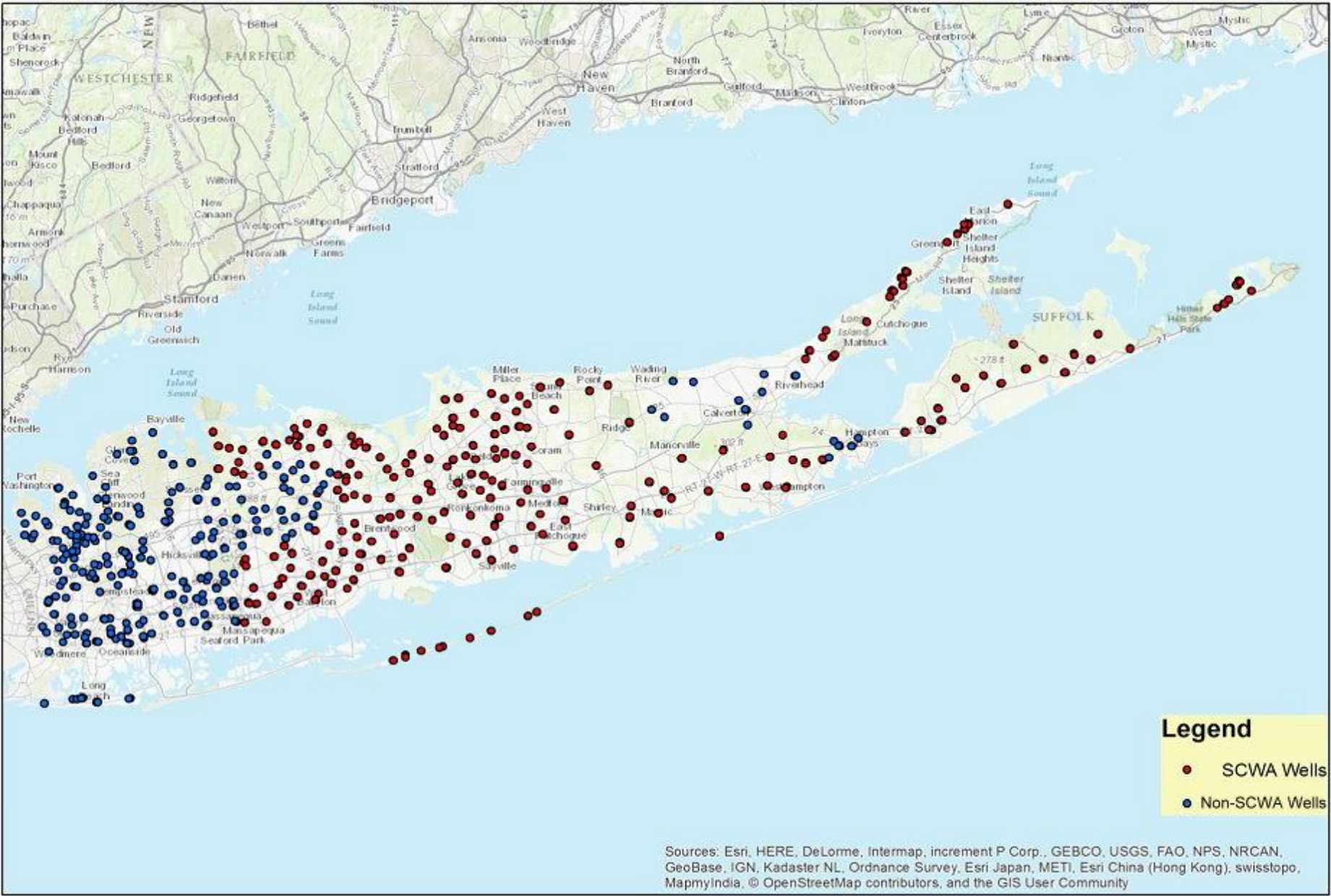


Public Water Supply Emerging Contaminants Challenges and Technologies



Tyrand Fuller, P.G.
Director of Strategic Initiatives
Suffolk County Water Authority
Tfuller@SCWA.com

Public Supply Wells on Long Island



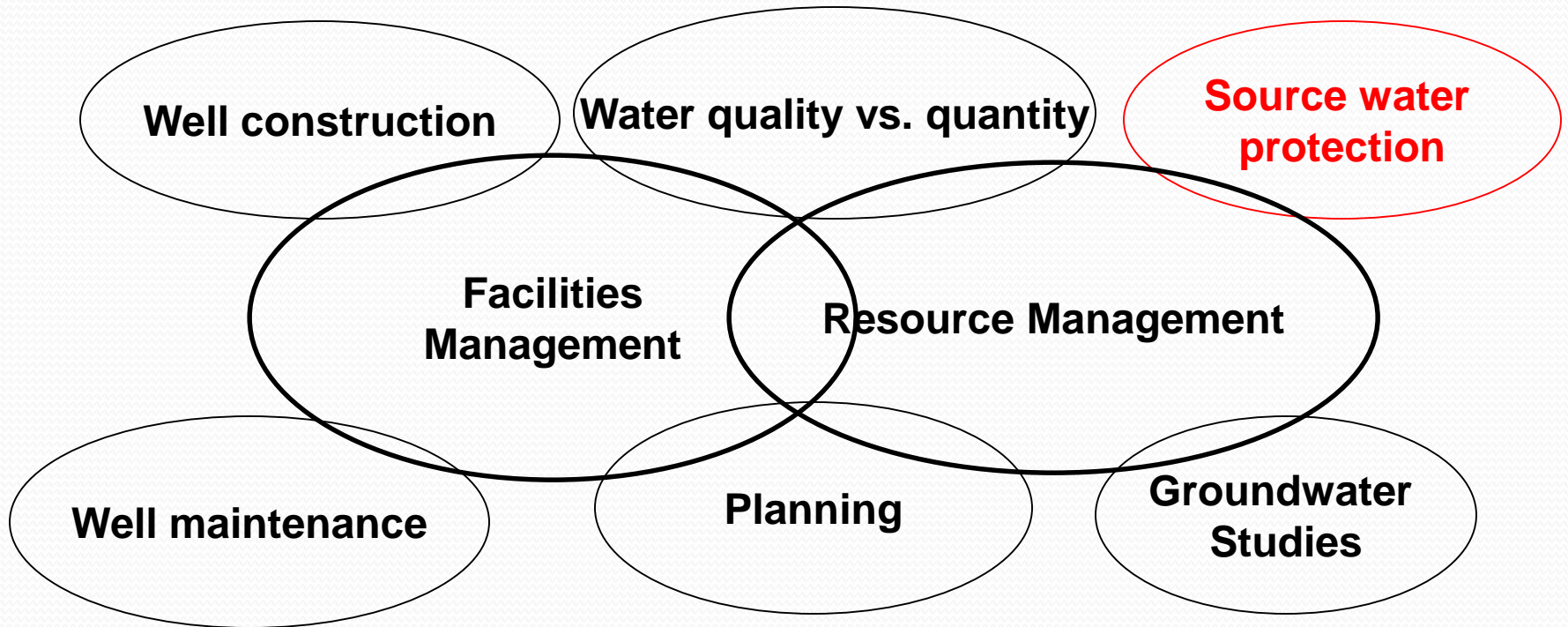
Legend

- SCWA Wells
- Non-SCWA Wells

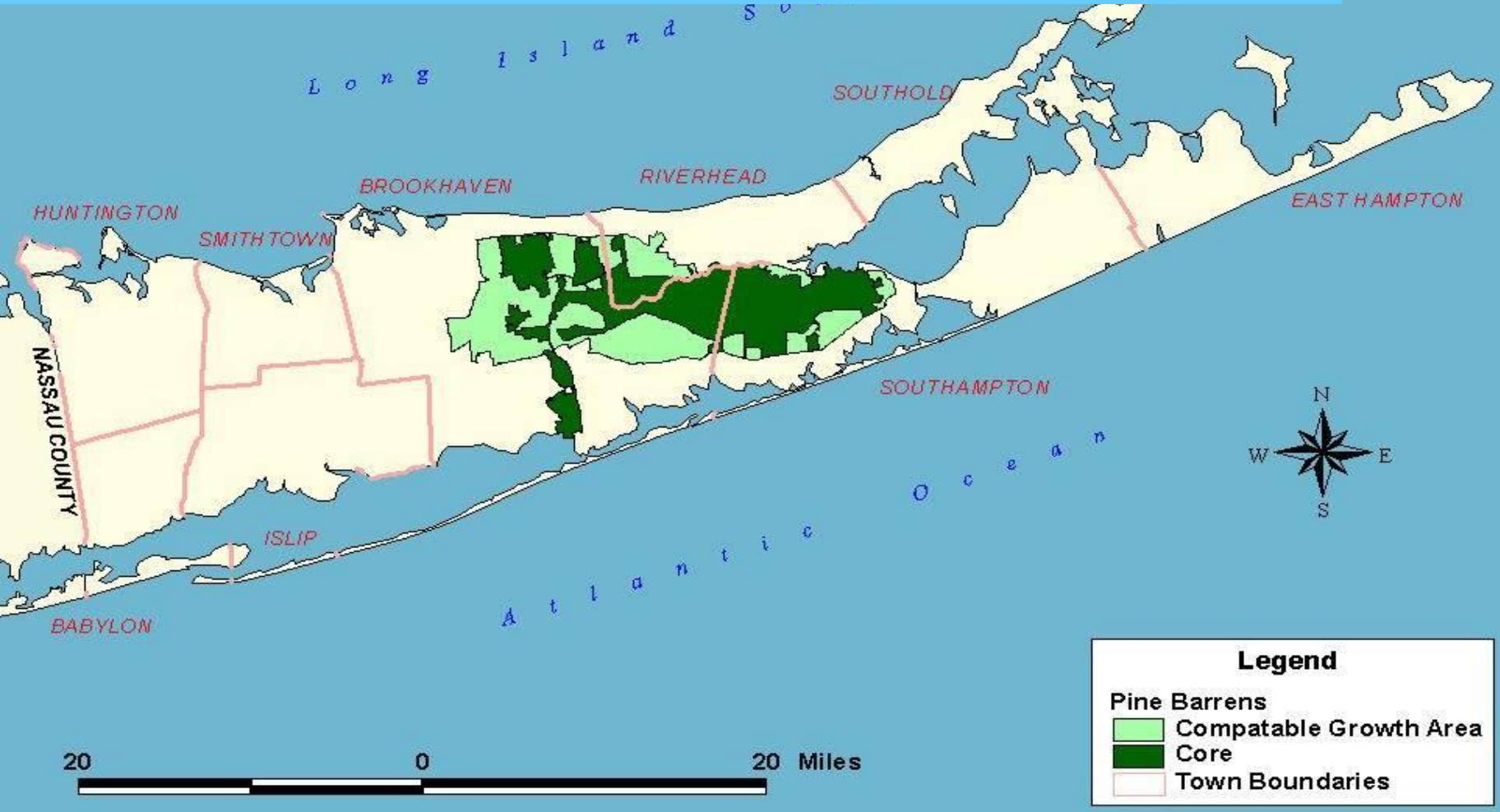
Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community



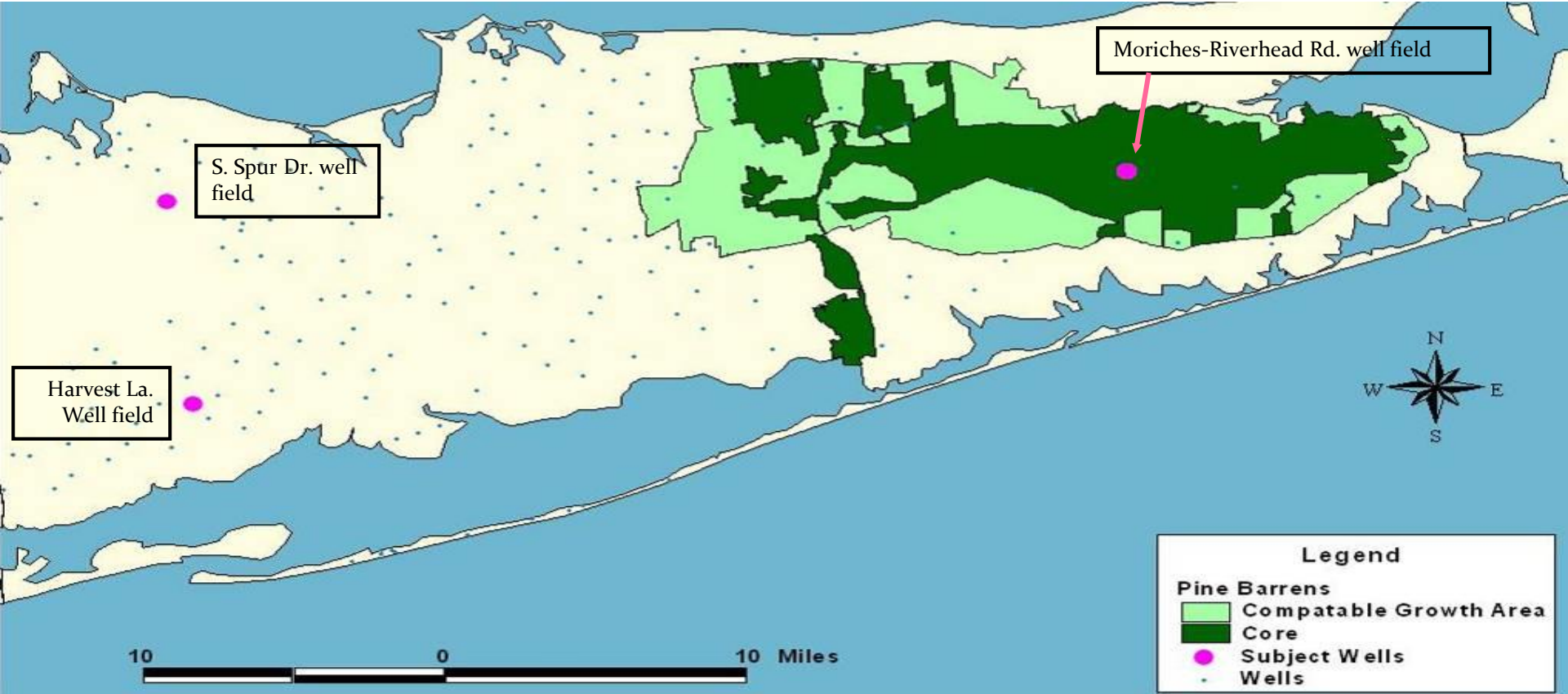
Evolution of Water Supply



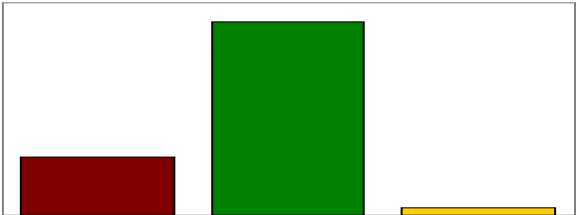
Close - up of Central Pine Barrens Area



Open Space Preservation = Improved Water Quality



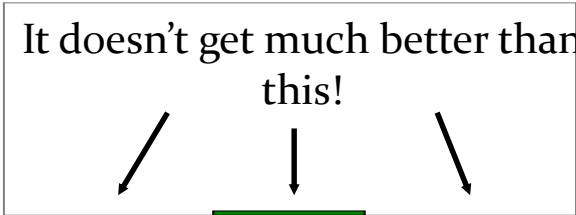
South Spur Drive, Northport



Harvest La., West Islip



Moriches - Riverhead Rd., Riverside



THE BEST SOURCE WATER – No signs of civilization !!

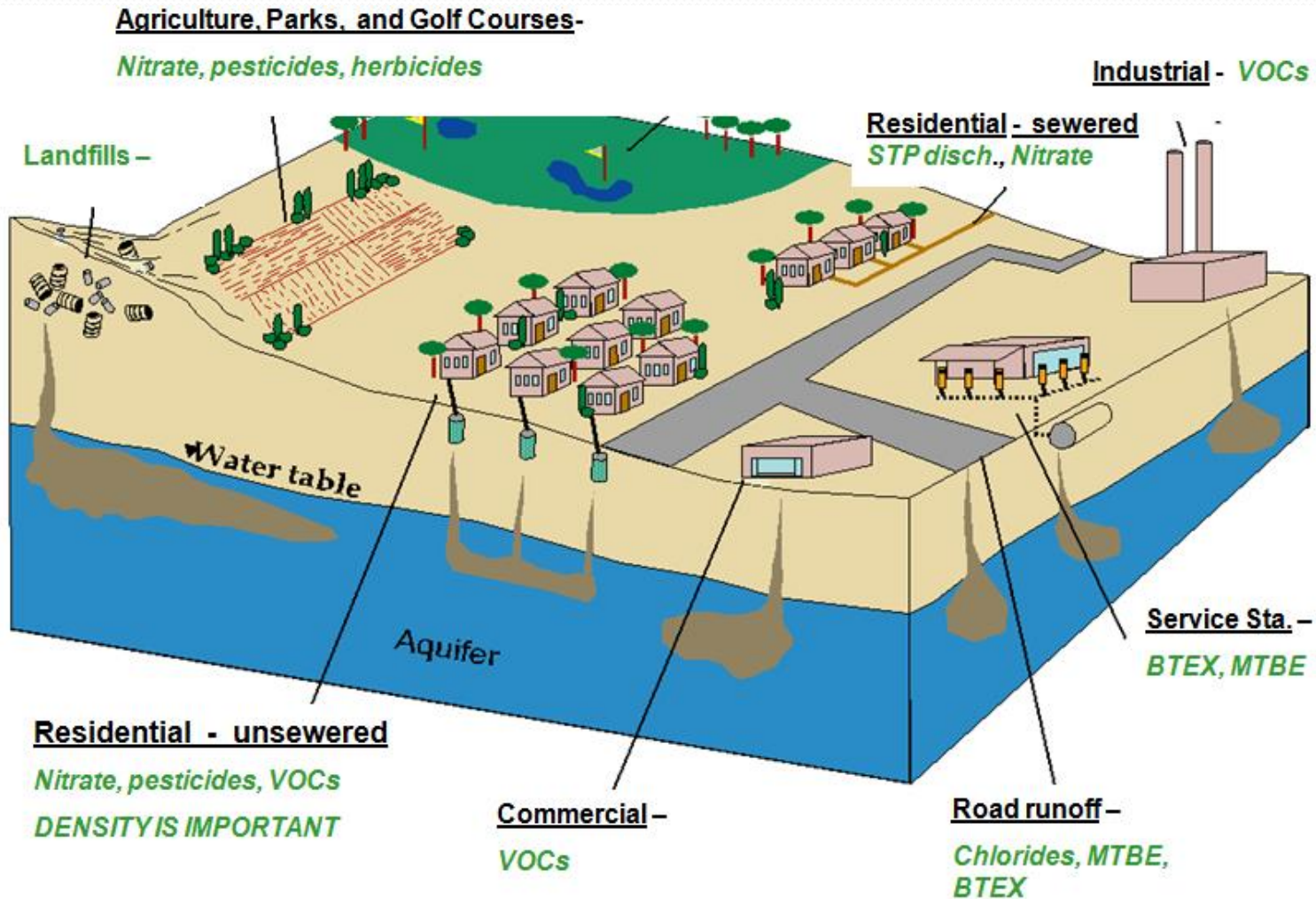


“Poor, Scrubby Land of Indifferent Quality” – George Washington



Public Supply Well Management:

Land Uses vs. contaminant "signature"

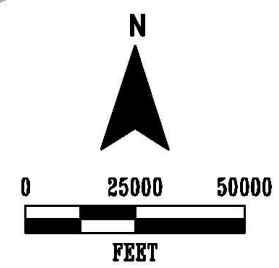
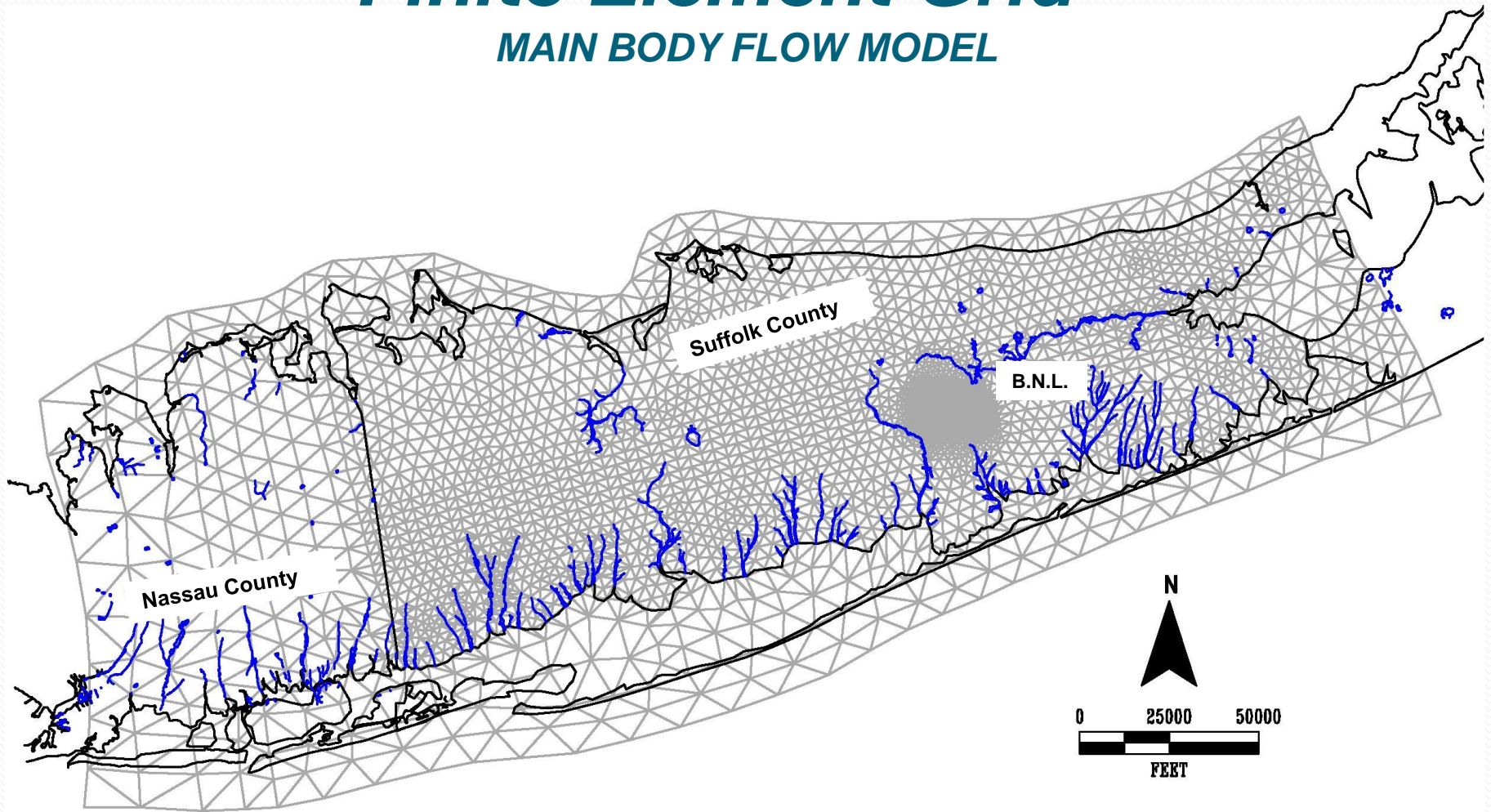


Source Water Assessment



Finite Element Grid –

MAIN BODY FLOW MODEL



SOURCE WATER ASSESSMENT PROGRAM (S W A P)

- **Objective:** IDENTIFY POTENTIAL THREATS TO PUBLIC WATER SUPPLIES
- Utilized **Suffolk County Groundwater Model** to delineate Source Areas to wells
SUB REGIONAL GRIDS – better detail
- Every PSW in Nassau and Suffolk (1300 + wells)
- Assumed simultaneous, annualized avg. pumping

AFTER SOURCE AREAS WERE DELINEATED

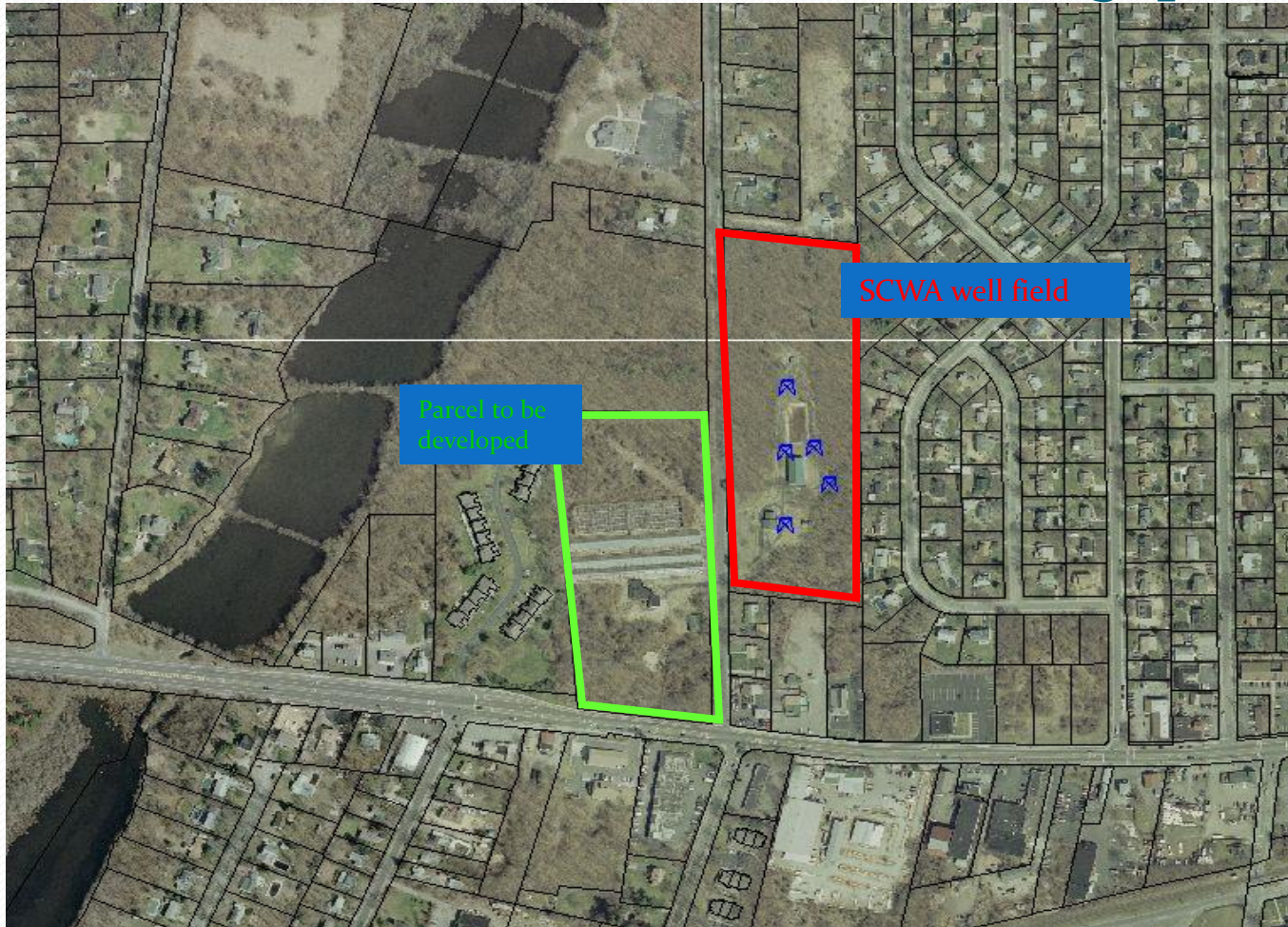
- Used existing information
 - Land use
 - point sources – tanks, spills, SPDES, etc. to produce **contaminant inventory** and **susceptibility assessment**



Example of
S W A P
Concepts Applied to
Real World Situations

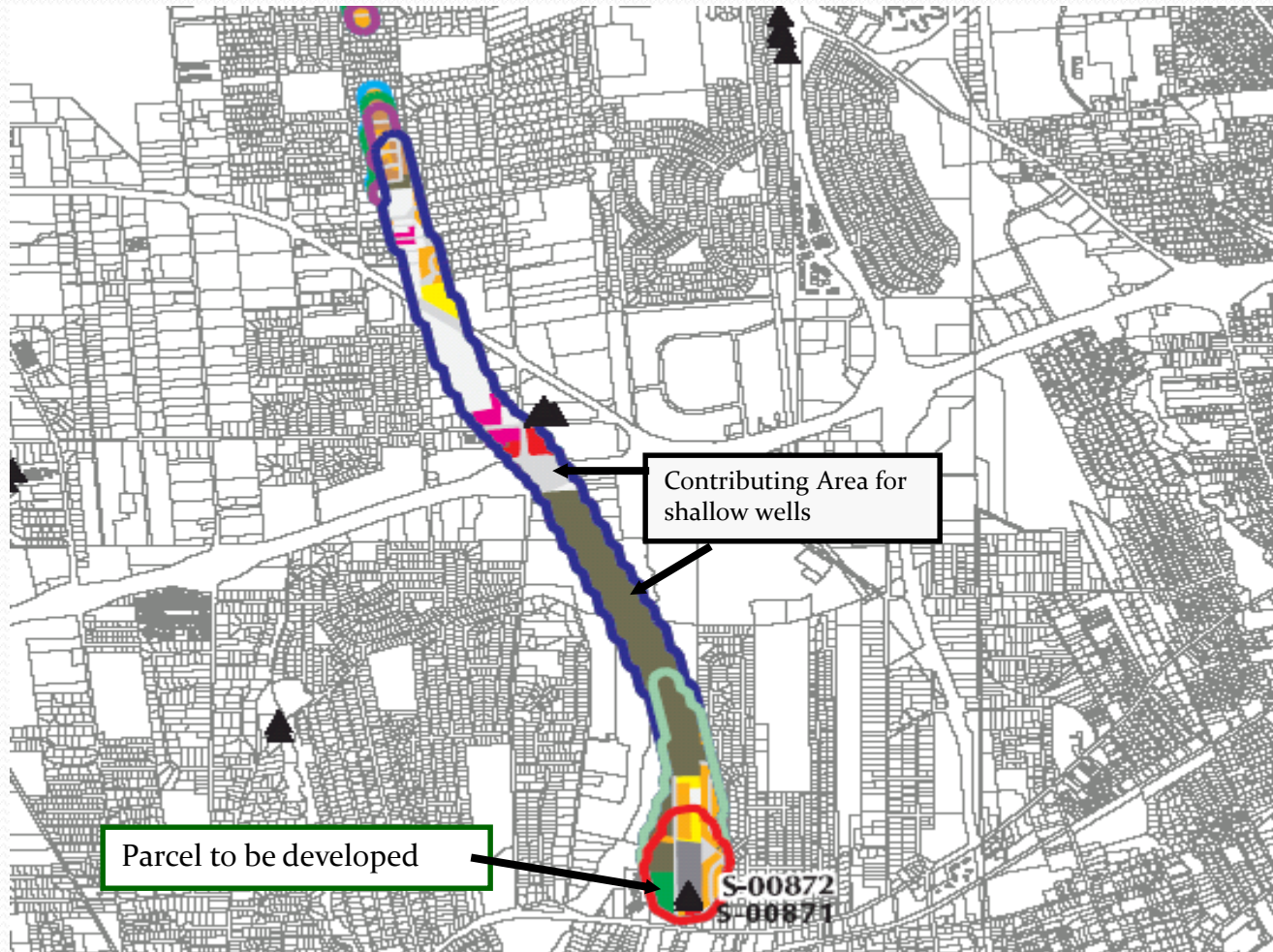


Lakeview Avenue, Bayport



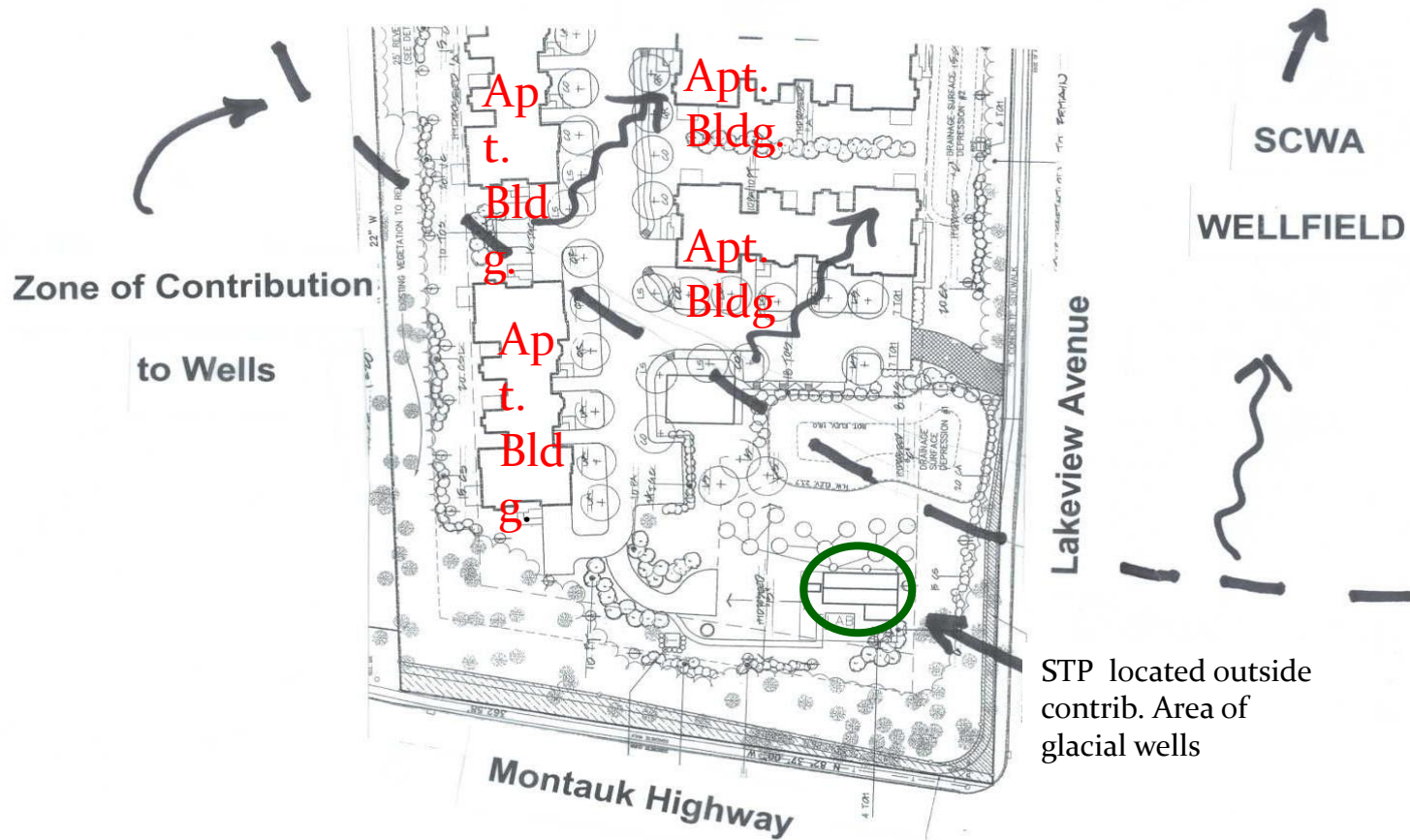
SWAP Map

Lakeview Avenue well field



Site Plan – Lakeview Ave.

LAKEVIEW AVENUE SITE PLAN (south portion)

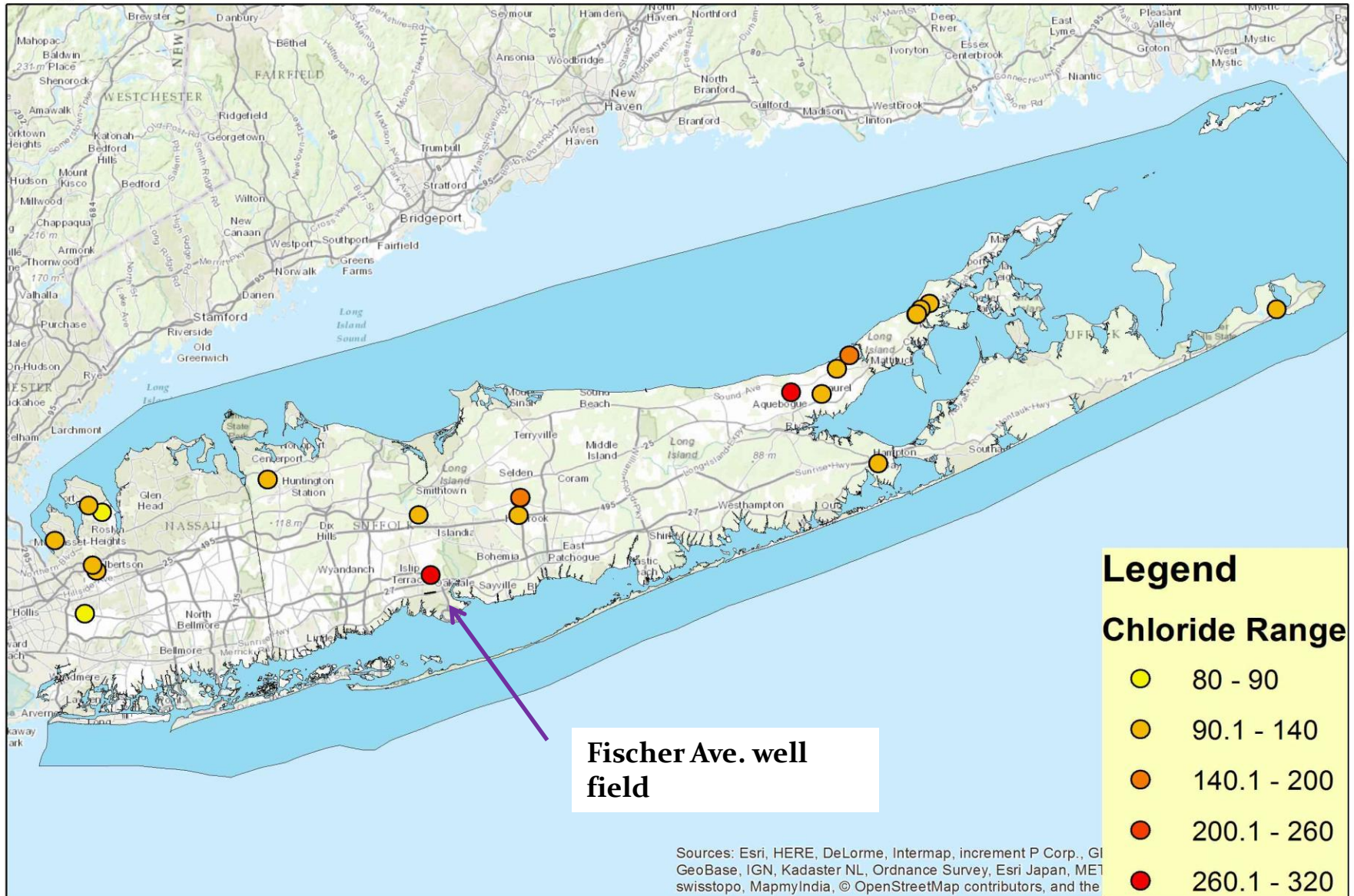


Example of
S W A P
Concepts Applied to
Investigations

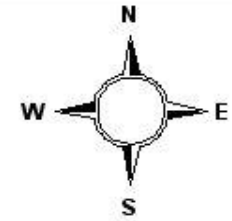
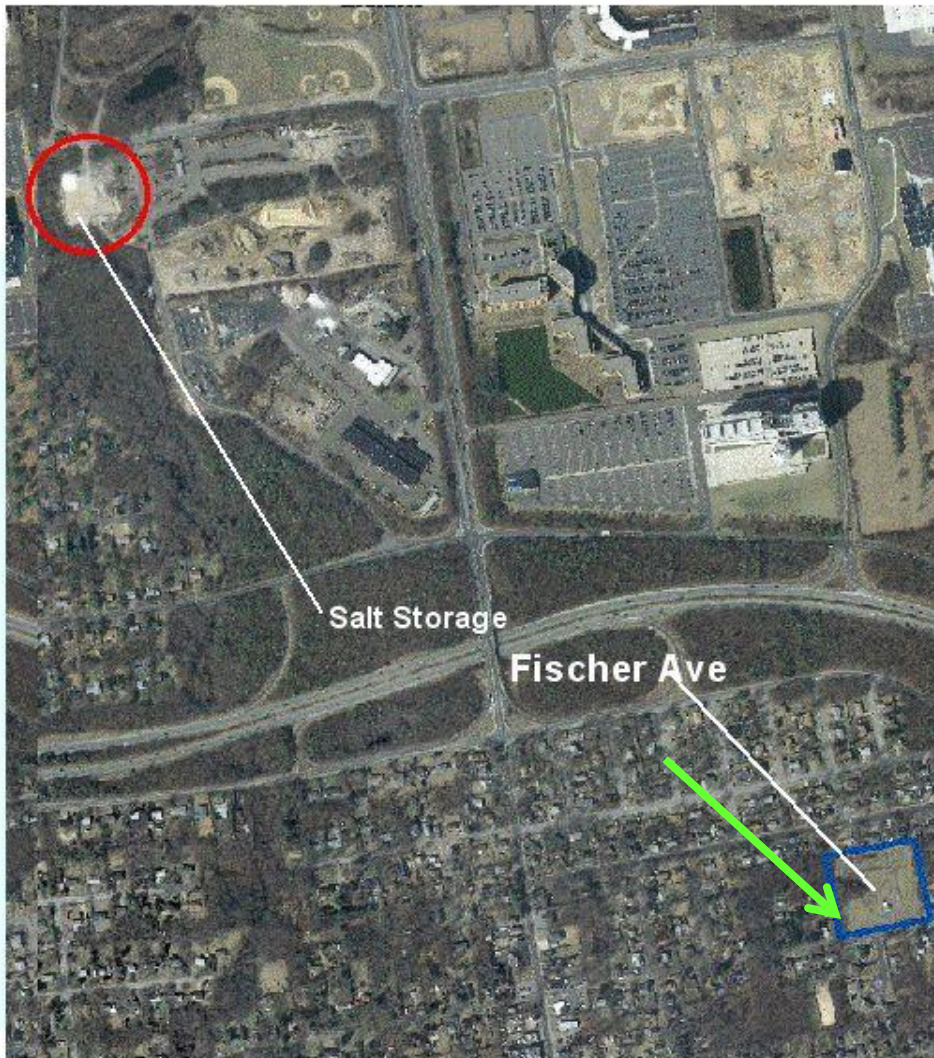




Chlorides in Long Island wells greater than 80 mg/l



Fischer Ave Wellfield Islip



-  SCWA Properties
-  Land and Coastline
-  Water
-  Land

200000 0 200000 400000 Feet





W
2D 3D Road Aerial
S N
E

DPW Dr

DPW Dr

25 feet 10 m

© 2010 Microsoft Corporation © 2009 NAVTEQ © AND Pictometry Bird's Eye © 2009 Pictometry International Corp





***The first line of defense is
Prevention***

The last line of defense:

***Drinking Water Protection
via Well Head
Remediation***



Granular Activated Carbon (GAC)

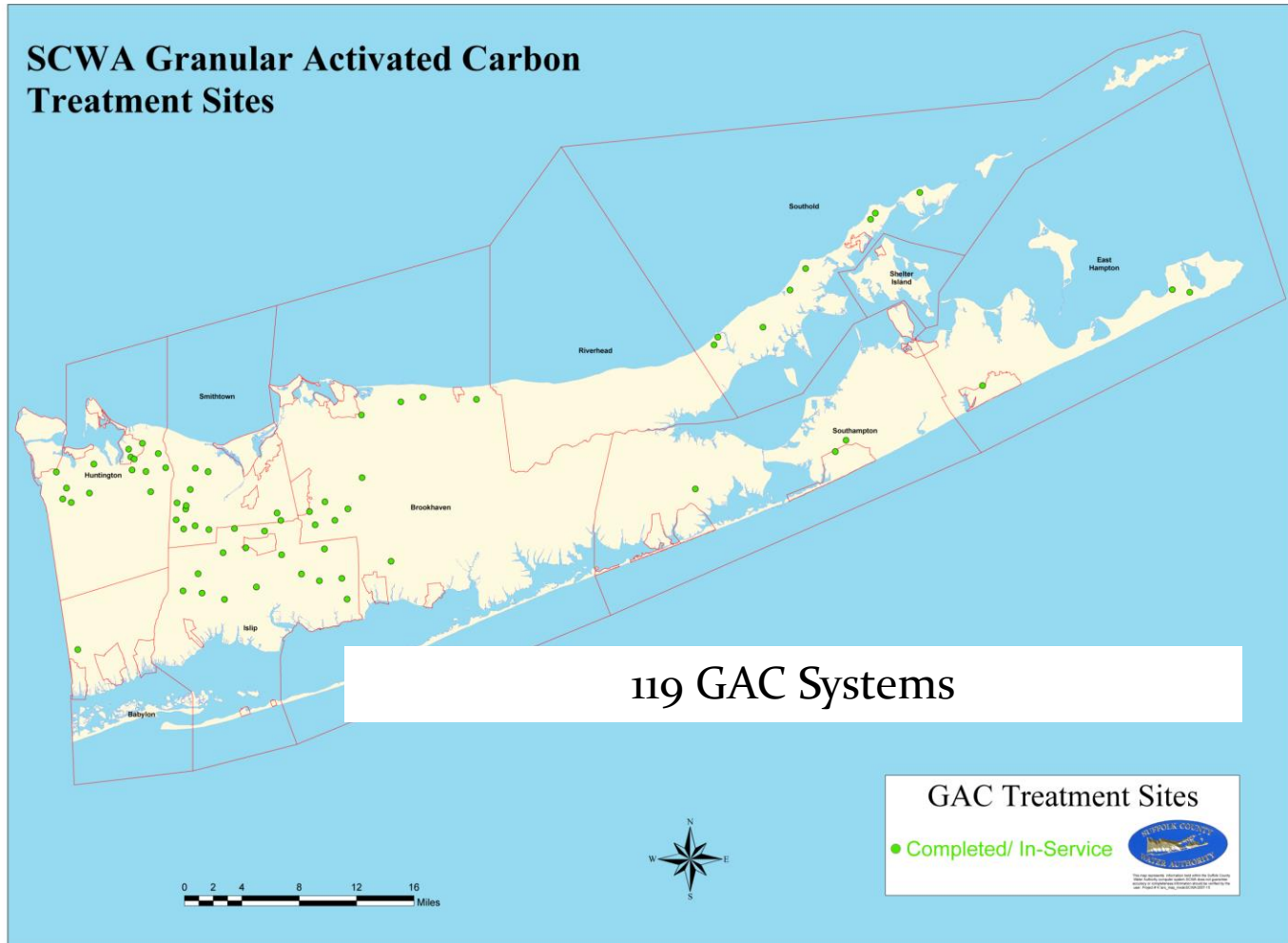


↑
GAC tank

Carbon media

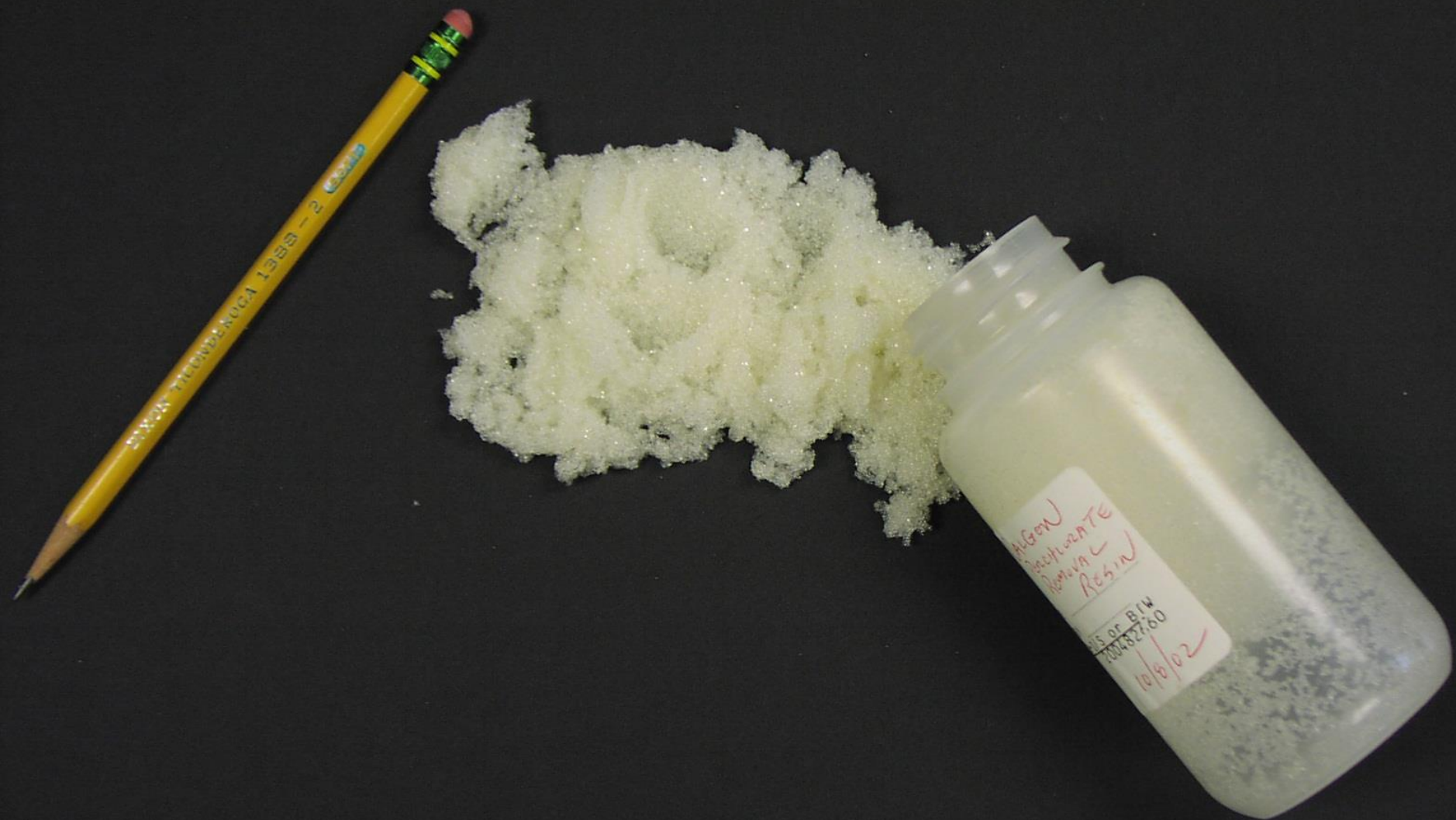


Granular Activated Carbon Adsorption Locations



Ion Exchange Nitrate Removal Plant





Ion Exchange Resin

Perchlorate-specific ion exchange resin



Iron Removal



Reverse Osmosis

Membranes



Air Stripper Filtration



Contaminants of Emerging Concern

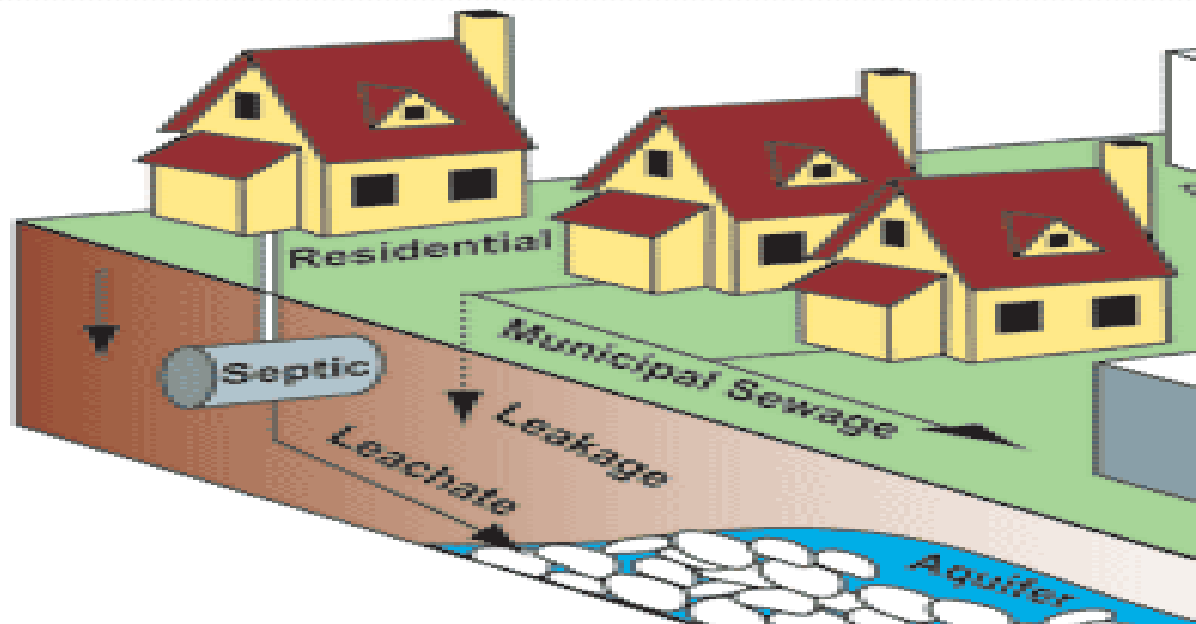
- PPCP's
- PFC's (PFOS/PFOA, etc.)
- 1,4-Dioxane
- PAHs
- Algal Toxins
- Microplastics
- Pathogens

PPCP's



Cotinine	metabolite of nicotine
Albuterol	Salbutamol-asthma and chronic obstructive pulmonary disease
Acetaminophen	Tylenol , analgesic (pain reliever) and antipyretic (fever reducer)
Codeine	opiate-used for its analgesic, antidepressant, and sedative properties
Hydrocodone	narcotic analgesic and antitussive (cough medicine)
Trimethoprim	antibiotic
Caffeine	Stimulant
1,7 Dimethylxanthine	a caffeine metabolite
Imidacloprid	insecticide
Sulfamethoxazole	antibiotic
Diphenhydramine	Benadryl , antihistamine
Meprobamate	minor tranquilizer
Diltiazem	heart medication
Fluoxetine	Prozac , antidepressant
Furosemide	heart medication
Dilantin (Phenytoin)	anti-seizure
Carbamazepine	anti-seizure
Naproxen	Aleve - nonsteroidal anti-inflammatory drug (NSAID)
Diazepam	Valium - anti-anxiety, muscle relaxer
Warfarin	Coumadin , blood thinner
Ibuprofen	Advil - nonsteroidal anti-inflammatory drug (NSAID)
Oxybenzone	sunscreen
Gemfibrozil	cholesterol medication
Triclocarban	antibacterial and antifungal
Triclosan	antibacterial and antifungal
Phenobarbital	barbiturate, most widely used anti-seizure medicine

PPCP Entry into the Environment



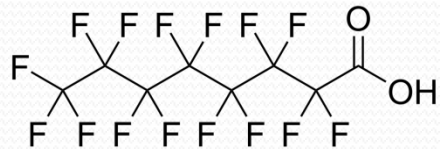
Methods of PPCP entry into the environment from residential homes via septic and sewage systems

Putting it in perspective:

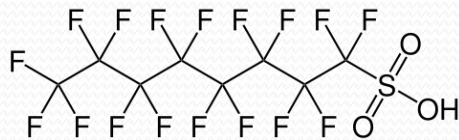
- **Our detection level for Pharmaceuticals and Personal Care products is 50 ng/L. A typical dose of medicine is 5 to 50 mg. That is a factor of 100,000 to 1,000,000 times less. So you would have to drink 100,000 liters of water for a “dose”. If you drank two liters of water a day (approximately a half a gallon) it would take 137 years to consume one equivalent dose.**

What are PFAS?

- Perfluoro-Alkyl Substances, or PFAS, are used in making fluoropolymer coatings to make products resistant to stain, heat, oil, grease, and water.^[1]
- PFAS are a class of chemicals which include:^[2]
 - PFOA (perfluorooctanoic acid)



- PFOS (perfluorooctane sulfonic acid)



- Carbon-fluorine bond is one of the strongest in chemistry: very stable compound!



Slide Courtesy of Evoqua Water Technologies

PFAS Concerns

- PFAS accumulate in the human body.^[3]
- According to the CDC, health effects are not yet known however some lab studies have linked it to effects in growth, development, reproduction, and liver injury.^[4]
- EPA: Health Advisory Limit for PFOA and PFOS in May 2016.^[5]
 - 70 ppt for a combined concentration of PFOA and PFOS
- Some states have enacted regulations for PFAS removal (e.g. Vermont).^[6]



Courtesy of Evoqua Water Technologies

PFOS



PFOS



PFAS Treatment Options

Granular Activated Carbon



Pros:

- Most proven technology
- Reduces liability
- Removes other organic contaminants
- Minimal maintenance

Cons:

- Performance impacted by background organics

Anion Exchange Resins



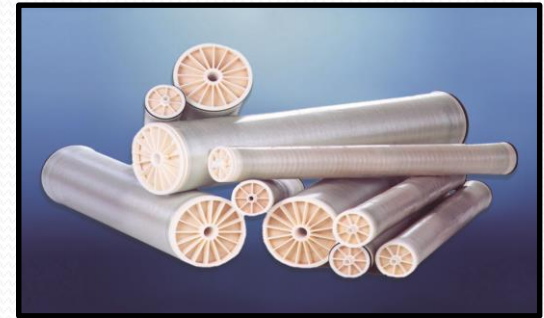
Pros:

- High throughput expected
- No chemicals
- No liquid waste
- Minimal maintenance

Cons:

- Developing data
- Non-regenerable - must be landfilled or incinerated

Membranes



Pros:

- Highly effective
- Removes dissolved solids

Cons:

- High capital cost
- High maintenance
- Produces concentrated waste stream
- Chemicals onsite

Courtesy of Evoqua Water Technologies

IX Resin for PFAS Removal?

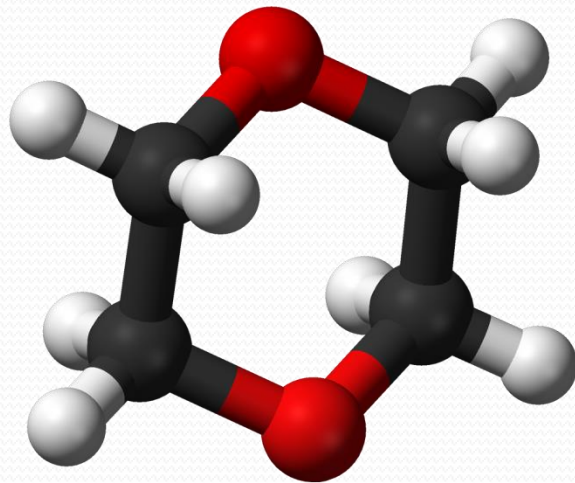
Retrofit Vessels for IX Resin?

- 600 gpm/vessel
- Bed depth = 5.5 ft.
- Resin volume = 280 ft³/vessel
- Loading rate = 12 gpm / ft²
- EBCT = 3.52 min (2 minute min.)
- Predicted Throughput: 1.48 BG

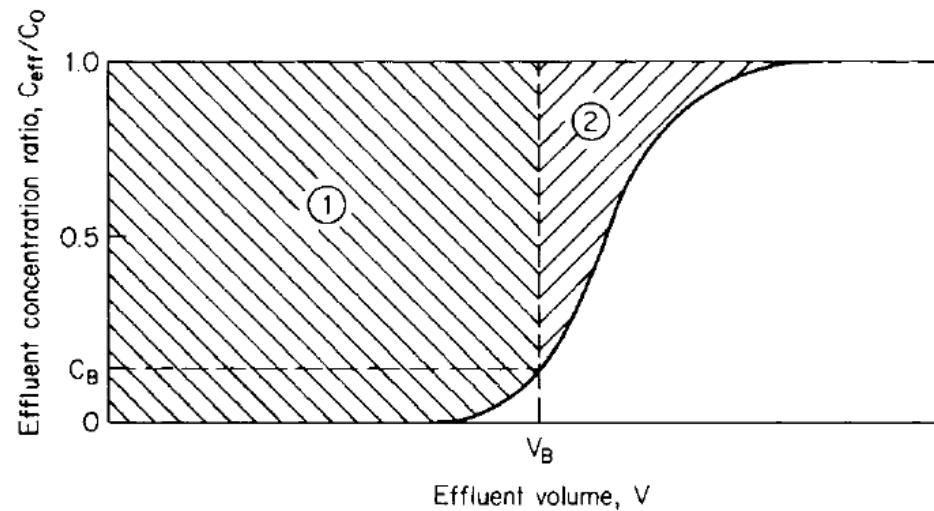


Note: SCWA has not yet investigated IX removal of PFOS. Calculations are based on mfg. representative estimates

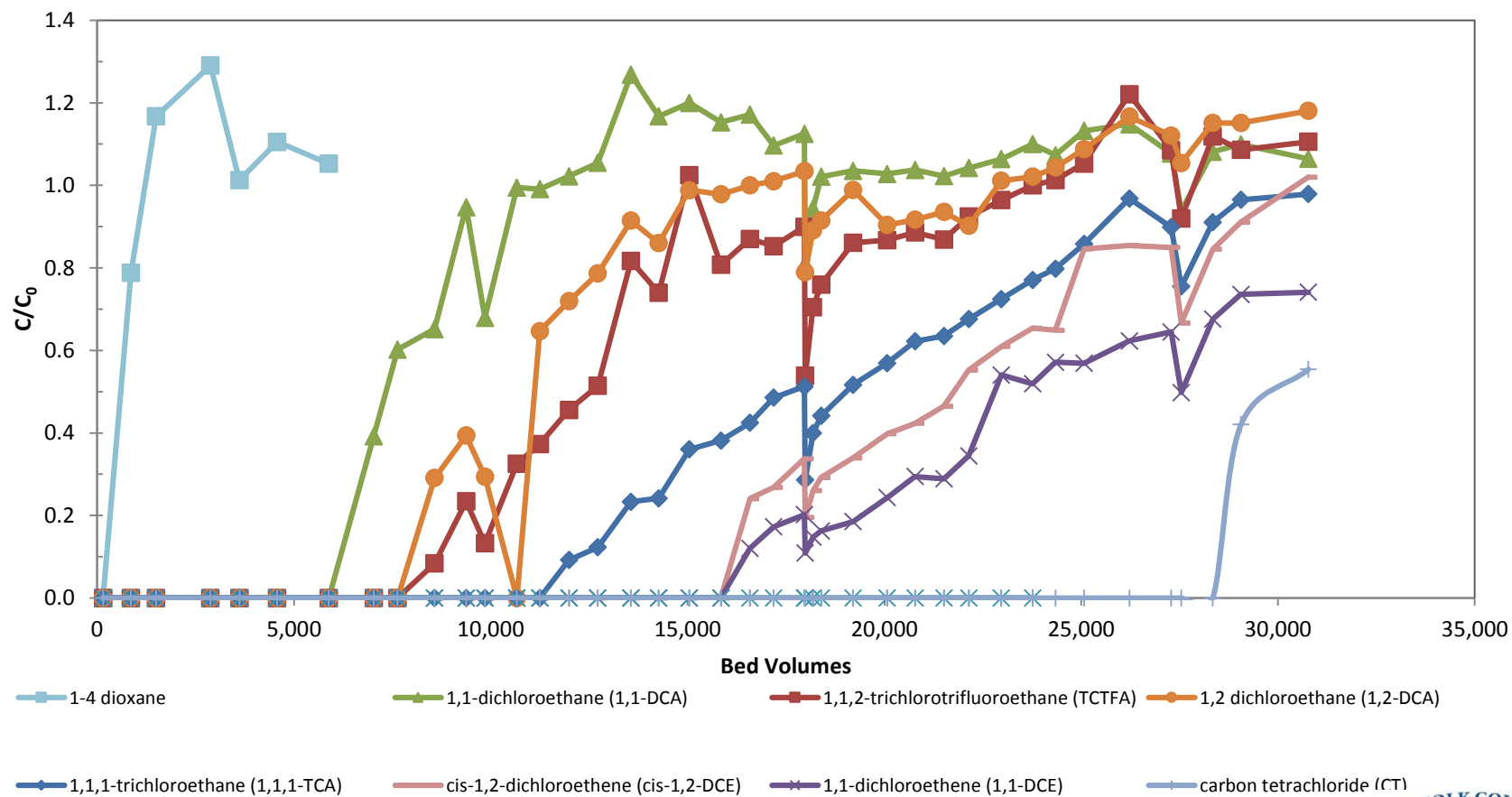
1-4 Dioxane



Breakthrough in GAC Filter



Contaminant Breakthrough in GAC



Standard in discussion

1-4 Dioxane Occurrence in SCWA Wells

- Detected in approx. 40% of all SCWA wells
- ≥ 0.35 ppb - 94 wells
- ≥ 1.0 ppb - 28 wells
- ≥ 3.5 ppb - 5 wells

Advanced Oxidation Process (AOP)

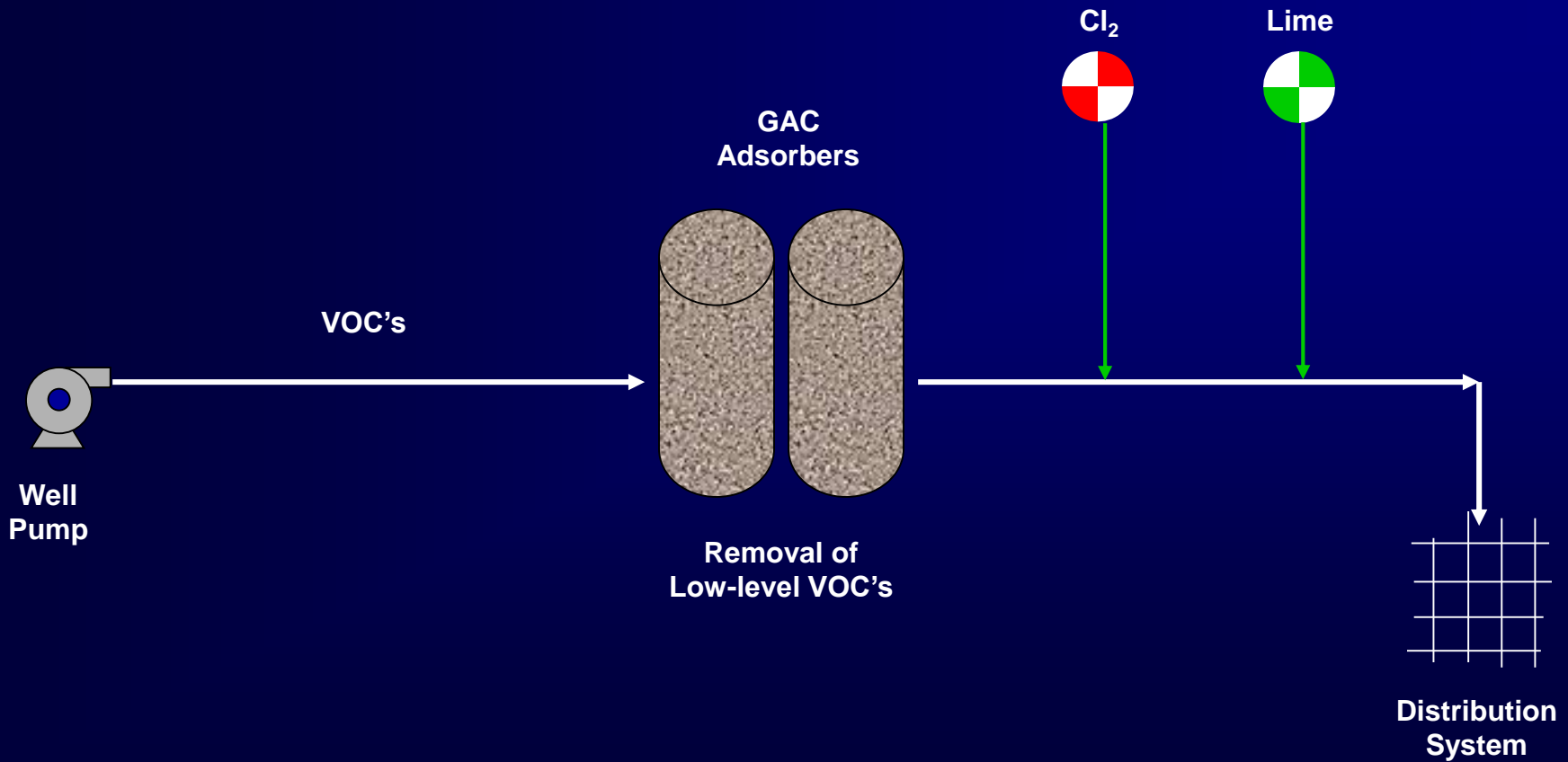
- UV light systems: commonly used for DW disinfection
- UV AOP:

$UV + \text{oxidant} \rightarrow \cdot\text{OH}$

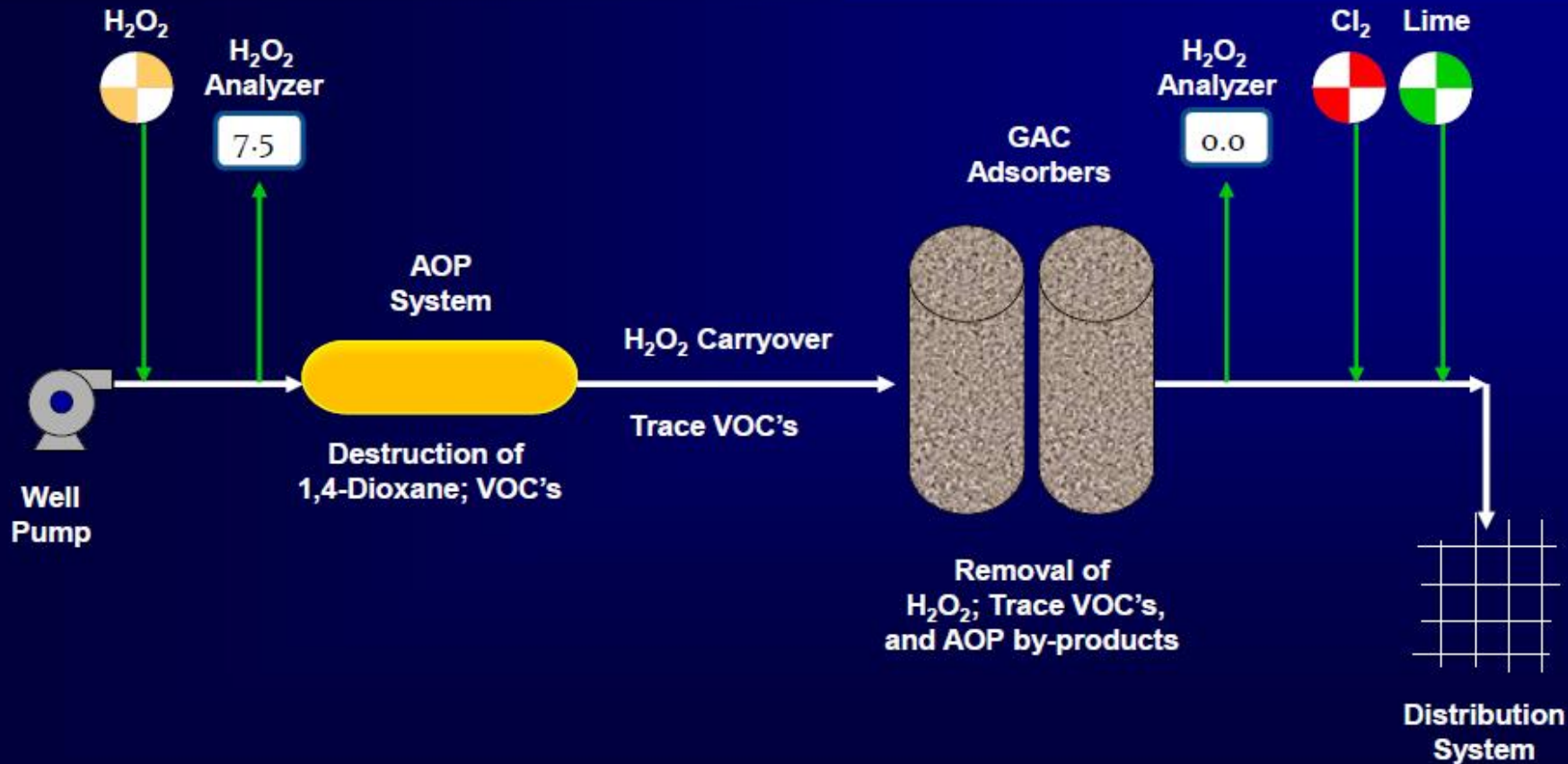
highly reactive $\cdot\text{OH}$ radical formed.
- Common oxidants: H_2O_2 ; O_3 ; Cl_2
- Effective for oxidation of many organic contaminants
- Most common AOP uses:
 - indirect potable reuse
 - GW remediation
- Process transforms, does not remove.



Typical GAC Process Flow Diagram



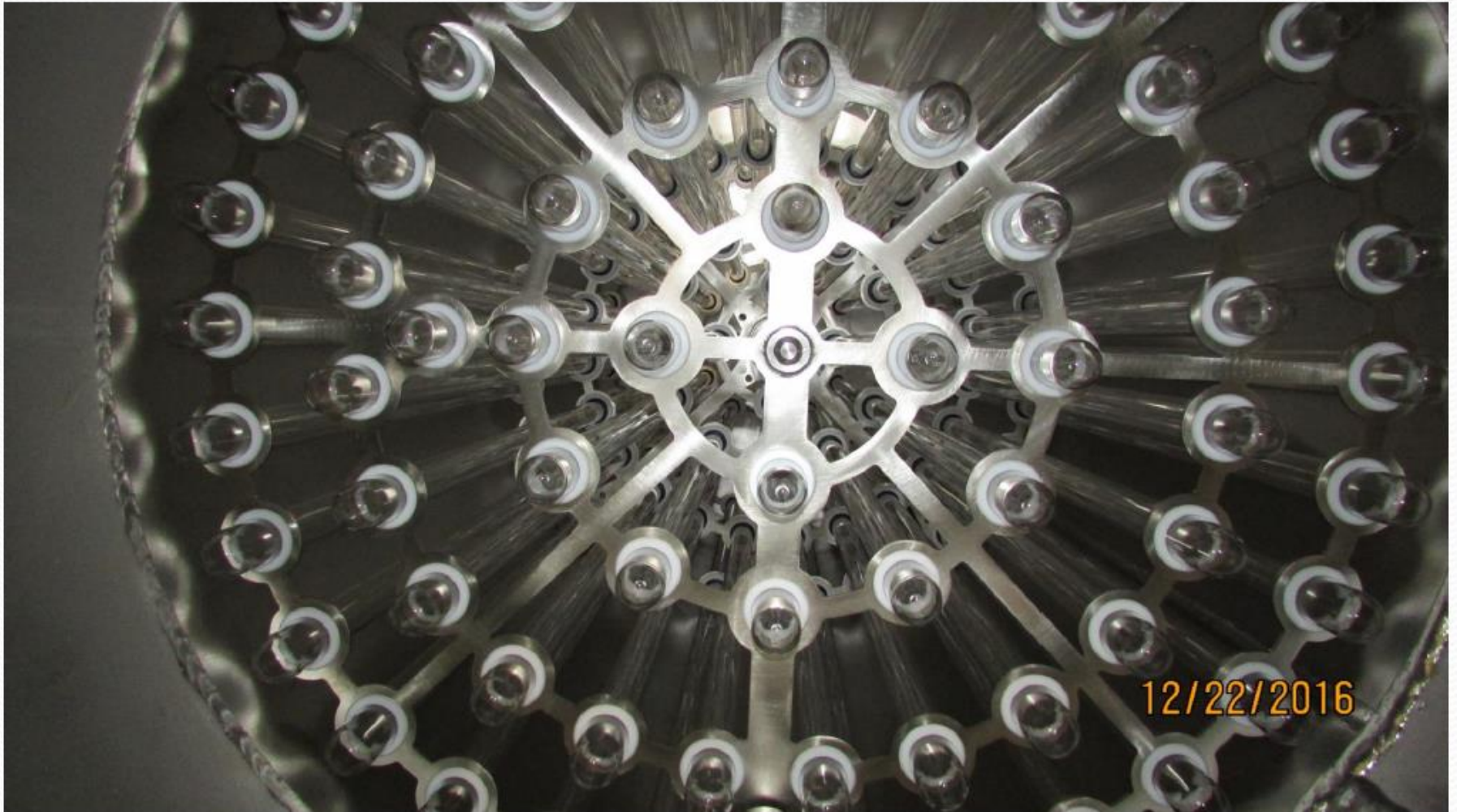
AOP+GAC Process Flow Diagram



AOP Construction



AOP Lamp Sleeves



AOP Construction



Capital Costs for Commercial Blvd Full-Scale AOP Project

- Construction of project (AOP, piping, electrical, etc):
\$910,000
- Initial Laboratory Sampling costs (non-recurring):
\$28,564
- Total: \$938,564

SCWA COSTS SYSTEM-WIDE BASED ON A GIVEN PROPOSED 1,4 DIOXANE TARGET VALUE

Proposed target value (in ug/l) :

3.5

System-wide Capital Costs:	\$ 6,854,256.72
System-wide Fixed Annual O&M Costs:	\$ 384,272.58
*System-wide Annual Variable O&M costs:	\$ 139,481.92
Total Expected Annual O&M costs:	\$ 523,754.50

*(Annual variable costs are based on actual 2016 pumpage)



SCWA COSTS SYSTEM-WIDE BASED ON A GIVEN PROPOSED 1,4 DIOXANE TARGET VALUE

Proposed target value (in ug/l) :

0.35

System-wide Capital Costs:	\$ 154,844,982.18
System-wide Fixed Annual O&M Costs:	\$ 9,702,882.58
*System-wide Annual Variable O&M costs:	\$ 4,394,837.02
Total Expected Annual O&M costs:	\$ 14,097,719.61

*(Annual variable costs are based on actual 2016 pumpage)



SCWA COSTS SYSTEM-WIDE BASED ON A GIVEN PROPOSED 1,4 DIOXANE TARGET LEVEL

Proposed target value (in ug/l) :

0

System-wide Capital Costs:	\$ 458,506,737.54
System-wide Fixed Annual O&M Costs:	\$ 24,305,240.53
*System-wide Annual Variable O&M costs:	\$ 11,877,025.21
Total Expected Annual O&M costs:	\$ 36,182,265.74

*(Annual variable costs are based on actual 2016 pumpage)



GAC Capital Cost Estimating

- Cost of installing GAC treatment is ~\$800,000 for each well
 - GAC contractors: \$250,000
 - Building: \$200,000
 - Installation (piping, construction): \$350,000





For Immediate Release: 10/2/2018

GOVERNOR ANDREW M. CUOMO

GOVERNOR CUOMO ANNOUNCES \$200 MILLION TO ADDRESS EMERGING CONTAMINANTS IN DRINKING WATER

\$185 Million Available for Water Treatment System Upgrades to Combat Emerging Contaminants PFOA, PFOS, and 1,4-dioxane

\$15 Million Awarded to Communities Already Pursuing System Upgrades and Innovative Pilot Treatment Technologies

Water Quality Rapid Response Team to Provide Hands-On Technical Assistance to All Interested Communities

Drinking Water Quality Council to Convene on Wednesday, October 17th



Next Steps





“Dedicated to a Pure and Plentiful Water Supply”

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