Shoreplan Engineering Limited
20 Holly Street, Suite 202
Toronto, ON Canada M4S 3B1
T) 416.487.4756 F) 416.487.5129
E) mail@shoreplan.com

SHOREPLAN

January 12, 2017

Carl Hentschel, P.Eng
BluMetric Environmental Inc.
3108 Carp Road
PO Box 430
Ottawa, Ontario, Canada
K0A 1L0

Dear Mr. Hentschel:

RE: Marine Assessment, Michipicoten Island Lightstation, Lake Superior
Our file 16-2455

We have completed our review of the marine access aspects of the above noted project and offer the following comments. Shoreplan's role on this project was to provide recommendations for site access options during remediation. We participated in a site review on September 23, 2016, and the photographs presented below were taken at that time. The water level during our review was approximately 183.6m IGLD1985.

Coastal Setting

Physical Setting

Michipicoten Island is located in the north-east portion of Lake Superior, as shown in the Location Plan of Figure 1. It is approximately 70 km southwest of Wawa and 170 km northwest of Sault Ste. Marie. The lightstation is located on the northeast tip of the island.

Figure 2 is a site plan of the lightstation property. The shoreline is generally jagged rock that is not well suited for marine access. Photo 1 is a northerly looking view of the site. There is a concrete helicopter landing pad in the foreground and a concrete breakwall extending a short distance offshore in an easterly direction. Photo 2 shows a westerly looking view of the breakwall and a narrow channel adjacent to it that was dredged through the nearshore rock substrate. The shoreline on the south side of the breakwall is a cobble beach (Photo 3). There is also a short dock north of the lighthouse which does not extend offshore of the rock outcrop that abuts its eastern side (Photo 4).

The dock north of the lighthouse is approximately 10m long with water depths varying irregularly from 1.2 to 2.0m over that length. A shallow draft vessel could be berthed here during calm conditions, but there is a 2m long concrete base for a hoist (Photo 4) that limits access to the berth.

The breakwall east of the lighthouse is approximately 21.5m long in total, but there is a bend in it that effectively limits the area available for berthing to the innermost 13m. Depths over that 13m length range from approximately 0.25m at the shore to 0.75m at its mid-point and 1.1m at its outer end. The dredged access channel (Photo 2) was visually estimated to be approximately 3m wide and in the order of 1m deep.

Wind and Wave Conditions

The lighthouse station is on an exposed tip of the island and will experience frequent rough conditions under winds coming from the north through to the south. Figure 3 shows the monthly distribution of the mean and standard deviation of wind speed and wave heights for the NOAA buoy in East Superior. These plots were produced from data measured over an eighteen year period (1990-2008). Within one standard deviation wave heights exceeded 3m in each month.

Water Levels

Water levels on Lake Superior fluctuate on seasonal, short-term, and long-term bases. Briefly, seasonal fluctuations reflect the annual hydrologic cycle which is characterized by higher net basin supplies during the spring and early part of summer with lower supplies during the remainder of the year. Figure 4 is a hydrograph for Lake Superior showing long-term mean monthly water levels with respect to chart datum. It can be seen from Figure 4 that water levels generally peak in the late summer (August-September) with the lowest water levels generally occurring in the spring (March). The average annual water level fluctuation is approximately 0.35 metres.

Short-term fluctuations last from under an hour up to several days and are caused by local meteorological conditions. These fluctuations are most noticeable during storm events when barometric pressure differences and surface wind stresses cause temporary imbalances in water levels at different locations on the lake. MNR (1989) investigated storm surges throughout the Great Lakes as part of their analysis of extreme water levels for design conditions. They determined that storm surges in the order of 0.4m occur annually in the vicinity of Michipicoten Harbour. Surges will be noticeable at Michipicoten Island, but they will be smaller in magnitude than those at Michipicoten Harbour because of the island's location.

Long-term water level fluctuations on the Great Lakes are the result of persistently high or low net basin supplies. More than a century of water level records show that there is no consistent or predictable cycle to the long-term water level fluctuations. Figure 5 shows Lake Superior's mean monthly water levels from 1918 to 2013. Both long-term and seasonal fluctuations can be seen in Figure 5. Storm surges are not discernable in monthly mean data.

The water level during our site review was approximately 183.6m IGLD1985. There was an easterly wind which would not have caused any wind setup and may have caused a minor set-down at the eastern end of the lake. Figure 4 shows that water level to be above the average mean water level so it would be prudent to assume that the berth depths described above are maximum depths.

Marine Access Requirements

The marine access requirements were provided to us in general terms only; there was not a specific list of equipment that was required to be taken to the island and the material to be removed was not quantified. It is our understanding that at present only scaffolding is to be taken to the island. At a later date an excavator will be required and bagged soil will be removed.

The size of the excavator that can be taken to the island and the size of soil bags to be removed will be limited somewhat by access constraints, as described below.

Marine Access Alternatives

The marine access alternatives at this site are limited due to the jagged rock shoreline and the size of the existing dock and breakwall. It is our understanding that when this site was operational it was supplied and serviced by a small boat, described as a landing craft type vessel with an azimuth thruster propulsion system, with a shallow draft that could be berthed alongside the breakwall or dock. It had a flat deck and was capable of carrying approximately 5 tons of cargo. The landing craft was carried aboard a coast guard ship and launched with a derrick once it was offshore of Michipicoten Island. The landing craft then shuttled people and material to and from the supply ship and the lighthouse station.

Using a similar operation is the only practical marine access alternative for this site. The landing craft vessel is too small to travel to Michipicoten Island on its own so it will need to be transported there by barge and tug. The tug size will be dictated by the risk of inclement sea conditions, which in turn is dependent upon the time of year the work is done. The closest port with suitable equipment to do this is Sault Ste. Marie. For a large project you might get competitive prices for marine equipment out of Thunder Bay or one of the lower lakes, but it is not certain to be the case here. Travel time from Sault Ste. Marie to Michipicoten Island is approximately 18 hours for a tug pulling a large barge. In case of rough seas the barge and tug can seek shelter in Quebec Harbour (Figure 1).

The landing craft can be assumed to have a cargo capacity in the order of 4.5 tonnes, based on the vessel previously used by the Coast Guard. That will limit the size of the excavator that that can be taken to the island to a class described as mini-excavators. The landing craft can be fitted with a ramp to

allow access to the island via the cobble beach on the south side of the breakwall (Photos 2 and 3).

There are two reasonable methods of removing excavated soil from the island. One is to have the excavator place the soil in 1 or 2 cubic metre bags and transport the bag to the landing craft. The other is to place the excavated soil in small bags and hand-bomb them to the landing craft where they are then placed in larger bags. The bags (either option) will be shuttled out to the barge and placed on the barge with its crane.

For marine work at remote locations it is standard practice to have a faster safety boat on standby in case of an accident or medical emergency. Given the distance out to Michipicoten Island and the possibility of rough seas, it would be more appropriate to use a standby helicopter. Wilderness Helicopters in Wawa requires a minimum daily charge of 4 hours to keep a helicopter available for emergency service.

Closing Comments

We trust that this letter provides sufficient details about the coastal conditions and access alternatives for the Michipicoten Island lightstation. Please contact the undersigned if you have any questions or comments.

Yours truly,
Shoreplan Engineering Limited

Bruce Pinchin, P. Eng.

Figure 1 **Location Plan, Michipicoten Island Lighthouse**

SHOREPLAN

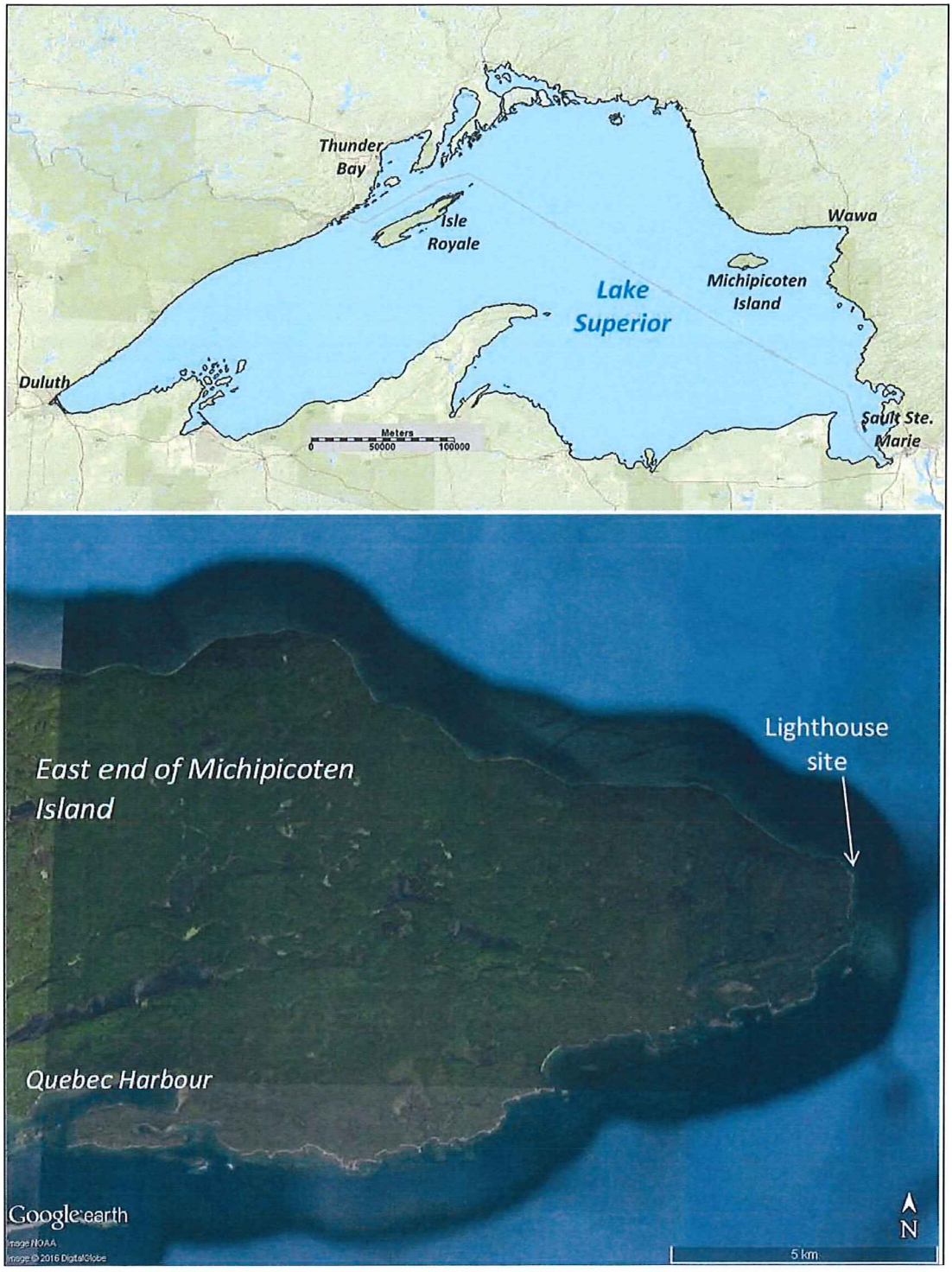
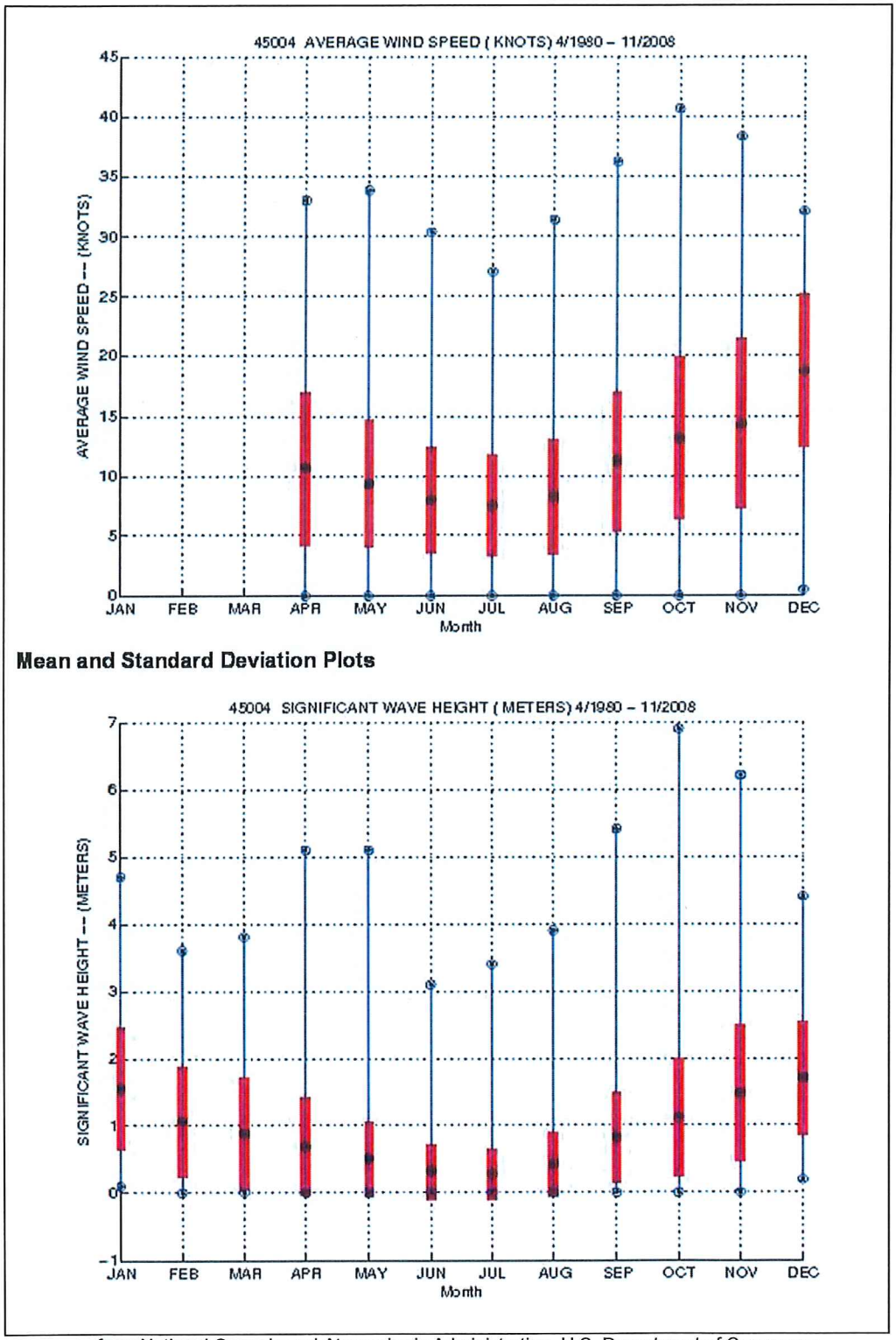


Figure 2 Site Plan

SHOREPLAN

Figure 3 Wind and Wave Climatic Summaries, East Superior



from National Oceanic and Atmospheric Administration, U.S. Department of Commerce

Figure 4 Lake Superior Annual Hydrograph

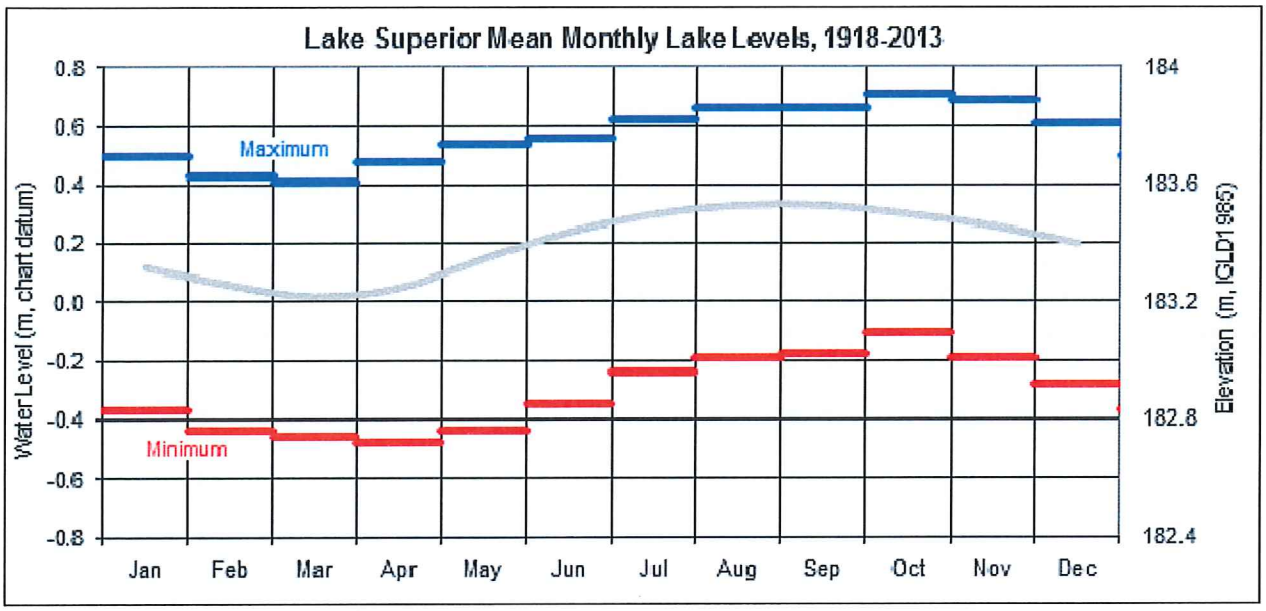


Figure 5 Long-Term Mean Monthly Water Levels

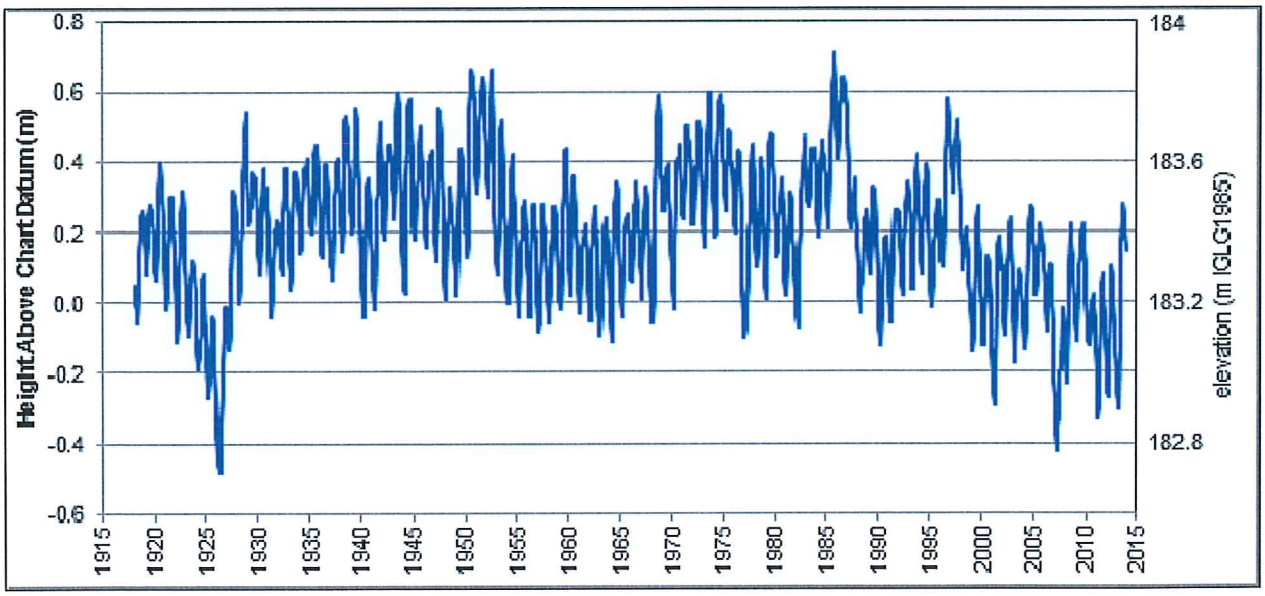
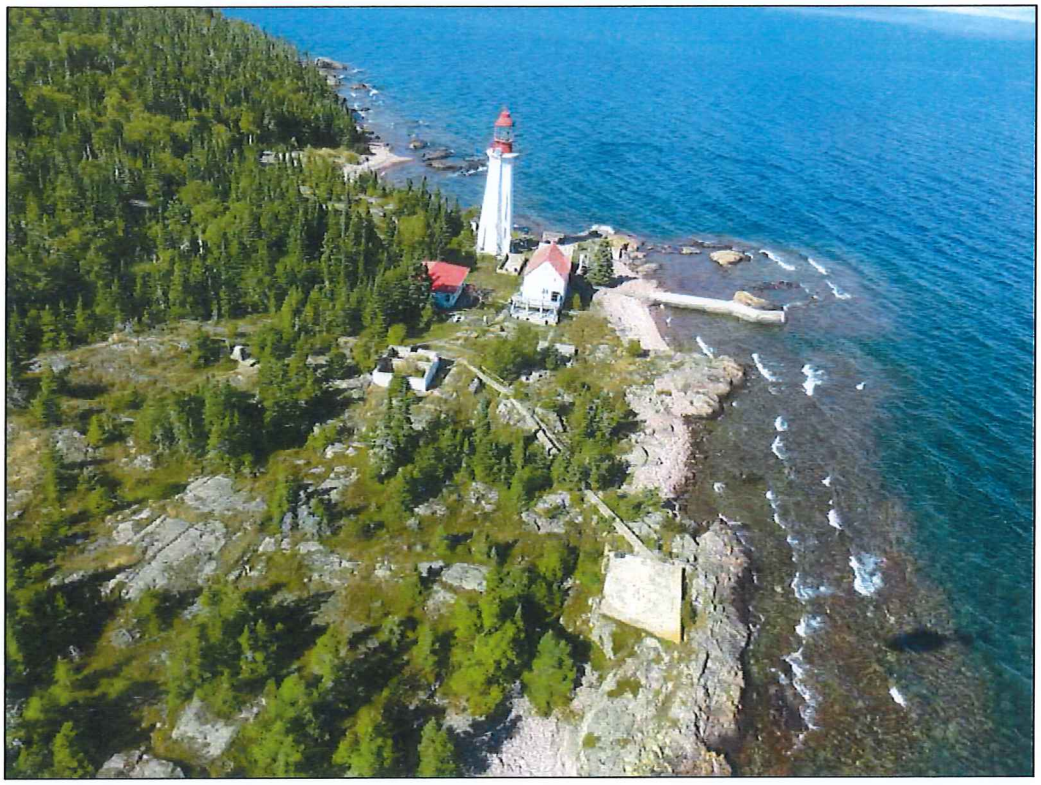


Photo 1 **Northerly Looking View of Lightstation**



SHOREPLAN

Photo 2 **Westerly Looking View of Breakwall and Channel**

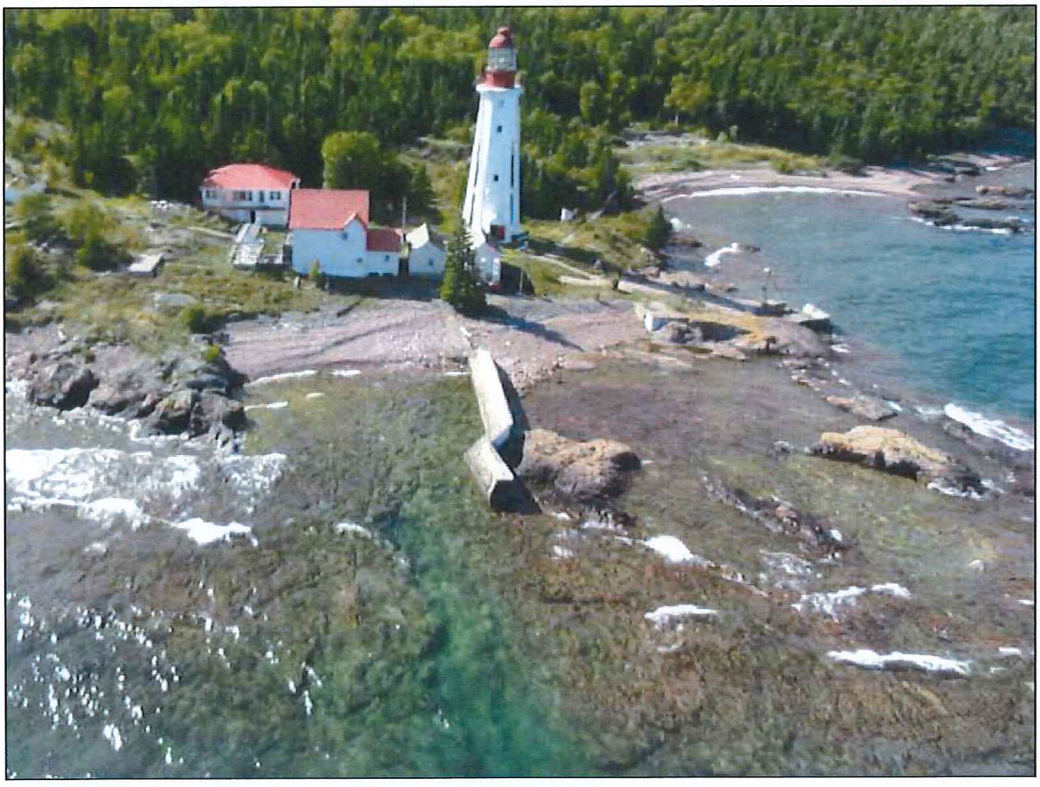


Photo 3 **Cobble Beach on South Side of Breakwall**

SHOREPLAN

Photo 4 **Dock North of Lighthouse**