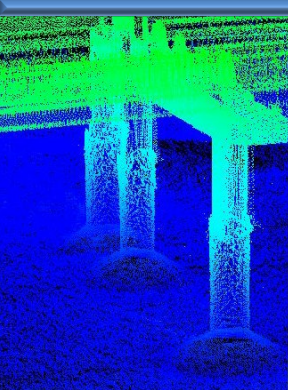




Measutronics Corporation

Teledyne RESON SeaBat T-Series Multibeam Sonars and Turbidity in Real-Time During Dredge Operations

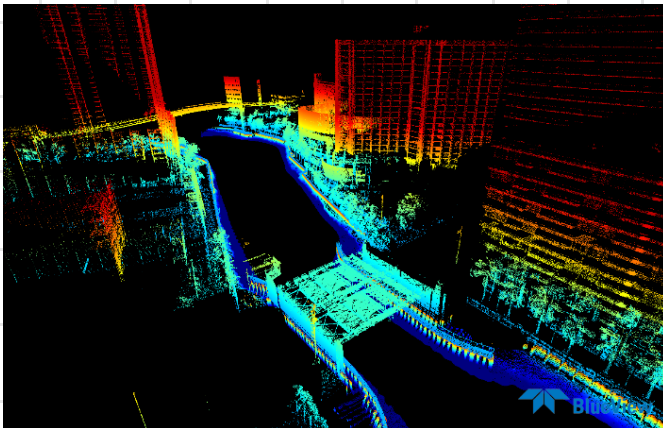


Monday, October 7, 2019

About Me

Keith Dixon

- **Operations Manager & Sonar Systems Specialist at Measutronics Corporation – since 2009**
- **14 Years in the Marine Industry**
- **10 Years Using Teledyne Marine Technology (Both single beam & multibeam)**
- **Licensed USCG Captain – OUPV (6 Pack)**



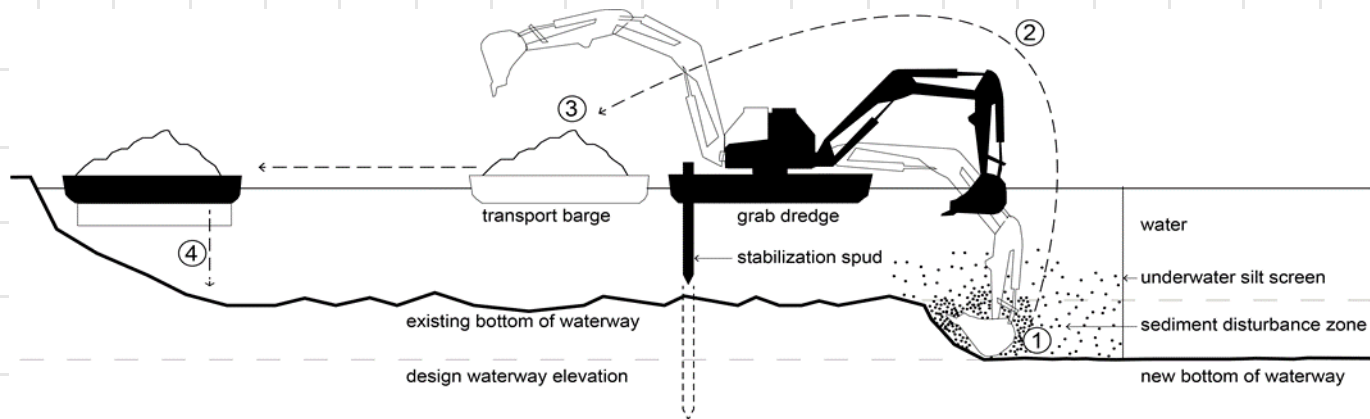
Overview

- **Multibeam sonars are used for design verification of dredging projects**
- **Real-time monitoring of dredge progress enables more efficient dredge work**
- **Turbidity, the presence of suspended material in the water column, greatly affects quality of MB scans**
- **Analyze MB data from RESON SeaBat T20-P as well as data from BlueView BV5000 on dredge jobs of varying levels of turbidity**

What is Dredging?

Dredging is the removal of bottom sediments from streams, rivers, lakes, coastal waterways and oceans.

Dredge material is transported by ship, barge or pipeline to a designated site on land or in the water.



- ① - dislodging of in-situ sediment
- ② - raising of dredged material to the surface
- ③ - horizontal transport
- ④ - placement or further treatment

Required Dredging Areas

- **Ports and Harbors**
- **Inland Waterways**
- **Coastal Re-Nourishment**
- **Oil and Gas**
- **Recreation Water Bodies**
- **Aggregate Mines**



What is a Dredge?

An apparatus for bringing up materials or sediment from a body of water or seabed by scooping or dragging.

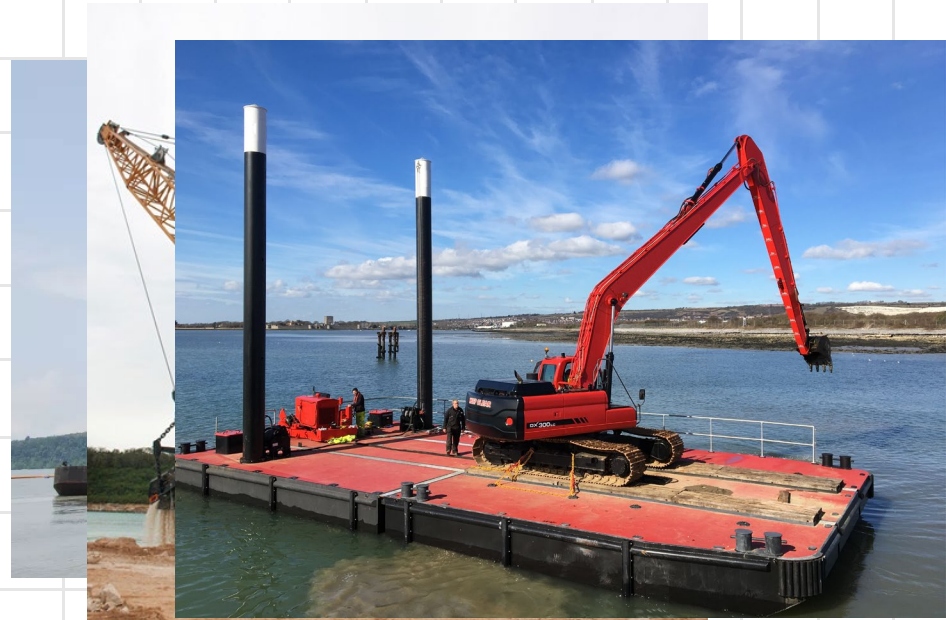


Mechanical Dredges

Mechanical dredges work by mechanically digging sediment from the bottom surface of a body of water, typically using a bucket. Mechanical dredging takes place at the shoreline or from a barge

Types:

- **Clamshell**
- **Dragline**
- **Excavator**

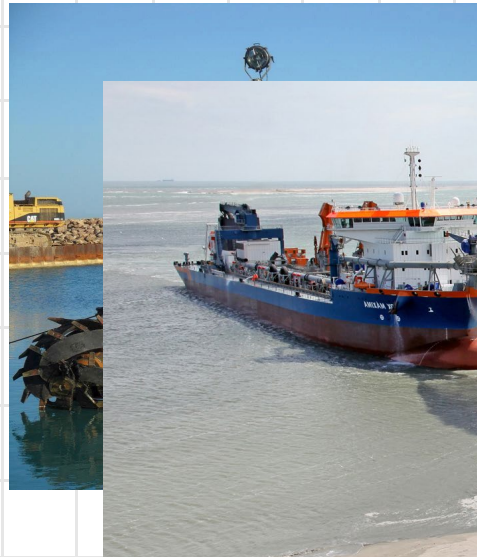


Hydraulic Dredges

Hydraulic dredges work by sucking a mixture of sediment and water (known as slurry) from the bottom surface and transferring the mixture through a pipeline to another location.

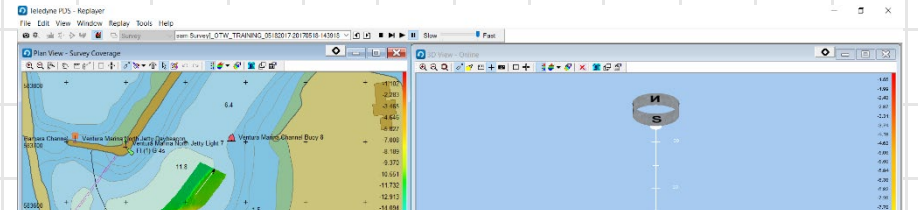
Types:

- Cutter Head
- Hopper
- Dustpan



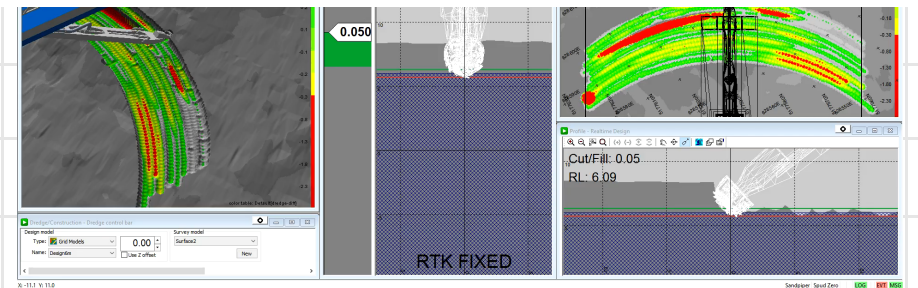
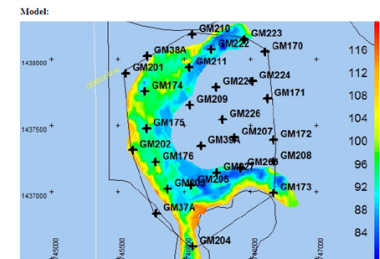
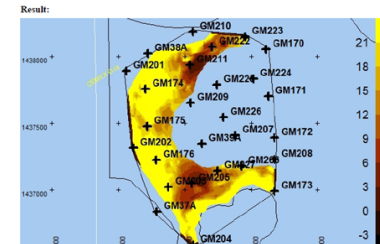
Dredging Process

- **Planning & Design**
- **Pre-survey**
- **Mobilization**
- **Dredge Production**
- **Progress/Post Survey**
- **Generate Volumes**
- **Re-work??**



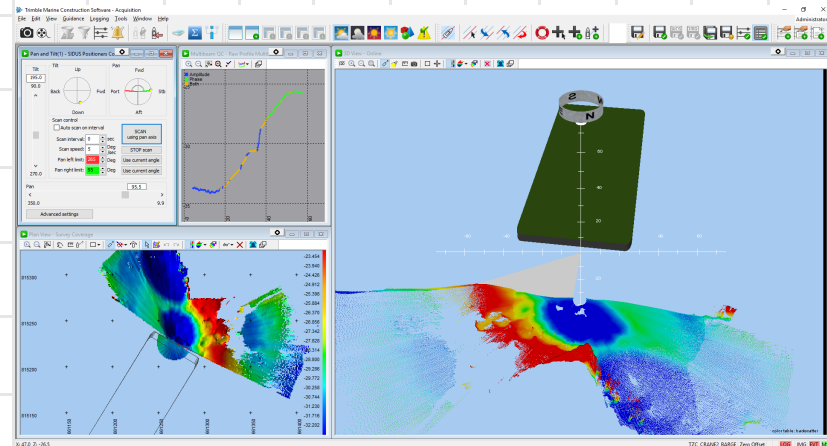
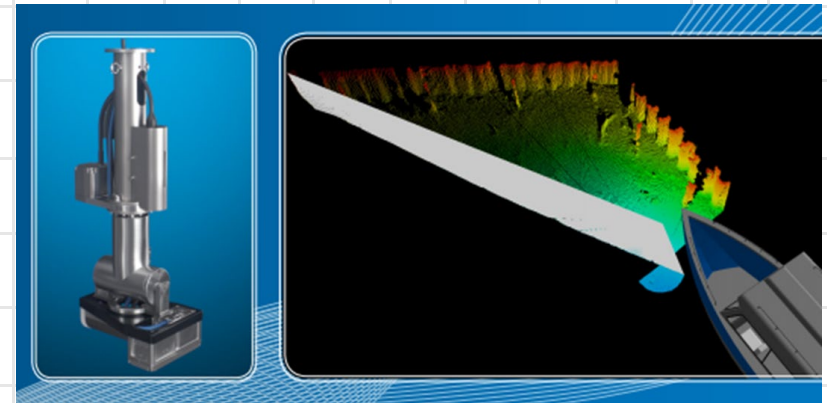
Grid model volume computation: DrillHoles2

Project	
Generated	7/3/2019 5:06:10 PM
Grid model	
Clipping polygon	
Area of clipping polygon	1436006.80 ft²
Reference	Reference Grid Model:
Reference Offset	0.00 m
Reference Z Shift	0.00 m
Method	Lowest
Second reference	Reference Grid Model: DrillHoles
Volume above	491551.19 yd³
Volume below	0.00 yd³
Volume difference	491551.19 yd³
Area above	654772.00 ft² (45.60 %)
Area below	201.68 85 ft² (1.40 %)
Area without data	703916.15 ft² (49.02 %)
Area without reference	57140.78 ft² (3.98 %)
Average layer thickness	19.66 m



Advantages of Realtime Sonar for Dredging

- Realtime progress information – “Eyes Under the Water”
- No need to stop dredge production
- No added cost for moving equipment
- Enhance safety during real-time operations
- No more re-work: “Know Before You Go”



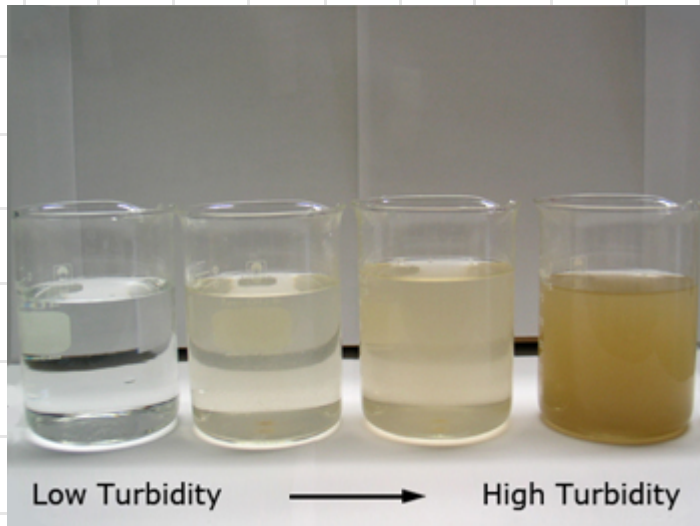
Turbidity

- **Turbidity is the cloudiness or haziness of a fluid caused by large numbers of individual particles that are generally invisible to the naked eye, similar to smoke in air.**
- **Fluids can contain suspended solid matter consisting of particles of many different sizes. While some suspended materials will be large enough and heavy enough to settle rapidly to the bottom, very small particles will settle very slowly or not at all if regularly agitated.**



How to Measure Turbidity

- Nephelometer is used to measure suspended particles by employing a beam of light and a light detector
- Turbidity is measured in NTU: Nephelometric Turbidity Units

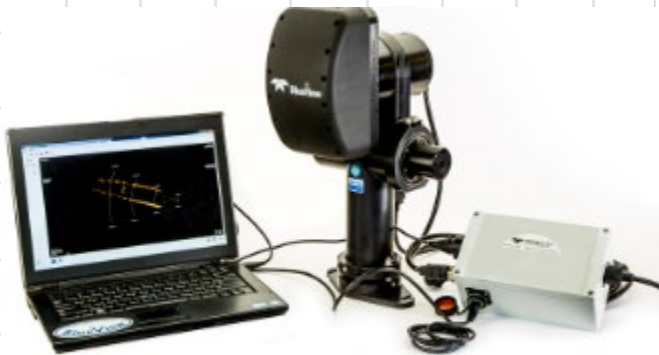


Example:

- Turbidity of drinking water shouldn't be more than 5 NTU and ideally should be below 1 NTU

Data Acquisition

Teledyne BlueView BV5000



	BV5000-1350	BV5000-2250-N / 2250-W
Sonar & Software		
Sector/Spherical Scan Area (°):	45 - 360	45 - 360
Sonar Field of View (°):	42 x 1, 76 x 1	42 x 1, 76 x 1
Update Rate (Hz):	Up to 30	Up to 30
Frequency (MHz):	1.35	2.25
Maximum Range:	30 m (98 ft.)	10 m (32 ft.)
Optimum Range:	1 - 20 m (3.2 - 65 ft.)	0.5 - 7 m (1.6 - 23 ft.)
Number of Beams:	256	256
Beam Width (°):	1 x 1	1 x 1
Beam Spacing (°):	0.18	0.18
Time Resolution:	0.015 m (0.59 in.)	0.010 m (0.39 in.)
Data Output Format:	.son and .xyzi files	.son and .xyzi files
Mechanical		
Size (L x W x H in inches):	10.5 x 9.2 x 15.4	8.9 x 8.6 x 15.4
Weight in Air/Water (lbs.):	21.7/8.2	19.1/6.0
Depth Rating:	1000 m (3,280 ft.) 4,000 m (13,123 ft.)	1000 m (3,280 ft.) 4,000 m (13,123 ft.)
Communication (Sonar/Pan & Tilt):	Ethernet/RS485	Ethernet/RS485
Power Consumption (W):	45 max.	45 max.
Power Requirement (V DC):	20 - 29	20 - 29



Data Acquisition

Teledyne RESON SeaBat T20-P

SEABAT T20-P SYSTEM SPECIFICATIONS

Input voltage	24VDC or 100-230VAC 50/60Hz
Power (typical / max)	200W / 300W
Ingress protection	Water resistant (IP54)
TRANSDUCER CABLE LENGTH	10m (standard), 25m, 50m, 100m (optional)
Temperature (operational / storage)	Portable Sonar Processor: -5°C to +45°C / -30°C to +70°C Sonar wet-end: -2°C to +35°C / -30°C to +55°C

	Height [mm]	width [mm]	depth [mm]	weight [kg/air]	weight [kg/water]
T20 Rx (EM7219)	102.0	254.0	123.0	5.0	4.2
T20 Tx (TC2181)	86.6	93.1	280	5.4	3.4
Portable Sonar Processor	131	424	379	14	N/A

T20 Acoustic performance	400kHz (max. frequency)	200kHz(min. frequency)
Across-track receiver beam width ¹	1° (center)	2° (center)
Along-track beam width ¹	1°	2°
Number of beams	Min 10, Max 256 (Optional 512)	
Swath coverage (up to)	140° Equi distance 165° Equi Angle (12x water depth with dual head)	
Typical Depth (CW ²)	0.5-150 meters	0.5-375 meters
Max Depth (CW ³)	250 meters	550 meters
Typical Depth (FM ²)	0.5-180 meters	0.5-450 meters
Max Depth (FM ³)	300 meters	575 meters
Ping rate (range dependent)	Up to 50 pings/s	
Pulse length (CW)	30 – 300µs	
Pulse length (FM)	300µs – 10ms	
Depth resolution	6mm	
Depth rating (sonar head)	50 meters	

For relevant tolerances for dimensions above and detailed outlined drawings see Product Description

1 Nominal values

2 This is a depth range within which the system is normally operated, from the minimum depth to a depth value corresponding to the max. swath -50%.

3 This is the single value corresponding to the depth at which the swath is reduced to 10% of its max. value. For actual swath performance refer to Product Description.



Data Acquisition

Valeport SWiFTplus Turbidity

Sensor Specification	
Turbidity	
Linear Range	Nephelometer: 0 to >1,000 NTU - linear response ¹ OBS: 0 to >4,000 NTU - linear response ^{1,2} ¹ depending on suspended material ² >4,000 NTU has a non-linear monotonic response that allows derivation of higher values using look-up tables/secondary calibration
Linearity	0.99 R ²
Minimum Detection Level	0.03 NTU (Nephelometer)
Conductivity*	
Range	0 - 80 mS/cm
Resolution	0.001 mS/cm
Accuracy	±0.05 mS/cm
Temperature (Platinum Resistance Thermometer)	
Range	-5°C to +35°C
Resolution	0.001°C
Accuracy	±0.01°C
Pressure (Temperature compensated piezo-resistive pressure transducer)	
Range	10 Bar or 20 Bar
Resolution	0.001% FS
Accuracy	±0.05% FS
Sound Velocity (Digital time of flight sensor)	
Range	1375 - 1900 m/s
Resolution	0.001 m/s
Accuracy	±0.02 m/s
Salinity*	
Range	0 - 42 PSU
Resolution	0.001 PSU
Accuracy	±0.05 PSU
Density*	
Range	990 - 1035 kg/m ³
Resolution	0.001 kg/m ³
Accuracy	±0.05 kg/m ³

Physical dimensions	
Materials	Housing: Titanium Sinker weight: Stainless steel Optical window: Sapphire glass
Depth rating	200m
Dimensions	Ø78mm x Length 307mm (with sinker weight)
Weight	2.7kg (in air) / 1.7kg (in water) including optional sinker weight
Communications (set-up and data offload)	
Bluetooth v4 - low energy	
USB Serial	
Memory	
2 GB Internal Flash Card Storage	
Electrical	
Battery	Internal rechargeable Li-ion battery pack
Charging	USB - Supplied mains AC adapter
Software	
<ul style="list-style-type: none"> • Connect iOS for Bluetooth compatible mobile devices: <ul style="list-style-type: none"> - instrument set-up, data offload and data display • Connect PC for both USB and Bluetooth connectivity: <ul style="list-style-type: none"> - instrument set-up, data offload and data display • Both will export data in common file formats that are compatible with industry standard Hydrographic software packages • Android App to follow 	
Ordering	
0660047-10-Tu	SWiFTplus profiler with Turbidity sensor - 100m rated
0660047-20-Tu	SWiFTplus profiler with Turbidity sensor - 200m rated
Supplied with: <ul style="list-style-type: none"> • Deployment weight • PC Bluetooth adapter • USB interface and charging cable and charger • Valeport Connect PC software \ iOS App • Transit Case 	

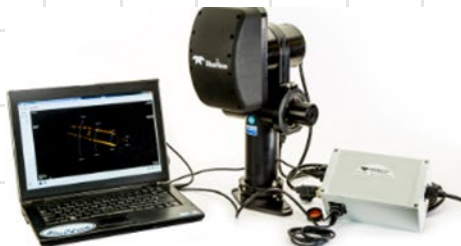
Minimum Detection Level:
0.03 NTU (Nephelometer)

Linear Range:
Nephelometer: 0 to >1,000 NTU - linear response
OBS: 0 to >4,000 NTU - linear response

Linearity: 0.99 R²



Data Acquisition

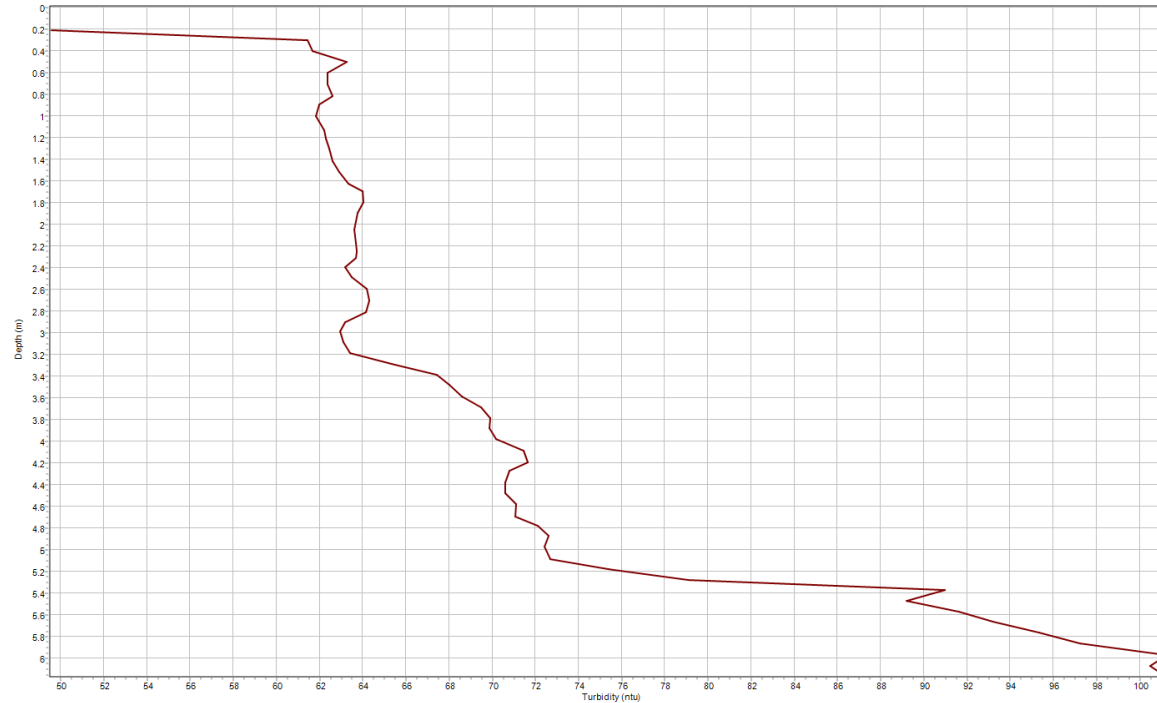


Data Acquisition

Valeport Connect - 1.0.6.0



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Depth (m)	Turbidity (ntu)
2.697	64.292
2.806	64.133
2.903	63.189
2.984	62.94
3.087	63.093
3.184	63.407
3.291	65.511
3.383	67.419
3.479	68.016
3.584	68.593
3.682	69.485
3.784	69.901
3.874	69.856
3.974	70.183
4.081	71.439
4.194	71.63
4.272	70.776
4.373	70.598
4.474	70.604
4.577	71.098
4.69	71.062
4.773	72.094
4.869	72.616
4.968	72.396
5.082	72.678
5.175	75.404
5.275	79.104
5.368	90.983
5.472	89.174
5.567	91.64
5.663	93.205
5.762	95.347
5.862	97.237
5.968	101.253
6.071	100.494
6.161	101.173

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Turbidity

Depth



TELEDYNE RESON
Everywhere you look™

Data Acquisition



TELEDYNE RESON
Everywhereyoulook™

Data Acquisition



TELEDYNE RESON
Everywhereyoulook™

Data Acquisition



TELEDYNE RESON
Everywhere **you** look™

Further Testing in “Dirty” Water

- Higher Turbidity Levels ($\pm 4,000$ NTU)
- Much finer suspended material – never settling to the bottom



Questions?



www.Measutronics.com