Mitigating Nutrient Impacts on a Stressed Watershed Through Construction of a New Ocean Outfall

Anastasia Rudenko | GHD
Lenna Quackenbush | GHD

NEWEA 2020

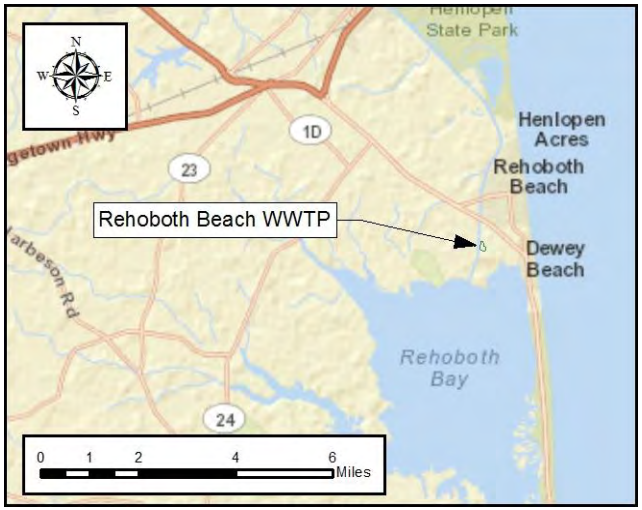
Session overview

1. Background
2. Planning
3. Design
4. Construction

Background

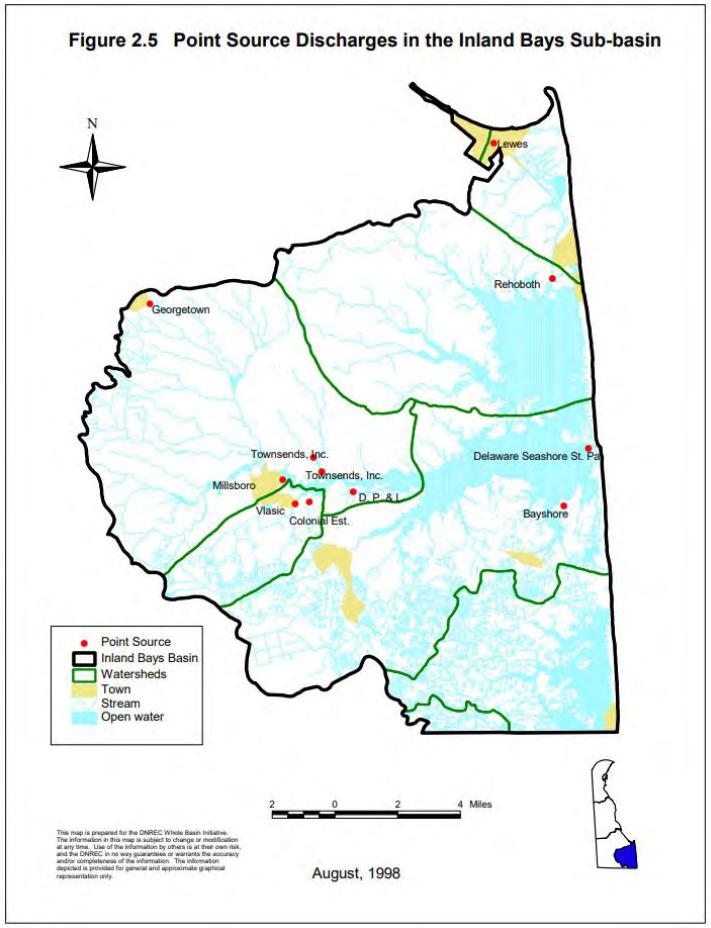
Rehoboth Beach, Delaware

- Seasonal community
- Winter population under 1,500
- Summer population peaks around 25,000
- Over 100,000 beach visitors on any given day in the peak season



Rehoboth Beach Wastewater Treatment Plant History

- 1989 – Constructed
  - Original discharge to the Lewes-Rehoboth Canal
    - Empties into Inland Bay
- 1990's - Upgraded for Biological Nutrient Removal (N and P)
- 1996 - Listed as "water quality impaired"
  - Nitrogen and Phosphorus Impacts
- 1998 - TMDL issued
  - Requiring "all point source discharges and their tributaries to be eliminated systematically"
- 2002 - Consent Order and Revised Discharge Permit required discharge to be eliminated from Inland Bay



Planning

Alternatives Considered

Alternative 1: **No Action**

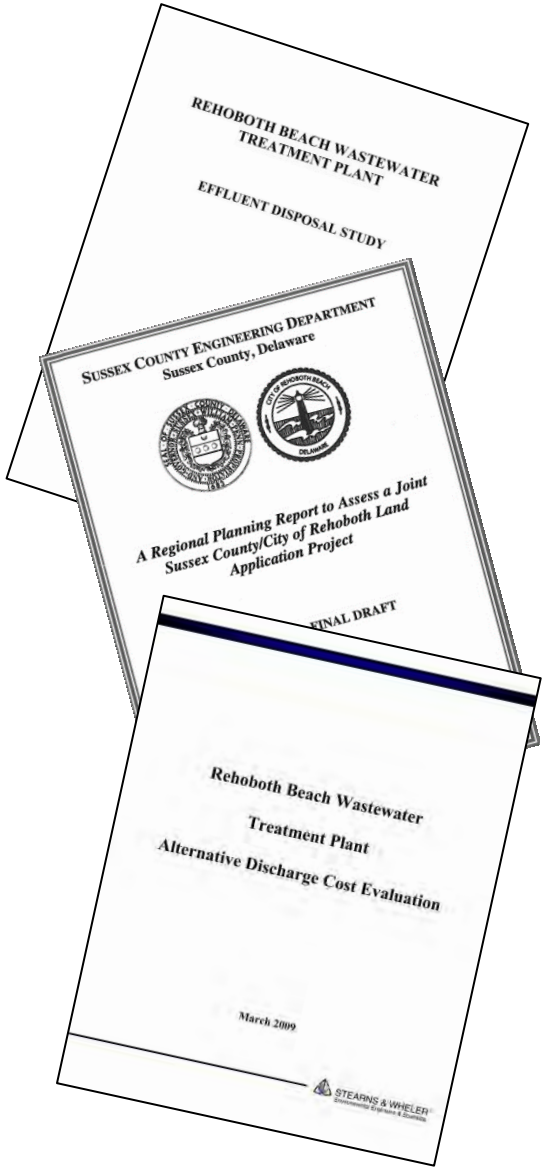
Alternative 2: **Nutrient Trading**

Alternative 3: **Land Application**

Alternative 4: **Rapid Infiltration Beds (RIBs)**

Alternative 5: **Ground Water Injection**

Alternative 6: **Ocean Outfall**



Alternatives Not Carried forward

Alternative 2: Nutrient Trading

- Only allowable if no other options are technically or economically feasible (Consent Order)

Alternative 4: Rapid Infiltration Beds

- Land not available
- Potential to contribute nutrients through groundwater migration
- Potential for groundwater mounding

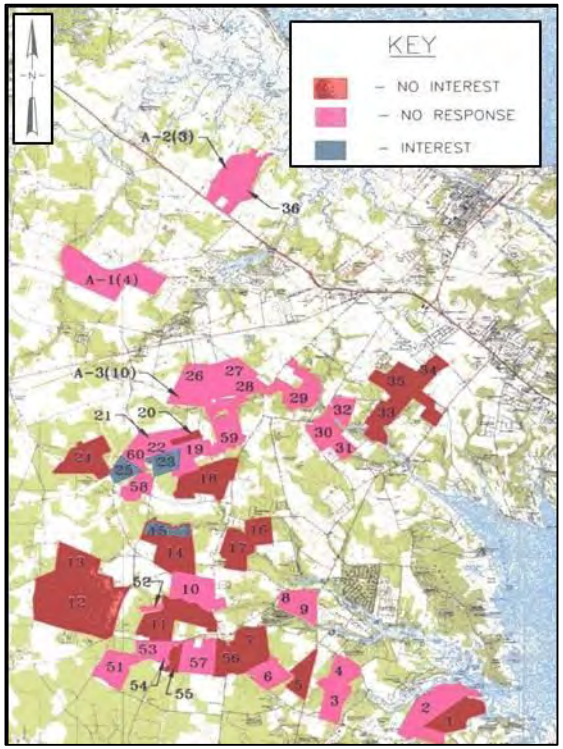
Alternative 5: Ground Water Injection

- Shallow
  - Potential to contribute nutrients through groundwater migration
- Deep
  - Excessive risk and cost
  - No qualified local contractor

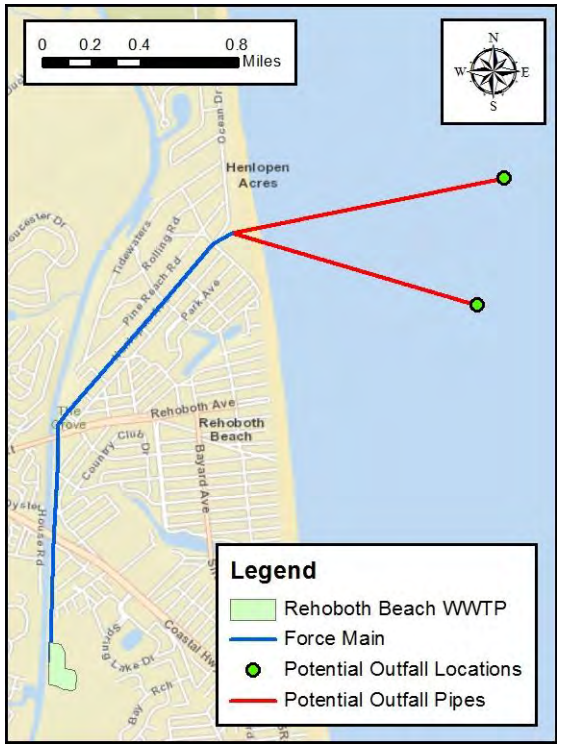
Alternatives Considered in Environmental Impact Statement (EIS)

Alternative 1:
No Action

Alternative 3:
Land Application



Alternative 6:
Ocean Outfall



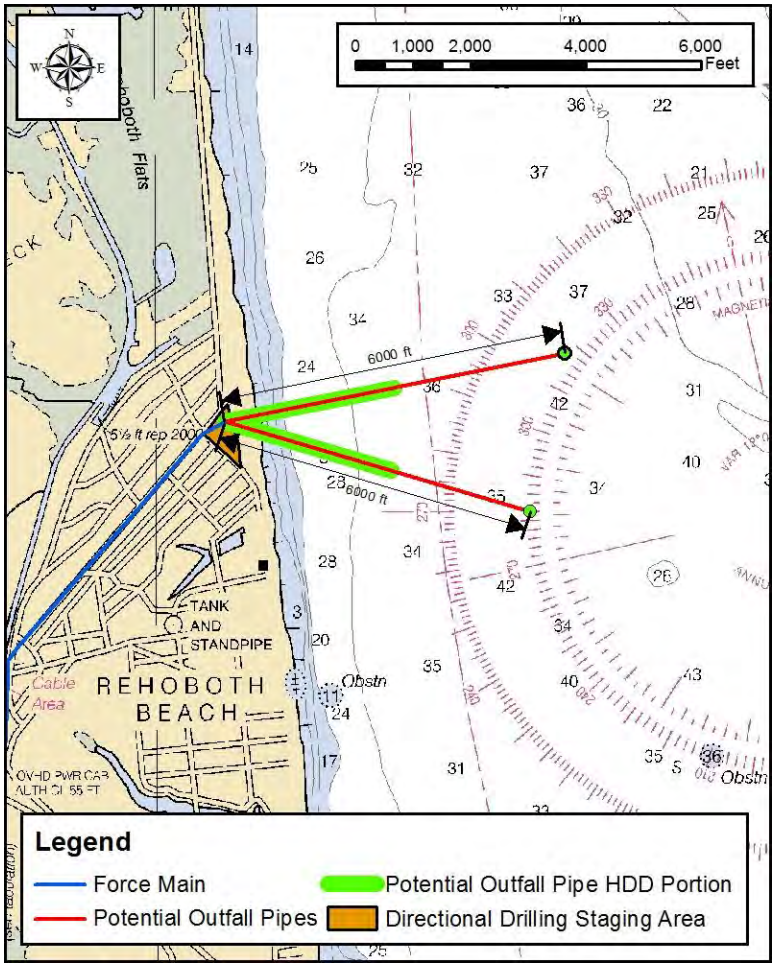
Ocean Outfall

Proposed Ocean Outfall

- Two locations investigated
- 24-inch diameter pipe extending 6,000 linear feet from the Deauville Beach access parking lot
- Terminates with diffuser

Construction Methods

- 3,000 feet or more of pipe will be directionally drilled
- Directional drilling maximized to minimize environmental impact
- Remainder open cut excavation



Force Main

Proposed Force Main Alignment

- Force Main Alignment Study completed in December 2011
- 11,400 linear feet long, 24-inch diameter
- Will predominately follow existing utilities and right of ways

Construction Methods

- 9,150 linear feet open cut
- 2,250 linear feet near Grove Park directionally drilled

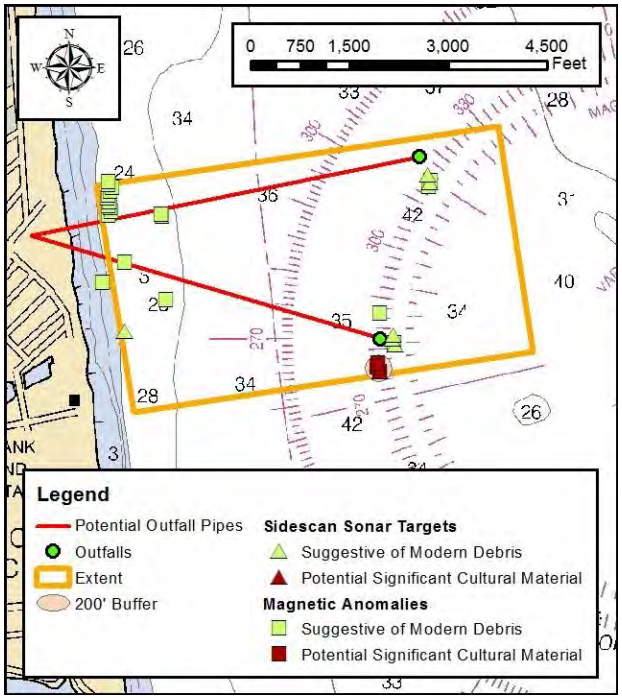
Field Studies

Soil borings

- 1500, 3000, 4500 and 6000 feet from shore
- Each drilled to a depth of 80 ft
- High probability that HDD portion could extend beyond 3,000 feet

Archaeological Survey

- Magnetometer and side-scan sonar
- Most anomalies suggest debris or buoys
- Several potential targets but not near northern outfall



Physical Oceanography

Acoustic Doppler Current Profiler (ADCP) & Fixed Conductivity, temperature, density (CTD) buoys

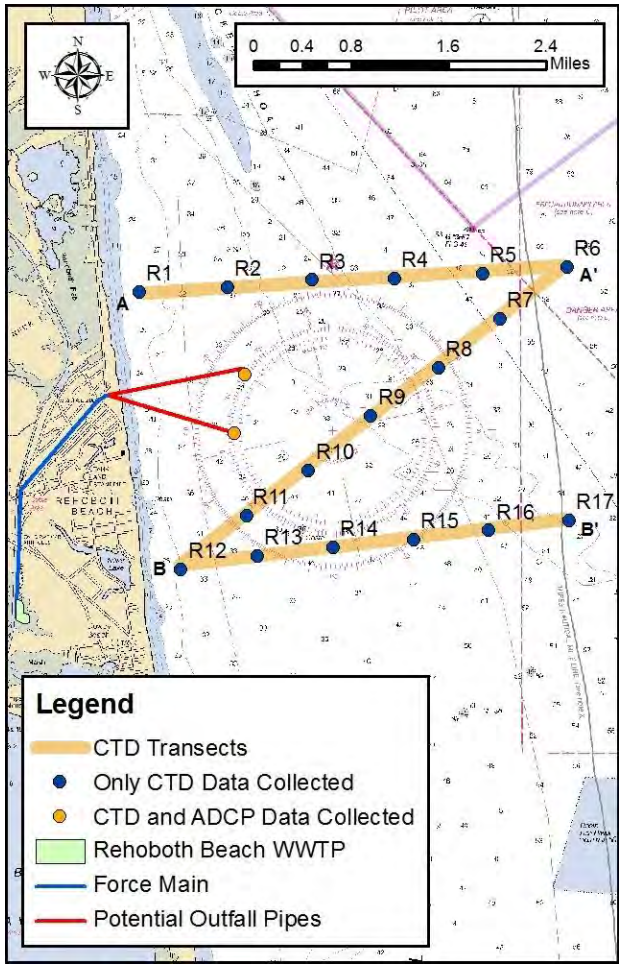
- Deployed at each outfall location for two 2-month periods
  - 9/2/2010 to 11/9/2010
  - 7/6/2011 to 9/12/2011
- ADCP Data recorded at 1.6 ft (0.5 m) increments
  - Current speed & direction – every 10 min
  - Wave height – every 60 min
- CTD data recorded at three or four different depths every 10 minutes

Physical Oceanography

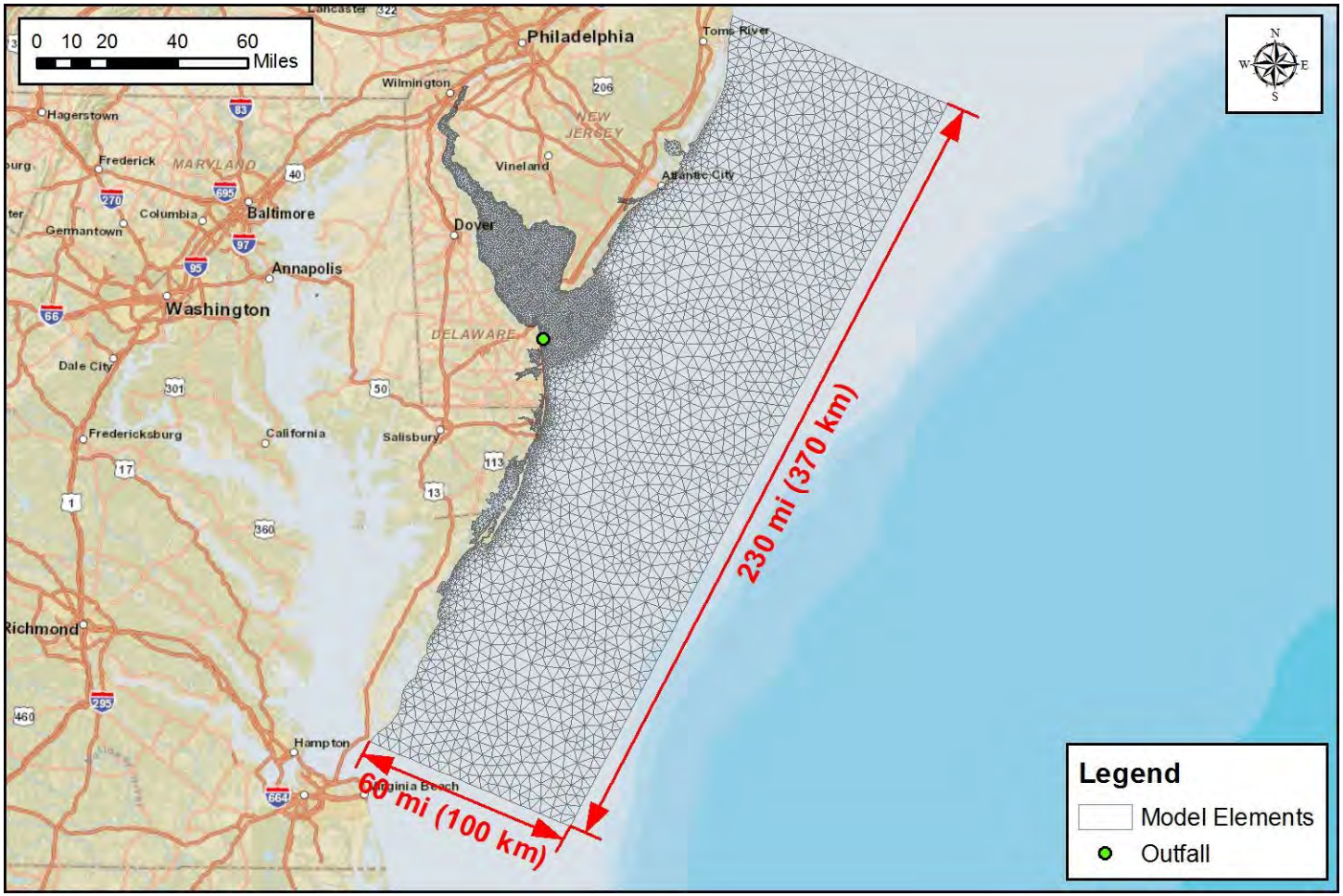
CTD Cruises

- Conductivity, temperature, density, and salinity measured at multiple locations
- Recorded at approximately 1 ft depth increments from ocean surface to ocean floor

CTD Cruise #	Date
CTD Cruise #1	Nov. 18, 2010
CTD Cruise #2	Jan. 25, 2011
CTD Cruise #3	March 17, 2011
CTD Cruise #4	May 25, 2011
CTD Cruise #5	July 11, 2011
CTD Cruise #6	Sept. 14, 2011

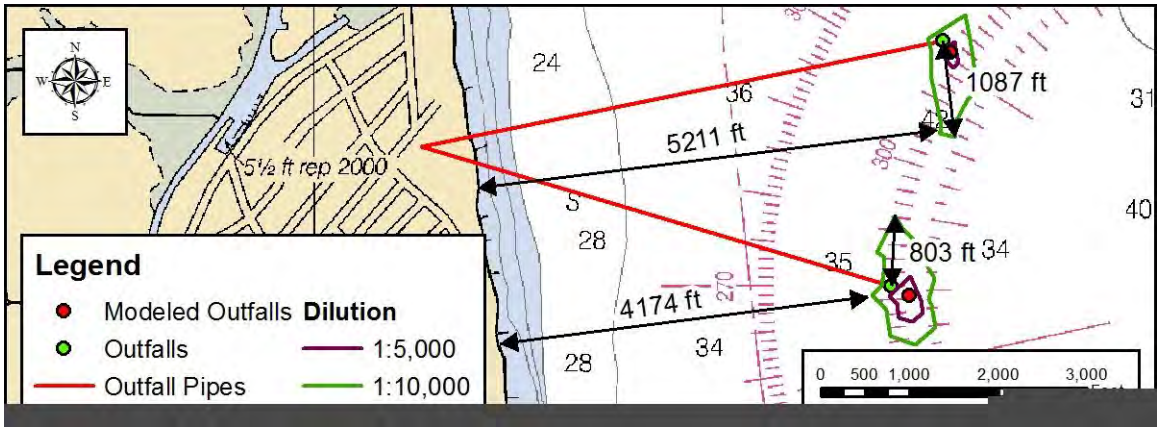


Far Field Model – Modeling Domain



Far Field Modeling Results

- Modelling indicated required effluent dilution ratios met for:
  - Typical operations
  - Worst case scenario (plant upset)



Environmental Consequences

- Physical Environment (Chapter 7 of EIS)
- Biological Environment (Chapter 8)
- Human Health Environment (Chapter 9)
- Cumulative Impacts (Chapter 10)

Rehoboth Beach EIS

Concluding Remarks

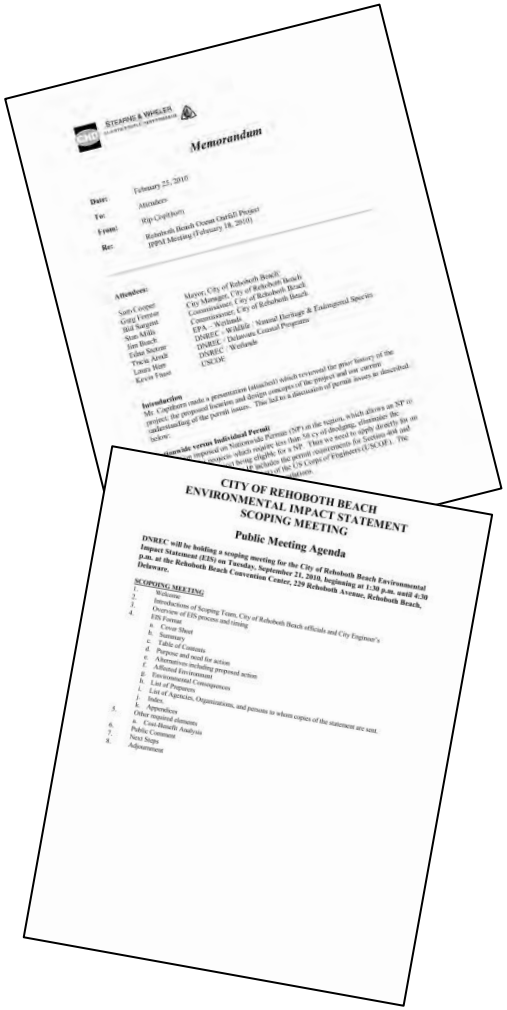
- Both land application and ocean outfall are protective of human health and the physical and biological environment under all conditions
- Environmental Impacts, where present, are temporary and can be mitigated
- Preferred alternative is the ocean outfall

Environmental Impact Statement – Review Agencies

- City of Rehoboth Beach
- Delaware Department of Natural Resources and Environmental Control (DNREC)
- US EPA
- US Army Corps of Engineers
- Sussex County
- Coast Guard
- Concerned Citizens

Birth and Development of the EIS

February 2010	JPPM Meeting
March 2010	DNREC Meeting
June 2010	DNREC Meeting
July 2010	JPPM Meeting
September 2010	EIS Public Scoping Meeting
March 2011	EIS Review Meeting
June 2011	EIS Review Meeting
June 2011	JPPM Meeting for FM
September 2011	EIS Review Meeting
March 2012	Draft EIS Completed
April 2012	Public Meeting
July 2012 to April 2013	Final EIS Development



Memorandum

CITY OF REHOBOTH BEACH
ENVIRONMENTAL IMPACT STATEMENT
SCOPING MEETING

Public Meeting Agenda

Design

Ocean Outfall Design and Construction

- The Ocean Outfall was one of 3 projects occurring simultaneously.
- Forcemain: 24” PVC Treated Effluent Force Main, including a section of Jack and Bore under Rehoboth Avenue, with a total length of 11,300 linear feet.
- Effluent Pumpstation with 4 vertical turbine pumps through the forcemain and outfall.
- All three projects need to be completed by June 1, 2018 per Consent Order from DNREC

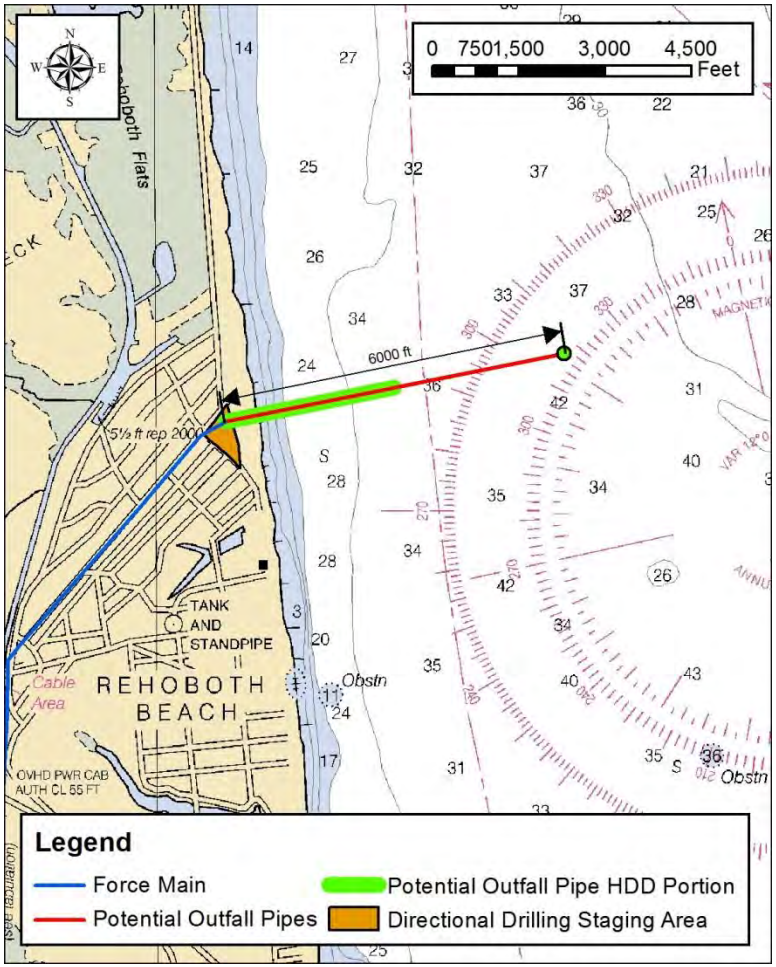
Design- Ocean Outfall

Proposed Ocean Outfall

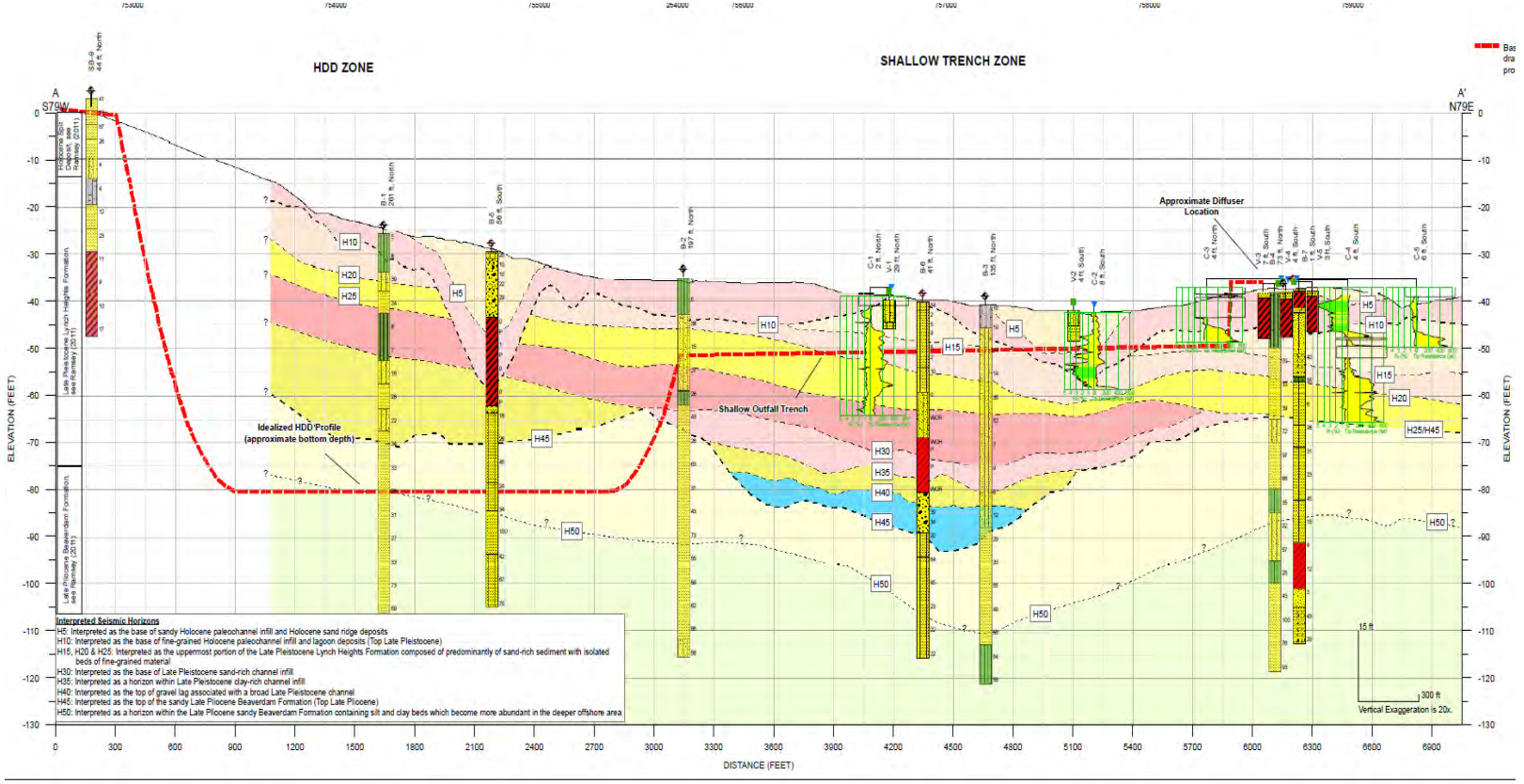
- 24-inch diameter pipe extending 6,000 linear feet from the Deauville Beach access parking lot
- Terminates with diffuser

Construction Methods

- 3,000 feet or more of pipe will be directionally drilled
- Directional drilling maximized to minimize environmental impact
- Remainder open cut excavation



Ocean outfall design considerations - site characterization profile

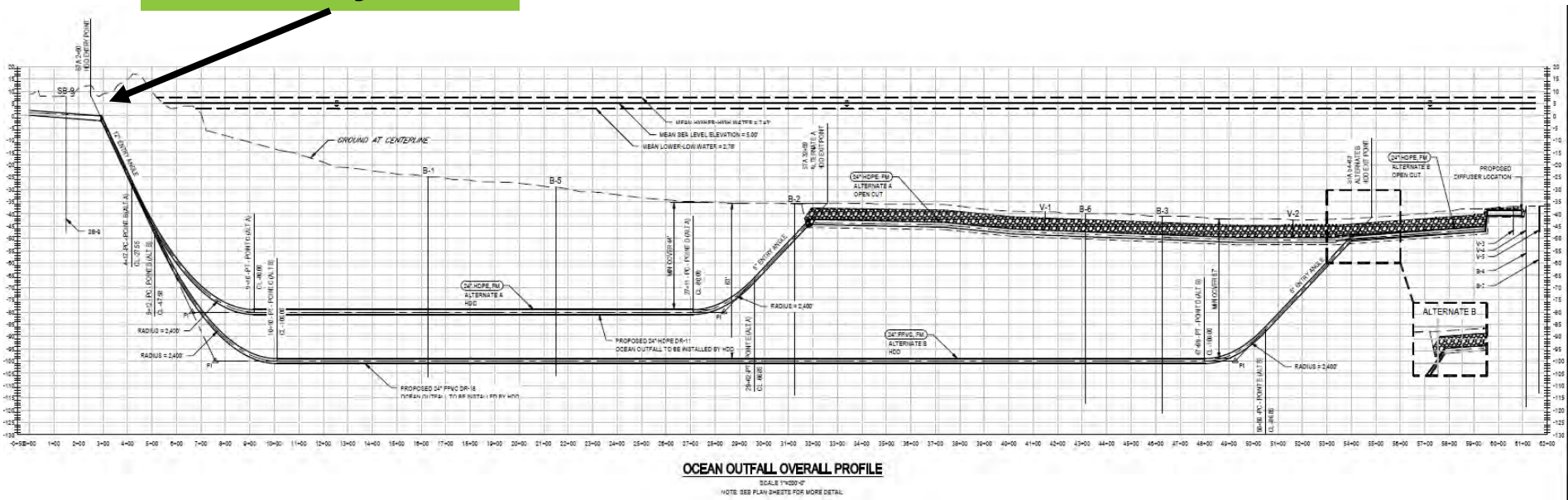


Ocean Outfall Profile

Bid alternatives

- 2,971 LF of 24” HDPE pipe and 2,641 LF marine plowed trench
- 5,612 LF of FPVC exiting near diffuser outlet

HDD Entry Point



OCEAN OUTFALL OVERALL PROFILE

SCALE 1"=200'-0"

NOTE: SEE PLAN SHEETS FOR MORE DETAIL

Construction

Ocean outfall construction timeline & costs

Permits and schedule

- Construction was constrained to Fall, Winter and Spring (7 month construction period)

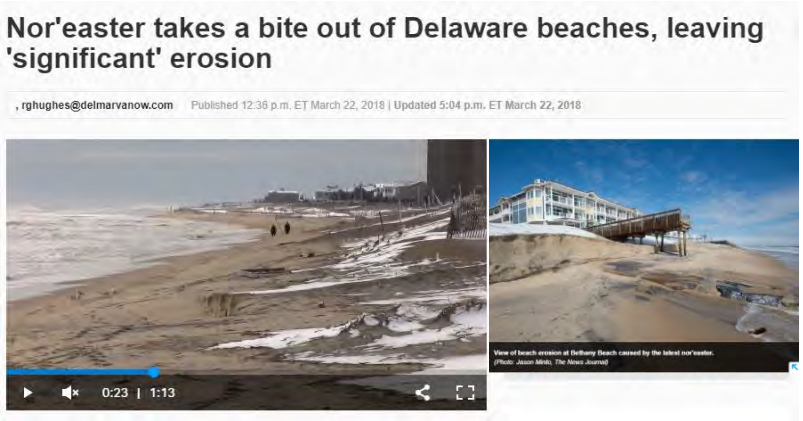
Ocean Outfall Construction Cost

- $28.1 M

Significant Days	Date
Notice to Proceed	9/5/2017
USACE Window Expiration	2/28/2018
DNREC Window Expiration	3/15/2018
Marine Work Completion	3/31/2018
Project Completion	4/30/2018

Weather Impacts

- Construction was initially constrained to Monday to Friday, 7:00 AM to 6:00 PM
- Working hours were changed to 7 days per week, 24 hours per day to meet schedule



Contractor Staging

Horizontal Drilling at Deauville Beach

Offshore Staging at Cape Henlopen

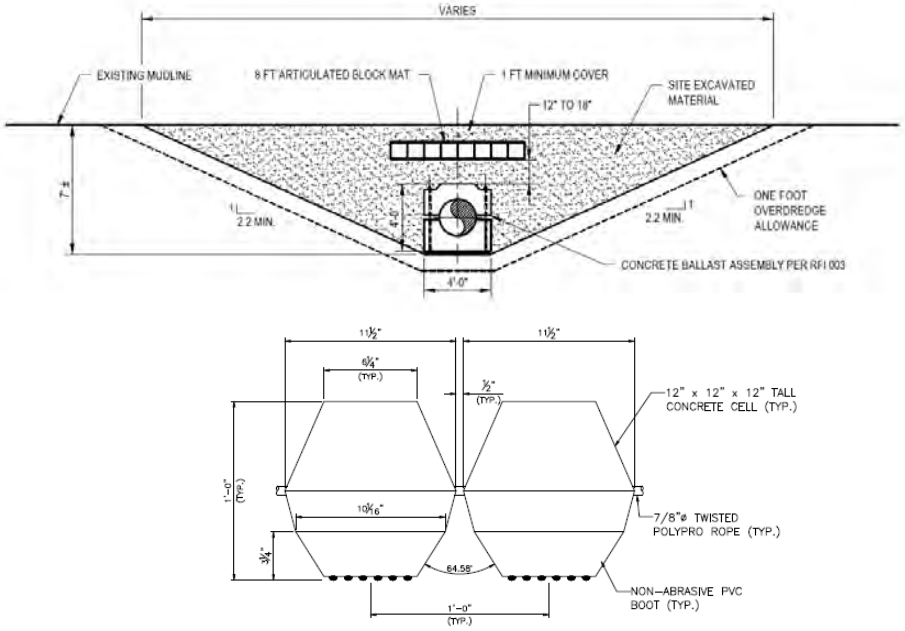
HDD Installation

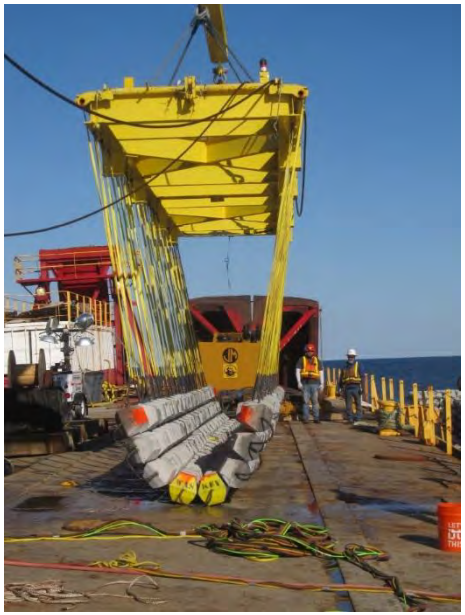
- Pilot hole advanced from land to reduce offshore equipment support
- Outfall pipe pulled from ocean to shore
- Pullback took ~ 24 hours

Ocean Outfall Cross-section – Open Cut

ACB Mat

Articulated precast concrete mat to protect pipe



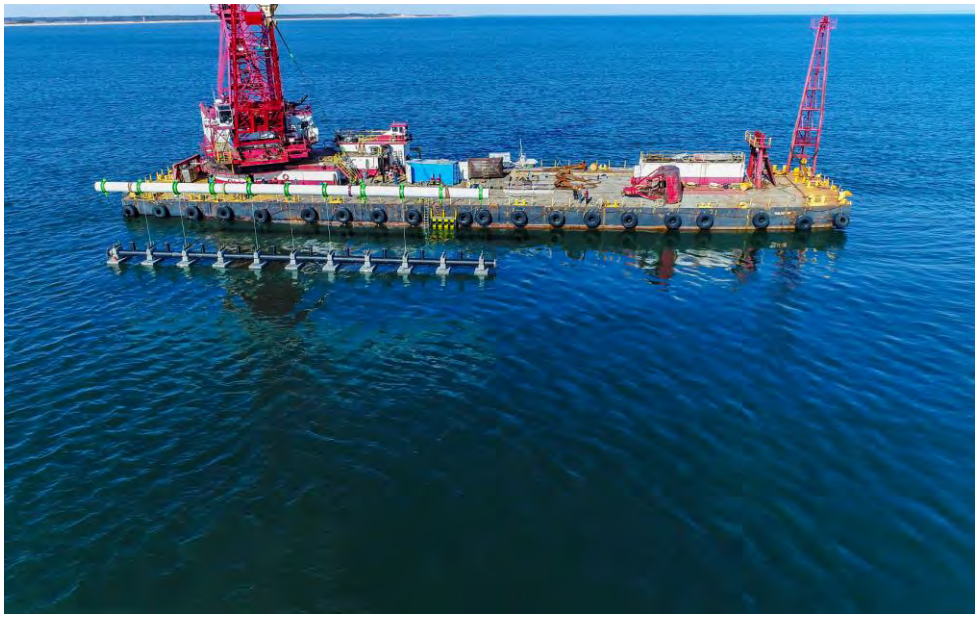


ACB Mat Placement

Diffuser Placement

Precast grade beam for diffuser support

Diffuser Placement



General lessons learned

- The weather is the number one enemy for an offshore project.
- Make allowance for adequate number of weather delay days in the contract.
- Be flexible with working hours
- Always be aware of unforeseen conditions.

Summary

- Ocean outfall can be a feasible alternative for watershed nutrient management
  - Relatively small land area required
  - Effluent discharge occurs outside impacted watershed, greatly reducing nitrogen loading impacts to coastal estuaries
- Hydrodynamic modelling required to determine effluent nutrient load fate
- Extensive permitting period anticipated
- Extensive public outreach / participation critical for a successful project

Questions

Anastasia.Rudenko@ghd.com
Lenna.Quackenbush@ghd.com

NEWEA 2020