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Field Guide For Monitoring Shoreline Change, Fortress of Louisbourg National Historical Site, Nova Scotia

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2011

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2011

doi:10.4095/289619

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It can also be downloaded free of charge from GeoPub (http://geopub.nrcan.gc.ca/).

Recommended citation:
Taylor, R.B., Frobel, D., Brown, A.O., Duggan, R., and Reeves, L., 2011. Field Guide for Monitoring Shoreline Change, Fortress of Louisbourg National Historical Site, Nova Scotia; Geological Survey of Canada, Open File 6966, 134 p. doi:10.4095/289619

Publications in this series have not been edited; they are released as submitted by the author.

ABSTRACT

This field guide is an updated version of a 1996 Shoreline Monitoring report for Fortress Louisbourg Historical Site. It is designed to assist park staff in locating specific shore sites and line markers for accurately measuring shoreline change following severe storms or during routine patrols. Location maps, sketches, photos, GPS coordinates of markers and tables are provided for examining and recording changes at each shore site. Deterioration and loss of markers at a number of shore sites during the past few years and a focus by archaeologists on newly exposed cultural resources on Rochefort Point and along Louisbourg Harbour necessitated this revision. Additional sites were added in 2011 at White Point and Battery Island. Any information collected or changes observed at any of these sites should be reported to the archaeological group at Fortress Louisbourg for inclusion in their computer data base and assessment of shoreline changes.

Front Cover: D. Frobel surveying Canadian Hydrographic Service monument 29 at Rochefort Point (Site 1539) on 6 Nov. 1997. The marker was established 5.2 m from the bank in 1938 and it had fallen over the bank by early 2009. The average rate of cliff top erosion for those seventy years was only 0.07m /year. However, toe retreat at the bank has accelerated significantly during the last ten years warning of greater bank top retreat in the future.

TABLE OF CONTENTS

INTRODUCTION

People who have lived at Fortress Louisbourg and those who work there are ever mindful of the power of the sea and changes it can inflict on the shoreline. Sea level has risen roughly 90 cm since the fortress was established and predictions of increasing sea level rise for the future have raised concerns about flooding. Staff who have been at Fortress of Louisbourg (FOL) for many years can recount several examples of dramatic shoreline changes at specific locations, but in many cases only visual estimates of retreat were available and few quantitative measurements were collected during or just after specific storm events. As part of a larger scale program to assess coastal issues at this National Historical Site a network of markers were established in December 1995, for measuring shoreline changes at 19 sites (Brown, 1996, Taylor and Brown 1996). Sites were selected from six geographic areas (Figure 1, table 1) and from specific shore segments defined along the coast (Brown, 1996, Table 1). Each monitoring site was selected as a representative example of local shore morphology (cliff or beach, rock and non- rock) and because of its proximity to cultural resources or its protective role of resources situated farther landward. Seven new sites were established in 2011 bringing the total to 26 sites (Table 1). Eighteen were shore cliff or bank sites, six were beach sites and sites 1531 and 1555 included a survey at a cliff and beach line. Each site is designated by a unique number, by shore segment, and a geographic name associated with its location. GPS coordinates listed in Table 1 are for site markers (listed) which can be used to quickly orient oneself on individual site maps and to locate other line markers.

By 2011 the sites had been re-measured from three to ten times providing valuable information on rates and types of shoreline change (Taylor and Frobel, 2000; CBCL Limited, 2010). Survey data collected at each site was compiled on excel spreadsheets and archived by the archeologists at the Fortress for incorporation into the coastal heritage management plan for FOL (Duggan, in review). The data was also archived in a national coastal monitoring database maintained by the Geological Survey of Canada, Atlantic (GSCA), Dartmouth, Nova Scotia.

The 1996 field guide and the present one are designed to assist park staff in locating shore sites, individual line markers and provide information for accurately measuring and photographing shoreline change during routine patrols or following severe storms. Methods on how to measure specific features along shore cliffs and beaches are also provided to alleviate questions raised during field surveys.

Deterioration and loss of markers at a number of sites during the past few years and a focus by archaeologists on newly exposed cultural resources necessitated this review of older sites and the addition of seven new sites 1555, 1556, 1557 to 1561 in 2011 (Figure 1, Table 1). In addition, new markers were re-established at sites where previous markers could no longer be found and at site 1533 a few survey lines were removed and a new one was added. Site 1535 was removed from the monitoring network which now includes a total 26 sites (Figure 1). Information provided for each survey site at the end of this guide includes measurements collected in March 2011 at sites within view of the reconstructed portion of the Fortress of Louisbourg and information collected from other more distant sites in late summer and fall of 2011.

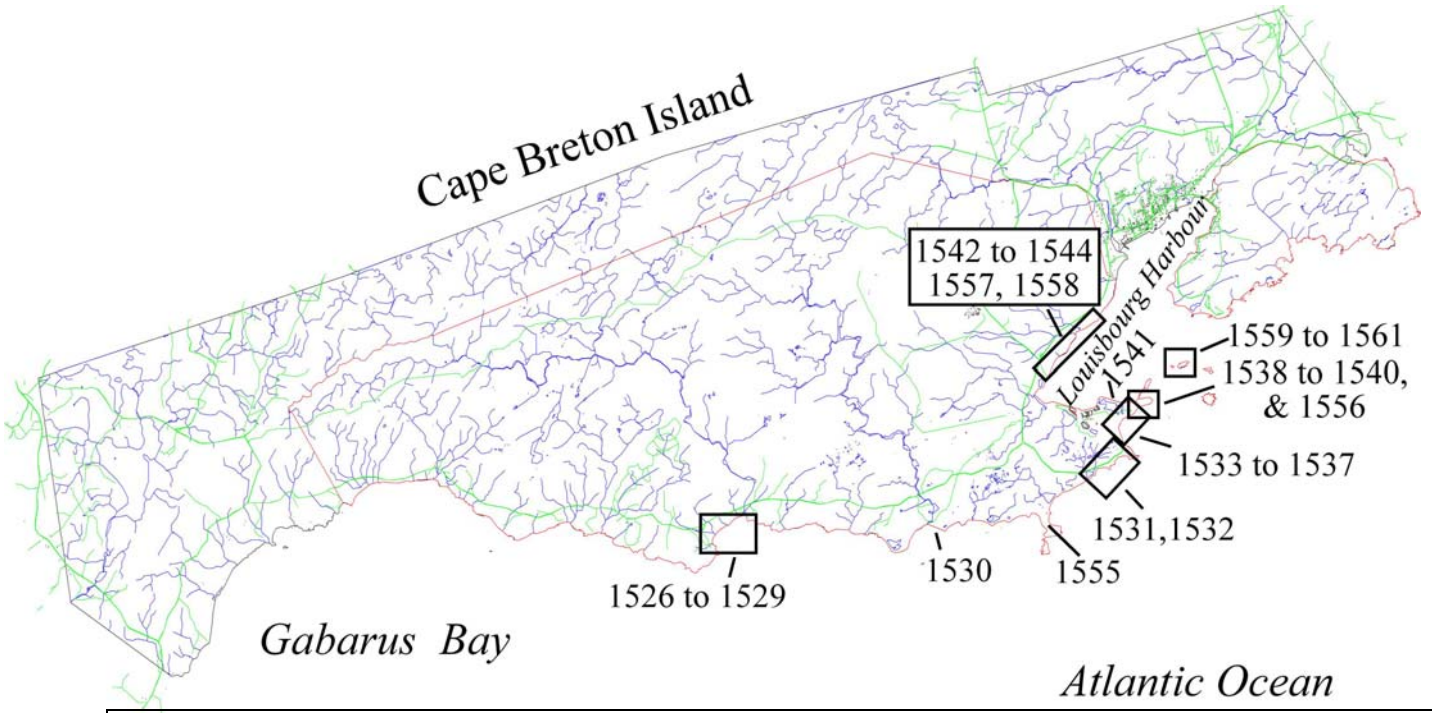


Figure 1. Location map of shoreline monitoring sites present in 2011 at Fortress of Louisbourg National Historical Site, Nova Scotia. More detailed maps and instructions for locating specific monitoring sites are provided in this report.

Table 1. SHORELINE MONITORING SITES ESTABLISHED IN LOUISBOURG NATIONAL HISTORICAL SITE, NOVA SCOTIA

Site Number	Shore Segment Number	Geographic Name	Latitude* NAD 83	Longitude* NAD 83	Easting NAD 83 Zone 20	Northing NAD 83 Zone 20	Site Marker	Date of First Survey	Date of Last Survey	No. of Surveys	No. of Survey Lines
1526	152	Kennington Cove Beach	45.87654041	-60.06153596	727998.431	5084526.316	L1 PIPE	1995	2002	3	1
1527	154	Kennington Cove Cliff	45.87964018	-60.05674426	728393.783	5084887.915	L2BM1	1995	2011	8	3
1528	156	Kennington Cove Cliff	45.87881453	-60.05441683	728541.559	5084799.352	NOTCHED BOULDER	1995	2011	8	2
1529	158	Kennington Cove Cliff	45.87875689	-60.05335333	728625.313	5084795.599	WOLFES MONUMENT	1995	2011	8	1
1530	180	Simons Point Cliff	45.87739179	-60.01727543	731465.787	5084751.920	GSC 490	1995	2011	8	5
1555	200 & 206	White Point	45.88254224	-59.994445	733238.929	5084773.215	L2 BM1 rebar	2011	2011	1	3
1531	215	Black Rock Beach and Cliff	45.88502187	-59.98364047	734043.762	5085697.807	GSC 485	1995	2011	8	2
1532	220	Black Rock Cliff	45.88672761	-59.97837204	734445.426	5085902.797	GSC 500	1995	2011	9	1
1533	223 & 224	Princess Bastion & Le Cavalier Cliff, Louisbourg Fortress	45.88900663	-59.97900017	734387.080	5086154.137	GSC 499	1995	2011	10	8
1534	225	Princess Bastion Beach, Louisbourg Fortress	45.89047308	-59.98012107	734293.953	5086313.787	GSC 498	1995	2011	9	1
1535	225	Broüillon Bastion Bank, Louisbourg Fortress	45.89163531	-59.97918423	734361.709	5086445.645	CORNER OF BASTION	1995	1998	3	2
1536	226	Rochefort Pt Monuments Bank, Louisbourg Fortress	45.8934517	-59.97699716	734523.730	5086653.877	PWC 93-7 CAP	1995	2008	8	3
1537	227	Rochefort Point Beach, Louisbourg Fortress	45.89326157	-59.97604168	734582.528	5086616.657	L1 GSC 440	1995	2011	9	3
1556	227	South Burials Bank, Rochefort Point West	45.89377193	-59.97512472	734667.639	5086694.965	L2 GSC 411	2011	2011	1	3
1538	228	Rochefort Point West Bank, Louisbourg Fortress	45.8939435	-59.97411135	734745.463	5086717.071	GSC 497	1995	2011	8	3
1539	229	Rochefort Point East Bank, Louisbourg Fortress	45.89450751	-59.97310668	734843.806	5086777.095	L1 GSC 441 and L2 PWC cap	1995	2011	7	4
1540	231	Navigation Light Bank, Rochefort Point East	45.8940212	-59.97612132	734594.579	5086702.281	GSC 443	1995	2011	7	1
1559	nd	Battery Island north end glacial till cliff	45.8989435	-59.96672339	735297.255	5087294.201	L1 BM1 rebar	2011	2011	1	1
1560	nd	Battery Island southwest end, archaeological feature	45.89927519	-59.96573553	735372.830	5087334.016	L1 BM1 rebar	2011	2011	1	1
1561	nd	Battery Island southeast end bedrock rubble	45.89932311	-59.96597014	735354.397	5087338.809	L1 BM1 rebar	2011	2011	1	1
1541	234	Grand Etang Barrier Beach, Louisbourg Fortress	45.89446282	-59.9811287	734347.816	5086708.475	East rebar	1985	2011	6-11	3-26
1557	242	Fishing Properties Cliff, Harbour N. Shore	45.89845383	-59.99356378	733214.573	5087161.014	GSC 414	2011	2011	1	2
1558	242	Fishing properties Beach, Harbour N. Shore	45.89989368	-59.99266158	733278.522	5087323.621	GSC 412	2011	2011	1	2
1542	242	Navigation markers Bank, Harbour, N. Shore	45.90171	-59.98987	733503.510	5087520.751	SWD RANGE LIGHT swd concrete pad	1995	2011	6	1
1543	245	Louisbourg Harbour Cliff, N. Shore	45.90557952	-59.98476718	733870.008	5087978.471	L1 BM1(PWC)	1995	2011	7	3
1544	246	Old Cemetery Beach, Harbour, N. Shore	45.90679189	-59.98281062	733993.993	5088132.024	L1 GSC 442	1995	2011	6	1

At each shoreline monitoring site there is a designated site marker and several other benchmarks (BM) used to identify survey lines and facilitate repetitive measurements of the distance to cliff top edge, beach crest, vegetation and sand limits or wave overwash positions. A combination of natural or man made features, wooden stakes, steel rebar, existing survey markers or newly installed GSC benchmark caps, were used as markers. Two physical markers or benchmarks, one behind the other, aligned at right angles to the general shoreline are established on each line. Benchmark 1 (BM1) is farthest landward and benchmark 2 (BM2) is closer to the ocean. If additional markers are required on a survey line, those established seaward of BM2 increase in number ie BM3, BM4, BM5.... and those established landward of BM1 decrease in number BM0, BM-1, BM-2,...etc with increasing distance from BM1 and BM2.

The geographic location of each benchmark (excl. sites 1555, 1559-1561) was obtained using high precision GPS survey equipment in real time kinematic (RTK) mode with a base station established at provincial survey marker 2094 on Black Rock. GSCA surveys have always used the Universal Transverse Mercator (UTM) grid system for geographic positioning. However, Fortress Louisbourg Historical Site (FOLHSC) is covered by two UTM zones. When a UTM grid is used it is preferred that zone 20 be used. In the vicinity of Louisbourg hand-held GPS units may default to zone 21 which will require a subsequent conversion to zone 20.

One or more survey lines were established at each site. Where more than one line was established, they were extended seaward from a baseline set up parallel to shore. The objective is to complete repetitive measurements from the same point of origin, along the same line, to the cliff top edge or beach crest to document changes in shoreline position.

Measurements can be made at any time but should be completed immediately after a major storm and at regular time intervals, ie. annually. To avoid inconsistent measurements because of difficulty in defining the edge of some cliff lines or the crest of a beach, it is recommended that the same person or persons be selected from the Fortress to conduct future measurement of the sites.

With the exception of the beaches at Kennington Cove, - (site 1526) and Grand Étang, -(site 1541), where detailed surveying is required, the markers have been set up to allow one or two persons with a minimum of equipment to quickly document shoreline position at any given time. Benchmarks were established less than 30m from the present shoreline so that errors caused by moving a measuring tape were eliminated. A known landmark, e.g Kings Bastion Tower, or a second benchmark was established on most survey lines to allow persons completing the measurements to quickly align themselves along the survey line. Where only one marker exists a compass will be required to re-establish a line. Compass bearings are magnetic so over time, corrections for magnetic declination will need to be applied. Equipment required to resurvey the sites include: a 30 m measuring tape, a hand held GPS, a compass, one or more stakes to temporarily mark locations, a clipboard, pencil, digital camera, and this manual with specific site information. If more detailed information about morphological changes is required, e.g. cliff

face changes, then more conventional or high precision GPS survey equipment will be required to complete cross-sectional profiles or plan maps of the sites. Photographs should be taken during each visit to a site. The photos should be taken from the same location each time, looking each way alongshore to illustrate shoreline change (Fig. 2). Protocols for establishing new shore cliff monitoring sites are provided at COASTWEB http://gsc.nrcan.gc.ca/coast/coastmon_e.php#site.

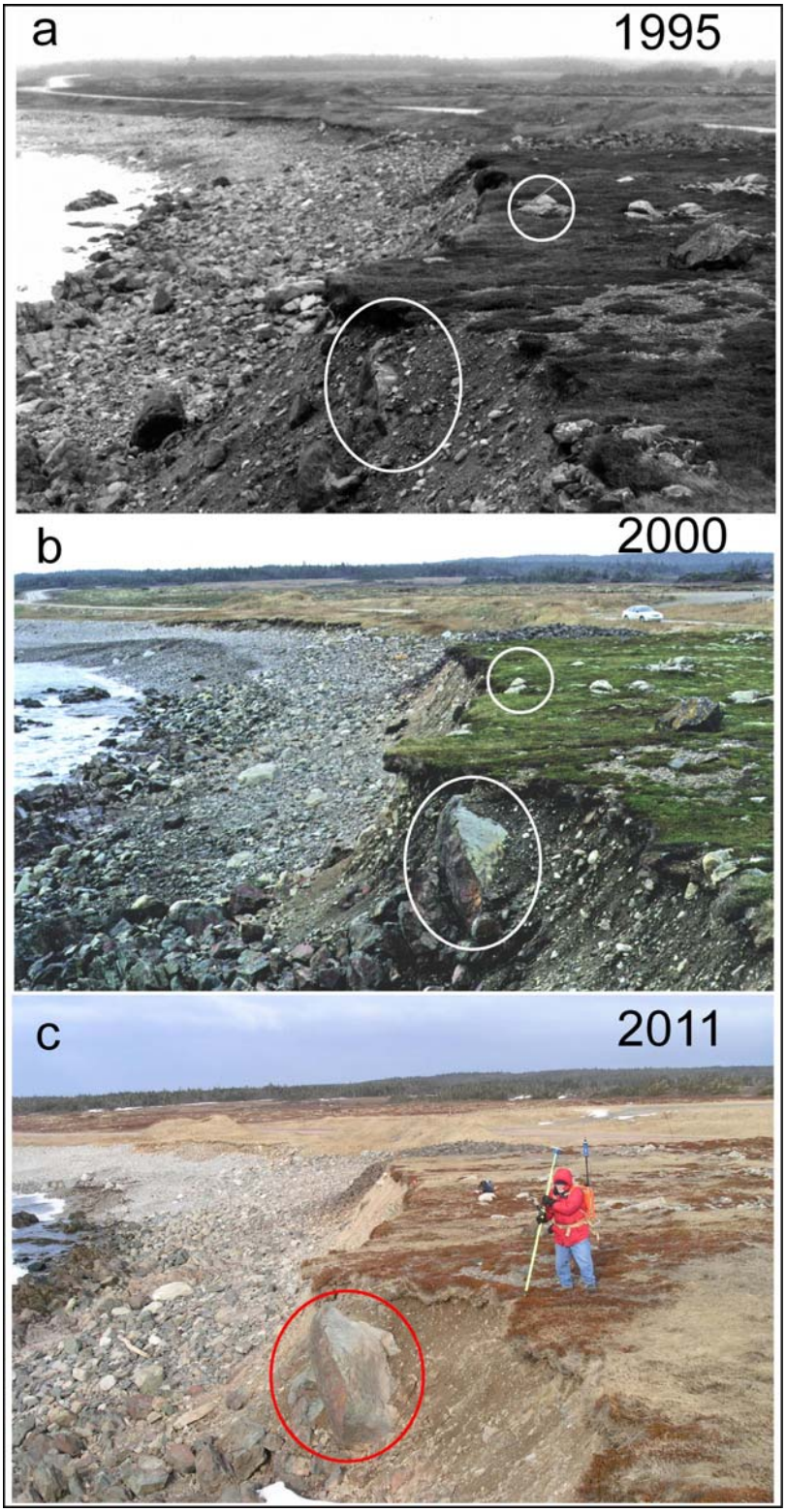


Figure 2. Repetitive photos with views looking alongshore in each direction at monitoring sites are very important in documenting shoreline changes. In this example from Black Rock, site 1532, rocks on the survey line in 1995 (circled on upper cliff) were sliding over the cliff by 2000. Cliff top retreat was 4 times higher between 1995 and 2000 than between 2000 and 2011. The photos also illustrate a large boulder (circled in foreground) which has reduced cliff top retreat over the 16 years. With increasing exposure the boulder will soon fall to the beach, accelerating cliff top retreat.

Shore Cliff and Bank Sites

Distance is measured from known line markers to the top edge of the cliff. It is also useful to measure the height of the cliff or bank from the top edge to its base. In most cases the seaward position of the cliff top is marked by a sharp eroded edge however in other cases the top edge is a rounded grass sod or vegetated slope. Where a grass sod exists, distance measurements should be extended to the cliff top location where a crack or fissure in the sod and/ or a significant break in slope occurs which denotes subsurface slope instability (Fig. 3b, c). In a few cases, the upper shore bank remained vegetated but the lower bank had been cut by waves in 2011, e.g. site 1539. It is useful to at least note the occurrence of these wave cut banks and if time permits, to measure the distance to the top edge of the cut from a known marker. The information would provide an indication whether the cut is progressing upslope over time or being infilled and healed with beach deposits. When GPS survey equipment is available it is better to survey along all or longer segments of the cliff top edge or base, noting where the individual survey lines are located.

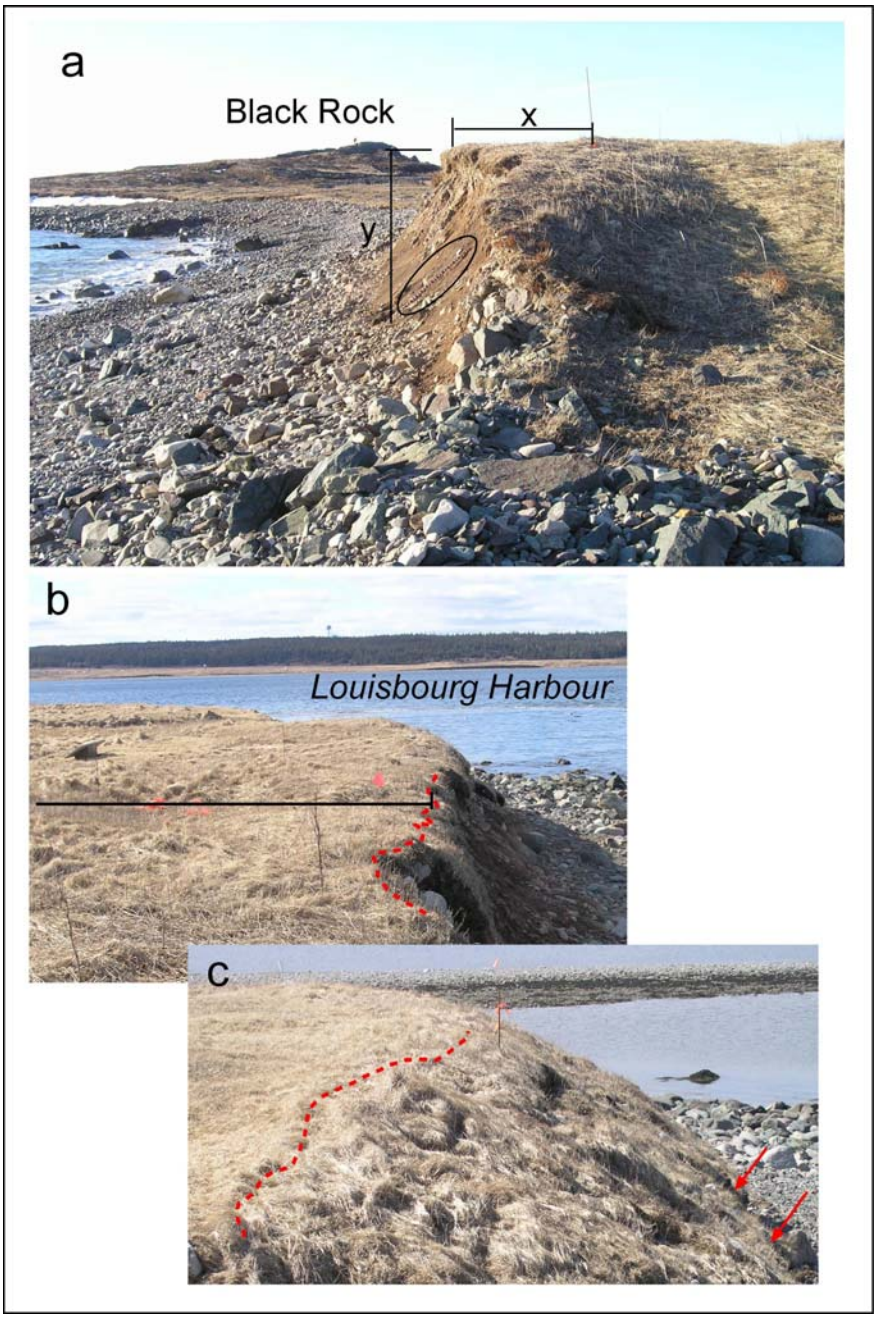
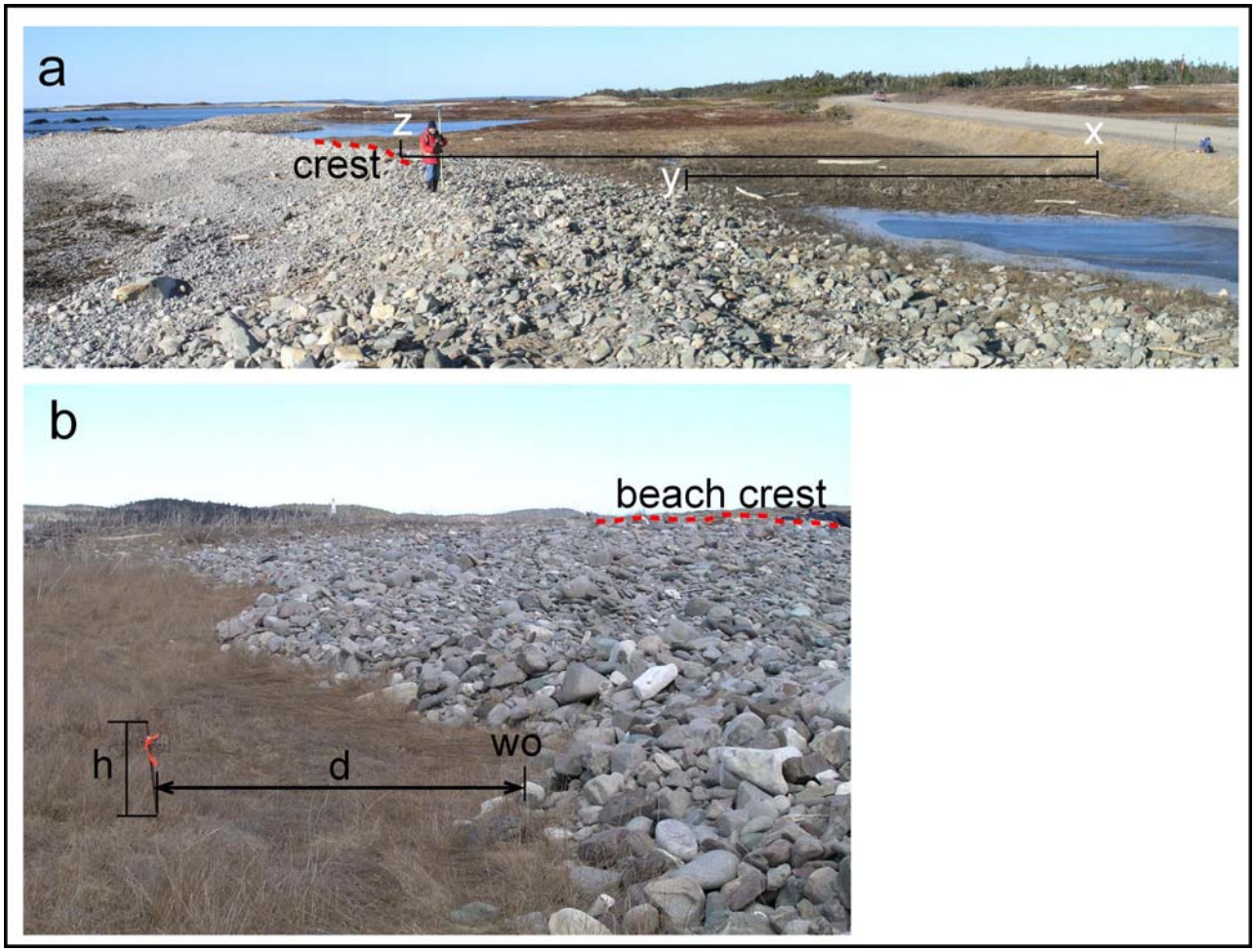


Figure 3. Measurements from line markers at shore cliff sites include (a) the distance to the cliff top edge (x) and height of the cliff face (y). A 1.5 m long graduated pole (circled) is provided for scale. Views of site1539(b and c) where the cliff top edge is more difficult to determine. The red line marks where the cliff top edge is selected based on a more distinctive break in slope or a break in the grass sod. Erosion along the cliff base (c-arrows) is also important to document in notes and photos.

Beach Sites

Distance measurements are made from known markers to the crest of gravel barrier beaches (Fig. 4a), to the landward limit of sand cover (site 1526), wave washover deposits (Fig 4) and/or debris lines deposited by wave run-up or by flooding. The beach crest is the highest elevation along a gravel barrier beach. The crest is most often a linear longshore ridge marking the interface between top edge of the foreshore and backshore slopes (red dash line -Fig 4a). However in some cases the upper barrier beach is wide and flat with no well defined crest position. In this case, distances are measured to the position where the upper barrier surface has its most distinct slope seaward (Fig. 4a, b).

Figure 4. Views of beach monitoring site 1531 (a) illustrating distance measured from the line marker (x- in this case a road culvert) to the landward edge of wave washover deposits (y) and the beach crest position (z). The beach crest is the highest portion of a pebble -cobble beach. (b) View of site 1537. The height of the line marker (h) is documented to quantify future sediment accumulation and distance (d) to the landward edge of wave washover (wo) is measured to quantify landward beach migration.



The landward edge of wave washover deposits is marked by a distinct change in sediment and /or vegetation cover. Distances should be measured to the landward base of a washover deposits (Fig. 4b). Debris lines of flotsam and seaweed mark the landward extent of wave run-up or flooding during storms. Measure the distance from known line markers to where a debris line crosses the survey line. When GPS survey equipment is available surveys can be completed along all or some of the beach crest, washover deposits or at individual flotsam debris lines.

Site Line Markers

Measurements of marker height from the ground surface to its top are routinely taken during detailed cross-shore surveys however even when detailed surveys are not possible, the height of line markers is useful to document (Fig. 4b) because it provides an indication of sediment deposition or erosion at the marker, and whether a marker has been disturbed.

SITE INFORMATION AND TABLES

The remainder of the field guide includes detailed information required for resurveying and photographing each shoreline monitoring site. Sites are organized into eight geographic areas with a common access and correspond to conservation policy units used within FOL. They include: (A) Kennington Cove, sites 1526-1529; (B) Simons Point, site 1530; (C) White Point to Black Rock; sites 1555, 1531 and 1532 (D) Black Rock to Rochefort Point, sites 1533-1537; (E) Rochefort Point, sites 1538-1540, and 1556 (F) Battery Island, sites 1559 to 1561 (G) Grand Étang barrier beach, site 1541; and (H) north shore Louisbourg Harbour, sites 1542-1544 and 1557 and 1558 (Figure 1, Table 1). A map or air photo showing the location of monitoring sites is provided for each of the eight areas. For each monitoring site there is a table describing how to reach the site and all information required to complete accurate resurveys of the lines, or if necessary, to re-establish them. Site tables contain GPS coordinates for locating all line markers, elevations, dates of previous surveys, types of markers and a history of whether markers have changed or been lost in the past. The history of line markers becomes important in identifying which markers are present. Older markers can become buried in new beach deposits and re-exposed at a later time resulting in more markers present than the maps show. Complimenting the site tables are field sketches and air photos of each site and selected photographs to assist in locating line markers and assessing shoreline changes. With each visit to a site, photographs should be taken from the same location, as shown in the manual. A comparison of photos over time (Fig. 2) will provide a visual record of shoreline changes.

Site tables were designed to summarise previous measurements and for recording new measurements in the field. The tables are EXCEL spreadsheets stored and easily updated on computers. When examining the rate of cliff top retreat on site forms it should be noted that where the first two measurements of cliff top change do not extend more than a year, the retreat rate is artificially extrapolated to an annual period and may not represent what really occurred at the site.

When compiled and analysed, the information will provide park management with quantitative measurements of short and longer term shoreline changes which will be useful in documenting the effects of storms and for managing cultural resources and important coastal infrastructure within FOL. Value of these monitoring sites will depend on whether routine surveys can be maintained by Parks Canada staff in the future.

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ACKNOWLEDGEMENTS

The authors appreciate the support and field assistance in 2011 by Parks Canada staff Michael St. Denis, Chad Magee and volunteer Natalie Gracie-Clarke. Michael St Denis also kindly provided a review of this manual.

Shore Monitoring Sites

1526 to 1529

Kennington Cove Area

Site 1526

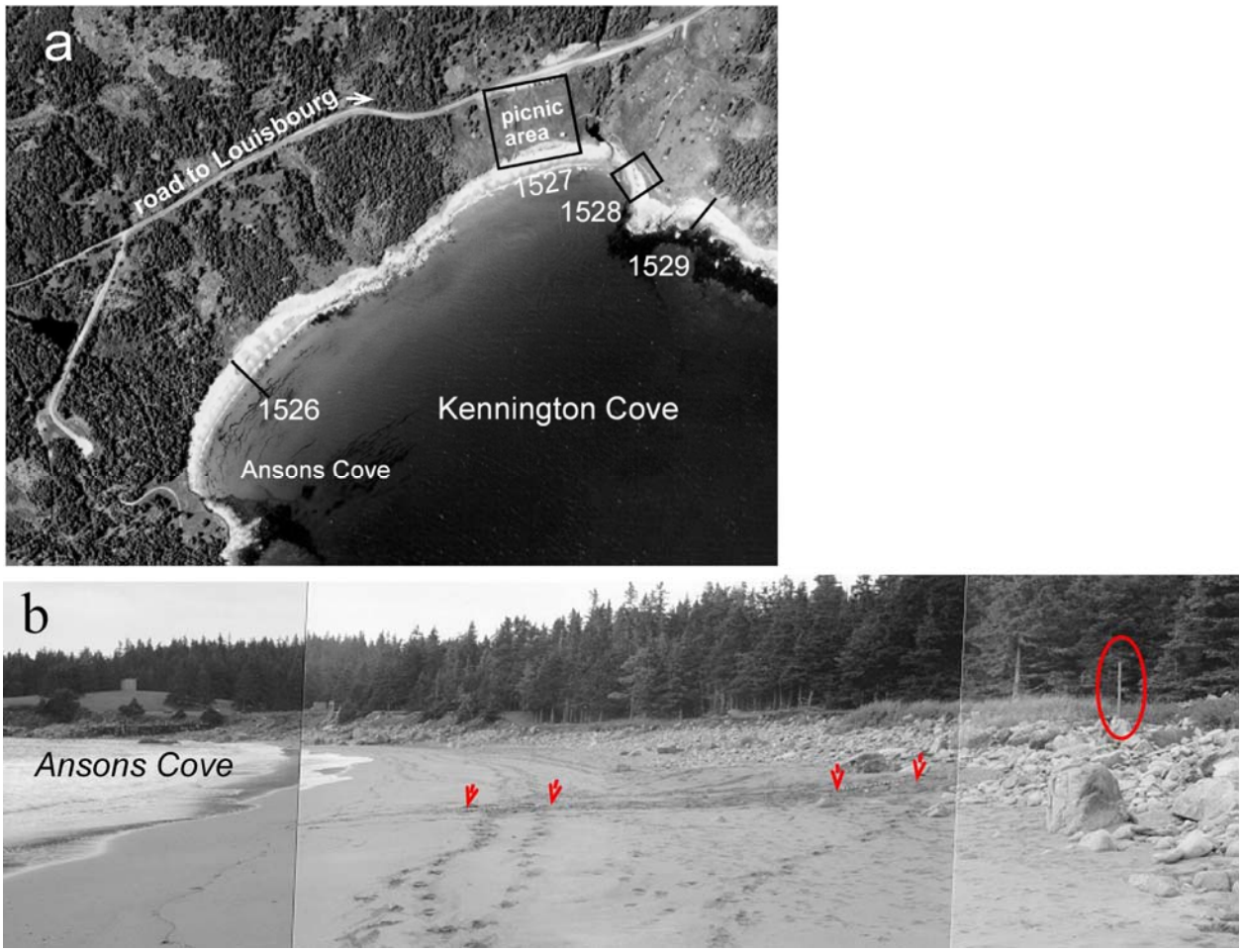


Figure 1526-1. (a) Location map and (b) photograph of beach site 1526, looking west along Ansons Cove. On the photograph the survey line is marked by footprints extending up the beach and scale is provided by two graduated rods each 1.5 m long (arrows). The survey line was marked with a metal pole at the top of the beach (circled). A detailed cross-beach survey is preferred however if equipment is not available one should note the landward extent of beach sand, the condition and height of the line marker and take photos looking each way alongshore at the survey line. Sand cover was near its maximum seasonal extent at the time of the first survey, shown here on October 2, 1995.

SITE NO.	SHORE TYPE	GEOGRAPHIC NAME	COUNTY	PROVINCE	NTS REF	HORIZ DATUM	VERTICAL DATUM
1526	BEACH	KENNINGTON COVE	CAPE BRETON	NOVA SCOTIA	11F/16	NAD 83	GEODETIC

ACCESS

From the town of Louisbourg follow the road toward the fortress and Kennington Cove. Proceed along the dirt road past the picnic area at Kennington Cove to the parking area for Ansons Cove at the end of the road. Follow the road/walking trail beyond the gate to the beach, then walk eastward along the beach to a low backshore area between the shore cliffs. The line was marked by a metal post in concrete at the top of the beach but it had broken off by 2002. Two waypoints are provided (boulder and htl) to re-establish the line

SITE INFORMATION (1998)

LINE	BM TYPE	LATITUDE°	LONGITUDE°	NORTHING°	EASTING°	ELEVATION°
1	METAL POST	45.87654041	-60.06153596	5084527.23	727999.045	3.359 m
1	High Tide Level (waypoint)			5084520.175	728010.217	0.432 m
1	Seaward edge boulder (waypoint)			5084528.898	727996.497	3.771 m

LINE NO.	GSC BM	SURVEY DATE (D/M/YR)	LINE BEARING(°)	TYPE	BM0 HEIGHT (m)	BASE ELEV.	TYPE OF SURVEY	OTHER INFO
1		2-Oct-95	147	METAL POST	1.51		EMERY	PRINTS
		25-Jun-98	147	METAL POST	1.51	3.359	RTK	PRINTS& SLIDES
		5-Jun-02		METAL POST			LEVEL	PRINTS
		4-May-05					PHOTOS ONLY	

°ELEVATIONS AND UTM AND GEOGRAPHIC COORDINATES (N83) ARE BASED ON N.S. CONTROL MONUMENT 29300 (Provisional data, N.S. Geomatics, 1998)

UTM Grid: Zone 20

LINE BEARING (DEGREES MAGNETIC)

Where only one marker exists on a line, waypoints are provided for those wishing to stakout to a line using GPS technology

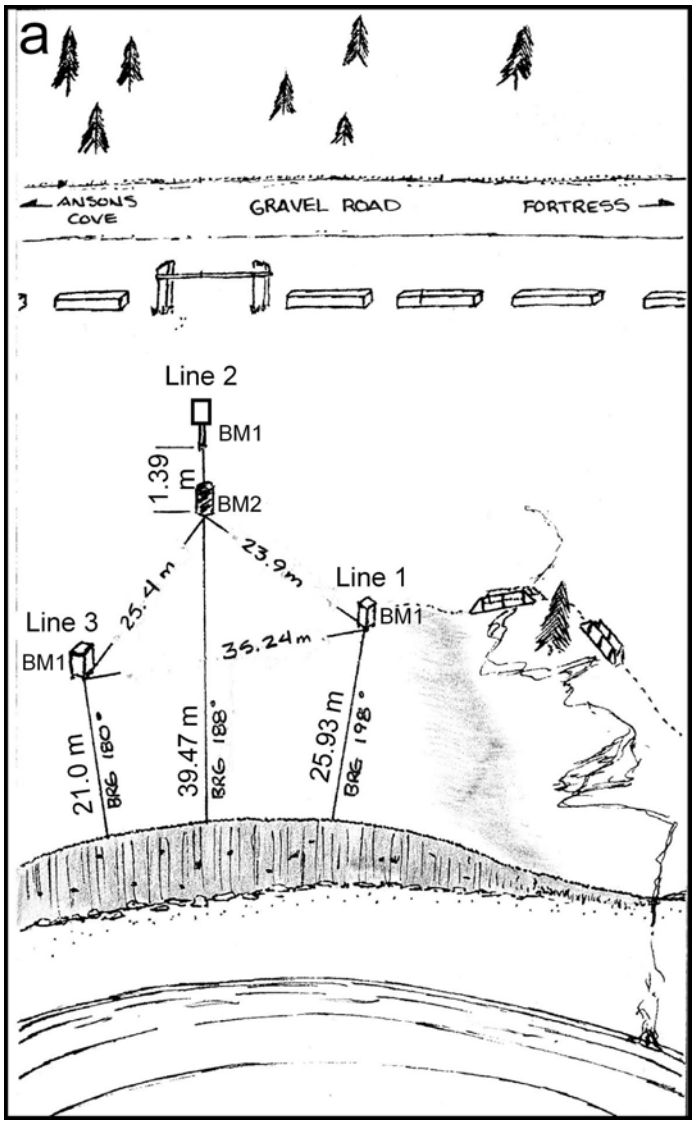
SURVEY METHOD:
RTK (REAL TIME KINEMATIC) differential GPS
EMERY (range poles and tape measure)
GEOD (total station)
LEVEL standard level and stadia rod

REFERENCE NOTEBOOKS:

2-Oct-95	CBI /95 p12
25-Jun-98	CBI /95 P88
5-Jun-02	Parks Canada
4-May-05	Parks Canada

BENCHMARK HISTORY: SITE 1526

2-Oct-95	BM0 METAL POST (OLD SIGN POST) AT TOP OF BEACH IN CONCRETE
25-Jun-98	BM0 METAL POST (OLD SIGN POST) AT TOP OF BEACH IN CONCRETE
5-Jun-02	BM0 (METAL OLD SIGN POST) AT TOP OF BEACH IN CONCRETE-BROKEN OFF ONLY A STUB REMAINS IN CONCRETE, LWD EDGE OF SAND WAS 7.2 M SWD OF BM,
4-May-05	Photos only no line survey- Parks Canada -R. Duggan



Site 1527

Figure 1527-1. (a) Sketch showing location of line markers and survey lines at Site 1527 and (b) view of cliff site 1527 from the east showing the cliff face and the extent and thickness of sand beach protecting the cliff on 21 Oct. 2011.

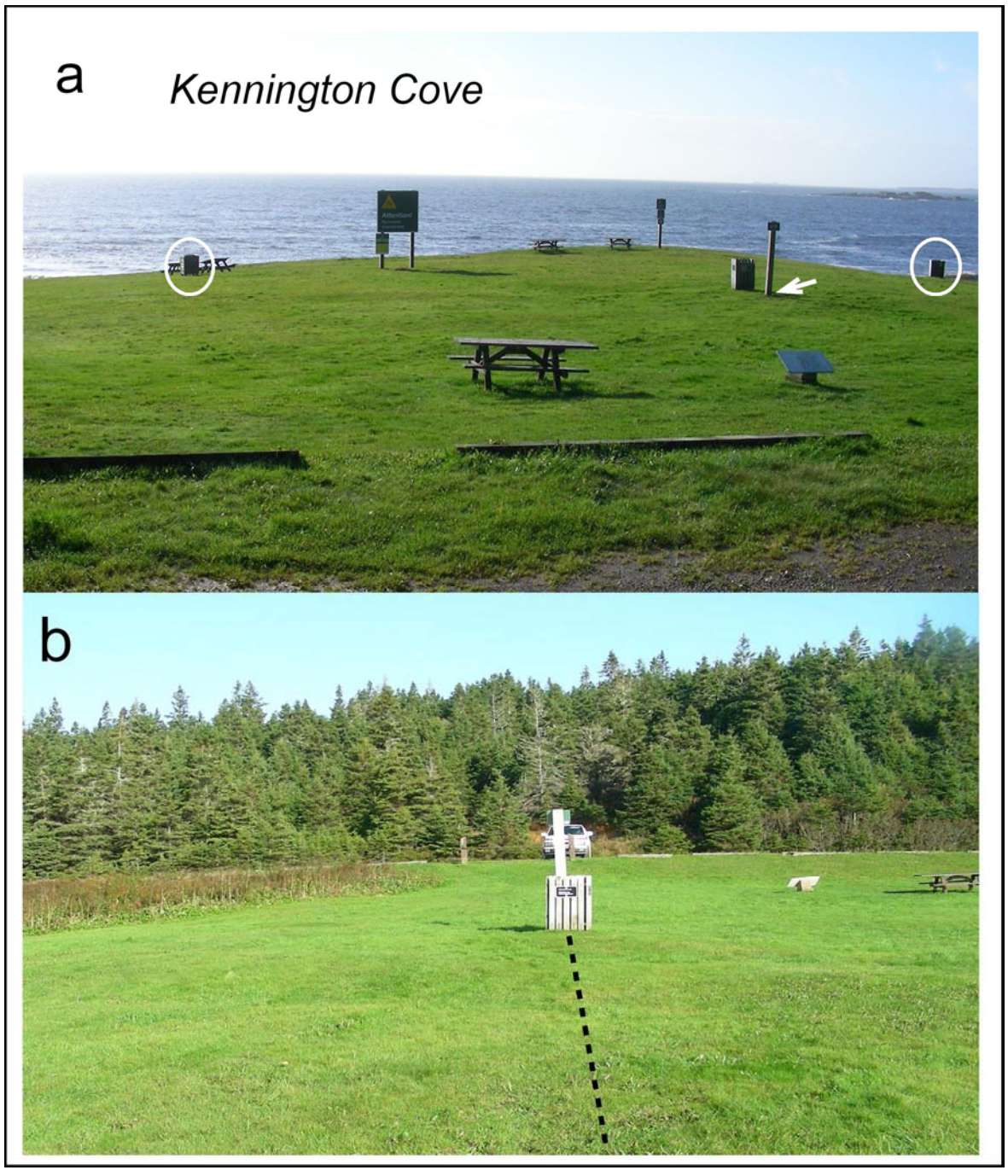


Figure 1527-2. Site 1527 (a) View from parking area at road. The two square wood frames which hold garbage containers (circled) mark lines 1 and 3 and a sign post (arrow) marks line 2. Many of the original signs had been removed including those north of the parking area by 2011, so instructions for measuring lines differ from those in the 1990s (b) view looking landward along line 2 toward BM2 the cylindrical ash container (photos 21-Oct-2011).

SITE NO.	SHORE TYPE	GEOGRAPHIC NAME	COUNTY	PROVINCE	NTS REF	HORIZ. DATUM	VERTICAL DATUM
1527	CLIFF	KENNINGTON COVE	CAPE BRETON	NOVA SCOTIA	11F/16	NAD 83	GEODETIC

ACCESS

Drive from the town of Louisbourg toward the fortress and take the dirt road to Kennington Cove.

Park at the main picnic area; the three cliff lines are immediately seaward of the parking area.

SITE INFORMATION (1998)

LINE	BM TYPE	LATITUDE°	LONGITUDE°	NORTHING*	EASTING*	ELEVATION*
1	WD FRAME	45.879526	-60.056475	5084876.865	728415.744	9.759 m
1	TOP CLIFF EDGE (waypoint)			5084850.945	728416.896	8.35 m
2	METAL CYLNDR	45.879618	-60.056756	5084886.309	728393.583	10.935 m
2	SIGN POST	45.879640	-60.056744	5084888.110	728393.197	10.950 m
3	WD FRAME	45.879415	-60.056900	5084863.367	728383.223	9.903 m
3	TOP CLIFF EDGE (waypoint)			5084843.853	728392.175	9.256 m

CLIFF TOP RECESSION SURVEYS

LINE NO.	GSC BM	SURVEY DATE (D/M/Y)	LINE BEARING(°)	NO YEARS BTW SURVEY	RETREAT (m) BTW SURVEY	TOTAL CUM NO YEARS	CUM RETREAT (m)	CUM RETREAT (m\a)	(BM TO CLIFF EDGE) BM1 TO CE	(BM TO CLIFF EDGE) BM2 TO CE	SURVEY METHOD	CLIFF / BANK ELEVATION (m)
1		6-Dec-95	198						26.25		TAPE	
		10-Jun-96	198	0.50	0.02	0.50	0.02	0.04	26.23		TAPE	
		25-Oct-96		0.38	0.18	0.88	0.20	0.23	26.05		TAPE	
		6-Nov-97	203	1.04	0.00	1.92	0.20	0.10	26.05		TAPE	
		25-Jun-98		0.63	*0.12*	2.55	0.32	0.13	*25.93*		RTK	8.35
		22-Nov-00	198	2.41	-0.12	4.96	0.20	0.04	26.05		TAPE	
		5-Jun-02		1.54	0.12	6.50	0.32	0.05	25.93		TAPE	
		4-May-05		2.91	-0.05	9.41	0.27	0.03	25.98		TAPE	
		3-Nov-11	198	6.50	0.05	15.91	0.32	0.02	25.93		TAPE	
2		6-Dec-95	188						42.13	40.15	TAPE	
		10-Jun-96	188	0.50	0.15	0.50	0.15	0.30	*41.98*	40.00	TAPE	
		25-Oct-96	188	0.38	0.00	0.88	0.15	0.17	*41.98*	40.00	TAPE	
		6-Nov-97	188	1.04	0.05	1.92	0.20	0.10		39.95	TAPE	
		25-Jun-98		0.63	*0.26*	2.55	0.46	0.18	*41.53*	*39.69*	RTK	9.30
		22-Nov-00	188	2.41	-0.04	4.96	0.42	0.08		39.73	TAPE	
		5-Jun-02		1.54	0.13	6.50	0.55	0.08		39.60	TAPE	
		4-May-05		2.91	0.10	9.41	0.65	0.07		39.50	TAPE	
		3-Nov-11	188	6.5	0.03	15.91	0.68	0.04		39.47	TAPE	

SITE 1527 continued

LINE NO.	GSC BM	SURVEY DATE (D/M/Y)	LINE BEARING(°)	NO YEARS BTW SURVEY	RETREAT (m) BTW SURVEY	TOTAL CUM NO YEARS	CUM RETREAT (m)	CUM RETREAT (m\a)	CLIFF TOP RECESSION SURVEYS (BM TO CLIFF EDGE) BM1 TO CE	BM2 TO CE	SURVEY METHOD	CLIFF / BANK ELEVATION (m)
3		6-Dec-95	180						21.70		TAPE	
		10-Jun-96	180	0.50	0.10	0.50	0.10	0.20	21.60		TAPE	
		25-Oct-96		0.38	0.00	0.88	0.10	0.11	21.60		TAPE	
		6-Nov-97	180°	1.04	0.00	1.92	0.10	0.05	21.65		TAPE	
		25-Jun-98		0.63	*0.19*	2.55	0.29	0.11	*21.46*		RTK	9.25
		22-Nov-00	180	2.41	-0.14	4.96	0.15	0.03	21.6		TAPE	
		5-Jun-02		1.54	-0.08	6.50	0.07	0.01	21.68		TAPE	
		4-May-05		2.91	0.00	9.41	0.07	0.01	21.68		TAPE	
		3-Nov-11	180	*6.5*	0.68	15.91	0.75	0.05	21.00		TAPE	

*ELEVATIONS AND UTM AND GEOGRAPHIC COORDINATES (N83) ARE BASED ON N.S. CONTROL MONUMENT 29300 (Provisional data, N.S. Geomatics, 1998) UTM Grid: Zone 20

LINE BEARING (DEGREES MAGNETIC)

Where only one marker exists on a line, a waypoint is provided for those wishing to stakout to a line using GPS technology

REFERENCE NOTEBOOKS:

6-Dec-95	OWEN BROWN NOTES
10-Jun-96	INFO ON FORMS
25-Oct-96	INFO ON FORMS
6-Nov-97	RTK; CBI / 95, P 73
25-Jun-98	RTK; CBI / 95, P 87
22-Nov-00	CBI 98/1 P37
5-Jun-02	R. DUGGAN / B. CUNNINGHAM (PARKS CANADA)
4-May-05	R. DUGGAN (PARKS CANADA)
3-Nov-11	L.REEVES (PARKS CANADA)

DISTANCE BETWEEN LINES:

LINE #1-2:	23.9 m
LINE #2-3:	25.4 m
LINE #1-3:	35.24 m

SURVEY METHOD:

RTK (REAL TIME KINEMATIC): differential GPS

TAPE: tape measure

BENCH MARK HISTORY: SITE 1527

LINE 1:

6-Dec-95	BM1 (SWD CORNER WOOD FRAME OF GARBAGE CONTAINER) ORIGINALLY ALIGNED WITH MIDDLE SUPPORT POST OF LARGE SIGN (REMOVED BY 2011) ON LWD SIDE OF ROAD.
	NOTE: MEASUREMENTS ARE TAKEN FROM OUTSIDE CORNER OF 4 X 4 POST ANCHORING GARBAGE CONTAINER WTIH GROUND.
10-Jun-96	BM1 & SIGN INTACT
25-Oct-96	BM1 AND SIGN INTACT
6-Nov-97	BM1 AND SIGN INTACT, SURVEY PIN LEFT AT CLF TOP
25-Jun-98	BM1 AND SIGN INTACT AS WELL AS PIN AT CLF TOP
22-Nov-00	BM1 AND SIGN INTACT- DID NOT SEE THE PIN
5-Jun-02	BM1 INTACT
4-May-05	Bm intact measurements by R. Duggan
3-Nov-11	BM1 (Container) intact -Large sign north of road gone

BENCH MARKS PRESENTLY INTACT: BM1 (WOOD FRAME) GARBAGE CONTAINER

LINE 2:

6-Dec-95	BM1 (SIGN POST) 1.39 m lwd of BM2 (SWD EDGE CORREGATED METAL CYLINDER (ASH CONTAINER))
	BM1 & BM2 WERE ORIGINALLY ALIGNED WITH A WATER TAP/SIGN (REMOVED BY 2011) ON LWD SIDE OF ROAD.
10-Jun-96	BM1, BM2 & WATER SUPPLY SIGN INTACT
25-Oct-96	BM1, BM2 & WATER SUPPLY SIGN INTACT
6-Nov-97	BM1, BM2 & WATER SUPPLY SIGN INTACT; SURVEY PIN AT CLF TOP; GPS SURVEY POINT OBTAINED AT ONE POINT
25-Jun-98	BM1,BM2 & WATER SUPPLY SIGN INTACT AS WELL AS PIN LEFT AT CLF TOP EDGE
22-Nov-00	BM1,BM2 & WATER SUPPLY SIGN INTACT-DID NOT SEE PIN
5-Jun-02	WATER TAP SIGN ON LWD SIDE ROAD REMOVED
4-May-05	BM INTACT Survey by R Duggan
3-Nov-11	BM1 (new sign) 1.39m landward of BM2 (Container) INTACT

BENCH MARKS PRESENTLY INTACT: BM1 (SIGN POST) AND BM2 (METAL CYLINDER)

LINE 3:

6-Dec-95	BM1 (SWD CORNER OF WOOD FRAME OF GARBAGE CONTAINER).
	MEASUREMENTS ARE TAKEN FROM OUTSIDE CORNER OF 4 X 4 POST ANCHORING GARBAGE CONTAINER TO GROUND.
10-Jun-96	BM1 INTACT
25-Oct-96	BM1 INTACT
6-Nov-97	BM1 INTACT; SURVEY PIN LEFT AT CLF TOP
25-Jun-98	BM1 INTACT AND PIN AT CLF TOP EDGE
22-Nov-00	BM1 INTACT -DID NOT SEE PIN
5-Jun-02	BM1 INTACT
4-May-05	BM INTACT survey by R Duggan
3-Nov-11	BM1 (container) intact

BENCH MARKS PRESENTLY INTACT: BM1 (WOOD FRAME) GARBAGE CONTAINER

Site 1528

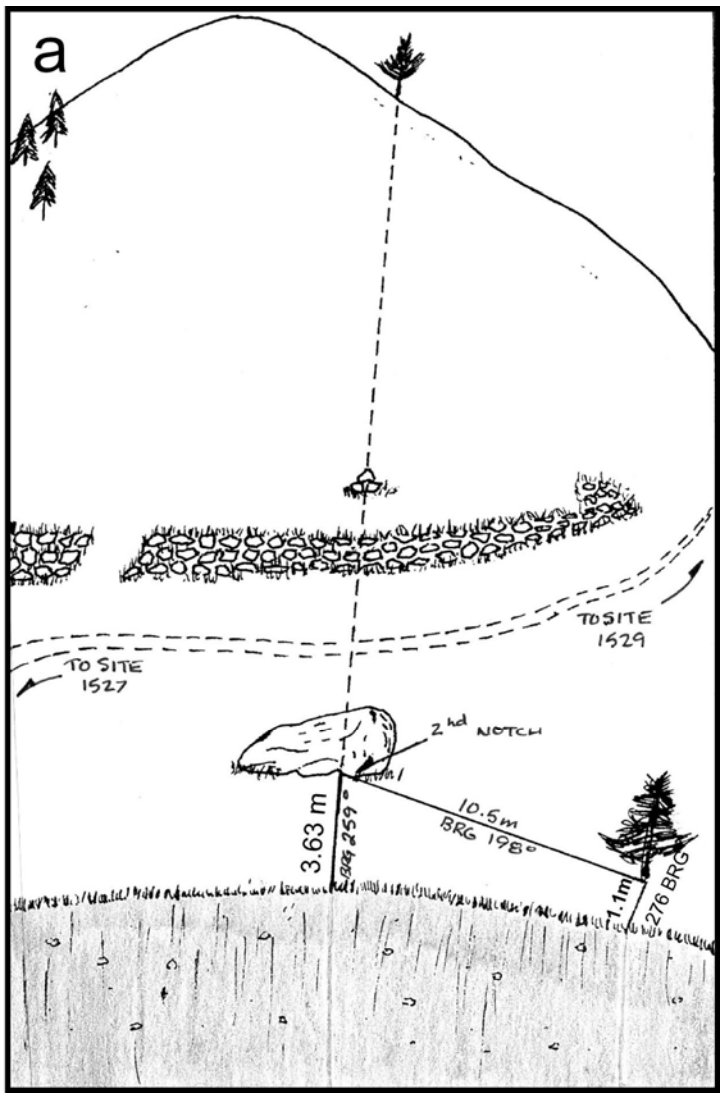


Figure 1528-1. (a) Sketch of survey line locations at Site 1528 and (b) View of Site 1528 from site 1527, showing, the path (dash line) and band of boulders (red arrows) landward of the cliff, the lone tree (circled) at the crest of the hill (line 1) and the tree marking line 2 (arrow). Site 1529 can be reached by following the path along the coast farther around the cliff to the east (photo 25 June 1998).

SITE NO.	SHORE TYPE	GEOGRAPHIC NAME	COUNTY	PROVINCE	NTS REF	HORIZ DATUM	VERT DATUM
1528	CLIFF	KENNINGTON COVE	CAPE BRETON	NOVA SCOTIA	11F/16	NAD 83 ZONE 20	GEODETIC

ACCESS

Drive from the town of Louisbourg toward the fortress and take the dirt road to Kennington Cove. Park at the main picnic area and follow a path that leads from the picnic area across two bridges toward the shore cliff on the southeast side of the cove and the monument erected in 1937 commemorating General Wolfe's landing (Site 1529). Look out for a line of boulders; line 1 is marked by a lone boulder swd of the line of boulders, and line 2 is marked by a lone fir tree at the crest of the shore cliff. Line 1 (Lone boulder) is 50 double paces from the beginning of the decking of the 2nd bridge on the foot path.

SITE INFORMATION (1998)

LINE	BM TYPE	LATITUDE°	LONGITUDE°	NORTHING*	EASTING*	ELEVATION*
1	BOULDER	45.878815	-60.054417	5084799.352	728541.559	8.285 m
1	Top cliff edge (waypoint)			5084798.906	728538.914	9.047 m
2	TREE	45.878704	-60.054881	5084789.202	728542.235	9.554 m
2	Top Cliff Edge (waypoint)			5084789.668	728541.972	9.904 m

CLIFF TOP RECESSION SURVEYS

LINE NO.	GSC BM	SURVEY DATE (D/M/Y)	LINE BEARING (°)	NO YEARS BTW SURVEY	RETREAT (m) BTW SURVEY	TOTAL CUM NO YEARS	CUM RETREAT (m)	CUM RETREAT (m\a)	(BM TO CLIFF EDGE) BM1 TO CE	(BM TO CLIFF EDGE) BM2 TO CE	SURVEY METHOD	CLIFF/BANK ELEVATION (m)
1		6-Dec-95	259						3.70		TAPE	
		10-Jun-96	259	0.50	0.00	0.50	0.00	0.00	3.70		TAPE	
		25-Oct-96		0.38	0.00	0.88	0.00	0.00	3.70		TAPE	
		6-Nov-97		1.04	0.00	1.92	0.00	0.00	3.70		TAPE	
		25-Jun-98		0.63	-0.03	2.55	-0.03	-0.01	*3.73*		TAPE/RTK	9.05
		22-Nov-00		2.41	0.08	4.96	0.05	0.01	3.65		TAPE	
		5-Jun-02		1.54	-0.07	6.50	-0.02	0.00	3.72		TAPE	
		4-May-05		2.91	-0.01	9.41	-0.03	0.00	3.73		TAPE	
		3-Nov-11	259	6.5	0.10	15.91	0.07	0.00	3.63		TAPE	
2		6-Dec-95	276						1.20		TAPE	
		10-Jun-96	276	0.50	0.03	0.50	0.03	0.06	1.17		TAPE	
		25-Oct-96		0.38	-0.03	0.88	0.00	0.00	1.20		TAPE	
		6-Nov-97		1.04	0.00	1.92	0.00	0.00	1.20		TAPE	
		25-Jun-98		0.63	-0.05	2.55	-0.05	-0.02	*1.25*		TAPE/RTK	9.90
		22-Nov-00		2.41	0.15	4.96	0.10	0.02	1.10		TAPE	
		3-Nov-11		10.96	0.00	15.92	0.10	0.01	1.10		TAPE	

*ELEVATIONS AND UTM AND GEOGRAPHIC COORDINATES (N83) ARE BASED ON N.S. CONTROL MONUMENT 29300 (Provisional data, N.S. Geomatics, 1998) UTM Grid: Zone 20

LINE BEARING (DEGREES MAGNETIC)

Where only one marker exists on a line, a waypoint is provided for those wishing to stakout to a line using GPS technology

REFERENCE NOTEBOOKS:

6-Dec-95	OWEN BROWN NOTES
10-Jun-96	INFO ON FORMS
25-Oct-96	INFO ON FORMS
6-Nov-97	CBI / 95 P 73.
25-Jun-98	CBI/95 P85
22-Nov-00	CBI 98/1 P37
5-Jun-02	R. DUGGAN / B. CUNNINGHAM (PARKS CANADA)
5-May-05	R. DUGGAN (PARKS CANADA)
3-Nov-11	L. REEVES (PARKS CANADA)

DISTANCE BETWEEN LINES:

LINE 1 to 2 10.5 m (TAPED)

SURVEY METHOD: RTK (REAL TIME KINEMATIC) differential GPS

TAPE: tape measure

BENCH MARK HISTORY: SITE 1528

LINE 1:

6-Dec-95 BM1 (BOULDER) ALIGNED WITH CAIRN OF 3 ROCKS NEAR BASE HILL AND LONE TREE AT CREST HILL
MEASUREMENTS TAKEN FROM 2ND NOTCH ON LONE BOULDER (REFER TO DIAGRAM). NOTCH BECOMES QUITE DISTINCT WHEN VEGETATION IS CLEARED AWAY .

10-Jun-96 BM1, ROCK CAIRN AND LONE TREE INTACT

25-Oct-96 BM1, ROCK CAIRN AND LONE TREE INTACT

6-Nov-97 BM1, ROCK CAIRN AND LONE TREE INTACT

25-Jun-98 BM1. ROCK CAIRN AND LONE TREE INTACT; SURVEYED BASE CLF; ALIGNMENT TO NS CONTROL BM 29300 IS 261 DEG.; RTK BOULDER TO CE=3.531

22-Nov-00 BM1. ROCK AND LONE TREE INTACT, CAIRN REBUILT;

5-Jun-02 BM1 ROCK AND LONE TREE INTACT

4-May-05 BM1 intact

3-Nov-11 BM1 intact

BENCH MARKS PRESENTLY INTACT: ROCK

LINE 2

6-Dec-95 BM1 (LONE TREE) LOCATED 10.0 M FROM 2nd NOTCH ON LONE BOULDER (BM1 Line 1), ON A LINE BRG 198°.

10-Jun-96 BM1 AND BOULDER INTACT

25-Oct-96 BM1 INTACT BUT HARD TO MEASURE ACCURATELY FROM TRUNK TO CE BECAUSE OF BRANCHES

6-Nov-97 BM1 INTACT NO CHANGE

25-Jun-98 BM1 INTACT NO CHANGE; SURVEYED BASE OF CLF; RTK TREE TO CE =0.985

22-Nov-00 BM1 INTACT; HARD TO MEASURE FROM TREE

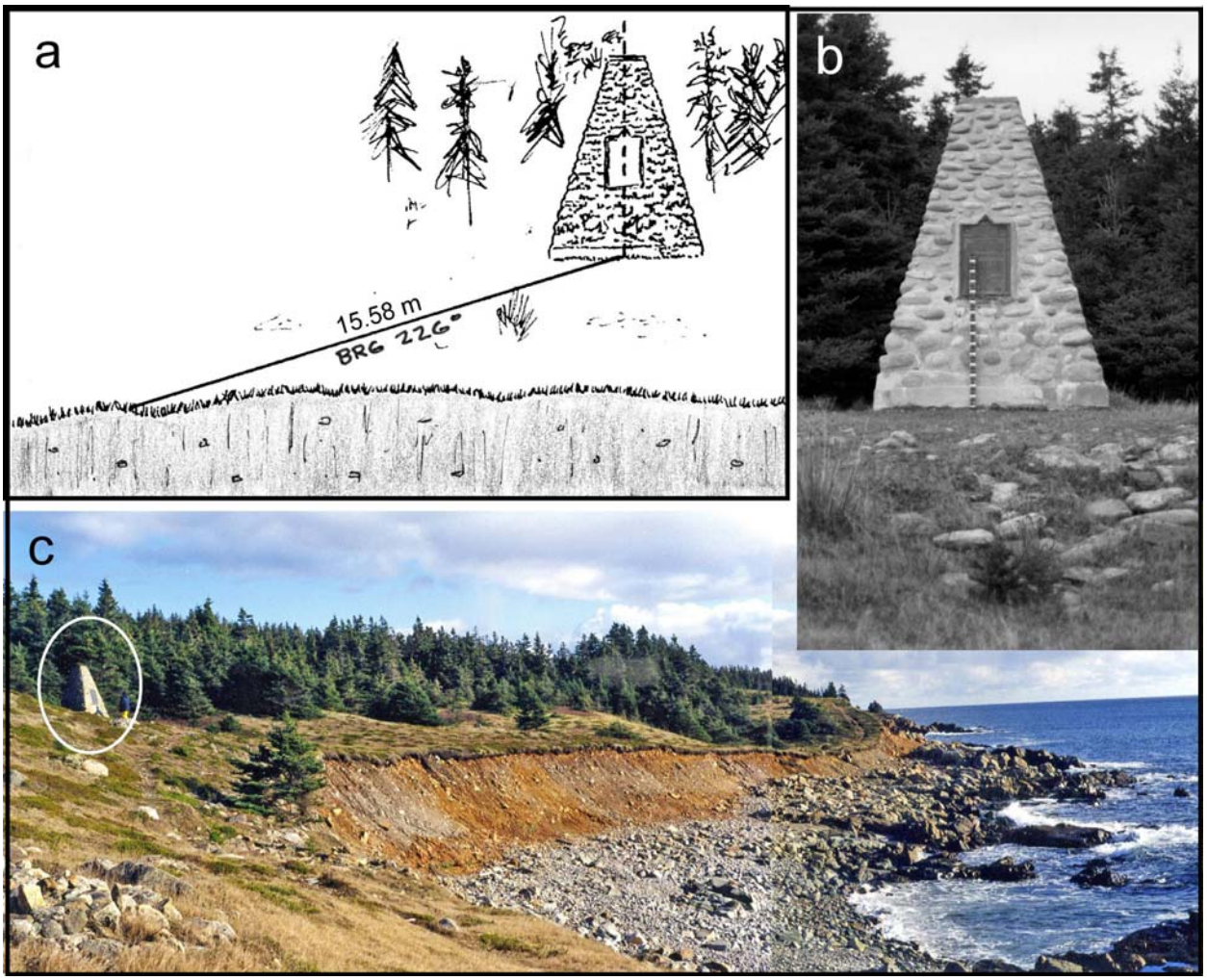
5-Jun-02 Tree still intact but no measurement taken

3-Nov-11 Tree still in tact 1.1M FROM CE

BENCH MARKS PRESENTLY INTACT: TREE

Site 1529

Figure 1529-1. Site 1529 is marked by a historic monument erected in 1937 to mark the landing site of troops led by General Wolf during the siege of Louisbourg. (a, b) Distance to cliff top is measured from the base of the monument immediately below the point marking the top of the plaque. (c) Example of a longshore view of Site 1529 on 22 Nov. 2000. Photos taken both directions alongshore during each visit provide a reference for detecting shoreline changes adjacent to the monument (circled with a person for scale).



SITE NO.	SHORE TYPE	GEOGRAPHIC NAME	COUNTY	PROVINCE	NTS REF	HORIZ DATUM	VERTICAL DATUM
1529	CLIFF	KENNINGTON COVE	CAPE BRETON	NOVA SCOTIA	11F/16	NAD 83	GEODETIC

ACCESS

Drive from the town of Louisbourg toward the fortress and take the dirt road to Kennington Cove. Park at the main picnic area and follow the path that leads from the picnic area across a bridge toward the shore cliff on the southeast side of the cove. Follow the walking path along the top of the cliff until you reach the historic monument about the landing of General Wolf.

SITE INFORMATION (1998)

LINE	BM TYPE	LATITUDE°	LONGITUDE°	NORTHING*	EASTING*	ELEVATION*
1	MONUMENT (mid swd base)	45.87875689	-60.05335333	5084796.513	728625.927	10.34 m
1	Top Cliff Edge (waypoint)			5084781.089	728620.57	8.05 m

CLIFF TOP RECESSION SURVEYS

LINE NO.	GSC BM	SURVEY DATE (D/M/Y)	LINE BEARING(°)	NO YEARS BTW SURVEY	RETREAT (m) BTW SURVEY	TOTAL CUM NO YEARS	CUM RETREAT (m)	CUM RETREAT (m\a)	BM TO CLIFF EDGE (m) BM1 TO CE	BM2 TO CE	BM3 TO CE	SURVEY METHOD	CLIFF/BANK ELEVATION (m)
1		2-Oct-95	226						16.94			TAPE	
		10-Jun-96	226	0.75	0.09	0.75	0.09	0.12	16.85			TAPE	
		25-Oct-96		0.38	0.00	1.13	0.09	0.08	16.85			TAPE	
		6-Nov-97	226°	1.04	0.00	2.17	0.09	0.04	16.85			TAPE	
		25-Jun-98	226	0.63	0.30	2.80	0.39	0.14	16.55			RTK/TAPE	8.05
		22-Nov-00	226	2.41	0.25	5.21	0.64	0.12	16.30			TAPE	
		5-Jun-02	226	1.54	0.10	6.75	0.74	0.11	16.20			TAPE	
		4-May-05	226	2.91	0.00	9.66	0.74	0.08	16.20			TAPE	
		3-Nov-11	226	6.50	0.62	16.16	1.36	0.08	15.58			TAPE	

ELEVATIONS AND UTM AND GEOGRAPHIC COORDINATES (N83) ARE BASED ON N.S. CONTROL MONUMENT 29300 (Provisional data, N.S. Geomatics, 1998) UTM Grid: Zone 20

LINE BEARING (DEGREES MAGNETIC)

Where only one marker exists on a line, a waypoint is provided for those wishing to stakout to a line using GPS technology

REFERENCE NOTEBOOKS:

2-Oct-95	CBI /95 P13	5-Jun-02	R DUGGAN / B CUNNINGHAM (PARKS CANADA)
10-Jun-96	INFO ON FORMS	4-May-05	R DUGGAN (PARKS CANADA)
25-Oct-95	INFO ON FORMS	3-Nov-11	L. REEVES (PARKS CANADA)
6-Nov-97	CBI / 95 P 85		
25-Jun-98	CBI / 95 P 75		
22-Nov-00	CB1 98/1 P37		

BENCH MARK HISTORY: SITE 1529

LINE 1

2-Oct-95 BM1 (HISTORIC MONUMENT) MEASUREMENT TAKEN FROM THE BASE OF THE MONUMENT IMMEDIATELY BELOW THE POINT IN THE TOP OF THE PLAQUE TO THE CLIFF EDGE.

10-Jun-96 BM1 INTACT

25-Oct-96 BM1 INTACT

25-Jun-98 BM1 INTACT; FRESH SLIDES AT BASE CLIFF AND SOME SOD BROKEN OFF SEE PHOTOS RTK SURVEY OF LINE; RTK dist base mon to top clf edge = 16.325

22-Nov-00 BM1 INTACT; TRUNCATED AT BASE CLIFF FACE; MORE BEDROCK EXPOSED

5-Jun-02 BM1 INTACT;

4-May-05 BM1 INTACT: NO APPARENT CHANGE

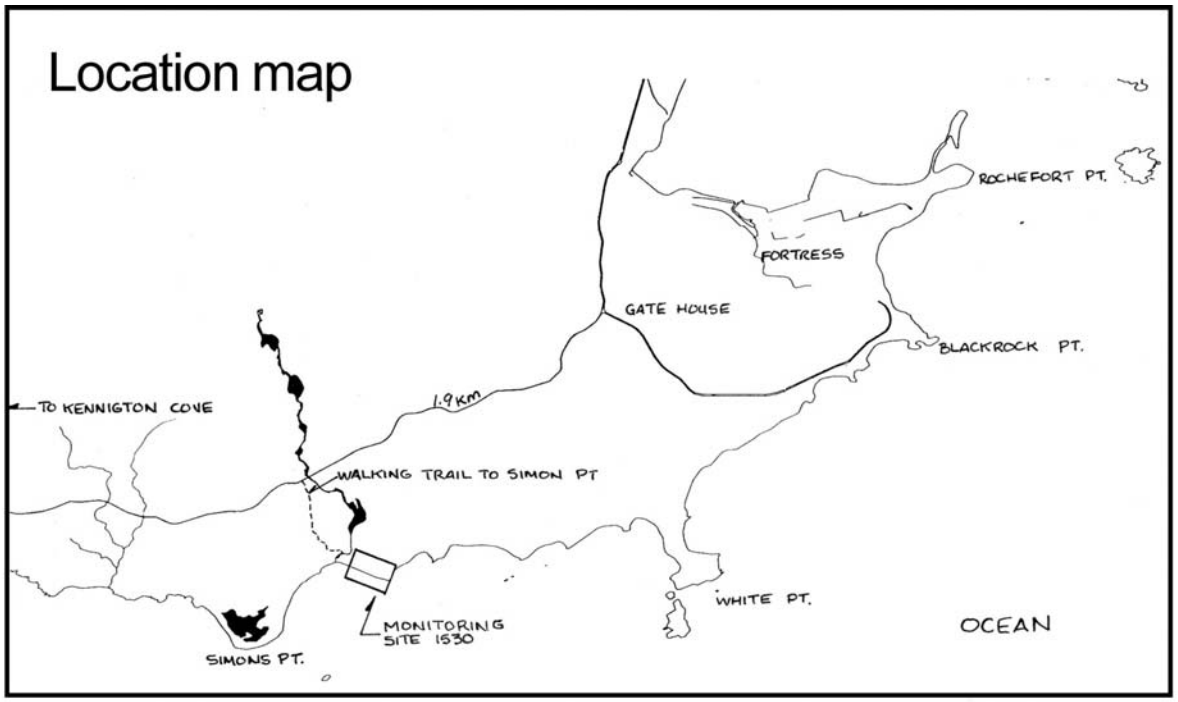
3-Nov-11 BM1 intact -tree regeneration obscuring line of sight from monument to cliff top edge

Shore Monitoring Site

1530

Simons Point

Figure 1530-1. Location map and sketch of markers at Simons Point Site 1530.



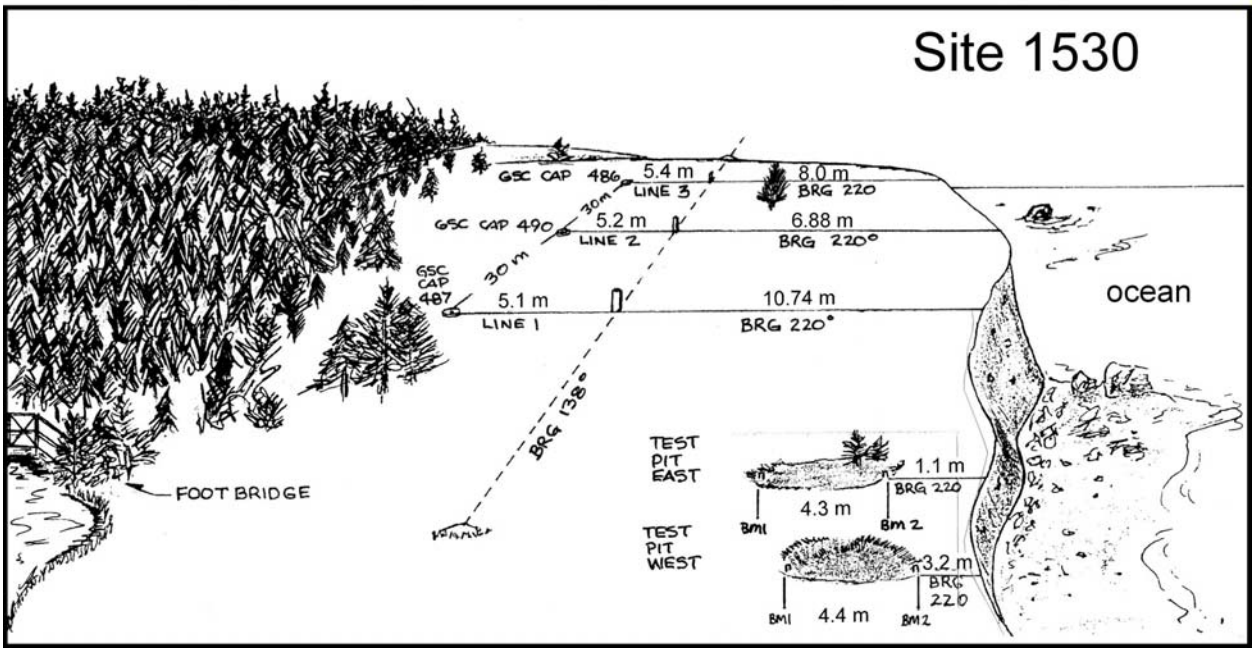


Figure 1530-2. (a) View of monitoring site 1530 (shore segment 180) from the west. Survey lines 1, 2, 3 are located farther upslope between test pit east and the crest of the hill where a lone tree exists. Survey lines also are located at the two test pits which are relics from a talc mining operation in early 1900s (photo Nov. 2, 1995). (b) Close-up view of test pit west and (c) test pit east showing the location of survey lines with original wood stakes BM1 and BM2 (circled) which were replaced in 2011. Seaward edge of cliff is to the right (photo June 10, 1996). Refer to figure 1530-2 for a view of the site from the summit of the hill.

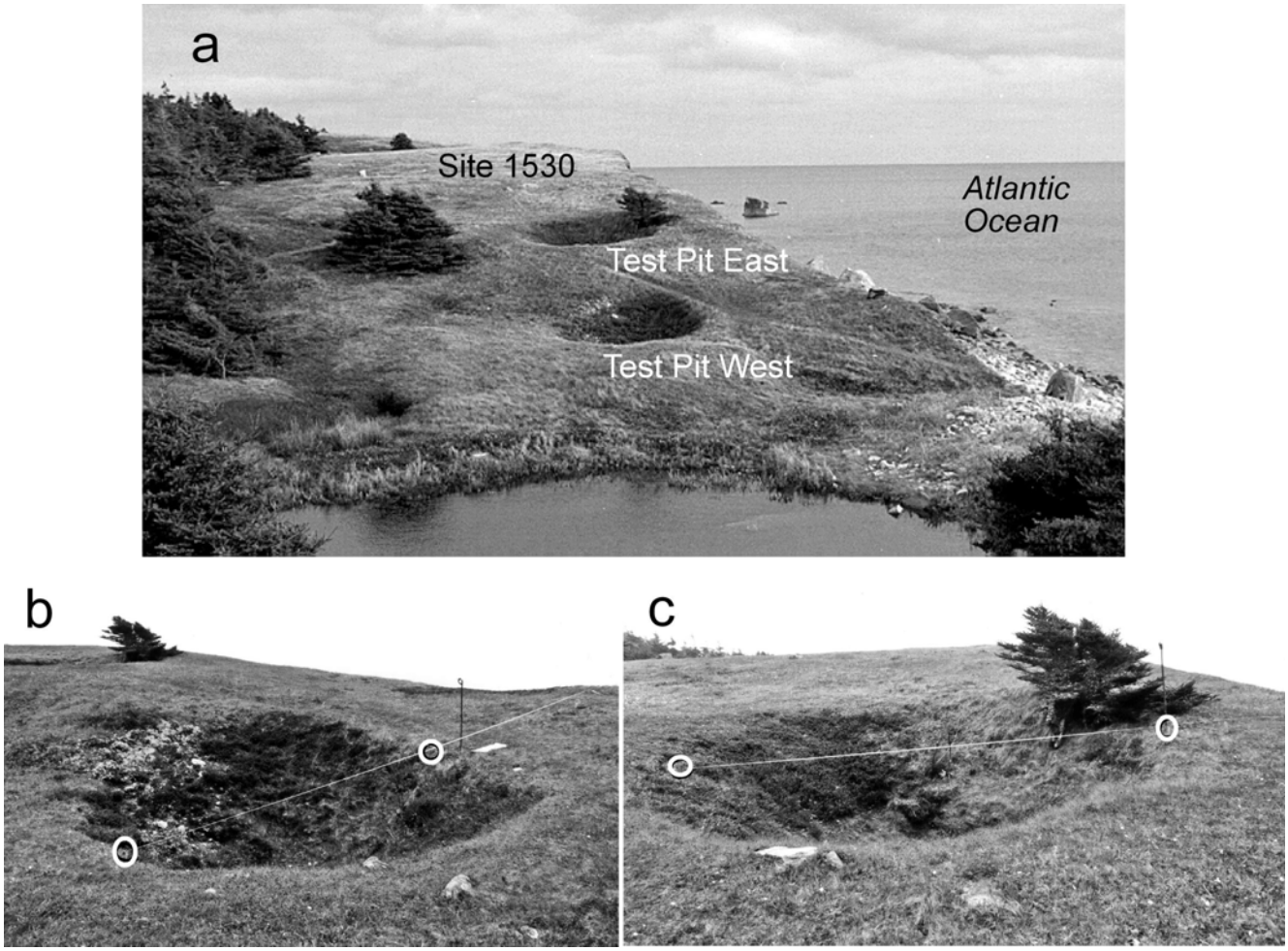


Figure 1530-3. View of the shore cliff at site 1530 looking westward from the summit of the hill. The pack (circled) is on line 3 at GSC cap 486; lines 1 and 2 are farther to the west (photo 21-Oct-2011). The path along the cliff top is more worn down than it was in 1995.

SITE NO.	SHORE TYPE	GEOGRAPHIC NAME	COUNTY	PROVINCE	NTS REF	HORIZ DATUM	VERTICAL DATUM
1530	CLIFF	SIMONS POINT	CAPE BRETON	NOVA SCOTIA	11F/16	NAD 83	GEODETIC

ACCESS

From the town of Louisbourg follow the road toward the fortress and Kennington Cove. Follow the dirt road to where it crosses a small stream at an enclosed picnic shelter park on the side of the road or at the shelter; cross the road and walk toward the sea following the walking trail to Simons Point. Just before you reach the ocean the path divides. Follow the path to the left across a bridge (Simons Point is actually the low point of land you can see to the west) and walk up onto the shore cliff. Cliff lines 1 to 3 are marked by GSC caps at ground level and a metal dedector is useful to find them. As you walk up the slope from the bridge they are located to the left along the edge of trees while the two test pits are to the right.

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SITE INFORMATION (1997, 2011)

LINE	BM TYPE	LATITUDE°	LONGITUDE°	EASTING*	NORTHING*	ELEVATION*	LINE	BM TYPE	EASTING*	NORTHING*	ELEVATION*
1	BM1 CAP 487	45.877490	-60.017638	731437.236	5084761.764	8.312	1	Top Cliff edge(waypoint)	731433.649	5084744.838	9.078
	BM2 wd stake			731434.000	5084757.000						
2	BM1 CAP 490	45.877392	-60.017275	731465.787	5084751.920	9.397	2	Top Cliff edge(waypoint)	731462.490	5084740.073	9.979
	BM2 wd stake			731463.000	5084747.000						
3	BM1 CAP 486	45.877294	-60.016915	731494.136	5084742.117	9.803	3	Top Cliff edge(waypoint)	731490.103	5084727.164	9.639
	BM2 wd stake			731492.000	5084738.000						
pit east	BM1 wd stake			731411.000	5084759.000		pit west	BM1 wd stake	731403.000	5084762.000	
	BM2 wd stake			731411.000	5084754.000			BM2 wd stake	no data	no data	

CLIFF TOP RECESSION SURVEYS

LINE NO.	GSC BM	SURVEY DATE (D/M/Y)	LINE BEARING(°)	NO YEARS BTW SURVEY	RETREAT (m) BTW SURVEY	TOTAL CUM NO YEARS	CUM RETREAT (m)	CUM RETREAT (m\a)	BM TO CLIFF EDGE (m) BM1 TO CE	BM2 TO CE	BM3 TO CE	SURVEY METHOD	CLIFF / BANK ELEVATION (m)
1	487	6-Dec-95	220						17.62	12.57		TAPE	
		10-Jun-96	220	0.50	0.20	0.50	0.20	0.40	17.42	*12.37*		TAPE	
		20-Oct-96		0.35	-0.03	0.85	0.17	0.20	17.45			TAPE	
		7-Nov-97	220	1.04	0.05	1.89	0.22	0.12	17.40	12.35		RTK /TAPE	7.02
		25-Jun-98		0.63	0.14	2.52	0.36	0.14	17.26	*12.21*		TAPE	
		22-Nov-00		2.41	0.01	4.93	0.37	0.08	17.25	*12.20*		TAPE	
		27-Jun-05		4.60	0.55	9.53	0.92	0.10	16.70	11.65		TAPE	
		8-Nov-11	220	6.35	0.86	15.88	1.78	0.11	15.84	not found	**10.74**	TAPE	
2	490	6-Dec-95	220						12.75	7.69		TAPE	
		10-Jun-96	220	0.50	0.00	0.50	0.00	0.00	12.75	7.57		TAPE	
		20-Oct-96		0.35	0.00	0.85	0.00	0.00	12.75			TAPE	
		7-Nov-97	220	1.04	0.30	1.89	0.30	0.16	12.45			RTK /TAPE	7.88
		25-Jun-98		0.63	0.00	2.52	0.30	0.12	12.45			TAPE	
		22-Nov-00		2.41	0.10	4.93	0.40	0.08	12.35	*7.29*		TAPE	
		5-Jun-02	220	1.54	0.30	6.47	0.70	0.11	12.05	*6.99*		TAPE	
		27-Jun-05		3.06	0.03	9.53	0.73	0.08	12.02	6.96		TAPE	
		8-Nov-11	220	6.35	-0.06	15.88	0.67	0.04	12.08	not found	**6.88**	TAPE	

Site 1530 continued

CLIFF TOP RECESSION SURVEYS

LINE NO.	GSC BM	SURVEY DATE (D/M/Y)	LINE BEARING(°)	NO YEARS BTW SURVEY	RETREAT (m) BTW SURVEY	TOTAL CUM NO YEARS	CUM RETREAT (m)	CUM RETREAT (m\a)	BM TO CLIFF EDGE (m) BM1 TO CE	BM2 TO CE		SURVEY METHOD	CLIFF / BANK ELEVATION (m)
3	486	6-Dec-95	220						15.62	10.65		TAPE	
		10-Jun-96	220	0.50	0.02	0.50	0.02	0.04	15.60	10.60		TAPE	
		20-Oct-96		0.35	0.00	0.85	0.02	0.02	15.60			TAPE	
		7-Nov-97	220	1.04	-0.05	1.89	-0.03	-0.02	15.65	10.75		RTK/TAPE	7.59
		25-Jun-98		0.63	0.16	2.52	0.13	0.05	15.49			TAPE	
		22-Nov-00		2.41	0.29	4.93	0.42	0.09	15.20	*10.15*		TAPE	
		5-Jun-02	220	1.54	0.17	6.47	0.59	0.09	15.03	*9.98*		TAPE	
		27-Jun-05		2.91	-0.05	9.38	0.54	0.06	15.00	10.03		TAPE	
		8-Nov-11	220	6.35	1.60	15.73	2.14	0.14	13.40	not found	**8.00**	TAPE	
TEST PIT EAST													
1		11-Jun-96	220						7.53	2.81		TAPE	
		20-Oct-96		0.35	-0.02	0.35	-0.02	-0.06	7.55	2.83		TAPE	
		7-Nov-97	220	1.04	0.20	1.39	0.18	0.13	7.35			RTK/ TAPE	
		25-Jun-98		0.63	0.06	2.02	0.24	0.12	7.29			TAPE	
		22-Nov-00		2.41	0.24	4.43	0.48	0.11	7.05	*2.33*		TAPE	
		5-Jun-02		1.54	0.28	5.97	0.76	0.13	*6.77*	2.05		TAPE	
		27-Jun-05	220	3.06	0.53	9.03	1.29	0.14	6.24	not found		TAPE	
1a		8-Nov-11	220						**5.35**	**1.10**		TAPE	
LINE NO.	GSC BM	SURVEY DATE (D/M/Y)	LINE BEARING(°)	NO YEARS BTW SURVEY	RETREAT (m) BTW SURVEY	TOTAL CUM NO YEARS	CUM RETREAT (m)	CUM RETREAT (m\a)	BM TO CLIFF EDGE (m) BM1 TO CE	BM2 TO CE		SURVEY METHOD	CLIFF/BANK HEIGHT (m)
TEST PIT WEST													
1		11-Jun-96	220						8.84	4.45		TAPE	
		20-Oct-96		0.35	0.00	0.35	0.00	0.00	8.84	4.45		TAPE	
		7-Nov-97	220	1.04	-0.04	1.39	-0.04	-0.03	8.88			RTK /TAPE	
		25-Jun-98		0.63	0.04	2.02	0.00	0.00	8.84			TAPE	
		22-Nov-00		2.41	0.54	4.43	0.54	0.12	8.30	*3.91*		TAPE	
		5-Jun-02		1.54	-0.13	5.97	0.41	0.07	GONE	*4.04*		TAPE	
		4-May-05		3.06		no data			not found	not found			
1a		8-Nov-11							**7.57**	**3.16**		TAPE	

° LATITUDE AND LONGITUDE ARE IN DECIMAL DEGREES AND ARE A CONVERSION OF MARCH 2011 RTK UTM USING GSRUG http://www.geod.nrcan.gc.ca/tools-outils/index_e.php

*Geographic positions and elevations based on N.S. CONTROL MONUMENT 2094 BLACK ROCK Elevation 12.827 m; Easting (734481.365) Northing (5085932.243) NAD 83 UTM GRID: Z 20

LINE BEARING (DEGREES MAGNETIC)

New wood stakes (in bold) were positioned in 2011 with hand-held GPS and are slightly west of previous markers

REFERENCE NOTEBOOKS:

6-Dec-95	OWEN BROWN NOTES
10-Jun-96	INFO ON FORMS
20-Oct-96	RTK; CBI/95 P 45
7-Nov-97	RTK; CBI / 95 P81.
25-Jun-98	CBI/95 P86
22-Nov-00	CBI 98/1 P36
5-Jun-02	R.DUGGAN / B. CUNNINGHAM (Parks Canada)
27-Jun-05	R.DUGGAN (Parks Canada)
8-Nov-11	L. Reeves (Parks Canada)

DISTANCE BETWEEN BMS ALIGNED ALONG BEARING 138° BETWEEN 2 ROCKS:

LINE #1-2:	30.0 m
LINE #2-3:	30.0 m

BENCH MARK HISTORY: SITE 1530

LINE 1:

6-Dec-95	BM1 (GSC CAP 487) IS 5.05 m LWD OF BM2 (WD STAKE)
10-Jun-96	ALL BMS INTACT
20-Oct-96	ONLY GSC CAP PRSENT
7-Nov-97	BM1 (CAP) AND BM2 (WD STK) PRESENT BUT BM2 BROKEN OFF AT GROUND LEVEL; SOD OVERHANG, CLIFF FACE DRY
25-Jun-98	BM1 (CAP 487) AND BM2 (WD STK) PRESENT BUT BM2 BROKEN OFF AT GROUND LEVEL; SOD OVERHANG
22-Nov-00	BM1 (CAP 487) AND BM2 (WD STK) PRESENT BUT BM2 BROKEN OFF AT GROUND LEVEL; SOD DRAPE AGAINST CLIFF FACE
5-Jun-02	BM1 AND BM2 NOT FOUND
27-Jun-05	BM1 INTACT, measurement from BM2?
8-Nov-11	BM1(GSC 487) intact and added a new BM2 (wood stake) 5.1 m swd from BM1

BENCH MARKS PRESENTLY INTACT: BM1 (GSC487) BM1 TO BM2 =5.1 m

LINE 2:

6-Dec-95	BM1 (GSC 490) IS 5.06 m LWD OF BM2 (2 wd sticks)
10-Jun-96	BM2 REPLACED BY AN UNPAINTED 1 X 2 WOOD STAKE
20-Oct-96	BM1 INTACT
7-Nov-97	BM1 (CAP) AND BM2 (WD STK) PRESENT BUT BM2 BROKEN OFF AT GR LEVEL, CLIFF FACE WET
25-Jun-98	BM1 (CAP) AND BM2 (WD STK) PRESENT BUT BM2 BROKEN OFF AT GR LEVEL, LARGER SOD OVERHANG
22-Nov-00	BM1 (CAP) AND BM2 (WD STK) PRESENT BUT BM2 BROKEN OFF AT GR LEVEL, SOD OVERHANDG ~0.3M
5-Jun-02	BM1(GSC 490) INTACT BM2 NOT FOUND
27-Jun-05	BM1 INTACT
8-Nov-11	BM1(GSC 490) INTACT and added a new BM2 (wood stake) 5.2 m swd of BM1

BENCH MARKS PRESENTLY INTACT: BM1 (GSC 490) BM1 to BM2 =5.2 m

LINE 3:

6-Dec-95	BM1 (GSC 486) IS 4.97 m LWD OF BM2 (wd stick and 4.99 m LWD OF STEEL PIN)
10-Jun-96	ORIGINAL BM2 MISSING (BROKEN OFF AT GROUND LEVEL), REPLACED BY AN UNPAINTED 1 X 2 WOOD STAKE, (STEEL PIN) NOT FOUND.
20-Oct-96	BM1 (GSC 486) IS INTACT
7-Nov-97	BM1 (CAP) AND BM2 (WD STK) PRESENT BUT BM2 BROKEN OFF AT GR LEVEL; FLOW /SLUMP SCARP AT BASE CLIFF
25-Jun-98	BM1 (CAP) AND BM2 (WD STK) PRESENT BUT BM2 BROKEN OFF AT GR LEVEL; LARGER SOD OVERHANG THAN 97 & MORE ACTIVE SLOPE THAN L1&2
22-Nov-00	BM1 (CAP) AND BM2 (WD STK) PRESENT BUT BM2 BROKEN OFF AT GR LEVEL; SOD OVERHANG OF 0.3-0.5 M
5-Jun-02	BM1 (GSC 486) AND BM2(WD STK) FOUND BUT BM2 BROKEN OFF AT GROUND LEVEL
27-Jun-05	BM1 INTACT measured to base short overhang

Benchmark History Con't

LINE 3 con't

8-Nov-11 BM1(GSC486) intact and added a new BM2 (wood stake) 5.4 m swd of BM1

BENCH MARKS PRESENTLY INTACT: BM1 (GSC486) BM1 to BM2 = 5.4 m

TALC TEST PIT EAST PIT DIAMETER (measured parallel to shore) =4.53M / DIA (measured at right angles to shore) =5.40M

11-Jun-96 BM1 AND BM2 (3/4 X 2 RED FLOURESCENT PAINTED WOOD STAKES) SET LOW IN GROUND JUST INSIDE DEPRESSION.

20-Oct-96 BM1 AND BM2 (3/4 X 2 RED FLOURESCENT PAINTED WOOD STAKES) SET LOW IN GROUND JUST INSIDE DEPRESSION.

7-Nov-97 BM1 AND BM2 PRESENT, SOME NEW SODS BROKEN OFF NEAR LINE

25-Jun-98 BM1 AND BM2 PRESENT,

22-Nov-00 BM1 AND BM2 PRESENT,

5-Jun-02 BM1 AND BM2 PRESENT,

27-Jun-05 BM1 present , BM2 not found

8-Nov-11 no markers found so established a new Line 1a with two new wood stakes BM1 (wood stake) in roughly same location as old one based on photos and GPS

BENCH MARKS PRESENTLY INTACT: BM1(wd stake) BM1 to Bm2 =4.3 m

BENCH MARK HISTORY: SITE 1530 continued

TALC TEST PIT WEST PIT DIAMETER (measured parallel to shore) =4.72M / DIA (measured at right angles to shore) =5.65M

11-Jun-96 BM1 AND BM2 (3/4 X 2 RED FLOURESCENT PAINTED WOOD STAKES) SET LOW IN GROUND JUST INSIDE DEPRESSION.

20-Oct-96 BM1 AND BM2 (3/4 X 2 RED FLOURESCENT PAINTED WOOD STAKES) SET LOW IN GROUND JUST INSIDE DEPRESSION.

7-Nov-97 BM1 AND BM2 PRESENT

25-Jun-98 BM1 HOLE ONLY PUT ROCK SLAB IN HOLE; BM2 INTACT;

22-Nov-00 BM1 BROKEN OFF SO ADDED NEW WD STAKE IN HOLE BM2 INTACT;

5-Jun-02 BM1 MISSING, BM2 INTACT

27-Jun-05 PIT SLOPE HAS SLUMPED no stakes found

8-Nov-11 no markers found so established a new line 1a in roughly same location as Line1 with BM1(wd stake) and BM2 (wd stake) 4.1m apart

BENCH MARKS PRESENTLY INTACT: BM1 (WD STAKE) BM1 TO BM2 = 4.1 M

Shore Monitoring Sites

1555, 1531, 1532,

White Point to Black Rock

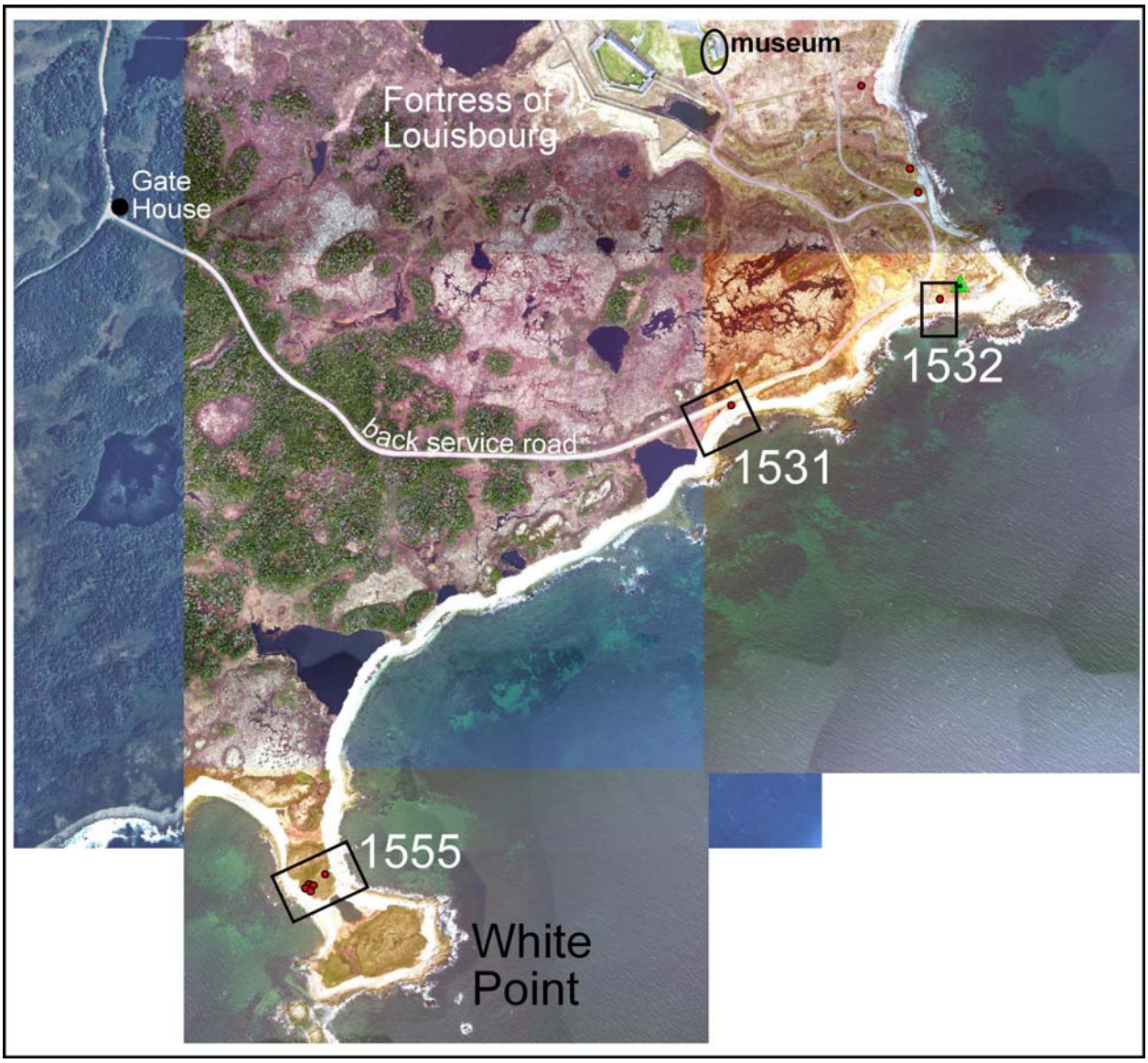


Figure 1555-1. Location of the shore monitoring stations 1555, 1531 and 1532 established between White Point and Black Rock along the outer coast of Fortress of Louisbourg National Historical Site (2010 air photo base).

Site 1555

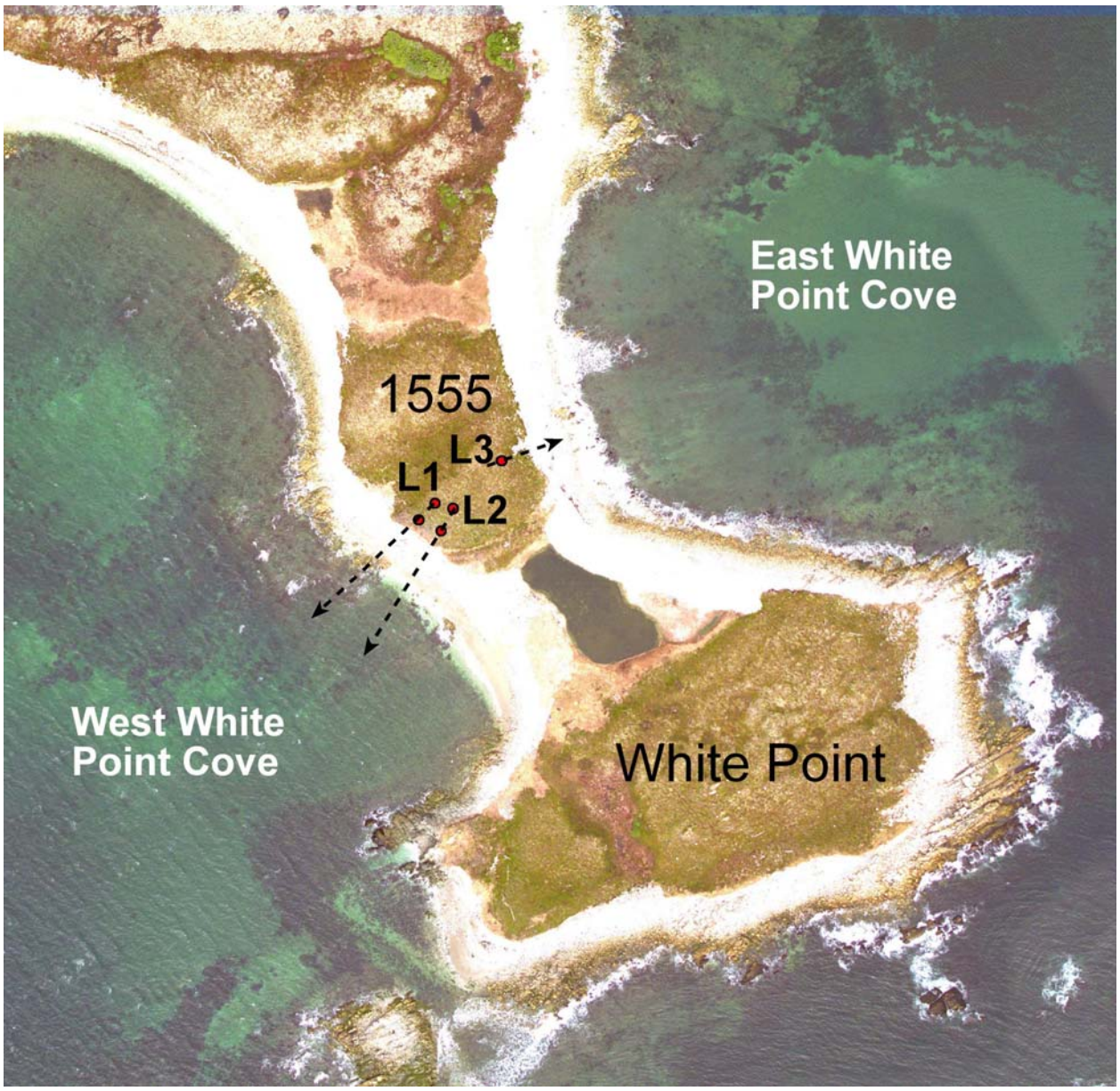


Figure 1555-2 Location map of survey lines and markers (red dots) at site 1555 near White Point archaeological site. Lines 1 and 2 are at a low shore cliff and line 3 is for monitoring landward cobble beach migration.

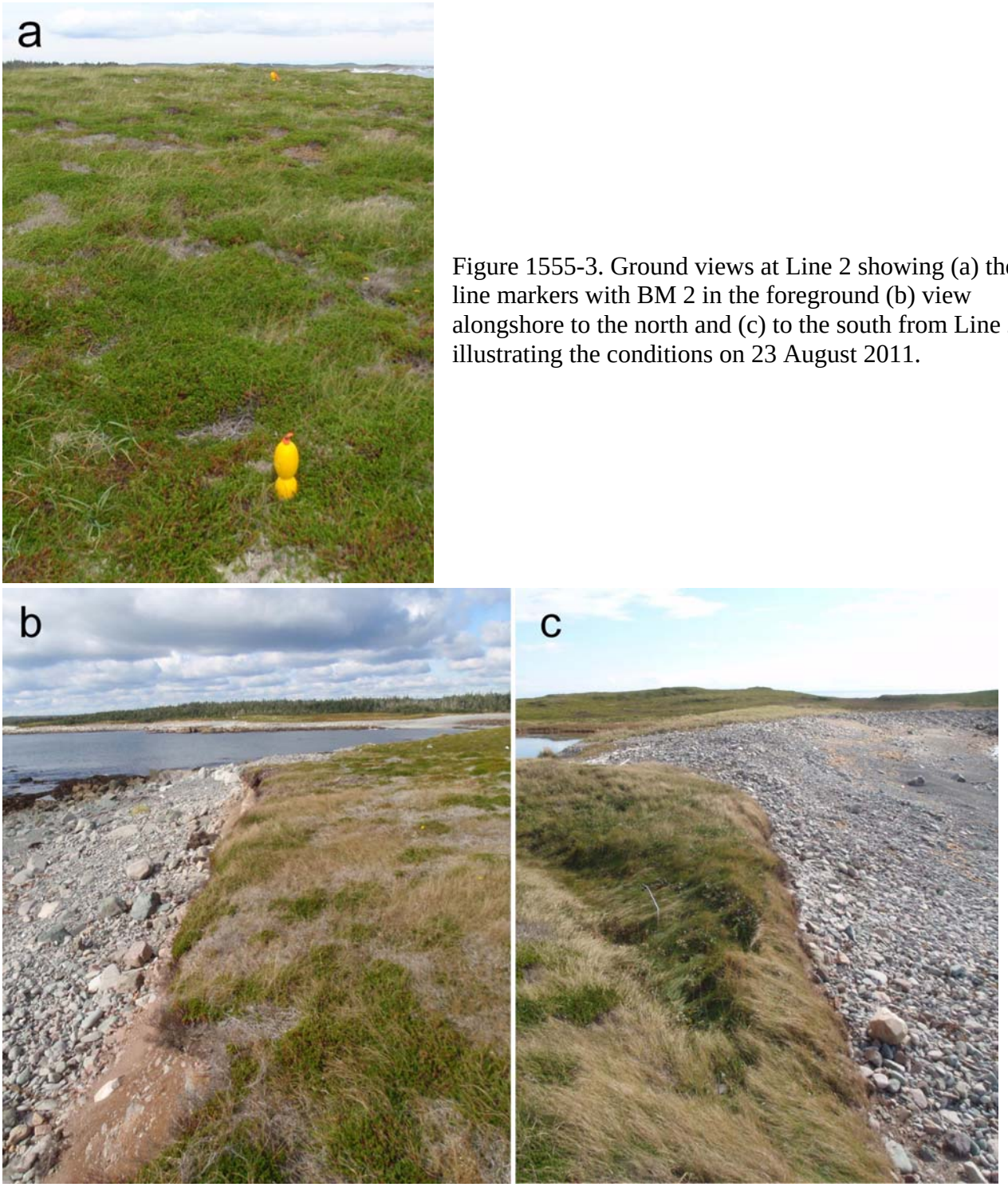


Figure 1555-3. Ground views at Line 2 showing (a) the line markers with BM 2 in the foreground (b) view alongshore to the north and (c) to the south from Line 2 illustrating the conditions on 23 August 2011.

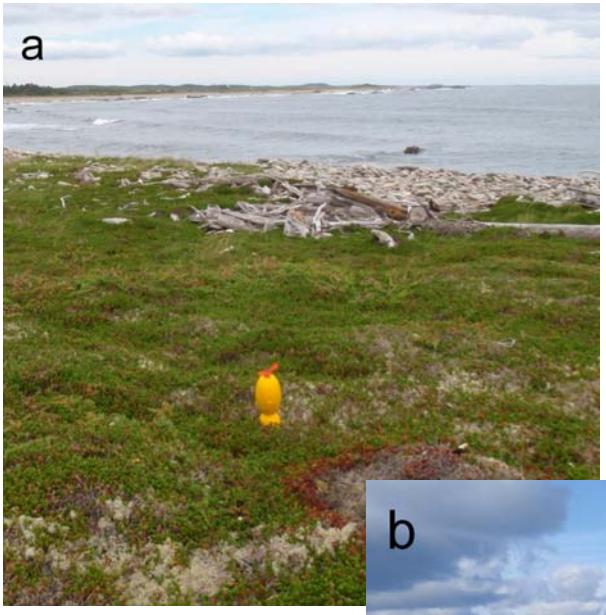


Figure 1555-4. Ground views at Line 3 site 1555 White Point showing (a) BM1 looking seaward toward the cobble beach and (b) views alongshore to the north and (c) to the south showing a cobble beach migrating overtop of bedrock outcrop and a low shore cliff. White Point lies in the background of (c) (23 August 2011).

SITE NO.	SHORE TYPE	GEOGRAPHIC NAME	COUNTY	PROVINCE	NTS REF	HORIZ. DATUM	VERTICAL DATUM
1555	CLIFF & BEACH	WHITE POINT	CAPE BRETON	NOVA SCOTIA	11G/13	NAD 83 ZONE 21	

ACCESS

The site is located on the grounds of Fortress Louisbourg. Vehicle access is only possible with the permission of the Fire & Security staff. From town of Louisbourg follow the road toward Kennington Cove to the Back Service Gate House. Once through the gate drive approximately 1.2 km to a large pond on the right side of the road. Park along Back Service Road and walk to the modern shoreline and turn right and proceed west along shore to White Point. Site 1555 is not at the outer end of White Point but rather is at the inner hill landward of the double tombolo. Line 1 and 2 are on the west facing low cliff shore where in situ resources (cannon balls) have been eroding from the bank and line 3 is at a cobble beach along the east facing shore.

SITE INFORMATION (2011)

	BM (TYPE)	LATITUDE*	LONGITUDE*	EASTING*	NORTHING*	ELEVATION**	EASTING (Z20)	NORTHING(Z20)
LINE 1	BM1 (rebar)			267615	5084744		733231.137	5084776.137
	BM2 (rebar)			267607	5084737		733223.346	5084767.859
LINE 2	BM1 (rebar)	45.88254224	59.994445	267623	5084741		733238.929	5084773.215
	BM2 (rebar)			267617	5084731		733233.572	5084762.502
LINE 3	BM1 (rebar)			267647	5084761		733261.329	5084795.129

LINE NO.	GSC BM	SURVEY DATE (D/M/Y)	LINE BEARING	NO YEARS BTW SURVEY	RETREAT (m) BTW SURVEY	TOTAL CUM NO YEARS	CUM RETREAT (m)	CUM RETREAT (m\a)	BM TO CLIFF EDGE (m) BM1 TO CE	BM2 TO CE	SURVEY METHOD	CLIFF/BANK ** HEIGHT (m)
1		23-Aug-11	59						13.65	3.65	TAPE	
2		23-Aug-11	62						14.76	4.76	TAPE	
3		23-Aug-11	60						18.70		TAPE	beach

* UTMs ARE BASED ON 2011 hand-held GPS READINGS (GARMIN 76)Using Z21 and the Z20 UTMS were converted using an Z20 ARC GIS project

** ELEVATIONS IN METRES (TAPED DIST FROM TOP EDGE TO BASE CLIFF FACE)

LINE BEARING (DEGREES MAGNETIC)

REFERENCE NOTEBOOKS:

23-Aug-11	Parks canada -LEE ANNE REEVES NOTES
24-Oct-11	Parks canada -LEE ANNE REEVES NOTES

DISTANCE BETWEEN BMS:

LINE 1: BM1 - BM2: 10.0 m

LINE 2: BM1 - BM2: 10.0 m

LINE3: MEASURE FROM BM1 - CREST OF COBBLE BEACH

BENCH MARK HISTORY:

LINE 1

23-Aug-11 Established BM1(rebar) and BM2(rebar) 10m apart -survey to cliff top edge -align markers with Louisbourg Lighthouse

24-Oct-11 BM position collected using hand-held GPS in Z 21

LINE 2

23-Aug-11 Established BM1(rebar) and BM2(rebar) 10m apart

24-Oct-11 BM position collected using hand-held GPS in Z 21and survey to cliff top edge

LINE 3

23-Aug-11 Established BM1(rebar) and survey to crest of cobble beach

24-Oct-11 BM position collected using hand-held GPS in Z 21

Site 1531

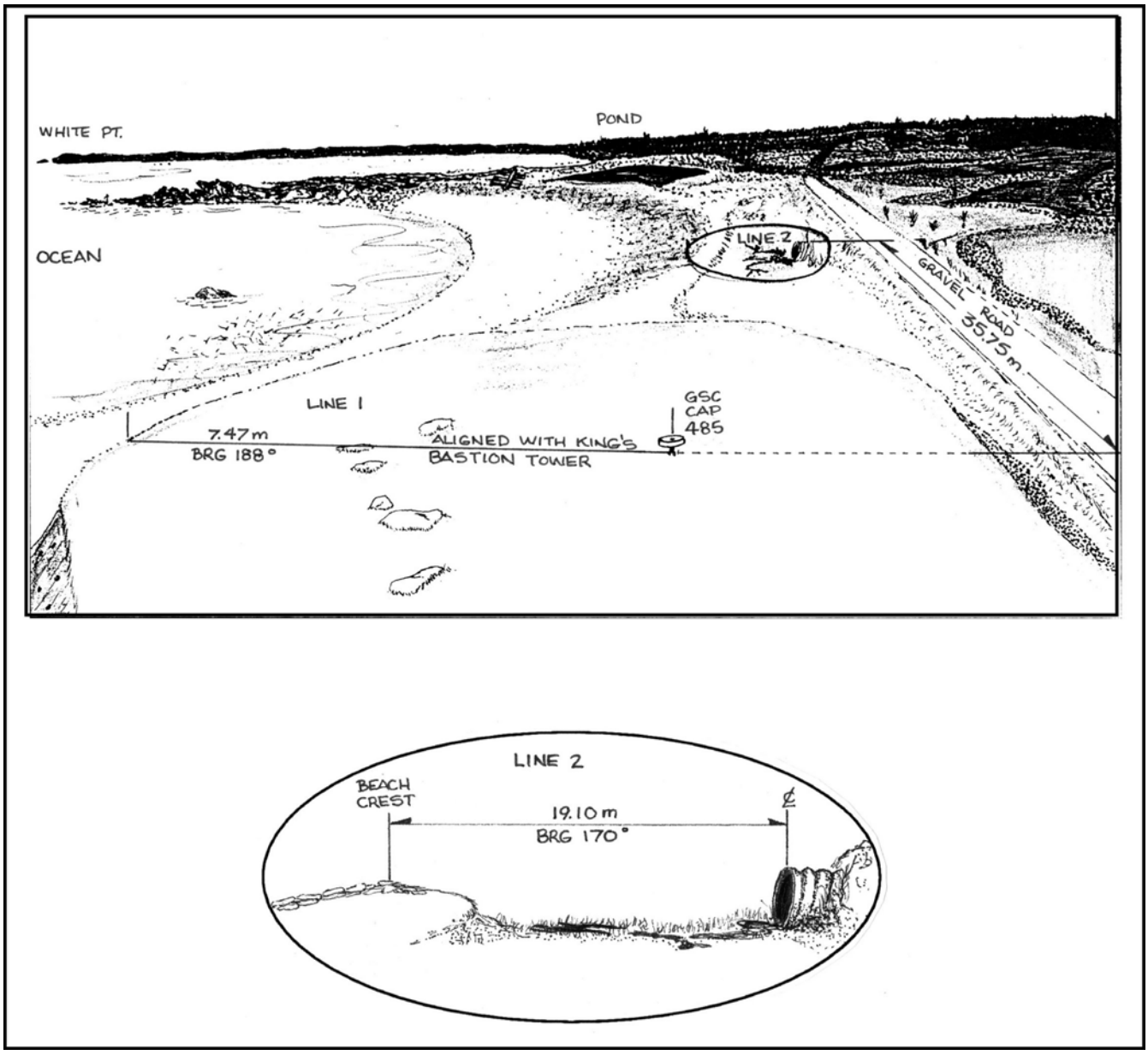
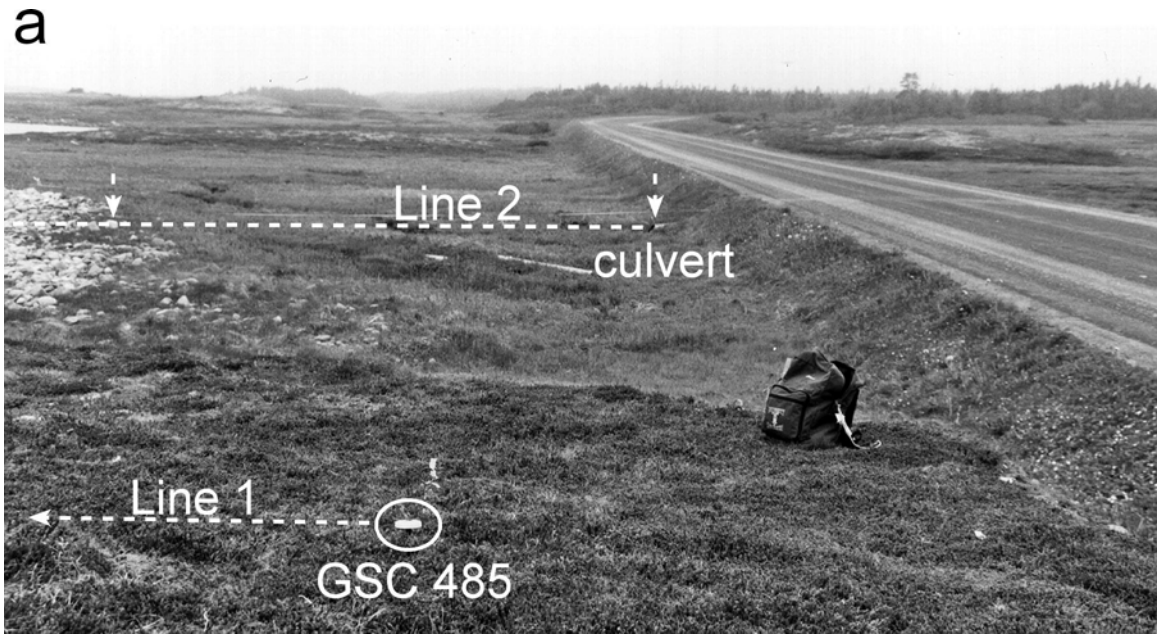
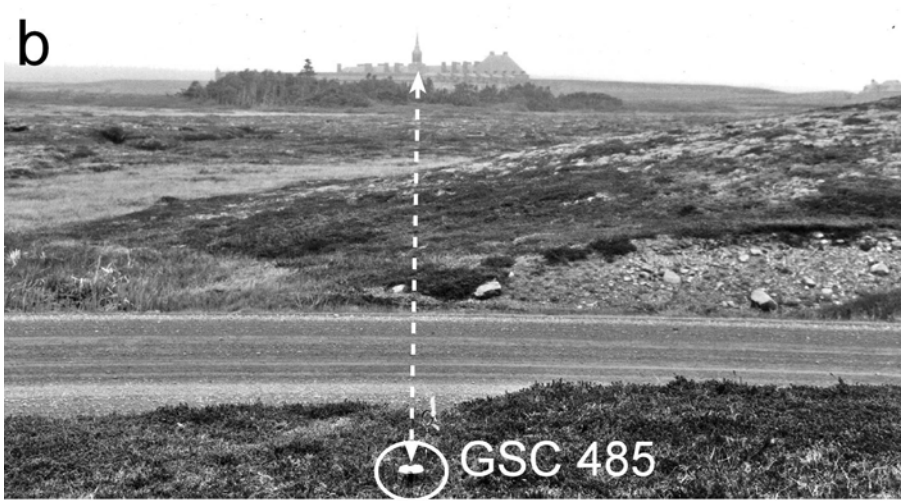


Figure 1531-1. Sketch of survey lines and markers at cliff and beach lines at site 1531.

Site 1531





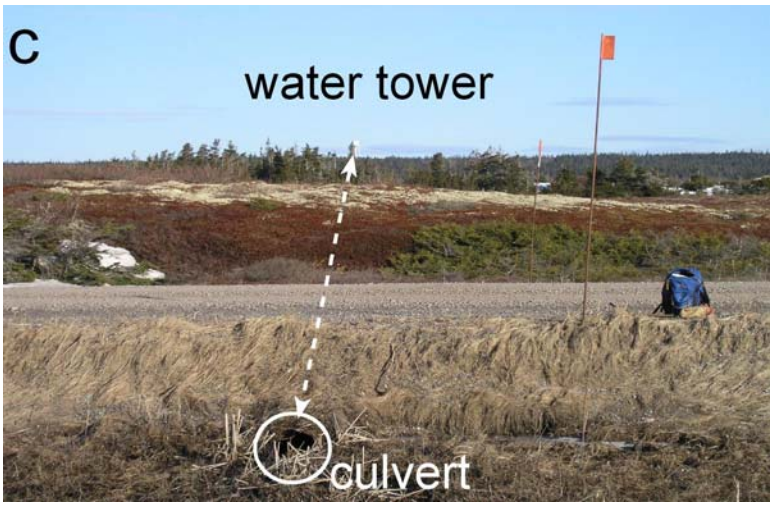


Figure 1531-2.
(a) View of site 1531 showing the relative positions of Lines 1 and 2 and the gravel road. Line 1 is marked with GSC 485 (circled) and line 2 is marked by a culvert (arrow) on the seaward side of the road (seaward arrow marks the landward limit of wave overwash (June 10, 1996).

(b) When measuring the distance to the cliff edge at Line 1 align the tape measure with the GSC cap (foreground -circled) and the top of the Kings Bastion Tower (photo June 10, 1996).

(c) When measuring the distance to the beach crest or landward limit of wave overwash at line 2 align the tape with the culvert and the water tower located farther inland (31 March 2011).

Site 1531

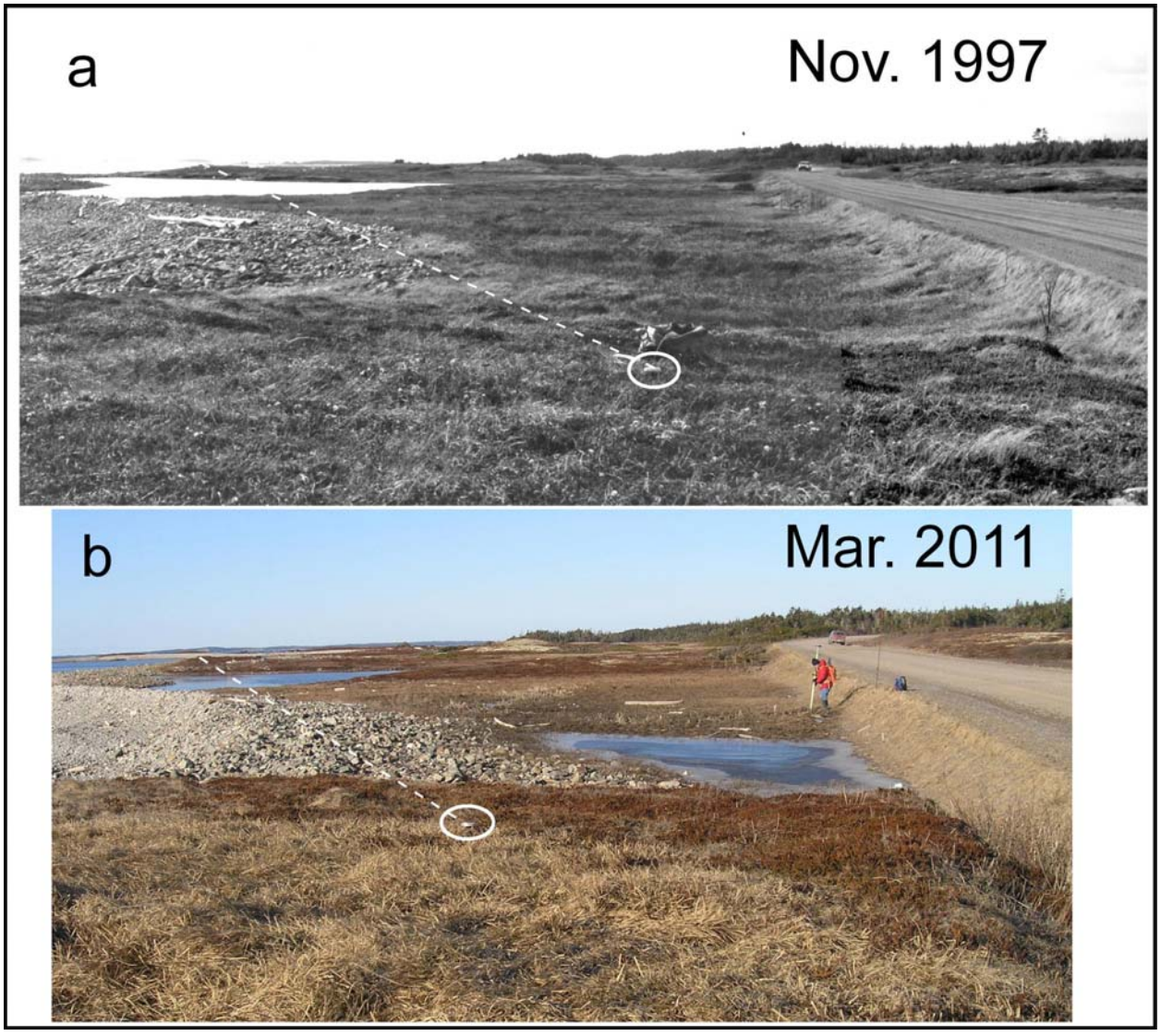


Figure 1531-3. Repetitive photos looking alongshore from the same location can illustrate physical changes at a shoreline monitoring site. A reference line extended from GSC cap 485 to a common landmark highlights the landward migration of pebble cobble washover deposits during the 13.5 years. Note: the road bank also has been modified making it difficult to find the culvert at line 2 where the surveyor is standing in March 2011.

SITE NO.	SHORE TYPE	GEOGRAPHIC NAME	COUNTY	PROVINCE	NTS REF	HORIZ. CONTROL	VERTICAL DATUM
1531	CLIFF BEACH	BLACK ROCK	CAPE BRETON	NOVA SCOTIA	11G/13	NAD 83 Z. 20	GEODETIC

ACCESS

The site is located on the grounds of the Fortress. Vehicle access is only possible with permission from park fire &security staff. From town of Louisbourg follow the road to Kennington Cove to the back service road gatehouse.Once through the gate follow the road to the sea. The site is 100 to 200 m west of Black Rock (a prominent black coloured outcrop situated on the seaward side of the road) at a small, < 1 m high till shore cliff where the road is very close to the shoreline. Line 2 is before (west of) line 1 at a culvert on the seaward side of the road. **The taped distance along the road from line 1 (GSC 485) to line 2 (culvert) is only 35.75 m**. (Do not use the culvert at the far west end of the main pond)

SITE INFORMATION (2011)

LINE	BM TYPE	LATITUDE*	LONGITUDE*	EASTING*	NORTHING*	ELEVATION**
1	GSC CAP 485	45.885021933	-59.983640850	734043.762	5085697.807	5.269 (top)
2	CULVERT	45.884930867	-59.984090450	734009.261	5085686.370	3.771 (top)

LINE NO.	GSC BM	SURVEY DATE (D/M/Y)	LINE BEARING (°)	NO YEARS BTW SURVEY	RETREAT (m) BTW SURVEY	TOTAL CUM NO YEARS	CUM RETREAT (m)	CUM RETREAT (m\a)	**CLIFF TOP RECESSION SURVEYS** BM1 TO CLIFF EDGE (m)	SURVEY METHOD	CLIFF TOP ELEVATION (m)
1	485	8-Dec-95	188						7.47	TAPE	
		11-Jun-96	188	0.50	0.09	0.50	0.09	0.18	7.38	TAPE	
		6-Nov-97	188°	1.42	0.08	1.92	0.17	0.09	7.30	TAPE / RTK	4.92
		2-Feb-00	188°	2.17	0.23	4.09	0.40	0.10	7.07	TAPE	
		5-Jun-02		2.33	0.12	6.42	0.52	0.08	6.95	TAPE	
		10-Mar-05		2.80	0.20	9.22	0.72	0.08	6.75	TAPE	
		17-Dec-08	188	3.78	0.24	13.00	0.96	0.07	6.51	TAPE	
		29-Mar-11		2.25	0.00	15.25	0.96	0.06	6.51	TAPE/ RTK	4.87
LINE NO.	GSC BM	SURVEY DATE (D/M/Y)	LINE BEARING (°)	NO YEARS BTW SURVEY	RETREAT (m) BTW SURVEY	TOTAL CUM NO YEARS	CUM RETREAT (m)	CUM RETREAT (m\a)	**BEACH MIGRATION SURVEYS** BM1 TO BEACH CREST (m)	SURVEY METHOD	BEACH CREST ELEVATION (m)
2		8-Dec-95	170°						19.10	TAPE	
		11-Jun-96	170°	0.5	0.22	0.50	0.22	0.44	18.88	TAPE	
		6-Nov-97	170°	1.42	-0.16	1.92	0.06	0.03	19.04	RTK	3.77
		2-Feb-00	170°	2.17	2.16	4.09	2.22	0.54	16.88	TAPE	
		5-Jun-02		2.33	0.08	6.42	2.30	0.36	16.80	TAPE	
		17-Dec-08							no survey -too wet		
		30-Mar-11		8.75	-1.60	15.17	0.70	0.05	18.40	RTK	3.84

° LATITUDE AND LONGITUDE ARE IN DECIMAL DEGREES AND ARE A CONVERSION OF MARCH 2011 RTK UTM USING GSRUG http://www.geod.nrcan.gc.ca/tools-outils/index_e.php

*Geographic positions and elevations based on N.S. CONTROL MONUMENT 2094 BLACK ROCK Elevation 12.827 m; Easting (734481.365) Northing (5085932.243) NAD 83 UTM GRID: Z 20

LINE BEARING (DEGREES MAGNETIC)

Site 1531 continued

REFERENCE NOTEBOOKS:

8-Dec-95	OWEN BROWN NOTES
11-Jun-96	INFO ON FORMS
6-Nov-97	RTK; CBI / 95 P 71
2-Feb-00	INFO ON FORMS (O.BROWN / B.DUNHAM)
5-Jun-02	R. DUGGAN / B. CUNINGHAM (PARKS)
10-Mar-05	CBI2001 p 65
17-Dec-08	CBI2001 pg 76
29-Mar-11	CBI2001 pg 77
30-Mar-11	CBI2011 p 6

BENCH MARK HISTORY SITE 1531:

LINE 1:

8-Dec-95 BM1(GSC 485) ON SMALL TILL HEADLAND, TO MEASURE, ALIGN BM1 WITH KINGS BASTION TOWER ON BACK BEARING OF 8°.
11-Jun-96
6-Nov-97 BM1 (GSC485) INTACT; RTK SURVEY OF CLIFF FACE 1.34 m HIGH AND BEACH TO SWASH
2-Feb-00 BM1 (GSC485) INTACT; TAPE SURVEY TO CLIFF EDGE. 0.3M OVERHANG
5-Jun-02 NO DATA
10-Mar-05 BM1 (CAP 485) INTACT; 0.4 TO 0.5M OVERHANG, DIGITAL PHOTO
17-Dec-08 BM1 (cap485) intact
29-Mar-11 BM1 (cap485) intact measurement aligned with Kings tower-RTK survey of CE alongshore and to beach, cliff face height 0.85m
BENCH MARKS PRESENTLY INTACT: BM1 (GSC485) AT GROUND LEVEL

LINE 2:

8-Dec-95 BM1 (SWD EDGE METAL DRAIN CULVERT) THAT LIES BENEATH ROAD. LINE NEARLY ALIGNED WITH WATER TOWER ON HILL FARTHER INLAND
11-Jun-96
6-Nov-97 BM1 (CULVERT) INTACT, RTK SURVEY OF PROFILE TO SWASH
2-Feb-00 BM1 (CULVERT) INTACT, TAPE SURVEY OF PROFILE TO SWASH
5-Jun-02 OLD STAKE STILL ON BEACH
10-Mar-05 CULVERT UNDER POND ICE -NO MEASUREMENT POSSIBLE
17-Dec-08 Culvert and low area back of beach is under water, no measurement
30-Mar-11 Culvert very had to see nearly buried by road fill -only a small pond remains -aligned with water tower -RTK survey of beach crest on either side of line
BENCH MARKS PRESENTLY INTACT: BM1 (METAL CULVERT) EXTENDS SWD OF & BENEATH DIRT ROAD

Site 1532

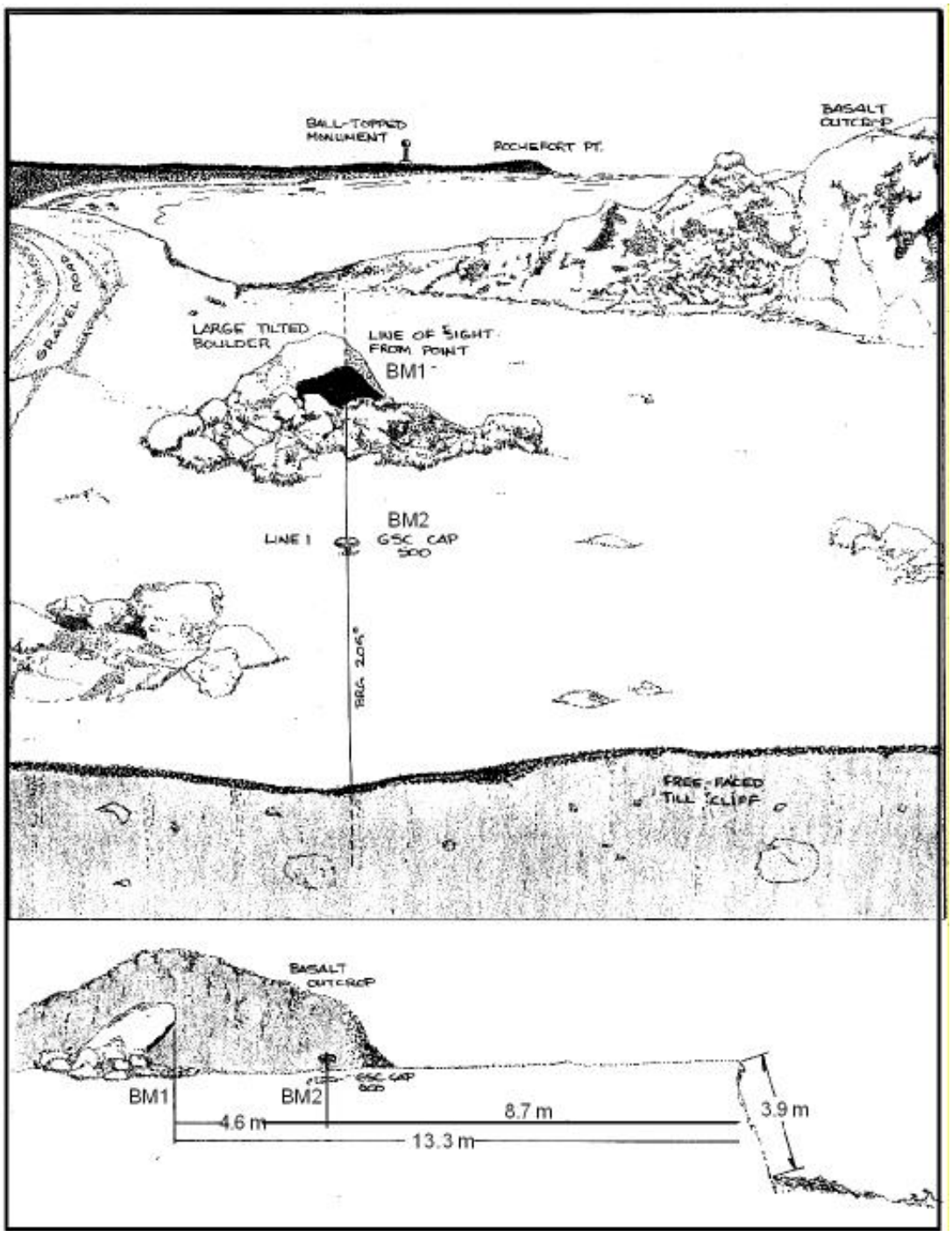


Figure 1532-1. Sketches of site 1532 in a plan and profile view showing the location of line markers and their distance from the cliff edge in 2011.

Site 1532

Figure 1532-2. Site 1532 showing the location of BM1 (pointed basalt outcrop-arrow) and BM2 @ GSC cap 500 at the feet of Owen Brown (photo Dec. 10, 1995).

Figure 1532-3. Views of the cliff face at site 1532 looking (a) to northwest and (b) to southeast showing conditions in March 2011. Dashed line marks the survey line location.

Re-photo the cliff face south of line 1 where a large boulder (circled -a)has limited cliff retreat since 1995 when our surveys began. Additional photos of this cliff face are shown in the survey methodology section of this report.

SITE NO.	SHORE TYPE	GEOGRAPHIC NAME	COUNTY	PROVINCE	NTS REF	HORIZ DATUM	VERTICAL DATUM
1532	CLIFF	BLACK ROCK	CAPE BRETON	NOVA SCOTIA	11G/13	NAD 83 Z 20	GEODETIC

ACCESS

The site is located on the grounds of the Fortress. Vehicle access is only possible with permission from park fire & security staff. From town of Louisbourg follow the road to Kennington Cove to the Back Service Road gatehouse. Once through the gate follow the dirt road to the sea. Black Rock is a prominent black coloured (basalt) outcrop situated on the seaward side of the road just before the road turns landward toward the Fortress. Park at side of road and follow the walking path that veers left (west) to GSC BM which is located along the west facing shore

SITE INFORMATION (2011)

LINE	BM TYPE	LATITUDE°	LONGITUDE°	EASTING*	NORTHING*	ELEVATION*
1	GSC CAP 500	45.886727683	-59.978371500	734445.426	5085902.797	7.573 (top)

CLIFF TOP RECESSION SURVEYS

LINE NO.	GSC BM	SURVEY DATE (D/M/Y)	LINE BEARING (°)	NO YEARS BTW SURVEY	RETREAT (m) BTW SURVEY	TOTAL CUM NO YEARS	CUM RETREAT (m)	CUM RETREAT (m\a)	BM TO CLIFF EDGE (m) BM1 TO CE	BM2 TO CE	SURVEY METHOD	CLIFF TOP ELEVATION (m)
1	500	4-Dec-95	205						14.87	10.26	TAPE	
		11-Jun-96	205	0.58	0.56	0.58	0.56	0.97	14.30	9.70	TAPE	
		5-Nov-97	205	1.42	-0.15	2.00	0.41	0.21		9.85	RTK/TAPE	7.40
		25-Jun-98	203	0.63	0.62	2.63	1.03	0.39		9.23	RTK	7.44
		2-Feb_00	205	1.58	0.24	4.21	1.27	0.30	13.60	8.99	TAPE	
		5-Jun-02		2.33	0.03	6.54	1.30	0.20	13.57	*8.96*	TAPE	
		10-Mar-05		2.75	0.16	9.29	1.46	0.16		8.80	TAPE	
		17-Dec-08		3.75	0.10	13.04	1.56	0.12	13.28	8.70	TAPE	
		29-Mar-11		2.25	0.00	15.29	1.56	0.10		8.70	RTK / TAPE	7.40

° LATITUDE AND LONGITUDE ARE IN DECIMAL DEGREES AND ARE A CONVERSION OF MARCH 2011 RTK UTM USING GSRUG http://www.geod.nrcan.gc.ca/tools-outils/index_e.php

*Geographic positions and elevations based on N.S. CONTROL MONUMENT 2094 BLACK ROCK Elevation 12.827 m; Easting (734481.365) Northing (5085932.243) NAD 83 UTM GRID: Z 20

LINE BEARING (DEGREES MAGNETIC)

REFERENCE NOTEBOOKS:

4-Dec-95	OWEN BROWN NOTES
11-Jun-96	INFO ON FORMS
5-Nov-97	RTK; CB1/95 P61
25-Jun-98	RTK; CB1/95 P84
2-Feb-00	INFO ON FORMS (O.BROWN/B.DUNHAM)
5-Jun-02	R DUGGAN / B CUNNINGHAM (PARKS)
10-Mar-05	CBI2001 P65
17-Dec-08	CBI2001 P71
29-Mar-11	CBI2001 p78

BENCH MARK HISTORY: **SITE 1532**

LINE 1:

4-Dec-95	A LARGE BASALT BOULDER (BM1) IS 4.61 m LANDWARD OF BM2 (GSC 500); A COBBLE MARKED THE SEAWARD EDGE OF THE LINE
11-Jun-96	BM1 AND BM2 INTACT, THE COBBLE MARKER HAS FALLEN OVER THE CLIFF. SEE PHOTO RECORD. EXTENSIVE OVERHANGS WERE OBSERVED AT THE TOP OF CLIFF.
5-Nov-97	BM1 AND BM2 INTACT, SOD OVERHANG IS 0.3 M; cliff face height is 3.9 m GPS SURVEY OF LINE TO WLO; BM TO CE BY TAPE =9.85
25-Jun-98	BM1 AND BM2 INTACT, SOD OVERHANG; NO TAPE MEASUREMENT
2-Feb-00	BM1 AND BM2 INTACT, 0.37M SOD OVERHANG
5-Jun-02	BM1 AND BM2 INTACT, CLIFF SLOPE DIST IS 5.48 M
10-Mar-05	BM1 AND BM2 INTACT, OVERHANGS OF 0.5M, BROKEN OFF ON LINE; SNOW DRIFT AT BASE OF CLIFF, DIGITAL PHOTO
17-Dec-08	BM1(rockoutcrop) and BM2 (cap 500) intact
29-Mar-11	BM1(rockoutcrop) and BM2 (cap 500) intact, there was a 0.5m sod overhang; RTK survey to CE=8.51m; RTKsurvey along CE top

BENCH MARKS PRESENTLY INTACT: BM1 (BOULDER) & BM2 (GSC 500).

Shore Monitoring Sites
1533 to 1537

Black Rock to Rochefort Point

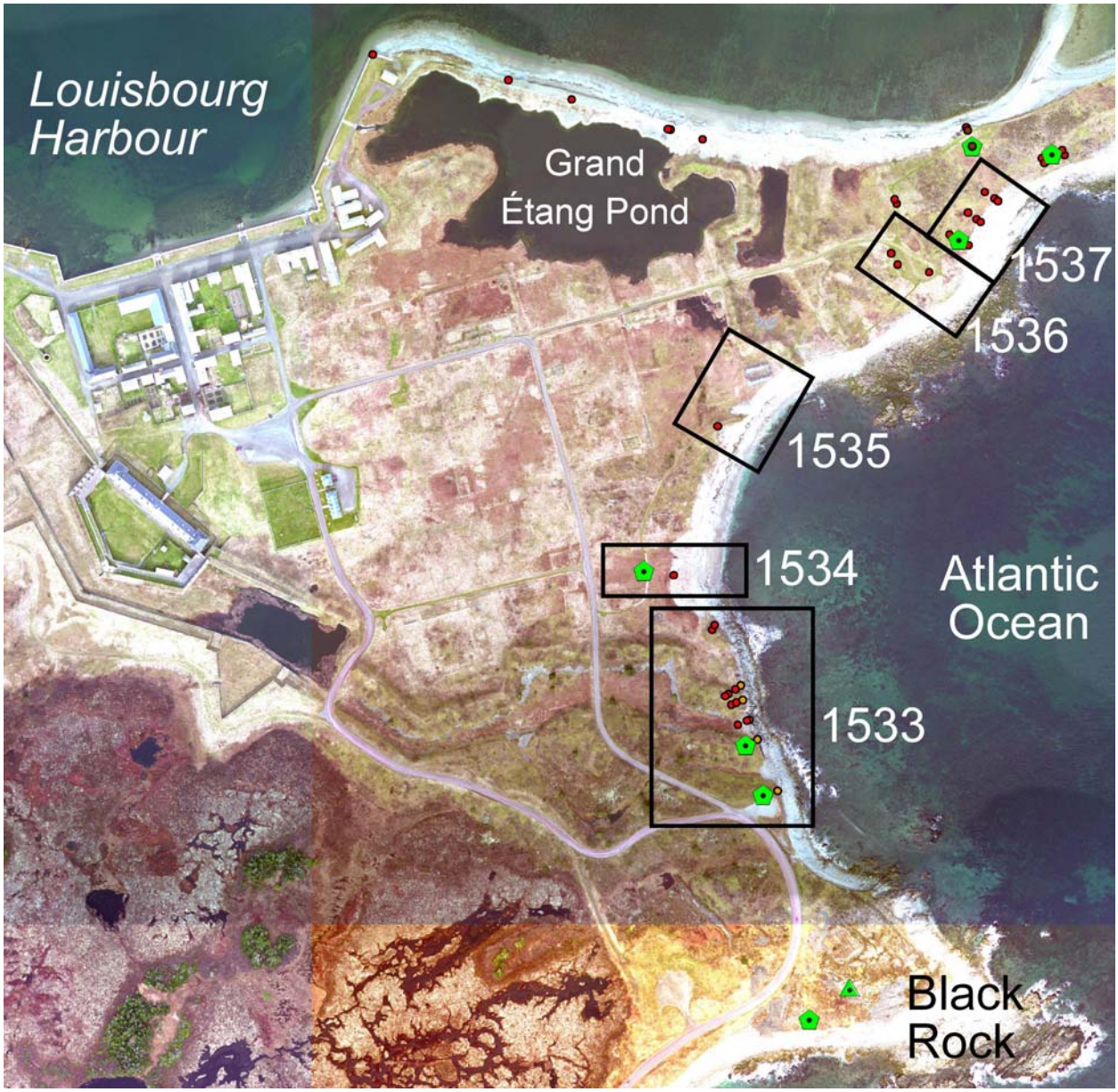


Figure 1533-1. Location map of shoreline monitoring sites 1533 to 1537 located between Black Rock and Rochefort Point. Site 1535 has not been actively surveyed since 1998 and is not described in this report.

Site 1533

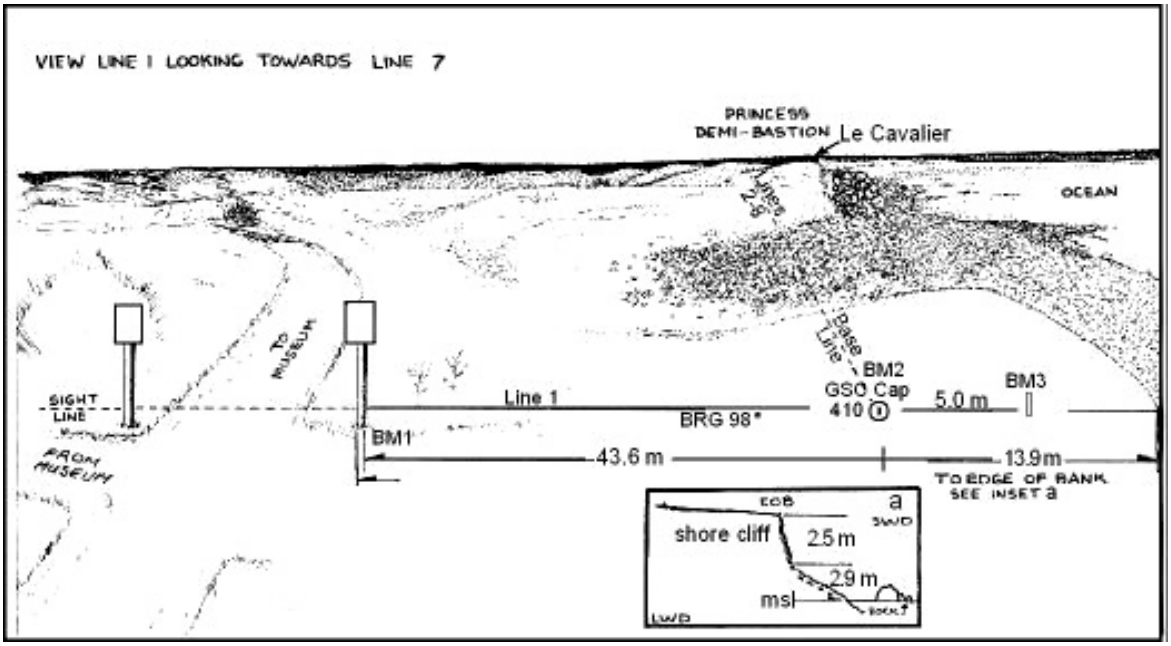
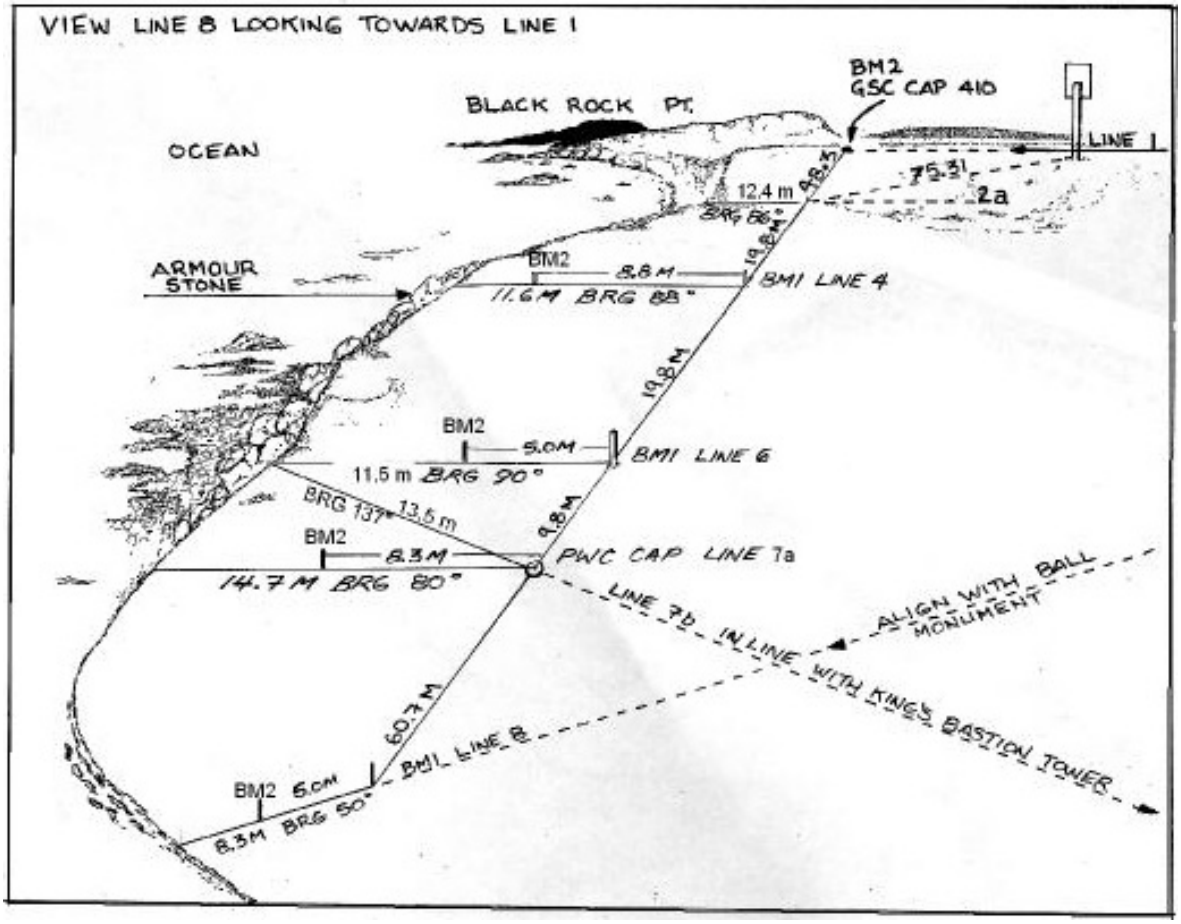


Figure 1533-2. Sketches of site 1533 Princess Bastion and Le Cavalier showing (a) view east at line 1 and (b) view west from line 8 showing line markers and their distance from the cliff edge in 2011. Lines 3 and 5 were not included in the 2011 survey lines and line 8 was added.



Site 1533

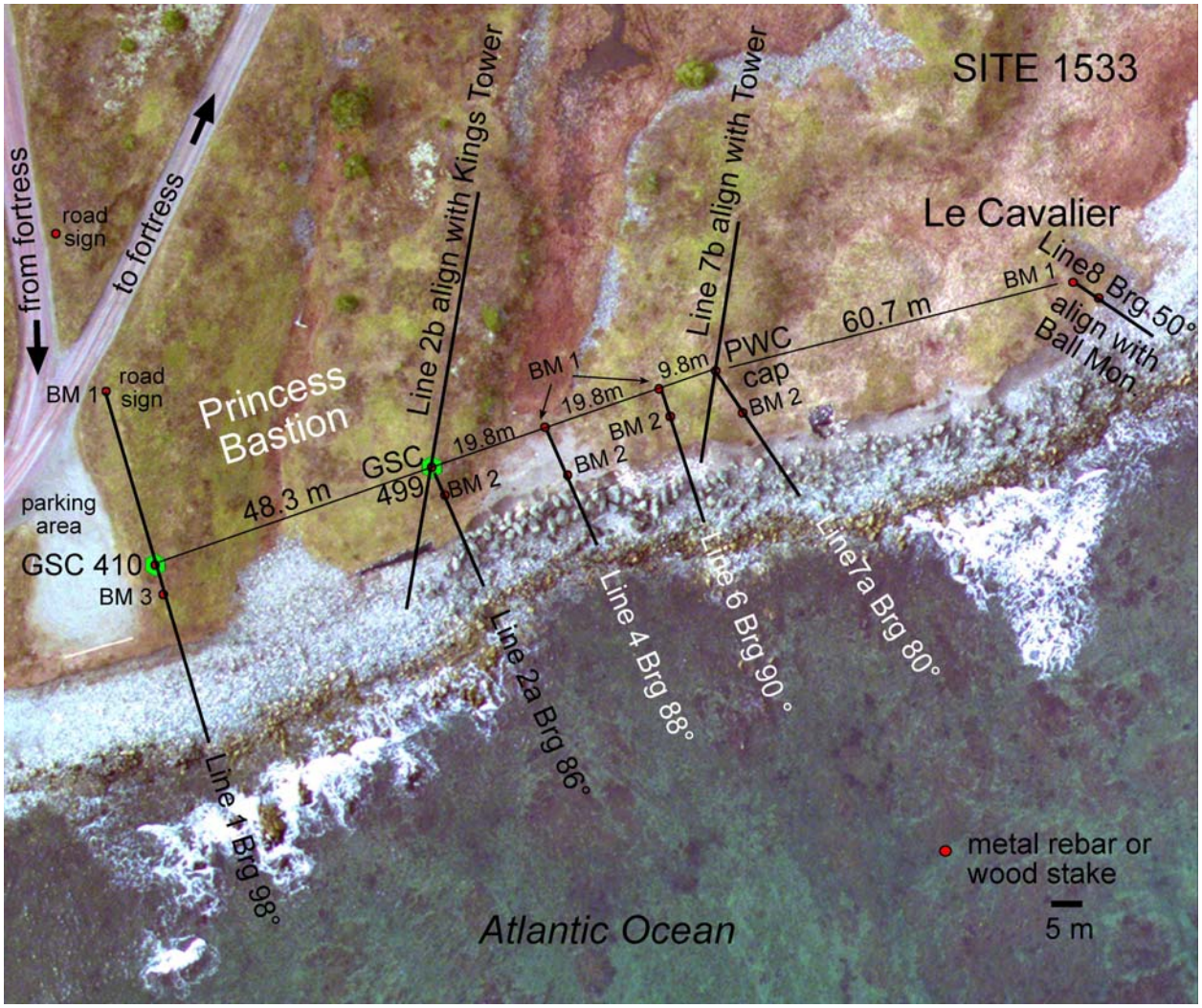
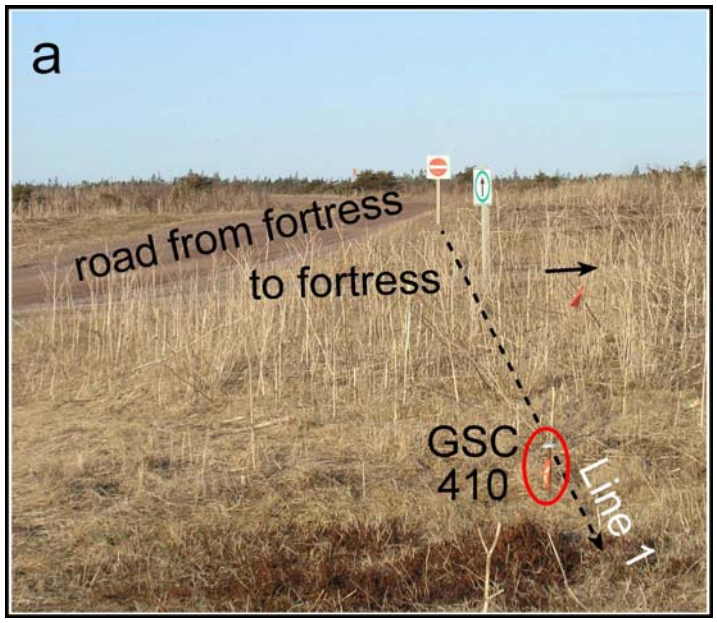
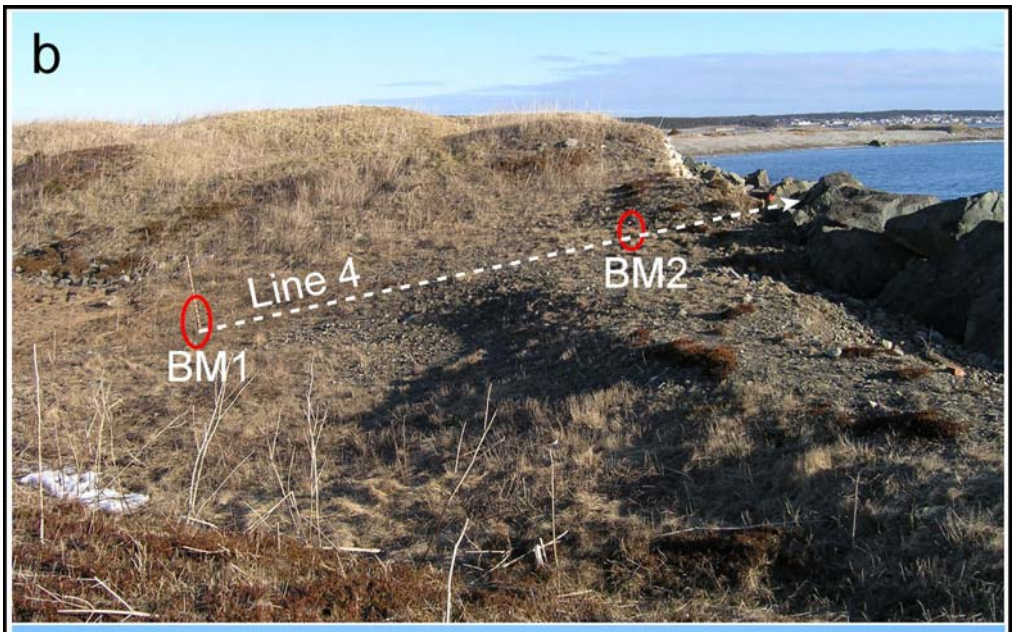


Figure 1533-3. Location map of survey lines and markers at Princess Bastion and Le Cavalier Site 1533 plotted in ARCGIS on a georectified 2010 vertical air photograph. The photo provides a good view of the distribution of armour rock between lines 2a and 6 and extent of wave erosion behind the rock in 2010.

Site 1533





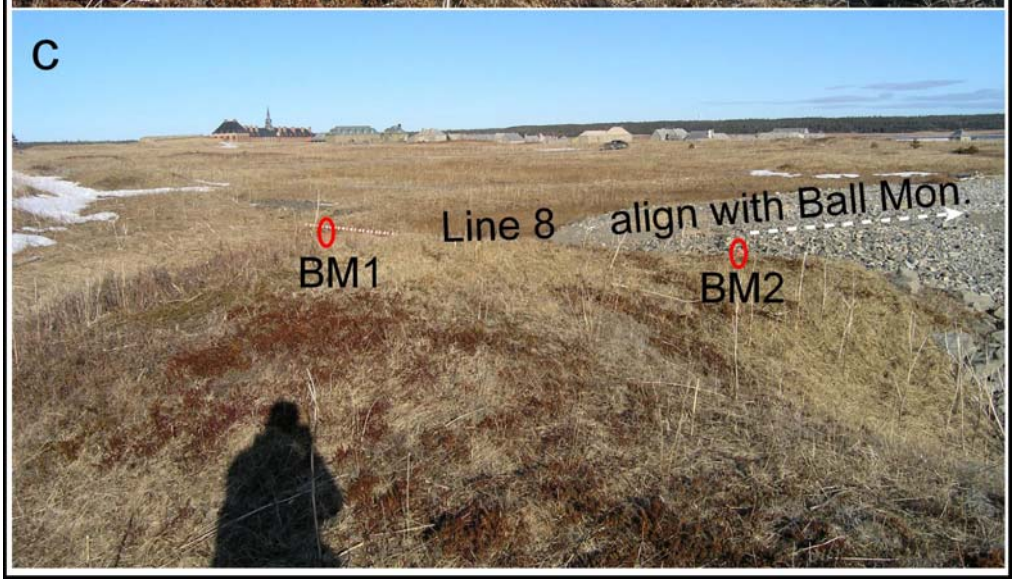


Figure 1533-4. Views of line markers on (a) Line 1, and (b) Line 4 at Princess Bastion and (c) Line 8 at Le Cavalier where measurement to cliff edge is aligned with the Ball Top monument located toward Rochefort Pt. Line markers are metal rebars, some with GSC caps.

Site 1533

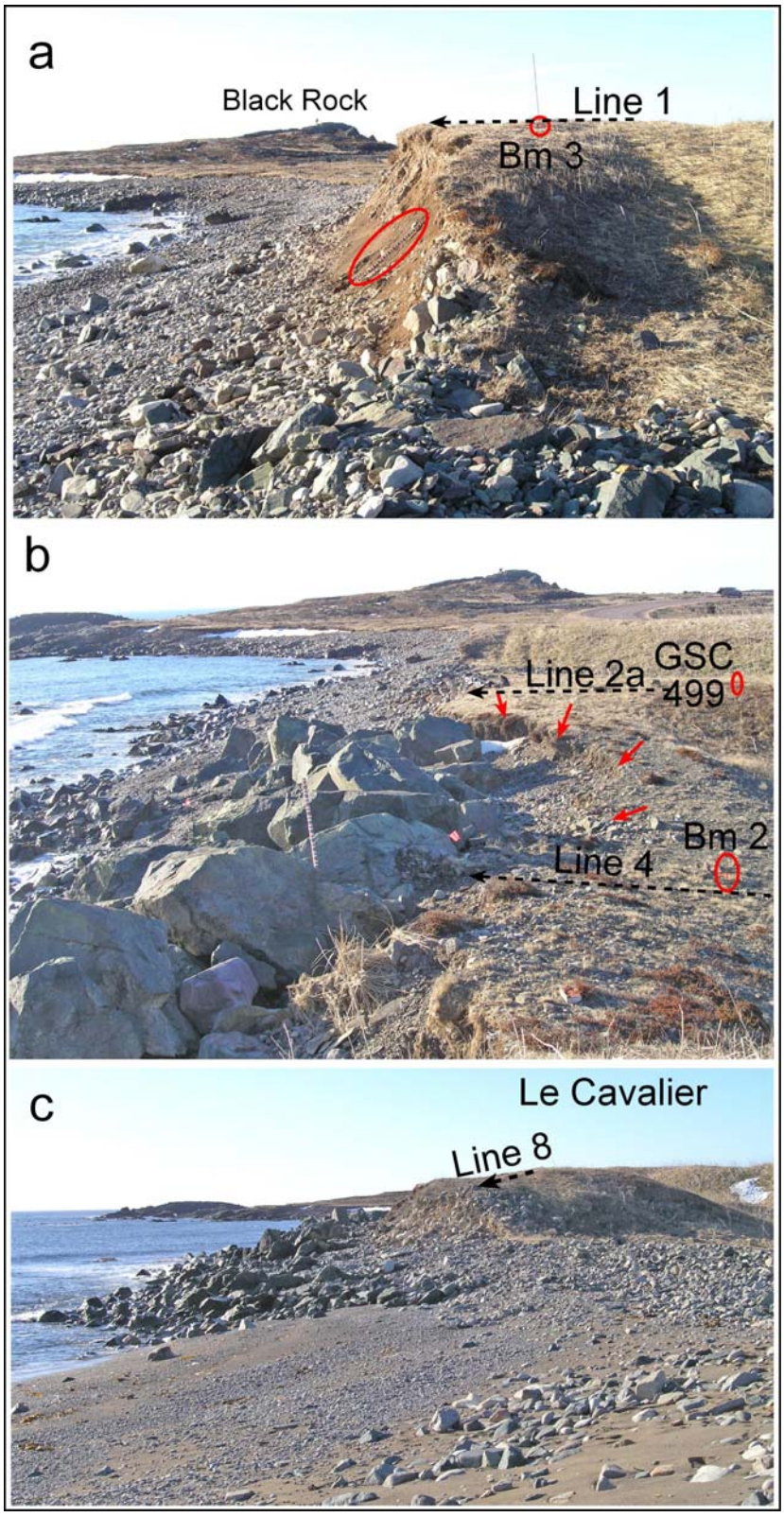


Figure 1533-5. Examples of cliff face conditions along Princess Bastion and Le Cavalier and locations where repetitive photos should be collected in the future to illustrate changes. (a) Line 1 is a natural cliff face, unprotected by armour rock (1.5m long staff circled for scale). (b) Between lines 2a and 4 armour rock exists but wave run-up has scoured a hollow (red arrows) landward of the rock; (c) cliff face erosion has accelerated as waves wrap around the headland at le Cavalier. Line 8 was established in 2011 to help document the changes. A rock defense is accumulating naturally seaward of line 8 but will become less effective in time as sea level rises and submerges the rock.

SITE NO.	SHORE TYPE	GEOGRAPHIC NAME	COUNTY	PROVINCE	NTS REF	HORIZ DATUM	VERTICAL DATUM
1533	CLIFF	PRINCESS BASTION & LE CAVALIER	CAPE BRETON	NOVA SCOTIA	11G/13	NAD 83 Z20	GEODETIC

ACCESS

The site is located on the grounds of the Fortress. Vehicle access is only possible with permission from park fire & security staff. From town of Louisbourg follow the road to Kennington Cove to the Back Service Road gatehouse. Once through the gate follow the dirt road to the sea. Park at the vehicle pulloff on the seaward side of the road just past Black Rock. Line 1 is at the parking area and lines 2 to 7 are farther east. The survey lines cross a series of hills and valleys. Lines 3 and 5 were not re-established in 2011 (see 1996 report for details). **Le Cavalier** Line 8 established in 2011 is at the east end of Princess Bastion adjacent to beach site 1534.

SITE INFORMATION (2011)

LINE	BM TYPE	LATITUDE°	LONGITUDE°	EASTING*	NORTHING*	ELEVATION*	LINE	BM TYPE	LATITUDE°	LONGITUDE°	EASTING*	NORTHING*	ELEVATION*
1	GSC CAP 410	45.888591450	-59.978814900	734403.177	5086108.557	6.150	6	WD STK+NAIL	45.889347150	-59.979148533	734374.086	5086191.458	5.726
1	WD 1x3	45.888600967	-59.978713600	734407.996	5086109.913	6.287	6	THIN REBAR	45.889362783	-59.979088933	734378.657	5086193.459	6.116
2	GSC CAP 499	45.889006600	-59.978999850	734387.080	5086154.137	5.249	7	PWC CAP	45.889432867	-59.979181167	734371.217	5086200.943	8.106
2	THIN REBAR	45.889024567	-59.978940167	734391.605	5086156.337	5.426	7	SPIKE	45.889470550	-59.979090950	734378.057	5086205.464	6.821
4	WD STAKE+Rebar	45.889176833	-59.979075467	734380.432	5086172.803	3.245	8	THIN REBAR	45.889967067	-59.979340833	734356.582	5086259.842	6.312 (baseonly)
4	THIN REBAR	45.889207150	-59.978972617	734388.415	5086176.489	4.686	8	THIN REBAR	45.890003950	-59.979306117	734359.120	5086264.042	6.174

LINE NO.	GSC BM	SURVEY DATE (D/M/Y)	LINE BEARING (°)	NO YEARS BTW SURVEY	RETREAT (m) BTW SURVEY	TOTAL CUM NO YEARS	CUM RETREAT (m)	CUM RETREAT (m\a)	BM TO CLIFF EDGE (m) BM 1 TO CE	BM 2 TO CE	BM 3 TO CE	SURVEY METHOD	CLIFF TOP ELEVATION (m)
1		5-Dec-95	96						45.73	15.83		TAPE	
		11-Jun-96	96	0.50	0.07	0.50	0.07	0.14	45.64	15.76		TAPE	
		5-Nov-97	96	1.42	0.00	1.92	0.07	0.04	46.00	15.80		RTK/TAPE	5.3
		25-Jun-98		0.63	0.00	2.55	0.07	0.03		15.80		TAPE	
		3-Feb-00		1.62	0.29	4.17	0.36	0.09		15.51		TAPE	
		22-Nov-00		0.81	0.08	4.98	0.44	0.09		15.43		TAPE / RTK	
		5-Jun-02		1.54	0.17	6.52	0.61	0.09		15.26		TAPE	
		10-Mar-05		2.75	0.11	9.27	0.72	0.08		15.15		TAPE	
		17-Dec-08		3.75	0.63	13.02	1.35	0.10		14.52		TAPE	
	410	29-Mar-11	98	2.25	0.61	15.27	1.96	0.13	43.64	13.91	8.85	RTK	5.5
2a	499	5-Dec-95	90						13.55			TAPE	
		11-Jun-96	90	0.50	0.10	0.50	0.10	0.20	13.45			TAPE	
		5-Nov-97	90	1.42	0.13	1.92	0.23	0.12	13.32			RTK/TAPE	4.7
		25-Jun-98	90	0.63	0.07	2.55	0.30	0.12	13.25			TAPE	
		3-Feb-00	90	1.62	0.37	4.17	0.67	0.16	12.88				
		22-Nov-00		0.81	-0.02	4.98	0.65	0.13	12.90			RTK	
		10-Mar-05	90	4.33	-0.35	9.31	0.30	0.03	13.25			TAPE	
		29-Mar-11	86	6.00	0.85	15.31	1.15	0.08	12.40	7.30		RTK/TAPE	4.4
2b	499	5-Dec-95	138						19.00			TAPE	
		11-Jun-96	138	0.50	0.05	0.50	0.05	0.10	18.95			TAPE	
		5-Nov-97	138	1.42	0.00	1.92	0.05	0.03	18.95			RTK	4.7
		25-Jun-98	138	0.63	1.10	2.55	1.15	0.45	17.85			TAPE	

Site 1533 continued

LINE NO.	GSC BM	SURVEY DATE (D/M/Y)	LINE BEARING (°)	NO YEARS BTW SURVEY	RETREAT (m) BTW SURVEY	TOTAL CUM NO YEARS	CUM RETREAT (m)	CUM RETREAT (m\a)	BM TO CLIFF EDGE (m) BM1 TO CE	BM2 TO CE	BM3 TO CE	SURVEY METHOD	CLIFF TOP ELEVATION (m)
4		5-Dec-95	90						12.80			TAPE	
		11-Jun-96	90	0.50	0.05	0.50	0.05	0.10	12.75	4.04		TAPE	
		5-Nov-97	90	1.42	-0.10	1.92	-0.05	-0.03	12.85	4.09		RTK/TAPE	4.8
		3-Feb-00	90	2.25	0.25	4.17	0.20	0.05	12.60	3.76		TAPE	
		5-Jun-02		2.33	1.06	6.50	1.26	0.19	11.54			TAPE	
		29-Mar-11	88	8.75	-0.03	15.25	1.23	0.08	11.57	2.76		TAPE	4.6

LINE NO.	GSC BM	SURVEY DATE (D/M/Y)	LINE BEARING (°)	NO YEARS BTW SURVEY	RETREAT (m) BTW SURVEY	TOTAL CUM NO YEARS	CUM RETREAT (m)	CUM RETREAT (m\a)	BM TO CLIFF EDGE (m) BM1 TO CE	BM2 TO CE	BM3 TO CE	SURVEY METHOD	CLIFF TOP ELEVATION (m)
6		5-Dec-95	90						11.85	1.40		TAPE	
		11-Jun-96	90	0.50	0.00	0.50	0.00	0.00	11.85	1.94		TAPE	
		5-Nov-97	90	1.42	0.05	1.92	0.05	0.03	11.80	1.94		RTK/TAPE	6.5
		25-Jun-98	90	0.63	0.05	2.55	0.10	0.04	11.75	1.81		TAPE	
		3-Feb-00	90	1.62	0.04	4.17	0.14	0.03	11.71	*1.77*		TAPE	
		22-Nov-00		0.81	0.18	4.98	0.32	0.06	11.53	1.67		RTK	
		5-Jun-02		1.54	-0.13	6.52	0.19	0.03	11.66			TAPE	
		29-Mar-11	90	8.79	0.20	15.31	0.39	0.03	11.46	6.45		RTK / TAPE	6.3
7a	PWC CAP	5-Nov-97	90						16.35			RTK/TAPE	4.1
		25-Jun-98	90	0.63	0.15	0.63	0.15	0.24	16.2			TAPE	
		10-Mar-05	90	6.7	2.60	7.33	2.75	0.38	13.6			TAPE	
		17-Dec-08	90	3.75	0.35	11.08	3.10	0.28	13.25			TAPE	
		29-Mar-11	90	2.25	0.00	13.33	3.10	0.23	13.3			TAPE	
		29-Mar-11	**80**				**1.95**	(1997-11) RTK	14.4	6.35		RTK	5.1
7b	PWC CAP	5-Dec-95	137						14.43			TAPE	
	PWC CAP	11-Jun-96	137	0.50	0.09	0.50	0.09	0.18	14.34			TAPE	5.4
		5-Nov-97	137	1.42	0.04	1.92	0.13	0.07	14.30			RTK/TAPE	
		3-Feb-00	137	2.25	0.00	4.17	0.13	0.03	14.30			TAPE	
		5-Jun-02		2.33	-0.10	6.50	0.03	0.00	14.40				
		17-Dec-08		6.50	0.77	13.00	0.80	0.06	13.63			TAPE	
		29-Mar-11		2.25	0.18	15.25	0.98	0.06	13.45			RTK/TAPE	
	LINE 7b IS AT SAME LOCATION AS LINE 6 SO ONLY USE IF YOU DONT HAVE A COMPASS & MUST ALIGN WITH KINGS TOWER												
	LINE 7A with RTK was completed at 80 not 90 degrees in 1997 and 2011												

LE CAVALIER at east end of Princess Bastion

LINE NO.	GSC BM	SURVEY DATE (D/M/Y)	LINE BEARING (°)	NO YEARS BTW SURVEY	RETREAT (m) BTW SURVEY	TOTAL CUM NO YEARS	CUM RETREAT (m)	CUM RETREAT (m\a)	BM TO CLIFF EDGE (m) BM1 TO CE	BM2 TO CE	BM3 TO CE	SURVEY METHOD	CLIFF TOP ELEVATION (m)
8		29-Mar-11	50						8.30	3.34		TAPE/RTK	5.2

° LATITUDE AND LONGITUDE ARE IN DECIMAL DEGREES AND ARE A CONVERSION OF MARCH 2011 RTK UTM USING GSRUG http://www.geod.nrcan.gc.ca/tools-outils/index_e.php

*Geographic positions and elevations based on N.S. CONTROL MONUMENT 2094 BLACK ROCK Elevation 12.827 m; Easting (734481.365) Northing (5085932.243) NAD 83 UTM GRID: Z 20

LINE BEARING (DEGREES MAGNETIC)

Site 1533 continued

DISTANCE BETWEEN LINES (2011)

LINE #1-2:	48.33 m
LINE #2-4:	19.81 m
LINE #4-6:	19.76 m
LINE #6-7:	9.86 m
LINE #7-8	60.7 m

1) BMS OF L2 to L7 ARE ESTABLISHED ON A BASELINE
ALIGNED 194 ° BTWN L1 (GSC 410) AND L7 (PWC CAP) :

2) DISTANCE L1 (GSC CAP 410) to L2 (GSC CAP 499) IS 48.33 m

3) DISTANCE L2 (GSC CAP 499) TO L1 (SIGN POST) IS 75.31 M BRG 236° MAG
(MEASURED FROM CORNER OF SIGNPOST CLOSEST TO L2)

4) LINE 2b and 7b ARE POOR ANGLES TO CLF EDGE -USE IF NO COMPASS AVAILABLE
AND NEED TO USE KINGS TOWER FOR ALIGNMENT

REFERENCE NOTEBOOKS:

5-Dec-95	OWEN BROWN NOTES
11-Jun-96	INFO ON FORMS
5-Nov-97	RTK SURV; CBI/95 P63
25-Jun-98	RTK SURV; CBI/95 P89
3-Feb-00	INFO ON FORMS (O.BROWN/B.DUNHAM)
22-Nov-00	RTK SURV; CBI 98/1 P36,38
5-Jun-02	R DUGGAN /B. CUNNINGHAM (PARKS)
10-Mar-05	CBI2001 P66
17-Dec-08	CBI2001 P71
29-Mar-11	CBI2001 p82-84

NOTE: 02-FEB-00 LOCATED RIP RAP BOULDERS WITH WHITE CORRECTION FLUID WHICH INDICATE FORMER SOIL (FILL) LINE
REPAINTED BOULDERS WITH WHITE CORRECTION FLUID. SEE PHOTOS ON CD

BENCH MARK HISTORY: SITE 1533

LINE 1:

5-Dec-95	BM1 (RD SIGN POST) ; BM2 (SANDSTONE SLAB) 29.9 M SWD OF BM1; ALIGNMENT WITH TWO RD SIGNS , MEASURE FROM SCRATCH MARK AT SWD EDGE OF ROCK SLAB.
11-Jun-96	ALL BMS INTACT
5-Nov-97	TWO SIGN POSTS AND ROCK SLAB IN PLACE (WD STK MARKS EDGE ROCK SLAB); RTK SURVEY OF LINE TO WLO
25-Jun-98	TWO SIGN POSTS AND ROCK SLAB IN PLACE (WD STK MARKS EDGE ROCK SLAB); NO APPARENT CHANGE
3-Feb-00	ONE SIGN POST CLOSEST TO ROCK SLAB IN PLACE. SIGN POST CLOSEST TO MUSEUM NOT IN ORIGINAL POSITION; SOME OVERHANG @ CLIFF EDGE.
22-Nov-00	BM1 (RD SIGN POST) ; BM2 (SANDSTONE SLAB) INTACT; SURVEYED FROM ROCK SLAB TO WLO; SOD BLOCKS ~1M FALLEN W OF LINE
5-Jun-02	ALIGNED WITH TWO SIGN POSTS BUT NOT ALIGNED WITH BEARING
10-Mar-05	BM1 APPEARS INTACT NOT MEASURED; BM2 INTACT (ROCK SLAB, NO WD STK) , SNOW DRIFT AT CLIFF FACE
17-Dec-08	BM1 APPEARS INTACT NOT MEASURED; BM2 INTACT (ROCK SLAB, NO WD STK) ,
29-Mar-11	BM1 (sign post -in summer direction arrow and in winter no entry)) BM2 (rock slab) was removed -replaced with GSC cap 410 using RTK ; and added BM3 (1x3 wd stake = 0.45m) 4.98 m swd of GSC cap (RTK survey BM2

BENCH MARKS PRESENTLY INTACT: BM1 (4X4 ROAD SIGN) & BM2 (GSCcap 410), BM3 (1x3 wd stake) BM1 to Bm2 = 29.73m Bm2 to Bm3= 4.98 m

LINE 2:

5-Dec-95	BM1 (GSC 499) TWO ALIGNMENTS TO CE (1) L2a 90° FROM BM1 TO CE and (2) L2b 132° (ALIGN WITH BM AND KINGS BASTION AT 312 ° .
11-Jun-96	BM1 WAS INTACT
5-Nov-97	BM1 (GSC 499) INTACT; RTK SURVEY OF LINE 2A TO WLO
25-Jun-98	BM1 (GSC 499) INTACT; FOGGY CANT SEE TOWER EROSION AT OUTER EDGES OF RIP RAP AND BTWN RIP RAP
3-Feb-00	BM1 WAS INTACT; MEASURED LINE 2B BUT GOT A LARGE MEASUREMENT DID NOT USE.
22-Nov-00	BM1(GSC 499, WD STK) INTACT AND BM2 (WD STK) ADDED IN 98 OR 00, ; RTK SURVEY FROM CAP TO WLO
10-Mar-05	BM1(GSC499) INTACT, ALIGNED 90 NOT WITH STK ON CLIFF TOP
29-Mar-11	BM1(GSC499, wd stake) INTACT, added BM2 (thin rebar = 0.4 m) 5.04 m seaward of BM1 (RTK survey GSCcap to WLO)

BENCH MARKS PRESENTLY INTACT: BM1 (GSC cap 499) and BM2 (thin rebar) BM1 to BM2 =5.04 m

LINE 3:

5-Dec-95	BM1 (WD STAKE) 10 M EAST OF L2
11-Jun-96	BM1 INTACT
5-Nov-97	BM1(WD STK) INTACT
3-Feb-00	BM1(WD STK) INTACT
5-Jun-02	NO DATA

Site 1533 continued

BENCH MARKS PRESENTLY INTACT: not reestablished in 2011

LINE 4:

5-Dec-95	BM1 (WD STAKE) 20 m EAST L2; 30 m WEST OF L7
11-Jun-96	BM1 (WD STAKE) 20 m EAST L2; 30 m WEST OF L7, BM2 (FLOURSCENT RED WD STAKE) 8.71 M SWD BM1
5-Nov-97	BM1(WD STK) AND BM2 (WD STK) IN TACT
3-Feb-00	BM1(WD STK) AND BM2 (WD STK) IN TACT
5-Jun-02	NO DATA
29-Mar-11	BMS replaced: BM1(wd stake and rebar =0.36 m) and BM2 (thin reba r=0.34 m) established 8.67 m (RTK) or 8.8m (tape) seaward of BM1 (RTK survey from BM1 to WLO)

BENCH MARKS PRESENTLY INTACT: BM1 (WD STAKE & rebar) & BM 2 (thin rebar) BM1 to BM2 =8.8 m

LINE 5:

5-Dec-95	BM1 (WD SLAT), 30 m EAST OF L2; BM2(WD SLAT) 10m SWD BM1
11-Jun-96	BM1 (WD SLAT), 30 m EAST OF L2; BM2 REPLACED WITH RED PAINTED WOOD STAKE 9.97m SWD BM1
5-Nov-97	BM1 (WD SLAT), 30 m EAST OF L2; BM2(WD STAKE) 10m SWD BM1
3-Feb-00	BM1 (WD SLAT), 30 m EAST OF L2; BM2(WD STAKE)
5-Jun-02	NO DATA
10-Mar-05	BM1 (GONE) ; BM2(WD STK) APPEARS INTACT?? MAY BEANOTHER STK

BENCH MARKS PRESENTLY INTACT: BM 2 WD STAKE

LINE 6:

5-Dec-95	BM1 (WD SLAT) 40 M EAST OF L2; BM2 (ROCK) 10.45 m SWD OF BM1
11-Jun-96	BM1 (WD SLAT) 40 M EAST OF L2; ORIGINAL BM2 (ROCK) HAS BEEN MOVED & REPLACED BY A FLUORESCENT RED-TOPPED STAKE 9.91M m SWD OF BM1
5-Nov-97	BM1 (WD SLAT) AND BM2 (WD STK) INTACT; RTK SURVEY OF LINE TO WLO
25-Jun-98	BM1 (WD SLAT) AND BM2 (WD STK) INTACT; CUTTING INTO BANK EAST OF LINE
3-Feb-00	BM1 (WD SLAT) AND BM2 (WD STK) INTACT
22-Nov-00	BM1 (WD SLAT) AND BM2 (WD STK) INTACT
5-Jun-02	BM1 INTACT
29-Mar-11	NEW BMS: BM1(wd stake=0.52and thin rebar) and BM2 (thin rebar=0.25) 4.94 m swd of BM1 (RTK survey from BM1 to WLO)

BENCH MARKS PRESENTLY INTACT: BM1 (REBAR & WD SLAT) & BM 2 (thin rebar) BM1 to BM2 = 4.94 m

LINE 7:

5-Dec-95	BM1(PWC CAP) 50 M EAST OF L2; TO MEASURE ALIGN PWC CAP WITH KINGS BASTION TOWER ON A BEARING OF 317° MAG
11-Jun-96	BM1 INTACT
5-Nov-97	BM1 (PWC CAP) INTACT, PHOTOS CONFIRM SLUMPING AND EROSION OF MATERIAL, RTK surveys to CE at 90° (L7a) and 134° (L7b)
25-Jun-98	**BM1 (PWC CAP) INTACT, only measured Line 7a 90° TO CAP**
3-Feb-00	BM1 INTACT
5-Jun-02	BM1 (PWC CAP) INTACT -ONLY MEASURED LINE 7B
10-Mar-05	BM1 (PWC CAP) INTACT -ONLY MEASURED LINE 7A AT 90°
17-Dec-08	BM1 (PWC CAP) INTACT - MEASURED LINE 7A AT 90°and &b with Kings Bastion tower steeple
29-Mar-11	BM1 (PWCcap) intact and for Line 7a at 80° mag BM2 (spike =0.12m) added 8.2 m swd of BM1. Line 7b align PWC cap and Kings Bastion Tower (RTK Survey BM1 to CE) Line 7a is a slightly different orientation than earlier lines and the same as L7a RTK line from 1997.

BENCH MARKS PRESENTLY INTACT: L7a BM1 (PWC CAP) and BM2 (spike) BM1 TO BM2= 8.2 m.

Le CAVALIER

LINE 8:

Two thin rebars established 4.96m apart at the east corner of the mounds (RTK survey from BM1 to base cliff)

BENCH MARKS PRESENTLY INTACT: BM1(THIN REBAR) AND BM2 (THIN REBAR) BM1 to Bm2 =4.96 m

Site 1534

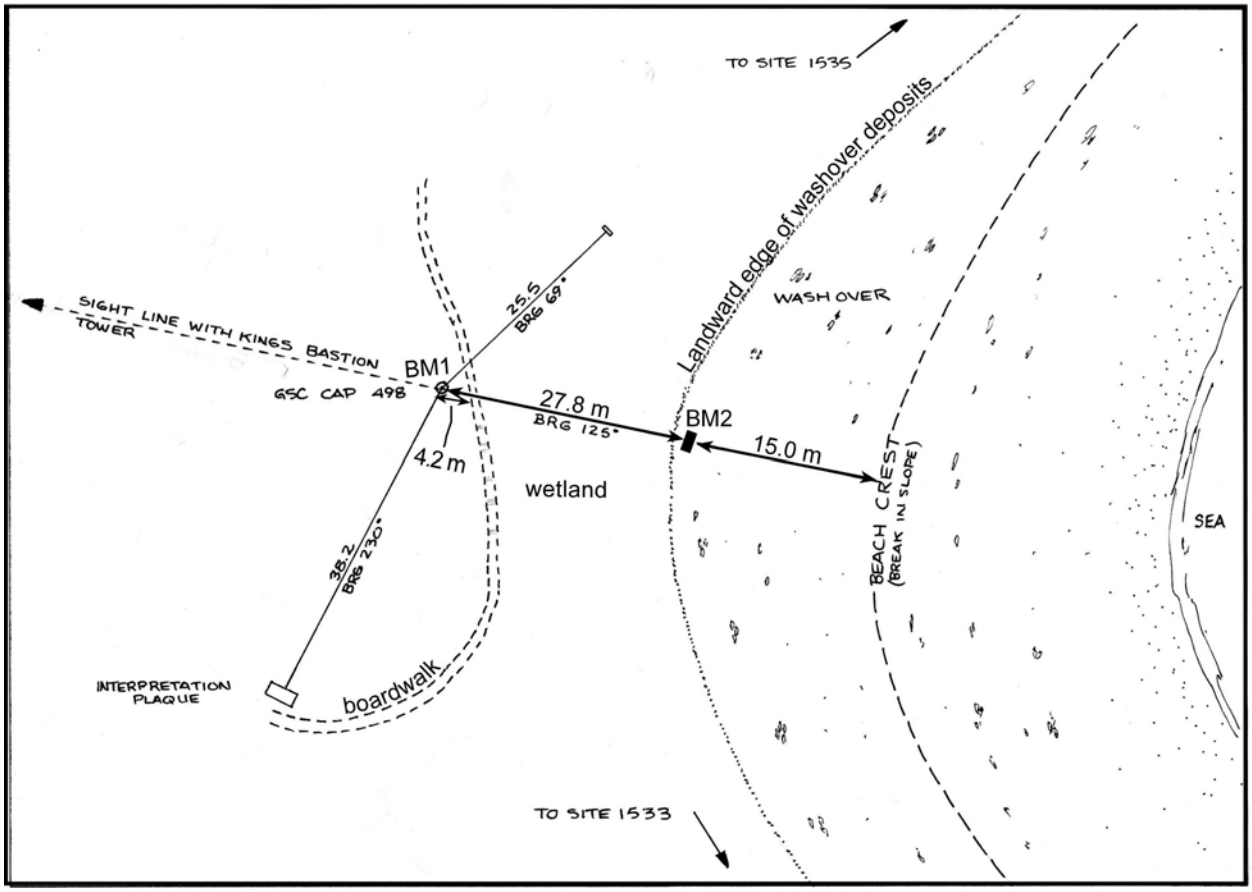


Figure 1534-1 Sketch of site 1534 showing the location of line markers relative to the landward extent of washover deposits and the beach crest.

Site 1534

Figure 1534-2 Le Cavalier Line 8 is the best location to obtain an overview photo of site 1534 and landward migration of the beach.

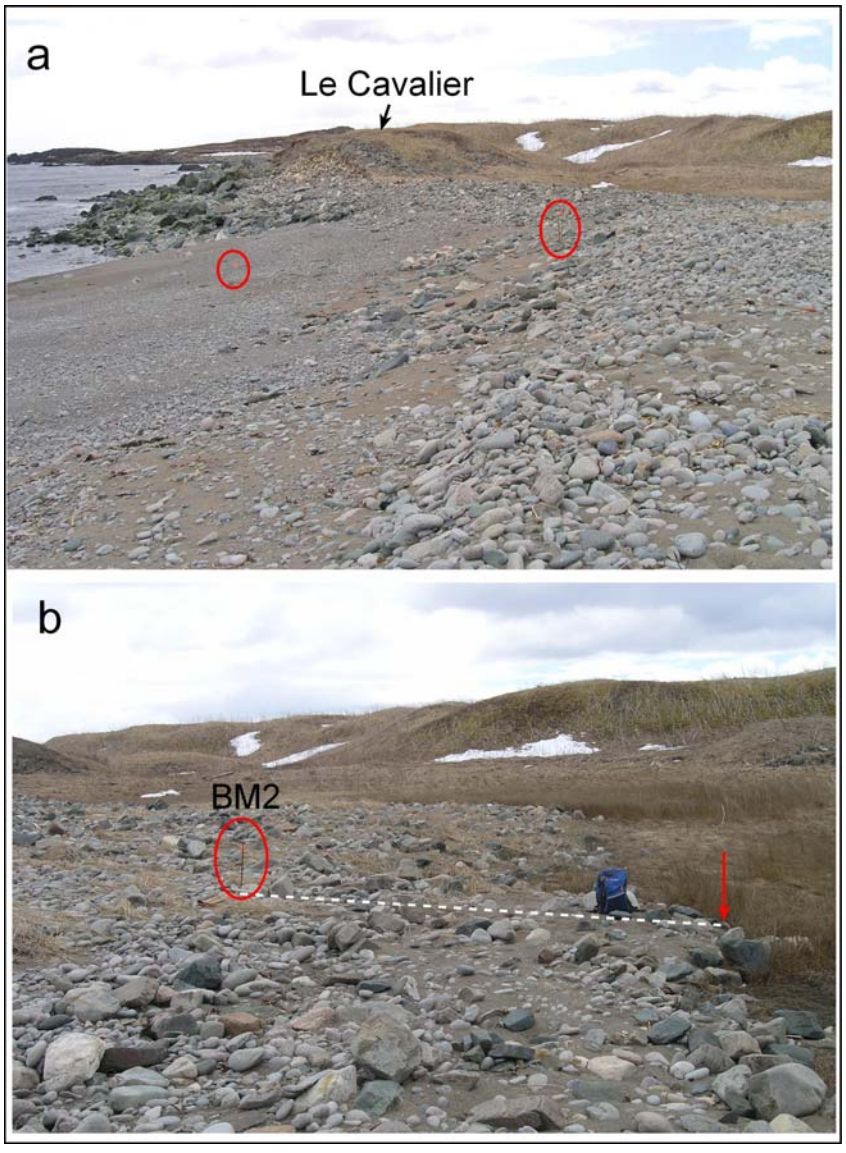


Figure 1534-3. Photos of (a) the beach slope (circles outline temporary flags marking the survey line) and (b) the landward edge of wave washover deposits. This position should be measured routinely to document changes in the composition and landward extent of wave overwash. (b) the arrow marks the edge of washover deposits where a cobble, (wrapped by orange flagging as part of a former cairn at BM2) was pushed landward, probably during the storms in December 2010.

SITE NO.	SHORE TYPE	GEOGRAPHIC NAME	COUNTY	PROVINCE	NTS REF	HORIZ DATUM	VERTICAL DATUM
1534	BEACH	PRINCESS BASTION	CAPE BRETON	NOVA SCOTIA	11G/13	NAD 83 Z 20	GEODETIC

ACCESS

The site is located within the Fortress grounds. Vehicle access is only with permission from park fire & security staff. Use Back Service Road and park just east of Black Rock.
If walking, follow the road from the Museum to the seaward edge of the Princess Bastion. The survey line is in the low wetland just to the east of the Bastion;
and the GSC BM is 4.2 m landward of a boardwalk that extends across the low wetland.

SITE INFORMATION (2011)

LINE	BM TYPE	LATITUDE°	LONGITUDE°	NORTHING*	EASTING*	ELEVATION*
1	CAP 498	45.890473250	-59.980120633	5086313.787	734293.953	3.157(top)
1	THIN REBAR	45.890429614	-59.979767572	5086309.977	734321.528	3.157 (top)

BEACH MIGRATION SURVEYS

LINE NO.	GSC BM	SURVEY DATE (D/M/Y)	LINE BEARING (°)	NO YEARS BTW SURVEY	CRST RETREAT (m) BTW SURVEY	TOTAL CUM NO YEARS	CUM CREST RETREAT (m)	CUM RETREAT (m/a)	BM 1 TO LWD EDGE WO	BM 1 TO BEACH CREST	BM 2 TO BCH CREST	BEACH CREST ELEVATION (m)	SURVEY METHOD
1	498	4-Dec-95	125						27.9	50.4	22.5		TAPE
	498	11-Jun-96	125	0.50	0.00	0.50	0.00	0.00	27.9		22.5		TAPE
	498	6-Nov-97		1.42	0.45	1.92	0.45	0.23	27.9	50.0	22.1	2.98	RTK/TAPE
	498	25-Jun-98		0.63	1.35	2.55	1.80	0.71	NO CHANGE		20.7		EMERY
	498	3-Feb-00		1.62		4.17	1.80	0.43			--		TAPE
	498	22-Nov-00		0.81	-1.75	4.98	0.05	0.01	28.0	50.5	22.5	2.87	RTK
		5-Jun-02		1.54	2.01	6.52	2.06	0.32			20.4		TAPE
		17-Dec-08		6.5	4.71	13.02	6.77	0.52	23.0	43.6	*15.7*		EMERY
		29-Mar-11	118	2.25	0.73	15.27	7.50	0.49	22.7	42.9	15.0	3.28	RTK

° LATITUDE AND LONGITUDE ARE IN DECIMAL DEGREES AND ARE A CONVERSION OF MARCH 2011 RTK UTM USING GSRUG http://www.geod.nrcan.gc.ca/tools-outils/index_e.php
*Geographic positions and elevations based on N.S. CONTROL MONUMENT 2094 BLACK ROCK Elevation 12.827 m; Easting (734481.365) Northing (5085932.243) NAD 83 UTM GRID: Z 20
LINE BEARING (DEGREES MAGNETIC)

DISTANCE BETWEEN BENCHMARKS

BM1 (GSC498) to BM2 (thin rebar)=27.9 m

REFERENCE NOTEBOOKS

4-Dec-95	OWEN BROWN NOTEBOOK
11-Jun-96	INFO ON FORMS
6-Nov-97	RTK; CBI/95 P65
25-Jun-98	CBI/95 P90
3-Feb-00	INFO ON FORMS (O. BROWN R. DUNHAM)
22-Nov-00	RTK; CBI 98/1P38
5-Jun-02	R. DUGGAN /B CUNNINGHAM (PARKS)
17-Dec-08	CBI2001,pg72
29-Mar-11	CBI2001 p80

BENCH MARK HISTORY: SITE 1534

LINE 1:

4-Dec-95	BM1 (GSC 498) BM2 (2 WD SLATS IN CAIRN) AT EDGE WASHOVER 27.87 m SWD OF BM1
11-Jun-96	BM1 (GSC 498) and BM2 ARE ALIGNED WITH THE KINGS BASTION TOWER
6-Nov-97	BM1(GSC498) AND BM2 (WD STK/CAIRN) INTACT; LINE SURVEYED TO SWASH WITH RTK
25-Jun-98	BM1(GSC498) AND BM2 (WD STK/CAIRN) INTACT; LINE SURVEYED TO SWASH WITH EMERY POLES, NO CHANGE LWD OF CAIRN;
3-Feb-00	BM1(GSC498) AND BM2 (WD STK/CAIRN) INTACT; DIFFICULT TO ESTABLISH CREST, SECTION HAS WASHED OVER WITH GRAVELS DEPOSITED LANDWARD OF BM2 INTO FROZEN WATER - UNABLE TO LOCATE EDGE OF WASH. SEE PHOTOS
22-Nov-00	BM1(GSC 498) AND BM2 (WD STK/CAIRN) INTACT ; SURVEYED TO WLO, NO CHANGE LWD OF CAIRN; BEACH CREST REBUILT SINCE JAN STORM
5-Jun-02	BM1 AND BM2 INTACT, BCH CREST NOT WELL DEFINED APPEARS SHIFTED LWD
17-Dec-08	BM1 (cap 498) intact and but BM2 not found so added a new cairn taped same distance from BM1 -emery pole survey.
29-Mar-11	BM1 (GSC 498=0.1 m) intact and established a new BM2 (thin rebar=0.50m) at 1979 cairn location 27.9 m swd of BM1. (RTK survey BM1 to WLO)

BENCH MARKS PRESENTLY INTACT: BM1 (GSC 498) & BM2 (thin rebar) and (ribbon on one rockat Lwd edge WO) BM1 to BM2 =27.9 m

Site 1536

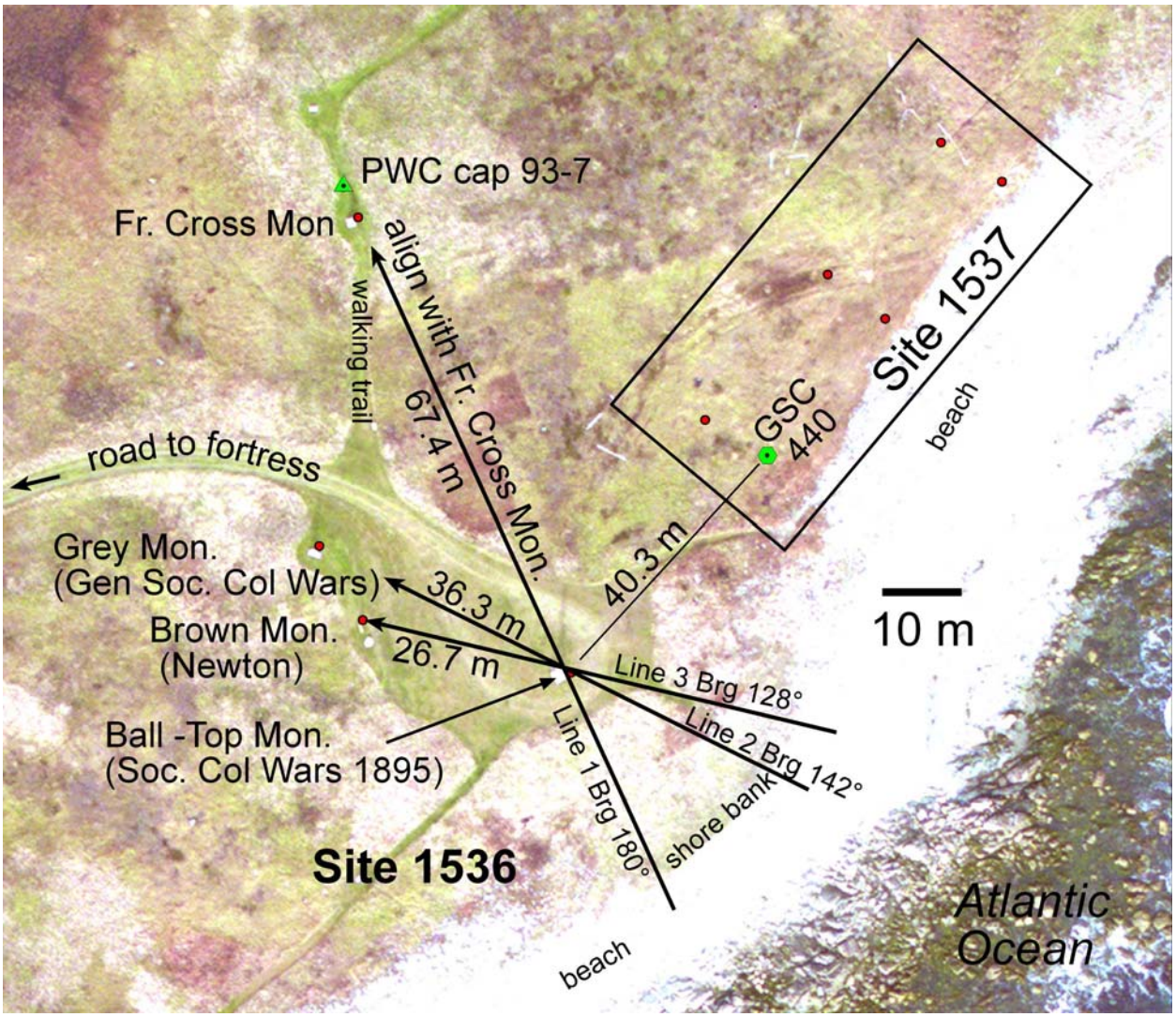


Figure 1536-1. Site map with location of three survey lines from "Ball Top" Monument. Measurements are aligned between "Ball Top" monument and specific monuments located farther landward. Site was selected to monitor landward migration of the shore bank and landward extent of wave overwash and flooding around historical monuments during storms. Red dots are line markers, the green octagon symbol is a GSC benchmark cap and the green triangle is a PWC benchmark cap.

SITE NO.	SHORE TYPE	GEOGRAPHIC NAME	COUNTY	PROVINCE	NTS REF	HORIZ. DATUM	VERTICAL DATUM
1536	BANK	ROCHEFORT POINT	CAPE BRETON	NOVA SCOTIA	11G/13	NAD 83 Z 20	GEODETIC

ACCESS

The site is located within the Fortress grounds. Vehicle access is only with permision from park fire & security staff. Either park at the museum and walk, or drive and take the first road to the right that leads to Rochefort Point and a group of tall monuments (only visible on clear days).
Lines 1-3 are measured from the seaward base of the "ball-topped" monument.

SITE INFORMATION (1997)

LINE	BM TYPE	LATITUDE°	LONGITUDE°	EASTING*	NORTHING*	ELEVATION**
1	BM1 FR CROSS MON	45.893413292	59.976972664	734525.792	5086649.682	4.226
2	BM1 COL. WARS MON	45.893006532	59.977064425	734520.387	5086604.221	4.925
3	BM1 NEWTON MON	45.892912486	59.976991830	734526.415	5086593.986	4.677
1 TO 3	BM2 BALL TOP MON	45.892836920	59.976624941	734555.196	5086586.670	3.916

CLIFF TOP RECESSION SURVEYS

LINE NO.	GSC BM	SURVEY DATE (D/M/Y)	LINE BEARING (°)	NO YEARS BTW SURVEY	RETREAT (m) BTW SURVEY	TOTAL CUM NO YEARS	CUM RETREAT (m)	CUM RETREAT (m\a)	BM TO BANK EDGE (m) BM1 TO CE	BM TO BANK EDGE (m) BM2 TO CE	SURVEY METHOD	CLIFF/ BANK HEIGHT (m)
1		5-Dec-95	180							32.90	TAPE	
		11-Jun-96	180	0.50	0.09	0.50	0.09	0.18	101.86	32.81	TAPE	
		6-Nov-97		1.42	-0.05	1.92	0.04	0.02	102.39	32.86	RTK	0.20
		3-Feb-00	180	2.25	1.46	4.17	1.50	0.36		31.40	TAPE	
		5-Jun-02		2.33	-0.87	6.50	0.63	0.10		32.27	TAPE	
		10-Mar-05		2.75	0.49	9.25	1.12	0.12		31.78	TAPE	0.30
		17-Dec-08	180	3.75	0.00	13.00	1.12	0.09		31.78	TAPE	
2		5-Dec-95	142							34.65	TAPE	
		11-Jun-96	142	0.50	0.05	0.50	0.05	0.10		34.60	TAPE	
		6-Nov-97		1.42	0.09	1.92	0.14	0.07	73.50	34.51	RTK	0.50
		25-Jun-98	142	0.63	1.01	2.55	1.15	0.45		33.50	TAPE	
		3-Feb-00	142	1.62	1.40	4.17	2.55	0.61		32.10	TAPE	
		5-Jun-02		2.33	-0.41	6.50	2.14	0.33		32.51	TAPE	
		10-Mar-05		2.75	0.51	9.25	2.65	0.29		32.00	TAPE	0.30
		17-Dec-08	142	3.75	-0.40	13.00	2.25	0.17		32.40	TAPE	
3		5-Dec-95	128							36.70	TAPE	
		11-Jun-96	128	0.5	0.03	0.50	0.03	0.06		36.67	TAPE	
		6-Nov-97		1.42	0.42	1.92	0.45	0.23	65.95	36.25	RTK	<0.2
		3-Feb-00	128	2.25	2.55	4.17	3.00	0.72		33.70	TAPE	
		5-Jun-02		2.33	0.13	6.50	3.13	0.48		33.57	TAPE	
		10-Mar-05		2.75	0.32	9.25	3.45	0.37		33.25	TAPE	
		17-Dec-08						no measurement completed				

° LATITUDE AND LONGITUDE ARE IN DECIMAL DEGREES AND ARE A CONVERSION OF NOV'97 RTK UTM USING GSRUG http://www.geod.nrcan.gc.ca/tools-outils/index_e.php
*NORTHING AND EASTING (NAD 83) AND ELEVATION ARE BASED ON DIFFERENTIAL GPS SURVEYS USING BASE STATION AT NSBM2094, BLACK ROCK @ elevation 12.827m
LINE BEARING (DEGREES MAGNETIC)

REFERENCE NOTEBOOKS

5-Dec-95	OWEN BROWN NOTES
11-Jun-96	INFO ON FORMS
6-Nov-97	RTK; CBI /95 P67
25-Jun-98	CBI/95 P91
3-Feb-00	INFO ON FORMS (O.BROWN/B.DUNHAM)
5-Jun-02	R.DUGGAN / B. CUNNINGHAM (PARKS)
10-Mar-05	CBI2001 P67
17-Dec-08	CBI 2001pg76 collected by R Duggan

BENCH MARK HISTORY: SITE 1536

LINE 1:

5-Dec-95	BM1 (FRENCH CROSS "DES FRERES HOSPITALIERS ... 1939" MONUMENT); BM2 (BALL TOPPED "SOCIETY OF COLONIAL WARS 1895" MONUMENT); DIST MEASURED FROM SEAWARD CENTRE BASE OF BALL TOPPED MONUMENT TO SEAWARD TOP EDGE BANK
11-Jun-96	TAPED DISTANCE FROM FRENCH CROSS TO LWD BASE OF BALL TOP MONUMENT IS 67.4 M; (BASE OF BALL TOP IS 1.65 M x 1.65 M; BASE OF FRENCH CROSS IS 1.O7 M x1.07 M); PWC 93-7 CONTROL MONUMENT IS 4.6 M AWAY FROM BASE OF FRENCH CROSS MONUMENT ON A LINE BEARING 5° MAG
6-Nov-97	DIFFERENTIAL GPS SURVEY USING RTK AND BASE STATION AT NS 2094 BLACK ROCK
3-Feb-00	TAPED DISTANCE MEASURED FROM SEAWARD CENTRE BASE OF BALL TOPPED MONUMENT TO SEAWARD TOP EDGE BANK
5-Jun-02	TAPED DISTANCE MEASURED FROM SEAWARD CENTRE BASE OF BALL TOPPED MONUMENT TO SEAWARD TOP EDGE BANK
10-Mar-05	SEAWARD CENTRE BASE OF BALL TOPPED MONUMENT TO SEAWARD TOP EDGE BANK; END OF LINE CLOSE TO OLD NAVIGATION LIGHT FOUNDATION
17-Dec-08	SEAWARD CENTRE BASE OF BALL TOPPED MONUMENT TO SEAWARD TOP EDGE BANK;

BENCH MARKS PRESENTLY INTACT: BM1 (FRENCH CROSS MONUMENT) AND BM2 (BALL TOPPED MONUMENT)

LINE 2:

5-Dec-95	DIST IS MEASURED FROM BM2 (BASE SE CORNER OF BALL TOPPED MONU) TO SWD EDGE VEG, ALIGNED WITH GREY "GENERAL SOCIETY OF COLONIAL WARS 1936" MONUMENT SITUATED FARTHER LANDWARD.
11-Jun-96	TAPED DISTANCE FROM GREY MONUMENT TO LWD BASE OF BALL TOP MONUMENT IS 36.25 M; (BASE OF GREY MONUMENT IS 0.63 M x 1.57 M)
6-Nov-97	DIFFERENTIAL GPS SURVEY USING RTK AND BASE STATION AT NS 2094 BLACK ROCK
25-Jun-98	TAPED DIST; SODS THROWN UP ON GRASS, LOTS OF C,B THROWN UP IN WEST PART OF SITE
3-Feb-00	TAPED DISTANCE AS ABOVE SODS THROWN UP ON GRASS, LOTS OF C,B THROWN UP IN WEST PART OF SITE
5-Jun-02	UNDULATING CLIFF LINE GIVES VARIABLE READINGS
10-Mar-05	OVERWASH PEBBLE AND ICE FROM YESTERDAY, SCARP OF 30CM
17-Dec-08	MEASURED BASE OF MONUMENT TO TOP EDGE BANK

BENCH MARKS PRESENTLY INTACT: BM2 (BALL TOPPED MONUMENT) AND GREY MONUMENT

LINE 3:

5-Dec-95	DIST IS MEASURED FROM BM2 (BASE SE CORNER BALL TOPPED MONU) TO SWD EDGE VEG, ALIGNED WITH SMALL BROWN "SOCIETY OF COLONIAL WARS IN IN THE STATE OF CONNECTICUT 1938" MONUMENT, SITUATED FARTHER LANDWARD.
11-Jun-96	TAPED DISTANCE FROM BROWN MONUMENT TO LWD BASE BALL TOP MONUMENT IS 26.73 M; (BASE OF BROWN MONUMENT IS 0.49 M x 1.14 M)
6-Nov-97	DIFFERENTIAL GPS SURVEY USING RTK AND BASE STATION AT NS 2094 BLACK ROCK
3-Feb-00	TAPED DISTANCE MEASURED FROM BASE BALL TOP MONUMENT
5-Jun-02	UNDULATING CLIFF LINE GIVES VARIABLE READINGS
10-Mar-05	HARD TO MEASURE ON ANGLE THERE IS A NOTCH CUT IN GRASS ON LINE . LOTS OF COBBLE SCATTERED ACROSS BACKSHORE TO EAST
17-Dec-08	LINE NOT SURVEYED DUE TO INCLEMENT WEATHER

BENCH MARKS PRESENTLY INTACT: BM2 (BALL TOPPED MONUMENT) AND BROWN MONUMENT

Site 1537

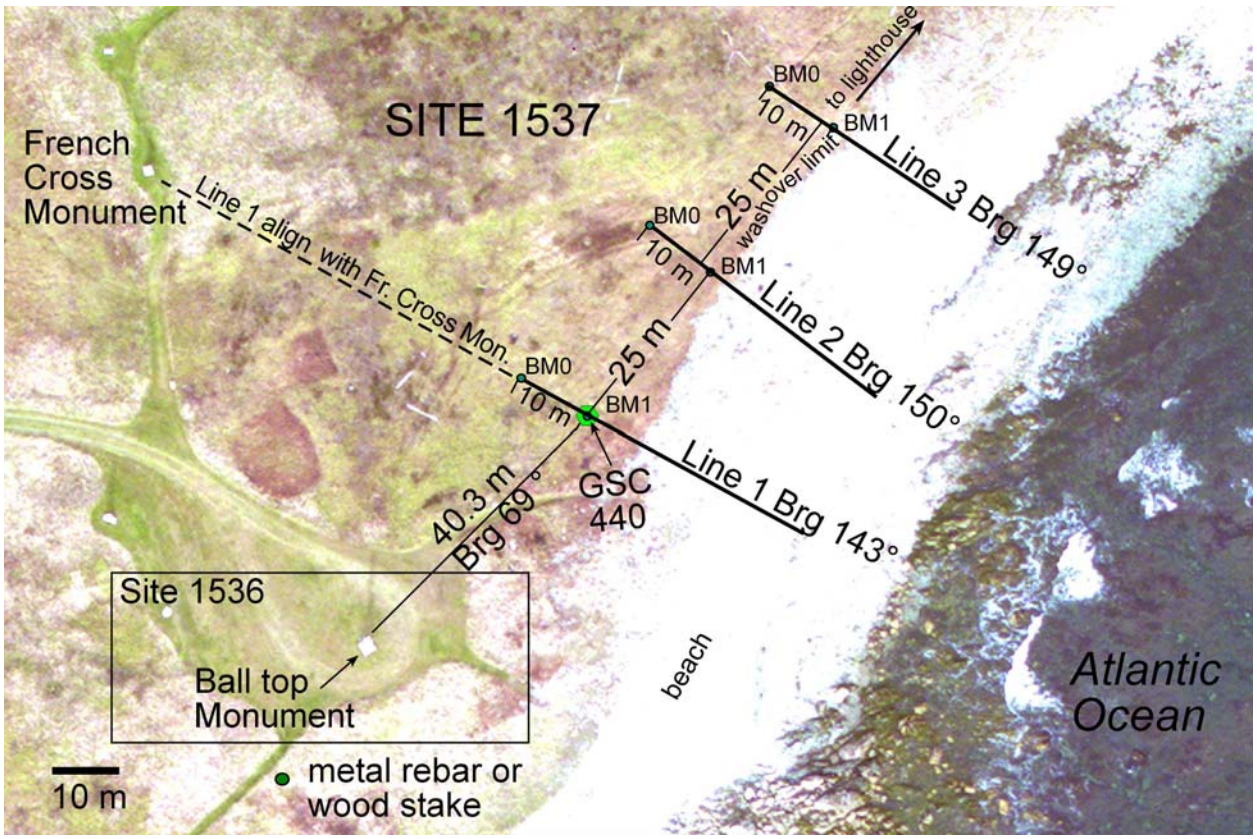


Figure 1537-1. Location of survey lines and information required for resurveying them at a location where the rate of landward beach migration and building is of primary interest. In the past the beach has been pushed farther landward toward line 3.

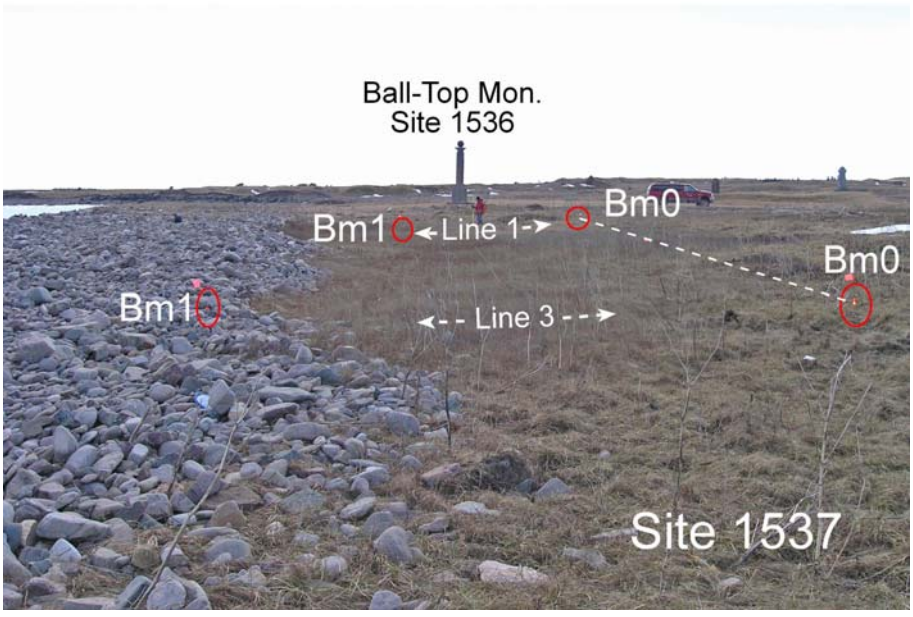


Figure 1537-2. A good location to photograph the landward beach migration is from this view point. Mark the line markers (red flags) before photographing the site. (photo March 2011)

SITE NO.	SHORE TYPE	GEOGRAPHIC NAME	COUNTY	PROVINCE	NTS REF	HORIZ. DATUM	VERTICAL DATUM
1537	BEACH	ROCHEFORT POINT	CAPE BRETON	NOVA SCOTIA	11G/13	NAD 83 Z 20	GEODETIC

ACCESS

The site is located within the Fortress grounds. Vehicle access is only with permision from park fire & security staff. Park at the museum within the fortress or drive east to end of road near Grand Etang Pond and turn seaward (right) toward the tall monuments (only visible on clear days) on Rochefort Point. Park at the monuments. The site is the low beach area just east of the ball-topped monument.

SITE INFORMATION (2011)

LINE	BM TYPE	LATITUDE°	LONGITUDE°	EASTING*	NORTHING*	ELEVATION*	LINE	BM TYPE	LATITUDE°	LONGITUDE°	EASTING*	NORTHING*	ELEVATION*
1	WD 2x2	45.893143567	-59.976329967	734573.788	5086621.607	3.475	3	WD 1x3	45.893478667	-59.975890617	734606.459	5086660.129	3.301
1	GSC Cap	45.893096100	-59.976219883	734582.528	5086616.657	3.112	3	REBAR	45.893426567	-59.975785567	734614.828	5086654.650	3.325
2	WD 1x3	45.893318817	-59.976101800	734590.750	5086641.748	2.995							
2	REBAR	45.893261483	-59.976002267	734598.713	5086635.671	3.124							

									BEACH MIGRATION SURVEYS (m)				BEACH	
									BM0 TO		BM1 TO		CREST	SURVEY
LINE NO.	GSC BM	SURVEY DATE (D/M/Y)	LINE BEARING (°)	NO YEARS BTW SURVEY	RETREAT (m) BTW SURVEY	TOTAL CUM NO YEARS	CUM CREST RETREAT (m)	CUM CREST RETREAT (m\a)	LWD EDGE WO	BCH CREST	LWD EDGE WO	BCH CREST	ELEVATION	METHOD
1		5-Dec-95	143								9.95	22.40		TAPE
		11-Jun-96	143	0.50	0.00	0.50	0.00	0.00			9.95	22.40		TAPE
		6-Nov-97		1.42	0.89	1.92	0.89	0.46			9.94	21.51	3.40	RTK,TAPE
		3-Feb-00	143	2.25	0.41	4.17	1.30	0.31			1.10	21.10		TAPE
		5-Jun-02		2.33	0.85	6.50	2.15	0.33				20.25		TAPE
	440	30-Mar-11	143	8.79	2.27	15.29	4.42	0.29	16.42	28.12	6.28	17.98	3.60	RTK
2		5-Dec-95	149								4.78	19.60		TAPE
		11-Jun-96	149	0.50	0.00	0.50	0.00	0.00			4.78	19.60		TAPE
		6-Nov-97		1.42	-0.08	1.92	-0.08	-0.04			4.76	19.68	3.60	RTK,TAPE
		25-Jun-98		0.63	1.08	2.55	1.00	0.39			5.45	18.60		TAPE
		3-Feb-00	149	1.62	2.20	4.17	3.20	0.77			4.60	16.40		TAPE
		5-Jun-02		2.33	-0.01	6.50	3.19	0.49				16.41		TAPE
		17-Dec-08	149	6.5	-0.19	13.00	3.00	0.23			2.00	16.60		TAPE
		30-Mar-11	150	2.29	0.60	15.29	3.60	0.24	11.97	26.05	1.92	16.00	3.80	RTK
3		5-Dec-95	143								3.91	18.80		TAPE
		11-Jun-96	143	0.50	0.00	0.50	0.00	0.00			3.91	18.80		TAPE
		6-Nov-97		1.42	-0.01	1.92	-0.01	-0.01			3.88	18.81	3.80	RTK, TAPE
		3-Feb-00	143	2.25	4.92	4.17	4.91	1.18			3.00	13.89		TAPE
		5-Jun-02		2.33	-1.78	6.50	3.13	0.48				15.67		TAPE
		10-Mar-05		2.75	1.87	9.25	5.00	0.54				13.80		TAPE
		17-Dec-08	143	3.75	-0.20	13.00	4.80	0.37			1.66	14.00		TAPE
		31-Mar-11	149	2.29	2.16	15.29	6.96	0.46	8.92	22.15	-1.38	11.84	4.00	RTK

° LATITUDE AND LONGITUDE ARE IN DECIMAL DEGREES AND ARE A CONVERSION OF MARCH 2011 RTK UTM USING GSRUG http://www.geod.nrcan.gc.ca/tools-outils/index_e.php

*Geographic positions and elevations based on N.S. CONTROL MONUMENT 2094 BLACK ROCK Elevation 12.827 m; Easting (734481.365) Northing (5085932.243) NAD 83 UTM GRID: Z 20

LINE BEARING (DEGREES MAGNETIC)

NOTE: AN INCREASED DIST TO EDGE OF WO MEANS THE SEDIMENT HAS BEEN REVEGETATED OR MOST RECENT STORM EVEN WAS NOT AS SEVERE AS LAST ONE MEASURED.

DISTANCE BETWEEN BMS:

LINE 1 - 2: 25 m aligned with lighthouse brg 66° mag

LINE 2 - 3: 25 m aligned with lighthouse brg 66° mag

REFERENCE NOTEBOOKS

5-Dec-95	OWEN BROWN NOTEBOOK
11-Jun-96	INFO ON FORMS
6-Nov-97	RTK; CBI/95 P67
3-Feb-00	INFO ON FORMS (O.BROWN/B.DUNHAM)
5-Jun-02	R.DUGGAN /B. CUNNINGHAM (PARKS)
10-Mar-05	CBI2001 P67
17-Dec-08	CBI2001 P75
30-Mar-11	CBI2011/01 p4

BENCH MARK HISTORY: SITE 1537

LINE 1: (West Line)

5-Dec-95	DISTANCE BM1 (REBAR) TO BALL TOPPED MONUMENT = 40.29 M BRG 249° MAG; BM2 (REBAR) 9.95 m SWD OF BM1 AT LWD EDGE WASHOVER ALIGNED WITH FRENCH CROSS MONUMENT; BM2 260° TO BALL TOPPED MONUMENT)
6-Nov-97	BM1(REBAR) AND BM2 (REBAR) INTACT; SURVEY OF LINE TO SWASH WITH DIFFERENTIAL GPS
3-Feb-00	BM1 (REBAR) NOT INTACT; REPLACED WITH ORANGE TOPPED WOOD STAKE; MEASUREMENT FROM BM1 TO WASHOVER SAND 1.1M. BM1 TO CREST 21.3M (CREST DIFFICULT TO DEFINE)
5-Jun-02	BM2 INTACT, BEACH CREST HARD TO DEFINE
10-Mar-05	No information
17-Dec-08	Markers not found
30-Mar-11	BM0 (wd 2x2stake) established 10m Lwd of BM1(wd stake) intact and added GSC 440 at BM1 (RTK survey BM0 to WLO)

BENCH MARKS PRESENTLY INTACT: BM0 (wd 2x2) and BM1 (GSC 440 & wd stake) DISTANCE BM0 to BM1=10.3 m

FORMER NOTATION "BENCH MARKS PRESENTLY INTACT: BM1 (REBAR) & BM2 (REBAR) AT LWD EDGE OF WASHOVER; BM1 to BM2= 9.95 m"

LINE 2:

5-Dec-95	BM1(REBAR / WD STAKE) & BM2 (WD STAKE)
6-Nov-97	BM1(REBAR / WD STK) AND BM2 (WD STK) INTACT; SURVEY OF LINE TO SWASH WITH DIFFERENTIAL GPS
25-Jun-98	BM1(REBAR / WD STK) AND BM2 (WD STK) INTACT;
3-Feb-00	BM1 (REBAR) INTACT; EVIDENCE OF OVERWASHED SAND LANDWARD OF BM1 FOR A DISTANCE OF APPROX 4.25M
5-Jun-02	BM1 INTACT, BCH CREST HARD TO DEFINE
10-Mar-05	BM1 INTACT BUT FROZEN IN THIN ICE NO MEASUREMENT
17-Dec-08	BM 1 (rebar) intact-wet grass covered area partly snow covered hard to see washover sediment
31-Mar-11	BM0 (wd stake 1x3) added 10m lwd of BM1 (rebar) intact

BENCH MARKS PRESENTLY INTACT: BM0 (wd 1x3 stake) and BM1 (Rebar) in grass wetland DISTANCE BM0 to BM1 =10.05m

LINE 3: (East Line)

5-Dec-95	BM1 (REBAR) & BM2 (WD STAKE) AT WO; ALIGN WITH WATER TOWER AT 323°.
6-Nov-97	BM1 (REBAR) AND BM2 (WD STK) INTACT; SURVEY OF LINE TO SWASH WITH DIFFERENTAIL GPS
3-Feb-00	BM1 (REBAR) INTACT; NO EVIDENCE OF BM2 (WD STK); BM1 TO WELL DEFINED CB WASHOVER IS 3M; SAND DEPOSITS LIE 0.5M AND 1.5M SEAWARD OF BM1
5-Jun-02	BM1 INTACT
10-Mar-05	BM1(REBAR) INTACT; BRASH ICEFOOT AT CREST FROM STORM , DIGITAL PHOTO
17-Dec-08	BM1(rebar) intact partly snow covered hard to see edge wo sediment
30-Mar-11	BM0 (wd 1x3 stake) added 10m lwd of BM1 (rebar) intact in washover deposit (RTK survey BM0 to WLO)

BENCH MARKS PRESENTLY INTACT: BM0 (wd 1x3 stake) and BM1 (REBAR) LWD EDGE OF WASHOVER DISTANCE BM0 to BM1=10.30 m

FORMER NOTATION "BENCH MARKS PRESENTLY INTACT: BM1 (REBAR) & BM2 (WD STAKE) AT LWD EDGE OF WASHOVER; BM1 to BM2= 3.88 m"

Shore Monitoring Sites

1538 to 1540
and 1556

Rochefort Point

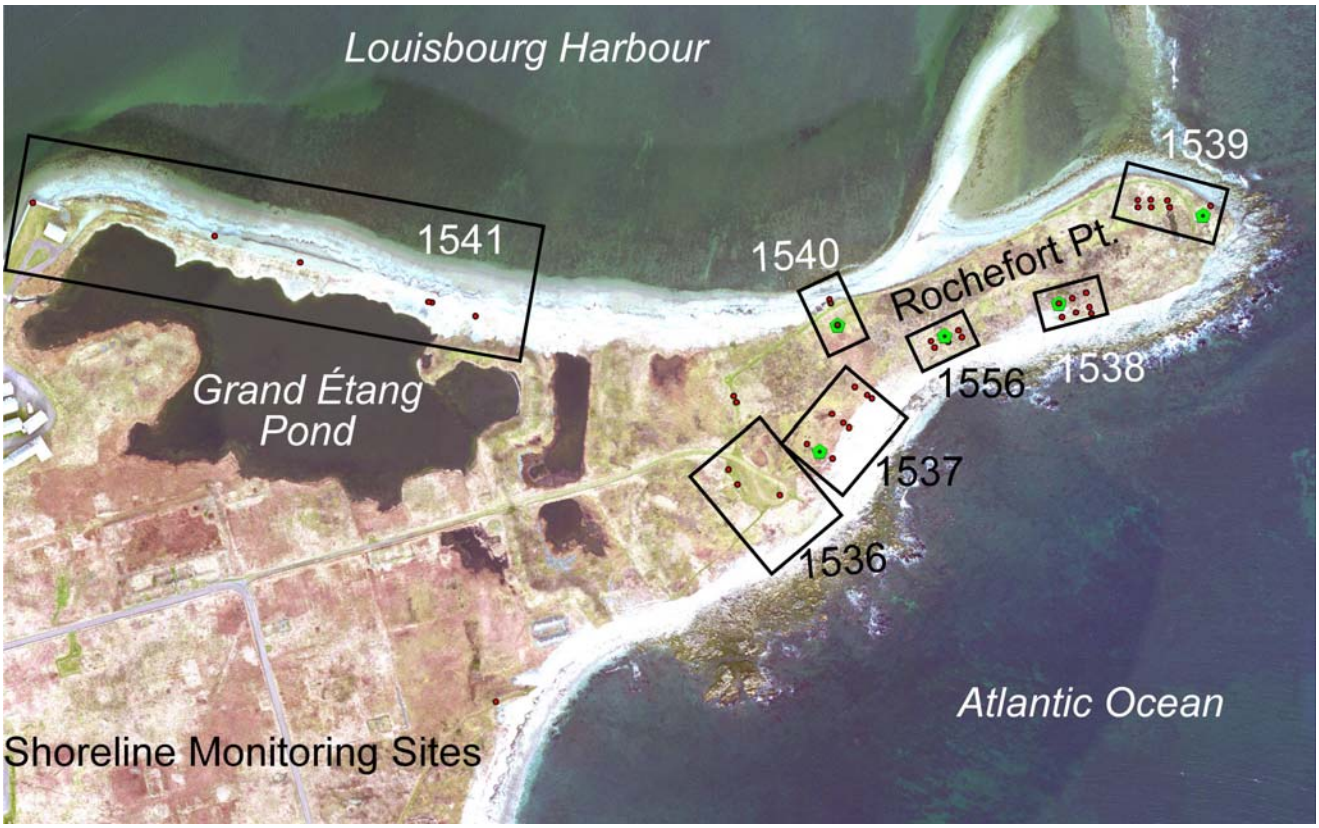


Figure 1556-1. Map of shoreline monitoring sites 1556 to 1540 located on Rochefort Point. Line markers are shown as red dots and site markers (GSC caps) are shown as green octagons. Site 1556 was initiated in 2011 because of the exposure of single burials back of the shore bank. A mass burial site was exposed by wave erosion adjacent to the former navigation range marker at site 1540.

Site 1556

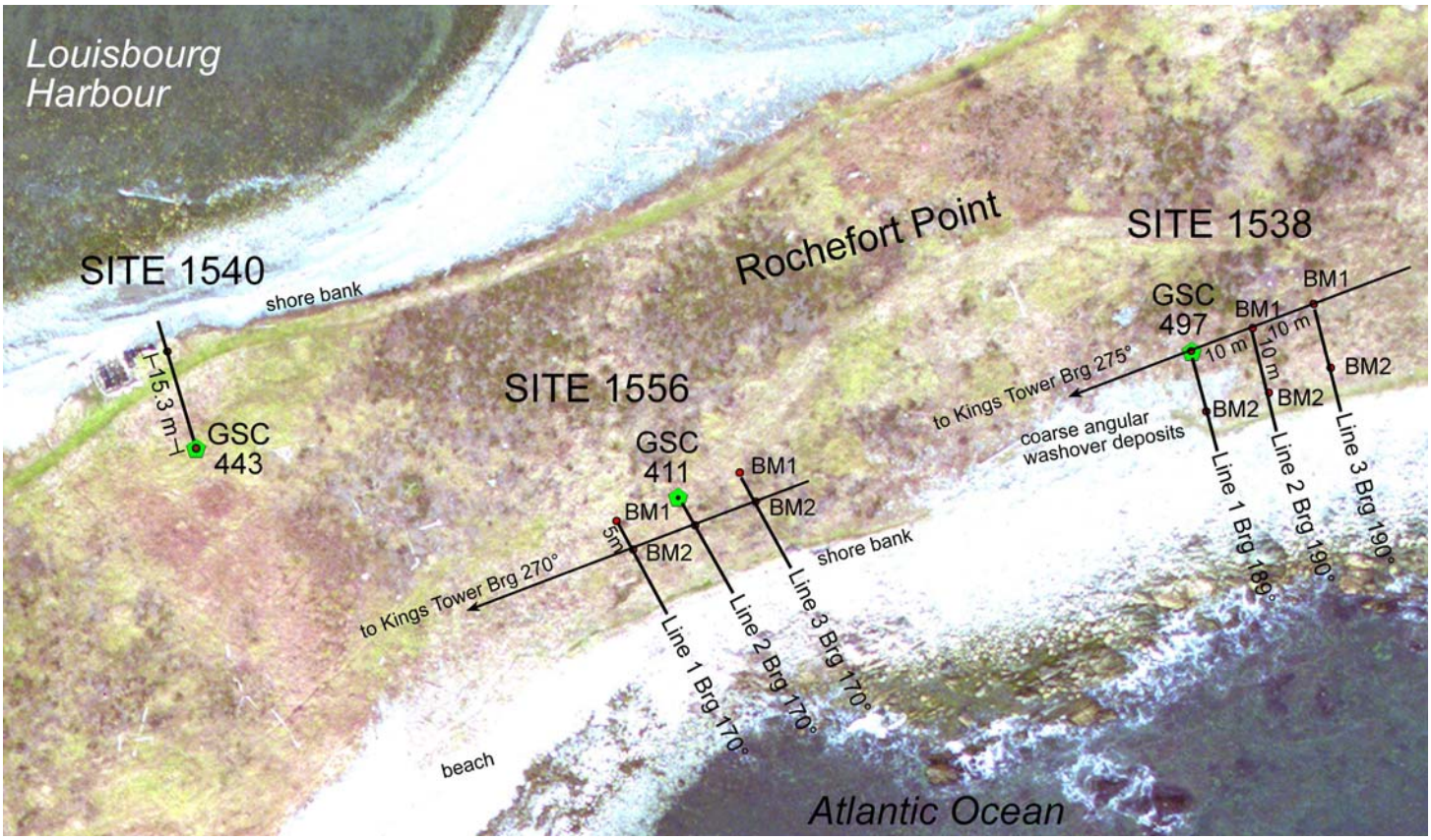


Figure 1556-2. Map of survey lines and markers established at site 1556 in 2011 and its location relative to sites 1538 and 1540. The line markers are plotted on 2010 georeferenced air photos using ARCGIS. Red dots represent rebars and \ or wooden stakes and green octagons are GSC caps.

Site 1556

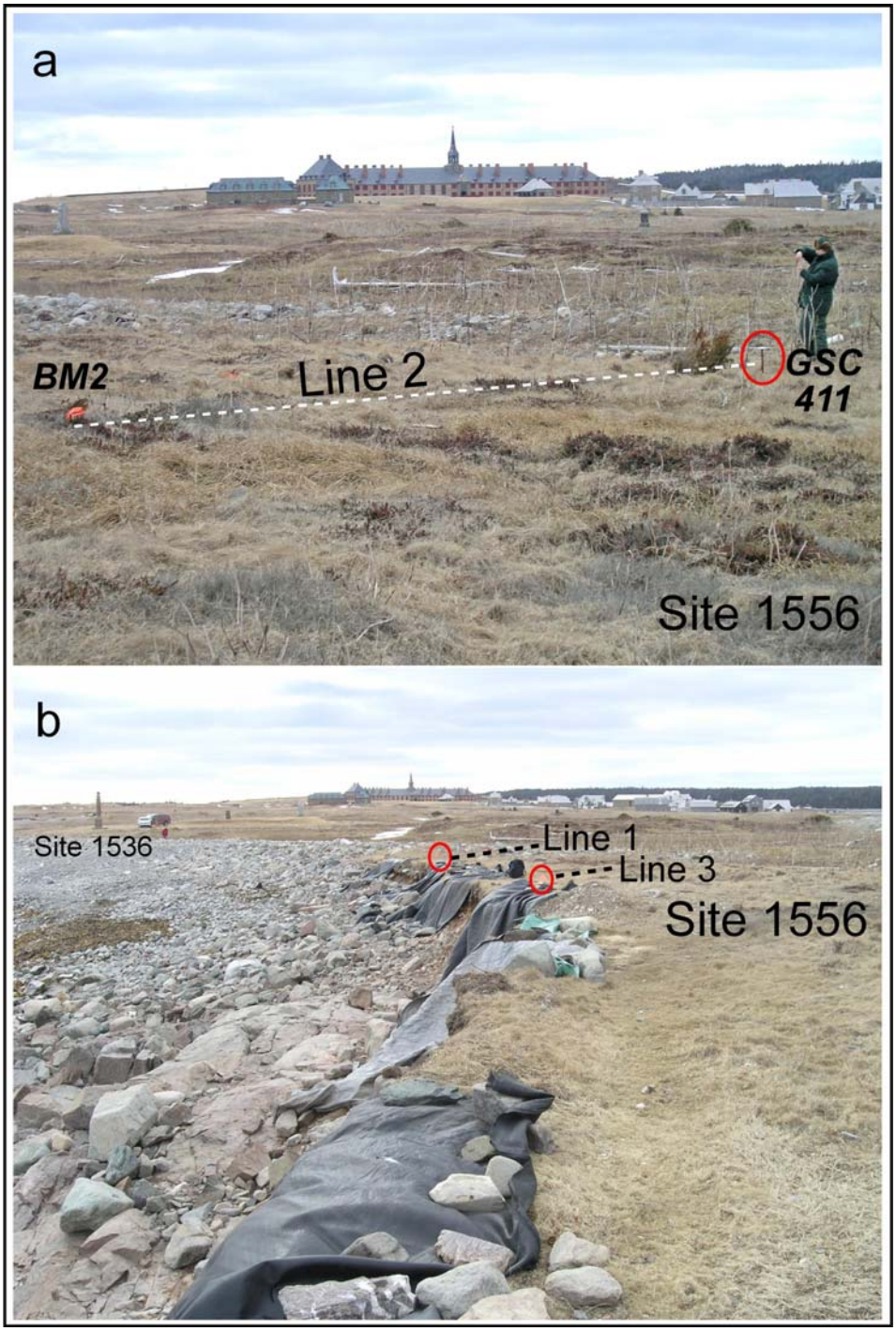


Figure 1556-3. (a) Location of markers on Line 2 and (b) example of where photos should be taken looking each way alongshore to illustrate site conditions during each visit (photo March 2011). Strips of geofabric cover burial sites.

SITE NO.	SHORE TYPE	GEOGRAPHIC NAME	COUNTY	PROVINCE	NTS REF	HORIZ DATUM	VERTICAL DATUM
1556	BANK	ROCHEFORT POINT SOUTH BURIALS	CAPE BRETON	NOVA SCOTIA	11G/13	NAD 83 Z 20	GEODETIC

ACCESS

The site is located within the Fortress grounds. Vehicle access is only with permision from park fire & security staff. Either park at the museum and walk, or drive and take the first road just east of the museum that leads to Rochefort and a group of tall monuments (Only visible on clear days). If driving park at the monuments and walk along the path that leads east and south along Rochforte Point. The site is toward the south end of where the shore bank is cov black geotextile material. The line markers (BMS) are located just landward of a footpath that leads to the end of the Point. Line 1 is at the north end and Line 3 is at the south end of each area.

SITE INFORMATION (2011)

LINE	BM TYPE	LATITUDE °	LONGITUDE°	EASTING*	NORTHING*	ELEVATION*	LINE	BM TYPE	LATITUDE°	LONGITUDE°	EASTING*	NORTHING*	ELEVATION*
1	THIN REBAR	45.893742300	-59.975247317	734658.253	5086691.312	4.203	3	THIN REBAR	45.893801767	-59.975003083	734676.950	5086698.638	4.793
1	THIN REBAR	45.893702600	-59.975216433	734660.817	5086686.992	4.335	3	THIN REBAR	45.893761250	-59.974974200	734679.361	5086694.221	4.986
2	GSC 411	45.893771933	-59.975124717	734667.639	5086694.965	4.625							
2	THIN REBAR	45.893732150	-59.975094633	734670.141	5086690.634	4.579							

CLIFF RECESSION SURVEYS

LINE NO.	GSC BM	SURVEY DATE (D/M/Y)	LINE BEARING (°)	NO YEARS BTW SURVEY	RETREAT (m) BTW SURVEY	TOTAL CUM NO YEARS	CUM RETREAT (m)	CUM RETREAT (m\a)	BM TO CLIFF EDGE (m) BM1 TO CE	BM TO CLIFF EDGE (m) BM2 TO CE	SURVEY METHOD	CLIFF/BANK HEIGHT (m)
1		29-Mar-11	170						14.20	9.18	TAPE / RTK	
2	411	29-Mar-11	170	2.29					14.32	9.30	TAPE / RTK	
3		29-Mar-11	170	2.29					13.74	8.73	TAPE / RTK	

Geographic positions and elevations based on N.S. CONTROL MONUMENT 2094 BLACK ROCK Elevation 12.827 m; Easting (734481.365) Northing (5085932.243) NAD 83 UTM GRID: Z 20.
LINE BEARING (DEGREES MAGNETIC)

DISTANCE BETWEEN BMS ALIGNED 275° WITH KINGS BASTION TOWER:

LINE 1 - 2: 10 m
LINE 2 - 3: 10 m

REFERENCE NOTEBOOKS

29-Mar-11 CBI2001 p84

BENCH MARK HISTORY: SITE 1556

LINE 1: (North Line)
29-Mar-11 BM1 (thin rebar) is 5.02 m lwd of BM2(thin rebar) 2011 (RTK survey along entire cliff top edge of the site

BENCH MARKS PRESENTLY INTACT: BM1 (thin rebar) and BM2 (thin rebar)

LINE 2:
29-Mar-11 BM1 (GSC 411) is 5.02m lwd of BM2 (thin rebar)

BENCH MARKS PRESENTLY INTACT: BM1 (GSC 411) and BM2(thin rbar)

LINE 3: (South Line)
29-Mar-11 BM1 (thin rebar) is 5.01 m lwd of BM2 (thin rebar)

BENCH MARKS PRESENTLY INTACT: BM1(thin rebar) and BM2 (thin rebar)

Site 1538

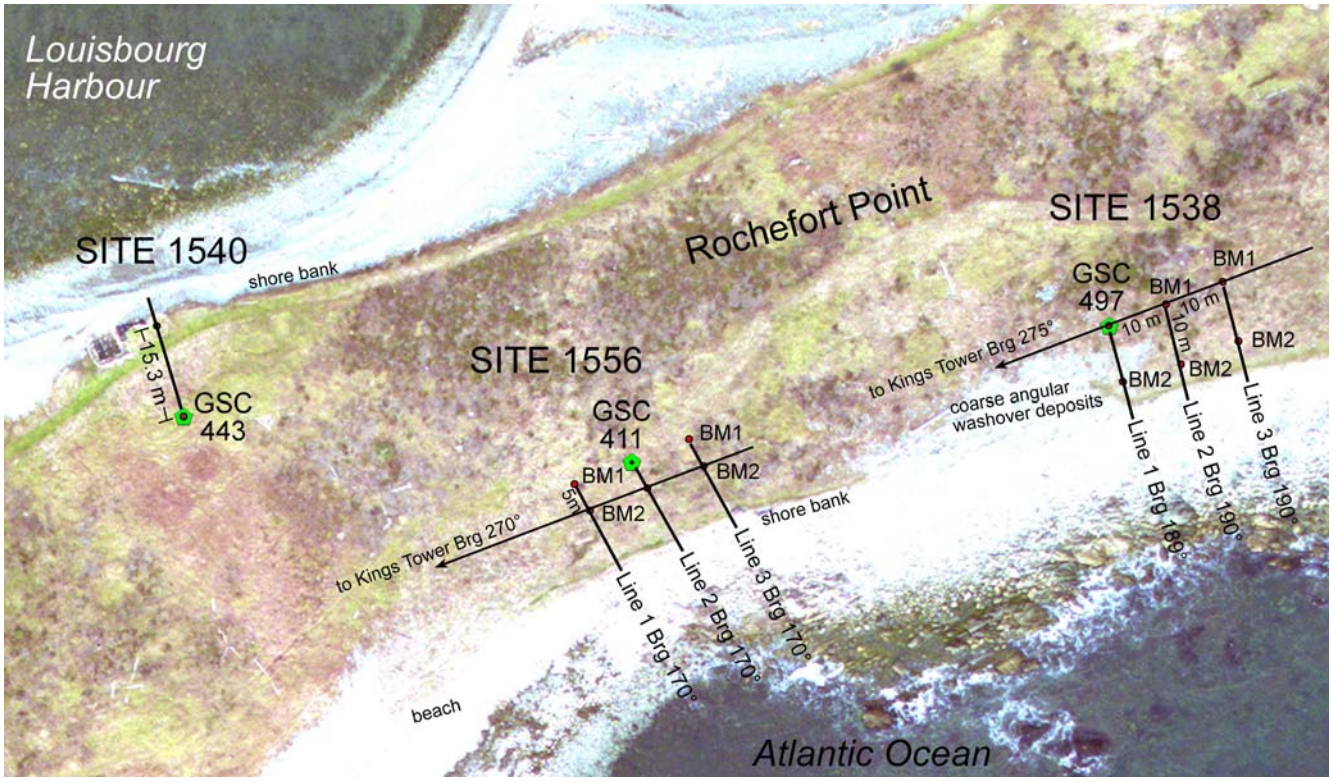


Figure 1538-1. Location map and information for resurveying shore bank changes at site 1538. The landward line markers are aligned with Kings Bastion tower. The site is located just south of a large washover deposit of angular rock fragments on Rochefort Point. Red dots are metal rebar or wood stakes. Green octagons mark the location of GSC caps.

Site 1538

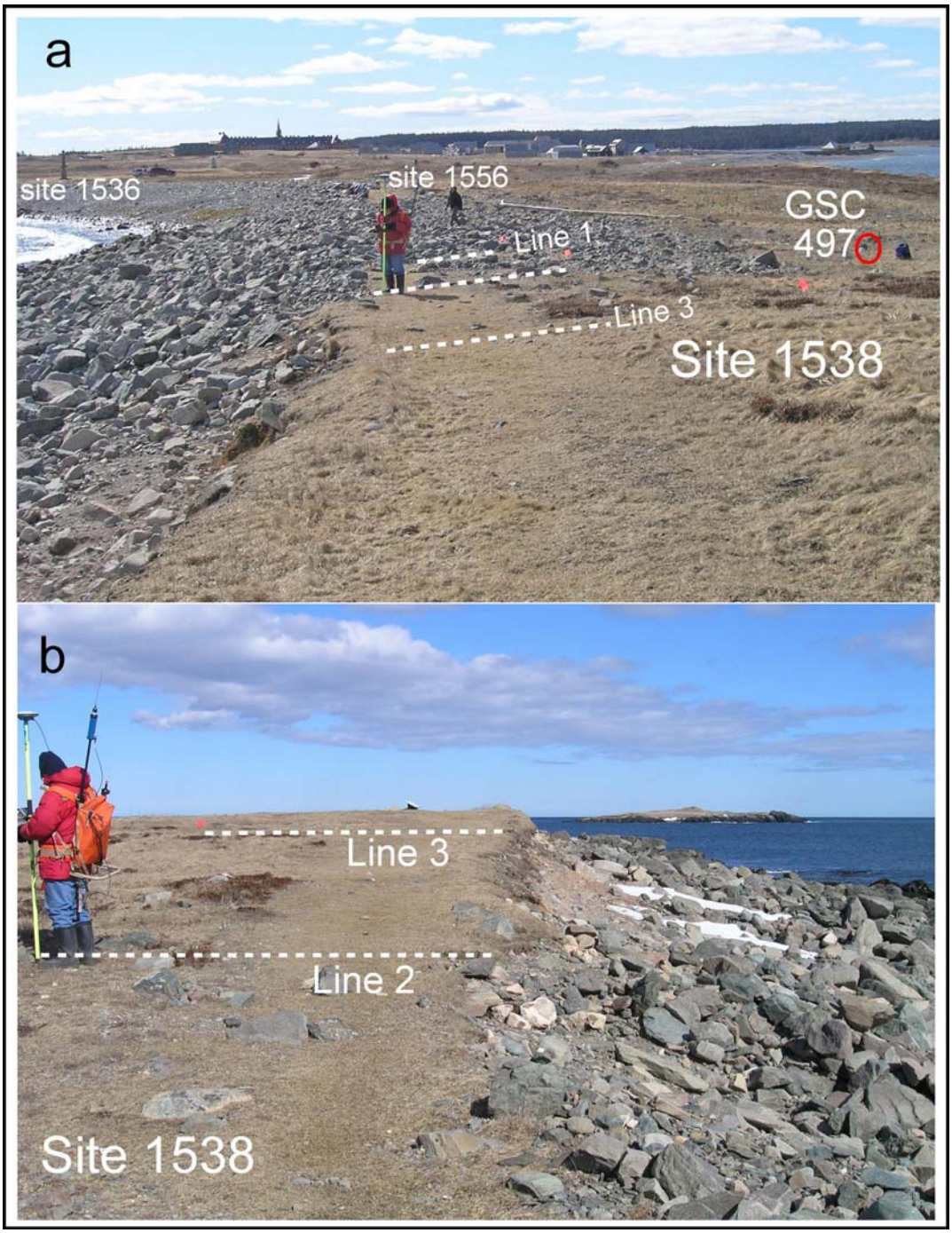


Figure 1538-2. Site photos (a) showing the location of site 1538 relative to other sites on Rochefort Point GSC cap 497 is circled and (b) longshore view of shore bank and beach in March 2011 relative to known points such as the trail plaque and island in background.

SITE NO.	SHORE TYPE	GEOGRAPHIC NAME	COUNTY	PROVINCE	NTS REF	HORIZ. DATUM	VERTICAL DATUM
1538	BANK	ROCHEFORT POINT (WEST)	CAPE BRETON	NOVA SCOTIA	11G/13	NAD 83 Z 20	GEODETIC

ACCESS

The site is located within the Fortress grounds. Vehicle access is only with permision from park fire & security staff. Park at the museum and walk or drive to the first road just east of the museum that leads to Rochefort Point and a group of tall monuments (Only visible on clear days). If driving, park at the monuments and walk along the path that leads east and south along Rochford Point. Walk past site 1556 until reaching a series of markers just landward of the path before the end of the Point. Line 1 is at the north end and Line 3 is at the south end.

SITE INFORMATION (2011)

LINE	BM TYPE	LATITUDE°	LONGITUDE°	EASTING*	NORTHING*	ELEVATION*	LINE	BM TYPE	LATITUDE°	LONGITUDE°	EASTING*	NORTHING*	ELEVATION*
1	GSC CAP 497	45.89394408	##########	734745.463	5086717.071	4.463 (top)	3	REBAR	45.89400217	59.97386967	734764.031	5086724.239	5.071 (BASE)
1	REBAR	45.893861158	59.9740873	734747.742	5086707.932	4.29 (BASE)	3	REBAR	45.89391446	59.97384170	734766.571	5086714.577	5.101 (BASE)
2	REBAR	45.893972671	59.9739909	734754.752	5086720.605	4.371 (BASE)							
2	REBAR	45.89388389	59.9739632	734757.271	5086710.823	4.652 (BASE)							

CLIFF RECESSION SURVEYS

LINE NO.	GSC BM	SURVEY DATE (D/M/Y)	LINE BEARING (°)	NO YEARS BTW SURVEY	RETREAT (m) BTW SURVEY	TOTAL CUM NO YEARS	CUM RETREAT (m)	CUM RETREAT (m\a	BM TO CLIFF EDGE (m) BM1 TO CE	BM2 TO CE	SURVEY METHOD	CLIFF/BANK HEIGHT (m)
1	497	5-Dec-95	189						14.00		TAPE	
		11-Jun-96	189	0.50	0.00	0.50	0.00	0.00	14.00		TAPE	
		6-Nov-97		1.42	-0.14	1.92	-0.14	-0.07	14.14		RTK/TAPE	
		4-Feb-00	189	2.25	1.25	4.17	1.11	0.27	12.89		TAPE	
		5-Jun-02		2.33	-0.18	6.50	0.93	0.14	13.07		TAPE	
		10-Mar-05		2.75	-0.35	9.25	0.58	0.06	13.42		TAPE	
		17-Dec-08		3.75		13.00			11.4-14.0		TAPE	
		31-Mar-11		2.29	1.12	15.29	1.70	0.11	12.30		RTK	
2		5-Dec-95	190						14.75	4.65	TAPE	
		11-Jun-96	189	0.50	0.08	0.50	0.08	0.16	14.67	4.60	TAPE	
		6-Nov-97	189	1.42	-0.03	1.92	0.05	0.03	14.70	4.68	RTK/ TAPE	
		4-Feb-00	189	2.25	0.60	4.17	0.65	0.16	14.10		TAPE	
		5-Jun-02		2.33	0.06	6.50	0.71	0.11	14.04		TAPE	
		10-Mar-05		2.75	0.24	9.25	0.95	0.10	13.80		TAPE	
		17-Dec-08		3.75	0.05	13.00	1.00	0.08	13.75		TAPE	
		31-Mar-11		2.29	0.46	15.29	1.46	0.10	13.29		RTK	
3		5-Dec-95	190						14.95		TAPE	
		11-Jun-96	190	0.50	0.00	0.50	0.00	0.00	14.95		TAPE	
		6-Nov-97	190	1.42	-0.01	1.92	-0.01	-0.01	14.96		RTK/ TAPE	
		4-Feb-00	190	2.25	0.31	4.17	0.30	0.07	14.65		TAPE	
		5-Jun-02		2.33	-0.19	6.50	0.11	0.02	14.84		TAPE	
		10-Mar-05		2.75	0.14	9.25	0.25	0.03	14.70		TAPE	
		17-Dec-08		3.75	0.45	13.00	0.70	0.05	14.25		TAPE	
		31-Mar-11		2.29	-0.30	15.29	0.40	0.03	14.55		RTK	

° LATITUDE AND LONGITUDE ARE IN DECIMAL DEGREES AND ARE A CONVERSION OF MARCH 2011 RTK UTM USING GSRUG http://www.geod.nrcan.gc.ca/tools-outils/index_e.php

*Geographic positions and elevations based on N.S. CONTROL MONUMENT 2094 BLACK ROCK Elevation 12.827 m; Easting (734481.365) Northing (5085932.243) NAD 83 UTM GRID: Z 20

LINE BEARING (DEGREES MAGNETIC)

DISTANCE BETWEEN BMS ALIGNED 275° WITH KINGS BASTION TOWER:

LINE 1 - 2: 10 m
LINE 2 - 3: 10 m

REFERENCE NOTEBOOKS

5-Dec-95	OWEN BROWN NOTES
11-Jun-96	INFO ON FORMS
6-Nov-97	RTK; CBI/95 P 69
4-Feb-00	INFO ON FORMS (O.BROWN/R. DUGGAN)
5-Jun-02	R. DUGGAN / B CUNNINGHAM (PARKS)
10-Mar-05	CBI2001 P68
17-Dec-08	CBI2001 P75
31-Mar-11	CBI2011/01 P4

BENCH MARK HISTORY: SITE 1538

LINE 1:

5-Dec-95 BM1 (CAP) ALIGNED WITH PEAK WHITE HOUSE (WILSON'S BED & BREAKFAST) BY PARK BOUNDARY, BACK BEARING 9° MAG
11-Jun-96 BM1 (CAP) SURROUNDED BY ROCK CAIRN
6-Nov-97 BM1 (CAP) SURROUNDED BY ROCK CAIRN
4-Feb-00 BM1 (CAP) INTACT; ROCK CAIRN NOT IN PLACE
5-Jun-02 NO DATA
10-Mar-05 BM1(GSC497) INTACT; MEASURE TO EDGE OF GRASS, LARGE BOULDER OVERWASH TO NORTH OF LINE
17-Dec-08 BM1(cap 497) intact , measure to edge of boulder wo =11.4m and to Approx bank edge =14.0 washover spread to line
31-Mar-11 BM1(GSC 497) intact, BM2 (short rebar) added; measured to where angular rock and cut in grass occur
BENCH MARKS PRESENTLY INTACT: BM1 (GSC 497) and BM2 (rebar)

LINE 2:

5-Dec-95 BM1 (WD STAKE) AND BM2 (WD STAKE) 10.1 M APART ALIGNED WITH PEAK OF WHITE HOUSE (WILSON'S BED & BREAKFAST) BY PARK BOUNDARY, BACK BRG 9° MAG
11-Jun-96 BM1 and BM2 INTACT
6-Nov-97 BM1 and BM2 INTACT
4-Feb-00 BM1 AND BM2 NOT INTACT; BM1 REPLACED BY TEMPORARY ROCK CAIRN FOR MEASUREMENT PURPOSES (GROUND FROZEN, COULD NOT REPLACE STAKE
5-Jun-02 NO DATA
10-Mar-05 BM1 (WD STK) INTACT; MEASURE TO EDGE OF GRASS
17-Dec-08 BM1 (WD STK) INTACT; MEASURE TO EDGE OF GRASS bank
31-Mar-11 BM1 (short rebar) and BM2 (short rebar) re-established at 1997 locations using RTK; measured distance to edge of grass at top of shore cut
BENCH MARKS PRESENTLY INTACT: BM1 (rebar) and BM2 (rebar)

LINE 3:

5-Dec-95 BM1 (WD STAKE) -ALIGNED WITH PEAK WHITE HOUSE (WILSON'S BED & BREAKFAST) BY PARK BDRY, BACK BEARING 10° MAG
11-Jun-96 BM1 INTACT
6-Nov-97 BM1 (WD STK) INTACT
4-Feb-00 BM1 (WD STK) INTACT
5-Jun-02 NO DATA
10-Mar-05 BM1(WD STK) INTACT, MEASURE TO EDGE OF GRASS Bank
17-Dec-08 BM1(WD STK) added a new wood slab, MEASURE TO EDGE OF GRASS
31-Mar-11 BM1(rebar) and BM2 (rebar) reestablished at 1997 locations using RTK; measured to top edge of low bank
BENCH MARKS PRESENTLY INTACT: BM1 (rebar) and BM2 (rebar)

Site 1539

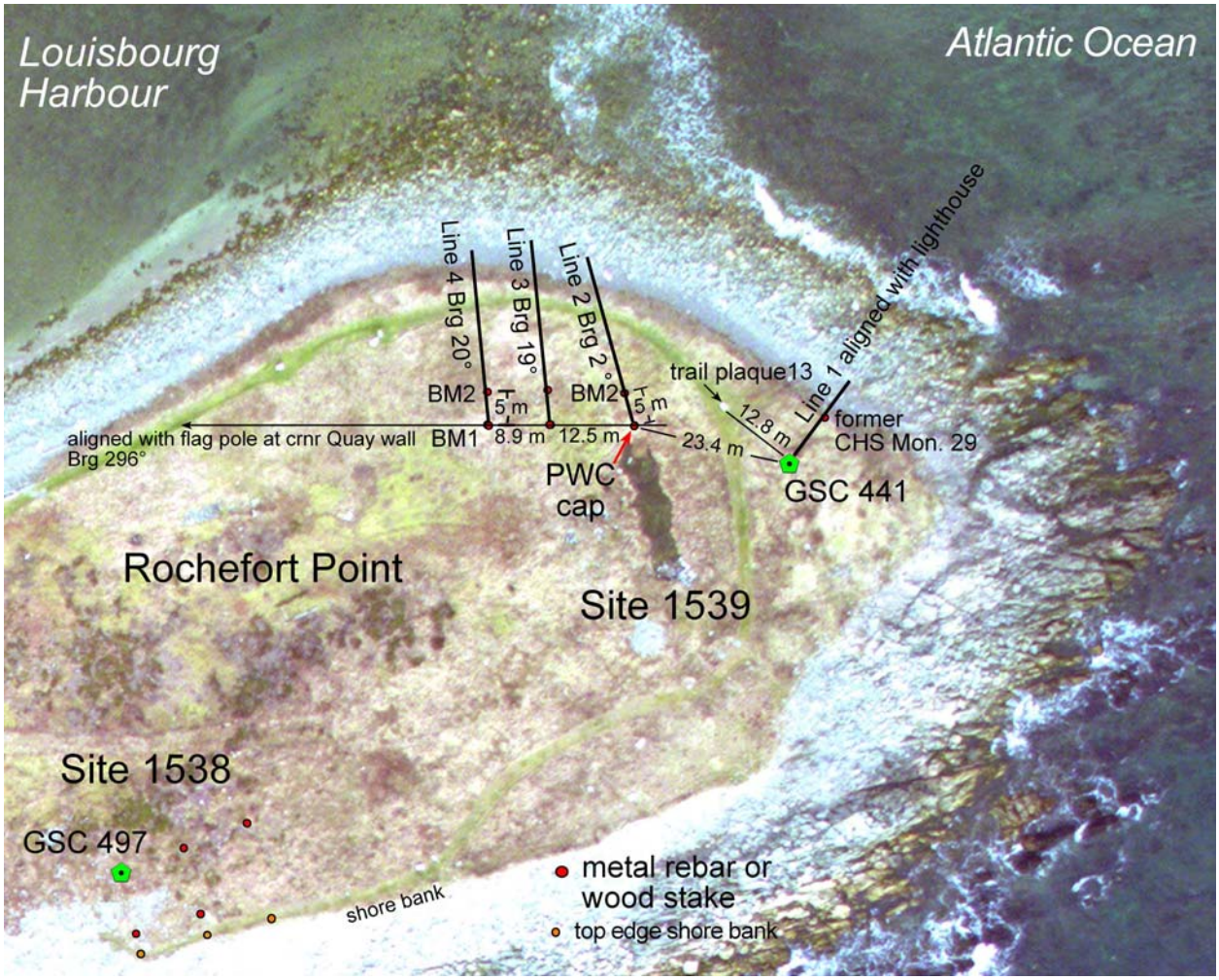


Figure 1539-1. Location map of survey lines used to monitor shore bank retreat along the end of Rochefort Point. The top edge of the shore bank at Lines 2 to 4 is difficult to identify because of a rounded vegetated slope however in 2011 the lower portion of the bank was actively being cut back by waves. The PWC cap is at the northeast end of a small elongated pond which makes finding the site markers easier, when GPS is not available.

Site 1539

Figure 1539-2. Future photos of shoreline change at the end of Rochefort Point should be taken from this viewpoint using marker GSC 441, trail plaque 13 and rock outcrops at the shore as visual references.

SITE NO.	SHORE TYPE	GEOGRAPHIC NAME	COUNTY	PROVINCE	NTS REF	HORIZ. DATUM	VERTICAL DATUM
1539	BANK	ROCHEFORT POINT (EAST)	CAPE BRETON	NOVA SCOTIA	11G/13	NAD 83 Z 20	GEODETIC

ACCESS

The site is located within the Fortress grounds. Vehicle access is only with permision from park fire & security staff. Park at the museum and walk or drive to the first road just east of the museum that leads to Rochefort Point and a group of tall monuments (only visible on clear days). If driving park at the monuments and walk along the path that leads east and south to the end of Rochefort Point. Line 1 is at the SE corner of Rochefort Point. Measurements at L1 which is marked by GSC cap 44 should be aligned with Louisbourg Lighthouse. GSC cap 441 is 12.8 m SW of walking trail interpretive panel #13. Survey lines 2, 3, & 4 are closer to the Fortress along the east shore of Rochefort Point. L 2, marked by a PWC cap, is at east end of a small pond and extends seaward along a narrow well defined channel.

SITE INFORMATION (2011)

LINE	BM TYPE	LATITUDE°	LONGITUDE°	EASTING*	NORTHING*	ELEVATION*	LINE	BM TYPE	LATITUDE°	LONGITUDE°	EASTING*	NORTHING*	ELEVATION*
1	GSC cap 441	45.89444898	-59.97277837	734843.806	5086777.095	5.046	3	thin rebar	45.89451303	-59.9732683	734808.527	5086782.768	5.222
2	PWC CAP	45.89450735	-59.97310748	734821.028	5086782.610	4.518	3	thin rebar	45.89455908	-59.9732693	734808.257	5086787.881	5.114
2	thin rebar	45.89455005	-59.97312395	734819.5706	5086787.305	4.668	4	thin rebar	45.89451497	-59.9733834	734799.595	5086782.644	5.316
							4	thin rebar	45.8945594	-59.9733834	734799.408	5086787.580	4.776 (BASE)

CLIFF RECESSION SURVEYS

LINE NO.	GSC BM	SURVEY DATE (D/M/Y)	LINE BEARING (°)	NO YEARS BTW SURVEY	RETREAT (m) BTW SURVEY	TOTAL CUM NO YEARS	CUM RETREAT (m)	CUM RETREAT (m\a)	BM TO CLIFF EDGE (m) BM0 TO CE	BM1 TO CE	BM2 TO CE	SURVEY METHOD	CLIFF/ BANK HEIGHT (m)
1	CHS 29	5-Dec-95	62							1.85		TAPE	4.00
	CHS 29	11-Jun-96	62	0.50	0.26	0.50	0.26	0.52		1.59		TAPE	
		6-Nov-97	62	1.42	0.02	1.92	0.28	0.15		1.57		RTK	
	CHS 29	4-Feb-00	62	2.25	0.00	4.17	0.28	0.07		1.57		TAPE	
	CHS 29	10-Mar-05		5.08	0.22	9.25	0.50	0.05		1.35		TAPE	
	CHS 29	17-Dec-08		3.75	1.12	13.00	1.62	0.12		0.23		TAPE	
	GSC 441	30-Mar-11	align with	2.29	0.28	15.29	1.90	0.12	8.50	-0.05		TAPE	
			lighthouse										
2	PWC	5-Dec-95	6							19.25		TAPE	
	PWC	11-Jun-96	6	0.50	0.06	0.50	0.06	0.12		19.19		TAPE	
		6-Nov-97	6	1.42	0.11	1.92	0.17	0.09		19.08		RTK	
	PWC	4-Feb-00	6	2.25	0.00	4.17	0.17	0.04		19.08		TAPE	
	PWC	10-Mar-05		5.08	-0.22	9.25	-0.05	-0.01		19.30		TAPE	
	PWC	17-Dec-08		3.75	0.50	13.00	0.45	0.03		18.80		TAPE	
	PWC	30-Mar-11	2	2.29	-0.06	15.29	0.39	0.03		18.86	9.68	TAPE	
3	WD STAKE	5-Dec-95	19							20.20		TAPE	
	WD STAKE	11-Jun-96	19	0.50	0.05	0.50	0.05	0.10		20.15		TAPE	
		6-Nov-97	20	1.42	0.02	1.92	0.07	0.04		20.13		RTK	
	WD STAKE	4-Feb-00	20	2.25	-0.99	4.17	-0.92	-0.22		*21.12*		TAPE	
	WD STAKE	10-Mar-05		5.08	0.82	9.25	-0.10	-0.01		*20.30*		TAPE	
	thin rebar	30-Mar-11	19	6.54	0.17	15.79	0.07	0.00		20.13	15.05	TAPE	

SITE 1539 continued

CLIFF RECESSION SURVEYS

LINE NO.	GSC BM	SURVEY DATE (D/M/Y)	LINE BEARING (°)	NO YEARS BTW SURVEY	RETREAT (m) BTW SURVEY	TOTAL CUM NO YEARS	CUM RETREAT (m)	CUM RETREAT (m\a)	BM TO CLIFF EDGE (m) BM0 TO CE	BM1 TO CE	BM2 TO CE	SURVEY METHOD	CLIFF/ BANK HEIGHT (m)
4	WD STAKE	5-Dec-95	21							22.30		TAPE	
	WD STAKE	11-Jun-96	21	0.50	0.06	0.50	0.06	0.12		22.24		TAPE	
		6-Nov-97	21	1.42	0.25	1.92	0.31	0.16		21.99		RTK	
	WD STAKE	4-Feb-00	21	2.25	0.21	4.17	0.52	0.12		21.78		TAPE	
	WD STAKE	10-Mar-05		5.08	-0.02	9.25	0.50	0.05		21.80		TAPE	
	thin rebar	30-Mar-11	20	6.54	-0.10	15.79	0.40	0.03		21.90	16.88	TAPE	

° LATITUDE AND LONGITUDE ARE IN DECIMAL DEGREES AND ARE A CONVERSION OF MARCH 2011 RTK UTM USING GSRUG http://www.geod.nrcan.gc.ca/tools-outils/index_e.php

*Geographic positions and elevations based on N.S. CONTROL MONUMENT 2094 BLACK ROCK Elevation 12.827 m; Easting (734481.365) Northing (5085932.243) NAD 83 UTM GRID: Z 20

LINE BEARING (DEGREES MAGNETIC)

REFERENCE NOTEBOOKS

5-Dec-95	OWEN BROWN NOTES
11-Jun-96	INFO ON FORMS
6-Nov-97	RTK; CBI /95 P 71
4-Feb-00	INFO ON FORMS (O.BROWN/B.DUNHAM)
10-Mar-05	CBI2001, P68
17-Dec-08	CBI2001, P74
30-Mar-11	CBI 2011/01 p9

DISTANCE BETWEEN ;

BMS L2 TO L4 ON BEARING 296° MAG (BTWN PWC CAP &FLAG POLE AT EAST END QUAY WALL):

LINE 1 - 2: L1 BM1 (GSC 441) to L2 BM1(PWC) AND = 23.4 m

LINE 2 - 3: L2 BM1 to L3 BM1 =12.50 m

LINE 3 - 4: L3 BM1 to L4 BM1 =8.9 m

BENCH MARK HISTORY: SITE 1539

LINE 1:

5-Dec-95 CHS pin established in 1938 17ft back of bluff (updated coordinates in 1950)

11-Jun-96 CHS CAP 029 ALIGNED WITH LIGHTHOUSE ACROSS HARBOUR, BRG 62°

6-Nov-97 CHS CAP UNDER GRASS BUT MARKED BY UPTURNED ROCK AND WD STK.

4-Feb-00 CHS CAP UNDER GRASS BUT MARKED BY UPTURNED ROCK

10-Mar-05 CHS CAP INTACT; STEEP SNOWBANK

17-Dec-08 CHS cap in rock slab which is overhanging Bank

30-Mar-11 CHS cap and rock fallen over cliff leaving a square cut in grass. Established new BM1(GSC cap 441) 8.55 m lwd of former CHS marker. (RTK survey to CE only)

BENCH MARKS PRESENTLY INTACT: GSC CAP 441 (align measurements to CE with Lighthouse)

LINE 2:

5-Dec-95 BM1(PWC CAP) ALIGN WITH PEAK WHITE HOUSE (WILSON'S BED & BREAKFAST) JUST PAST PARK BDRY, BRG 6° MAG

11-Jun-96

6-Nov-97 BM1 (PWC CAP) INTACT JUST SWD OF SMALL POND

4-Feb-00 BM1 (PWC CAP) INTACT JUST SWD OF SMALL POND

10-Mar-05 BM1 (PWC CAP) INTACT JUST SWD OF SMALL POND; ROUNDED EDGE , SLUMPING SEAWRD

17-Dec-08 BM1 (PWC CAP) INTACT JUST SWD OF SMALL POND; ROUNDED EDGE , SLUMPING SEAWRD, 18.4 m to bk in slope

30-Mar-11 BM1 (PWC cap) intact, added a thin rebar 4.97m swd of cap (RTK survey to CE only)

BENCH MARKS PRESENTLY INTACT: PWC CAP and thin rebar 4.97 m swd

BENCH MARK HISTORY: SITE 1539 continued

LINE 3:

5-Dec-95	BM1(SHORT WD STAKE) ALIGN WITH WHITE CHURCH (STEEPLE) IN TOWN OF LOUISBOURG, BRG 19° MAG
11-Jun-96	
6-Nov-97	BM1 (SHORT WD STK) INTACT
4-Feb-00	BM1 (SHORT WD STK) INTACT;
10-Mar-05	BM1 (SHORT WD STK) INTACT
17-Dec-08	not found
30-Mar-11	BM1 (thin rebar) and BM2 (thin rebar) added 5.0 m swd of BM1(RTK survey to CE only)

BENCH MARKS PRESENTLY INTACT: two thin rebars 5.0 m apart

LINE 4

5-Dec-95	BM1(SHORT WD STAKE) ALIGN WITH WHITE CHURCH (STEEPLE) IN TOWN OF LOUISBOURG, BRG 21° MAG
11-Jun-96	BM1 (SHORT WD STK) INTACT
6-Nov-97	
4-Feb-00	BM1 (SHORT WD STK) INTACT
10-Mar-05	BM1 (SHORT WD STK) INTACT, VEGETATED SLOPE
17-Dec-08	not found
30-Mar-11	New BMS BM1 (thin rebar) and BM2 (thin rebar) established 4.85 m swd of BM1 (RTK survey to CE only)

BENCH MARKS PRESENTLY INTACT: two thin rebars 4.85 m apart

Site 1540

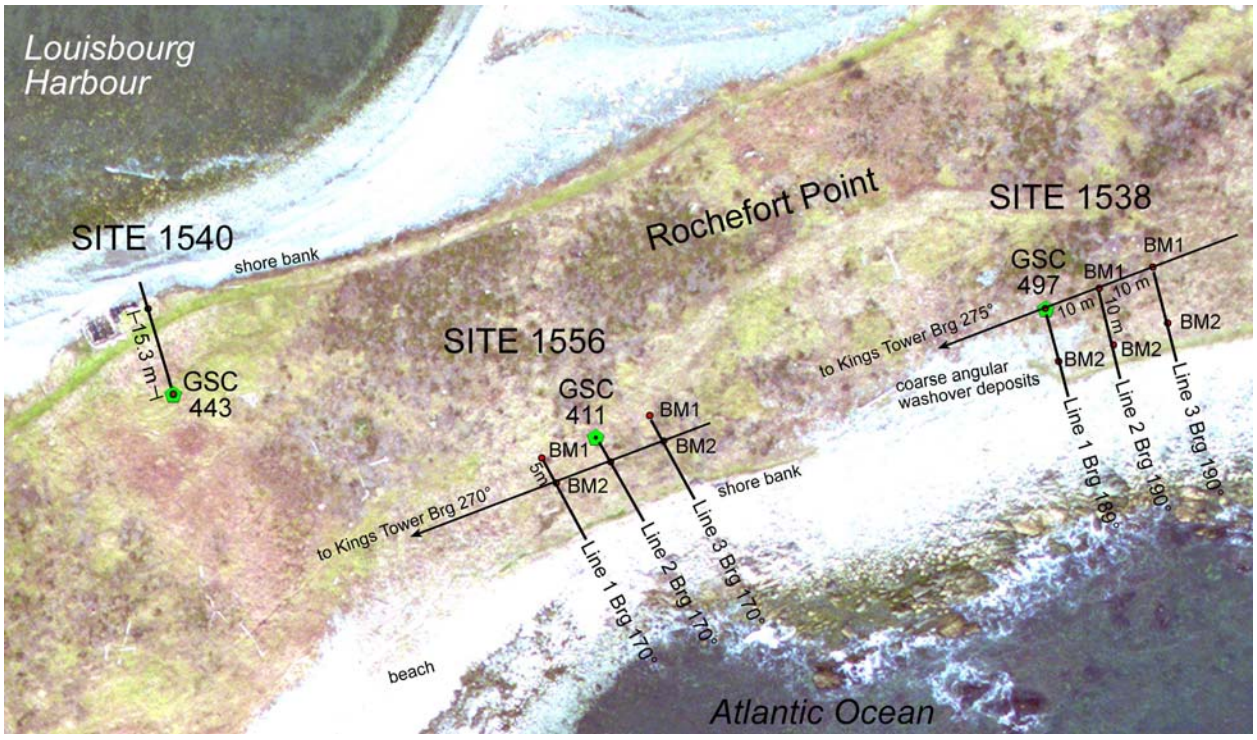


Figure 1540-1. Location of site 1540 on Rochefort Point where a single line marked by GSC 443, is adjacent to a former navigational range marker (only part of the concrete foundation remains). The site is useful for monitoring shoreline buildup and retreat along this part of outer Louisbourg Harbour where a mass human burial site (left of line) was recently exposed.

Site 1540

Figure 1540-2. Views alongshore of beach and shore bank conditions at site 1540 in March 2011. (a) shows recent beach sediment build-up against the shore bank that was eroded and a large slab of concrete broke away from the foundation and (b) shows the human burial site (geofabric cover) just north of the concrete foundation. Survey line 1 is at person in background.

1540	BANK	ROCHEFORT POINT	CAPE BRETON	NOVA SCOTIA	11G/13	NAD 83 Z 20	GEODETIC

ACCESS

The site is located within the Fortress grounds. Vehicle access is only with permision from park fire & security staff. Park at the museum and walk or drive to the first road to your right which leads to Rochefort Point and a group of tall monuments (only visible on clear days). If driving, park at the monumentsand walk along the footpath that leads northeast to the east shore of Rochefort Point. Be on the lookout for a concrete foundation and excavation site protruding seaward from the low (shore) bank.GSC cap 443 is landward of the footpath and a clump of bushes.

SITE INFORMATION (1997, 2011)

LINE	BM TYPE	LATITUDE°	LONGITUDE°	EASTING*	NORTHING*	ELEVATION*
1	CONCRETE FOUNDATION	45.894232	-59.977087	734589.275	5086719.726	3.786
1a	GSC 443	45.893862600	-59.976061567	734594.579	5086702.281	3.625
	wd marker	45.893994200	-59.976110633	734590.218	5086716.757	4.618

LINE NO.	GSC BM	SURVEY DATE (D/M/Y)	LINE BEARING (°)	NO YEARS BTW SURVEY	RETREAT (m) BTW SURVEY	TOTAL CUM NO YEARS	CUM RETREAT (m)	CUM RETREAT (m\a)	BM TO CLIFF EDGE (m) BM1 TO CE	BM2 TO CE	SURVEY METHOD	CLIFF/ BANK HEIGHT (m)
1	CONCRETE	5-Dec-95							1.38		TAPE	
	FOUNDATION	12-Jun-96		0.50	0.09	0.50	0.09	0.18	1.29		TAPE	
		6-Nov-97	27°	1.42	-0.03	1.92	0.06	0.03	1.32		RTK/TAPE	
		4-Feb-00		2.25	1.32	4.17	1.38	0.33	0.00		TAPE	
		10-Mar-05									PHOTO ONLY	
		17-Dec-08		*8.83*	*2.15*	*13.00*	*3.53*	*0.27*	*-2.15*			0.84
		30-Mar-11		11.16	-1.35	15.33	2.73	0.18	-1.35			
1a	GSC 443	30-Mar-11		2.29					17.10	1.79	Tape /RTK	

° LATITUDE AND LONGITUDE ARE IN DECIMAL DEGREES AND ARE A CONVERSION OF MARCH 2011 RTK UTM USING GSRUG http://www.geod.nrcan.gc.ca/tools-outils/index_e.php

*Geographic positions and elevations based on N.S. CONTROL MONUMENT 2094 BLACK ROCK Elevation 12.827 m; Easting (734481.365) Northing (5085932.243) NAD 83 UTM GRID: Z 20

LINE BEARING (DEGREES MAGNETIC)

USING COORDINATES OF FOUNDATION FROM 1979 AND 2011 CE THE LOSS OF CLIFF WAS ONLY 1.35 M (LESS THAN SUGGESTED IN 2008).

REFERENCE NOTEBOOKS

5-Dec-95	OWEN BROWN NOTES
12-Jun-96	INFO ON FORMS
6-Nov-97	RTK; CBI / 95 p 71
4-Feb-00	INFO ON FORMS (O.BROWN/B.DUNHAM)
10-Mar-05	CBI2001; P68
17-Dec-08	CBI2001 p 75
30-Mar-11	CBI2011/01 p10

BENCH MARK HISTORY: SITE 1540

LINE 1

5-Dec-95 THE MEASUREMENT OF 1.38M IS FROM BM1(CORNER OF CONCRETE FOUNDATION) TO TOP BANK CREST WHERE VEGETATION SLOPES OR BREAKS AWAY; THE MEASUREMENT 4.15 M IS FROM BM1 TO SWD EDGE OF EXISTING CRIBWORK FRAME.

12-Jun-96 NOTE: SWD EDGE CRIB FRAME NOT VISIBLE IN JUN 1996

6-Nov-97 CORNER OF CONCRETE INTACT; DIST TO SWD EDGE CRIBWK (PIN) IS 4.14 m LINE BEARING OF 27° IS ON THE CHURCH IN TOWN

4-Feb-00 CORNER OF CONCRETE INTACT BUT NOW COMPLETELY EXPOSED; UNABLE TO MEASURE TO CRIBWORK WHICH HAS BEEN SIGNIFICANTLY DISTURBED

10-Mar-05 CORNER OF CONCRETE INTACT BUT NOW COMPLETELY EXPOSED; TIMBER CRIBWORK IS EXPOSED TOP OF BEACH SOME FOUNDATION BROKEN TO SOUTH OF LINE

17-Dec-08 MUCH OF CONCRETE FOUNDATION EXPOSED , NO WOOD CRIB SEEN; MEASURED LANDWARD TO EDGE OF BANK FROM SWD POINT OF FOUNDATION FOR MAX LOSS

30-Mar-11 CONCRETE FOUNDATION BROKEN OFF- New Line 1a established

LINE 1a

30-Mar-11 ESTABLISHED BM1 (GSC cap 442) and BM2 (Saint Marie Property marker (wood) 15.3 m swd of BM1

BENCH MARKS PRESENTLY INTACT: BM1 (GSCcap 443) and BM2 (wd stake of Saint Marie Property marker) BM1 to BM2 =15.3 m

Shore Monitoring Sites
1559 to 1561
Battery Island

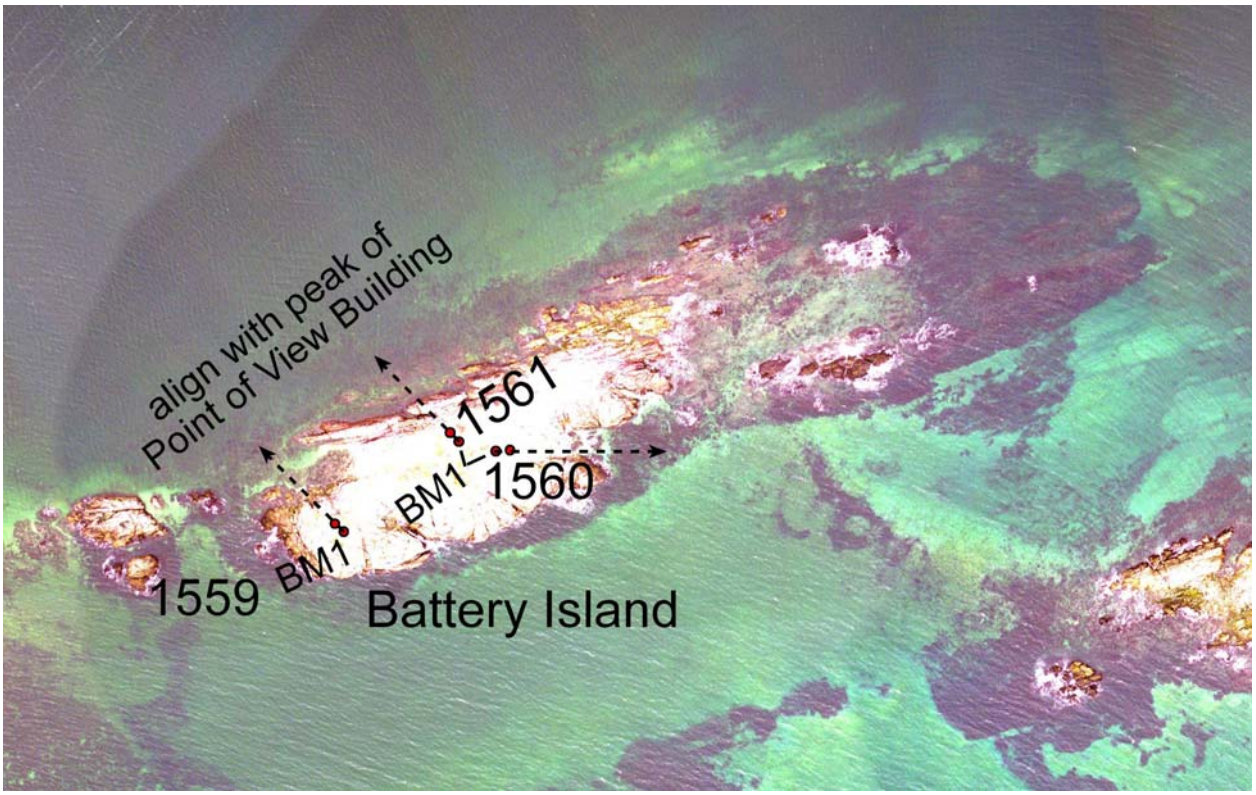


Figure 1559-1. Aerial view of Battery Island at the mouth of Louisbourg Harbour. Three shoreline monitoring sites were established in 2011. Site 1559 is at a till shore cliff, 1560 is at an archaeological resource and 1561 is essentially a bedrock shore where less change is anticipated but provides a comparison with the other two sites. The sites are plotted on a georectified 2010 air photo using ARCMAP.

Figure 1559-2 Ground views at site 1559 showing (a) line markers and alignment with peak on Point of View building in Louisbourg; shoreline looking (b) west and (c) east from Line 1 (Photos 23 September 2011).

SITE NO.	SHORE TYPE	GEOGRAPHIC NAME	COUNTY	PROVINCE	NTS REF	HORIZ. DATUM	VERTICAL DATUM
1559	SHORE	BATTERY	CAPE	NOVA	11G/13	NAD 83	
	CLIFF (TILL)	ISLAND	BRETON	SCOTIA		ZONE 21	

ACCESS

Access to the island is by shallow bottomed vessel via a narrow inlet on the west side of the island. Notification of the Fire and Secuirty staff is required prior to accessing the island.
The site is at the west end of the island.

SITE INFORMATION (2011)

	BM TYPE	LATITUDE*	LONGITUDE*	EASTING*	NORTHING*	ELEVATION**	EASTING (Z20)	NORTHING(Z20)
LINE 1	BM1 (rebar)	45.8989435	59.966723	269865	5087100		735297.255	5087294.201
	BM2 (rebar)			269861	5087104		735293.015	5087297.887

LINE NO.	GSC BM	SURVEY DATE (D/M/Y)	LINE BEARING	NO YEARS BTW SURVEY	RETREAT (m) BTW SURVEY	TOTAL CUM NO YEARS	CUM RETREAT (m)	CUM RETREAT (m\a)	BM TO CLIFF EDGE (m) BM1 TO CE	BM2 TO CE	SURVEY METHOD	CLIFF/BANK HEIGHT (m)
1		23-Sep-11	328						19.20	14.20	TAPE	

* UTMs ARE BASED ON 2011 HAND-HELD GPS READINGS(GARMIN 76) using Z21 UTMs were converted using a ARCGIS project in Z20

** ELEVATIONS IN METRES (TAPED DIST FROM TOP EDGE TO BASE CLIFF FACE)
LINE BEARING (DEGREES MAGNETIC)

REFERENCE NOTEBOOKS:

23-Sep-11 PARKS CANADA-LEE ANNE REEVES NOTES

DISTANCE BETWEEN BMS:

LINE 1: BM 1 - BM2: 5.0M

BENCH MARK HISTORY:

LINE 1

23-Sep-11 BM1 (rebar) and BM2 (Rebar) established 5m apart -when measuring align markers with the centre peak on the POINT OF VIEW building close to park entrance in town of Louisbourg

Figure 1560-1. Ground views of Line 1 site 1560, Battery Island (a) line marker (circled) and views alongshore (b) west and (c) east of line 1 (photos 23 September 2011).

SITE NO.	SHORE TYPE	GEOGRAPHIC NAME	COUNTY	PROVINCE	NTS REF	HORIZ. DATUM	VERTICAL DATUM
1560	CLIFF	BATTERY ISLAND	CAPE BRETON	NOVA SCOTIA	11G/13	NAD 83 ZONE 21	

ACCESS

Access to the island is by shallow bottomed vessel via a narrow inlet on the west side of the island. Notification of the Fire and Secuirty staff is required prior to accessing the island.
The site is at an archaeological feature on the south side of the island .

SITE INFORMATION (2011)

	BM TYPE	LATITUDE*	LONGITUDE*	EASTING*	NORTHING*	ELEVATION**	EASTING (Z20)	NORTHING (Z20)
LINE 1	BM1 (rebar)	45.89927519	59.9657355	269943	5087134		735372.83	5087334.016
	BM2 (rebar)			269950	5087134		735379.465	5087334.569

LINE NO.	GSC BM	SURVEY DATE (D/M/Y)	LINE BEARING	NO YEARS BTW SURVEY	RETREAT (m) BTW SURVEY	TOTAL CUM NO YEARS	CUM RETREAT (m)	CUM RETREAT (m\a)	BM TO CLIFF EDGE (m) BM1 TO CE	BM2 TO CE	SURVEY METHOD	CLIFF/BANK HEIGHT (m)
1		23-Sep-11	275						10.89	5.89	TAPE	

* UTMs ARE BASED ON 2011 HAND-HELD GPS READINGS (GARMIN 76)USING Z21 The Z20 UTMS were converted using a Z20 ARC GIS project

LINE BEARING (DEGREES MAGNETIC)

REFERENCE NOTEBOOKS:

23-Sep-11 PARK CANADA- LEE ANNE REEVES NOTES

DISTANCE BETWEEN BMS:

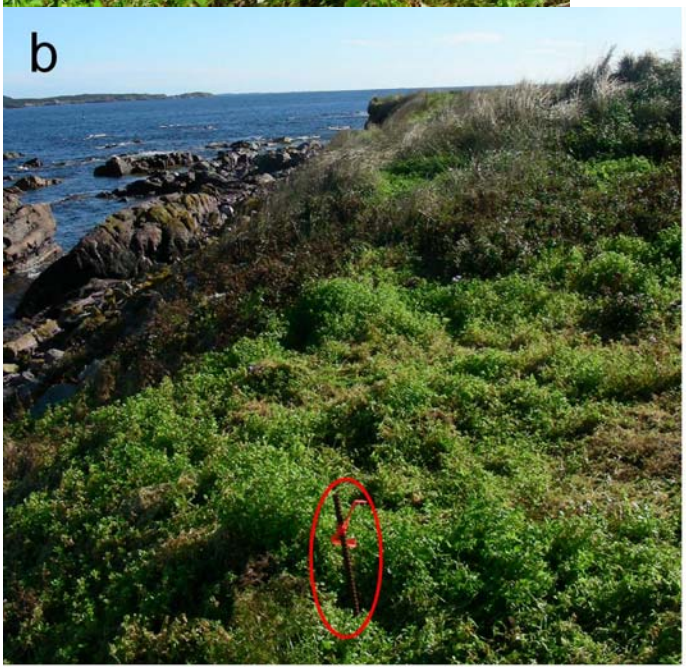
LINE 1: BM 1 - BM2: 5.0M

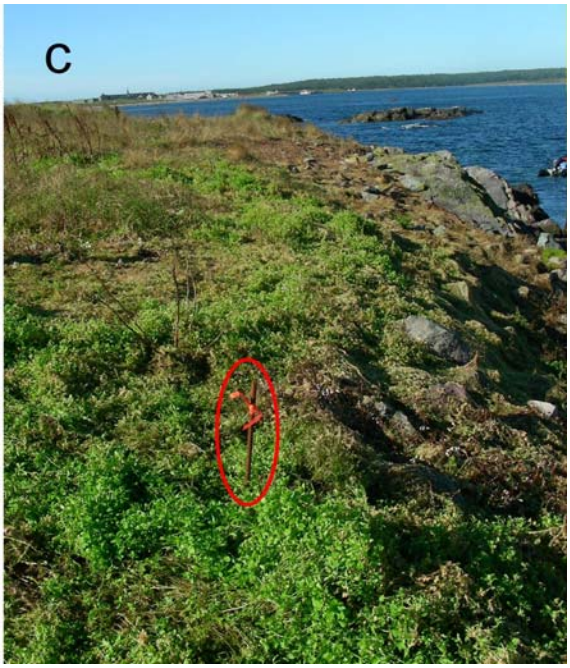
BENCH MARK HISTORY:

LINE 1

23-Sep-11 BM1 (rebar) and BM2 (rebar) established 5m apart -when measuring distance align markers with the landward navigation range marker on north shore FOL

Figure 1561-1. Ground views at site 1561, Battery Island showing (a) line markers and alignment with peak at Point of View building in Louisbourg and views (b) east and (c) west alongshore with BM2 line marker (circled) in foreground. (Photos 26-Sept 2011).





SITE NO.	SHORE TYPE	GEOGRAPHIC NAME	COUNTY	PROVINCE	NTS REF	HORIZ. DATUM	VERTICAL DATUM
1561	CLIFF	BATTERY	CAPE	NOVA	11G/13	NAD 83	
	BEDROCK	ISLAND	BRETON	SCOTIA		ZONE 21	

ACCESS

Access to the island is by shallow bottomed vessel via a narrow inlet on the west side of the island. Notification of the Fire and Secuirty staff is required prior to accessing the island.
The site is at north side of the island and it is not expected to change because of bedrock

SITE INFORMATION (2011)

	BM TYPE	LATITUDE*	LONGITUDE*	EASTING*	NORTHING*	ELEVATION**	EASTING (Z20)	NORTHING (Z20)
LINE 1	BM1 (rebar)	45.89932311	59.96597014	269925	5087140		735354.397	5087338.809
	BM2 (rebar)			269921	5087145		735349.788	5087343.785

LINE NO.	GSC BM	SURVEY DATE (D/M/Y)	LINE BEARING	NO YEARS BTW SURVEY	RETREAT (m) BTW SURVEY	TOTAL CUM NO YEARS	CUM RETREAT (m)	CUM RETREAT (m\a)	BM TO CLIFF EDGE (m) BM1 TO CE	BM2 TO CE	SURVEY METHOD	CLIFF/BANK HEIGHT (m)
1		26-Sep-11	330						6.47	1.39	TAPE	

* UTMs ARE BASED ON 2011 GPS READINGS(GARMIN 76)USING Z21 . The Z20 UTMS are converted using a Z20 ARC GIS project

** ALIGN MARKERS WITH THE CENTRE PEAK ON THE POINT OF VIEW SUITE BUILDING

LINE BEARING (DEGREES MAGNETIC)

REFERENCE NOTEBOOKS:

26-Sep-11 PARKS CANADA- LEE ANNE REEVES NOTES

DISTANCE BETWEEN BMS:

LINE 1: BM 1 - BM2: 5.08 m

BENCH MARK HISTORY:

LINE 1

26-Sep-11 BM1(rebar) and BM2 (rebar) established 5.1 m apart -when measuring distance align markers with the centre peak on the POINT OF VIEW Building close to the park entrance in town of Louisbourg

Shore Monitoring Site
1541
Grand Étang Barrier Beach

Site 1541

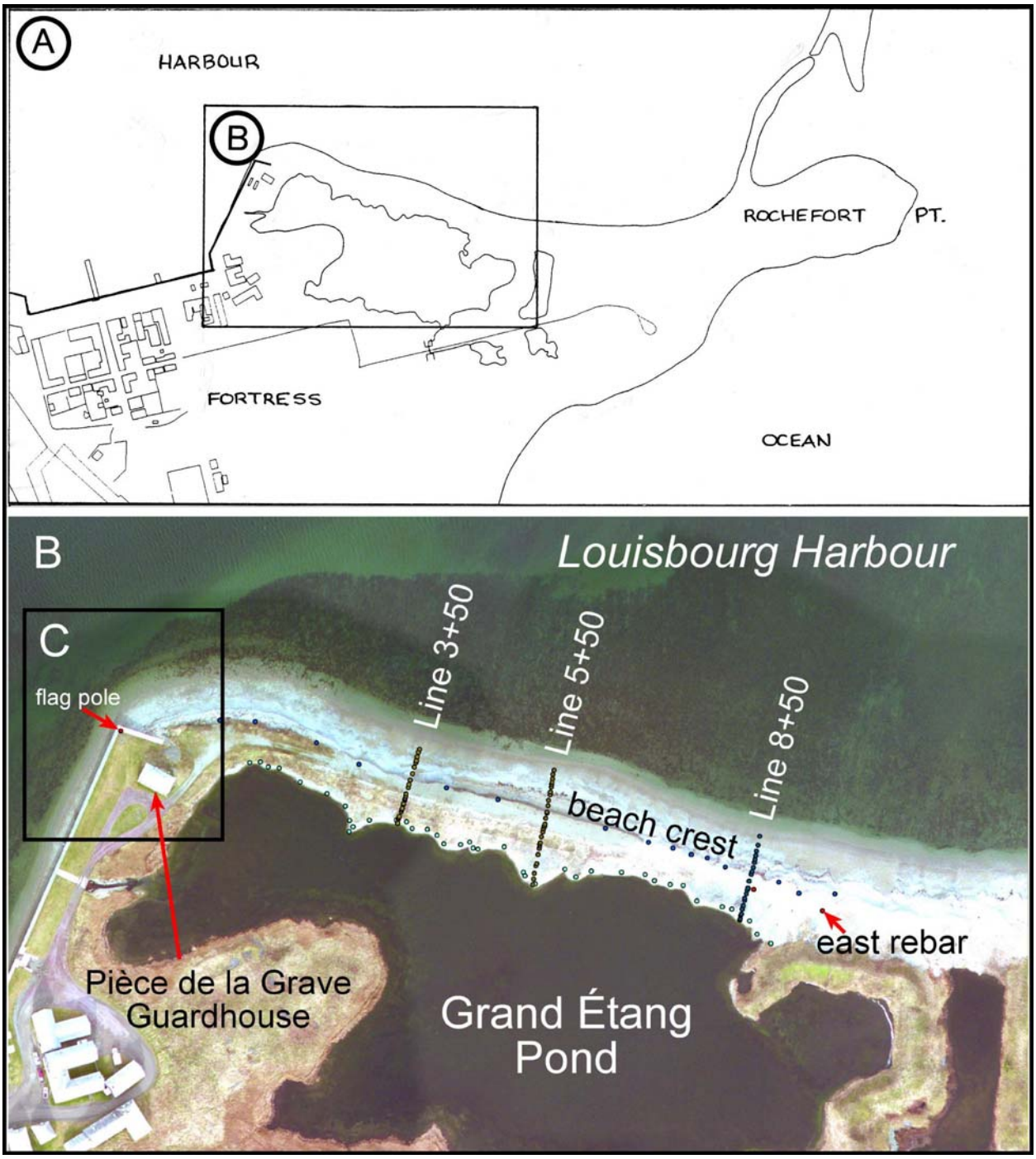


Figure 1541-1.The barrier beach fronting Grand Étang Pond is low lying and subject to wave overwash and erosion during large north easterly storms. Repetitive surveys along the crest and across the beach at three locations have been completed since the early 1990s by GSC and even earlier by PWC. The survey information was used to design a beach crest building (sediment nourishment) program to reduce wave overwash, landward beach migration and ultimately protect archaeological resources buried in the pond (Taylor 1992 and Taylor et al. 2003).

Site 1541

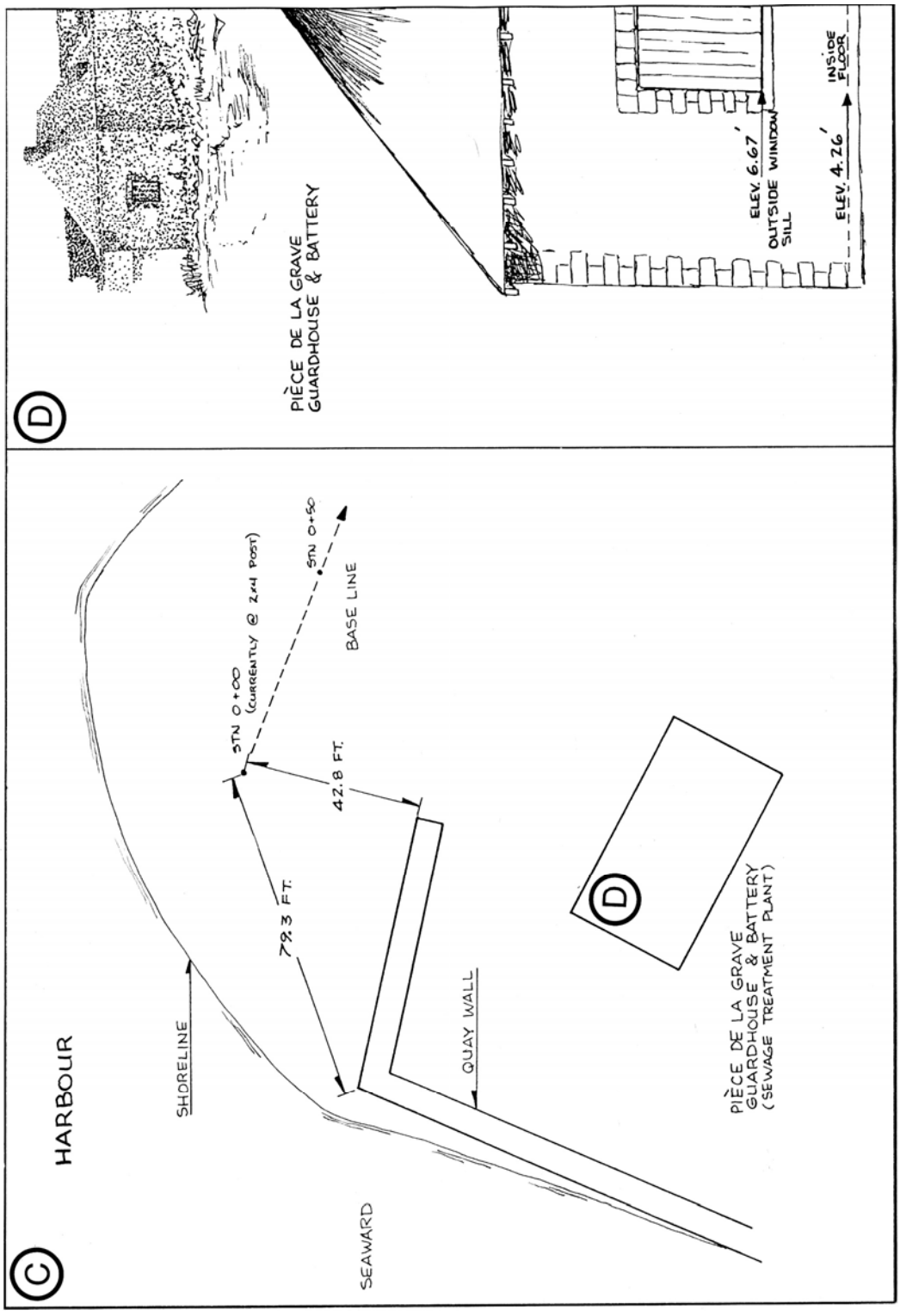
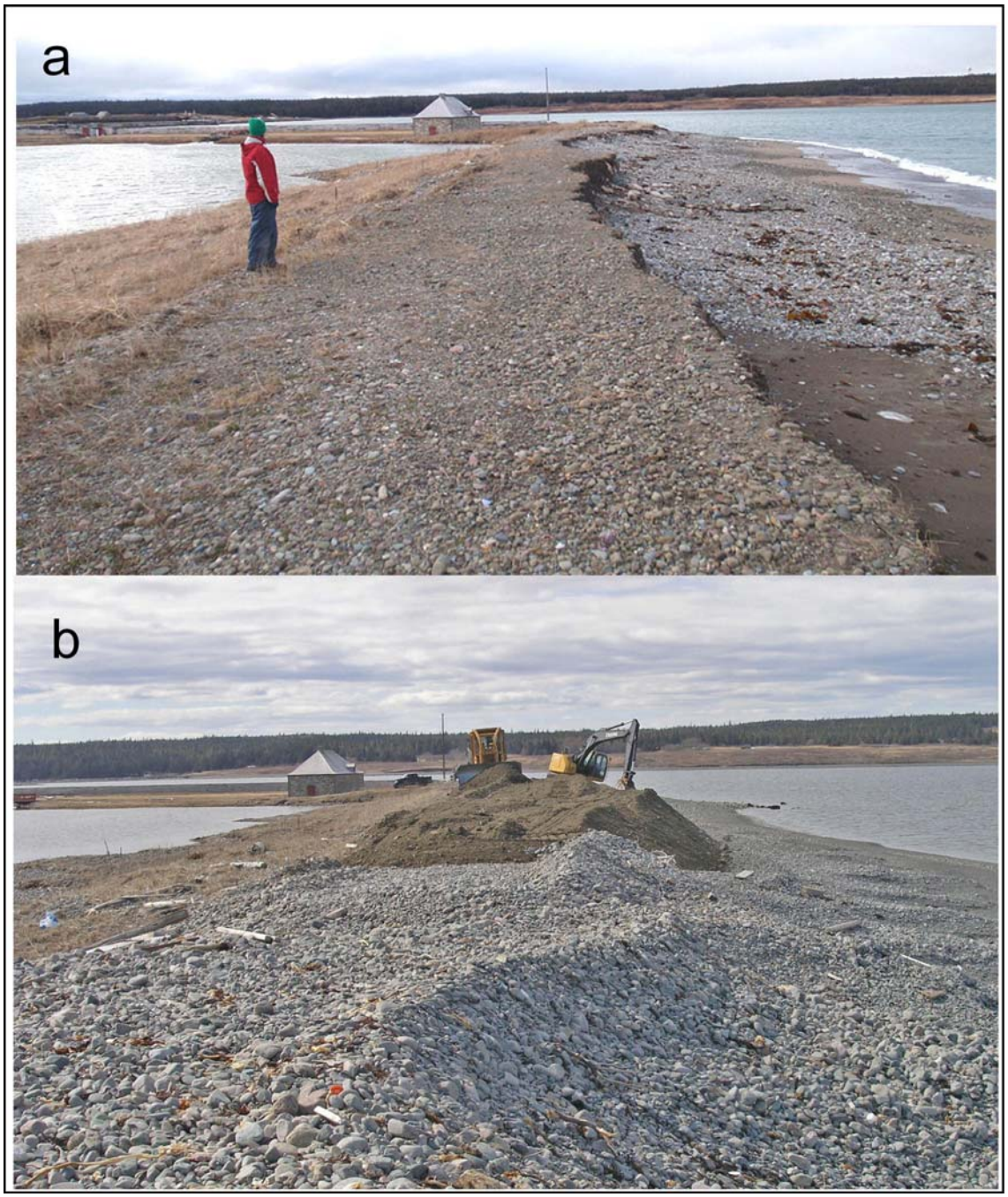


Figure 1541-2. Geographic information required to establish the baseline along Grand Étang barrier beach and control elevations at Pièce de la Grave Guardhouse (pumphouse).

Figure 1541-3. Grand Étang Beach looking north (a) in January 2011 showing the narrow extent of upper beach that survived the four December 2010 storms (photo R. Duggan); (b) 31 March 2011 showing the beach crest rebuilding and seaward slope smoothing program . (b) also illustrates the significant difference in the composition of the new fill and the natural cobble beach (foreground) at the south end of the barrier beach. Pièce de la Grave Guardhouse in the background.



SITE NO.	SHORE TYPE	GEOGRAPHIC NAME	COUNTY	PROVINCE	NTS REF	HORIZ DATUM	VERTICAL DATUM
1541	BARRIER BEACH	GRAND ETANG	CAPE BRETON	NOVA SCOTIA	11G/13	ZONE 20 NAD 83	GEODETIC

ACCESS

The survey site is on the grounds of the Fortress; vehicle access is prohibited unless permission is granted by the park wardens. Outside the tourist season you may be able to drive to the Piece de la Grave Guardhouse at the northwest end of the barrier beach. Park, and walk along the crest of the barrier beach looking for any wood stakes that mark the baseline or a rebar at the southeast end of the barrier beach. Three cross shore lines L3+50, 5+50 and 8+50 have at least one line marker on the backshore. Control elevation for all surveys is the top of the east rebar and the window sill of the guardhouse. Originally there were 24 survey lines spaced 15.24 m (50 ft) apart along a baseline (bearing 132°) extending along the barrier beach.
Surveys were started in 1985 by the Engineering Department at the Fortress but only surveys completed since 1995 are reported on this form.

SITE INFORMATION (1997,2011)

	BM TYPE	LATITUDE°	LONGITUDE°	EASTING*	NORTHING*	ELEV* (m)
Building (1997)	WINDOW SILL	45.894583	59.982812	734067.847	5086762.428	1.772
L 0+00	baseline (base WD 2X4)	45.894872	59.982793	734068.118	5086794.691	1.477
L2+50	baseline position (base)	45.894644	59.981866	734140.989	5086772.050	3.437
L3+50	baseline (base wd stake)	45.894553	59.981498	734169.964	5086763.047	3.263
L3+50	rebar at backshore	45.894484	59.981532	734167.578	5086755.188	nd
L5+50	baseline (base wd stake)	45.894371	59.980758	734228.127	5086744.978	3.250
L5+50	BM1 (base wd stake)	45.894228	59.980807	734224.897	5086728.87	1.224
L8+50	baseline wd stake	45.894101	59.979642	734315.730	5086718.130	3.521
L8+50	BM1 (base red stake)	45.894034	59.979672	734313.816	5086710.685	2.047
rebar West (2000	top rebar	45.894094	59.979611	734318.224	5086717.554	3.317
rebar East (1997)	top rebar	45.894002	59.979235	734347.816	5086708.475	3.802

LINE NO.	SURVEY DATE (D/M/YR)	LINE BEARING (°)	BM1 TYPE	BM1 HEIGHT (m)	BM1 ELEV.**	BM2 (baseline markers) TYPE	BM2 HEIGHT (m)	BM2 ELEV.**	SURVEY METHOD	OTHER INFO
2+50	20-Jul-88								THEODOLITE	
	15-Dec-92								THEODOLITE	
	7-Dec-95	41						3.437 (base)	GEODAT	PRINTS
3+50	20-Jul-88								THEODOLITE	
	15-Dec-92								THEODOLITE	
	7-Dec-95	42						3.318 (base)	GEODAT	PRINTS
	7-Nov-97	42				WD STK		3.263 (base)	DGPS	PRINTS
	3-Feb-00								DGPS	
	24-Nov-00		WD STK		3.267 (base)	WD STK		3.734 (base)	DGPS	PRINTS
	31-Mar-11		Short Rebar					4.036 (base)	RTK	Digital
5+50	20-Jul-88								THEODOLITE	
	15-Dec-92								THEODOLITE	
	7-Dec-95	36						3.286 (base)	GEODAT	PRINTS
	7-Nov-97	36				WD STK		3.250 (base)	DGPS	PRINTS
	3-Feb-00								DGPS	
	24-Nov-00		WD STK		1.30 (base)	WD STK		3.776 (base)	DGPS	PRINTS
	31-Mar-11		WD STK		1.224 (base)	WD STK		3.794	RTK	Digital
8+50	20-Jul-88								THEODOLITE	
	12-Nov-92								THEODOLITE	
	7-Dec-95	40						3.332 (base)	GEODAT	PRINTS
	7-Nov-97	40				survey pin		3.263(base)	DGPS	PRINTS
	3-Feb-00								DGPS	
	24-Nov-00		WD STK		2.103 (base)	WD STK		3.253 (base)	DGPS	PRINTS
	30-Mar-11		red wd stk (rebar?)		2.047 (base)	WD STK		3.521 (base)	RTK	Digital

° LATITUDE AND LONGITUDE ARE IN DECIMAL DEGREES AND ARE A CONVERSION OF MARCH 2011 RTK UTM USING GSRUG http://www.geod.nrcan.gc.ca/tools-outils/index_e.php
*Geographic positions and elevations based on N.S. CONTROL MONUMENT 2094 BLACK ROCK Elevation 12.827 m; Easting (734481.365) Northing (5085932.243) NAD 83 UTM GRID: Z 20
LINE BEARING (DEGREES MAGNETIC) 1988 and 1992 surveys completed by PWC from Fortress Engineering Department.
Note: baseline markers are sighted in from instructions and only temporary wd stakes are used. In 2011 used the 1997 survey points to relocate the baseline

REFERENCE NOTEBOOKS:

20-Jul-88	PWC survey
12-Nov-92	PWC survey
15-Dec-92	PWC survey
7-Dec-95	CBI /95 P 29
7-Nov-97	CBI / 95 P77
3-Feb-00	MacKinnon UCCB-original in ATS77
24-Nov-00	CBI98/1 P40,41
31-Mar-11	CBI2011/01 p12

BENCHMARK HISTORY: SITE 1541

Line 2+50

20-Jul-88	PWC survey
15-Dec-92	Survey immediately after placement of fill
7-Dec-95	Survey across barrier includes pond and nearshore

Line 3+50

20-Jul-88	PWC survey
15-Dec-92	Survey immediately after placement of fill
7-Dec-95	Survey across barrier includes pond and nearshore
7-Nov-97	BM2 (baseline wd stk) is 17.78 m swd of WLL
3-Feb-00	UCCB survey
24-Nov-00	BM1 (wd stake) 10.2 m from WLL and BM2 (baseline wd stake) 6.0 m swd of BM1
31-Mar-11	BM1 (short rebar) sighted in from 1997 survey but not resurveyed in 2011 (no elev data) and BM2 (baseline wd stk) is 17.46 m swd of WLL

Line 5+50

20-Jul-88	PWC survey
15-Dec-92	Survey immediately after placement of fill
7-Dec-95	Survey across barrier includes pond and nearshore
7-Nov-97	BM2 (baseline wd stk) is 27.25m swd of WLL
3-Feb-00	UCCB survey
24-Nov-00	BM1 (wd stick) 9.3m from WLL and BM2 (baseline wd stake) 16.41m swd of BM1
31-Mar-11	BM1(wd stk) is 9.3 m from WLL and BM2 (baseline wd stk) is 16.53 m swd of BM1

Line 8+50

20-Jul-88	PWC survey
12-Nov-92	PWC survey
7-Dec-95	Survey across barrier includes pond and nearshore
7-Nov-97	BM1( ) 7.0 m from WLL and BM2 (pin) is 7.7m swd of BM1
3-Feb-00	UCCB survey
24-Nov-00	BM1 (red wd stake) 6.6m from WLL and BM2 (baseline red wd stake) 6.4m swd from BM1
30-Mar-11	BM1 (red stake, rebar?) is 6.4m from WLL and BM2 (wd stk-baseline) is 7.88 m swd of BM1

Shore Monitoring Sites
1542 to 1544
and
Sites 1557, 1558

North Shore, Louisbourg Harbour

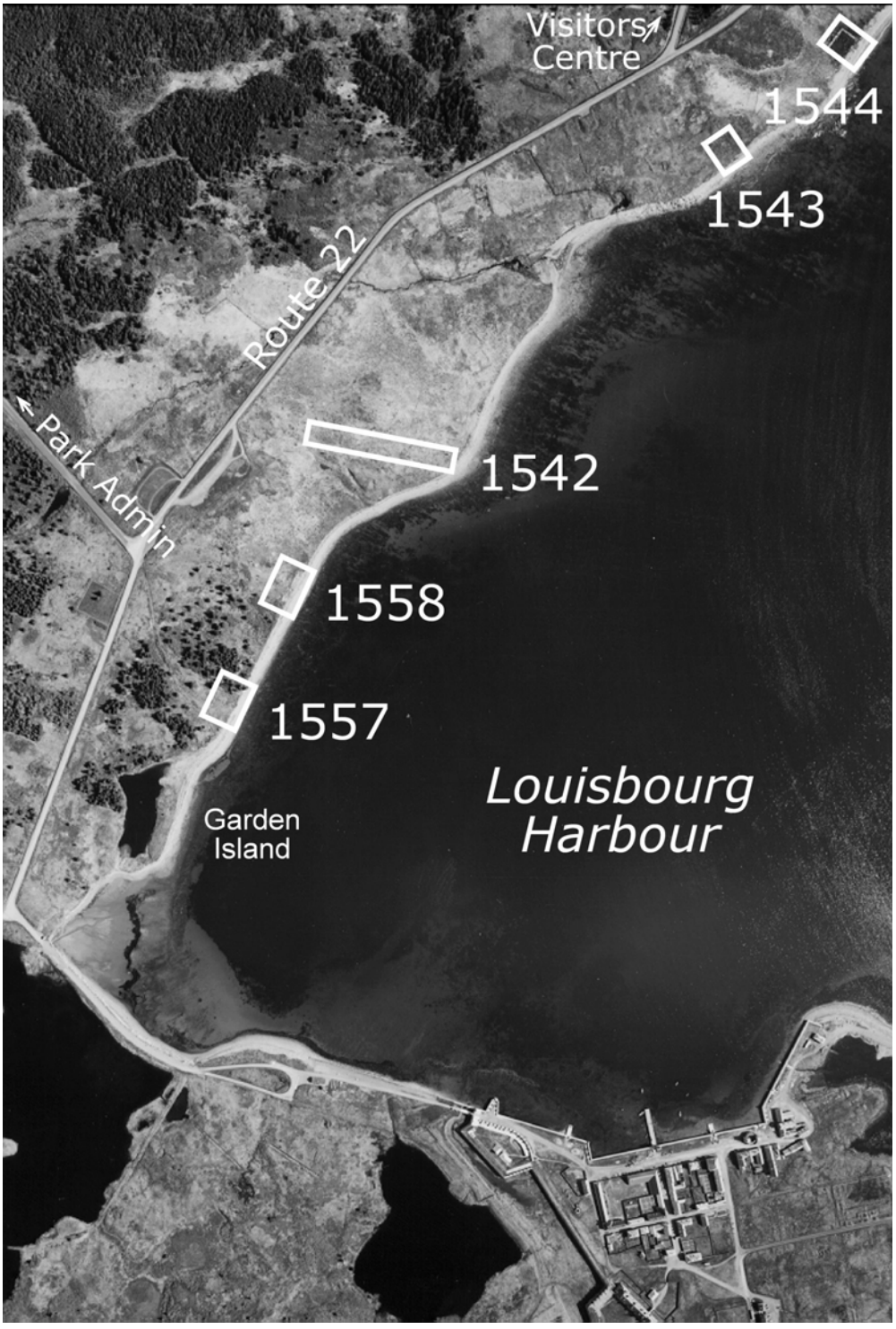


Figure 1557-1. Aerial view of Louisbourg Harbour and Fortress Louisbourg showing the location of five shoreline monitoring sites established on the north shore of Louisbourg Harbour (air photo 93300-76). Sites 1557 and 1558 were initiated in 2011.

Site 1557and 1558

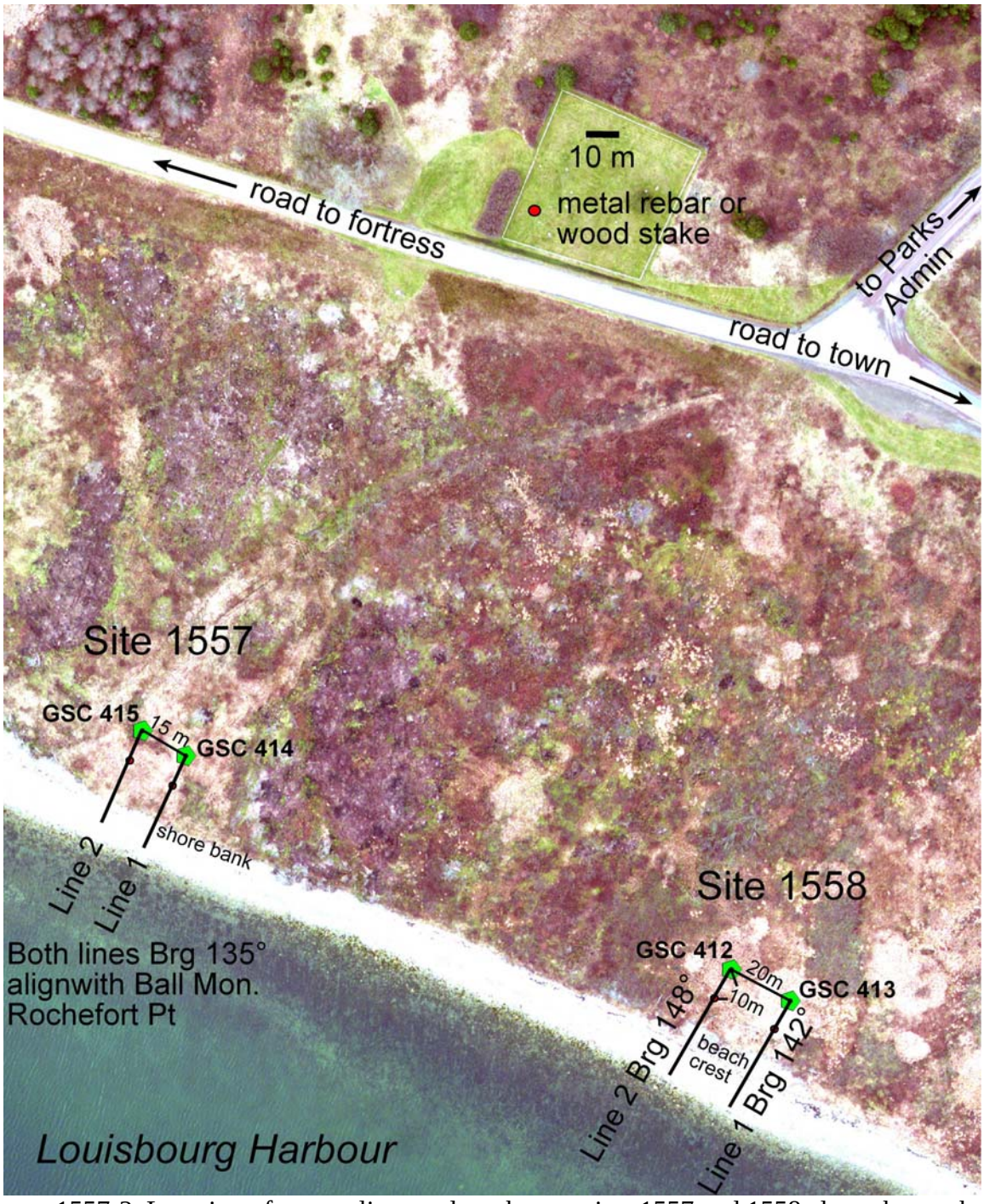


Figure 1557-2. Location of survey lines and markers at sites 1557 and 1558 along the north shore of Louisbourg Harbour. Site 1557 is where archeological ruins were being exposed by shore bank retreat and site 1558 has a low backshore where the beach is migrating landward.

Site 1557

Figure 1557-3. Views looking alongshore at site 1557 (a) to the west and (b) east showing the location of survey lines (circled red flags) and the condition of the shore bank in March 2011. Figure 1557-2 provides a more general view of the site location along the north shore of Louisbourg Harbour.

SITE NO.	SHORE TYPE	GEOGRAPHIC NAME	COUNTY	PROVINCE	NTS REF	HORIZ. DATUM	VERTICAL DATUM
1557	CLIFF	FISHING PROPERTIES	CAPE BRETON	NOVA SCOTIA	11G/13	NAD 83 Z 20	GEODETIC

ACCESS

The site is located on the north shore of Louisbourg Harbour. From the town of Louisbourg drive toward the causeway that leads to the Fortress. Park at the pull off on left side of road just before the gate at the causeway. Walk east along the north harbour shore past Garden Island to a low shore cliff where sand bags are exposed in the cliff face. The survey lines are at and just west of the sand bags.
Line 1 marked by GSC 414 is the east line and Line 2 marked by GSC cap 415 is the west line.

SITE INFORMATION (2011)

LINE	BM TYPE	LATITUDE°	LONGITUDE°	EASTING*	NORTHING*	ELEVATION*
1	GSC 414	45.89845383	-59.99356378	733214.573	5087161.014	4.979
1	THIN REBAR	45.89841458	-59.99344932	733223.617	5087156.988	4.298
2	GSC 415	45.8983397	-59.9936652	733207.184	5087148.037	5.222
2	THIN REBAR	45.89830295	-59.99355032	733216.250	5087144.290	4.294

CLIFF RECESSION SURVEYS

LINE NO.	GSC BM	SURVEY DATE (D/M/Y)	LINE BEARING (°)	NO YEARS BTW SURVEY	RETREAT (m) BTW SURVEY	TOTAL CUM NO YEARS	CUM RETREAT (m)	CUM RETREAT (m\a)	BM TO CLIFF EDGE (m) BM1 TO CE	BM TO CLIFF EDGE (m) BM2 TO CE	SURVEY METHOD	CLIFF/BANK HEIGHT (m)
1	414	30-Mar-11	135						20.50	10.60	TAPE / RTK	1.35
2	415	30-Mar-11	135						22.66	12.76	TAPE / RTK	0.72

° LATITUDE AND LONGITUDE ARE IN DECIMAL DEGREES AND ARE A CONVERSION OF MARCH 2011 RTK UTM USING GSRUG http://www.geod.nrcan.gc.ca/tools-outils/index_e.php
*Geographic positions and elevations based on N.S. CONTROL MONUMENT 2094 BLACK ROCK Elevation 12.827 m; Easting (734481.365) Northing (5085932.243) NAD 83 UTM GRID: Z 20
LINE BEARING (DEGREES MAGNETIC)

REFERENCE NOTEBOOKS:

30-Mar-11 CBI 2011/01 p1

DISTANCE BETWEEN LINES

LINE 1 TO 2 15 m

DISTANCE BETWEEN BENCHMARKS

LINE 1: BM1 to BM2 =10.0 m
LINE 2: BM1 to BM2 =10.0 m

BENCH MARK HISTORY: SITE 1557

LINE 1: (East Line)
30-Mar-11 BM1 (GSC cap 414) BM2 (thin rebar) 10.0 m apart-aligned with Ball Monument on Rochefort Pt (RTK SURVEY BM1 to WLO)

BENCH MARKS PRESENTLY INTACT: BM1 (GSC 414) AND BM 2 (THIN REBAR)

LINE 2: (West Line)
30-Mar-11 BM1 (GSC cap 415) BM2 (thin rebar) 10.0 m apart -aligned with Ball Monument on Rochefort Pt (RTK SURVEY BM1 to WLO)

BENCH MARKS PRESENTLY INTACT: BM1 (THIN REBAR) AND BM 2 (THIN REBAR)

Site 1558

Figure 1558-1 Views looking alongshore at site 1558 (a) to the west and (b) east showing the location of survey lines and the navigation marker at site 1542. This low beach is often overwashed by waves as shown by the debris along the backshore in March 2011. Figure 1557-2 provides a more general view of the site location along the north shore of Louisbourg Harbour.

SITE NO.	SHORE TYPE	GEOGRAPHIC NAME	COUNTY	PROVINCE	NTS REF	HORIZ. DATUM	VERTICAL DATUM
1558	BEACH	FISHING PROPERTIES	CAPE BRETON	NOVA SCOTIA	11G/13	NAD 83 Z 20	GEODETIC

ACCESS

The survey site is on the north shore of Louisbourg Harbour. From the town of Louisbourg drive toward the Fortress. Park at the pull off on left side of road at the gate to the causeway leading to the fortress.
Walk east along the north harbour shore to a low embayed shore just before the bluff where the navigation markers (SITE 1542) are located.
LINE 1 is the east line which is aligned with the Ball Monument and Line 2 (west Line) is aligned with the small monument west of the Ball Monument on Rochefort Point

SITE INFORMATION (2011)

LINE 1	BM TYPE	LATITUDE°	LONGITUDE°	EASTING*	NORTHING*	ELEVATION*
1	GSC 413	45.9000502	-59.99253443	733287.729	5087341.382	3.468
1	THIN REBAR	45.90000265	-59.99242813	733296.173	5087336.411	3.001
2	GSC 412	45.89989368	-59.99266158	733278.522	5087323.621	3.333
2	THIN REBAR	45.89984517	-59.99255657	733286.871	5087318.538	2.904

								BEACH MIGRATION SURVEYS (m)				
LINE NO.	GSC BM	SURVEY DATE (D/M/Y)	LINE BEARING (°)	NO YEARS BTW SURVEY	RETREAT (m) BTW SURVEY	TOTAL CUM NO YEARS	CUM RETREAT (m)	BM1 TO LWD EDGE WASHOVER	BM1 TO BEACH CREST	BM2 TO LWD EDGE WASHOVER	BM2 TO BEACH CREST	SURVEY METHOD
1	413	30-Mar-11	142°					18.25	22.56	8.34	12.65	TAPE / RTK
2	412	30-Mar-11	148°					18.50	22.46	8.53	12.49	TAPE / RTK

° LATITUDE AND LONGITUDE ARE IN DECIMAL DEGREES AND ARE A CONVERSION OF MARCH 2011 RTK UTM USING GSRUG http://www.geod.nrcan.gc.ca/tools-outils/index_e.php
*Geographic positions and elevations based on N.S. CONTROL MONUMENT 2094 BLACK ROCK Elevation 12.827 m; Easting (734481.365) Northing (5085932.243) NAD 83 UTM GRID: Z 20
LINE BEARING (DEGREES MAGNETIC)

REFERENCE NOTEBOOKS

30-Mar-11 CBI 2011/01 p2

DISTANCE BETWEEN LINES:

LINE 1 to 2: 20 m

DISTANCE BETWEEN BMS:

LINE 1: BM1 (GSC413) TO BM2 (THIN REBAR) =9.91

LINE 2: BM1 (GSC412) TO BM2 (THIN REBAR) =9.97

BENCH MARK HISTORY: SITE 1558

LINE 1: (EAST LINE)

30-Mar-11 BM1(GSC 413) is 9.91 m lwd of BM2(thin rebar) in a low boggy backshore (RTK SURVEY BM1 TO WLO)

BENCH MARKS PRESENTLY INTACT: BM1(GSC 413) AND BM2 (THIN REBAR)-ALIGN WITH BALL MONUMENT

LINE 2: (WEST LINE)

30-Mar-11 BM1(GSC 412) is 9.97 m lwd of BM2 (thin rebar) in a low boggy backshore (RTK SURVEY BM1 TO WLO)

BENCH MARKS PRESENTLY INTACT: BM1(GSC412) AND BM2 (THIN REBAR)-ALIGN WITH SMALL MONUMENT WEST OF BALL MONUMENT

Site 1542

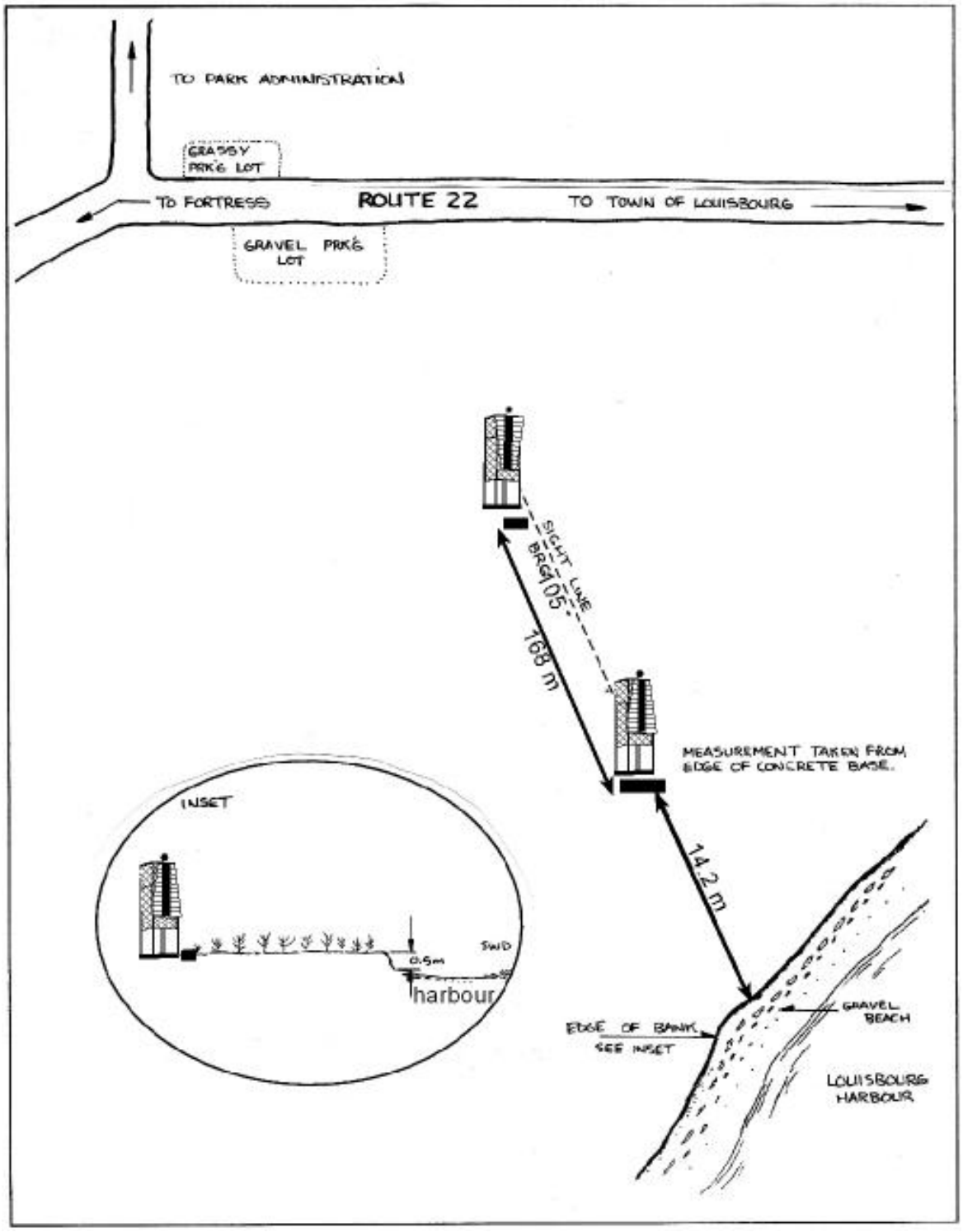


Figure 1542-1 Sketch of site 1542 showing the location of navigation markers relative to the shoreline in 2011.

Site 1542

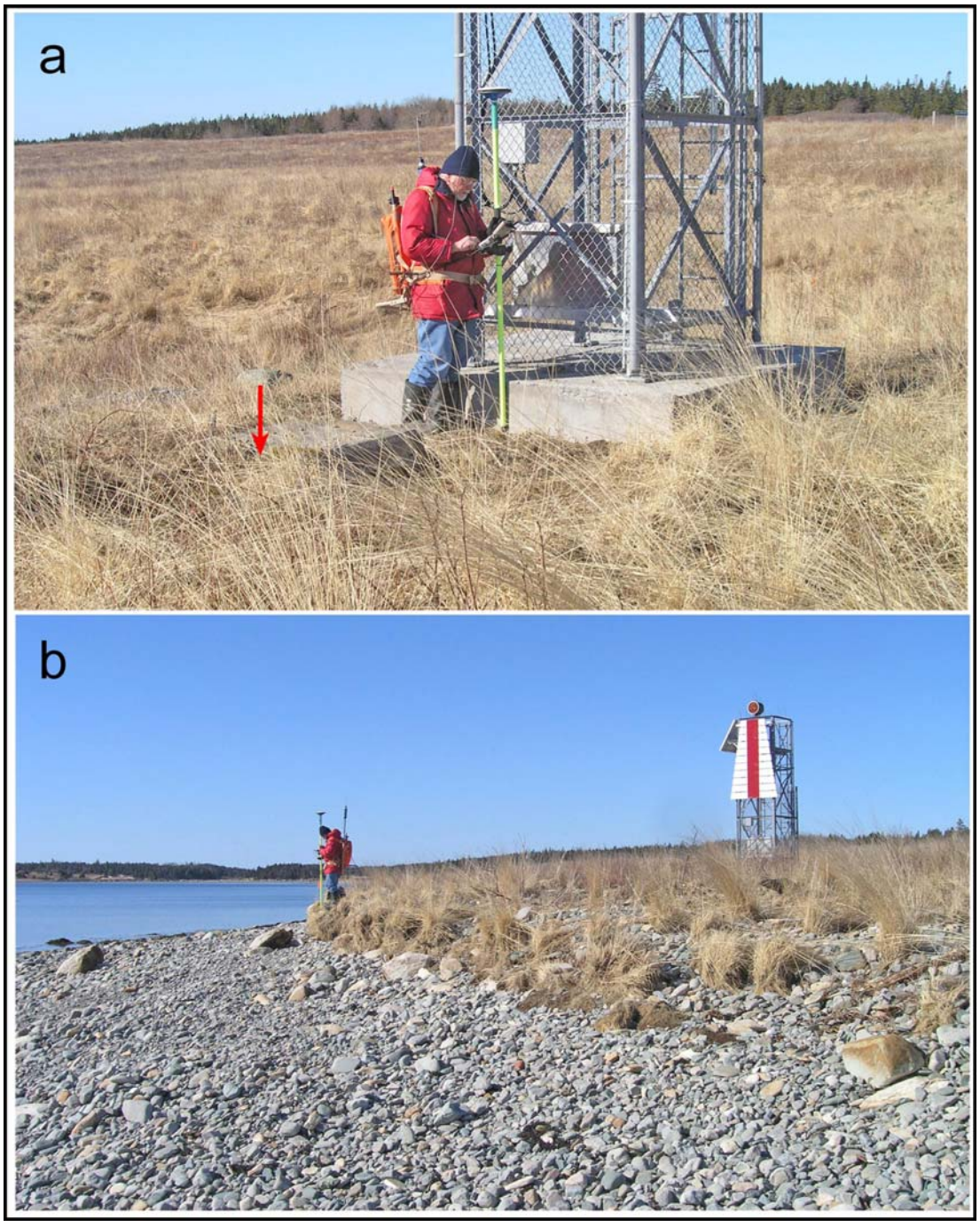


Figure 1542-2. (a) Closeup of the navigation markers delineating site 1542. Prior to 2011 measurements to the shore bank were from the seaward small concrete slab and in 2011 measurements were made from the seaward edge of both the old and new concrete slabs. (b) longshore view of monitoring site showing the proximity of the seaward navigation marker to the shore bank in March 2011.

SITE NO.	TYPE	NAME	COUNTY	PROVINCE	NTS REF	HORIZ. CONTROL	VERTICAL DATUM
1542	CLIFF	NAVIGATION MARKERS	CAPE BRETON	NOVA SCOTIA	11G/13	NAD 83 Z. 20	GEODETIC

ACCESS

The site is marked by two navigation markers located on the north shore of Louisbourg Harbour. From Louisbourg drive toward the Fortress, the navigation markers (BMS) are clearly visible seaward of the intersection with the road that leads to the park administrative offices. Park in the parking area adjacent to the intersection and walk seaward to the Navigation markers.

SITE INFORMATION (2011)

LINE	BM TYPE	LATITUDE°	LONGITUDE°	EASTING*	NORTHING*	ELEVATION*
1	CONCRETE PAD	45.901590183	-59.989707983	733503.510	5087520.751	3.392

LINE NO.	GSC BM	SURVEY DATE (D/M/Y)	LINE BEARING (°)	NO YEARS BTW SURVEY	RETREAT (m) BTW SURVEY	TOTAL CUM NO YEARS	CUM RETREAT (m)	CUM RETREAT (m\a)	BM TO CLIFF EDGE (m) BM1 TO CE	BM2 TO CE	SURVEY METHOD	CLIFF/BANK HEIGHT (m)
		5-Dec-95	ALIGN						19.95		TAPE	0.50
NAV MKERS			NAV MKERS									
		10-Jun-96	109	0.58	1.67	0.58	1.67	2.88	18.28		TAPE	
		4-Feb-00	109	3.66	1.86	4.24	3.53	0.83	16.42		TAPE	
		5-Jun-02		2.33	0.22	6.57	3.75	0.57	16.20		TAPE	
		11-Mar-05		2.75	0.48	9.32	4.23	0.45	15.72		TAPE	0.40
		31-Mar-11	105	6.54	1.52	15.86	5.75	0.36	14.20		TAPE	0.60

° LATITUDE AND LONGITUDE ARE IN DECIMAL DEGREES AND ARE A CONVERSION OF MARCH 2011 RTK UTM USING GSRUG http://www.geod.nrcan.gc.ca/tools-outils/index_e.php

*Geographic positions and elevations based on N.S. CONTROL MONUMENT 2094 BLACK ROCK Elevation 12.827 m; Easting (734481.365) Northing (5085932.243) NAD 83 UTM GRID: Z 20

LINE BEARING (DEGREES MAGNETIC)

REFERENCE NOTEBOOKS:

5-Dec-95	OWEN BROWN NOTES
10-Jun-96	INFO ON FORMS
4-Feb-00	INFO ON FORMS (O.BROWN/B.DUNHAM)
5-Jun-02	B.DUGGAN /B. CUNNINGHAM (PARKS)
11-Mar-05	CBI2001, P69
31-Mar-11	CBI2011/01 p6

DISTANCE BETWEEN BMS:

LINE 1: 166.1 m

BENCH MARK HISTORY: SITE 1542

LINE 1:

5-Dec-95	BM1 (RANGE MKER 757) IS THE SWD OF TWO RANGE MKERS. ALIGN THE TWO MKERS AND MEASURE FROM THE CENTER SWD FACE OF THE CONCRETE BASE OF SWD PAD (BM1) TO CLIFF TOP.
10-Jun-96	RANGE MARKERS INTACT
4-Feb-00	RANGE MARKERS INTACT
5-Jun-02	RANGE MARKERS INTACT
11-Mar-05	RANGE MARKERS INTACT; EROSIONAL CLUMPS ANONG TOP OF CLIFF
31-Mar-11	New Nav Markers had been established by 2011 lwd of old ones -used smaller foundations of former swd range marker as benchmark

BENCH MARKS PRESENTLY INTACT: smaller concrete pads swd of present Nav markers Distance btwn swd side of old Nav markers pads =166.1 m

Site 1543

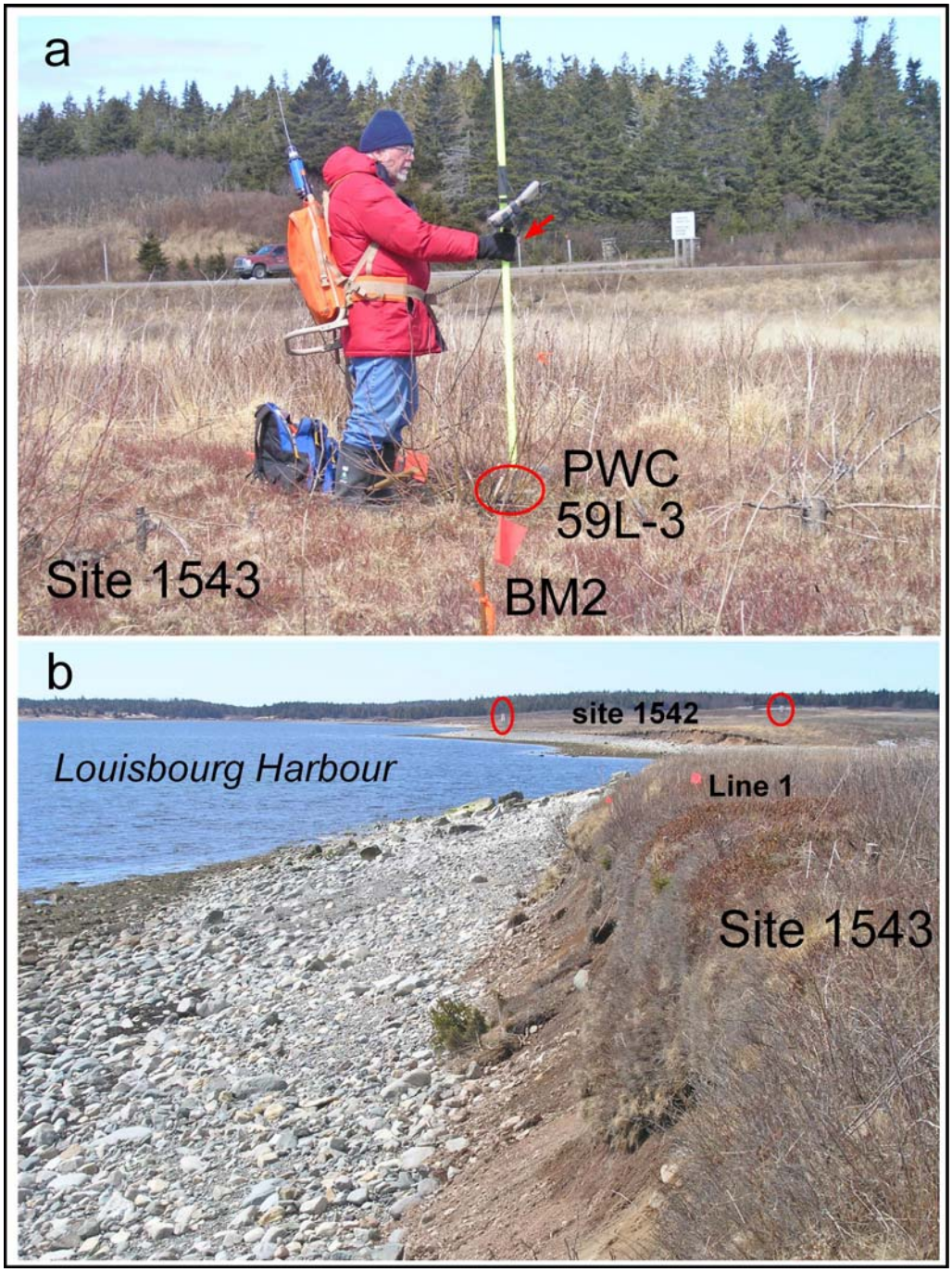


Figure 1543-2. (a) view of the PWC cap and the stop sign (arrow) on the road farther landward which should be aligned when measuring the distance to the cliff top edge at Line 1, site 1543 and (b) view looking west along the cliff face showing an extensive sod drape along the cliff top edge and some recent sod slumps near the base of the cliff. Red flags mark the location of survey lines with line 1 in the foreground.

Site1543

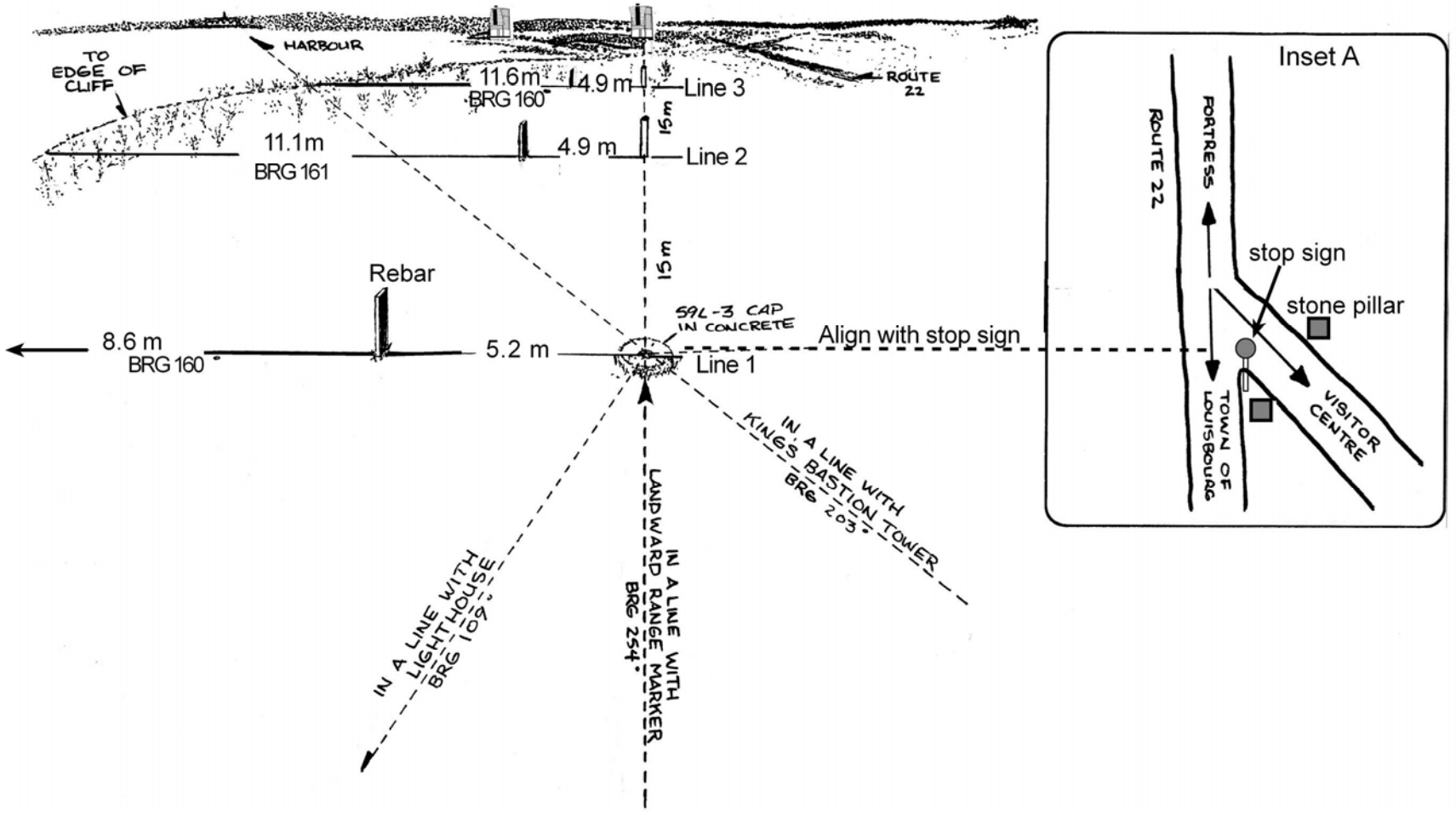


Figure 1543-1 Sketch of site 1543 on the north shore of Louisbourg Harbour showing the position of line markers and Inset A shows the position of objects at the main road used to find the site.

SITE NO.	SHORE TYPE	GEOGRAPHIC NAME	COUNTY	PROVINCE	NTS REF	HORIZ. DATUM	VERTICAL DATUM
1543	CLIFF	LOUISBOURG HARBOUR	CAPE BRETON	NOVA SCOTIA	11G/13	NAD 83 Z 20	GEODETIC

ACCESS

The site is located on the north shore of Louisbourg Harbour. From the town of Louisbourg drive toward the Fortress. Park at the cemetery located just outside of the park bdry.
Walk along the fence bordering the western side of the cemetery to the shore. Turn right and walk along the beach for approximately 200 double paces to a low shore cliff.
The survey site is marked by a benchmark (cap in concrete) labelled PWC 59L-3 atop the cliff directly seaward of a road marked by a stone gate post. The road is the back route to
the Fortress visitor centre.The landward benchmark (BM1) of lines 2 and 3 are located 15 m apart along a line bearing 254° closely aligned btwn PWC59L-3 and the landward navigation marker at site 1542.

SITE INFORMATION (2011)

LINE	BM TYPE	LATITUDE°	LONGITUDE°	EASTING*	NORTHING*	ELEVATION*	LINE	BM TYPE	LATITUDE°	LONGITUDE°	EASTING*	NORTHING*	ELEVATION*
1	PWC CAP 59L-3	45.905579683	-59.984766850	733870.008	5087978.471	7.074	3	(THIN REBAR)	45.905408933	-59.985065450	733847.566	5087958.625	6.044
1	(THIN REBAR)	45.905541017	-59.984724617	733873.446	5087974.299	7.247	3	(THIN REBAR)	45.905376650	-59.985020917	733851.156	5087955.169	5.892
2	(THIN REBAR)	45.905493650	-59.984915867	733858.812	5087968.476	6.955							
2	(THIN REBAR)	45.905458717	-59.984876433	733862.017	5087964.710	6.474							

CLIFF RECESSION SURVEYS

LINE NO.	GSC BM	SURVEY DATE (D/M/Y)	LINE BEARING (°)	NO YEARS BTW SURVEY	RETREAT (m) BTW SURVEY	TOTAL CUM NO YEARS	CUM RETREAT (m)	CUM RETREAT (m\a)	BM TO CLIFF EDGE (m) BM1 TO CE	BM TO CLIFF EDGE (m) BM2 TO CE	SURVEY METHOD	CLIFF / BANK HEIGHT (m)
1	PWC 59L-3	8-Dec-95	160						15.50	10.46	TAPE	6.00
		12-Jun-96	160	0.5	0.30	0.50	0.30	0.60	15.20	10.16	TAPE	
		6-Nov-97	160	1.43	0.01	1.93	0.31	0.16	15.19	10.09	RTK/TAPE	
		4-Feb-00	160	2.25	0.03	4.18	0.34	0.08	15.16	10.12	TAPE	
		5-Jun-02		2.33	0.44	6.51	0.78	0.12	14.72	9.68	TAPE	
		11-Mar-05		2.75	0.25	9.26	1.03	0.11	14.47		TAPE	
		31-Mar-11	160	6.54	0.60	15.80	1.63	0.10	13.87	8.64	RTK	
2		8-Dec-95	160						17.45	12.43	TAPE	5.50
		12-Jun-96	160	0.50	0.35	0.50	0.35	0.70	17.10	12.08	TAPE	
		6-Nov-97	160	1.43	0.04	1.93	0.39	0.20	17.06	12.02	RTK/TAPE	2.89
		4-Feb-00	160	2.25	0.00	4.18	0.39	0.09	17.06	12.02	TAPE	
		5-Jun-02		2.33	0.64	6.51	1.03	0.16	16.42	11.40	TAPE	
		11-Mar-05		2.75	0.32	9.26	1.35	0.15	16.10	SNOW	TAPE	
		31-Mar-11	161	6.54	0.11	15.80	1.46	0.09	15.99	11.08	RTK	
3		8-Dec-95	160						17.05	12.00	TAPE	5.00
		12-Jun-96	160	0.50	0.00	0.50	0.00	0.00	17.05	12.00	TAPE	
		6-Nov-97	160	1.43	-0.73	1.93	-0.73	-0.38	17.78		RTK/TAPE	2.71
		4-Feb-00	160	2.25	-0.12	4.18	-0.85	-0.20	17.90		TAPE	
		5-Jun-02		2.33	0.43	6.51	-0.42	-0.06	17.47	*12.38*	TAPE	
		11-Mar-05		2.75	0.00	9.26	-0.42	-0.05	17.47		TAPE	
		31-Mar-11	160	6.54	0.95	15.80	0.53	0.03	16.52	11.61	RTK	

° LATITUDE AND LONGITUDE ARE IN DECIMAL DEGREES AND ARE A CONVERSION OF MARCH 2011 RTK UTM USING GSRUG http://www.geod.nrcan.gc.ca/tools-outils/index_e.php
*Geographic positions and elevations based on N.S. CONTROL MONUMENT 2094 BLACK ROCK Elevation 12.827 m; Easting (734481.365) Northing (5085932.243) NAD 83 UTM GRID: Z 20
LINE BEARING (DEGREES MAGNETIC)

SITE 1543 continued

REFERENCE NOTEBOOKS:

8-Dec-95	OWEN BROWN NOTES
12-Jun-96	INFO ON FORMS
6-Nov-97	RTK; CBI / 95 P 75
4-Feb-00	INFO ON FORMS (O.BROWN/B.DUNHAM)
5-Jun-02	B. DUGGAN / B CUNNINGHAM (PARKS)
11-Mar-05	CBI2001 P69
31-Mar-11	CBI2011/01 p8

DISTANCE BETWEEN

LINE 1 TO 2	15m
LINE 2 TO 3	15 m

BENCH MARK HISTORY: SITE 1543

LINE 1:

8-Dec-95 BM1 (PWC 59L-3 CONCRETE /CAP) BM2 (WD STAKE) 5.04 M SWD OF BM1
6-Nov-97 BM1 (PWC CAP) AND BM2 (WD STK) INTACT; CLIFF FACE WET WITH RILLS
4-Feb-00 BM1 (PWC CAP) AND BM2 (WD STK) INTACT; CLIFF FACE WET WITH RILLS
5-Jun-02 BM1 (PWC CAP) AND BM2 (WD STK) INTACT;
11-Mar-05 BM1(PWC CAP) INTACT; LARGE SOD DRAPE OVER UPPER CLIFF, DIGITAL PHOTO
31-Mar-11 BM1 (PWC cap) intact, BM2 (thin rebar) established xx mswd of BM1

BENCH MARKS PRESENTLY INTACT: BM1 (CONCRETE CAP PWC 59L-3) AND BM 2(THIN REBAR) IS 5.40 m SWD of BM1

LINE 2

8-Dec-95 BM1 (WD STAKE) ALIGNED WITH BM1 LINE 1 AND LINE 3 254° ,BM2 (WD STAKE) 5.02 M SWD OF BM1
6-Nov-97 BM1 (WD STK) AND BM2 (WD STK) INTACT; CLIFF FACE WET; GPS SURVEY TO BAS CLF
4-Feb-00 BM1 (WD STK) AND BM2 (WD STK) INTACT; MANY ALDERS ON TAPE LINE TAPE MEASUREMENT 17.35M, USED OLD GPS READING, CLIFF FACE WET;
5-Jun-02 BM1 (WD STK) AND BM2 (WD STK) INTACT;
11-Mar-05 BM1(WD STK) INTACT , BM2 IN SNOW; LARGE VEGETATED SLUMP BLOCK DOWNSLOPE ON LINE, DIGITAL PHOTO
31-Mar-11 BM1(thin rebar) and BM2(thin rebar) established at original wd stk locations

BENCH MARKS PRESENTLY INTACT: BM1 (THIN REBAR) AND BM 2 (THIN REBAR) IS 5.1 m SWD OF BM1.

LINE 3

8-Dec-95 BM1(WD STAKE) ALIGNED WITH OTHER BM1'S LINE 1 AND 2, BM2 IS 5.05M SWD OF BM1(IN ALDERS)
6-Nov-97 BM1 (wd stk) and BM 2 (wd stk) INTACT; CLIFF FACE COVERED BY ALDERS; GPS SURVEY TO NEARLY WLO
4-Feb-00 BM1 (wd stk) and BM 2 (wd stk) INTACT; ENCOUNTERED SLUMP IMMEDIATELY BEYOND TAPED LINE TOWARDS 1542 A SLUMP MEASURING 1.5M LDWD, 3M WIDE (WHERE CLIFF EDGE ORIGINALLY STOOD) AND 1.3M DEEP
5-Jun-02 BM1 and BM2 INTACT
11-Mar-05 BM1(WD SK) INTACT ; CRACK IN SOD AT 17.47AND EDGE AT 17.55 M HARD TO MEASURE
31-Mar-11 BM1 (thin Rebar) and BM2(thin rebar) establisherd in original location of wd stakes (very wet area)

BENCH MARKS PRESENTLY INTACT: BM1 (THIN REBAR) AND BM 2 (THIN REBAR) IS 5.20 m SWD OF BM1

Site 1544

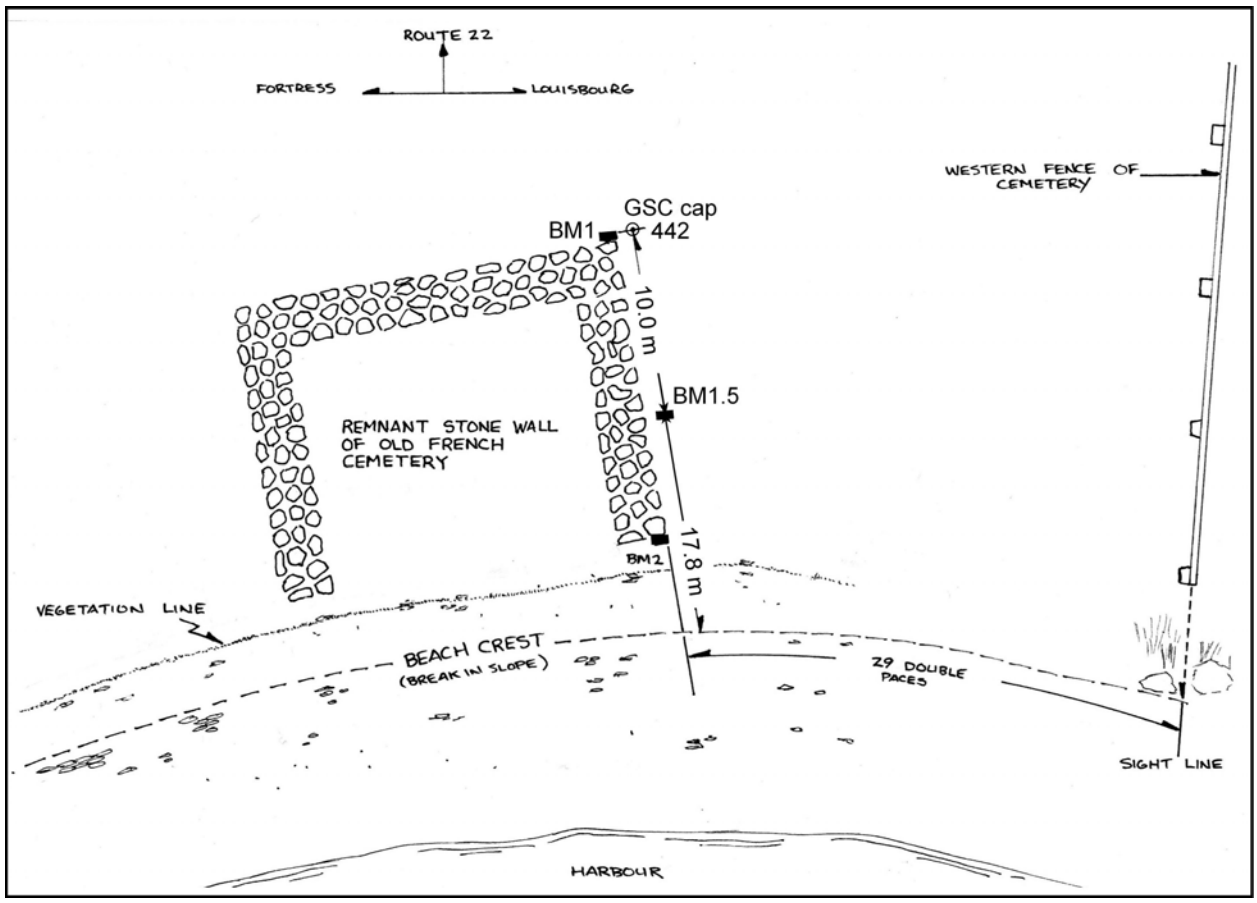


Figure 1544-1 Sketch of site 1544 showing its position relative to Stella Maris cemetery on right side of diagram and the location of line markers at the site in 2011.

Site 1544

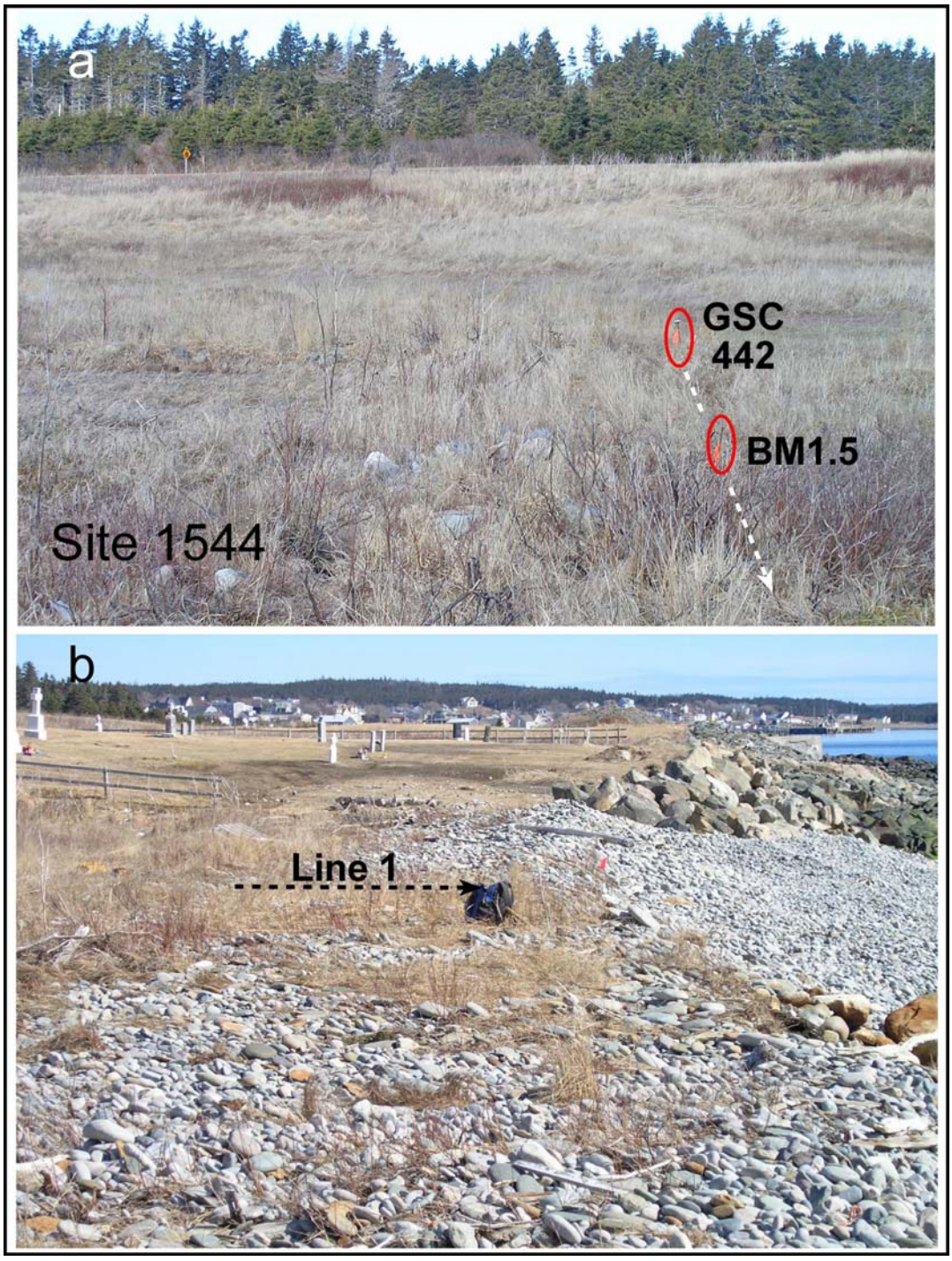


Figure 1544-2 (a) View of line markers at site 1544 that were established along the east side of a stone enclosure which is more easily identified from the backshore. (b) looking alongshore showing the extent of landward beach migration between site 1544 and the armoured shore at Stella Maris cemetery (in background) (photos March 2011).

SITE NO.	SHORE TYPE	GEOGRAPHIC NAME	COUNTY	PROVINCE	NTS REF	HORIZ DATUM	VERTICAL DATUM
1544	BEACH	LOUISBOURG HARBOUR	CAPE BRETON	NOVA SCOTIA	11G/13	NAD 83 Z 20	GEODETIC

ACCESS

The survey site is on the north shore of Louisbourg Harbour. From the town of Louisbourg drive toward the Fortress. Park at the cemetery just outside the Park gate.
Walk along the fence bordering the western side of the cemetery to the shoreline. Turn right and walk 29 double paces along the beach to the old French cemetery.
The French cemetery is outlined by a remnant stone wall (ground level)which is difficult to see from the beach. The survey line is located along outside edge of the eastern wall; BM1 is GSC Cap 442 at lwd edge rock wall.

SITE INFORMATION (2011)

	BM TYPE	LATITUDE°	LONGITUDE°	EASTING*	NORTHING*	ELEVATION*
LINE 1	GSC 442	45.906917650	-59.983095750	733993.993	5088132.024	4.695
	THIN REBAR	45.906869217	-59.982983983	734002.865	5088126.972	4.413

									BEACH MIGRATION SURVEYS (m)			
LINE NO.	GSC BM	SURVEY DATE (D/M/Y)	LINE BEARING (°)	NO YEARS BTW SURVEY	RETREAT (m) BTW SURVEY	TOTAL CUM NO YEARS	CUM RETREAT (m)	CUM RETREAT (m\a)	BM1 TO BCH CREST	BM 1.5 TO BEACH CREST	BM 2 To BEACH CREST	SURVEY METHOD
1		8-Dec-95	142						31.10		5.00	TAPE
OLD		10-Jun-96	142	0.50	0.00	0.50	0.00	0.00	31.10		5.00	TAPE
CEMETERY		7-Nov-97	142	1.42	-2.61	1.92	-2.61	-1.36	33.71		7.66	RTK/TAPE
		4-Feb-00	142	2.25	3.66	4.17	1.05	0.25	30.05		3.95	TAPE
		5-Jun-02		2.33	-0.05	6.50	1.00	0.15	30.1			TAPE
	442	30-Mar-11	137	8.83	2.10	15.33	3.10	0.20	28.00	17.79		TAPE / RTK

° LATITUDE AND LONGITUDE ARE IN DECIMAL DEGREES AND ARE A CONVERSION OF MARCH 2011 RTK UTM USING GSRUG http://www.geod.nrcan.gc.ca/tools-outils/index_e.php
*Geographic positions and elevations based on N.S. CONTROL MONUMENT 2094 BLACK ROCK Elevation 12.827 m; Easting (734481.365) Northing (5085932.243) NAD 83 UTM GRID: Z 20
LINE BEARING (DEGREES MAGNETIC)

REFERENCE NOTEBOOKS

8-Dec-95	OWEN BROWN NOTES
10-Jun-96	INFO ON FORMS
7-Nov-97	RTK; CBI / 95 P81
4-Feb-00	INFO ON FORMS (O.BROWN/B.DUGGAN)
5-Jun-02	REBECCA DUGGAN/ B. CUNNINGHAM
11-Mar-05	CBI 2001, P70
30-Mar-11	CBI 2011/01 p7

DISTANCE BETWEEN BMS:

BM1 (GSC 442) to BM 1.5(thin rebar) =10.0 m

BENCH MARK HISTORY: SITE 1544

LINE 1:

8-Dec-95	BM 1 SHORT ORANGE WD SURVEY STAKE AT LWD EDGE ROCK PILE; BM2 SHORT ORANGE WD SURVEY STAKE AT SE SWD EDGE ROCK PILE OF CEMETERY
10-Jun-96	BM 1 SHORT ORANGE WD SURVEY STAKE AT LWD EDGE ROCK PILE; BM2 SHORT ORANGE WD SURVEY STAKE AT SE SWD EDGE ROCK PILE OF CEMETERY
7-Nov-97	BM1 (WD STK) AND BM2 (WD STK) INTACT BUT ROTTING QUICKLY; COMPLETED PROFILE WITH GPS
4-Feb-00	BM1 (WD STK) AND BM2 (DID NOT FIND WD STK; FOUND A SURVEY PIN; BM1 INTACT DIFFICULT TO FIND AT GROUND LEVEL; C/B OVERWASH 3.3M LWD OF PIN; 22.8M SWD OF BM1
5-Jun-02	MEASURED BM1 TO VEGETATION LINE WHICH IS AT THE HIGHEST COBBLE LINE, NO CLEAR BEACH CREST.
11-Mar-05	SITE SNOW COVERED NO MEASUREMENT, BEACH CUSPATE AT CREST AS IS THE SOD
15-Dec-08	NO MARKERS FOUND -PHOTOS ONLY VERY WET AND PARTIALLY FROZEN GRASS SURFACE
30-Mar-11	BM1 (GSC cap 442 &wd stake) and BM 1.5 (thin rebar) 10.0m swd of BM1. (RTK SURVEY FROM BM1 TO WLO)

BENCH MARKS PRESENTLY INTACT: BM1(GSC cap 442) at lwd edge ROCK PILE ALONG (OLD CEMETERY) and BM1.5 (thin rebar) BM1 to BM1.5 =10.0m

NOTES