



**GEOLOGICAL SURVEY OF CANADA
OPEN FILE 4988**

**Cruise Hart 2003087
Seafloor Video surveys near Saint John, NB
22-27 September 2003**



Barge en route to Black Point offshore disposal site – September 2003

D.R. Parrott and M.B. Strong

2010



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Background

Canada's ports and harbours require routine dredging to maintain operational viability and allow passage of deep-draft vessels. Dredge spoils from these operations are often placed in offshore disposal sites. Monitoring of these disposal sites is required to understand the long term fate of the dredged materials.

The Geological Survey of Canada (GSC), an agency of Natural Resources Canada (NRCan) have initiated a project "Assessing Marine Environmental Quality in coastal Waters of Eastern Canada", that is designed to assess the effects of human activities in marine environments. The project will provide decision makers with geoscience information to resolve user conflicts and balance competing demands for seafloor use and development with conservation. One of the project priorities is to assess the impact of marine disposal of dredge spoil. Conceptual models will be developed for the behaviour of material in disposal sites under various marine environments, ranging from sheltered areas to exposed sites with high tidal and current stress. The project focuses on sites with differing degrees of human impact, management, and user conflict. The project will provide outputs, consisting of geoscience maps conforming to new marine-mapping protocols, databases in high-priority areas, conceptual models and interpreted reports. The primary outcome of this project will be that ocean-management decisions made by stakeholders will be based on sound scientific information collected and interpreted by NRCan.

Environment Canada (EC) is mandated with a responsibility to administrate the Disposal at Sea Regulation under Part 7 of the Canadian Environmental Protection Act (CEPA). CEPA requires the Minister of Environment to monitor disposal sites.

NRCan and EC have formed a partnership and initiated a joint project to study the effects of offshore disposal of dredged material with the intention that collaborative efforts will contribute to, and accelerate, the objectives of both departments.

During 2003, several sites were selected for monitoring that provide an opportunity for case studies of the effects of disposal activities in unique environments: a sheltered coastal environment off Summerside, PEI; a partially protected site off Yarmouth, NS; a tidal estuary at Miramichi, NB; and a high energy site at Saint John, NB. The results of the monitoring will be used to compare and contrast the impact of disposal activities in these sites.

Survey Hart 2003087 was conducted from 22-26 September 2003, as part of the joint project between the Geological Survey of Canada Atlantic (GSCA) and Environment Canada to provide information on the character and distribution of seafloor sediments near offshore disposal sites in Saint John Harbour and approaches.

A suite of seafloor video observations were collected from the CCGS *JL Hart* (Figure 1) to groundtruth previous geophysical and multibeam bathymetry surveys which had been performed to determine if material had been transported from the disposal area. Seafloor samples were taken to provide additional information on the character and composition of the sediments on the seafloor. Locations of the transects and samples are shown in Figure 2.



Figure 1. The seafloor video and sampling programs were conducted from the CCGS *JL Hart*.

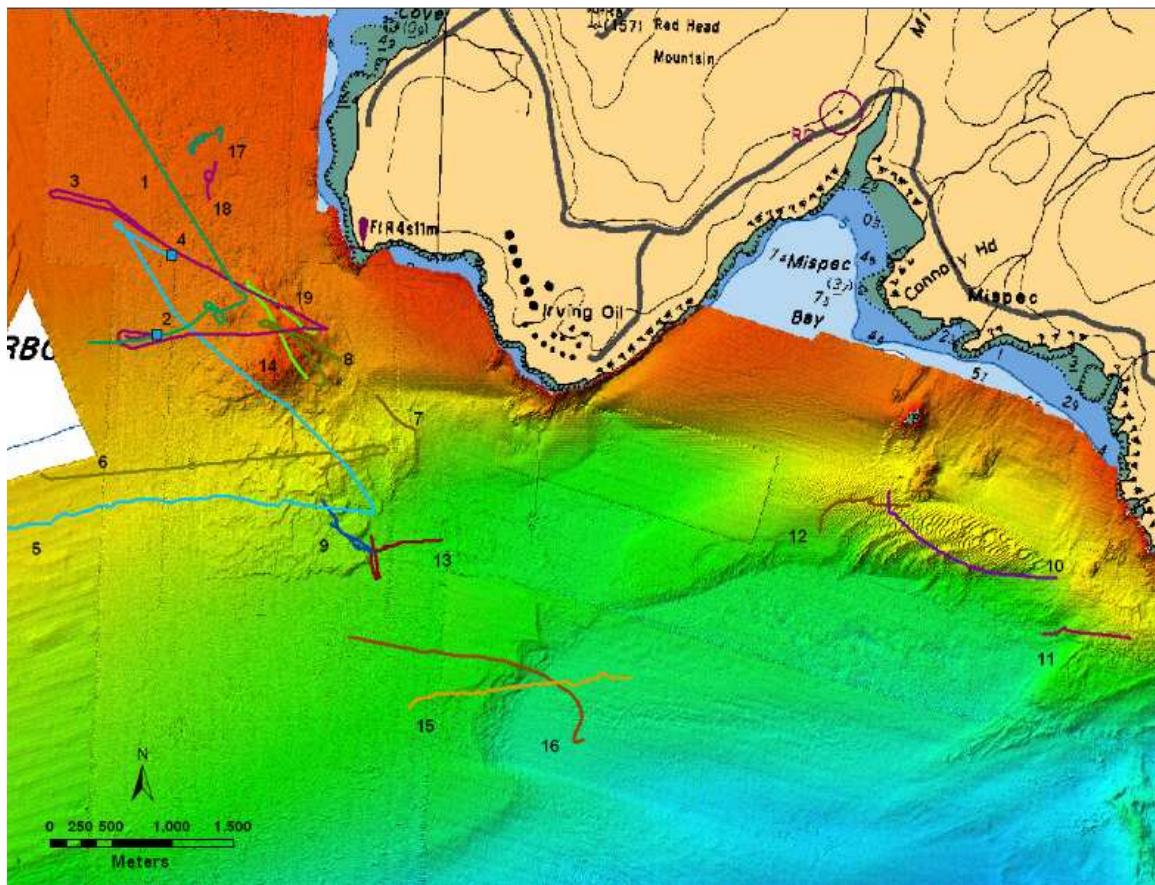


Figure 2. Location of seafloor video transects (coloured lines) and sediment samples (blue rectangles) that were collected in the approaches to Saint John NB during survey Hart 2003087. The background image is a multibeam bathymetry map of the seabed showing colour-coded depths.

Data Acquisition and Processing

The following geophysical and sampling equipment were used during survey Hart 2003087:

- Regulus survey navigation package with input from differential GPS
- Shipeck grab sampler
- SABS video camera and logging system

Seafloor Grab Samples



Figure 3. Seafloor samples were collected during survey Hart 2003097 with a Shipeck grab sampler, shown here.

A Shipeck grab sampler was used to collect sediment samples in the survey area (Figure 3). The sample locations are provided in Table 1, shown in Figure 2, and are also included in Appendix IV. Digital photographic images were taken of the grabs and are incorporated as 'hotlinks' in an ArcView GIS data base to provide geographically referenced access to the images. Copies of all available grab sample images are presented in this report in Appendix III. A copy of a CDROM with the images is archived at the Geological Survey of Canada offices in Dartmouth, NS.

SABS Digital video system

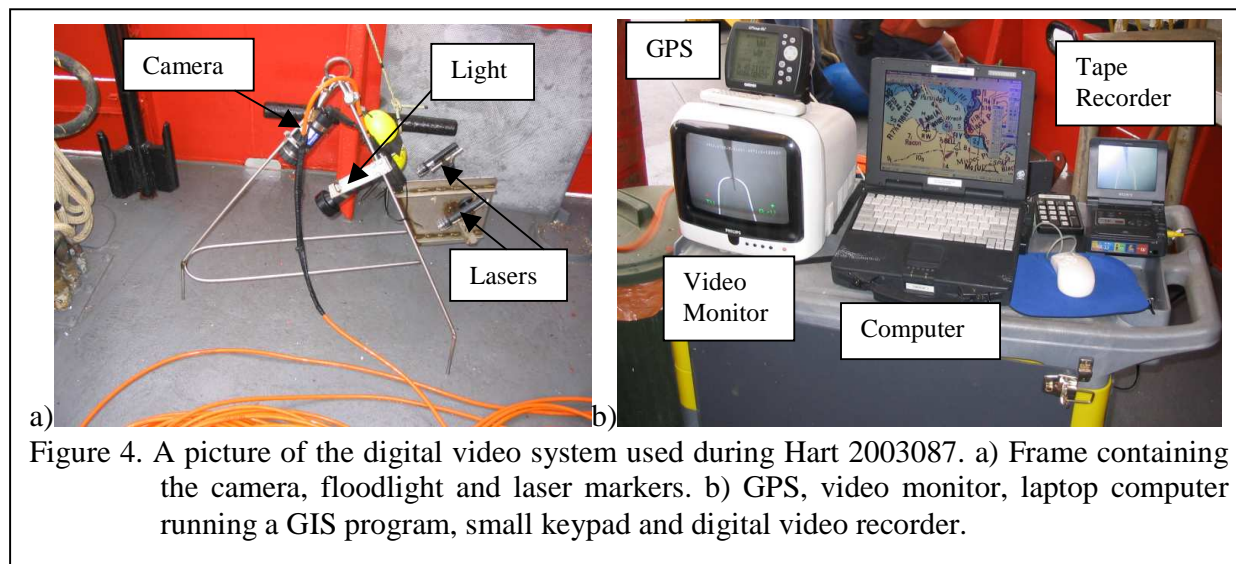


Figure 4. A picture of the digital video system used during Hart 2003087. a) Frame containing the camera, floodlight and laser markers. b) GPS, video monitor, laptop computer running a GIS program, small keypad and digital video recorder.

Digital video images of the seafloor were obtained with a system integrated by the scientists at the Saint Andrews Biological Station (SABS). A full description of the video system is provided in Strong and Lawton 2003.

The system has been called URCHIN for Underwater Reconnaissance and Coastal Habitat Inventory. The URCHIN video system was designed in 1997, for maximum survey depths of 50 meters, to augment SCUBA diver-based field survey methods and provide detailed descriptions of coastal benthic habitats. The system provides high-quality geo-referenced video (with positional data overlaid on video), geo-referenced log files for benthic habitat classification and biota encounters, and associated depth and temperature data. A Kongsberg Simrad low light level camera and floodlight are mounted on a stainless steel frame, and two laser pointers are focused to provide a 35 cm reference distance (Figure 4a). The robust, light-weight camera and frame permit manual deployment, with survey speeds over bottom of up to 1 knot, and operation in low light and turbid bottom conditions. Video was recorded on a SONY GV-D900 Digital Videocassette Recorder. Navigation was provided by a Garmin differential GPS receiver, and input to a laptop computer running the MapInfo GIS program. The ship's position was displayed, in real time, on a digital hydrographic chart, and recorded by the computer. An image generated from multibeam bathymetry data was overlain on the hydrographic chart, and helped identify specific targets on the bathymetry data. A small keypad was used to enter codes to identify the nature of the sediments on the seafloor and to indicate the presence of lobsters, crabs and other targets of interest. The entire system stores inside the small plastic trolley used as the workbench shown in Figure 4b. The system can be easily transported and can be installed on a vessel-of-opportunity in 1 to 2 hours. A relational database (Oracle-based) houses video survey data, and SQL queries have been written for various data extractions. Hardware and software components are described, as well as survey procedures, database design, and examples of typical SQL queries.

A description of the video transects and locations are provided in Appendix IV. Locations are provided in Table 2 shown in Figure 2.

Preliminary Results

A suite of 19 video transects were collected during the survey over the disposal site and surrounding areas. The video showed a variety of sediments ranging from soft mud to large gravel and boulders. Some areas showed evidence of sediment transport, with sand and shell hash in motion during the survey. Several unidentified objects, and a possible shipwreck or debris, were also seen.

Much of the video was taken in areas with high turbidity in the water column. To reduce the effects of the turbidity, the camera was lowered onto the seafloor to reduce the distance from the camera to the sediments. A suite of frame grabs has been made from the video and presented in Figure 5. Notice that the forward leg of the camera frame, is visible in each frame, and shows variable penetration into the sediments. The penetration of the leg provides a qualitative estimate of the stiffness of the sediments on the seafloor.

The images in Figure 5a and b show coarse, angular gravel present over the main spoil pile at the Black Point disposal site. This coarse material provides a protective armour over the spoil pile and prevents erosion of underlying material. East of the main spoil pile, the seafloor is covered with small ripples indicating the presence of a sandy sediment (Figure 5c).

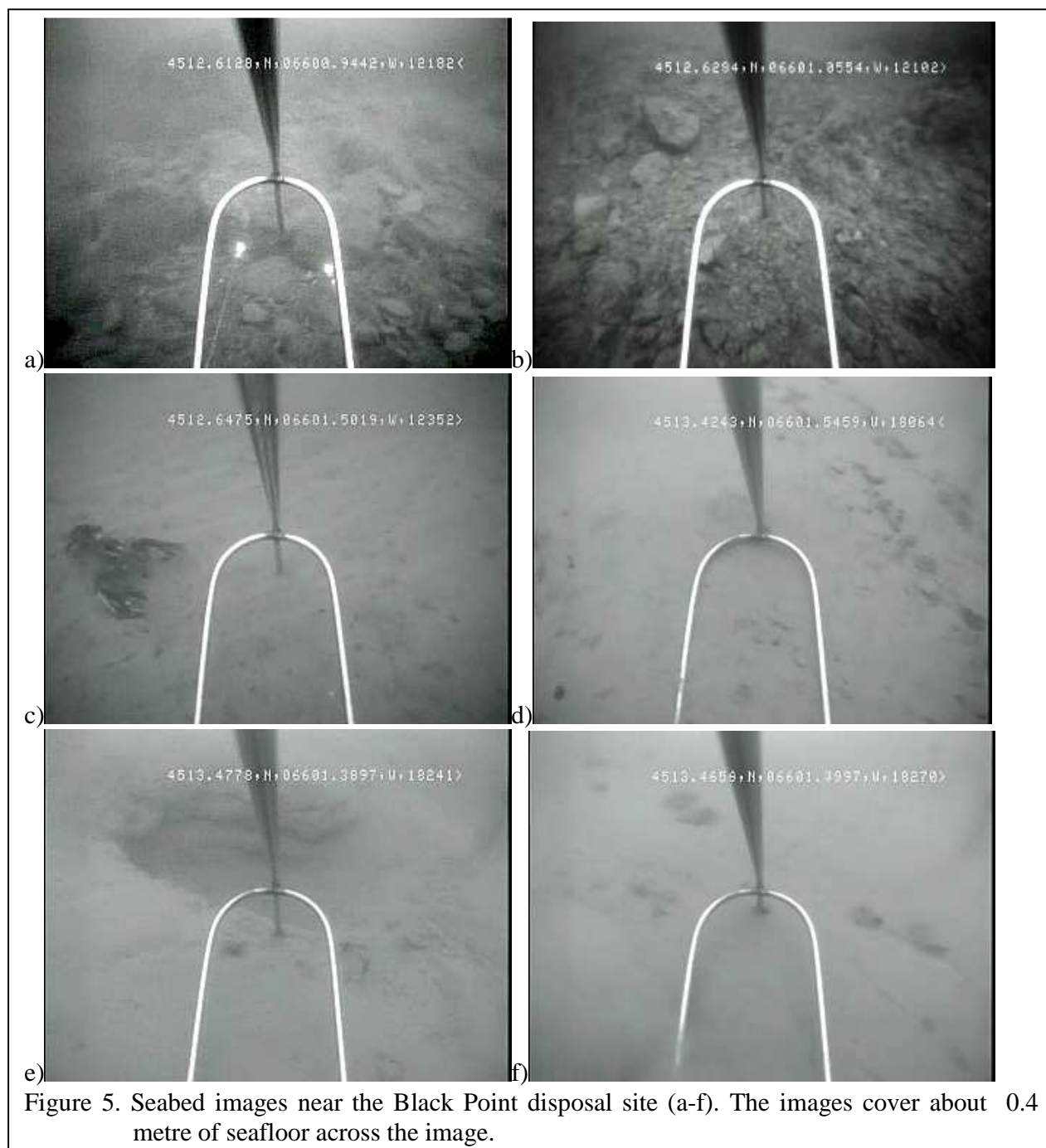


Figure 5. Seabed images near the Black Point disposal site (a-f). The images cover about 0.4 metre of seafloor across the image.

A series of images taken north of the disposal site (shown in Figures 5d to f) show that the seafloor is mainly composed of a fine-grained sediment, with variable hardness. Note the variable penetration of the forward leg of the camera frame. A series of lobster tracks and a lobster burrow were observed.

Seafloor samples were taken in two locations to verify observations made on the video screen. The sample at station Hart2003087-04 was taken to determine the cause of numerous small holes observed in the seafloor video. The sample contained several “Sea Grapes”; the tunicate *Bostrichobranthus pilularis* (Verrill) (Wildish and Thompson, 1985).



Figure 6. Photograph of a sediment encrusted “Sea Grape” or tunicate *Bostrichobranchus pilularis* (Verrill) found in the grab sample at station 2003087_04. Note: the stainless steel sampler shown in the photograph has the same size and shape as a common soup spoon.

Access to Data and Samples

Data are archived at the Geological Survey of Canada (Atlantic), in Dartmouth Nova Scotia. The tapes will be copied to DVCam tapes at a later date. The original digital video tapes were copied to DVD and separate copies provided to SABS and GSCA. Additional copies of the transects in Mispec were made and provided to UNB.

For access to data and samples contact the senior scientist for the survey, Russell Parrott (902-426-7059) or Susan Merchant of the GSCA Curation group (902-426-3410). For some data, long term access can be achieved by logging on to the Geological Survey of Canada (Atlantic) site at <http://gsca.nrcan.gc.ca> and the Canadian Geoscience Knowledge Network <http://cgkn.net/>.

References

Canadian Geoscience Knowledge Network internet site at <http://cgkn.net/>

Geological Survey of Canada Atlantic internet site at <http://gsca.nrcan.gc.ca>

Strong M.B. and P. Lawton, 2003. URCHIN – Manually-deployed Geo-referenced Video System for Underwater Reconnaissance and Coastal Habitat Inventory. Canadian Technical Report of Fisheries and Aquatic Sciences, 2003

Wildish, D.J. and Thomas, M.L.H. (1985). Effects of dredging and dumping on benthos of Saint John Harbour, Canada. *Marine Env Res* 15, 45-57.

Tables

Table 1 Location of Shipeck Grab Samples

Stn No.	Stn Type	Depth (m)	Latitude	Longitude	Julian Day/time	Comments
2	VanVeen		45.209580	-66.029040	2661353	Fine brown mud veneer over dark grey black clay.
4	VanVeen	17.9	45.215450	-66.027830	2661529	Brown clay with small grape shaped sea squirts

Table 2 Start Points of Video Transects

Stn No.	Stn Type	Depth (m)	Latitude	Longitude	Julian Day/time
1	Video transect	21.9	45.211150	-66.024560	2661230
3	Video transect	21.0	45.210660	-66.011920	2661416
5	Video transect	39.0	45.205705	-66.017645	2661549
6	Video transect	28.0	45.201965	-66.005908	2661729
7	Video transect	24.6	45.206147	-66.006270	2661821
8	Video transect	13.0	45.210465	-66.017520	2671210
9	Video transect	37.6	45.193392	-66.006775	2671259
10	Video transect	38.2	45.194057	-65.934525	2671550
11	Video transect		45.189940	-65.927068	2671708
12	Video transect	31.0	45.197030	-65.959002	2671739
13	Video transect	37.0	45.192207	-66.005283	2671902
14	Video transect		45.213195	-66.000000	2681204
15	Video transect		45.182780	-66.001125	2681334
16	Video transect	46.8	45.180715	-65.983895	2681531
17	Video transect		45.224498	-66.025080	2681755
18	Video transect		45.221148	-66.024018	2681841
19	Video transect		45.211940	-66.017338	2681908

Appendices

Appendix I - Survey Particulars

Name of Vessel:	J.L. Hart
Dates	22-26 September 2003
Vessel captains:	David Pink
Area of Operation	Saint John, NB
Senior Scientist:	Russell Parrott

<u>List of Participants</u>	<u>Affiliation</u>
Russell Parrott	Geological Survey of Canada (Atlantic)
Mike Strong	St. Andrews Biological Station
Adrian MacDonald	Environment Canada
Garrett Duffy	University of New Brunswick
Ulrich Lobsiger	DeepSlope Explorations (DSE)

Appendix II - Cruise Log (all times in GMT)

22 September 2003 Monday

- 10:30 Mike Strong arrives CCGS *JL Hart* and starts to mobilize the video system.
- 12:00 System mobilized.
- 17:00 Parrott and Lobsiger depart BIO with AGC Icehole camera.
- 22:00 Arrive *JL Hart* docked at the Coast Guard base in Saint John NB. Discuss schedule for upcoming survey.

23 April 2003 Tuesday

- 11:00 *JL Hart* departs for survey site with Parrott, Strong, Lobsiger and Duffy.
Perform a series of video transects over the disposal site and surrounding area.
Grab samples taken at two locations to verify sediment type and to sample worm tubes observed in video transects.
- 19:45 Return to Coast Guard base in Saint John.

24 April 2003 Wednesday

- 10:00 *JL Hart* departs for survey site with Parrott, Strong, Lobsiger and Duffy. Adrian MacDonald from EC joins the survey for the day.
Perform a series of video transects over the disposal site and surrounding area and over sand waves indentified in Mispic.
- 20:45 Return to Coast Guard base in Saint John.
MacDonald and Lobsiger return to Halifax.

25 April 2003 Thursday

- 10:00 *JL Hart* departs for survey site with Parrott and Strong.
Perform a series of video transects over the disposal site and surrounding area including a 2 hour transect over the erosional scarp seen south of Black point, the test disposal site in Anthony's Cove, over a site indicating a wreck on the chart, and over the area where the barges were observed to be dumping.
- 20:45 Return to Coast Guard base in Saint John. Demobilize all gear from *JL Hart*.
Strong returns to St. Andrews, and Parrott returns to Halifax.

26 April 2003 Friday

- CCGS *JL Hart* returns to St Andrews.

Appendix III Grab Samples Photographs



Photographs of grab samples taken during Hart 2003087.

- a) Station 2003087_02,
- b) Station 2003087_04,
- c) Sediment encrusted "Sea Grape" or tunicate *Bostrichobranthus pilularis* (Verrill) found in sample 2003087_04,
- d) close up view of the sediment encrusted sea grape.

Note: the stainless steel sampler shown in the photographs c) and d) is the same size and shape as a common soup spoon.

Appendix IV Description of video transects and grab samples

Stn No.	Stn Type	Depth (m)	Latitude	Longitude	Julian Day/time	Comments
1	Video transect	21.9	45.211150	-66.024560	2661230	sand ripples, lobsters, lobster pits, 25 cm between laser points
					2661242	large lobster pits
		2661310			larger ripples, lobster pit crescent shaped, a lot of large lobster burrows	
		2661330			with smaller pits softer sediments, end transect	
		27.0	45.208830	66.036060		
2	VanVeen		45.209580	-66.029040	2661353	Fine brown mud veneer over dark grey black clay.
3	Video transect	21.0	45.210660	-66.011920	2661416	quite variable coarse bottom, gravel, cobbles
					2661422	angular gravel
					2661510	large lobster burrows, worm tubes
			45.219170	-66.037730	2661512	stiff bottom, 2" penetration, sand/silt sediments with large lobster burrows, end transect
4	VanVeen	17.9	45.215450	-66.027830	2661529	Brown clay with small grape shaped sea squirts
5	Video transect	39.0	45.205705	-66.017645	2661549	camera deployed
					2661558	hard bottom, shell fragments, cobbles, debris, concrete pipe, sand ripples.
					2661601	seaweed, sponges, pebbles
					2661604	cobbles, sand ripples, subangular boulders
					2661611	pulled up camera, cable under ship's keel
					2661612	resumed transect
					2661616	a lot of debris, old tire
					2661619	debris, shell hash
					2661622	start new record
					2661628	sand ripples, shell hash
					2661630	large ridge, quahog shells
					2661633	sand ripples, shell hash
					2661640	sand ripples, shell hash, outside slump
					2661642	less shell has
					2661644	lights off
					2661650	shell hash, concave up
					2661655	shell hash, lobster pits, sandy silt
					2661700	ghost lobster trap
					2661703	cable under ship's keel
			45.194943	-66.043850	2661713	end transect
6	Video transect	28.0	45.201965	-66.005908	2661729	camera deployed
					2661735	gravel, shell hash, east to west transect across slump
					2661743	flustra, lemon weed, gravel
					2661746	old lobster trap
					2661748	scallop, gravel, lemon weed. 10 ridge neptune
					2661751	large lobster, scallops, lemon weed, 1 – 2" penetration
					2661755	boulders
					2661757	lemon weed on boulders
		27.1	45.206275	-66.006370	2661806	end transect
7	Video transect	24.6	45.206147	-66.006270	2661821	start transect, ripples, recover camera to straighten light.
					2661827	mottled appearance, a lot of marine snow
					2661835	plate?
					2661838	poorly sorted gravel, shell hash
					2661842	tire
					2661844	scallops
					2661845	boulders
					2661846	gravel, shell hash
					2661848	scallops
8	Video transect	13.0	45.210465	-66.017520	2671210	camera deployed
					2671211	clay, whit oxidized layer
					2671215	cobbles, lemon weed, cable, dredge spoils.
					2671219	angular cobbles and boulders

			2671221	
	18.0		2671228	gravel with boulders
			2671229	water depth changing
			2671234	sand bottom
		45.208083 -66.009307	2671237	sand ripples
			2671244	end transect
9 Video transect	37.6	45.193392 -66.006775	2671259	camera deployed
			2671309	sand, gravel lag, a lot of marine snow
			2671317	scallops, lemon weed
			2671320	shell hash
			2671329	linear debris, unique?
			2671334	tire
			2671344	sand/silt, bounders, lemon weed
			2671351	debris
			2671353	debris
			2671359	debris
			2671408	end of video tape
			2671410	start of new video tape
			2671417	pulled camera to check
			2671432	recovered camera, move
			2671435	camera deployed again, sand ripples, shell hash
			2671442	lemon weed
			2671443	pebbles
		45.196128 -66.010268	2671506	back on slump?
			2671512	end transect
10 Video transect	38.2	45.194057 -65.934525	2671550	camera deployed
			2671552	
				sandy bottom, sand ripples, shell hash, lemon weed, strong currents, strong sediment transport
			2671559	
			2671606	
			2671624	very strong bedload
			2671625	shell hash
			2671626	tip of camera buried in 5 seconds
			2671629	big clump of weeds
			2671630	weed barely moving
			2671631	no weeds
			2671633	fine ripples
			2671634	bridge, going over 2m sand waves
			2671636	strong bedload sediment transport
			2671637	shell hash
			2671638	a lot of weeds moving slowly
			2671640	coarse shell hash
			2671642	little weed
			2671643	concave down shells
			2671646	no weeds for last 6 minutes
			2671648	weed
			2671649	tip buried very easily
		45.200255 -65.951762	2671650	lots of weed in situ
			2671654	end transect
11 Video transect		45.189940 -65.927068	2671708	camera deployed
			2671713	till
			2671720	large angular boulders, barnacles, lemon weed
		45.189903 -65.935273	2671727	end transect
12 Video transect	31.0	45.197030 -65.959002	2671739	camera deployed
			2671743	sand, shell hash
			2671743	slower current than station 10
			2671745	coarse sand, intact shells
			2671746	slow current, shell hash, no bedforms seen
			2671749	ripples, sand dollars
			2671750	sand, coarse shell hash
			2671751	sand ripples
			2671752	sand ripples
			2671755	lemon weed
			2671756	in situ weed
			2671758	flat seabed
			2671759	in situ weed

			2671800	swifter current
			2671801	mottled light/dark bedforms
			2671802	in situ weed
			2671805	mottled appearance
			2671807	strong current
			2671815	strong current but no sediment transport
			2671818	topography changing up and down sand waves
			2671819	going down
			2671819	feeding out seaweed (bryophytes)
			2671821	a lot of bryophytes, current stronger
			2671824	a lot of shell going deeper
			2671825	something hard, could be plastic
			2671826	deeper into another hole, shells
		45.198988 -65.949568	2671827	end transect
13 Video transect	37.0	45.192207 -66.005283	2671902	camera deployed
			2671903	sand
			2671905	ripples with shells in the lee
			2671906	sharp crests
			2671907	heavier shell hash
			2671910	
			2671912	sediment very soft
			2671916	sediment continues to be very soft
			2671922	Mermaid's Purse?
			2671926	sediments firm
			2671930	shell hash
			2671931	debris and/or wood
			2671932	debris
			2671943	moving into Canaport buoy exclusion zone
		45.195525 -65.999060	2671946	end transect
14 Video transect		45.213195 -66.000000	2681204	camera deployed
			2681205	mud bottom, occasional boulder, soft bottom, full penetration, ambient light
			2681207	lobster burrow, spoils, boulder on hard bottom, lemon weed, sand ripples
			2681215	lemon weed
			2681220	sand and gravel patches
			2681224	tractor tire
			2681226	boulders, gravel, lemon weed
		45.210217 -66.012530	2681304	end transect
15 Video transect		45.182780 -66.001125	2681334	camera depolyed
			2681338	sand, shell hash
			2681342	sand ripples, shells
			2681351	surf clam, concave down
			2681355	substrate - less ripples and shell hash, finer particles.
			2681400	sand ripples
			2681401	debris, wood? Wreck?
			2681409	large sand ripples > 20cm
			2681412	ripples, shell hash, lemon weed
			2681415	off bottom, helicopter over boat
			2681420	back on bottom, sand ripples, shell hash
			2681427	clump of boulders, lobster
			2681429	debris
			2681431	sand ripples, lemon weed, debris
		45.185625 -65.978392	2681435	end transect
16 Video transect	46.8	45.180715 -65.983895	2681531	camera deployed
			2681533	sand, pebbles
			2681535	ocean pout
			2681545	increased shell hash, sand, pebbles
			2681546	sand ripples
			2681551	boulders
			2681555	sand, shell hash
			2681559	boulders, frustra
			2681604	unique
			2681606	sand ripples
			2681607	sand, cobbles
			2681608	boulders, frustra

		2681610	boulders, sand ripples
		2681612	unique, trawl door?
		2681613	boulders
		2681618	big ripples
		2681620	boulders
		2681625	sand ripples, shell hash
		2681628	on the erosional scarp, ripples, lower amplitude, softer sediments
		2681629	lobster trap and line, sand
		2681630	shell hash
		2681632	mottled sand, no shells
		2681634	off bottom to check cable
		2681636	back on bottom, sand, shell hash
		2681639	sand, sand ripples, broken shells
		2681645	sand, sand ripples, broken shells
		2681652	on top of scarp, sand, sand ripples, broken shells, concave down
		2681706	unique (anchor)
		2681706	major concentration of shell fragments
		2681713	out of shell hash
		2681714	back in shell hash
		2681715	out of shell hash
		2681716	back in shell hash
		2681710	boulder
		2681721	heavy shells
		2681722	out of shells
		2681726	unique (wood)
		2681727	shell hash
	45.187520 -66.007860	2681734	end transect
17 Video transect	45.224498 -66.025080	2681755	camera deployed
		2681758	Anthony's Cove test disposal site
		2681801	dredge spoils, murky water, soft sediments
		2681802	start recording, mud bottom, cohesive blocks
		2681804	change in character, worm tubes
		2681805	spoil
		2681807	lobster tracks on undisturbed seafloor
		2681810	lobster tracks and tube worms
		2681811	lobster burrows, stirred up mud in water column
		2681821	soft mud, no spoils, worm tubes, soft sediment in suspension
		2681823	lobster tracks and burrows
		2681826	lobster tracks and burrows
		2681828	lobster tracks and burrows, worm tubes
		2681833	lobster tracks and burrows
	45.223988 -66.023175	2681833	end transect
18 Video transect	45.221148 -66.024018	2681841	camera deployed
		2681842	mud, lobster tracks and burrows, tunicates
		2681844	lobster burrows
		2681848	lobster burrows
		2681849	
		2681851	lobster molt
		2681852	lobster in burrow
	45.219747 -66.024187	2681853	end transect
19 Video transect	45.211940 -66.017338	2681908	camera deployed
		2681909	mud, mud, mud
		2681911	boulders and flustra
		2681912	boulders
		2681913	cobbles and flustra
		2681914	boulders
		2681917	boulders
		2681919	cobbles and flustra
	45.211955 -66.015118	2681923	end transect