Designing a Salt Marsh Restoration via Re-Use of Dredged Material

A CASE STUDY FROM AVALON, NJ

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GreenVest
One Step Ahead.

Purpose

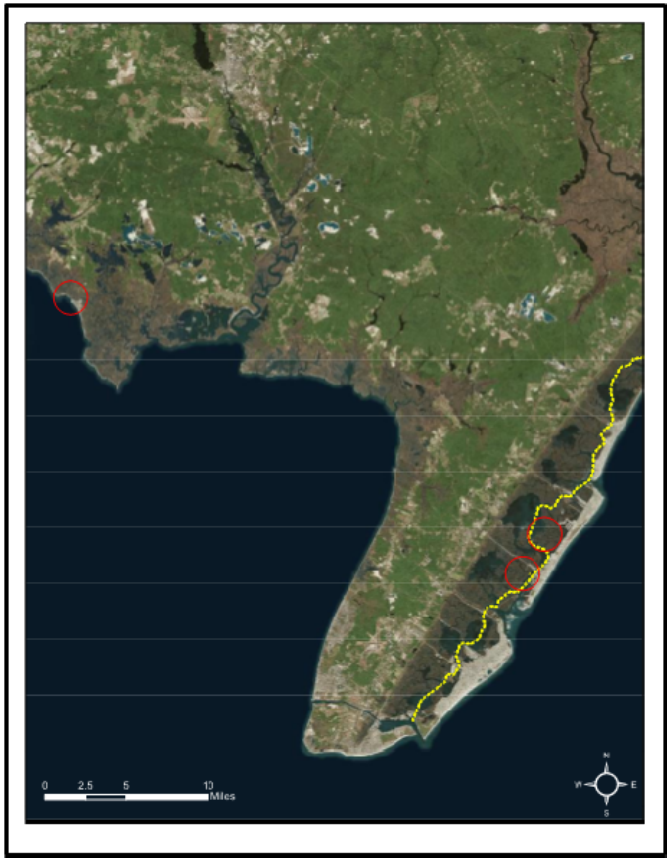
ERDC wants to address the following:

- How can we develop design criteria that lead to a responsible action for a distressed marsh?
- What are the metrics that produce a successful design?
- Are we linking site assessment metrics to design criteria?

Recap from Webinar 1

Project Background

- **Objective:** Three trial projects on degraded sites to test the beneficial re-use concept
- **Landowner:** NJ Division of Fish & Wildlife
- **Funding source:** Hurricane Sandy Coastal Resiliency grant
- **Project Team:**
  - The Nature Conservancy
  - GreenVest
  - Princeton Hydro
  - The Wetlands Institute
  - NJDEP and more.

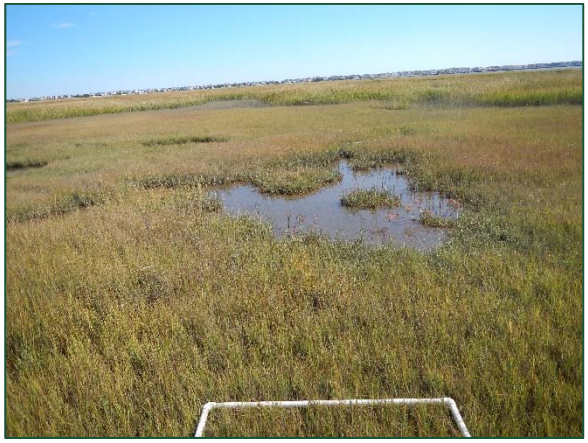


Site Assessment

The site assessment or problem identification process followed 3 steps and used the following tools or metrics:

1. High-level desktop analysis
   - LiDAR analysis
   - Historical aerial image analysis
   - Drainage analysis
   - Erosion rate analysis
2. Rapid on-the-ground assessment
3. Detailed site characterization
   - Topographic surveys
   - Water level monitoring
   - Vegetation surveys
   - Avifauna
   - Nekton
   - Epifaunal macroinvertebrates
   - Benthic Infauna
   - Soil/sediment properties of marsh and dredged sediments

Site Assessment



Webinar 2

Design

Let's look at those same tools and metrics and I will point out:

- which metrics were also used as design criteria and how
- which did not get used for design and why not

Site Assessment

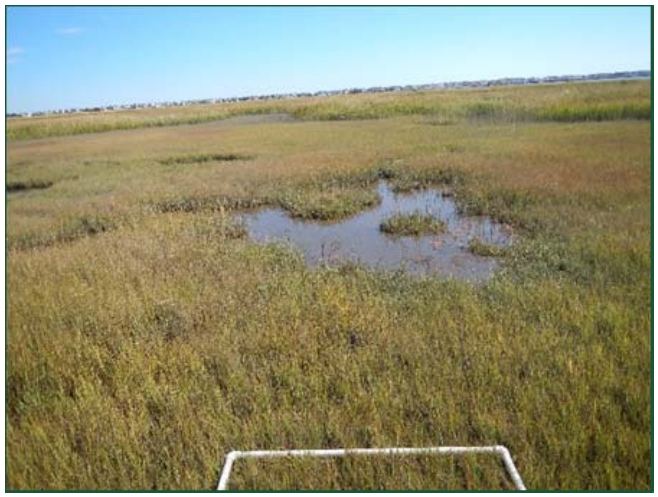
The site assessment or problem identification process followed 3 steps and used the following tools or metrics:

1. High-level desktop analysis
   - ~~LiDAR analysis~~
   - ~~Historical aerial image analysis~~
   - Drainage analysis – **this was used to help refine site boundaries**
   - ~~Erosion rate analysis~~

Site Assessment

The site assessment or problem identification process followed 3 steps and used the following tools or metrics:

2. Rapid on-the-ground assessment



The resulting qualitative observations also were used to refine site boundaries

- **Example: “expanding pools and unstable platform” and “sparse and stunted vegetation”**

Site Assessment

The site assessment or problem identification process followed 3 steps and used the following tools or metrics:

3. Detailed site characterization
   - Topographic surveys **– used to refine site boundaries, set target elevations and design containment measures**
   - ~~Water level monitoring~~
   - ~~Vegetation surveys~~
   - ~~Avifauna~~
   - ~~Nekton~~
   - ~~Epifaunal macroinvertebrates~~
   - ~~Benthic Infauna~~
   - Soil/sediment properties of marsh and dredged sediments **– used to plan locations of pipe discharge**

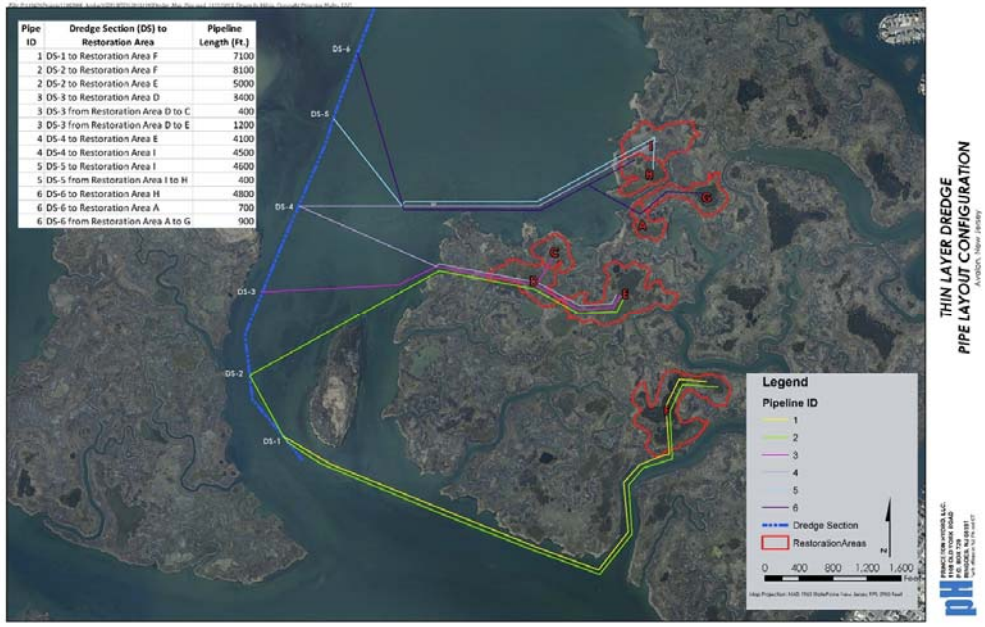
Design Process

Let's run through the design process to see:

- how those site assessment metrics were used
- what other design criteria were added
  - Regulatory restrictions
  - Project constructability
  - Dredged material characteristics
- what design criteria should have been used

Design Process

1. Delineating site boundaries
2. Setting target elevations
3. Specifying sediment containment measures
4. Specifying dredge pipe pathways



Pipe ID	Dredge Section (DS) to Restoration Area	Pipeline Length (Ft.)
1	DS-1 to Restoration Area F	7100
2	DS-2 to Restoration Area F	8100
2	DS-2 to Restoration Area E	5000
3	DS-3 to Restoration Area D	3400
3	DS-3 from Restoration Area D to C	400
3	DS-3 from Restoration Area D to E	1200
4	DS-4 to Restoration Area E	4100
4	DS-4 to Restoration Area I	4500
5	DS-5 to Restoration Area I	4600
5	DS-5 from Restoration Area I to H	400
6	DS-6 to Restoration Area H	4800
6	DS-6 to Restoration Area A	700
6	DS-6 from Restoration Area A to G	900

Design Process

STEP 1: Delineating site boundaries

Criteria used:

- **Drainage analysis**
- **Rapid on-the-ground assessment**
- **Topographic surveys**

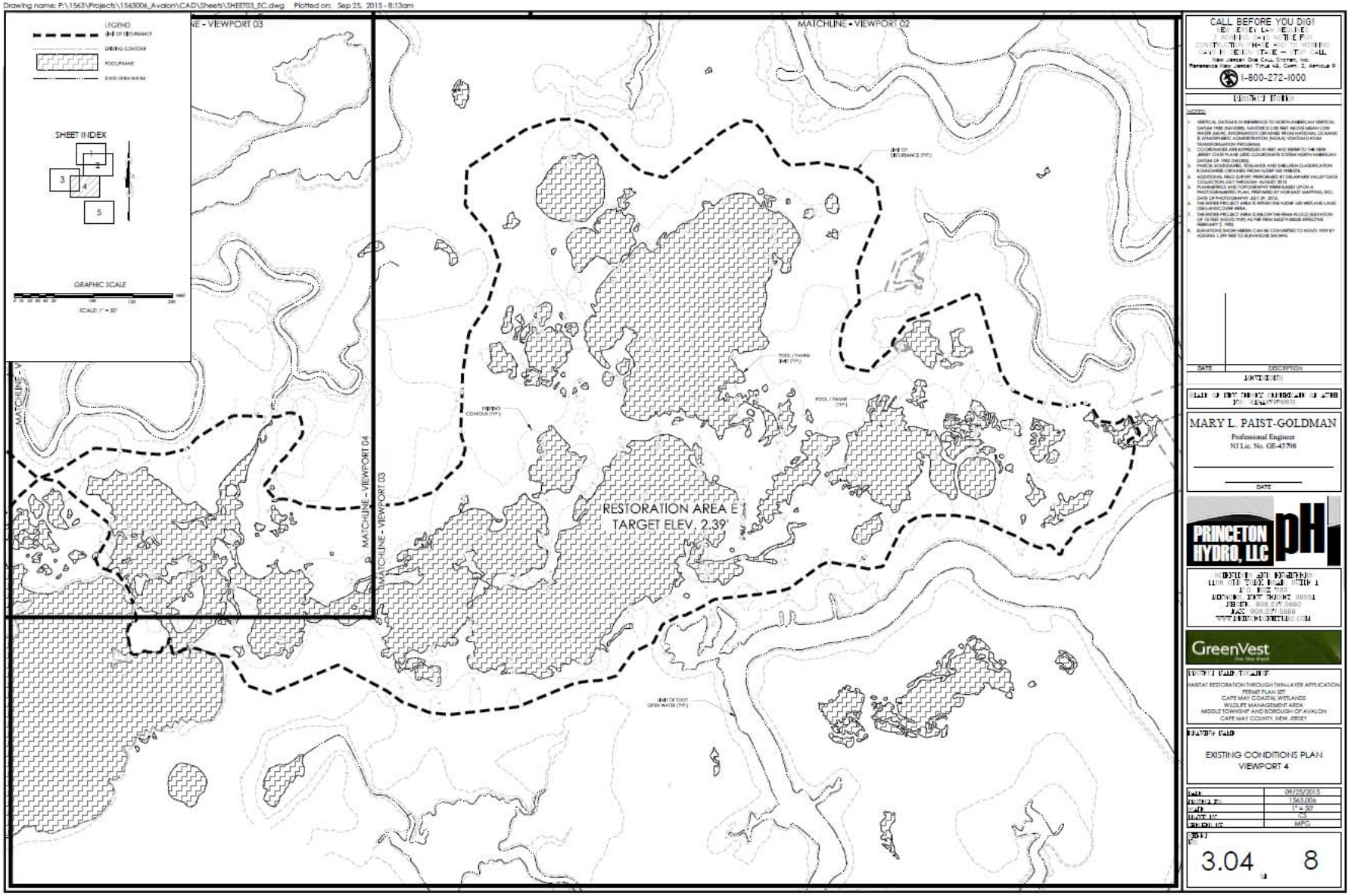
Design Process

STEP 2: Setting target elevations

Criteria used:

- **Topographic surveys**
  - **Looked at highest elevations surrounding the isolated pool/panne complexes**
- Local tidal boundaries
  - NOAA Vdatum software was used to delineate tidal boundaries
  - Wished we could have used data from our own gauges
  - Tidal boundaries were used to set target elevations by targeting plant community types
- On site bio-benchmark data (plant community and elevation)
- Dredged sediment dynamics
  - Could only use predictions of bulking and consolidation factors
  - Wished we had known factors to use as design criteria

Drawing name: P:\1563\Projects\1563006_Avalon\CAD\Sheets\SHEET03_EC.dwg Plotted on: Sep 25, 2015 - 8:13am



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1-800-272-1000

PROJECT NOTES

NOTES:

1. VERTICAL DATUMS IN REFERENCE TO NORTH AMERICAN VERTICAL DATUM 1988 (NAVD88). NAVD88 IS 0.00 FEET ABOVE MEAN LOW WATER (MLW). INFORMATION OBTAINED FROM NATIONAL OCEANIC & ATMOSPHERIC ADMINISTRATION (NOAA) VDATUM DATUM TRANSFORMATION PROGRAM.
2. COORDINATES ARE EXPRESSED IN FEET AND REFER TO THE NEW JERSEY STATE PLANE GRID COORDINATE SYSTEM NORTH AMERICAN DATUM OF 1983 (NAD83).
3. PARCEL BOUNDARIES, WETLANDS AND SHELLFISH CLASSIFICATION BOUNDARIES OBTAINED FROM NJDEP GIS WEBSITE.
4. ADDITIONAL FIELD SURVEY PERFORMED BY DELAWARE VALLEY DATA COLLECTION, LLC THROUGH AUGUST 2015.
5. PLANIMETRICS AND TOPOGRAPHY WERE BASED UPON A PHOTOGRAMMETRIC PLAN, PREPARED BY FOR EAST MAPPING, INC. DATE OF PHOTOGRAPHY JULY 29, 2013.
6. THE ENTIRE PROJECT AREA IS WITHIN THE NJDEP GIS WETLAND LAND USE/LANDCOVER AREA.
7. THE ENTIRE PROJECT AREA IS BELOW THE FEMA FLOOD ELEVATION OF 10 FEET (NGVD 1929) AS PER FEMA DATA FLOOD EFFECTIVE FEBRUARY 2, 1983.
8. ELEVATIONS SHOWN HEREIN CAN BE CONVERTED TO NGVD 1929 BY ADDING 1.299 FEET TO ELEVATIONS SHOWN.

DATE	DESCRIPTION

REVISIONS

SEAL OF THE PROFESSIONAL ENGINEER OR ARCHITECT RESPONSIBLE FOR THE DESIGN

MARY L. PAIST-GOLDMAN
Professional Engineer
NJ Lic. No. GE-45798

DATE

PRINCETON HYDRO, LLC

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PHONE: 908.879.5660
FAX: 908.879.5888
WWW.PRINCETONHYDRO.COM

GreenVest

PROJECT TITLE AND LOCATION

HABITAT RESTORATION THROUGH THIN-LAYER APPLICATION
PERMIT PLAN SET
CAPE MAY COASTAL WETLANDS
WILDLIFE MANAGEMENT AREA
MIDDLE TOWNSHIP AND BOROUGH OF AVALON
CAPE MAY COUNTY, NEW JERSEY

DRAWING TITLE

EXISTING CONDITIONS PLAN
VIEWPORT 4

DATE	09/25/2015
PROJECT NO.	1563.006
SCALE	1" = 50'
DRAWN BY	DJ
REVIEWED BY	MPG

SHEET NO.
3.04 8

Design Process

STEP 3: Specifying sediment containment measures

Criteria used:

- **Topographic surveys**
  - **Existing elevation**
  - **Location of tidal creeks**
- Target elevations

***Wished we had modelled drainage pathways on the marsh within each area to know where to beef up containment and where not to**

Design Process

STEP 4: Specifying dredge pipe pathways

Criteria used:

- Distance from the channel/marsh edge
- Flexibility/Rigidity of the pipe
- Dredged sediment dynamics
  - Could only use best guess at how far sediment will disperse, how quickly sediment will build up at each staging area, and what sort of hydraulic sorting we would see out there
  - Limited by not knowing these and only a few channel sediment samples
- Restrictions set by regulators
  - Elevated dioxin levels and like-on-like policy
- Sensitivity of the marsh
- Time to break-down and re-stage (time is money)

***Wished we had modelled drainage pathways on the marsh within each area to know where to stage pipes and where not to**

Verizon 9:40 PM 44%

Message

Area DC- placement plan.pdf

Placement Plan

Restoration Areas C (3.11 ac) and D (5.43 ac)

January 2015

Avalon Salt Marsh Restoration Project - Avalon, NJ

GreenVest

Conclusion

We had a lot of the criteria we need, but there were others we could have used including:

- Drainage pathways
- More bio-benchmark data
- Limits of dredge contractor equipment
- Impacts of equipment on marsh
- Detailed sediment dynamic factors including: bulking factor per sediment texture, consolidation rates in a tidal environment, and hydraulic sorting and dispersal dynamics

Final thought: For these new projects, it is important not only to link the evaluation phase (biologists' expertise) and the design phase (engineering expertise), but also the construction phase.