NJ-2015-004

Analysis of Genesis Rapid Dewatering System (RDS) and Related Technologies

FINAL REPORT
MARCH 2015

Submitted by

Christopher Titze
Cambridge Systematics, Inc.
New York, New York 10016

Nazmi Talimcioglu
Liam C. Gallagher
First Environment, Inc.
Boonton, New Jersey 07005

NJDOT Project Manager
Paul Thomas

In cooperation with
New Jersey
Department of Transportation
Bureau of Research

DISCLAIMER STATEMENT

TECHNICAL REPORT
STANDARD TITLE PAGE

<table>
<tr><td>1. Report No.
NJ-2015-004</td><td>2. Government Accession No.</td><td colspan="2">3. Recipient's Catalog No.</td></tr>
<tr><td colspan="2" rowspan="2">4. Title and Subtitle
Analysis of Genesis Rapid Dewatering System (RDS) and Related Technologies</td><td colspan="2">5. Report Date
March 2015</td></tr>
<tr><td colspan="2">6. Performing Organization Code</td></tr>
<tr><td colspan="2">7. Author(s)

C. Titze (CS), N. Talimcioglu (FE), L. Gallagher (FE)</td><td colspan="2">8. Performing Organization Report No.</td></tr>
<tr><td colspan="2" rowspan="2">9. Performing Organization Name and Address
Cambridge Systematics (CS)
38 East 32nd Street, 7th Floor
New York, NY 10016

First Environment, Inc. (FE)
91 Fulton St.
Boonton, NJ 07005</td><td colspan="2">10. Work Unit No.</td></tr>
<tr><td colspan="2">11. Contract or Grant No.</td></tr>
<tr><td colspan="2" rowspan="2">12. Sponsoring Agency Name and Address

New Jersey Department of Transportation
P.O. 600
Trenton, NJ 08625</td><td colspan="2">13. Type of Report and Period Covered</td></tr>
<tr><td colspan="2">14. Sponsoring Agency Code</td></tr>
<tr><td colspan="4">15. Supplementary Notes</td></tr>
<tr><td colspan="4">16. Abstract: Technological advancements over the last ten years have changed dewatering systems, making them more efficient and scalable. Integrated systems have become more prevalent, the Genesis Rapid Dewatering System (RDS) is one such example. Since the selection of a dewatering system is highly dependent on numerous variables, such as dredge selection, type and amount of material being dewatered and aesthetic variables, this research attempts to compare different dewatering systems when placed under hypothetical site stresses to the Genesis RDS.</td></tr>
<tr><td colspan="2">17. Key Words
Dewatering, Genesis Rapid Dewatering System, Integrated Systems, Geotextile Tubes, Traditional Dewatering Systems</td><td colspan="2">18. Distribution Statement</td></tr>
<tr><td>19. Security Classif. (of this report)
Unclassified</td><td>20. Security Classif. (of this page)
Unclassified</td><td>21. 18 pages</td><td>22. Price</td></tr>
</table>

Form DOT F 1700.7 (8-69)

ACKNOWLEDGEMENTS

The authors of this report particularly wish to thank the staff of the New Jersey Department of Transportation (NJDOT) and the Office of Maritime Resources (NJDOT/OMR).

TABLE OF CONTENTS

LIST OF TABLES

EXECUTIVE SUMMARY

Based on specifications provided by the New Jersey Department of Transportation Office of Maritime Resources (NJDOT/OMR), the research team performed an extensive literature review and research of case studies to present the differences, advantages and disadvantages of current dewatering technologies and techniques when compared to the Genesis Rapid Dewatering System (RDS). The research for this study focused on three types of systems that utilize different technologies, either independently or bundled together, to dewater dredged materials that fit within the NJDOT/OMR specifications. The research team then developed a screening process including, but not limited to, cost effectiveness, scalability and mobility to further analyze and compare the dewatering systems and technologies against the Genesis (RDS).

Once the screening process was complete, three hypothetical scenarios were developed to compare the feasibility of implementing dewatering systems under different site conditions. All scenarios were developed based on reasonable expectations for navigable channels in New Jersey that NJDOT would encounter.

The information presented represents an unbiased understanding of the Genesis RDS as well as alternative technologies, techniques and systems.

BACKGROUND

First Environment, Inc. (First Environment) teamed with Cambridge Systematics, Inc. (Cambridge) to provide the NJDOT with a limited feasibility analysis of the Genesis RDS and related dewatering technologies. The NJDOT had been examining different vendors of dewatering systems and this effort by the team identifies alternative technologies and examines them relative to the capabilities of the Genesis RDS. This research presents an independent comparative analysis of the systems and their abilities to effectively be employed in the State of New Jersey's navigable waterways.

OBJECTIVES

The goal of this report is to present a focused and limited feasibility analysis on whether or not the Genesis Rapid Dewatering System (RDS) and other related technologies could effectively be employed in the State of New Jersey. The dewatering systems under consideration were put through a screening process and compared based on qualitative and quantitative abilities and characteristics. Additionally, the systems all fit within the high level specification set forth by the NJDOT/OMR. The potential scenarios presented are based on sites that could reasonably be encountered throughout the state as potential NJDOT/OMR projects.

INTRODUCTION

The purpose of this project is to provide the NJDOT with an independent comparative analysis of the Genesis RDS and related dewatering technologies. The study team accomplished this by performing and in-depth literature review and an individual system analysis to understand all their strengths and limitations. High level conversations were also held with industry professionals to better understand performance standards of the technologies under review. This assisted in structuring a normalized unit cost analysis for the systems, which provides an additional level of information for which the NJDOT to use in their final decision.

SUMMARY OF LITERATURE REVIEW

To fully examine the Genesis RDS and alternate dewatering technologies the research team conducted a literature review of case studies, academic journals and white papers from around the United States to gather information on a range of dewatering systems and their applicability to navigable waterways in New Jersey. This information provided the team a baseline into the abilities and limitations of the systems and what recent technological advancements have done for the dewatering industry as a whole. Furthermore, this comprehensive review enabled the team to evaluate real-world scenarios that the dewatering technologies were utilized in and their relation to navigable waterways in the State of New Jersey.

Supportive information was found in the research paper entitled "Physical Separation Process Demonstrations-A Review of Three Dredging Projects" which offered insights into U.S. Army Corps of Engineers (USACE) application of physical separation technologies for two dredging projects and one remediation project. The issues faced in these cases were similar to standards set forth by the NJDOT including, stringent restrictions on placement of dredged material, with opportunities for beneficial use and an interest in using innovative technologies. Additionally, a separate research paper by the USACE entitled "Economical Treatment of Dredged Material to Facilitate Beneficial Use" identified valuable information about recent technological improvements that have improved the dewatering and handling of dredged materials.

To the extent practicable, the research includes a unit cost analysis for the dewatering systems. The costs included in the report were a result of high level conversations with individual companies including both Genesis Water and Del Tank and Filtration Systems.

SUMMARY OF WORK PERFORMED

At the direction of the NJDOT, the research team analyzed the Genesis RDS and related dewatering technologies in an independent analysis. Specific tasks included:

Literature Review

Research performed for the literature review showed that over the last 10 years technological advancements in the rapid dewatering field have greatly improved processes, throughputs, scalability and decreased costs. Studies show that rapid dewatering technologies and techniques accelerate the separation of solids and water from the dredged materials, often mitigating the issue of disposal areas and reducing the footprint of the overall project when compared to more traditional systems (Hodges, et. al 2009). More specifically, the research showed these developments have allowed for dredged materials to be repurposed after physical, chemical and biological characterization. The less contaminated, or uncontaminated, sediment contents require less rigorous treatment or disposal measures, and may be suitable for commercial or beneficial reuse without treatment (Estes and Palermo, 2004). This, in part, has a tremendous economic impact for project developers.

Furthermore, it has been determined that dewatering systems achieve optimum performance when there is minimal variation in solids loading, flow rate and particle size distribution. These systems are designed to perform under certain site-specific conditions and variables and it is imperative that the dredge site replicate those ideal conditions, to the extent practical (Englis and Hunter). To this end, sites which deviate from the ideal design conditions generally result in less efficient dewatering practices.

Based on both the literature review and case studies, it was found that dewatering systems largely use the following types of technology, either independently or bundled together:

- **Passive**, which refers to reliance on natural evaporation and drainage to remove moisture;
- **Chemical aids**, including polymers and coagulants which aggregate smaller particles together to form larger composite particles using various physical and chemical interactions;
- **Physical**, in which two or more components of a system are separated based on physical properties or characteristics of the materials; and
- **Mechanical**, which requires the input of energy to squeeze, press, or draw water from the hydrated material.

Comparative Analysis of Dewatering Systems

The comparative analysis of dewatering systems focuses on the following systems:

- Traditional Systems;
- Geotextile Tubes, and;
- Integrated Systems

These systems were analyzed because they fit within the following NJDOT/OMR's specifications:

- The dewatering system can be utilized in shallow draft recreational and light commercial channels,
- Most of the work will be done from September to December but could range from June to December,

- System must be compatible to both mechanical and hydraulic dredging,
- Contamination is not of concern for the dredged materials and will most likely be used for upland, beneficial use,
- Both cost efficiencies and scalability of the system are of high priority to ensure full utilization of the investment, and

Based on the specific footprint requirements, certain dewatering systems were screened out early in the process because of their size and immobility

Traditional Systems

Traditional System technologies provide the basic common core of dewatering, including but not limited to:

- Reduces residuals mass and volume to be stored and transported;
- Eliminates free liquids before disposal;
- Reduces Fuel Requirements;
- Eliminates ponding and runoff; and
- Optimizes air drying and other stabilization processes.

They are the most prevalent forms of dewatering systems found in the field today. However, all of these systems are highly variable in costs and size because of their basic nature and specific needs. Larger systems will be able to handle large inflows of dredged materials but they will become increasingly harder to move and more costly to operate. Furthermore, some of these systems, as noted in Table 2, do not continuously dewater dredged material but rather in batches. An example of a batch process is a filter press, which accepts a designated amount of water and sediment upon which flow from the dredge will stop. The filter press will squeeze or press out the water in the tank, leaving only dewatered materials behind. Those materials are then removed and the unit can then be filled again with dredged material.

Additionally, odors, excessive noise, energy requirements, increased operator attention, maintenance time, and lengthy repairs costs can be further issues. Capital costs can greatly range for these systems as well depending on size requirements, the EPA states these costs can generally range anywhere from $45,000-80,000 before construction, polymer and polymer feed system, maintenance and operation, power and fuel requirements are added in.

Table 1 – Analysis of Traditional Systems

System Type	Cost Per Cubic Yard	Type Of Process	Cake Solid % at End of Process	Truck-able	Allow-able Inlet Flow Rate	Foot-print	Additional Notes
Filter Press	Based on Unit Size	Batch*	25%	Yes	Variable	Variable	Low process and production rates, susceptible to cloth binding with oily sludge streams
Belt Filter Press	Based on Unit Size	Continuous	25%	Yes	Variable	Variable	Requires expensive polymer, does not dry sediments as effectively as filter press
Plate & Frame Press	Based on Unit Size	Batch	25%	Yes	Variable	Variable	High capital costs, requires high volume of expensive polymers, very noisy
Centrifuge	Based on Unit Size	Batch	30%	Yes	Variable	Variable	Labor intensive, expensive pre-conditioned polymer required, high fuel and power needs.
Hydro-cyclone	Based on Unit Size	~200 day filling plus drying period	15%	Yes	Variable	Variable	Limited capacity, overflows easily and disposal area must be available

<u>Geotextile Tubes</u>

Geotextile tubes are effective in reducing the surface area required for dewatering. They have been used to contain and dewater materials from channels and harbors since the late 1980's and technological improvements have increased scalability. When geotextile tubes are utilized in these scenarios, they have alternative structural applications once the dewatering process is complete. Numerous case studies have cited their use in the construction of coastal groins, off-shore wave breakwaters, beach nourishment, shoreline structures, on- and off-shore stability, shore berms and coastal sand dune protection.

Overall, geotextile tubes require less dewatering equipment, labor hours of operation and provide effective material containment relative to other systems. They are subject to seasonal inconsistencies if feed and solid lines are not freeze-protected. Furthermore, dewatering from geotextile tubes can take long periods of time and be adversely impacted by local weather conditions of high humidity and rain.

Table 2 – Analysis of Geotextile Tubes

System Type	Cost Per Cubic Yard	Type Of Process	Cake Solid % at End of Process	Truck-able	Allow-able Inlet Flow Rate	Foot-print	Additional Notes
Passive	$6-8	Tubes take 1-2 days to fill	95% of sediment is retained by tube	Yes	700 to 2,000 gpm	Variable (1 to 4,000 cubic meters)	Can be used to reinforce infrastructure projects, susceptible to climatic changes, little technology, low operator/labor inputs

**Depending on polymer used*

Integrated Systems

The goals of integrated systems are to maximize operational rates and reduce project downtime. They do not utilize pits or ponds to settle materials and generally emit little noise and odor. The small footprint of most integrated systems allows them to be set up in parking lots, on golf courses or even on barges and are more mobile than alternative system options.

Integrated systems themselves can be uniquely built and customized to include all necessary processes. Systems developed by both Brennan, in alliance with Phoenix Process Equipment, and Press Rentals have been reviewed and found to produce similar efficiencies as the Genesis RDS. Based on the literature review and research, numerous other dredging companies have the capacity to build customizable units. Based on their field expertise and experience, these systems can be built for specific projects or jobs sites by vendors. All of which have experience in dredging and dewatering sediments from navigable channels.

Customized system costs vary based on project necessities and will offer differing operational and labor intensities based on complexities. Research and case studies have shown customized press systems that have included the following technologies within a portable skid unit:

- Centrifuge;
- High Pressure belt press;
- Plate and Frame filter press;

- Screw Press;
- Grinders, screens, tanks and hydro-cyclones; and
- Geo-textile tubes

Table 3 – Analysis of Integrated Systems

System Type	Cost Per Cubic Yard	Type Of Process	Cake Solid % at End of Process	Truck-able	Allow-able Inlet Flow Rate	Foot-print	Additional Notes
Genesis	$7-10	Continuous	40%	Yes	2,000-5,000 gpm	150X150**	Completely patented process, requires a pilot study, accepts as low as 2% solids from dredge flow, low operational costs, unlimited scalability
Custom System (offered by Brennan and Press Rentals)	$7-10	Batch or Continuous *	40%	Yes	2,000-5,000 gpm	Variable	Customizable to fit client's needs, certain additions can introduce batch processing, unlimited scalability

**Depending on system additions*
*** Smallest footprint before add-ons*

Genesis RDS

While both the Brennan and Press Rentals customize more traditional systems to produce a portable unit, the Genesis RDS system has created a system to eliminate the need for slow clarifiers and filter presses while still allowing it to be scalable to any volume or dredge flow. Case studies of the Genesis RDS have shown that pilot studies, while not necessary, should be considered to ensure that the system has the capacity to meet all expectations.

The patented components of the RDS system are the following:

- AquaScreen – instantly strips free water from ultra- fine sediment in high volumes to ensure clear water return.

- TerraCore – receives the solids from the AquaScreen to produce stackable and truckable solids.

- VibraSnap – catches the more coarse debris from the slurry like rocks, shells or vegetation to separate and stockpile them.

- Desander – specifically added to separate and stockpile sand from dredge slurry.

- Polymer System – added to system when fine –grained sediment is encountered to achieve flocculation.

Comparative Analysis Based on NJDOT/OMR Specifications

Based on the research conducted and case studies reviewed, all analyzed systems could fit within the specified criteria for the NJDOT/OMR's intended use. The following table compares the NJDOT/OMR's specifications and concerns within the discussed systems. Table 4 is intended to provide a base comparison between the systems analyzed.

Table 4 – Comparative Analysis of General Dewatering Technologies

Criteria	Traditional	Geo-textile Tubes	Integrated Systems
Lowest Cost		✓	
Best Mobility			✓
Most prevalent in use in field currently	✓		
Least Amount of Noise		✓	
Unlimited Scalability			✓
Best Solid Cake Rate %			✓
Best Infrastructure Reuse		✓	
Smallest Base Footprint			✓
Highest Inlet Flow Rate			✓
Least Technical/Labor Intensive		✓	
Best Dredging to Dewatering Flow Rate			✓
Most Automated			✓
Most Susceptible to Climatic Changes		✓	

Comparative Metrics

The research then focused on the following comparative metrics for each type of system before analyzing each system under the proposed hypothetical situations.

- Cost per cubic yard

- Type of Process-Batch or Continuous

- Cake Solid % at the End of Process

- Truckable - Yes or No

- Allowable Inlet Flow Rate (GPM – gallons per minute)
- Footprint

The result of this comparative analysis resulted in the following comparison table:

Table 5 – Dewatering System Criteria Comparisons

System Type	Cost Per Cubic Yard	Type Of Process	Cake Solid % at End of Process	Truck-able	Allow-able Inlet Flow Rate	Foot-print	Additional Notes
Traditional Systems							
Filter Press	Based on Unit Size	Batch	25%	Yes	Variable	Variable	Low process and production rates, susceptible to cloth binding with oily sludge streams
Belt Filter Press	Based on Unit Size	Continuous	25%	Yes	Variable	Variable	Requires expensive polymer, does not dry sediments as effectively as filter press
Plate & Frame Press	Based on Unit Size	Batch	25%	Yes	Variable	Variable	High capital costs, requires high volume of expensive polymers, very noisy
Centrifuge	Based on Unit Size	Batch	30%	Yes	Variable	Variable	Labor intensive, expensive pre-conditioned polymer required, high fuel and power needs.
Hydro-cyclone	Based on Unit Size	~200 day filling plus drying period	15%	Yes	Variable	Variable	Overflows easily and disposal area must be available
Geotextile Tubes							
Passive	$6-8	Tubes take 1-2 days to fill	95% of sediment is retained by tube	Yes	700 to 2,000 gpm	Variable (1 to 4,000 cubic meters)	Can be used to reinforce infrastructure projects, susceptible to weather extremes, little

							technology, low operator/labor inputs
			Integrated Systems				
Genesis	$7-10	Continuo us	40%	Yes	1,500-2,000+ gpm*	150X150 **	Completely patented process, requires a pilot study, accepts as low as 2% solids from dredge flow, unlimited scalability, ability to hire company operators
Del Tank and Filtration Systems' (Del) -Total Clean System	$7-10	Batch or Continuo us***	40%	Yes	750-4,500 gpm****	Variable	Customizable to fit client's needs, certain additions can introduce batch processing, unlimited scalability, easy set-up

** For most efficient operation*
*** Smallest footprint before add-ons*
****Depending on system additions*
*****Depending on TCS selected*

Potential Application of Dewatering Technologies in New Jersey

For the purpose of this study, three hypothetical scenarios were established to compare the feasibility of implementing dewatering systems under differing site conditions. The following scenarios are based on sites that the New jersey Department of Transportation (NJDOT) would reasonably be expected to encounter throughout the state as potential projects. The following qualifiers were not evaluated or were held constant based on project specifications set by the NJDOT.

- **Contamination**-it is assumed the system will encounter minimally-contaminated dredge sediments or materials.

- **Polymer Use**- to be effective, the chemistry and dosage of a polymer must be matched to the site-specific requirements of the sediment.

- **Type of Dredging**-the screening process of potential systems ensured that all systems could receive material from both mechanical and hydraulic dredges.

Additional pumps, feed lines and other system add-ons were not analyzed as they are considered part of the dredging system.

The navigation channels, canals and inlets identified are only a small portion of what exist throughout the entire state but served as a representative baseline for this study. The study focused on each type navigable waterway and then compared the abilities of various dewatering systems within those scopes.

Table 6 – Hypothetical Scenarios

Scenario	Waterway	Size	Location
1- Large	Hackensack River	Approximately 45 miles long	Flows southeast from Rockland County, NY and empties into Newark Basin
2-Medium	Shark River	11.5 miles long	Flows southeast from eastern Monmouth County, through Shark River Inlet into the Atlantic Ocean
3- Small	Manasquan Inlet	Approximately ½ mile long	Connects the Atlantic Ocean with the Manasquan River

Under these scenarios, individual system pros and cons were developed to provide a unique look at how the site variables are highly indicative of the dewatering system selection.

The research team allowed the individual system strengths or weaknesses to drive their effectiveness in each scenario. The metrics provided above were further developed based on the hypothetical site-specific characteristics. To provide a consistent analysis the following systems were analyzed under all three site scenarios.

Table 7 – Types of Systems Analyzed in Hypothetical Scenarios

Site Name	Type of System
Belt Filter Press	Traditional System
Plate and Frame Press	Traditional System
Centrifuge	Traditional System
Del Filtration TCS	Integrated System
Genesis RDS	Integrated System
Geotextile Tubes	Geotextile Tubes

Scenario 1- Hackensack River Results

Dredged Material to be removed: 150,000 cubic yards, June through December
Type of Sediment Encountered: Sandy mud with clay mix at deeper depths (Konsevick)

Intended Use of Dewatered Materials: Unknown
Concerns: Large debris
Space Availability: 1 acre

For the evaluation of Scenario 1, the research team concluded that the Del Tank and Filtration Systems' (Del) patented Total Clean System provided the best option for the proposed scenario. The research team reviewed system results from the following real-world scenarios that tightly aligned with the proposed hypothetical situation set up in Scenario 1:

In Lake Worth, Florida, the Del TCS-3000 was employed to dewater 80,000 cubic yards of sand over a five-month period from a recreational lake. Flow rates from the 10-inch hydraulic cutterhead dredge averaged about 2,500 gpm over this time period with slurry containing about 15 percent solids. The dewatering rate over the course of the project averaged at approximately 100 cubic yards (cy) per hour. Effluent from the TCS-3000 was then pumped back to the lake through a 10-inch pipe with no additional treatment needed. Costs related to this specific project were not released.

Although both the Del Total Clean System and Genesis RDS have many of the same capabilities, based on the magnitude of this project, the Del TCS 3000 Plus is deemed more appropriate over the Genesis RDS. Based on successes under similar situations, the Total Clean System has the capacity to handle higher flow rates from the dredge to accomplish the project in a more efficient manner.

Estimated cost projections for the rental of Total Clean System below were based on conversations with Del Tank and Filtration Systems which provided additional evidence to support the selection the TCS-3000. The costs were structured around high-level conversations with Del to better understand unit costs and rates.

Table 8 – Del Total Clean System 3000 Estimated Cost Projections

Unit	Daily Rental Rate	Monthly Costs*
Scalping Tank	$400.00/day	$12,000
Total Clean System 3000	$1,750.00/day	$52,500
Thickener Tank	$400.00/day	$12,000
Overflow Pump	$150.00/day	$4,500
Underflow Pump	$125.00/day	$3,750
Slurry Water Pump	$150.00/day	$4,500
Booster Pump	$125.00/day	$3,750
400 bbl Mix Tank	$250.00/day	$7,500
Screen Panels	$300.00/each	$6,000 (assuming 20)
Operator Service**	$850.00/day	$25,500

**Monthly costs based on a 30-day month.*
***Optional add-on service, this includes up to 12 hours/day of labor. Travel and per diem are also included in this rate. Operator will also perform any maintenance or mechanical work on the unit.*

Table 9 – Estimated Total System Costs

Item	Unit Cost	Estimated Total Costs
Custom Total Clean System	$106,500/month	$432,000-$732,000 (depending on polymer used)
Labor	$25,500/month	
Polymer*	$300-600,000 total	

**Polymer costs generally range from $2-$4 per cubic yard of dredged material, regardless of the system that is implemented.*

Scenario 2: Shark River Results

Dredged Material to be removed: 100,000 cubic yards, 4 months (e.g., September through December)
Type of Sediment Encountered: Mostly sand
Intended Use of Dewatered Materials: Beach Replenishment and/or Landfill Daily Cover
Concerns: High recreational activity, noise
Space Availability: Less than 1 acre

Similar to Scenario 1, the selection of the Genesis RDS was chosen in this scenario because of a proven track record that is rooted in handling similar real-world scenarios as the one proposed. The uniqueness of the controls in this scenario, noise concerns and very prohibitive land requirements, set the Genesis RDS apart from all other competition given the restraints.

Similar project experience for the Genesis RDS includes the dewatering of 25,000 cy of the Santa Cruz Harbor in Santa Cruz, California. The Santa Cruz Port District utilized their own 8 inch dredge and dredge crew during the project, which had a very small dredging window because of concerns with local endangered species. The Genesis RDS was set up in the Harbor parking lot, on a footprint less than one-half of an acre, and still allowed for pedestrian, bike and car traffic to be routed around it. With that being said, production rates by the end of the project reached 500 cy per day with a solids content of at least 50% that were trucked off site.

Preliminary cost estimates for a semi-custom Genesis RDS systems was provided by Genesis based on hypothetical system mock ups. Again, these prices are based on estimates and should not be considered final. All Genesis RDS units are uniquely priced and sized to project specific needs. Furthermore, information about project mobilization/demobilization and personnel costs found below were presented to better capture the full operational costs of the unit.

Table 10 – Genesis RDS Cost Projections

Equipment	Standard or Custom Addition	Quantity	Price
AquaScreen*	Standard	2	Approximately $120,000/month
Vibra-Snap (72x26-3,000 gpm)	Standard	1	
Desander (3,000 gpm)	Standard	1	
Agitation feed tank for AquaScreen	Custom	1	
Large Auxiliary Water Support Tank	Custom	1	
Coroilis Meter	Custom	2	

**Need additional foundation platform and material holding area, not included in this pricing.*

Table 11 – Genesis RDS Additional Costs

One-time mobilization	$50,000
One-time demobilization	$35,000
Genesis Personnel*	$50,000/month

**For one superintendent and two skilled project managers to train customer on system for four months.*

Table 12 – Scenario 2 Genesis RDS Estimated Total Costs

Item	Unit Cost	Estimated Total Cost
Genesis RDS	$120,000/month	$965,000-1,165,000 (depending on polymer used)
Mobilization/Demobilization	$85,000 (total)	
Labor	$50,000/month	
Polymers	$200-400,000 (total)	

**This system set up may require specialized equipment, such as fork lifts, high cranes, conveyors belts, pumps, etc.

Scenario 3: Manasquan Inlet

Dredged Material to be removed: 5,000 cubic yards, 2 weeks (e.g., September through October)
Type of Sediment Encountered: Sand
Intended Use of Dewatered Materials: Beach Replenishment
Concerns: High recreational activity, noise
Space Availability: Less than 0.5 acre

Based on the restraints proposed by this unique scenario, the geotextile tubes were proven to provide the best resource to protect against future storm damage and further erosion of vulnerable areas. The tubes would be able to dewater in place while stabilizing vulnerable areas. Furthermore, the use of the geotextile tubes eliminates most of the assets and operational manpower required in hauling or unloading cake solids produced by other systems.

Cost estimates for this scenario was based on a specific geotextile tube case study done in Sea Isle City, New Jersey, to provide a baseline. Additionally, there is an unknown return on investment with the geotextile tubes that will remain in place protecting the shoreline for the foreseeable future. Final costs for the purchase, placement and filling of the tubes in this scenario was $160,000 for 900 feet of 12x12 tubing that was filled with 2,000 cubic yards of sand.

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

The research presented in these studies was delivered to the NJDOT/ORM to provide in-depth information about the Genesis RDS and related dewatering technologies. It was concluded that the Genesis RDS, when utilized in the right scenario, can provide optimal results when compared to other dewatering systems. For this to happen, extensive site-specific research must be done to ensure that the system set up and add-ons adequately address all needs. Furthermore, support materials and labor must be provided to ensure that the system can operate at full capacity. Additionally, the competence and experience of work crews with the dewatering system will have a large impact on the system's efficiencies.

Recommendations

The research team offers the following recommendations to NJDOT and the Office of Maritime Resources, with regard to the review, selection, and application of dewatering systems within the State of New Jersey:

- Extensive site-specific research must be done to ensure that the system set-ups and add-ons adequately address all needs;
- Support materials and labor must be provided to ensure that the system can operate at full capacity;
- Competence and experience of work crews with the dewatering system will have a large impact on the system's efficiencies and costs; the quality of these crews must be assessed;
- NJDOT/OMR must create a system of checks and balances to analyze any site against the abilities or shortcomings of specific dewatering systems; and
- Exact site scenarios must be established so that system parameters can be defined and cost estimates can be refined.

To support these activities, it is recommended that NJDOT and the Office of Maritime Resources create a decision matrix to capture all dewatering site specific characteristics versus the abilities and limitations of a specific dewatering system and include the following:

- Determine the exact type of dredge that will be used so that flows to the dewatering system can be estimated.
- Create an extensive site preparation plan where the dewatering system will be staged and operate from so an exact footprint for the system can be estimated.
- Determine if the dewatering system will be rented, leased or bought because this will have an impact on the project's bottom line and deadlines.
- Sample and analyze the exact material that will be encountered. Based on this, the dewatering system could potentially need specific add-ons which would increase its footprint.
- Based on the sample material, determine the types and costs of polymers that are needed.
- Define the aesthetic concerns with the surrounding community, from sounds to traffic concerns.
- Develop an exact, beneficial use plan for all dredged material so that logistical efforts can be appropriately prepared.
- Determine the competence of the labor force with the specific dewatering technology to gauge whether training is necessary or not.

BIBLIOGRAPHY

BCI, 2007. Rapid Dewatering Techniques for Dredged Lake Sediments Literature Review and Summary Report

B.J. Mastin and G.E. Lebster, WaterSolve, LLC. 2006 Use of Geotube Dewatering Containers in Environmental Dredging, Grand Rapids, Michigan

B.J. Mastin and G.E. Lebster, WaterSolve, LLC. Dewatering with Geotubes; A Good Fit for Water and Wastewater Facilities?, Grand Rapids, Michigan

Daniel E. Averett and Trudy J. Estes, 2011, Physical Separation Process Demonstrations-A Review of Three Dredging Projects.

David J. Yozzo, Pace Wilber and Robert J. Will, 2004, Beneficial Use of dredged material for habitat creation, enhancement and restoration in New York-New Jersey Harbor, Journal of Environmental Management.

James M. Ebeling and Kata L. Rishel, Performance Evaluation of Geotextile Tubes, United States Department of Agriculture Research Service under Cooperative Agreement 59-1930-1-130

Keith W. Jones, et al. 2001, Dredged Material decontamination demonstration for the port of New York/New Jersey, Journal of Hazardous Material

Lawrence Juda and Richard Burroughs, 2004, Dredging Navigation Channels in a Changing Scientific and Regulatory Environment, Journal of Maritime Law & Commerce, Vol. 34, No. 2

Matthew Englis and Dewey W. Hunter, A Description of Sediment Dewatering Methods, Ciba Specialty Chemicals Corporation

Michael Hodges, Steve Emmons and Kyle Cascioli.2009. High-Speed Dewatering and Stabilization of Contaminated Sediments, Columbus, Ohio

Michael Hodges, Carol Shobrook and David Frey. Genesis Fluid Solutions, Ltd. High Speed Dewatering of Oil Sands Tailings, Colorado

Otto S. Zapecza, 1989, Hydrogeologic Framework of the New Jersey Coastal Plain, United States Government Printing Office,

Strelow Consulting, 2009, Santa Cruz Harbor Dredge Management Plan, Prepared for: Monterey Bay National Marine Sanctuary

TenCate Geosynthetics (2005), Containment and Dewatering. www.geotube.com

Trudy J. Estes and Christian J. McGrath, 2014, Economical Treatment of Dredged Material to Facilitate Beneficial Use, Dredging Operations and Environmental Research Program, United States Army Coprs of Engineers.

T.J. Olin-Estes and M.R. Palermo, 2001, Recovery of dredged material for beneficial use: the future role of physical separation processes, Journal of Hazardous Materials

U.S. Environmental Protection Agency (2000a). Biosolids Technology Fact Sheet; Belt Filter Press. EPA 832-F-00-057. Washington, D.C.

U.S. Environmental Protection Agency (2000b). Biosolids Technology Fact Sheet; Centrifuge Thickening and Dewatering. EPA 832-F-00-053, Washington, D.C.

U.S. Environmental Protection Agency (Office of Wastewater Management). 2006 Emerging Technologies for Biosolids Management (EPA 832-R-06-005), Washington D.C.