EVOLUTION OF AN INNOVATIVE DREDGING TECHNOLOGY FOR HARVESTING COARSE-GRAINED SEDIMENT

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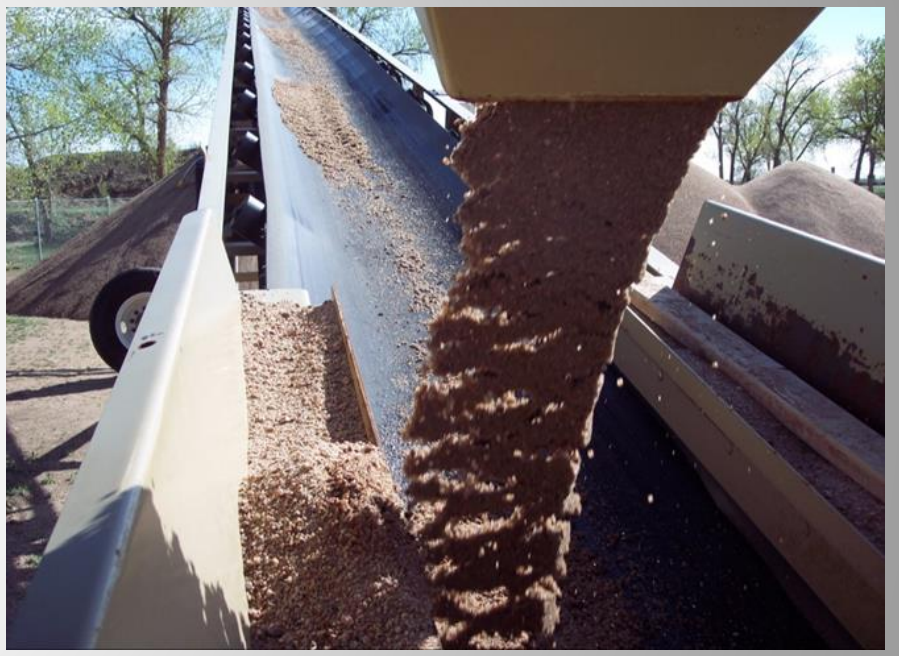
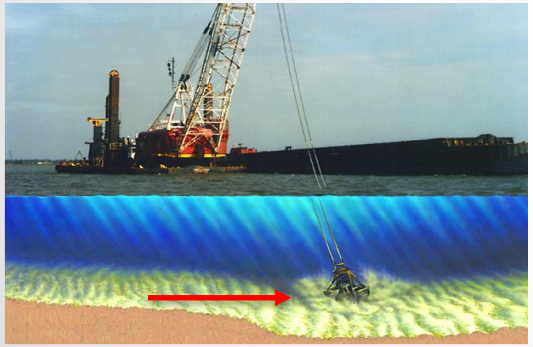
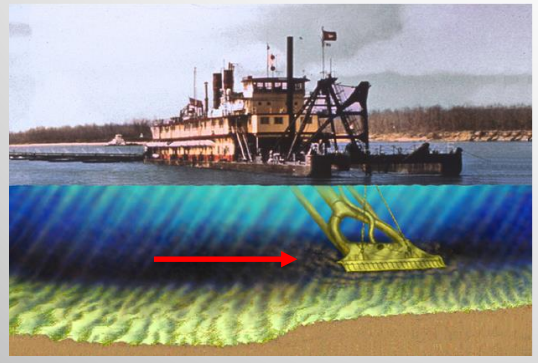


Dredging

Dredging is the process of excavating sediments and other materials from underwater locations, including the transportation and placement of the material, for an intended purpose (e.g., constructing or maintaining navigation channels, beach nourishment, obtaining materials from borrow sites, etc.).





Bedload Collector Technology

Fountain Creek in Pueblo CO

- Need to reduce dredging in Arkansas River

Grate Dimension: 9 m (30 ft) x 0.6 m (2 ft)
Pump: 37 kW (50 hp) submersible

Bedload Collector Technology

90 tonne/hr Spreader

90 tonne/hr Sand Washer

7 m^3 (1,800 gallon) Tank

Controller

150 mm (6 inch) dia Discharge

200 mm (8 inch) dia Return

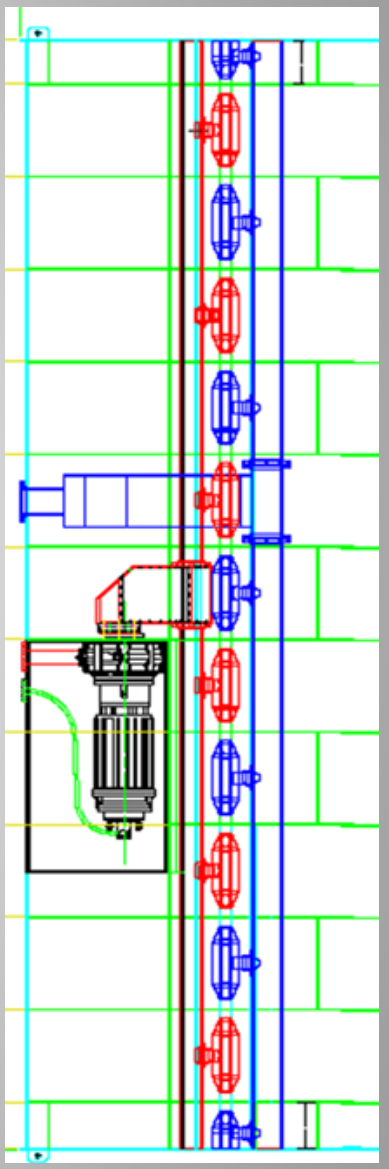
Bedload Collector Technology

Closed Cycle Mode:

- Water is returned to opposite side of manifold as injection water (balanced)
- Sediment “falls” into hopper by gravity
- Minimal impingement velocity (reducing potential for clogging) on the hopper screen and reduced risk of entrainment of aquatic organisms.

Open Cycle Mode:

- Water is drawn into the manifold from across the screen
- Area of the screen openings greater than the area of the manifold orifices velocity across the screen is very small (<1 ft/s (0.3 m/s))
- Yet velocity at the manifold is large enough to transport sediment.



Closed Cycle Mode

Estimating Production

Stream Flow (ft^3/s)	(m^3/s)	2 ft (0.6 m) Collector Bedload Extraction Rates (ft^3/min)	(m^3/min)	Estimated 30 ft (9 m) Collector Bedload Extraction Rate (yd^3/hr)	(m^3/hr)
120	3.4	3.0 ft^3/26 min	0.08 m^3/26 min	2.8	2.1
100	2.8	3.0 ft^3/38 min	0.08 m^3/38 min	2.6	2.0
600	17.0	3.0 ft^3/6 min	0.08 m^3/6 min	16.7	12.8

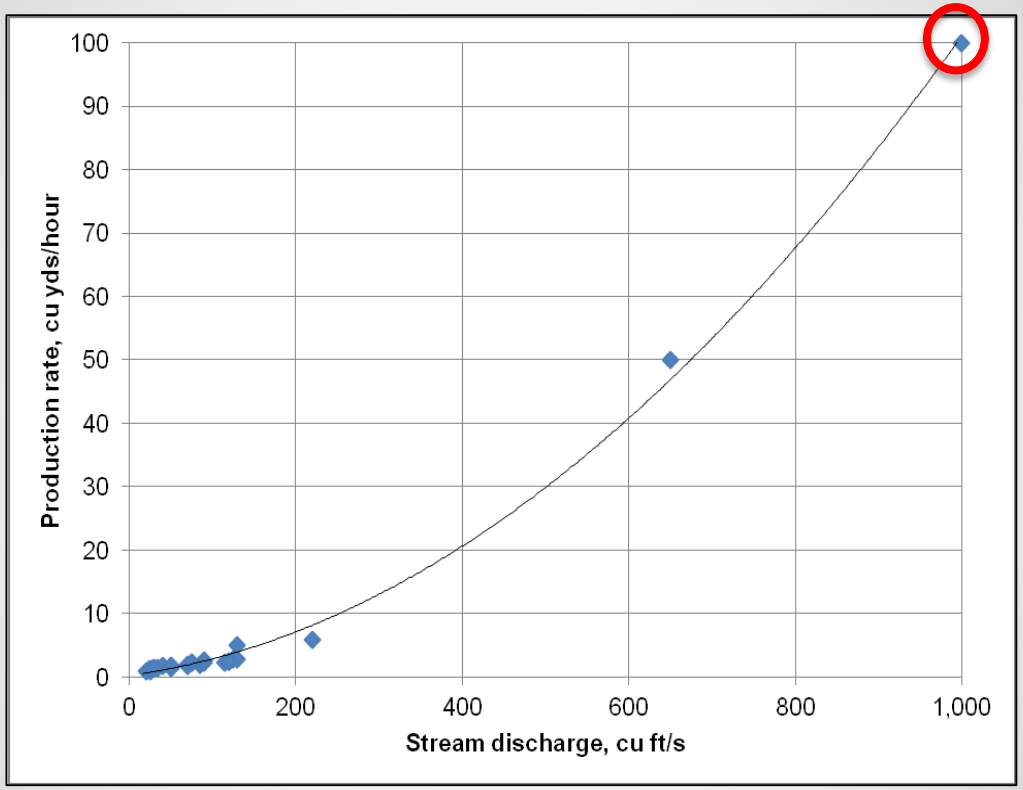
Performance

System Installed July 2011

Planned System

Performance Parameters:

- Stream bed elevation within ½ mile (800 m) of the collector
- water level
- Sediment volume removed,
- Electricity usage
- Maintenance required and hours in operation



- Unfortunately the system was only operated intermittently and for only a short amount of time.
- Specific performance data collected happened at various flow rates over approximately 500 hours.

Construction and Maintenance Cost

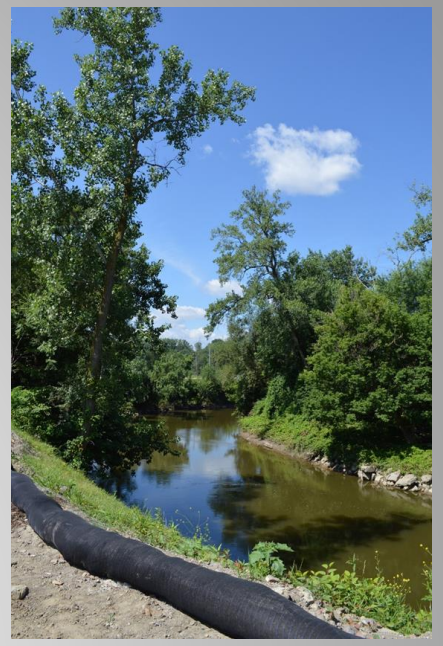
- Upgrades/Repairs:
  - Flood damages
  - Return flow tank and pump
- Operations
  - Uses 1kwh/min
  - <$53,000 per year if operated continuously

    @ $0.10/kWh

Collector (pumps, controllers, pipe, etc.)	$419,000.00
Sediment Spreader	$39,000.00
Installation	$110,000.00
Approx. Cost of Contract Documents	$50,000.00
Upgrades/Repairs	$10,000.00
Total	**$628,000.00**

**Demonstration project costs are approximate and do not includes some in-kind equipment and labor*

Cuyahoga River, Independence OH



- Installed by Kurtz Bros. Inc., The Port of Cleveland, and Streamside LLC.
- The Port of Cleveland received a grant from Ohio Environmental Protection Agency and Ohio Department of Natural Resources and collects a royalty on harvested material.

Cuyahoga River

Consists of a 30 ft (9.0 m) Bedload Collector but with some mods:

- But equipped with a screen deck flushing system.
- Required a separate water intake feeding a 3 in (76 mm) diameter discharge.
- Purpose to provide a jetting array for minimizing blinding from oversized material laying on top of the screen.
- No hopper-mounted pump.

Cuyahoga River

- Pump installed in a land-based wet well pumping station
- Reduced static suction lift) to improve pump efficiency
- Reduce priming issues.

Cuyahoga River

Sand washer was modified:

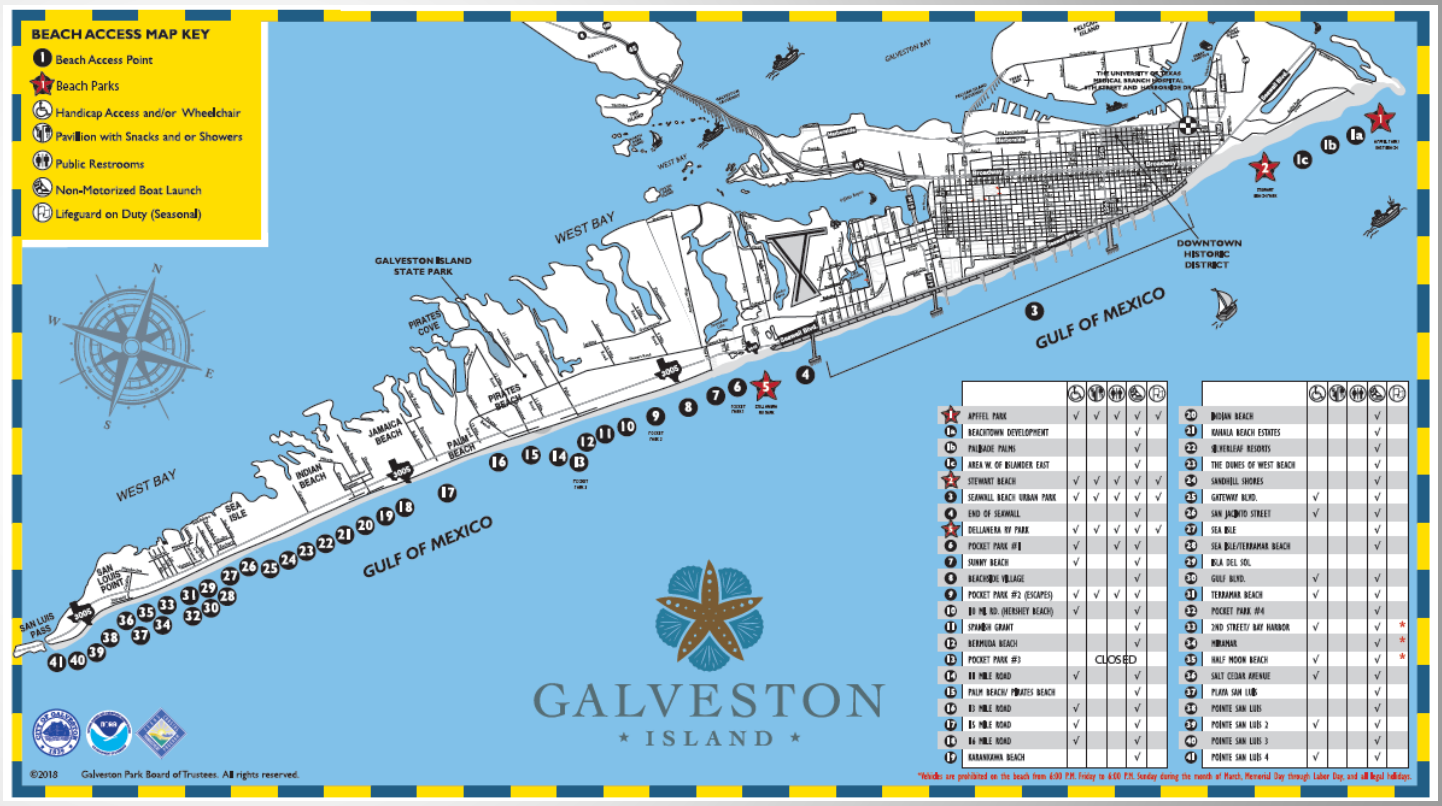
- Skid-mounted with a scalping box added to enhance separation efficiency.
- A 1,200 gallon (4.5 m^3) overflow sump added to collect effluent water from the washer tub.
- Water pumped through a separate 6 in (150 mm) diameter pump.
- Operation can be fully automated - auto sequencing based on input of river stage from USGS station.

Cuyahoga River

- System installed 14 July 2015
- Approximate budget $1.2 M for plant engineering, equipment, installation and operation and maintenance - two year pilot project.
- Production has seen events with approximately 3.3 yd^3/min (2.5 m^3/min).

Galveston Island

- 6.4 million visitors a year to Galveston's sand starved beaches.
- Majority of Galveston's beaches eroding -5 to -10 ft/yr (-1.5 to -3.0m/yr).



Source: Galveston Park Board of Trustees

Galveston Island

Ongoing investigation to evaluate this technology as a beach sediment bypass and/or backpass management option.

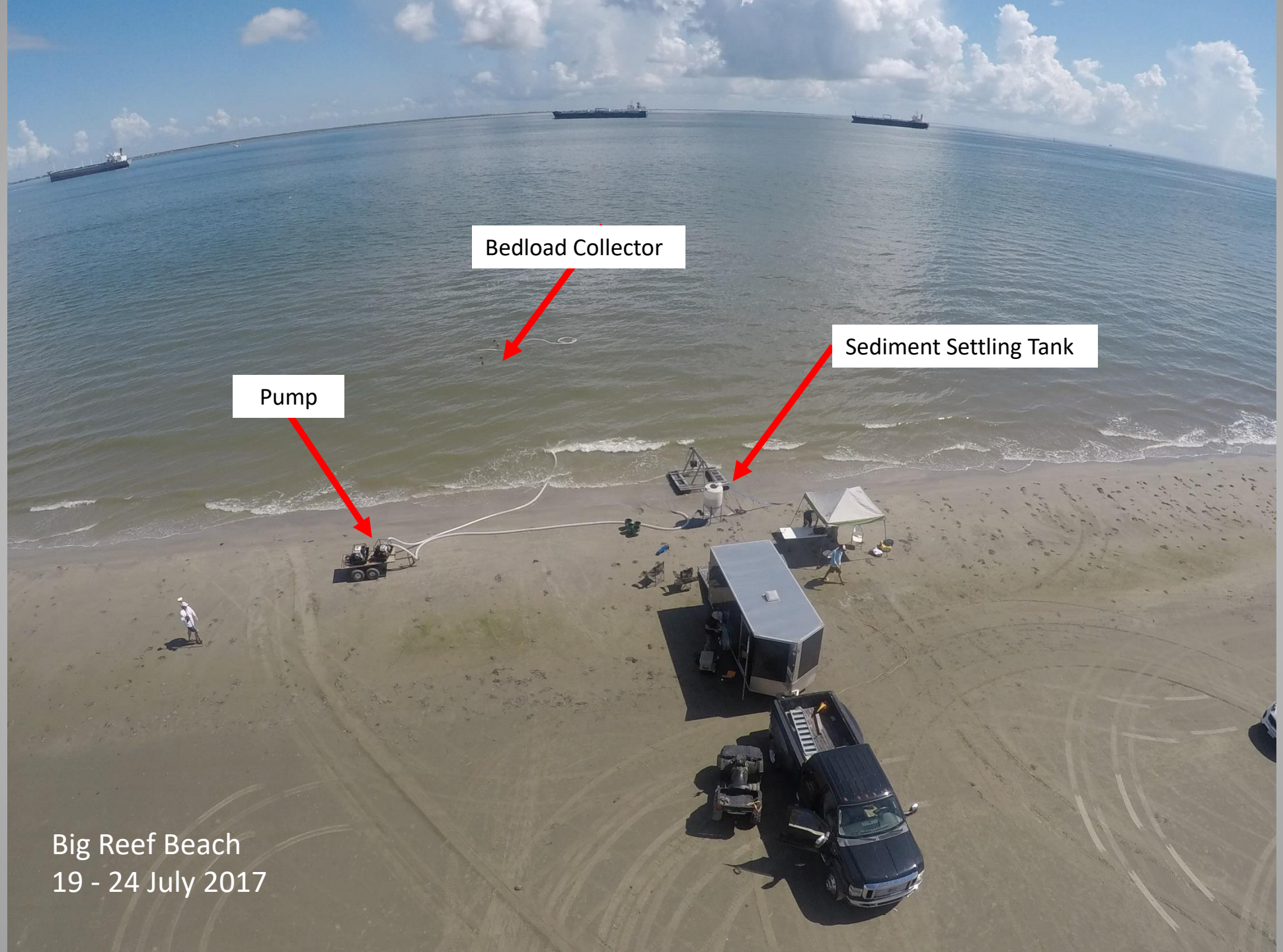
Objectives:

- To demonstrate this system's capability to excavate sand
- Select a harvesting location
- Provide a preliminary design.

Galveston Island

The 2 ft (0.6 m) long Bedload Collector was deployed:

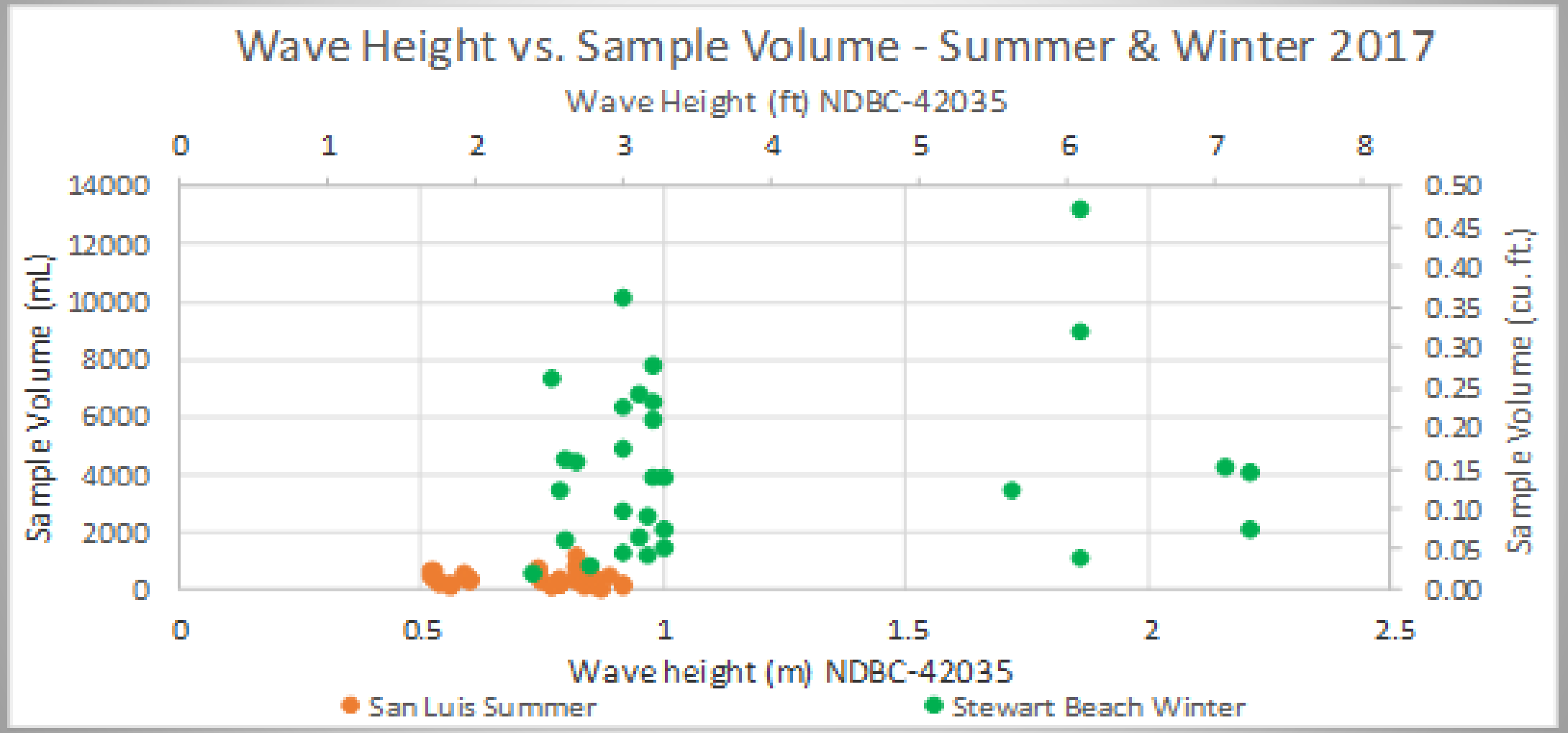
1) Big Reef Beach
19 - 24 July 2017
2) San Luis Pass
25 - 27 July 2017
3) Stewart Beach
4 - 6 December 2017


Bedload Collector
Sediment Settling Tank
Pump
Big Reef Beach
19 - 24 July 2017

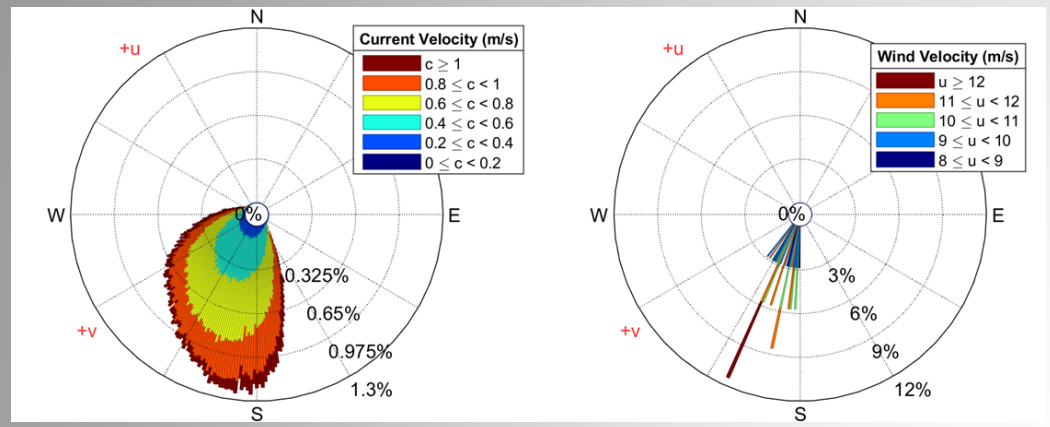
San Luis Pass
25 - 27 July 2017

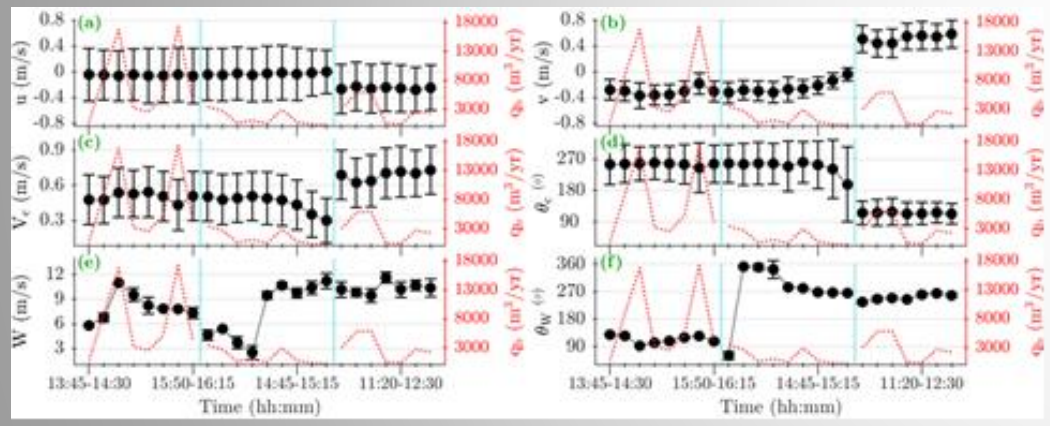

Stewart Beach
4 - 6 December 2017

Galveston Island



Galveston Island



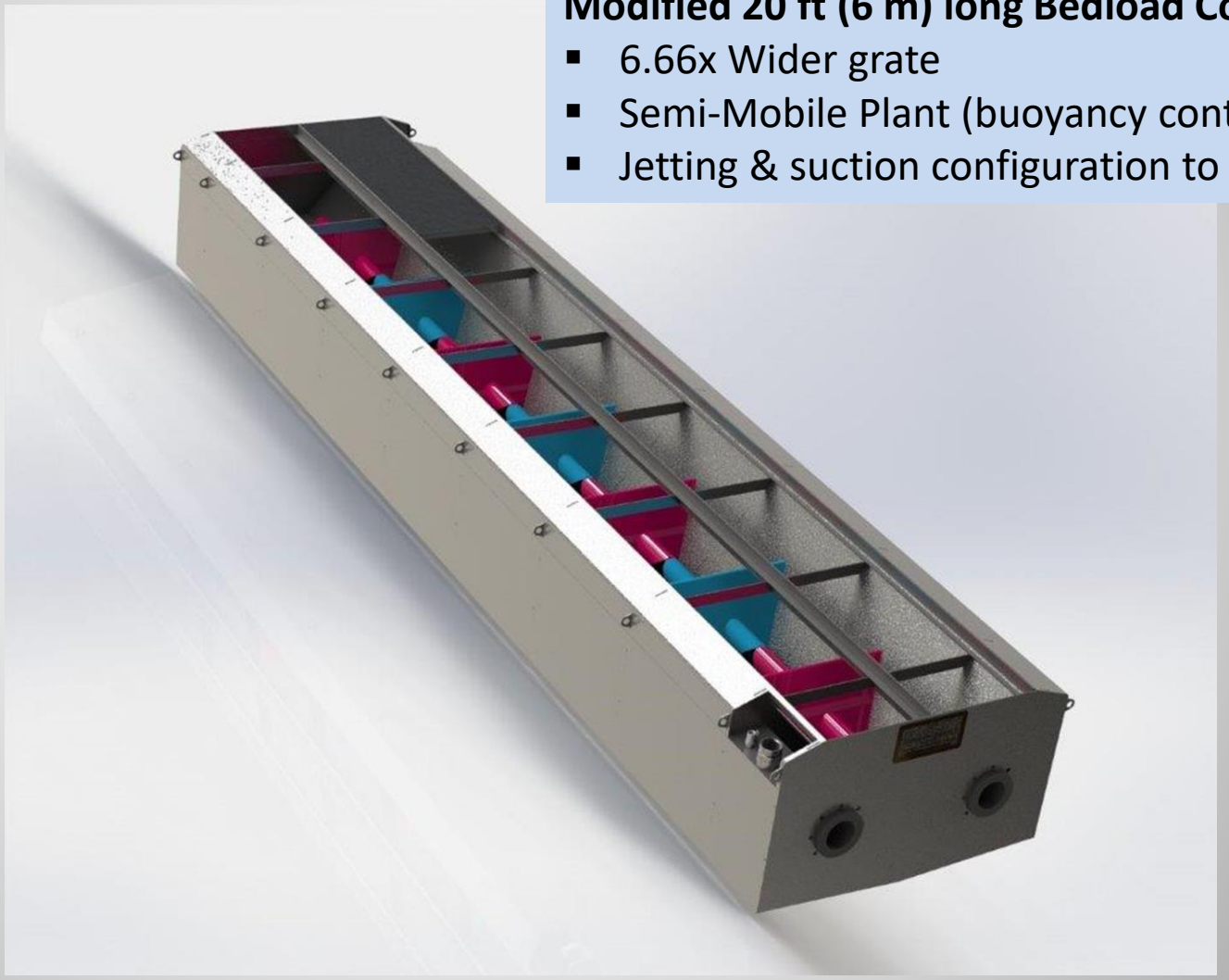


Nearshore hydrodynamic data collected by Texas A&M University during summer and winter tests.

- Acoustic Doppler velocimeter (ADV) for three-dimensional current velocities
- Summer deployments included two optical backscatter sensors (OBS) placed at different elevations in the water column to track suspended sediment concentration (SSC).

Galveston Island

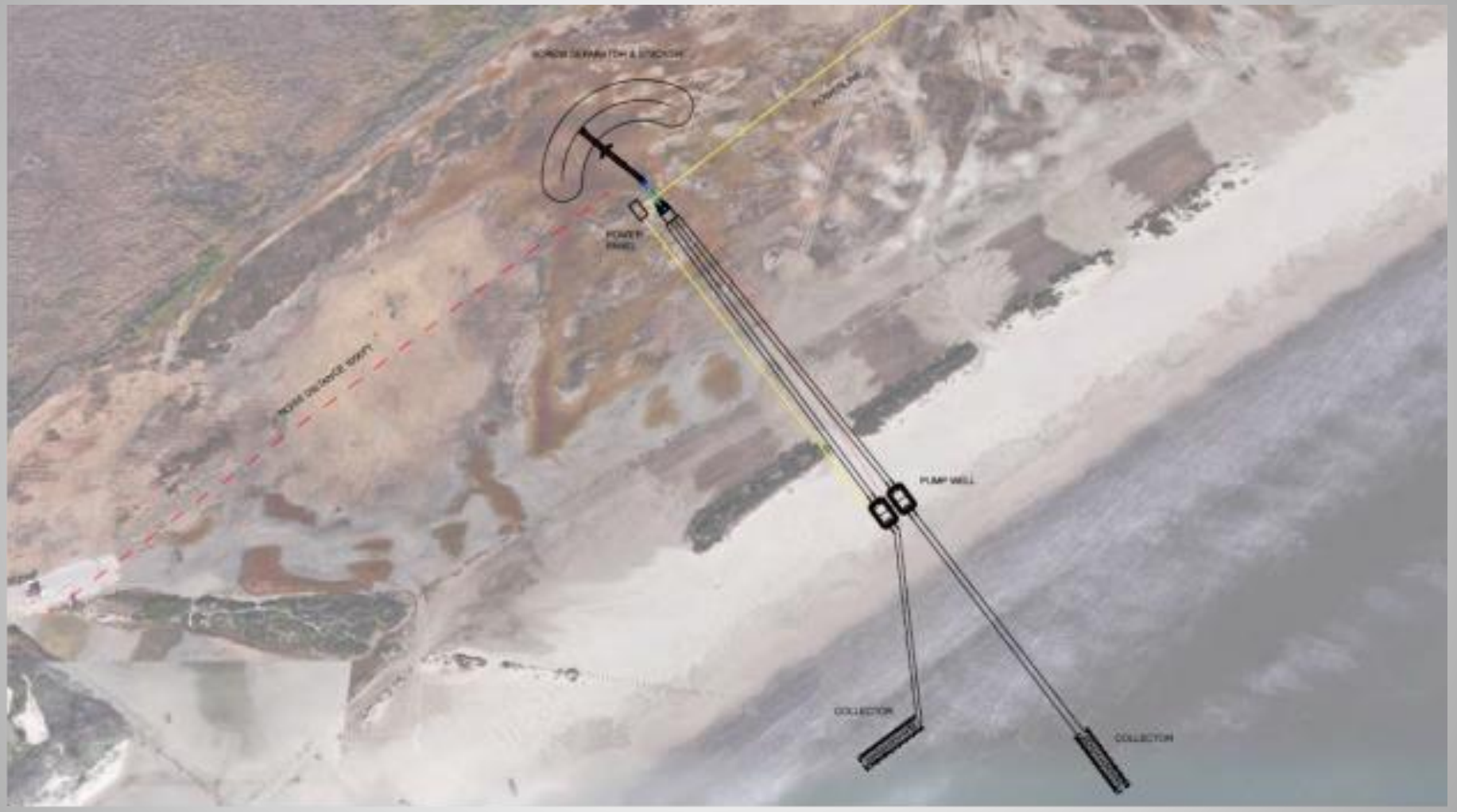
Based on the 2 ft (0.6 m) collector harvesting rates measured at Stewart Beach, annual harvesting rate of the 20 ft (6 m) long marine Bedload Collector deployed at East Beach is currently estimated to range between 30,000 yd^3/yr to 50,000 yd^3/yr.



Modified 20 ft (6 m) long Bedload Collector

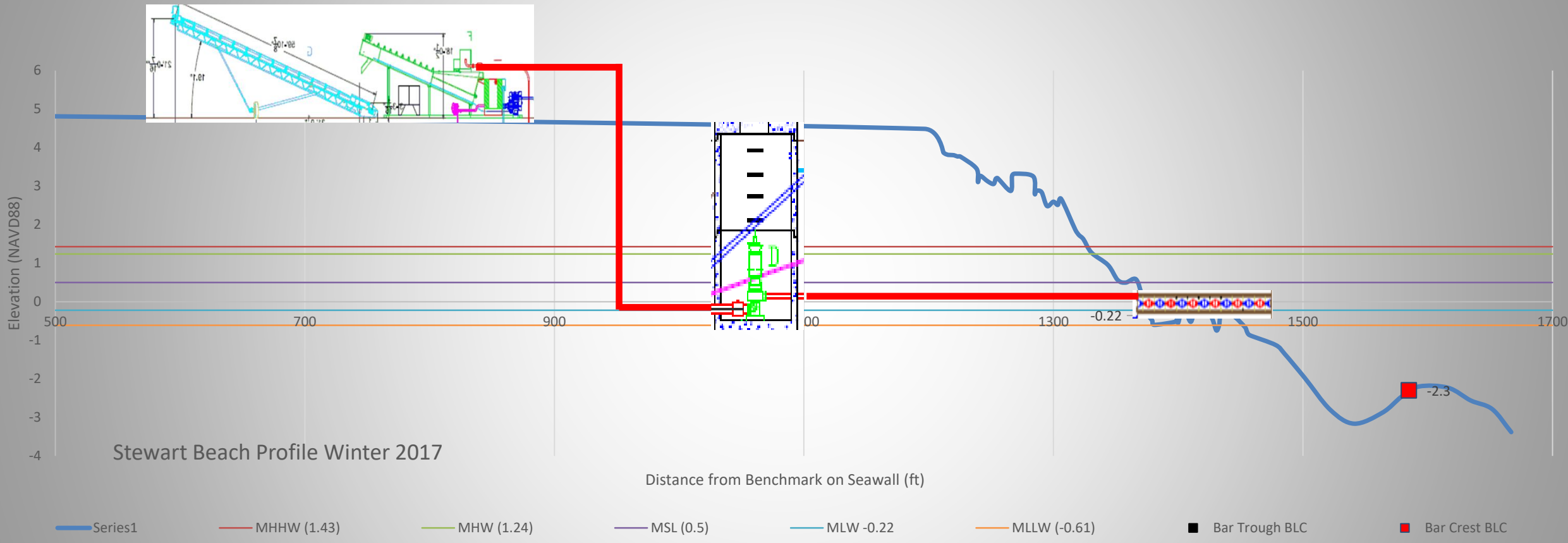
- 6.66x Wider grate
- Semi-Mobile Plant (buoyancy control & self-jetting)
- Jetting & suction configuration to reduce clogging

Galveston Island

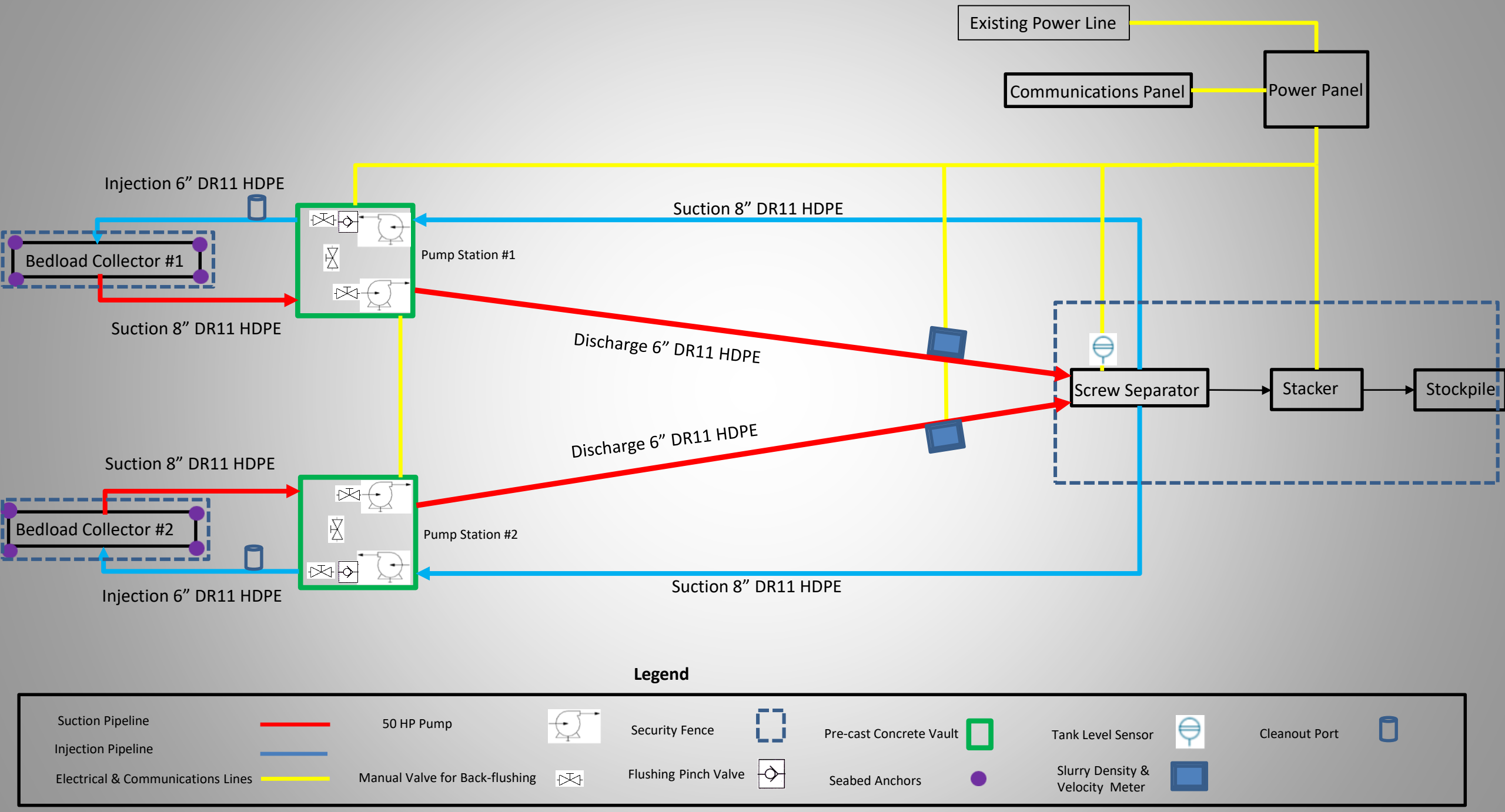


Plan View: Stewart Beach Semi-mobile System Conceptual Illustration

Galveston Island



Profile View: Stewart Beach Semi-mobile System Conceptual Illustration


Existing Power Line
Communications Panel
Power Panel
Injection 6” DR11 HDPE
Suction 8” DR11 HDPE
Bedload Collector #1
Pump Station #1
Suction 8” DR11 HDPE
Discharge 6” DR11 HDPE
Screw Separator
Stacker
Stockpile
Discharge 6” DR11 HDPE
Suction 8” DR11 HDPE
Bedload Collector #2
Pump Station #2
Injection 6” DR11 HDPE
Suction 8” DR11 HDPE
Legend
Suction Pipeline
Injection Pipeline
Electrical & Communications Lines
50 HP Pump
Manual Valve for Back-flushing
Security Fence
Flushing Pinch Valve
Pre-cast Concrete Vault
Seabed Anchors
Tank Level Sensor
Slurry Density & Velocity Meter
Cleanout Port

Questions?