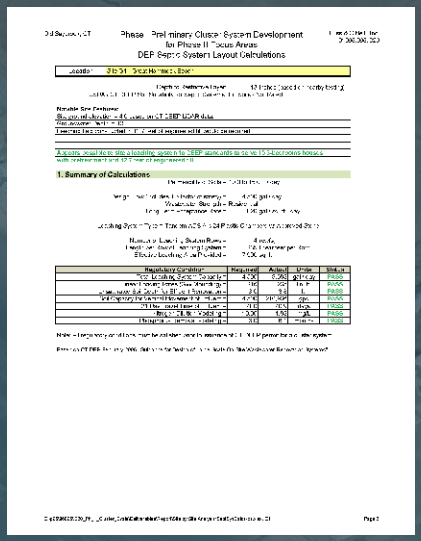
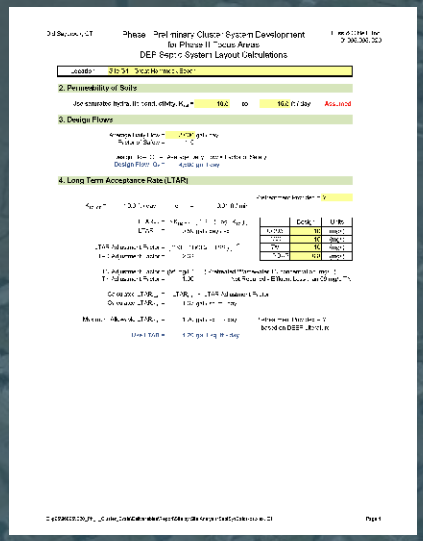
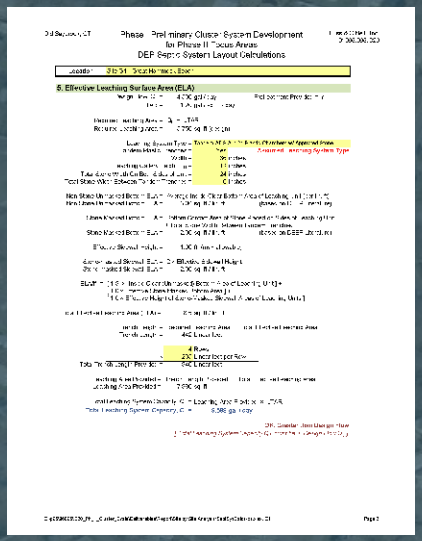
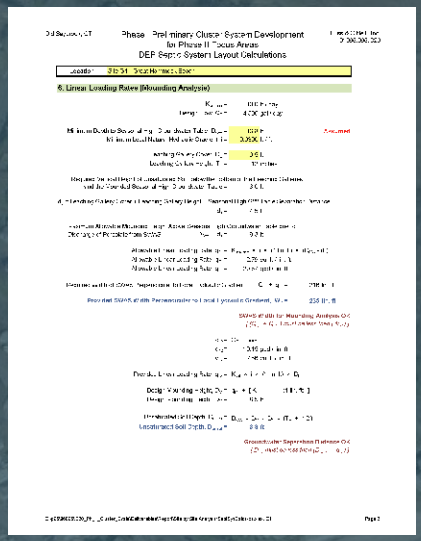
Desktop Evaluations of 19 Sites

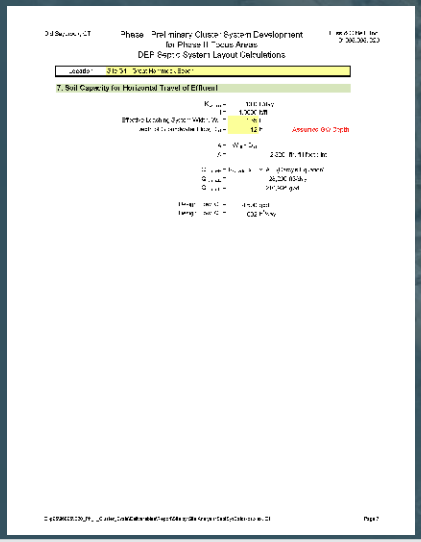
8 pages of calculations per site x 19 Sites = a lot of number crunching!

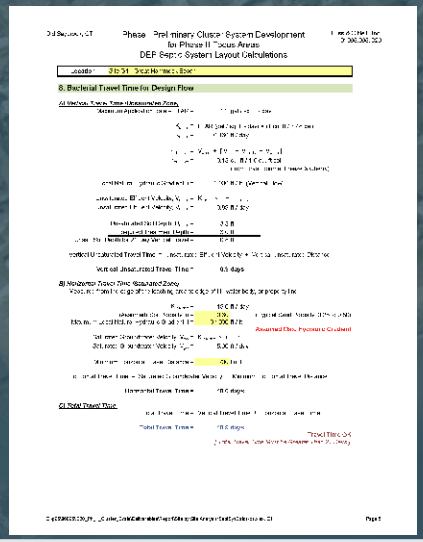


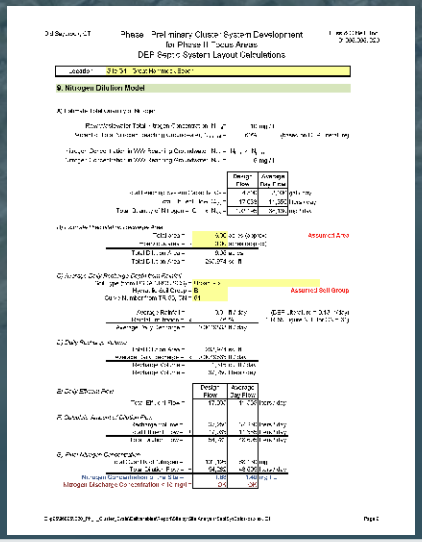


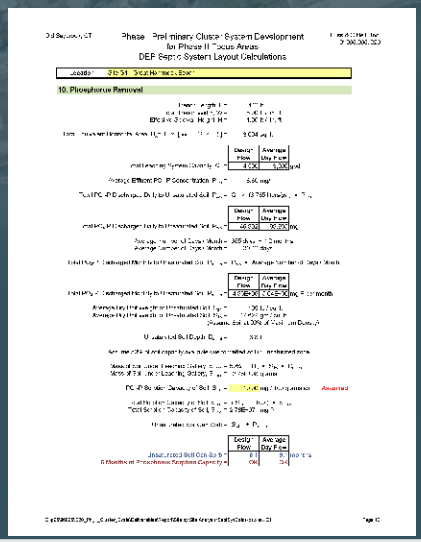












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Great Meadow Beach – Site G1

Great Meadow Beach – Site G1

Depth to Restrictive Layer:	13	inches (based on nearby testing)
USDA / CT DEEP Soil Suitability for Septic Systems:	Fill Soils - Not Rated	

Notable Site Features:

Site ground elevation = 4.0 based on CT DEEP LiDAR data.

Groundwater Depth = 13"

Leaching field constructed in 12.7 feet of engineered fill would be required

Appears possible to site a leaching system to DEEP standards to serve 10 3-bedrooms houses with pretreatment and 12.7 feet of engineered fill.

1. Summary of Calculations

Permeability of Soils =	10.0 to 15.0 ft / day	
Design Flow (includes 1.5 factor of safety) =	4,500	gal / day
Wastewater Strength =	Residential	
Long Term Acceptance Rate =	1.20	gal / sq. ft - day
Leaching System Type =	Tandem ADS Arc 24 Plastic Chambers w/ Approved Stone	
Number or Leaching System Rows =	4	row(s)
Length per Row of Leaching System =	235	linear feet per Row
Effective Leaching Area Provided =	7,990	sq. ft

Regulatory Condition	Required	Actual	Units	Status
Total Leaching System Capacity =	4,500	9,588	gal / day	PASS
Linear Loading Rates (GW Mounding) =	216	235	lin. ft.	PASS
Unsaturated Soil Depth for Effluent Renovation =	3.0	3.8	ft.	PASS
Soil Capacity for Vertical Movement of Effluent =	4,500	210,936	gpd	PASS
21 Day Travel Time of Effluent =	21.0	40.9	days	PASS
Nitrogen Dilution Modeling =	10.00	1.88	mg/L	PASS
Phosphorus Removal Modeling =	6.0	6.1	months	PASS

Note: All regulatory conditions must be satisfied prior to issuance of CT DEEP permit for a cluster system.

Based on CT DEP February 2006 "Guidance for Design of Large-Scale On-Site Wastewater Renovation Systems"

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Long Term ...		...q. ft - day
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N... ...ions must be satisfied prior to issuance of CT DEEP permit for a cluster system.

Based ... ...ebruary 2006 "Guidance for Design of Large-Scale On-Site Wastewater Renovation Systems"

12.7 Feet of Engineered Fill Required!

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Results of Cluster System Desktop Evaluations

Location		Technically Feasible	'Real World' Potential	SWAS Capacity	Comments
Great Hammock Beach	G1	YES	UNLIKELY	10 homes	12.7 ft of fill required
	G2	NO	NO	-	Fails 21-day bacteria travel time
	G3	NO	NO	-	Fails 21-day bacteria travel time
	G4	NO	NO	-	Fails 21-day bacteria travel time
	G5	NO	NO	-	Fails 21-day bacteria travel time
	G6	NO	NO	-	Fails 21-day bacteria travel time
Indiantown	IND1	YES	UNLIKELY	17 homes	8.9 ft of fill required
	IND2	NO	NO	-	Fails 21-day bacteria travel time
	IND3	NO	NO	-	Fails 21-day bacteria travel time
	IND4	YES	NO	1 home	Supports a 4-bedroom home
	IND5	NO	NO	-	Fails 21-day bacteria travel time
	IND6	YES	NO	1 home	Supports a 2-bedroom home
	IND7	YES	NO	1 home	Supports a 2-bedroom home
	IND8	NO	NO	-	Fails 21-day bacteria travel time
	IND9	NO	NO	-	Fails 21-day bacteria travel time
Ingham Hill	ING1	YES	VERY LIKELY	33 homes	Need detailed subsurface investigation
Meadowood	M1	YES	LIKELY	24 homes	Site drainage design challenges
	M2	NO	NO	-	Fails 21-day bacteria travel time
	M3	NO	NO	-	Fails 21-day bacteria travel time

Typical house size is 3 bedrooms (450 GPD per home) unless otherwise noted.

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Order of Magnitude Opinion of Costs

- With Standard 21-day Bacteria Travel Distance Requirement

Location		'Real World' Potential	Opinion of Cost (-30 to + 50%)	Number of Homes	Cost per Home (-30% to +50%)
Great Hammock Beach	G1	UNLIKELY	$ 1,368,000	10 homes	$ 136,800
Indiantown	IND1	UNLIKELY	$ 948,000	17 homes	$ 55,765
Ingham Hill	ING1	VERY LIKELY	$ 1,704,000	33 homes	$ 51,636
Meadowood	M1	LIKELY	$ 2,004,000	24 homes	$ 83,500

Note: Average home size of 3 bedrooms (450 GPD per home)

- Costs include 20% for Engineering/Permitting/Legal/Administrative

- DISCLAIMER: Since Fuss & O'Neill has no control over the cost of labor, materials, equipment or services furnished by others, or over the Contractor(s)' methods of determining prices, or over competitive bidding or market conditions, Fuss & O'Neill's opinion of probable Total Project Costs and Construction Cost are made on the basis of Fuss & O'Neill's experience and qualifications and represent Fuss & O'Neill's best judgment as an experienced and qualified professional engineer, familiar with the construction industry; but Fuss & O'Neill cannot and does not guarantee that proposals, bids or actual Total Project or Construction Costs will not vary from opinions of probable cost prepared by Fuss & O'Neill. If prior to the bidding or negotiating Phase the Owner wishes greater assurance as to Total Project or Construction Costs, the Owner shall employ an independent cost estimator.

Order of Magnitude Opinion of Costs

- With 5 Log pathogen reduction vs 21-day Bacteria Travel Distance Requirement

Location		'Real World' Potential	Opinion of Cost (-30 to + 50%)	Number of Homes	Cost per Home (-30% to +50%)
Great Hammock Beach	G1	UNLIKELY	$ 1,368,000	10 homes	$ 136,800
Indiantown	IND1	UNLIKELY	$ 948,000	17 homes	$ 55,765
Ingham Hill	ING1	VERY LIKELY	$ 840,000	33 homes	$ 25,455
Meadowood	M1	LIKELY	$ 2,004,000	24 homes	$ 83,500

Note: Average home size of 3 bedrooms (450 GPD per home)

- Costs include 20% for Engineering/Permitting/Legal/Administrative

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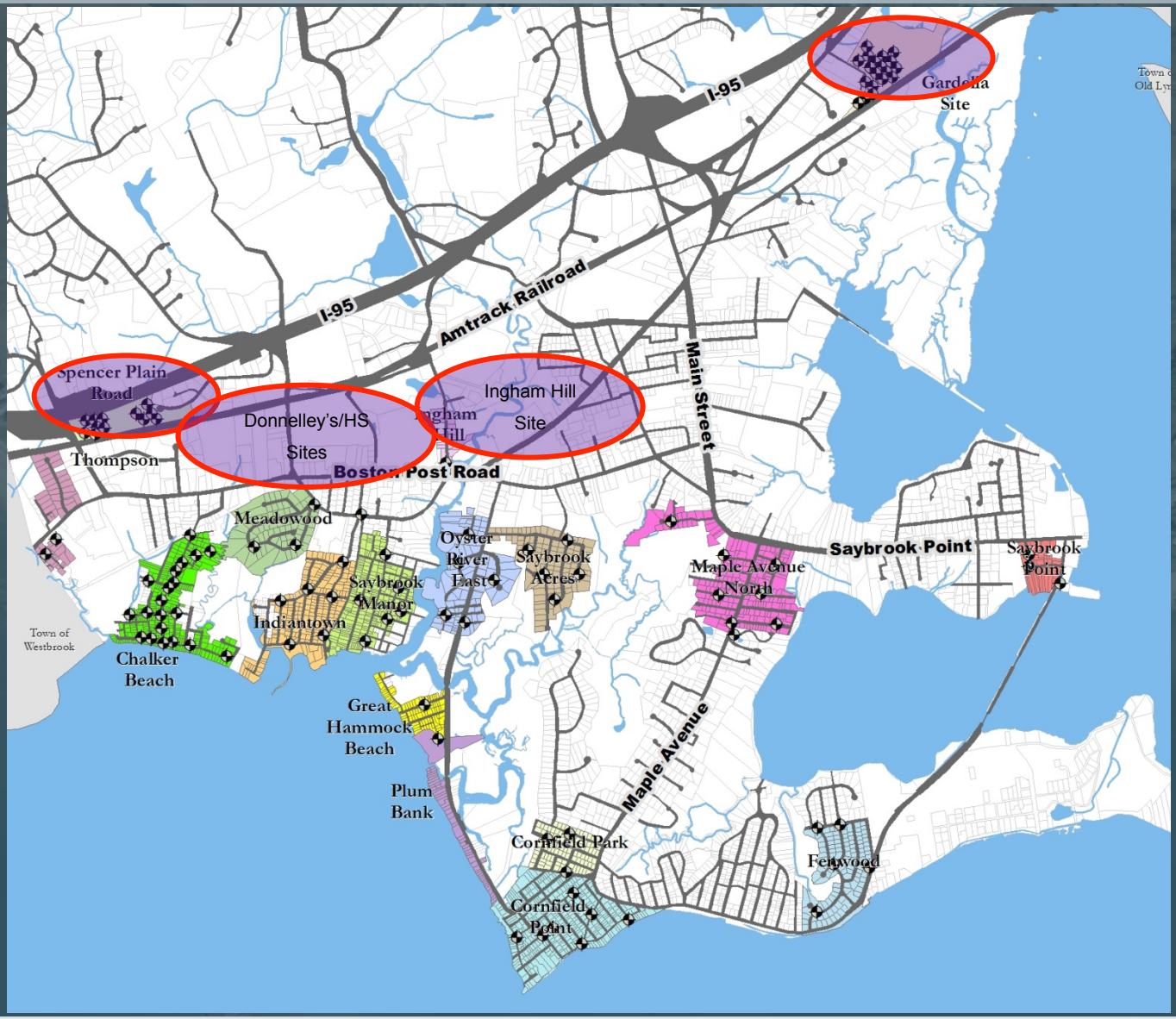
Now What?

- Desktop Evaluation of Remote Community Locations
  - Great Hammock Beach
  - Indiantown
  - Ingham Hill
  - Meadowood

Overall Map



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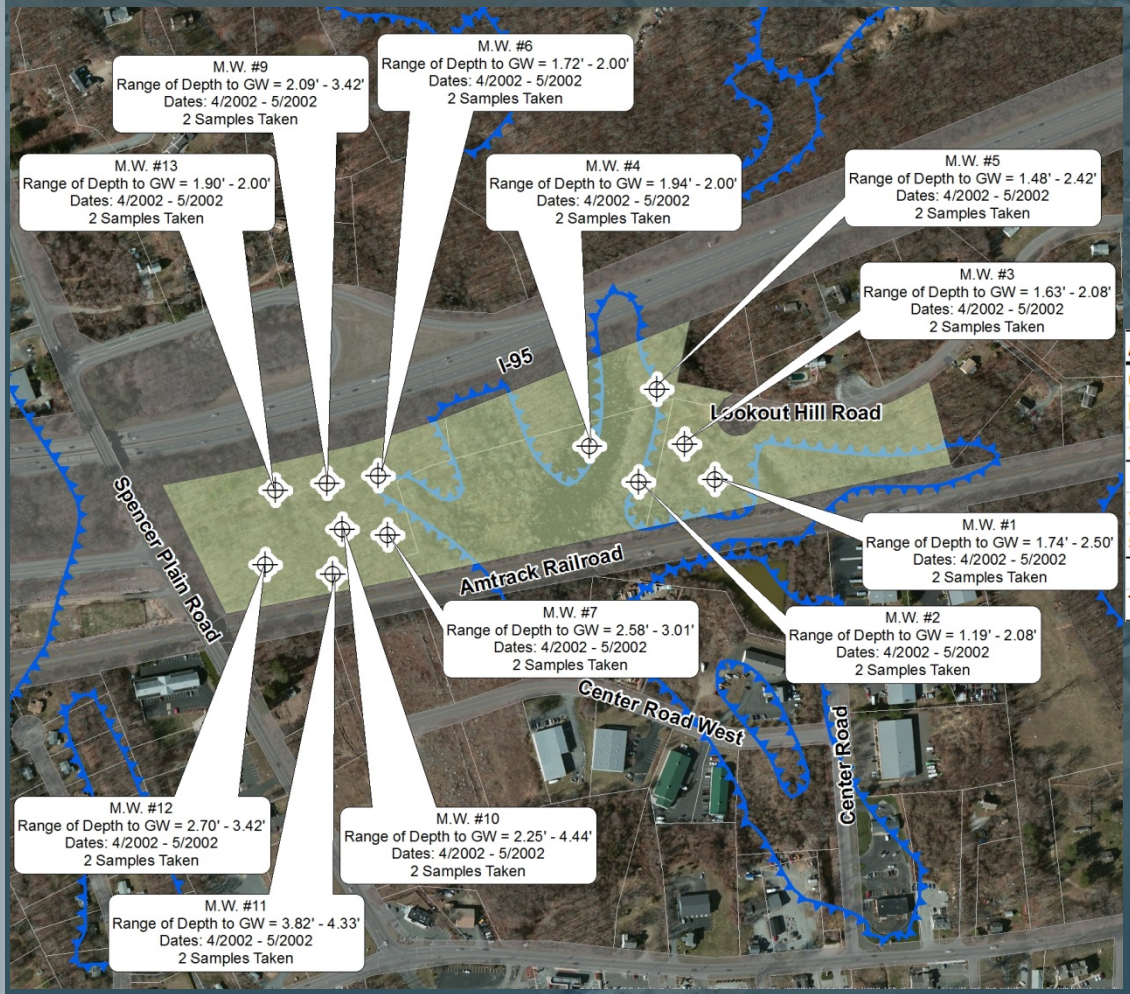
Site 12 – 52 Spencer Plain Road



- Evaluated in Fall 2002
- Evaluated to treat flow from the following Focus Areas:
  - Chalker Beach
  - Indiantown
  - Saybrook Manor
- All above mentioned focus areas are approx. 1.5 miles away from the site. Conveyance cost approx. $2.4M[1]

Area	# of Houses	Unit Wastewater Flows (1)	Total
Chalker Beach	252	140 gal./ho.-day	35,280
Indiantown	184	140 gal./ho.-day	25,760
Saybrook Manor	247	140 gal./ho.-day	34,580
Subtotal	683	140 gal./ho.-day	95,620
50% Safety Factor		70 gal./ho.-day	47,810
Total [Rounded Up] (2)			143,500

- Two options evaluated:
  - Option 1 Capacity – 155,00 GPD[2]
  - Option 2 Capacity – 148,000 GPD[2]
  - 24 Foot Mound

Notes:

1.) Conveyance costs estimated assuming $300 per LF of sewer main.

2.) Flow is based on Draft $A_{Municipal}$ Regulations that were never adopted by DEEP. Site capacity is 50,000 GPD not basing is on Draft $A_{Municipal}$ Regulations

12. BEACON HILL	Very st.f. Sandy Lm	3.0	0.5	DNA	DNA	240,000 (GW @ 20')

•Note: Site can handle larger flows with 5 log reduction in pathogens through UV

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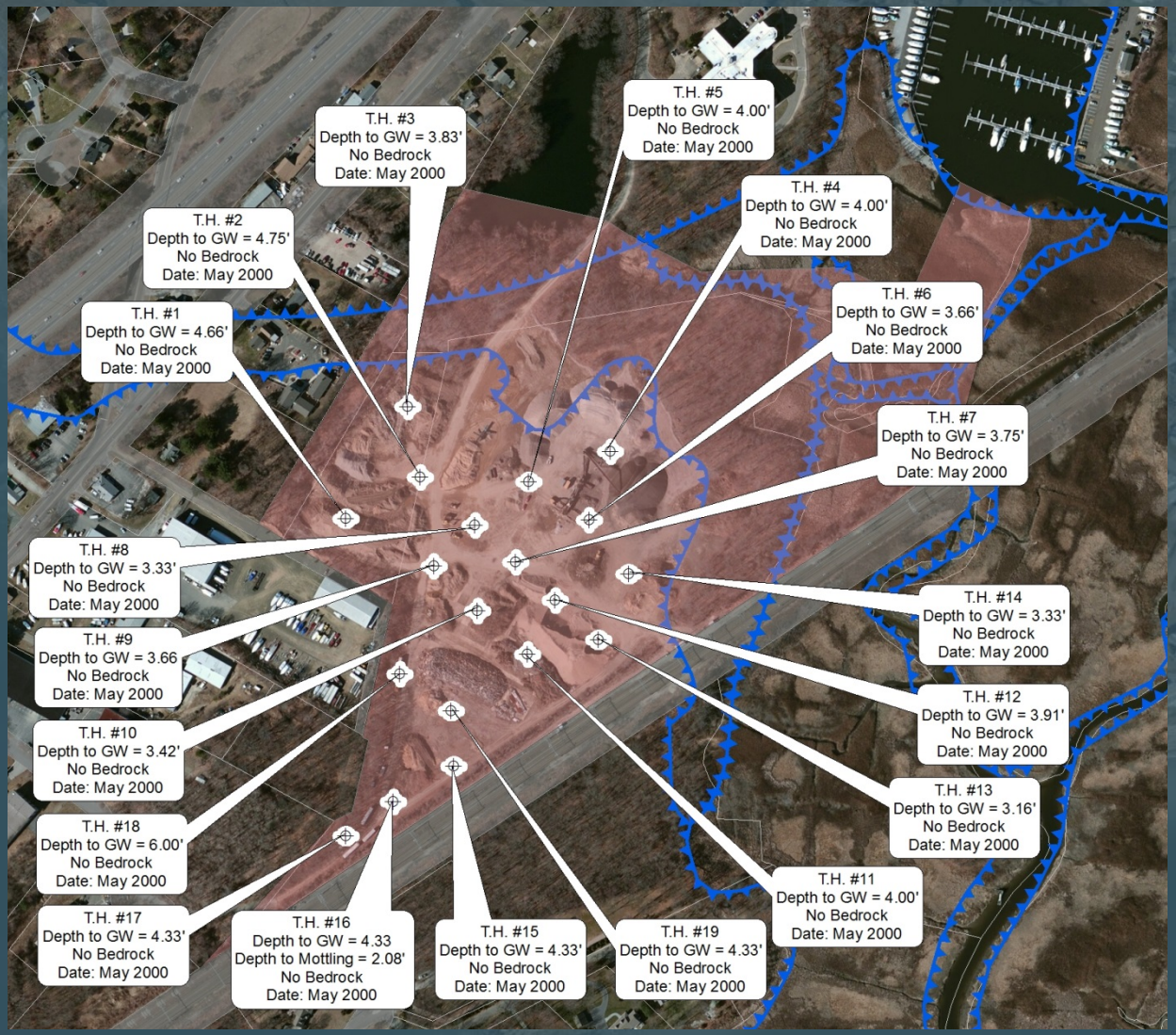
Gardella Site



- Evaluated in Spring 2000
- Identified as site with second highest disposal capacity per Weston & Sampson Report dated 1993.
- Site Characteristics:
  - 37 Acres
  - Capacity: 150,000 GPD[1]
- Evaluated to treat flow from the following Focus Areas:
  - Chalker Beach
  - Indiantown
  - Saybrook Manor
- Maple Ave. North to Gardella Site → Approx. 1.7 miles (Conveyance cost approx. $2.7M)[2]
- Saybrook Manor to Gardella Site → Approx. 2.2 miles (Conveyance cost approx. $3.5M)[2]

Notes:

1.) Flow is based on Draft $A_{Municipal}$ Regulations that were never adopted by DEEP

2.) Conveyance costs estimated assuming $300 per LF of sewer main.

•Note: Depth to groundwater likely inaccurate due to excavation at gravel pit site

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Donnelley Site and OS High School

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Site 8 – Ingham Hill Farm/Gravel Pit

- Address: 60 Ingham Hill Road

8. INGHAM GRAVEL PIT	Sandy Loam	13.0	0.8	60,000 (8' MOUND)	274'/SIDE (1.7 Ac.)	10,500 (GW @ 10')

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Next Steps

- Complete Conventional Systems/Continue AT Regs
- Obtain Access to Sites
- Boots on the Ground
  - Dig and log test pits with DEEP
  - Run grain size analysis of soil
  - Determine permeability samples
  - Test phosphorus sorption capacity of soil
  - Install groundwater standpipes
  - Monitor high groundwater levels
- Compare Costs vs AT with Updated Field Information
- Petition for 5-Log Pathogen Reduction
- Submit Revised Plans to DEEP and OSWPCA

Questions

Kurt A. Mailman, P.E.
kmailman@fando.com
860-646-2469 ext. 5244

Decentralized Nutrient Removal Systems

- Decentralized - Advanced Treatment
  - "Mini" treatment plants at each home

Textile Filter

Aerated Media Filter

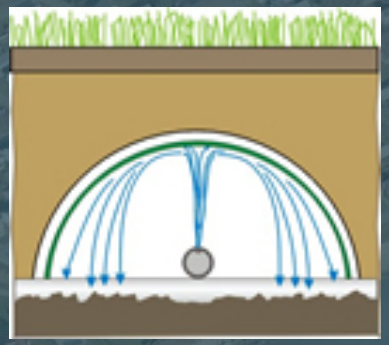
Trickling Filter

Nitrogen and Pathogen Reduction

- Aeration Systems
- Textile Filters
- Peat Filters
- Shallow Narrow Drainfields
- Sand Filters, etc.
- UV disinfection

Decentralized Dispersal Systems

Drip Dispersal



Shallow Narrow Drainfield*

Recirculating Sand Filter

* Shallow Narrow Drainfield Figure Courtesy of URI

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More Decentralized Dispersal Systems

Bottomless Sand Filter - Complete

HDPE Leaching Galleries

Smaller Bottomless Sand Filter

Textile Filter

Peat Filter

AT Treatment Train

Effluent Pump Chamber

Sequencing Distribution Valves

Treatment Train - Landscaped

Treatment Train with Nutrient Removal - NY

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Proprietary Low Profile Leaching System

Conventional Septic System

Basement

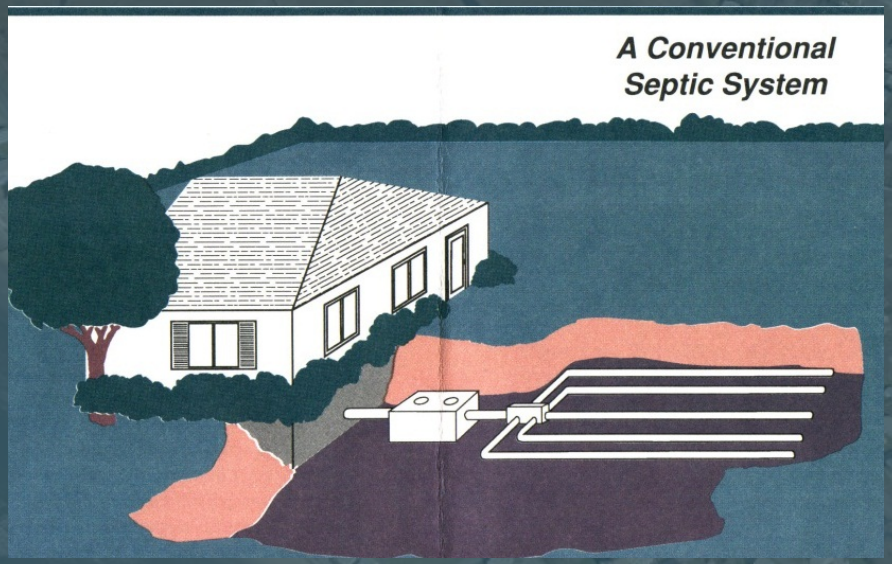
Septic Tank

Leaching System

Septic System Effluent

Minimum 24 inch Vertical Separation Distance Required

Ground Water


A Conventional
Septic System


YANMAR

Step 4: Construction

- Construct System Improvements
  - Contractor pulls Permit to Construct
  - WPCA Site Manager oversight
  - WPCA administers contract
    - *Pay Requisitions*
    - *Change Orders*
    - *Recordkeeping*
    - *Communication with Property Owners*
    - *Ensures work is Clean Water Fund eligible*

Upgrade Standards - Conventional

Leaching System

- Public Health Code Compliant
- Max. 4' new component height
- Max. Depth of System 8 ft
  - No Cesspools
  - Minimum 2/3 of Effective Leaching Area
- 72 sq. ft leaching per bedroom
- Must have 24 inches from the bottom of the leaching system and seasonal high groundwater
- *OTHERWISE ADVANCED TREATMENT REQUIRED!*