HAGGITT CONSULTING

2003 Bark Monitoring Survey Report

Thorne Bay LSA

JUNE 18, 19, 20, 2003

Thorne Bay Log Storage Area

Submitted to:
Alaska Department of Environmental Conservation
Water Programs
410 Willoughby Avenue, #303
Juneau, Alaska 99801

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Abstract

An underwater reconnaissance was conducted on June 18th, 19th, and 20th 2003 at the Thorne Bay Log Storage Area (LSA) to determine the extent of bark debris accumulation. Thorne Bay is located on the east coast of Prince of Wales Island, Alaska. The site surveyed included three of the four primary storage areas in Thorne Bay. The survey did not include the Log Transfer Facility or a former Log Storage Area that was operational in the 1950's. The "A" frame LTF, located in the west portion of the bay had been previously surveyed in 2002 by Haggitt Consulting for the U.S. Forest Service. The Log Storage Area in use during the 1950's, was located in the southeastern portion of the bay and was not included in the scope of this survey.

This inspection was done at the request of the Alaska Department of Environmental Conservation to assess the current extent of bark debris coverage in the Log Storage Areas formally operated by Ketchikan Pulp Company.

The parallel pattern used to survey the site consisted of 14 transects at 300 foot spacing intervals. The sampling frequency was at 300 foot intervals using Video survey methods, and at 15 foot intervals using Dive survey methods. The survey methods remained in compliance with the standard and alternate methods that can be found in **"Required Method for Bark Monitoring Surveys under the LTF General Permits".**

The survey documented that the Log Storage Area contained both continuous and discontinuous bark debris. The survey using the parallel transect pattern quantified the extent and type of coverage as 19.51 acres continuous bark debris, and 114.00 acres of discontinuous bark debris in a survey area of 161.18 acres.

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Introduction

The logging facility at Thorne Bay was developed as a result of a long term timber sales contract between the U.S. Forest Service and Ketchikan Pulp Company. In 1960, a floating logging camp was built, and in 1962 a shop, barge terminal, and a log sort yard were built to replace the facilities in Hollis. Thorne Bay was considered the largest logging camp in North America. At the peak of operations the site processed approximately 200 MMBF per year and was the log storage depot for all of the timber harvested by Ketchikan Pulp Company in S.E. Alaska. It is estimated that six to seven billion board feet of timber was stored in Thorne Bay from 1954 to 2001.

The Thorne Bay LSA was not operational at the time of the survey. The Log Storage area is located in the western portion of Thorne Bay, with an eastern exposure. The weather conditions and underwater visibility were good during this bark assessment survey. The bathymetric conditions at the site are that of a flat grade at an average elevation of -22 ft MLLW. Bark debris and other organic debris were noted in continuous and discontinuous coverage and tended to congregate at areas where log rafting had been extensively used.

A summary of the approach and techniques used in the LSA survey are provided below in the Methods Section. The result of the survey is then presented together with estimates of the spatial extent and depth of bark on the seafloor.

Video Survey Methods

The Video survey methods used are approved by DEC. The system is comprised of a 12 channel satellite receiver providing DGPS and WAAS coordinates to shipboard navigation and infrared camera equipment.

The satellite receiving antenna is located directly above the sample point being observed. The camera is weighted and lowered on lead line from the vessel to within 2 vertical feet of the sample point. The infrared camera records the substrate condition for at least 60 seconds, this video feed is combined with a live satellite data stream that includes; Latitude and Longitude (to the fourth decimal point), speed, heading, time (Greenwich mean time) and date. The video is then edited to the 30 second segment that includes the projected sample point location.

The live data and tapes that result from this survey are reviewed by professional bark monitoring divers to determine the percent of bark coverage at each sample point. Observations of the debris viewed over the full 60 seconds of tape are compared against the representative clip of the sample point to ensure fair portrayal of the intended sample point. Observations are recorded in data tables and a coverage map is produced. Each report includes a video appendix of the sample points observed.

Parallel Transects

The fixed hub reference points for the transects delineating bark debris areas are selected by observing the site conditions, operational history and positioning the hubs (baseline) in a location that would provide the best survey coverage of the area used as a Log Storage Area. Additionally, DGPS/WAAS coordinates are acquired at the hub and each sample point along the transect to facilitate relocation. Transects were established at 188 degrees magnetic and 300 foot intervals. Transects and sample points were pre-plotted onto an electronic chart[1], with coordinates. The vessel tracked on this chart using a satellite receiver that provides data for the electronic chart software to trace the vessels progress along the transect. Transect sample points and end points are recorded with DGPS/WAAS coordinates to provide actual sample points and headings traveled.

The transects were terminated by the requisite of beyond the area of significant bark accumulation, physical barrier or the required scope of services.

[1] See Figure 1, next page.

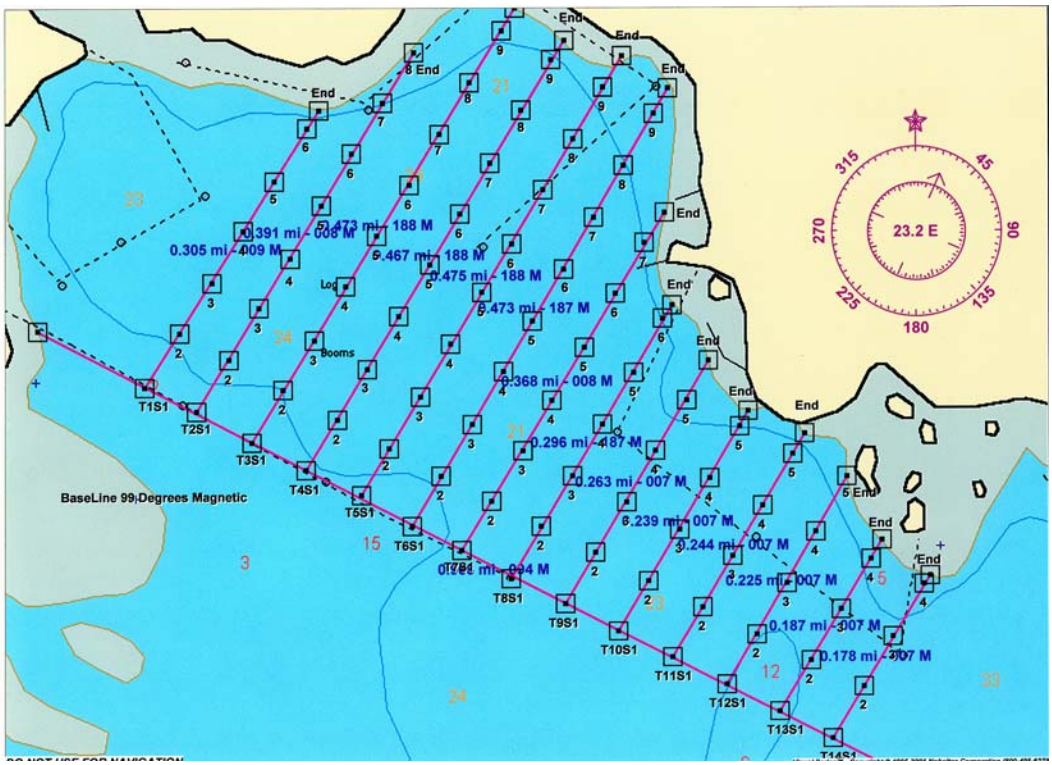


Figure 1 *Pre-plotted Chart*

Sample Points

Samples are taken at intervals of 300 linear feet along each parallel transect, unless an obstruction such as shallow water or a structure required a different interval distance. The interval distance is established with the use of a satellite receiver and a pre-plotted electronic chart. At each sample point observations are noted on the abundance and type of marine organisms present, the native vegetation, and composition of the substrate. Data including the sample point coordinates, water depth, current direction, and estimated current velocity also is incorporated into the field notes. Observation of the sample points includes notations of relevant operational debris and existing bark debris. Infrared video documentation is used at representative sample locations to record algal life, animal life, substrate, and debris present. Sample location depth notations are based on readings from a Furuno depth sounder.

Dive Survey Methods

Standard diving methods were used to survey the Log Storage Area. The methods used can be found in the publication "Required Method for Bark Monitoring Surveys under the LTF General Permits".

Parallel Transects
The parallel transects used in the dive survey were established during the prior video survey assessment. Of the 14 transects observed by video, five were selected for dive sampling:

- Transect 3, sample points 6 and 9.
- Transect 4, sample point1.
- Transect 5, sample point 1 and 8.
- Transect 8, sample point 5.
- Transect 9, sample point 4.

Each transect followed the same bearing as the video transects, at 188 degrees magnetic. Each transect was similarly spaced at 300 feet and used the original point of origin established for the video survey. Two separate magnetic compasses were compared to determine the bearings. Vessel based personal monitored the diver's progress and used radio/diver-telephone communications for course adjustments.

The transects are terminated by the scope of services requiring four sample points be observed on selected transects.

Sample Points
Sample point selection was based on observations resulting from the video survey. Seven dives with four sample points each were performed. Random sampling included areas' found to be 100 percent cover and areas' that exhibited low percentages of discontinuous coverage in the video survey. Areas' of low percentages within areas' of high percentages were also targeted for verification of findings.

Each diving transect began at a previously observed video sample point. The vessel operator would acquire the sample point by viewing a representation of the survey vessel moving on the pre-plotted chart. The operator would pass over the sample point and continue a short distance to a position directly up wind and current, to drop the anchor. After the vessel stabilized at the end of the anchor line, a reading was taken of the distance and direction to the sample point.

The sample points were acquired underwater by communication with topside observers—who monitored an electronic chart that depicted both the intended sample

point, and the divers initial drop position. Details on the number of linear feet, depth and direction to the sample point were relayed to the diver. The diver moved to the center of the boat shadow (under the GPS receiver) and used a rolling tape measure; the accuracy is reported as +/- 3 inches at 1000 feet to establish the distance. A suunto compass was used for direction. The initial diver drop point averaged within a 25 foot radius of the intended sample point.

Samples were taken at intervals of 15 linear feet along each parallel transect; the bearing selected matched the bearing established for the video survey. At each sample point observations were noted on the abundance and type of marine organisms present, the native vegetation, and composition of the substrate. Data including the water depth, current direction, and estimated current velocity also was incorporated into the field notes. Each of the sample points included relevant observations on operational debris and existing bark debris. A metal ruler was used to penetrate the substrate to determine the depth of the accumulated bark debris. Digital color photographic documentation was used at each representative sample location to record algal life, animal life, substrate, and debris present.

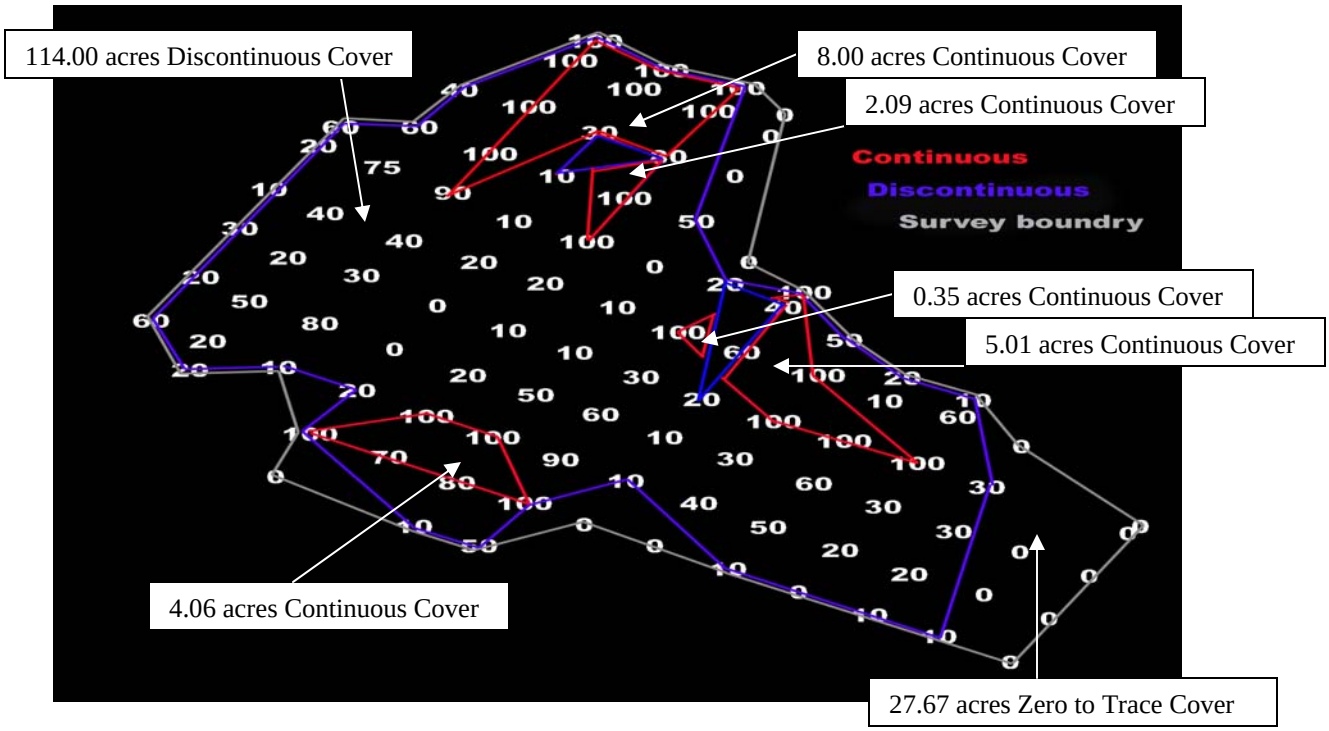
Six transects selected for invasive observation included core sampling. The cores were sealed and transported to the survey vessel in an upright position for ADEC analyses.

Sample location depth notations are based on readings from a Cochran Consulting Nemeses IIA dive computer calibrated for saltwater and altitude. The depth of each sample point is converted to MLLW by using the depth displayed by the dive computer and the time/date stamp that is contained in the buffer of the digital photograph of that sample point. This information is combined with the nearest tide station that has been further corrected to the center of the survey area though the use of Nobiltec navigation software.

Area of Bark Cover

For each survey, the percentage of bark coverage is determined by using the protocol for operating a bark-monitoring program given in the EPA General Permit. The area calculation used in this report is outlined in the ADEC publication “Required Method for Bark Monitoring Surveys under the LTF General Permits”.

Area calculations are accomplished by drafting scaled transect diagrams from the recorded sample point coordinates into Turbo CAD Professional V6. The Turbo CAD program then accomplished the area calculations. ADEC has approved the use of AutoCAD programs for area calculations.



The diagram above demonstrates how areas of continuous cover surrounded by areas of discontinuous cover were calculated.

The area calculations are based on the coordinates recorded and interpreted by Turbo CAD, this process contains no known errors. A comparison to the physical area observed and the calculated area observed may contain insignificant errors.

The errors result from the variable resolution or accuracy of the satellite navigation system. The degree of resolution for the DGPS/WAAS system used for this survey is reported by the Federal Aviation Administration is 1-2 meters. As each coordinate is established with a separate reading, these errors do not compound themselves over the course of the survey. When considering the distance between two sample points, the total error will be the combined error of both points. In other words a 1 meter error in the beginning and ending sample point for a transect will necessitate a two meter error factor for the entire transect. While in practical application the errors observed generally amount to only inches, this report includes the calculated area of coverage derived from the recorded sample point coordinates, and an estimated percent of accuracy of the survey; considering the FAA's average accuracy variations for DGPS/WAAS satellite navigation systems.

Chapter 1

Thorne Bay Dive/Video Survey

Surveyed on June 18, 19, 20, 2003

The survey was conducted at the request of the Alaska Department of Environmental Conservation, Juneau, Alaska. An underwater reconnaissance was requested to determine the representative condition of an area formally operating as a Log Storage Area (LSA). The Video survey was conducted on June 18 and 19, 2003. The Dive survey was conducted on June 20, 2003. The site surveyed is located in Thorne Bay, Prince of Wales Island, Alaska.

This inspection documented findings according to the Alaska Department of Environmental Conservation (ADEC), Environmental Protection Agency (EPA) and NPDES requirements. The percentage of bark coverage was determined by using the protocol for operating a bark-monitoring program given in the EPA General Permit. The area calculation used in this report is outlined in the ADEC publication **"Required Method for Bark Monitoring Surveys under the LTF General Permits".**

Findings[2]

Continuous Coverage	Discontinuous Coverage	Zero to Trace Coverage	Total Survey Area
19.51 Acres / 59,310.00 M_2	**114.00 Acres / 346,560.00 M_2**	**27.67 Acres / 84,117.00 M_2**	**161.18 Acres / 489,987.00 M_2**

[2] Please see Survey Summery for accuracy rating of these figures.

Log Storage Area

The rafting area in Thorne Bay was expansive, often covering the entire western portion of the bay. The top Photograph is what remains of an "A" frame bulkhead. A new "A" frame was later erected at the west end of the bay.

Northeast rafting area

Barge facility

June 18, 2003

Weather conditions during the survey consisted of overcast skies with winds at less than 5 knots. Surveying by video camera commenced at 8:30 a.m. on June 18, 2003 during mid water. The tidal station (subordinate station #1391) was used to correct depths to MLLW. The station reported a tide level of -1.5 ft at 8:30 a.m. The current conditions remained negligible. Seawater temperature was recorded at 43 degrees F. The horizontal visibility was estimated to be 10 feet.

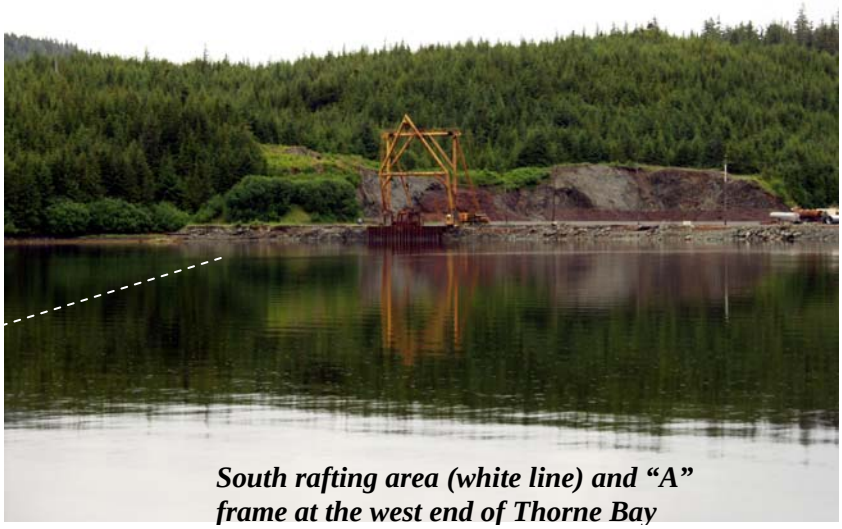
Ten transects, emanating from a bearing line located at the south end of the bay, traversed the bottom on bearings labeled: T1 - T10 at 188 degrees. A total of 84

sample locations at a 300-foot interval distance were assessed. Site conditions remained steady with winds less than 5 knots and overcast skies. Surveying concluded at 4:35 p.m. on June 18, 2003 during high tide. The tidal station (subordinate station #1391) was used for depth corrections, reporting a 13.6 ft tide level at 4:30 p.m. The tidal current velocity was estimated to be 0.0 knots. The horizontal visibility remained constant and was estimated to be 10 feet. The grade for these transects remained fairly flat.

June 19, 2003

Weather conditions during the survey consisted of overcast skies with winds at less than 5 knots. Surveying by video camera commenced at 9:30 a.m. on June 19, 2003 during low water. The tidal station (subordinate station #1391) was used to correct depths to MLLW. The station reported a tide level of 1.9 ft at 9:30 a.m. The current conditions remained negligible. Seawater temperature was recorded at 43 degrees F. The horizontal visibility was estimated to be 10 feet.

Four transects, emanating from a bearing line located at the south end of the bay, traversed the bottom on bearings labeled: T11 - T14 at 188 degrees. A total of 19 sample locations at a 300-foot interval distance were assessed. Site conditions remained steady with winds less than 5 knots and overcast skies. Surveying concluded at 11:45 a.m. on June 19, 2003 during low tide. The tidal station (subordinate station #1391) was used for depth corrections, reporting a -0.4 ft tide level at 11:30 a.m. The tidal current velocity was estimated to be 0.0 knots. The horizontal visibility remained constant and was estimated to be 10 feet. The grade for these transects remained fairly flat.



South rafting area (white line) and "A" frame at the west end of Thorne Bay

June 20, 2003

Weather conditions during the survey consisted of overcast skies with winds at less than 5 knots. Surveying by Diving methods commenced at 9:00 a.m. on June 20, 2003 during mid water. The tidal station (subordinate station #1391) was used to correct depths to MLLW. The station reported a tide level of 6.3 ft at 9:00 a.m. The current conditions remained negligible. Seawater temperature was recorded at 43 degrees F. The horizontal visibility was estimated to be 4 feet.

Seven transects, emanating from previously surveyed video sample points, traversed the bottom on bearings labeled: T3, T4, T5, T8 and T9 at 188 degrees. A total of 28 sample locations at a 15-foot interval distance were assessed. Site conditions remained steady with winds less than 5 knots and overcast skies. Surveying concluded at 3:30 p.m. on June 20, 2003 during mid tide. The tidal station (subordinate station #1391) was used for depth corrections, reporting a 7.4 ft tide level at 3:30 p.m. The tidal current velocity was estimated to be 0.0 knots. The horizontal visibility remained constant and was estimated to be 4 feet. The grade for these transects remained fairly flat.

East rafting area on the north side of Thorne Bay

Observations

Dive surveying began at transect three sample point nine, at 9 a.m. on June 20. Surface supplied diving apparatus was used that included voice communications with surface personnel. The first observations on descent was low visibility, no light was reflected off the bottom, some 15 feet below. The bottom became visible approximately four feet before touchdown. The first observations were what appeared to be 100% bark cover on a silty substrate.

As contact was made with the bottom, the silt substrate gave way and I sank into it approximately two feet. A horizon of visibility extending 10 linear feet and four vertical feet off the bottom was observed. This area had a distinct orange/brown cast and seemed to glow with the defused light, but did not contain the usual visual disturbances associated with fresh and salt water incompletely mixing.

The bark debris encountered varied from 80% to 100% coverage and the resistance felt by probing a ruler into the substrate was typical of bark pieces mixed in with natural substrate. This mixed debris varied between 6” and 12” deep. Beyond that depth the ruler encountered little resistance, other than silt.

Visibility conditions remained constant throughout the balance of the survey, the only notable difference being that, as the sample point depth increased, the defused glow reduced with the filtering on the natural light from the surface. At depths of 30 feet, the horizon of visibility reduced to about five linear feet as conditions grew darker.

The bark debris observed, while varying in size from a few inches to several feet, all appeared to be brittle in nature. No indications of beggatoa or continued degradation, was apparent. Most of the bark debris seemed to be residing in the top few inches of the silt substrate.

The core samples extracted from the bottom included driving a three inch steel pipe into the substrate. This pipe met with little resistance, even when penetrating almost five feet. The cores from this pipe proved unattainable as the suction resistance overwhelmed the one way valves on extraction. Cores were eventually obtained by using shorter, 2” polycarbonate tubes that were pressed into the silt and the ends capped before extraction.

Generally, the observations are that of a fairly flat grade of alluvial silt deposits. The bark debris appears to be brittle, and well mixed with the top few inches of the substrate. Marine life is considered low in abundance in

comparison to other bays observed with fine silt substrates. No operational debris was observed during the dive survey, however one of the core samples[3] deposited in a bucket on deck produced a sheen on the surface of the water. This core had a noticeable petroleum odor.

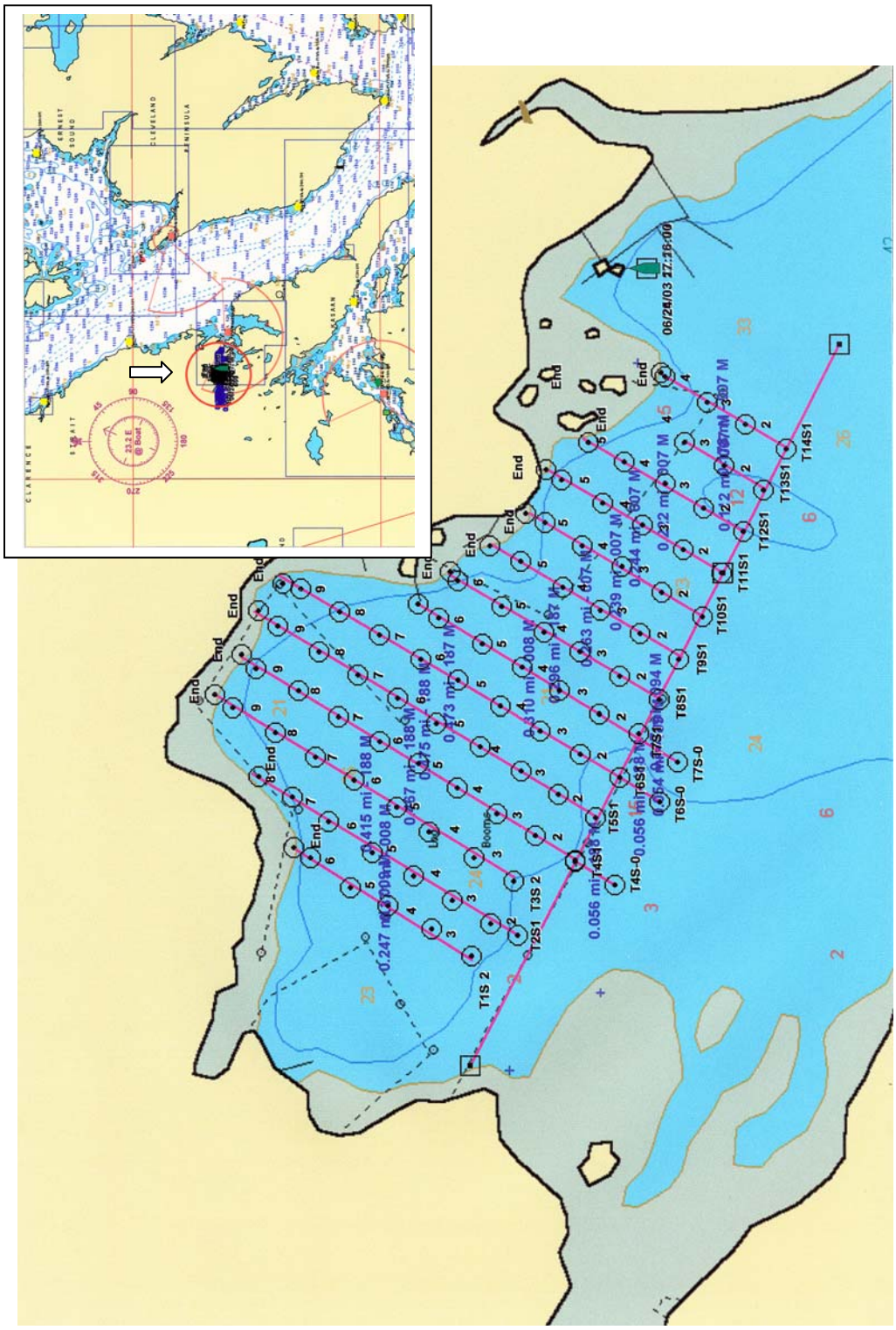
This determination is based on the calculations derived from the transect data collected for this report only. For further service regarding this report, please direct inquiries to (253) 209-9380 or e-mail at Haggitt1@juno.com.

Respectfully submitted,

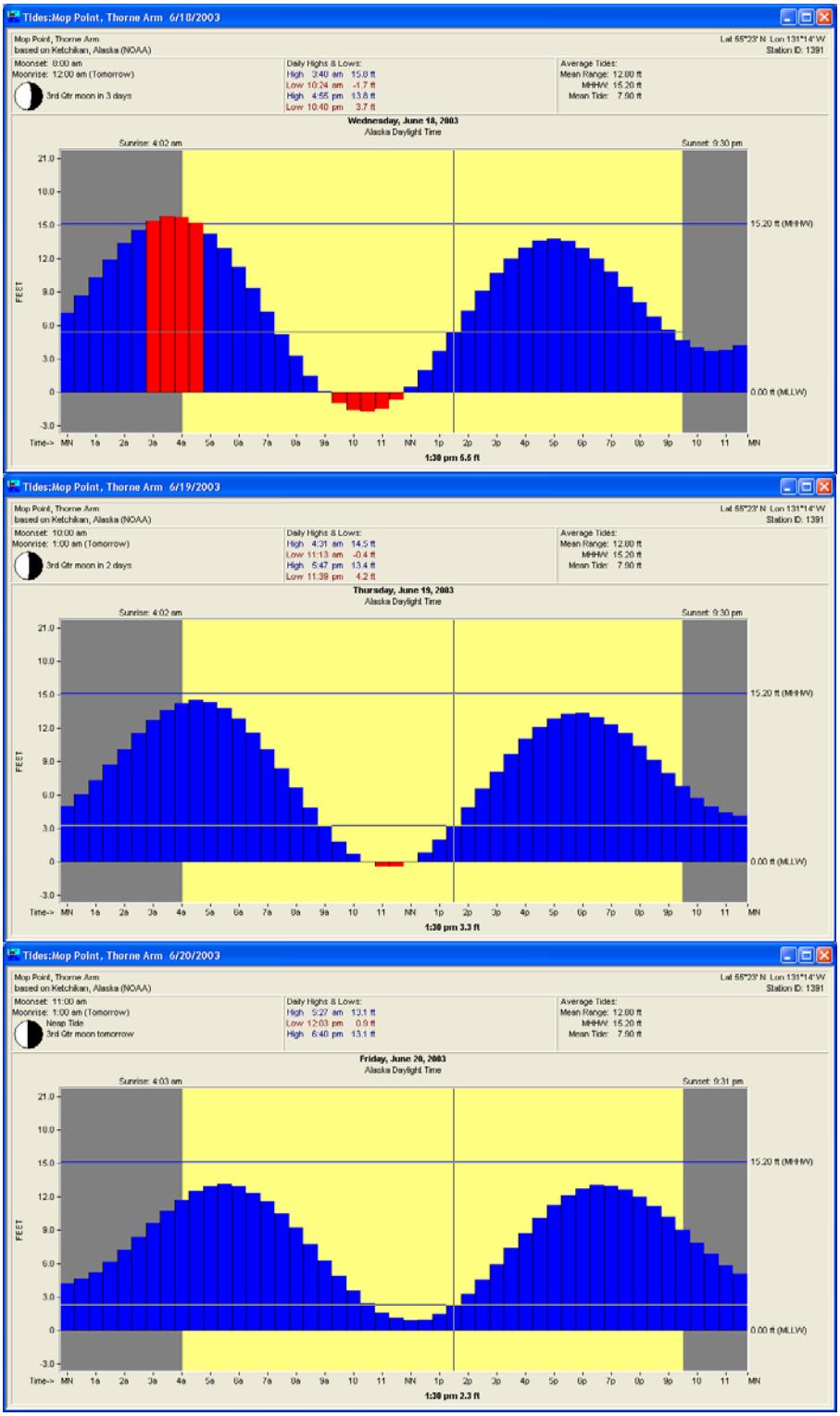
Stephen Haggitt

[3] The core was extracted from Transect three Sample point nine.

Vicinity Map



Tidal Chart

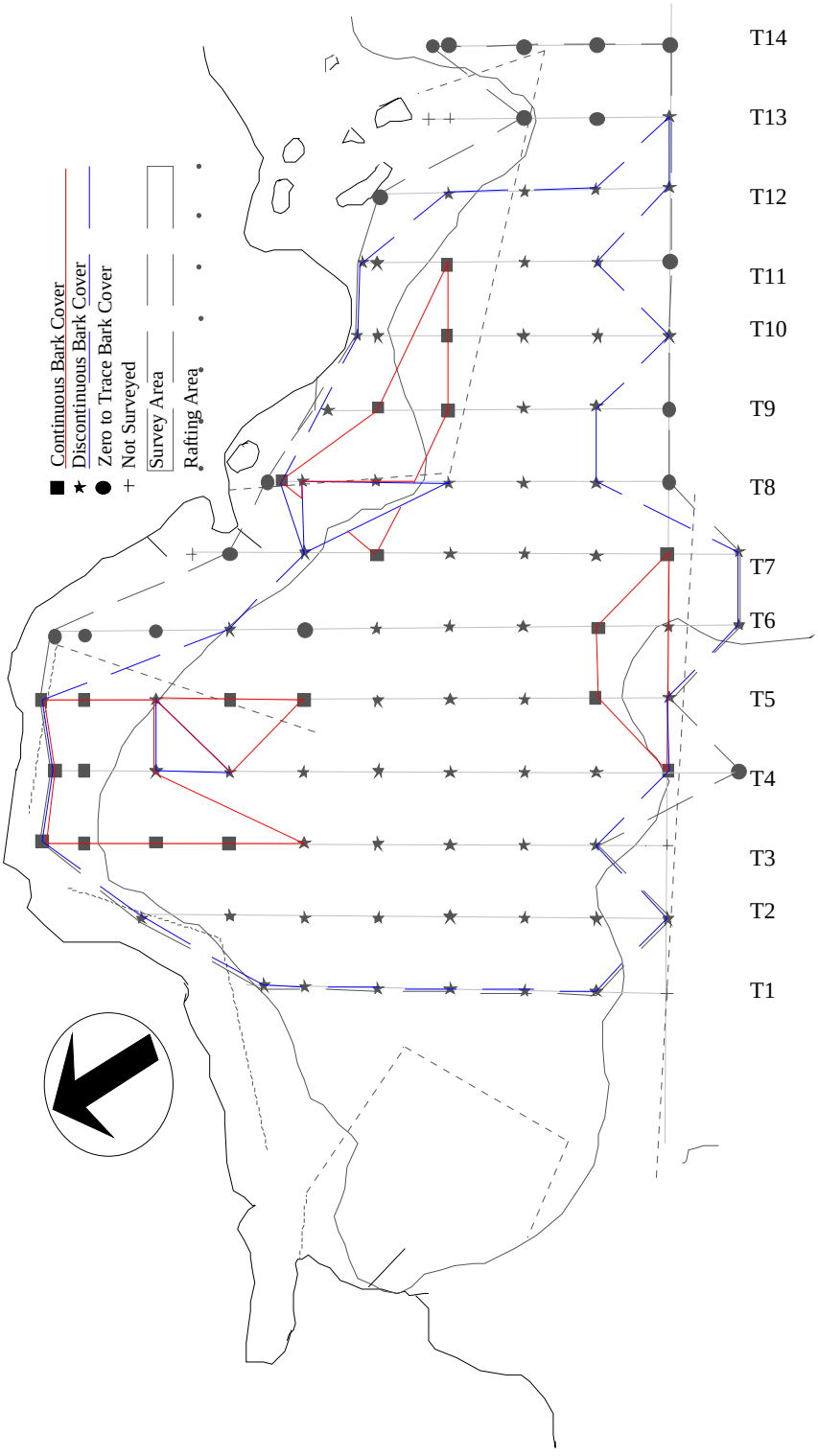

Tides:Mop Point, Thorne Arm 6/18/2003
Mop Point, Thorne Arm
based on Ketchikan, Alaska (NOAA)
Lat 55°23' N Lon 131°14' W
Station ID: 1391
Moonset: 8:00 am
Moonrise: 12:00 am (Tomorrow)
3rd Qtr moon in 3 days
Daily Highs & Lows:
High 3:40 am 15.8 ft
Low 10:24 am -1.7 ft
High 4:55 pm 13.8 ft
Low 10:40 pm 3.7 ft
Average Tides:
Mean Range: 12.80 ft
MHHW: 15.20 ft
Mean Tide: 7.90 ft
Wednesday, June 18, 2003
Alaska Daylight Time
Sunrise: 4:02 am
Sunset: 9:30 pm
FEET
15.20 ft (MHHW)
0.00 ft (MLLW)
Time-->
1:30 pm 5.5 ft
Tides:Mop Point, Thorne Arm 6/19/2003
Mop Point, Thorne Arm
based on Ketchikan, Alaska (NOAA)
Lat 55°23' N Lon 131°14' W
Station ID: 1391
Moonset: 10:00 am
Moonrise: 1:00 am (Tomorrow)
3rd Qtr moon in 2 days
Daily Highs & Lows:
High 4:31 am 14.5 ft
Low 11:13 am -0.4 ft
High 5:47 pm 13.4 ft
Low 11:39 pm 4.2 ft
Average Tides:
Mean Range: 12.80 ft
MHHW: 15.20 ft
Mean Tide: 7.90 ft
Thursday, June 19, 2003
Alaska Daylight Time
Sunrise: 4:02 am
Sunset: 9:30 pm
FEET
15.20 ft (MHHW)
0.00 ft (MLLW)
Time-->
1:30 pm 3.3 ft
Tides:Mop Point, Thorne Arm 6/20/2003
Mop Point, Thorne Arm
based on Ketchikan, Alaska (NOAA)
Lat 55°23' N Lon 131°14' W
Station ID: 1391
Moonset: 11:00 am
Moonrise: 1:00 am (Tomorrow)
Neap Tide
3rd Qtr moon tomorrow
Daily Highs & Lows:
High 5:27 am 13.1 ft
Low 12:03 pm 0.9 ft
High 6:40 pm 13.1 ft
Average Tides:
Mean Range: 12.80 ft
MHHW: 15.20 ft
Mean Tide: 7.90 ft
Friday, June 20, 2003
Alaska Daylight Time
Sunrise: 4:03 am
Sunset: 9:31 pm
FEET
15.20 ft (MHHW)
0.00 ft (MLLW)
Time-->
1:30 pm 2.3 ft

Calculation Diagram

Calculation Notes:

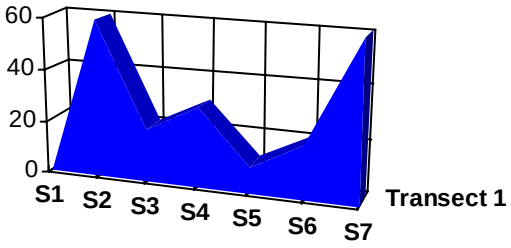
- Transect 3 sample point 6, was used as a corner of continuous cover because it was observed at 90% coverage.
- Transect 4 sample point 8, (30% cover) was used as a corner of continuous coverage because observation indicated 100% cover began just north of this sample point.
- Transect 5 sample point 8, (80% cover) was used to delineate continuous cover as it was observed to be within two adjacent areas of 100% cover.

Areas indicated with a + sign were scheduled for survey, but were not completed due to shallow depth or physical obstruction.



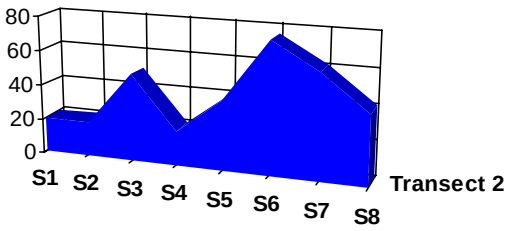
Data Tables

Key:
Substrate Type; S=Sand, M=Mud, SL=Silt, R=Rock, C=Cobble, G=Gravel
Bark Depth not recorded in video survey, recorded in inches in dive survey
Graph represents percent of cover by sample point



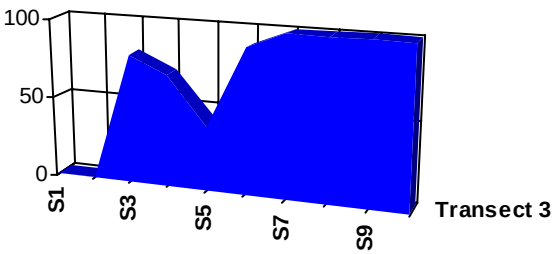
Video Transect Number 1

Sample Point Location	Depth	% of Cover	Substrate type
-1 55 41 110 / 132 32 741	Not surveyed—too shallow		
2 55 41 1530 / 132 32 6869	6	60	SL
3 55 41 1935 / 132 32 6340	23	20	SL
4 55 41 2421 / 132 32 5901	24	30	SL
5 55 41 2786 / 132 32 5749	24	10	SL
6 55 41 3200 / 132 32 5068	22	20	SL
7 55 41 3374 / 132 32 4854	20	60	SL



Video Transect Number 2

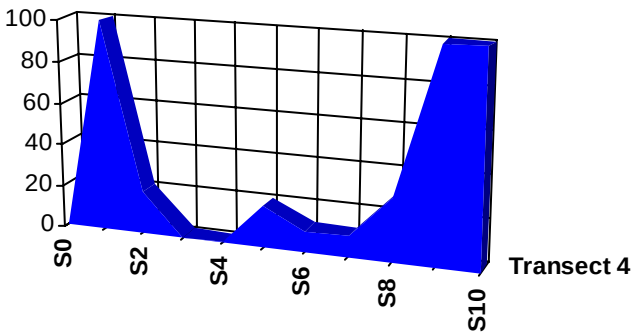
Sample Point Location	Depth	% of Cover	Substrate type
1 55 41 1046 / 132 32 6480	6	20	SL
2 55 41 1346 / 132 32 6345	18	20	SL
3 55 41 1731 / 132 32 5906	20	50	SL
4 55 41 2148 / 132 32 5468	21	20	SL
5 55 41 2558 / 132 32 4960	23	40	SL
6 55 41 3011 / 132 32 4387	23	75	SL
7 55 41 3392 / 132 32 3954	21	60	SL
8 55 41 3730 / 132 32 3572	5	40	SL



Video Transect Number 3

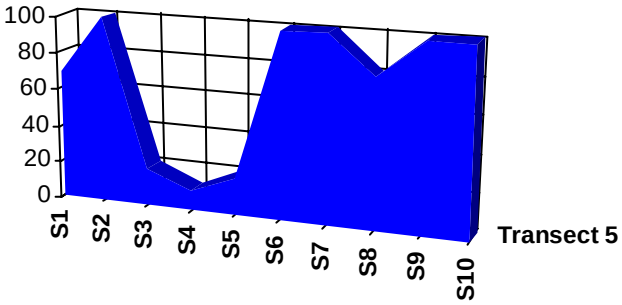
Sample Point Location	Depth	% of Cover	Substrate type
-1 55 41 065 / 132 32 587	Not surveyed—too shallow		
2 55 41 1070 / 132 32 5365	20	0	SL
3 55 41 1488 / 132 32 4968	22	80	SL
4 55 41 1930 / 132 32 4513	23	70	SL
5 55 41 2349 / 132 32 4017	28	40	SL
6 55 41 2746 / 132 32 3665	25	90	SL
7 55 41 3174 / 132 32 3226	25	100	SL
8 55 41 3574 / 132 32 2769	21	100	SL
9 55 41 3997 / 132 32 2429	17	100	SL
10 55 41 4159 / 132 32 2035	13	100	SL

Video Transect Number 4



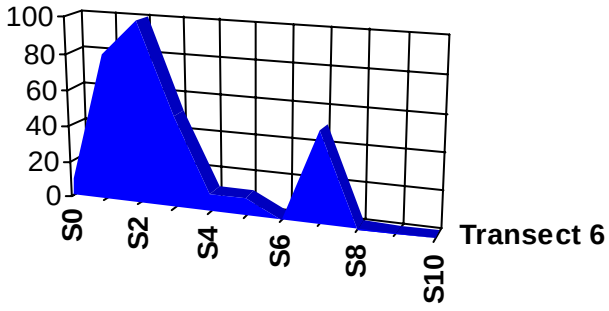
Sample Point Location	Depth	% of Cover	Substrate type
+0 55 41 0210 / 132 32 5433	8	0	SL
1 55 41 0455 / 132 32 5116	19	100	SL
2 55 41 0859 / 132 32 4652	21	20	SL
3 55 41 1231 / 132 32 4240	23	0	SL
4 55 41 1651 / 132 32 3802	25	0	SL
5 55 41 2106 / 132 32 3402	26	20	SL
6 55 41 2514 / 132 32 2866	27	10	SL
7 55 41 2907 / 132 32 2534	25	10	SL
8 55 41 3336 / 132 32 2077	24	30	SL
9 55 41 3775 / 132 32 1515	20	100	SL
10 55 41 3912 / 132 32 1333	10	100	SL

Video Transect Number 5



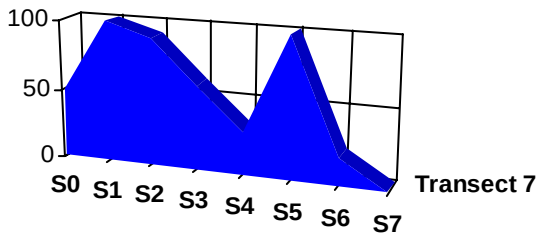
Sample Point Location	Depth	% of Cover	Substrate type
1 55 41 0205 / 132 32 4379	20	70	SL
2 55 41 0641 / 132 32 3957	23	100	SL
3 55 41 1100 / 132 32 3434	24	20	SL
4 55 41 1495 / 132 32 2973	26	10	SL
5 55 41 1889 / 132 32 2518	27	20	SL
6 55 41 2269 / 132 32 2100	29	100	SL
7 55 41 2732 / 132 32 1646	29	100	SL
8 55 41 3135 / 132 32 1308	26	80	SL
9 55 41 3571 / 132 32 0831	21	100	SL
10 55 41 3733 / 132 32 0522	13	100	SL

Video Transect Number 6



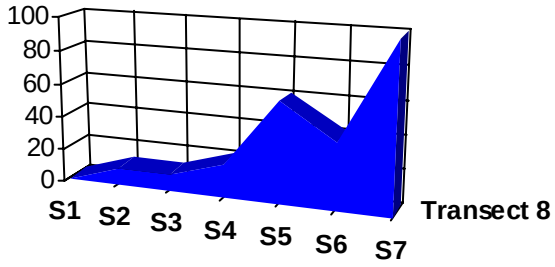
Sample Point Location	Depth	% of Cover	Substrate type
+0 55 40 9543 / 132 32 4060	22	10	SL
1 55 40 9956 / 132 32 3566	25	80	SL
2 55 41 0381 / 132 32 3219	27	100	SL
3 55 41 0797 / 132 32 2822	29	50	SL
4 55 41 1212 / 132 32 2287	29	10	SL
5 55 41 1606 / 132 32 1959	32	10	SL
6 55 41 2066 / 132 32 1380	32	0	SL
7 55 41 2474 / 132 32 0957	30	50	SL
8 55 41 2880 / 132 32 0611	25	0	SL
9 55 41 3299 / 132 32 0166	15	0	SL
10 55 41 3469 / 132 31 0060	7	0	SL

Video Transect Number 7



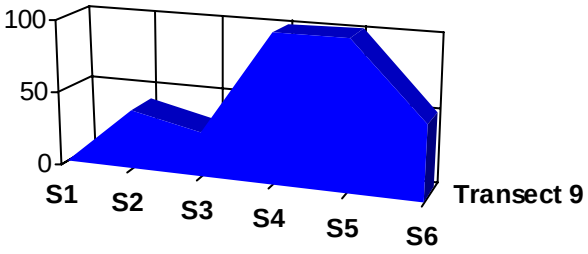
Sample Point Location	Depth	% of Cover	Substrate type
+0 55 40 9341 / 132 32 3343	20	50	SL
1 55 40 9777 / 132 32 2812	22	100	SL
2 55 41 0199 / 132 32 2431	21	90	SL
3 55 41 0618 / 132 32 1962	28	60	SL
4 55 41 0953 / 132 32 1578	28	30	SL
5 55 41 1432 / 132 32 1132	30	100	SL
6 55 41 1838 / 132 32 0671	31	20	SL, S
7 55 41 2079 / 132 32 0170	12	0	S, G, SH
8 55 41 251 / 132 31 996	Not Surveyed—Blocked at Boyer dock		

Video Transect Number 8



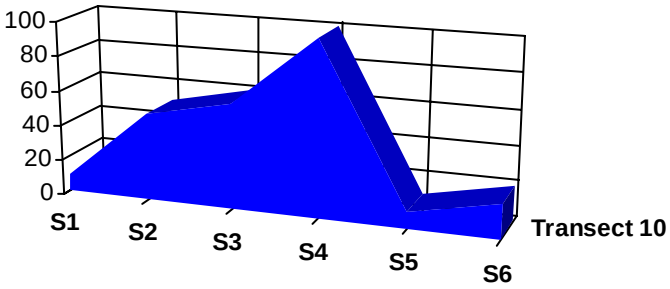
Sample Point Location	Depth	% of Cover	Substrate type
1 55 40 9529 / 132 32 2167	32	0	SL
2 55 41 9938 / 132 32 1753	34	10	SL
3 55 41 0343 / 132 32 1362	31	10	SL
4 55 41 0747 / 132 32 0930	34	20	SL
5 55 41 1198 / 132 32 0446	37	60	SL
6 55 41 1620 / 132 31 9950	31	40	SL
7 55 41 1725 / 132 31 9751	20	100	SL

Video Transect Number 9



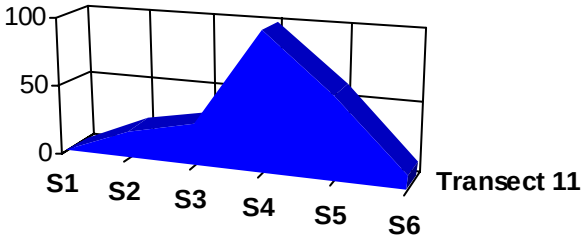
Sample Point Location	Depth	% of Cover	Substrate type
1 55 40 9279 / 132 32 1414	26	0	SL
2 55 40 9740 / 132 32 0937	27	40	SL
3 55 41 0178 / 132 32 0476	30	30	SL
4 55 41 0603 / 132 32 0084	33	100	SL
5 55 41 1001 / 132 31 9657	35	100	SL
6 55 41 1344 / 132 31 9350	24	50	SL

Video Transect Number 10



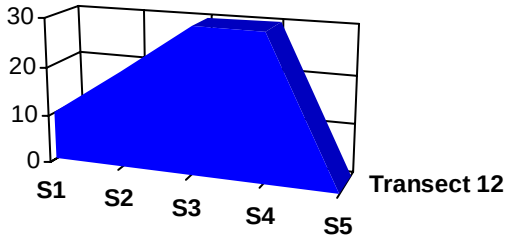
Sample Point Location	Depth	% of Cover	Substrate type
1 55 40 9105 / 132 32 0637	27	10	SL
2 55 40 9525 / 132 32 0166	25	50	SL
3 55 40 9902 / 132 31 9853	29	60	SL
4 55 41 0373 / 132 31 9411	33	100	SL
5 55 41 0734 / 132 31 8921	25	10	SL
6 55 41 0965 / 132 31 8791	14	20	SL

Video Transect Number 11



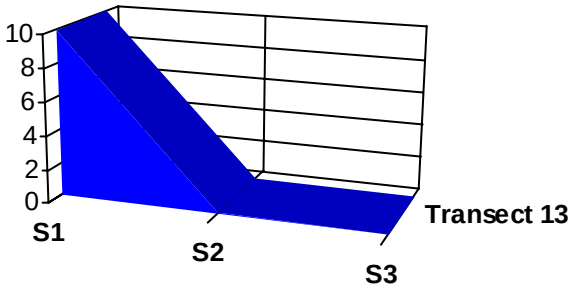
Sample Point Location	Depth	% of Cover	Substrate type
1 55 40 8845 / 132 31 9976	23	0	SL
2 55 40 9310 / 132 31 9432	21	20	SL
3 55 40 9730 / 132 31 8916	26	30	SL
4 55 41 0112 / 132 31 8520	30	100	SL
5 55 41 0557 / 132 31 8139	23	60	SL
6 55 41 0732 / 132 31 7956	13	10	SL

Video Transect Number 12



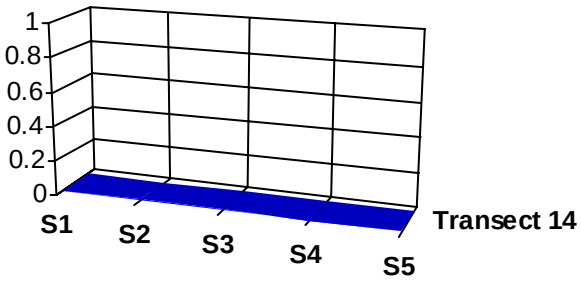
Sample Point Location	Depth	% of Cover	Substrate type
1 55 40 8672 / 132 31 9101	23	10	SL, S
2 55 40 9013 / 132 31 8617	28	20	S
3 55 40 9525 / 132 31 8181	33	30	SL
4 55 40 9893 / 132 31 7879	22	30	SL
5 55 41 0293 / 132 31 7493	13	0	S

Video Transect Number 13



Sample Point Location	Depth	% of Cover	Substrate type
1 55 40 8408 / 132 31 8304	23	10	R, S
2 55 40 8879 / 132 31 7874	29	0	S, SL
3 55 40 9296 / 132 31 7424	38	0	SL
-4 55 41 042 / 132 32 510	Not surveyed—too shallow		
-5 55 41 042 / 132 32 510	Not surveyed—too shallow		

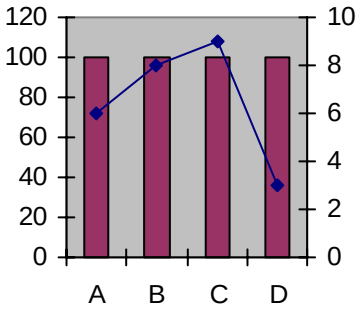
Video Transect Number 14



Sample Point Location	Depth	% of Cover	Substrate type
1 55 40 8205 / 132 31 7548	33	0	SL
2 55 40 8625 / 132 31 7155	35	0	SL
3 55 40 9032 / 132 31 6734	38	0	SL
4 55 40 9490 / 132 31 6248	20	0	S, SL
5 55 40 9545 / 132 31 6148	15	0	S

Dive Transect Number 3

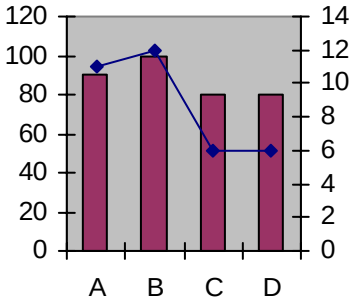
Sample point **6** (55 41 2746 N 132 32 3665 W)



Sample Point	Depth at MLLW	Bark Depth (Inches)	% of Cover	Substrate Type	Core Sample
6A	25	6	100	SL	YES
6B	24	8	100	SL	NO
6C	25	9	100	SL	NO
6D	23	3	100	SL	NO

Dive Transect Number 3

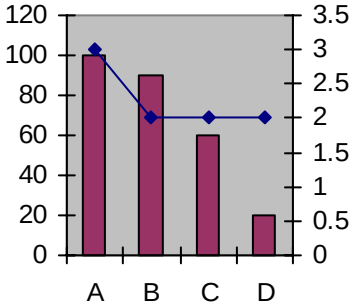
Sample point **9** (55 41 3997 N 132 32 2429 W)



Sample Point	Depth at MLLW	Bark Depth (Inches)	% of Cover	Substrate Type	Core Sample
9A	17	11	90	SL	NO
9B	17	12	100	SL	NO
9C	18	6	80	SL	NO
9D	18	6	80	SL	YES

Dive Transect Number 4

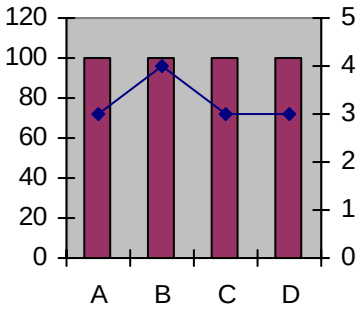
Sample point **1** (55 41 0455 N 132 32 5116 W)



Sample Point	Depth at MLLW	Bark Depth (Inches)	% of Cover	Substrate Type	Core Sample
1A	19	3	100	SL	NO
1B	20	2	90	SL	NO
1C	20	2	60	SL	NO
1D	20	2	20	SL	YES

Dive Transect Number 5

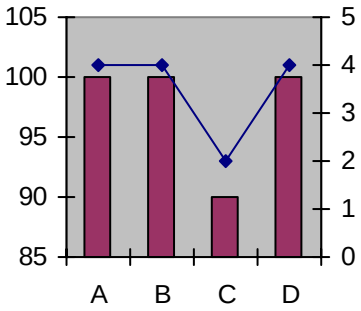
Sample point **1** (55 41 0205 N 132 32 4379 W)



Sample Point	Depth at MLLW	Bark Depth (Inches)	% of Cover	Substrate Type	Core Sample
1A	20	3	100	SL	NO
1B	20	4	100	SL	NO
1C	18	3	100	SL	NO
1D	18	3	100	SL	YES

Dive Transect Number 5

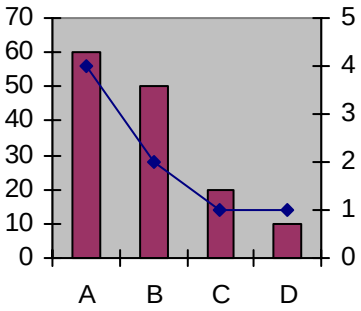
Sample point **8** (55 41 3135 N 132 32 1308 W)



Sample Point	Depth at MLLW	Bark Depth (Inches)	% of Cover	Substrate Type	Core Sample
8A	26	4	100	SL	NO
8B	26	4	100	SL	NO
8C	26	2	90	SL	NO
8D	25	4	100	SL	YES

Dive Transect Number 8

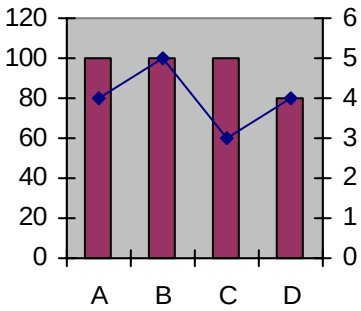
Sample point **5** (55 41 1198 N 132 32 0446 W)



Sample Point	Depth at MLLW	Bark Depth (Inches)	% of Cover	Substrate Type	Core Sample
5A	37	4	60	SL	NO
5B	37	2	50	SL	NO
5C	38	>1	20	SL	NO
5D	38	>1	10	SL	YES

Dive Transect Number 9

Sample point **4** (55 41 0603 N 132 32 0084 W)

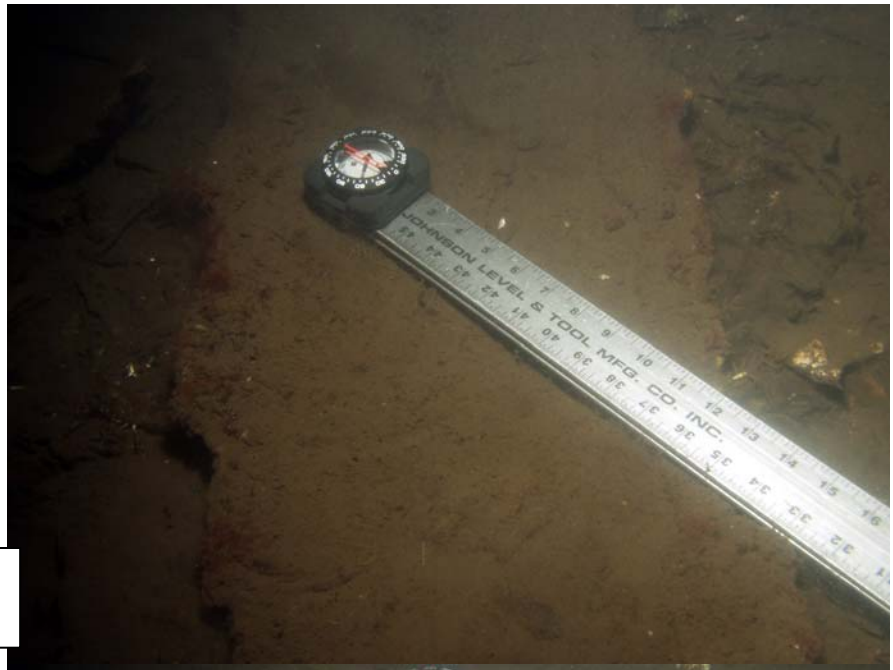


Sample Point	Depth at MLLW	Bark Depth (Inches)	% of Cover	Substrate Type	Core Sample
4A	32	4	100	SL	NO
4B	34	5	100	SL	NO
4C	33	3	100	SL	NO
4D	32	4	80	SL	YES

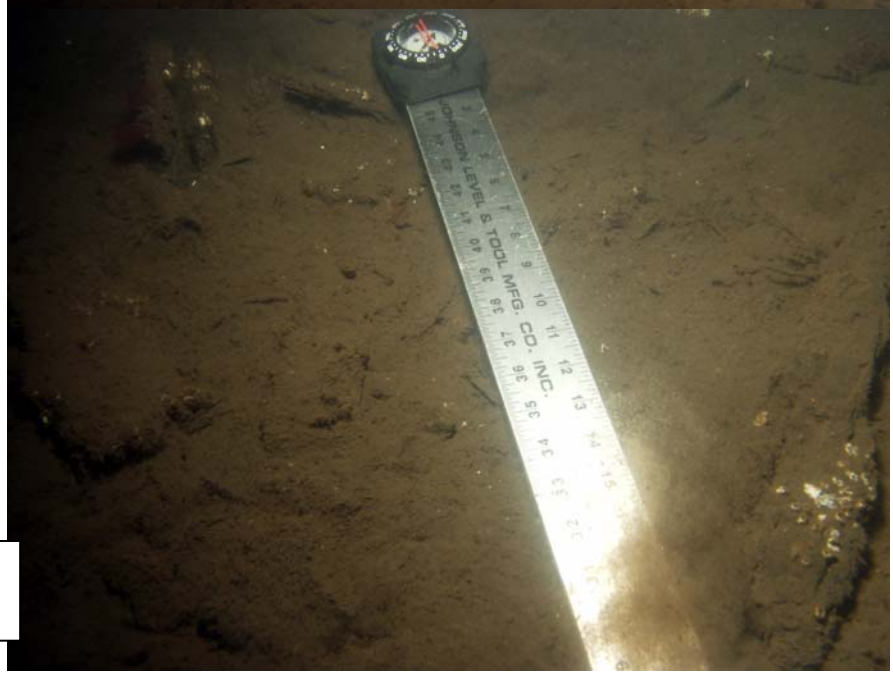
Abundance Tables

Scientific Name	Common Name	Abundance
Plants		
Ulva / Monstroma spp.	Sea lettuce	C
Lithothamnion spp.	Crustose red algae	NA
Agarum clathratum	Sieve Kelp	NA
Laminaria saccharina	Suger kelp	NA
Invertebrates		
Mediaster aequalis	Red star	NA
Luidia foliolata	Sand star	NA
Pycnopodia helianthoides	Sunflower star	L
Pisaster ochraceus	Ochre star	NA
Pododesmus macrochisma	Jingle	NA
Cucumaria miniata	Orange sea cucumber	L
Dermasterias imbricata	Leather star	NA
Solaster sp.	Sun star	NA
Ophiuroidea spp.	Brittle star	NA
Chionoecetes bairdi	Tanner crab	NA
Cancer products	Red rock crab	NA
Pandalus spp.	Shrimp	C
Pagurus spp.	Hermit crab	C
Bankia setacea	Shipworm	L
Protothaca staminea	Littleneck clam	NA
Beggiatoa sp.	Bacteria	NA
Polyplacophora spp.	Chiton	NA
Unidentified Benthic Infauna	Benthic Infauna	L
Metridium senile	Anemone	NA
Parastichopus californicus	Sea cucumber	L
Invertebrates		
Cottidae spp.	Sculpin	C
Hexagrammos decagrammus	Kelp greenling	NA

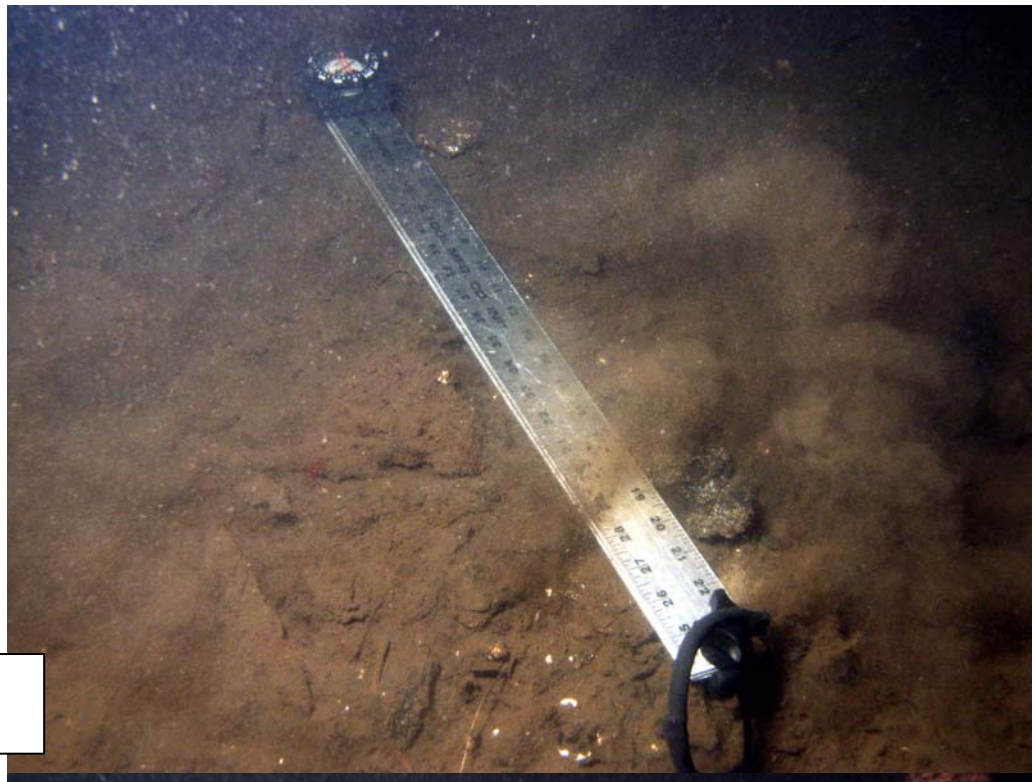
Photographic Representation



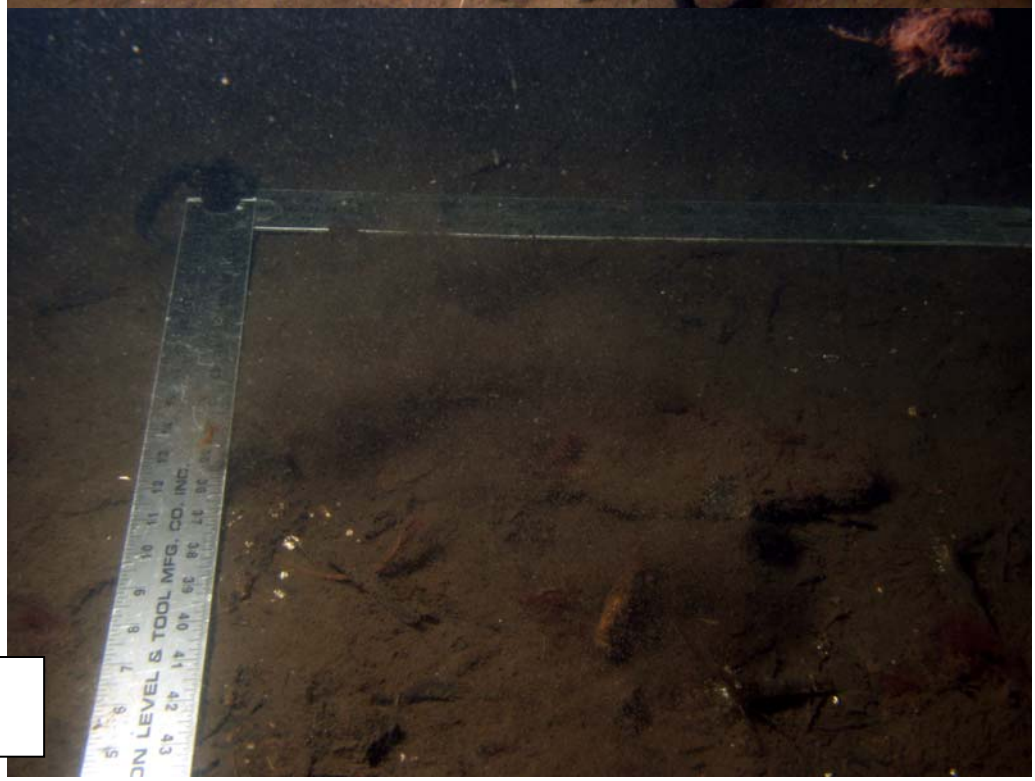
T3 S6A
6” 100% COVER



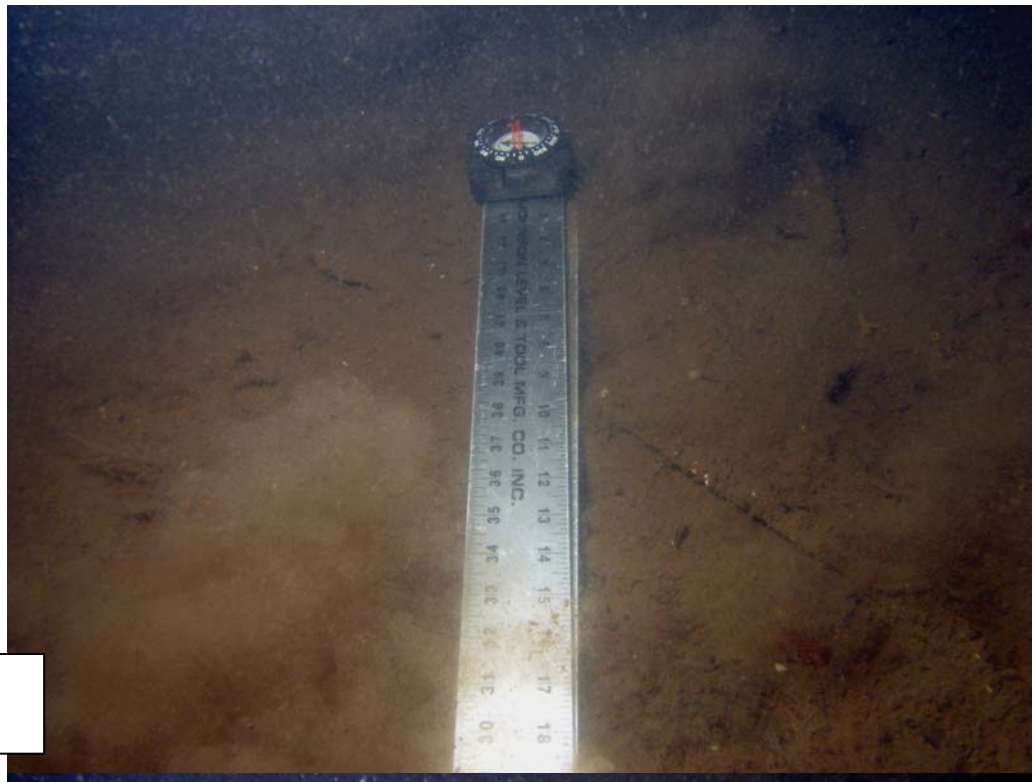
T3 S6B
8” 100% COVER



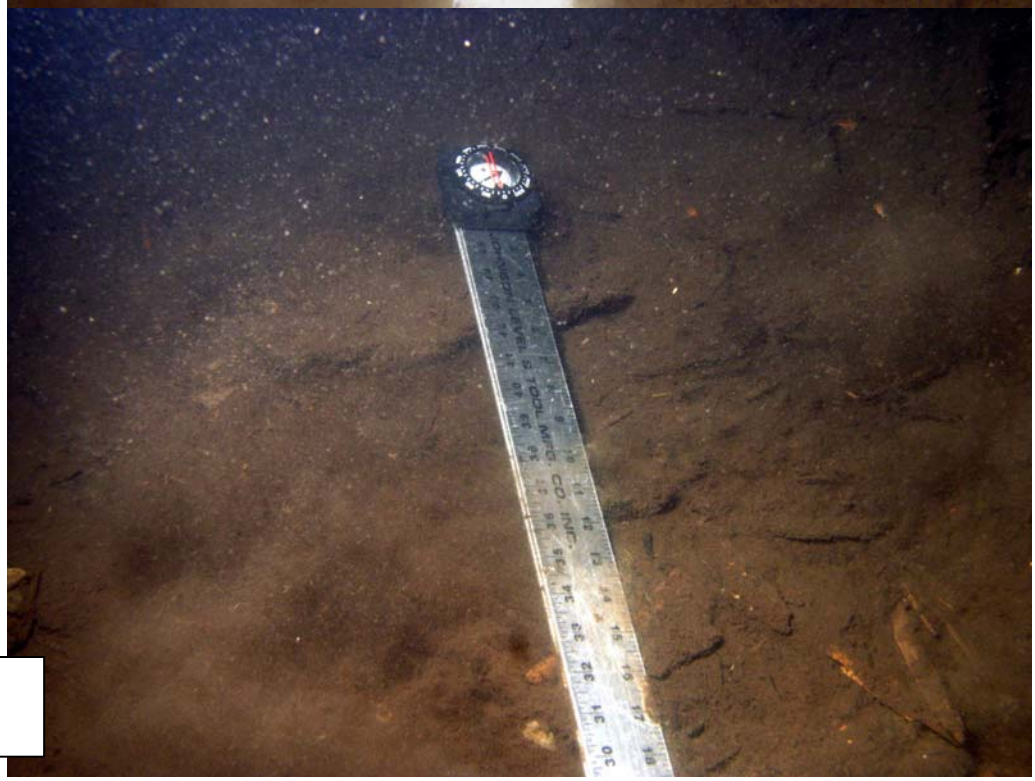
T3 S6C
9” 100% COVER



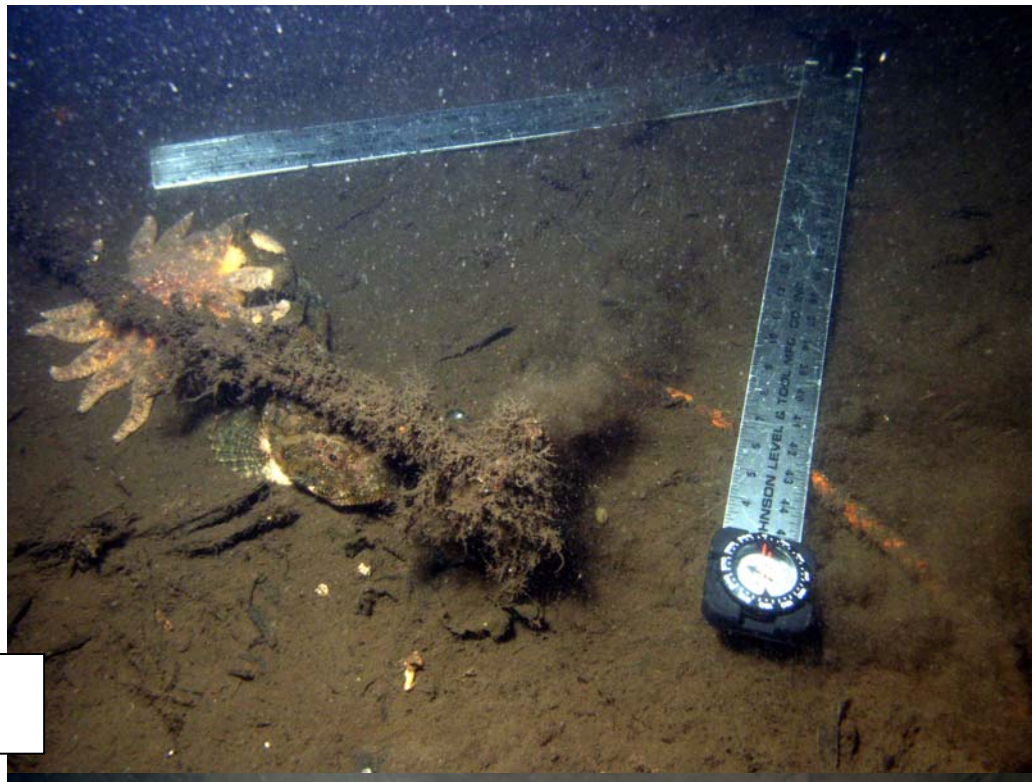
T3 S6D
3” 100% COVER



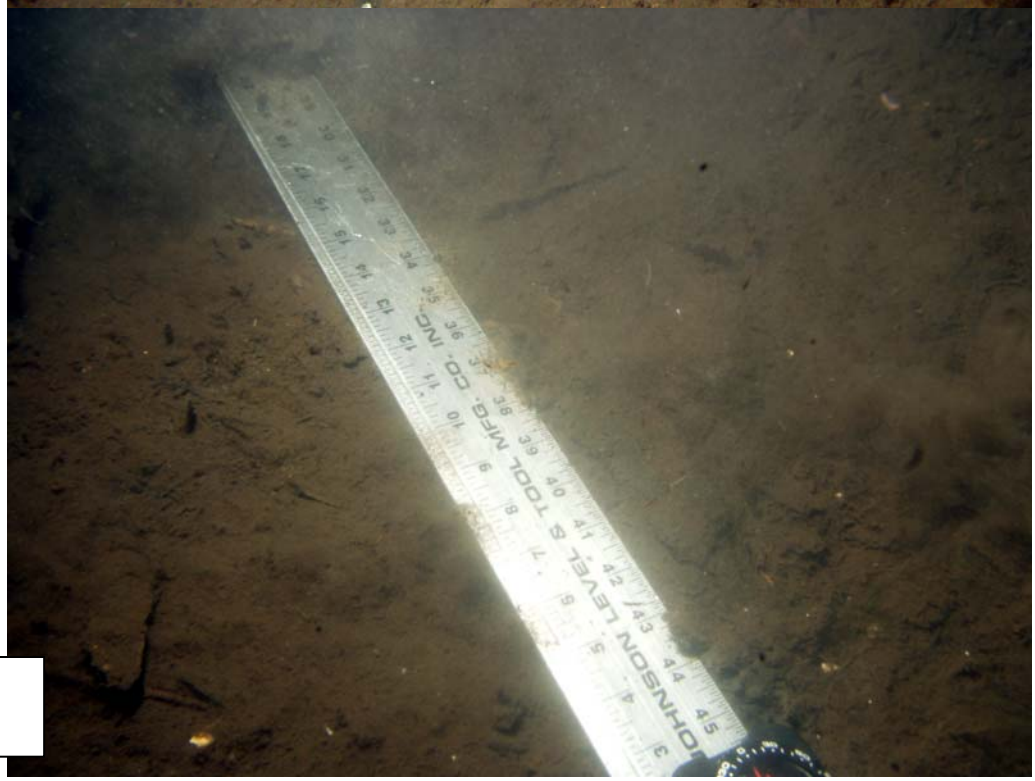
T3 S9A
11” 90% COVER



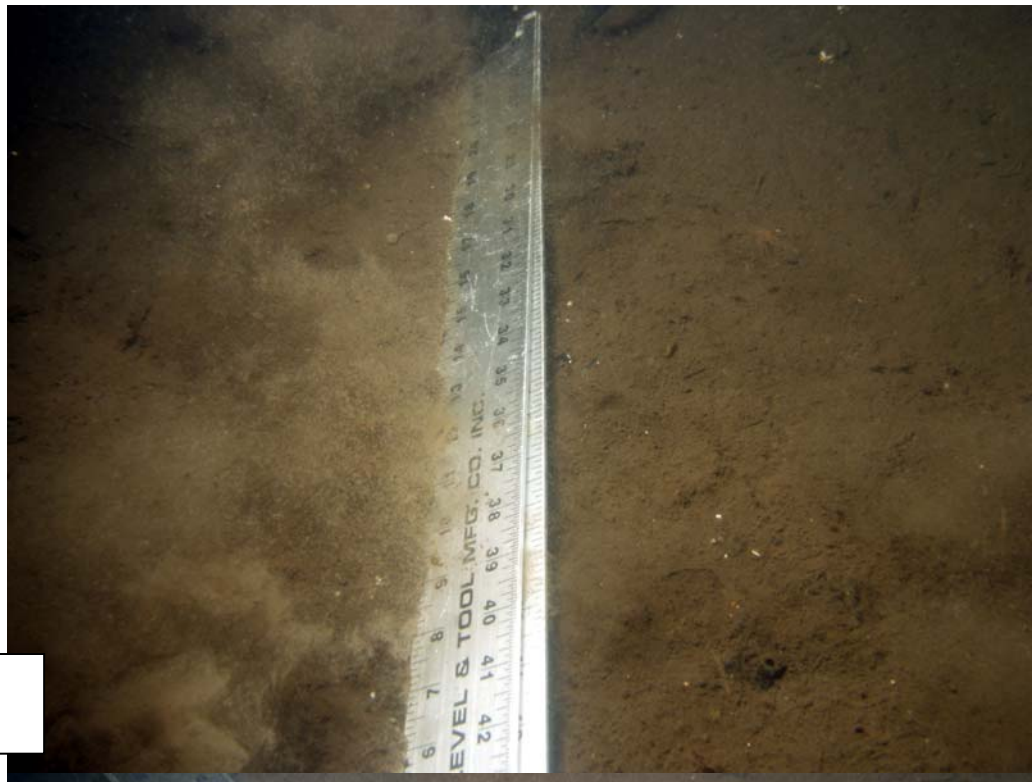
T3 S9B
12” 100% COVER



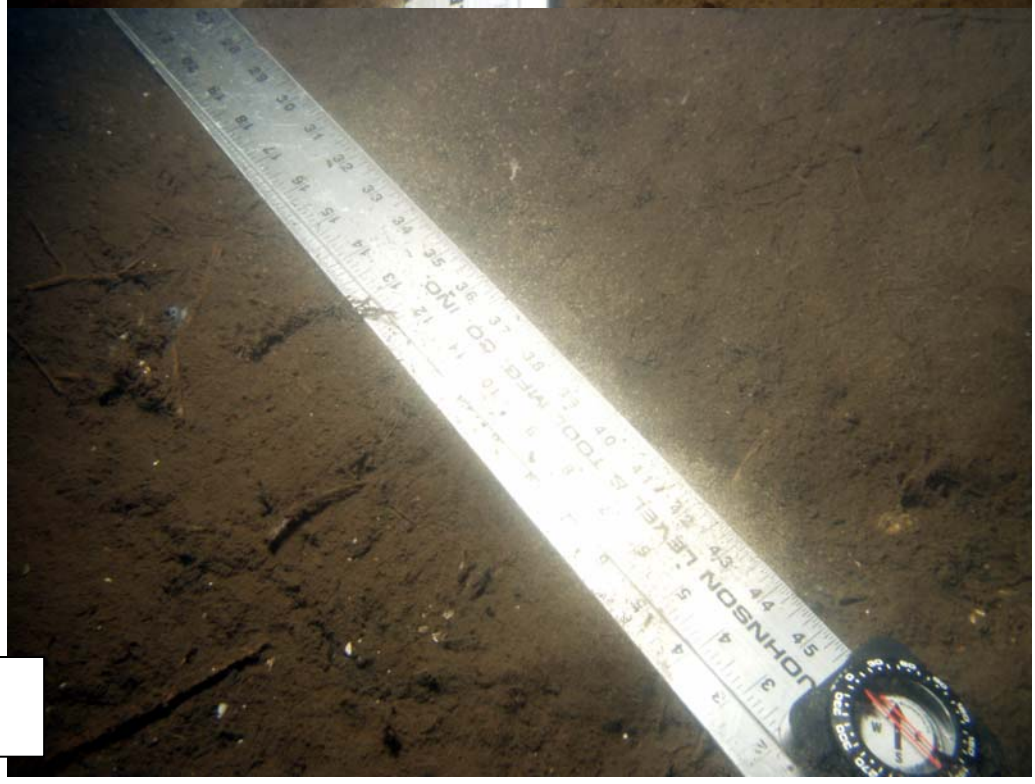
T4 S1C
2” 60% COVER



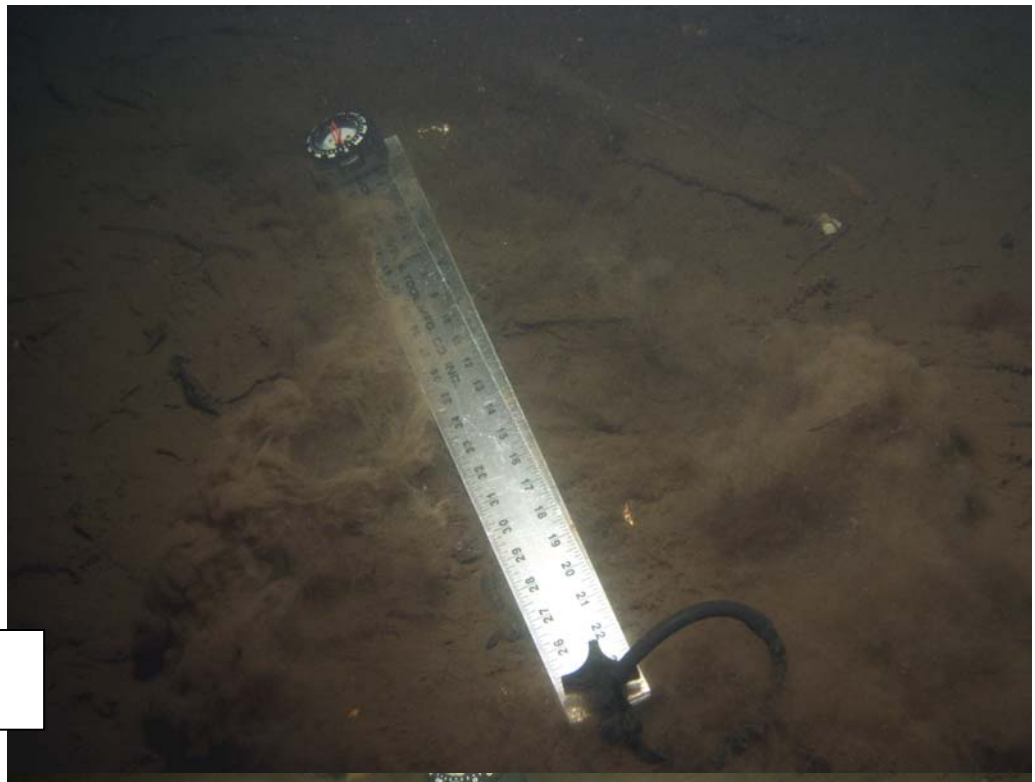
T4 S1D
2” 20% COVER



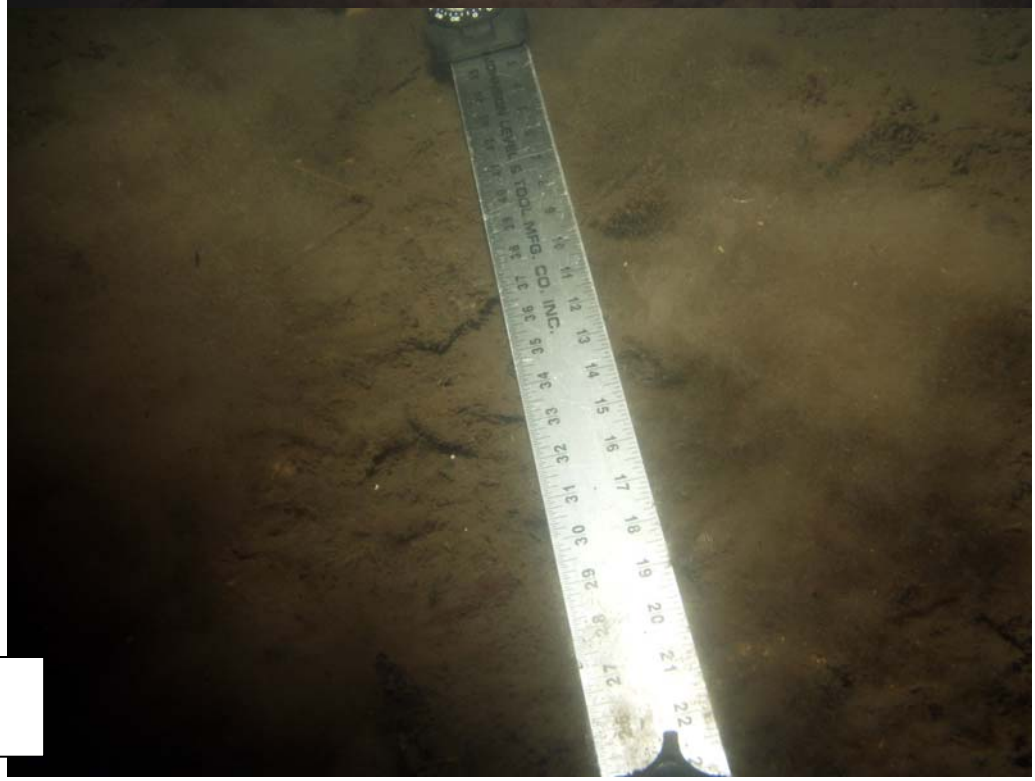
T5 S1A
3” 100% COVER



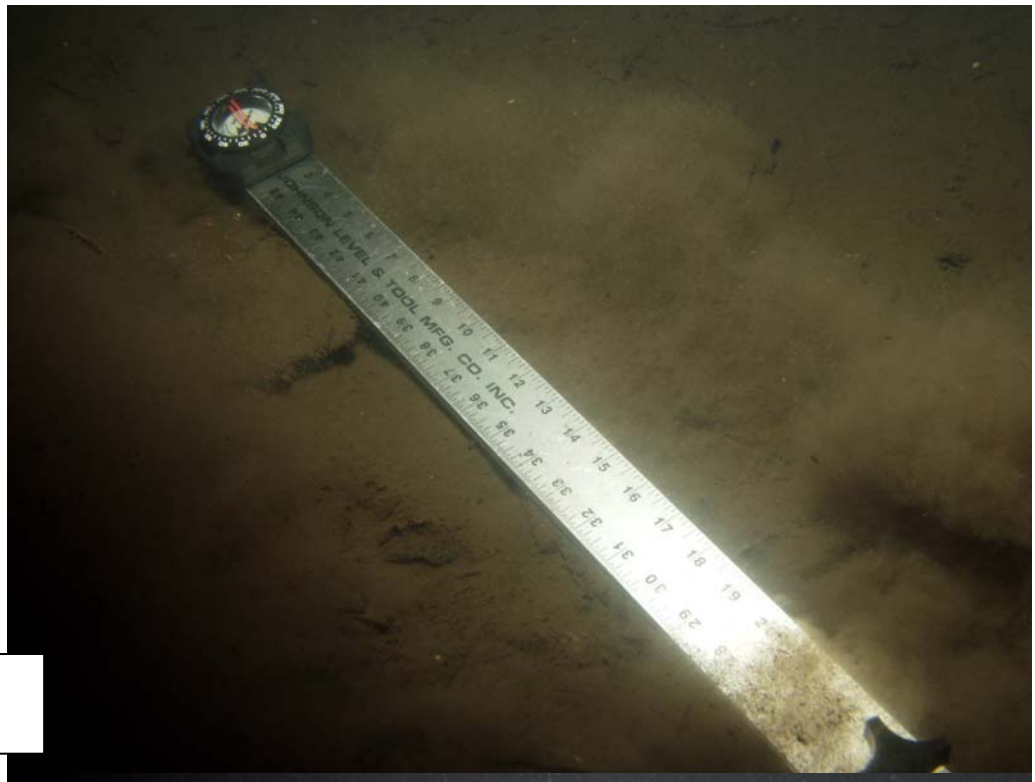
T5 S1C
3” 100% COVER



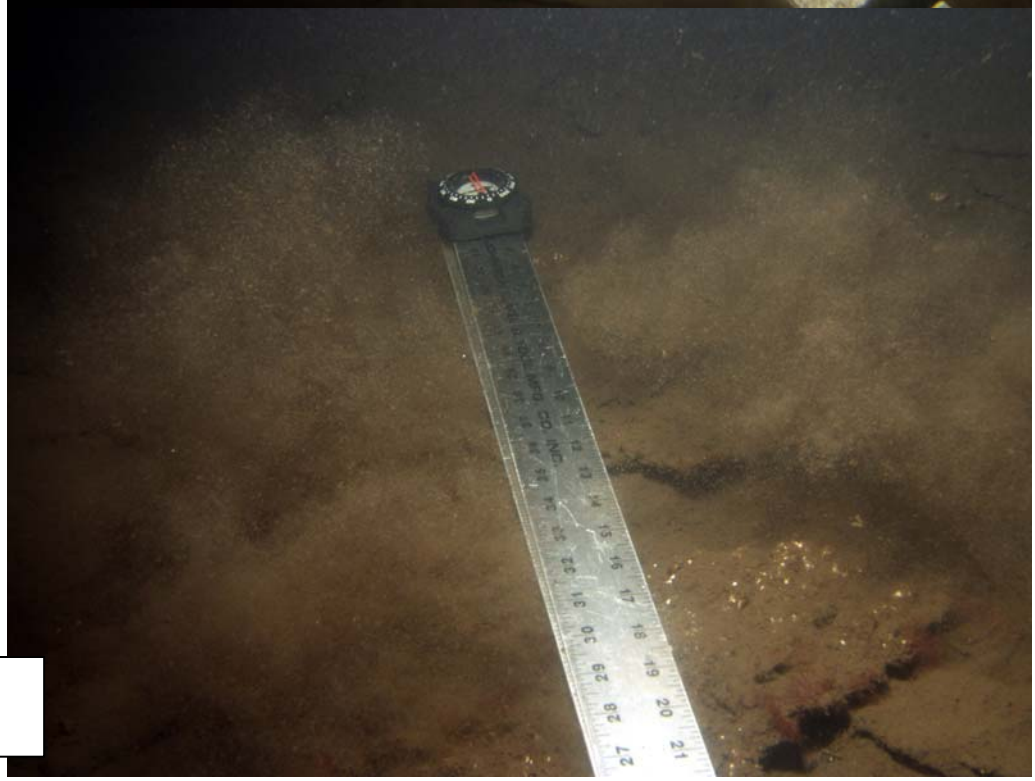
T5 S8A
4” 90% COVER



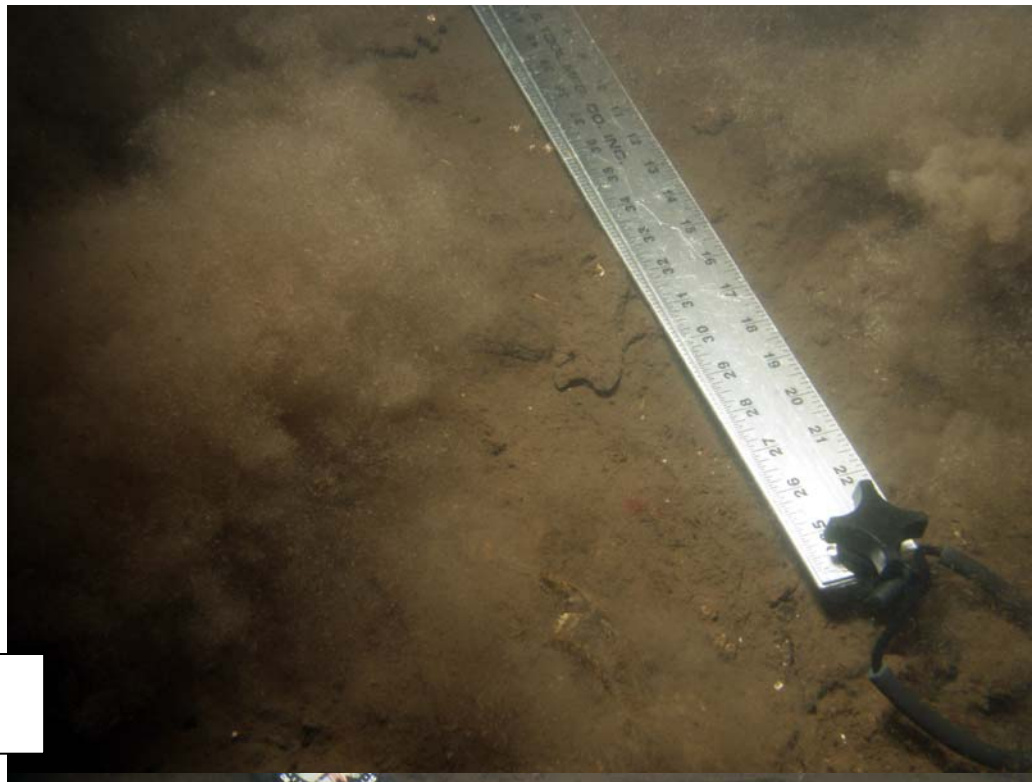
T5 S8C
2” 90% COVER



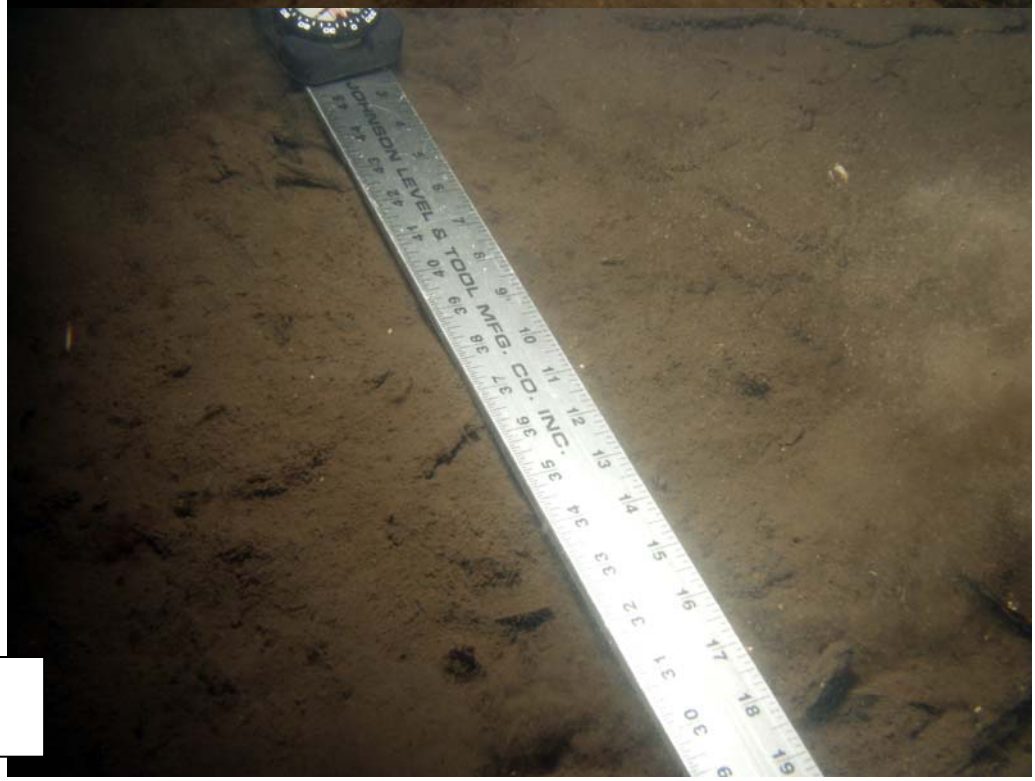
T8 S5A
4” 60% COVER



T8 S5B
2” 50% COVER



T9 S4A
4” 100% COVER



T9 S4D
4” 80% COVER

Chapter 2

Survey Summary

In July of 1972, four dive transects were conducted in Thorne Bay as a part of a general study by Bruce C. Pease for the U.S. Forest Service. The survey documented that the area in the north east portion of the bay formally used as an LTF (Crane), contained a bark layer 2-3 feet thick for an approximately 200 yard radius. The survey also reported observing a thin layer of bark on soft silt, over a gravel base in the northwest log rafting area.

Thorne Bay was 303(d) listed in 1998, based on two surveys conducted in 1988 and 1990[4]. Those surveys concluded that 55 acres of bark cover ranging from 6 to 24 inches thick was present in the area surveyed.

Two additional surveys were conducted in Thorne Bay in 2001 and 2002. Both of these surveys were concentrated at the west end of the bay, near an "A" frame. The 2001 and 2002 surveys did not overlap the surveys conducted in 1972, 1988, 1990 or this survey.

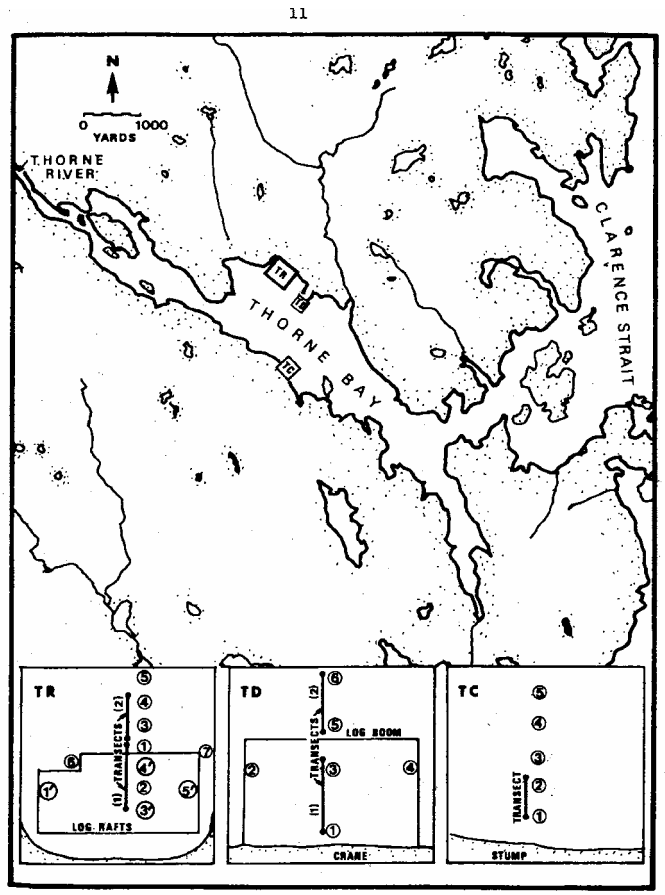
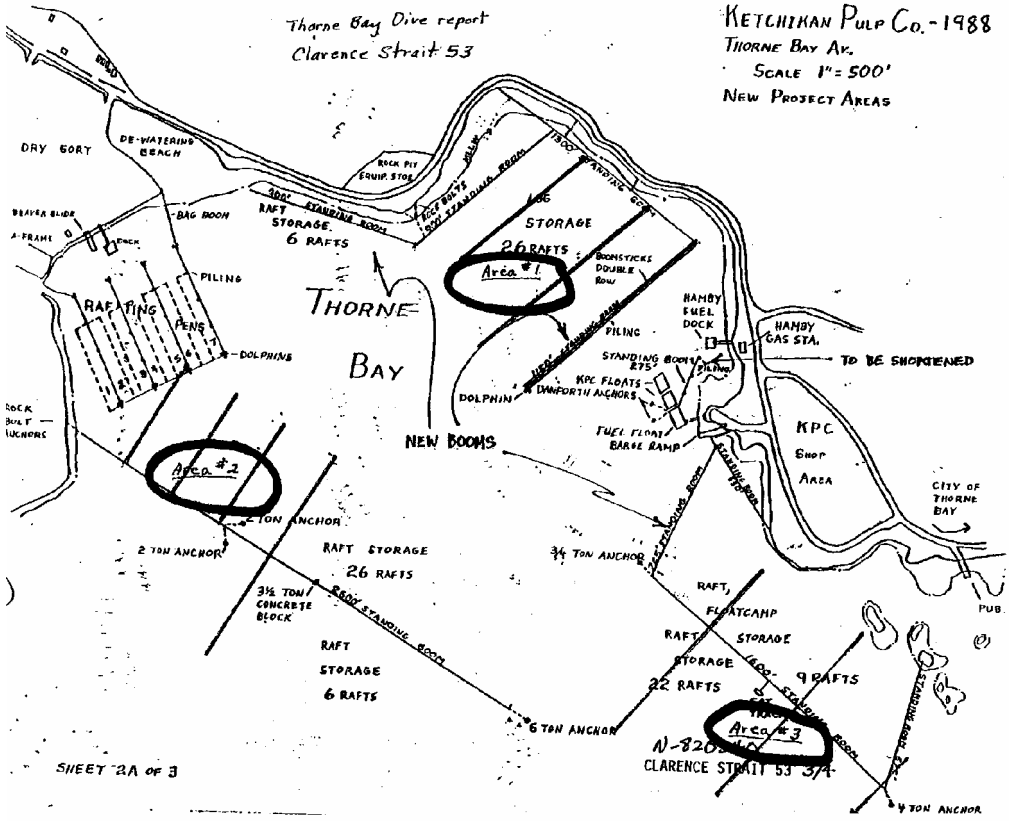


Figure 4. Thorne Bay sampling stations (stations 1',2,3', 4',5' sampled 7/19/72).

[4] Please see figure 5.

The 1972 survey also made observations of an area labeled TC (fig. 4) which was not part of the scope of this survey. A comparison of the surveys conducted in 1972, 1988, 1990 and the findings of this survey reveal that while the 1972, 88 and 90 surveys focused on the three primary areas used for log storage, this survey examined the substrate from the shallow limit on the south side of the bay to the shallow limit on the north side of the bay[5]. This took into consideration the three primary log storage areas' and the areas' in between.

Figure 5



[5] Please see Figure 6.

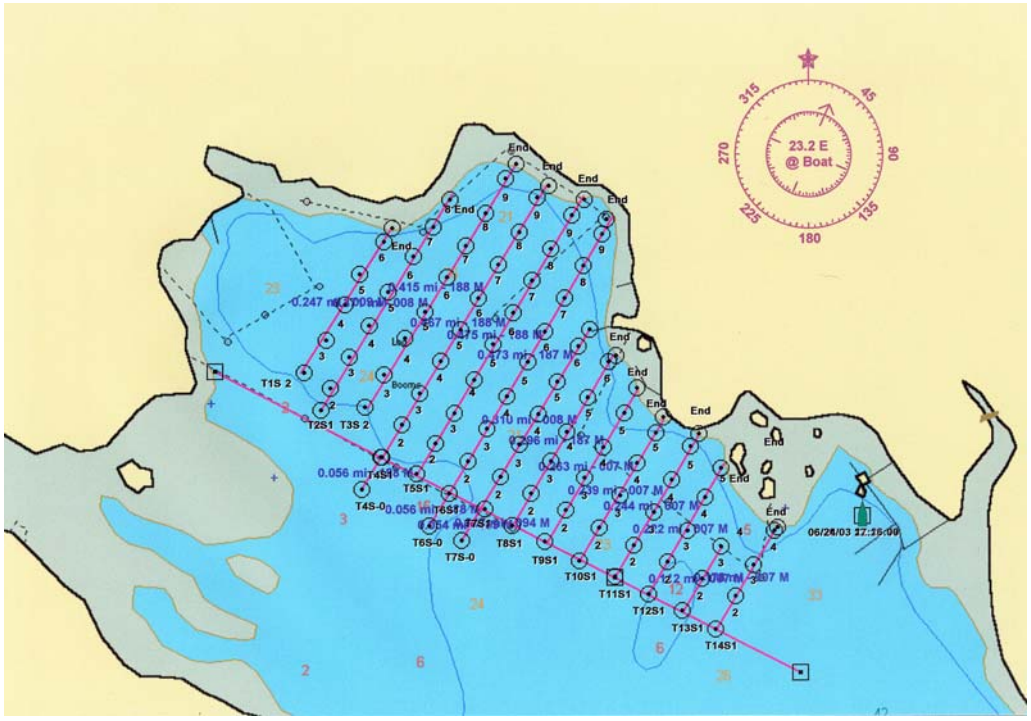


Figure 6

This increased the overall survey area considerably. The increase in overall survey area encompassed areas, not previously observed in the 1972, 1988 or 1990 surveys. This resulted in increased findings for discontinuous and continuous bark debris coverage as compared to earlier surveys.

The pattern of dispersal for the continuous bark debris remains consistent with the primary storage pattern. The higher concentration of bark debris on the south side of the bay, closely follow the rafting boom area on the nautical chart, although the pattern of continuous coverage is interrupted by heavy silt deposits from the Thorne River. The rafting area and elevated percents of cover abruptly end at the southern survey limit near an alluvial shelf.

The continuous coverage pattern located in the northwest portion of the survey area closely follows the primary storage pattern of booms lining the perimeter of the bay. According to Owen Graham of Alaska Forest Association--a 30 year veteran of operations at the site, the logs were generally stored along the boom and only occasionally, when the storage area was full did rafting occur in the center of the northwest rafting area. This pattern of use is mirrored by the percents of coverage located in this area.

The third primary storage area is located in the northeast portion of the survey area. Mr. Graham's description of the rafting pattern also closely matched the debris field observed in the survey. The area of continuous bark debris along transects T7 and

T8 may have been disturbed and the continuous coverage reduced by barge traffic approaching the Boyer dock. The substrate was observed to have a washed, gravely appearance that is commonly associated with prop wash from tugs.

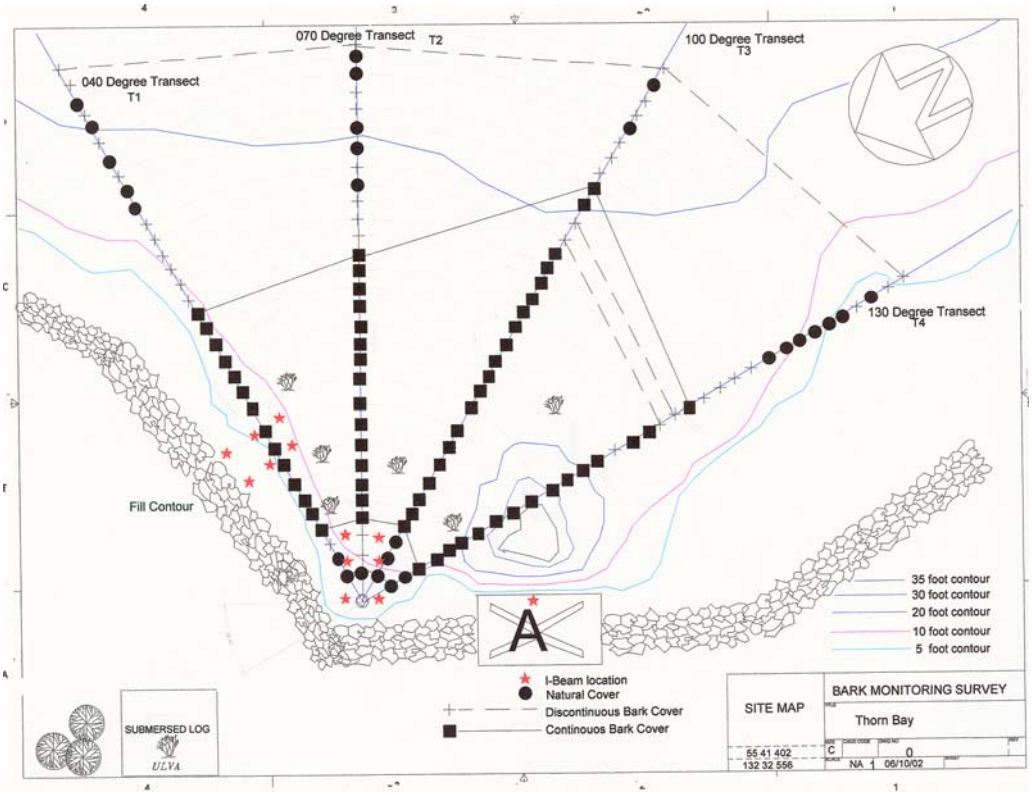
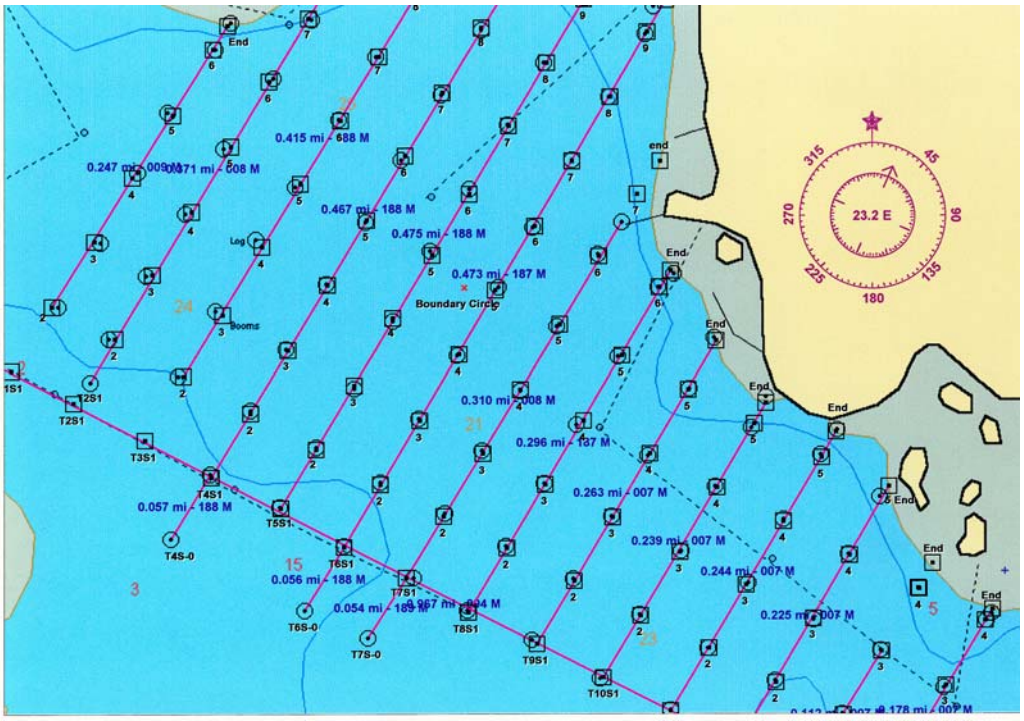


Figure 7

Evaluating both the 2002 LTF survey (fig. 7), and 2003 LSA survey present the following results:

1. The two surveys were adjacent, but the continuous coverage was not contiguous between the LTF and the LSA.
2. Combining the survey areas, results in a 165.08 acre total survey area for Thorne Bay.
3. Combining the continuous coverage results of both reports for Thorne Bay results in 20.49 acres of continuous coverage.
4. Combining the discontinuous coverage results of both reports indicates a combined total of 116.82 acres of discontinuous coverage.

It should be noted that one additional area exists in Thorne Bay that was used as a log storage area; located on the southeast side of the bay. This area has not been surveyed since 1972 and could contribute to the above figures.



The squares indicate the projected plan; the circles represent the sample point observed.

A comparison to the pre-survey plan for this report, and the "as surveyed" map indicates insignificant positional errors, and the addition and subtraction of sample points due to coverage and physical barriers. As stated earlier in the Methods section of this report, area calculations are based on the "as surveyed" map. This comparison is provided to measure contractual performance only.

The DGPS/WAAS error factor as reported by the FAA is 1-2 meters. This factor is calculated to provide an estimated percent of accuracy for the survey area. The variation of 6 feet to the X and Y coordinates of the survey, provide the following result:

6 x (X) = 10,219 square feet

6 x (Y) = 24,485 square feet

Total: 34,704 square feet.

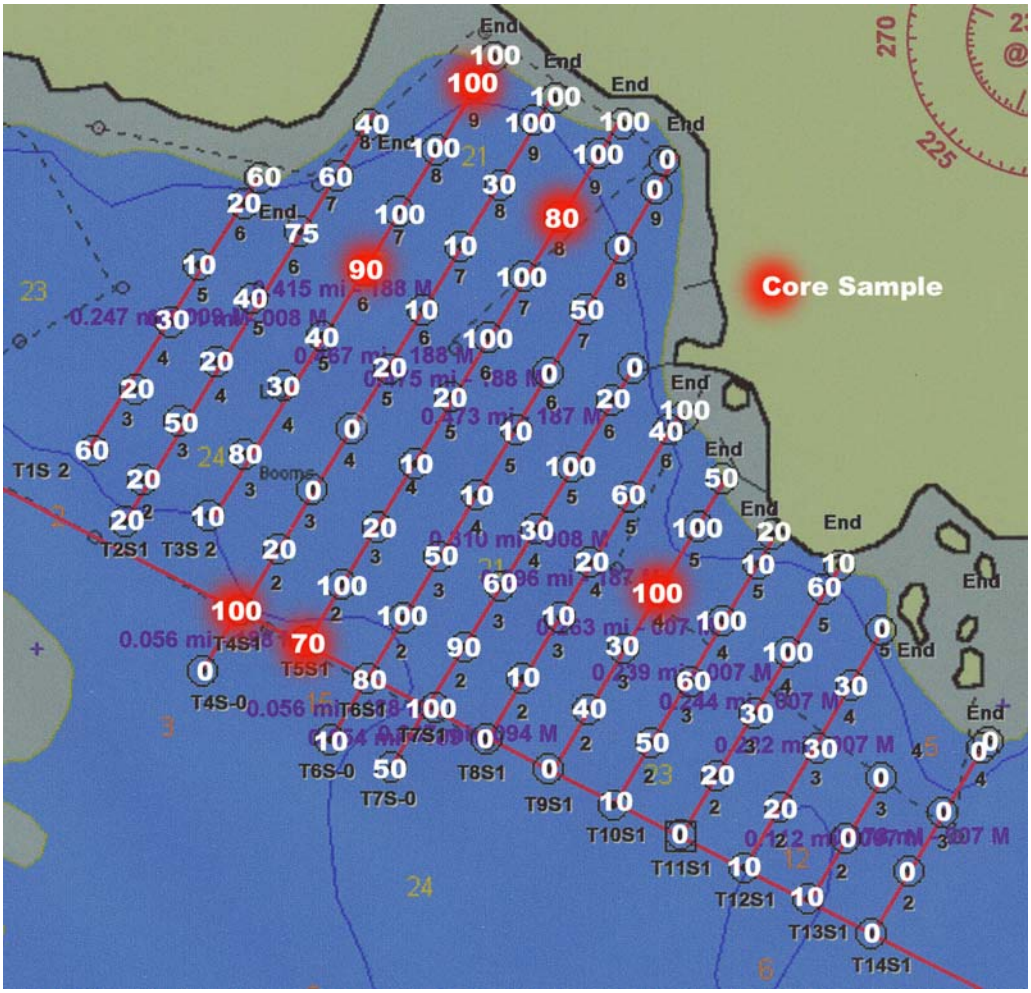
34,704 =.79 acres

0.49 x 161 acres = .79 acres

The survey may be considered 99.5% accurate with regard to the DGPS/WAAS error. This factor could result in a fluctuation of:

- 0.80 acres increase or decrease to the total survey area.
- 0.57 acres increase or decrease to the area of discontinuous coverage.
- 0.14 acres increase or decrease to the area of zero to trace coverage.
- 0.10 acres increase or decrease to the area of continuous coverage.

The relationship of continuous, discontinuous and trace coverage is more likely to be effected by the resolution of the sample point grid. The scope of this survey called for 300 foot video sample point distances; the dive survey required the standard 15 foot sample point intervals. The inconsistent nature of the coverage, and the variations to the percents of coverage over short distances, as were observed in the dive survey, would indicate that while generally sound, a conservative reliance should be applied to the stated proportions of continuous and discontinuous coverage.



This survey used standard reporting methods and included only coverage that was determined to be 10% to 90% in the reported discontinuous coverage area. Determinations of bark debris coverage over 90% are reported as continuous coverage and determinations of bark debris coverage of less than 10% are reported as zero or trace coverage.