2012

Mertarvik Waterfront Development
Project Number 80861

STATE OF ALASKA
DEPARTMENT OF TRANSPORTATION & PUBLIC FACILITIES
STATEWIDE DESIGN & ENGINEERING SERVICES
COASTAL ENGINEERING SECTION
5800 East Tudor Road, Anchorage, AK 99507
907-269-6239; Fax 907-269-6478
8/15/2012

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PREFACE

This final draft report was published for review and comment by the Newtok Traditional Council (NTC), residents of the city of Newtok, Newtok Native Corporation, Bureau of Indian Affairs BIA), and other regional, State and Federal agencies with an interest in the community and its relocation efforts. The information in this August 2012 version is similar to a previous version presented to the NTC and BIA in March of this year. Additional field and engineering work has been completed since the first draft was distributed. This final draft report will be posted on the State of Alaska, Department of Commerce, Division of Community and Regional Affairs, Newtok Planning Group Website at for a two week comment period.

http://www.commerce.state.ak.us/dca/planning/npg/Newtok_Planning_Group.htm

Comments will be incorporated into a final report, which will be posted on the website and presented to the NTC.

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SUMMARY OF STATUS

PROJECT NAME:	Mertarvik Waterfront Development
PRESENTED TO:	Newtok Traditional Council (Acting for the Village of Newtok)
PREPARED BY:	Ruth Carter, P.E., Coastal Engineer Harvey Smith, P.E., State Coastal Engineer

This document summarizes engineering work completed for Mertarvik Waterfront Development. This work is being done for Newtok Traditional Council, acting for the Village of Newtok. Newtok is relocating to a new village site called Mertarvik. This effort was funded through a Bureau of Indian Affairs grant that obtained by the Village of Newtok.

Summary - The following has been completed as of August 2012

- Conceptual Designs
- Draft Hydrographic Survey (term contract with R&M)
- Draft Geotechnical Work (term contract with R&M through ADOT&PF, Statewide Materials)
- Fetch Analysis
- Wind and Wave Analysis
- More detailed Engineering Design
  Including basin planform requirements for the fleet
- More detailed cross-sections of the breakwater
- Local Quarry Investigation
- Site visits to Newtok and Mertarvik
- A preliminary look at future possibilities for the entire Mertarvik waterfront

Modifications will be made to the preliminary design as final surveying and geotechnical data become available. Shoreline survey including bathymetric data and geotechnical work were delayed until late July and early August, respectively, due to late season ice, but fieldwork is completed at the site and draft information submitted for review. It is anticipated that the overall project will be completed in September 2012.

Draft final report will be presented to the Newtok Traditional Council on August 15, 2012 in the Village of Newtok for comment and review.

Comments will be addressed and incorporated into a final report for submittal to the Newtok Traditional Council along with final Geotechnical and Hydrographic Survey Reports.

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Table of Contents

PREFACE II

SUMMARY OF STATUS IV

LIST OF APPENDICES VIII

BACKGROUND 1

WATERFRONT PROJECT HISTORY 2

JUNE 2011 FIELD TRIP OBSERVATIONS 4

NOVEMBER 2011 FIELD TRIP OBSERVATIONS 6

HYDROGRAPHIC SURVEY 7

DRILLING AND MATERIALS TESTING 8

ENVIRONMENTAL CONSIDERATIONS 9

THE COMMUNITY WILL NEED TO COORDINATE WITH ALL STATE AND FEDERAL ENVIRONMENTAL AGENCIES ON THE HARBOR AND ASSOCIATED UPLAND DEVELOPMENT. FISH, BIRDS, AND WETLANDS ARE EXPECTED TO BE OF GREATEST CONCERN IN ALL DEVELOPMENT IN THE NINGLICK RIVER. EVERY EFFORT HAS BEEN MADE IN THE DESIGN PROCESS TO MINIMIZE IMPACTS BY CONSIDERING WATER QUALITY AND CIRCULATION, FISH PASSAGE AND OTHER ENVIRONMENTAL ASPECTS WHILE ADDRESSING THE LOCAL NEED FOR SAFE MOORAGE AND ACCESS TO TRADITIONAL USE FISHING AND HUNTING. 9

MERTARVIK IS LOCATED BETWEEN THE TWO MAIN STREAMS ON NELSON ISLAND. TAKIKCHAK CREEK IS WEST OF THE PROPOSED HARBOR SITE FLOWS DIRECTLY INTO THE NINGLICK RIVER; CHAKCHAK CREEK IS EIGHT MILES SOUTH OF THE SITE AND FLOWS EAST TO KOLAVINARAK RIVER. THE NINGLICK RIVER, TAKIKCHAK CREEK AND CHAKCHAK CREEK ARE ANADROMOUS FISH STREAMS AND CONSIDERED ESSENTIAL FISH HABITAT (EFH) 9

ALL DEVELOPMENT OF THE WATERFRONT IN THE NINGLICK RIVER AND COULD IMPACT EFH. THE HARBOR LAYOUT AND DESIGN HAS UNDERTAKEN TO MINIMIZE IMPACTS; HOWEVER, THIS WILL NEED TO BE CONSIDERED IN THE PERMITTING AND REVIEW PROCESS *(FROM RELOCATION REPORT: NEWTOK TO MERTARVIK, FINAL DRAFT ISSUED FOR REVIEW, BY THE COMMUNITY OF NEWTOK AND THE NEWTOK PLANNING GROUP, AUGUST 2011).* 9

CONCEPTUAL HARBOR DESIGN 9

FETCH ANALYSIS 9

WIND AND WAVE ANALYSIS 11

ENGINEERING DESIGN OF BASIN AND PLANFORM REQUIREMENTS FOR FLEET 12

COMMUNITY NEEDS 13

LOCAL QUARRY INVESTIGATION 14

CONCEPTUAL HARBOR DESIGNS CONSIDERED....15

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COMPARISON OF ALTERNATIVES....22

THERE ARE A NUMBER OF FACTORS TO CONSIDER WHEN SELECTING A PREFERRED ALTERNATIVE. 22

LOCALLY PREFERRED BREAKWATER DESIGN....24

DETAILED BREAKWATER CROSS-SECTIONS 24

ESTIMATED QUANTITIES....25

ESTIMATED COSTS....25

ADDITIONAL WATERFRONT DEVELOPMENT 25

WORK SCHEDULE CONSIDERATIONS....26

OBSERVATIONS RELATED TO PERMITS 27

PERMITS THAT WILL LIKELY BE REQUIRED 27

NEXT STEPS AND ADDITIONAL WORK....27

APPENDICES 27

LIST OF APPENDICES

A. MEMORANDUM OF AGREEMENT
B. HYDROGRAPHIC SURVEY
    a. CONTRACT 2012
    b. SURVEY RESULTS (DRAFT, to be finalized)
C. GEOTECHNICAL
    a. ADOT&PF, ROCK QUARRY RECONNAISSANCE, MERTARVIK TOWNSITE, NOV 2011
    b. CONTRACT AND DRILLING PERMIT (2012, RE-SCOPED AND REBID)
    c. Consultant Test Hole Logs and Test Results (DRAFT, to be finalized)
    d. ADOT&PF Geotechnical Report (DRAFT, to be finalized)
D. TRIP PHOTOS
    a. JUNE 2011
    b. NOVEMBER 2011
    c. AUGUST 2012 – may be added
E. CORRESPONDENCE
    a. Status and Draft Report cover sheet
    b. Letter to Stanley Tom with revised schedule

This page will be completed once the final geotechnical and hydrographic survey reports are incorporated.

Quyana - Thank You

Acknowledgements

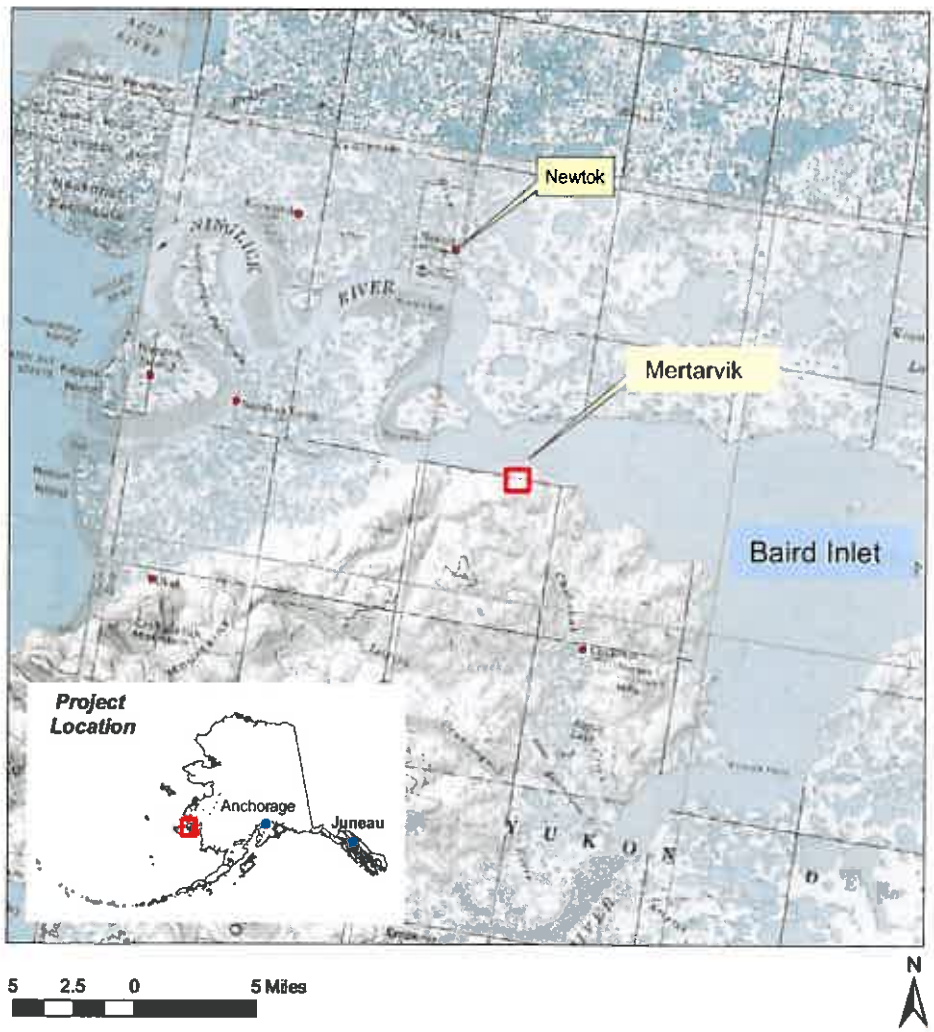
Community
Traditional Council of Newtok
Newtok Planning Group
BIA
DOT

Executive Summary

Background

Newtok is on the Ninglick River north of Nelson Island in the Yukon-Kuskokwim Delta Region. It is 94 miles northwest of Bethel. It is located at approximately 60° 56′ 34″ North Latitude and 164° 37′ 46″ West Longitude (State of Alaska, Division of Community and Regional Affairs).

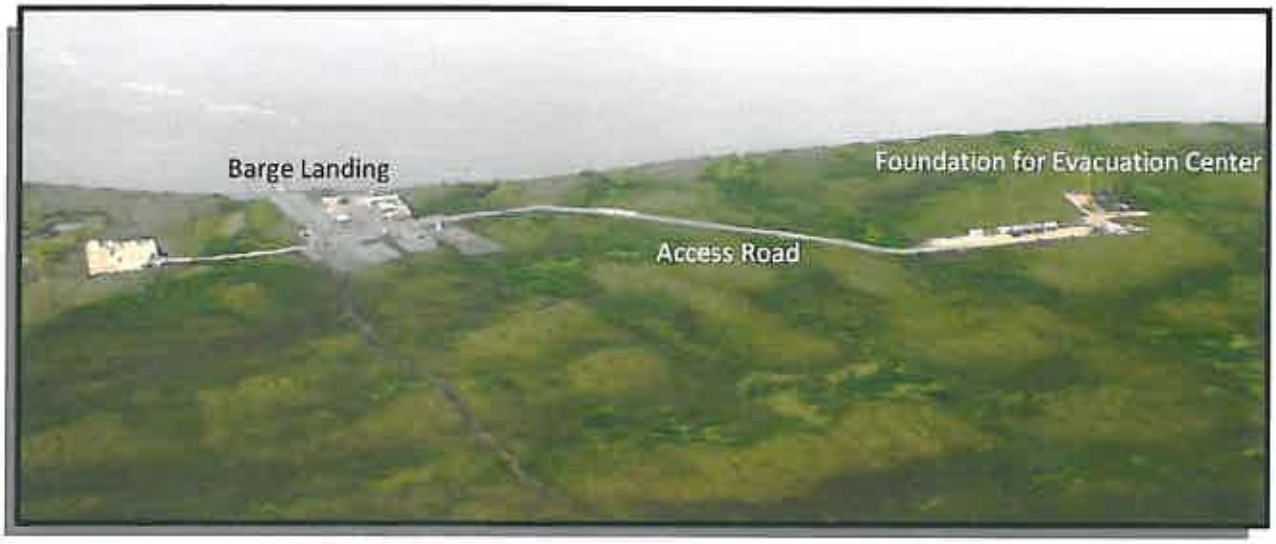
Newtok is located in a marine climate. Average annual precipitation is 17 inches, with 22 inches of snowfall. Summer temperatures range from 42 to 59 °F, and winter temperatures average 2 to 19 °F.



Mertarvik Townsite and Vicinity, ADOT&PF (Created with TOPO!, ©2003 National Geographic Maps, All Rights Reserved)

The village of Newtok is threatened by advancing erosion caused by the Ninglick River adjacent to the village. This progressive erosion, in combination with permafrost degradation and flooding of the village during seasonal storms has created a serious threat to the existence of the village. Years of erosion studies have concluded that Newtok must relocate as there is no permanent and cost-effective alternative for remaining at the current village site. Consequently, the community is relocating to a new site of Nelson Island called Mertarvik, which in Yup'ik means, "getting water from the spring."

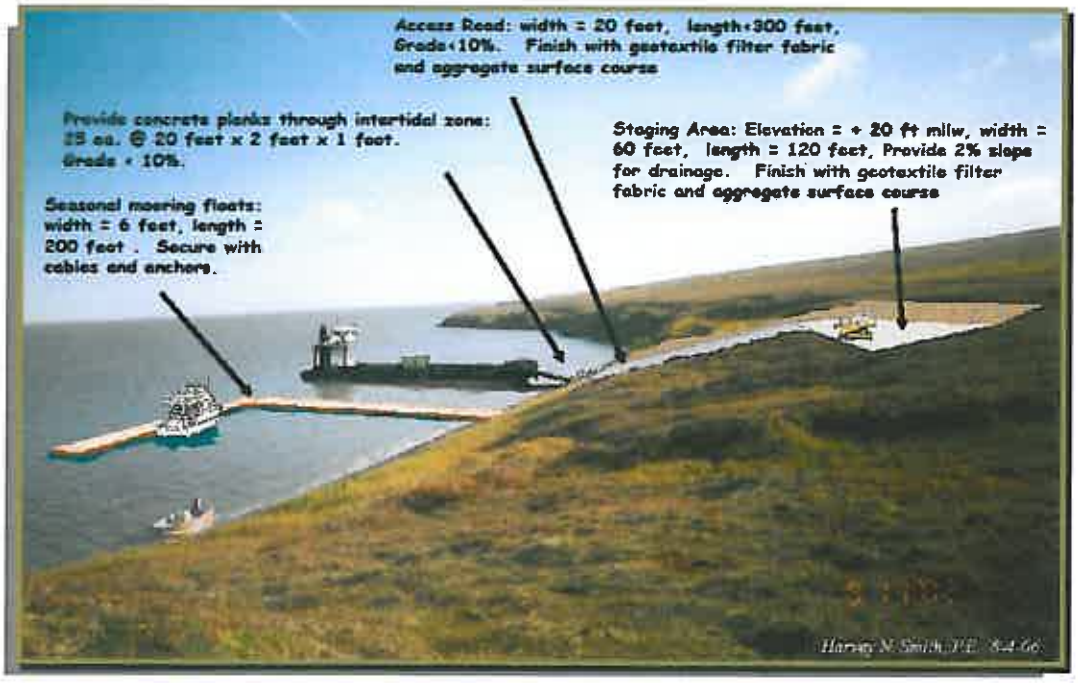
A great deal of work has been completed in planning and developing Mertarvik by the Newtok Planning Group (NPG) and others; however early efforts neglected to include safe moorage for the community's boats. Moorage at the Newtok town site is up the Kealavik River, off the Ninglick River and is somewhat protected; the coast along Mertarvik is exposed to waves from Baird Inlet and currents in the Ninglick River.



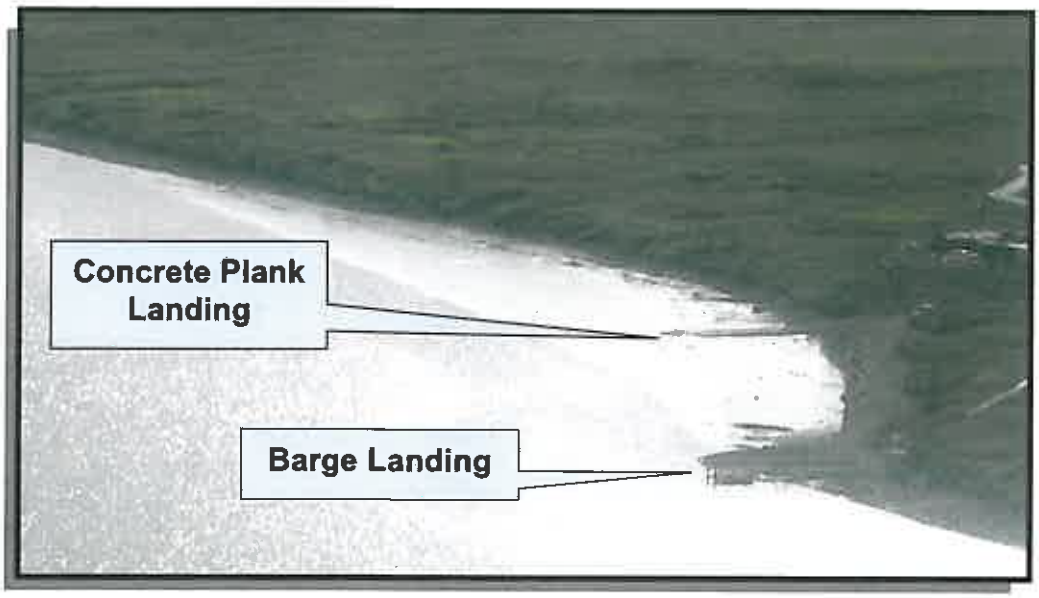
Mertarvik Barge Landing, Access Road & Evacuation Center Foundation. (Harvey Smith, ADOT&PF, 6-2011)

Waterfront Project History

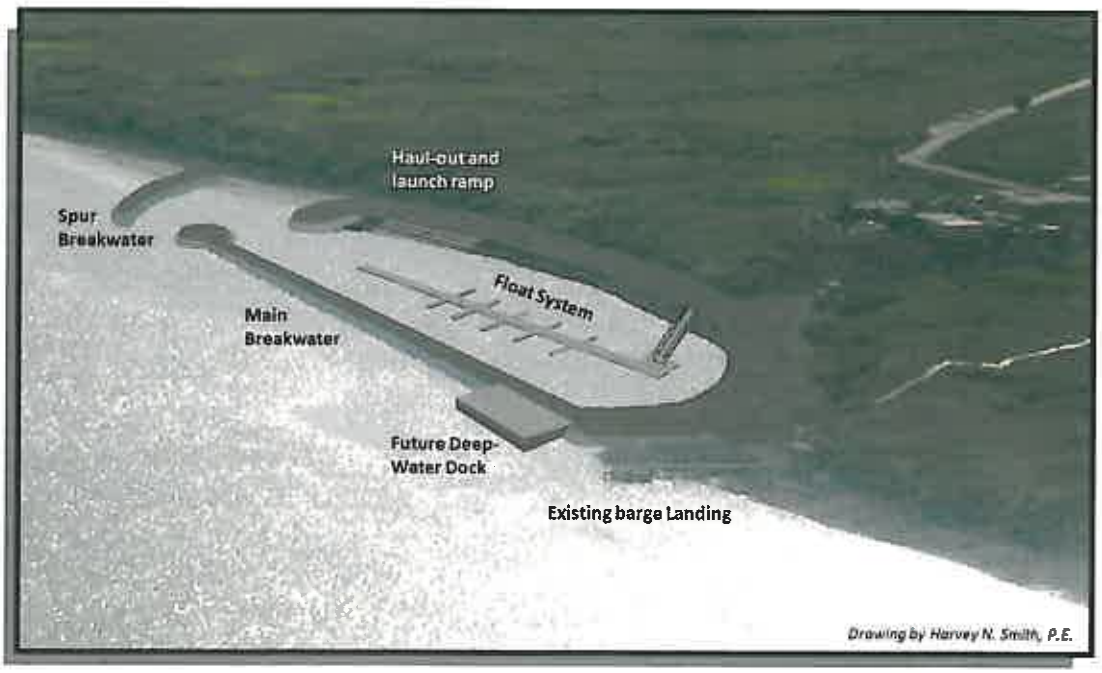
At the outset, waterfront development was recognized as a key element in the overall move from Newtok to Mertarvik. Harvey Smith, PE, State Coastal Engineer, proposed a barge landing site and seasonal boat moorage (2006).



This concept was used by the NPG, U.S. Army Corps of Engineers (USACE), and others in the development of the original community layout. Unfortunately the concrete plank landing was constructed without a thorough bathymetric survey and so an additional barge landing was constructed to better accommodate construction activity.



The Mertarvik site development remained focused on upland evacuation shelter, community layout, quarry and so on. Still recognizing the need for protected moorage, a small boat harbor was proposed. Additional field data and was needed to support the development of this concept; this is the basis for the Waterfront Development Plan (2011-2012).



June 2011 Field Trip Observations

Harvey Smith and Ruth Carter traveled to Newtok June 21-23; they stayed at the school. They intended to survey waterfront area at Mertarvik including preliminary soundings and geotechnical observations, along with current measurement. They also wanted to meet with local community in Newtok itself to investigate their fleet and discuss community needs for Mertarvik. They stayed at Newtok Ayaprun School. They hired Joseph Stewart to take them in his boat over to Mertarvik. His wife Elsie accompanied them and helped with the surveying.

The Field Team

Photos © Ruth Carter and Harvey Smith June 2011

Late arrival of field gear and tides limited access to Mertarvik; however the team talked to Newtok residents and explored their fleet and harbor needs. They also looked at erosion issues along the Ninglick River. Local residents noted that Kealavik River has been silting in and traditional boat access is greatly reduced. Larger scale progressive erosion associated with melting permafrost is evident along the Ninglick River.

On June 23, we boated from Newtok to Mertarvik on the morning tide with Joseph Stewart and his wife. Unfortunately, the boat was stuck from the previous night's low tide and we started about an hour later than originally planned. Time is essential due to limited access up the Kealavik River. As it was, on our return we were required to land the boat and wade through mud at Newtok.

Despite the limited time, we completed a preliminary hydrographic and geotechnical surveys using a survey rod, 300' tape, weight, bottom sampler and boat support. We had a handheld GPS unit and watch. Using this equipment we determined the upper mudflat is on a slope of about 50:1 (horizontal to vertical), and drops off along Ninglick River to a slope of about 8:1. Beyond tidal flat mud in the shallower areas, the bottom felt firm and a small gravel sample was obtained with our sampler. There is suspended sediment in the water column especially during tidal exchanges, so good circulation and flushing should be encouraged to minimize the effects of sedimentation.

While at the site, we also attempted to measure tidal currents using drogues; these were deployed but not recovered. Peak observed measurement, based on movement of boat relative to shore was 1.2 mph.

Tides were measured relative to artificial datum at the concrete ramp and adjusted.

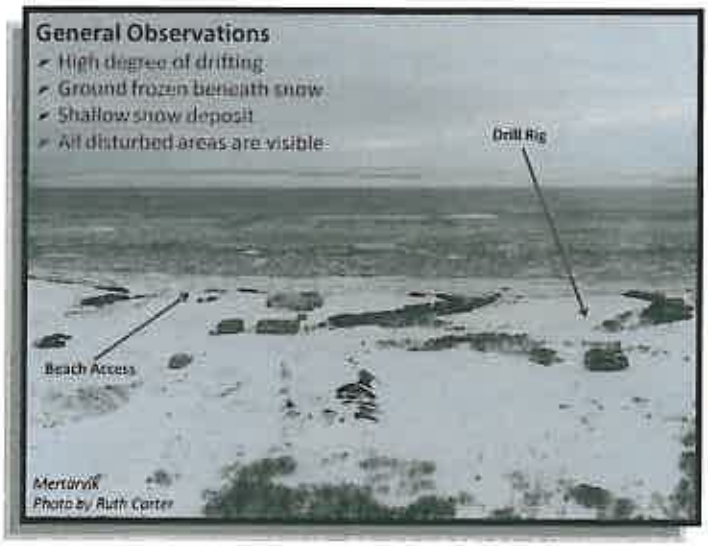
Originally it was assumed that the Ninglick River offshore slope was steep and likely comprised of mud and clay. During our field investigation we found it was a milder slope; probing and bottom samples indicated the presence of firm gravel. This greatly reduces the risk of a global slip-plane failure caused by the breakwater.

A few terns, gulls and long-tailed jaegers were seen in the area along with waterfowl, though none close enough to be identified. There was no eel grass or other vegetation visible at the low tide. Upland vegetation is typical of the Nelson Island area. Neither upland animals nor marine mammals were sighted. We were told that the community hunts walrus, seal and whale in the Bering Sea; they are rarely seen in the Ninglick River.

The project area is surrounded by the Yukon Delta Wildlife Refuge; the project site was acquired from the U.S. Fish and Wildlife Service. According to an environmental assessment, no endangered species are likely in this area (Newtok Evacuation Center, Revised Environmental Assessment, Finding of No Significant Impact, USACE, July 2008).

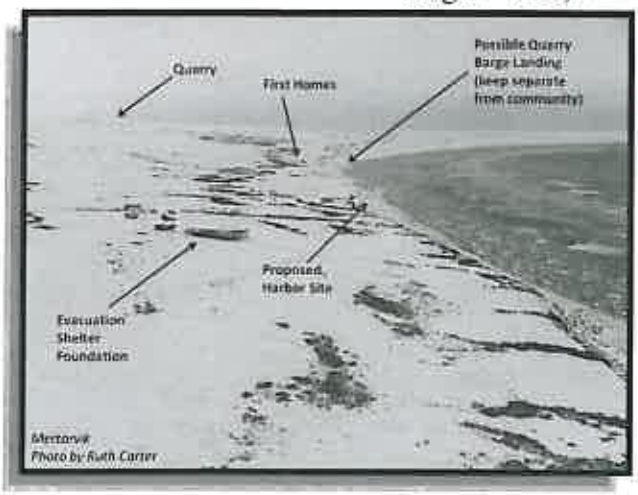
Trip photographs and additional observations are available in Appendix E.

November 2011 Field Trip Observations



Harvey Smith and Ruth Carter traveled to Bethel on November 2 and chartered with Tom Ratledge, Yukon Helicopters, for a flight to Mertarvik November 4 to investigate the quarry and waterfront. Trip photographs are available in Appendix F.

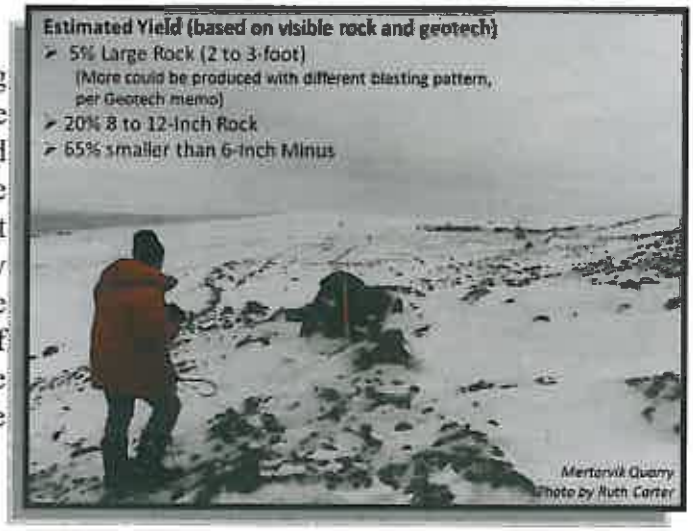
The original trip plan to meet the surveyors at Mertarvik, but that plan was thwarted by freezing conditions. One week earlier, ice had moved in and travel by the survey contractors from Newtok to Mertarvik was no longer safe; consequently, they were unable to collect bathymetric data and their contract was held until May or June of 2012. Fortunately, the flight allowed observation of the waterfront under ice conditions; and drifting snow revealed work at the quarry and town site.



The flight from Bethel to Mertarvik is almost due west approximately 90 mile; the flight track took us directly over Baird Inlet.

A high degree of drifting was evident. The pilot indicated that there doesn't tend to be a lot of snow on the ground as there are often mixed or alternating rain and snow events. The area is semi-arid. The ground was frozen beneath the snow. The drifting snow emphasized all disturbed areas on the ground.

We landed at the quarry and despite being frozen, we were able to see the face of the quarry and how it had been developed. Based on visible rock and the geotechnical report, we were able to estimate the yield. The report described 4-foot of overburden and shallow permafrost. There is basalt and mudstone present; they are not uniformly distributed. If properly developed the quarry, should produce core and filter material. It might also produce armor stone if correctly blasted and mined.



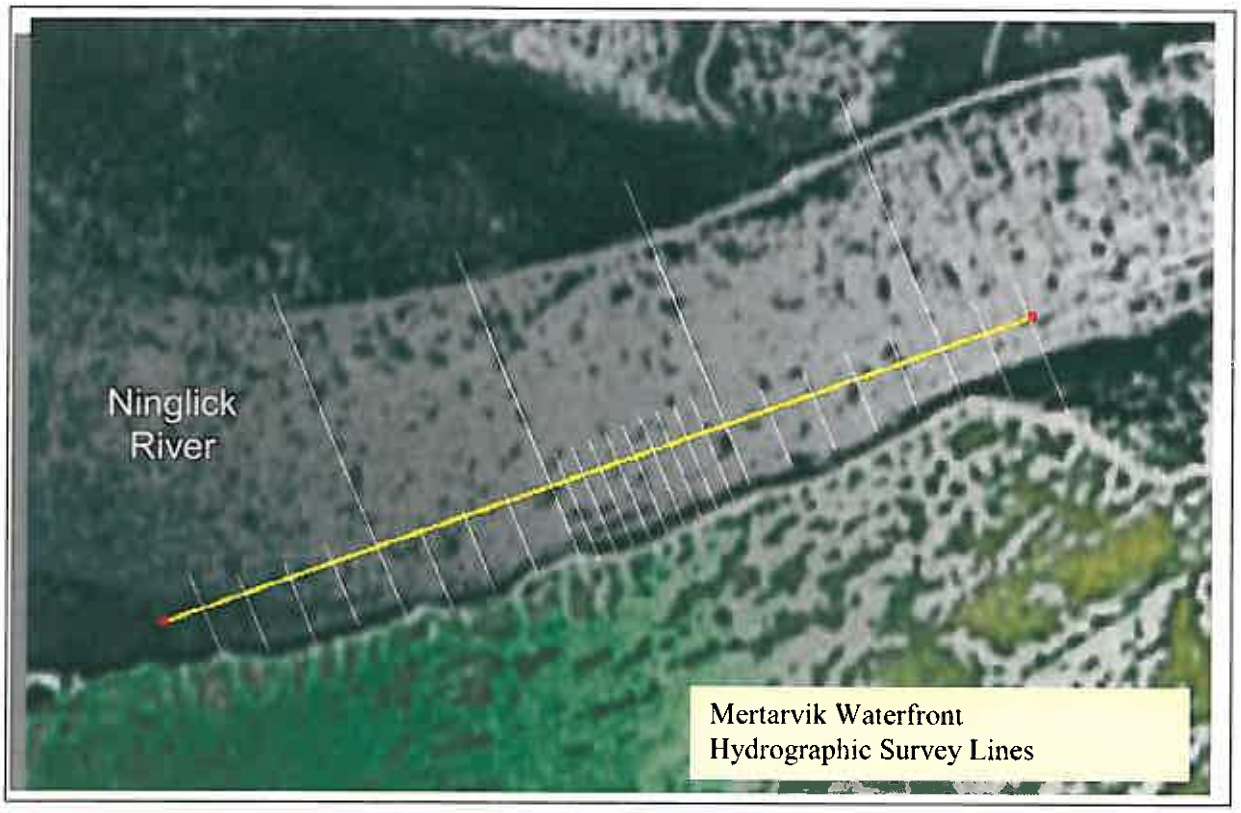
We decided not to land at the waterfront site due to the weather. We had a short window of opportunity during a lull between storms to view the area. Additionally with the presence of ice and snow, we felt the information we might obtain wouldn't improve what we had observed during our June field visit.

Hydrographic Survey

A hydrographic survey along roughly two miles of shoreline and extending 1000 feet offshore was completed in July 2012 to characterize the bathymetry offshore and better assess the local waves and currents. The survey will also be used to align and configure the mooring basin and breakwaters and also to aid in navigation. Four transits were taken across the full width of the Ninglick River to define the main channel. Upland surveys have been completed and are available.

The upper beach along the Mertarvik waterfront is a mud flat with exposed boulders at low tides and was included in the survey. There is a shelf on a relatively flat slope (1:25) to the -10 foot MLLW contour, which then drops off to -36 feet in the main channel of the Ninglick River and Baird Inlet. There is about a four foot tidal range.

The survey shows a small anomaly almost directly offshore from the concrete ramp; this is most likely bedrock due to the proximity of the point on which the barge landing was constructed. It is also consistent with the coastal geomorphology of this area. Further west, near the spring is another point, but that is alluvial in nature. The smooth contours offshore reflect a movable sediment bed in the Ninglick River and Baird Inlet.

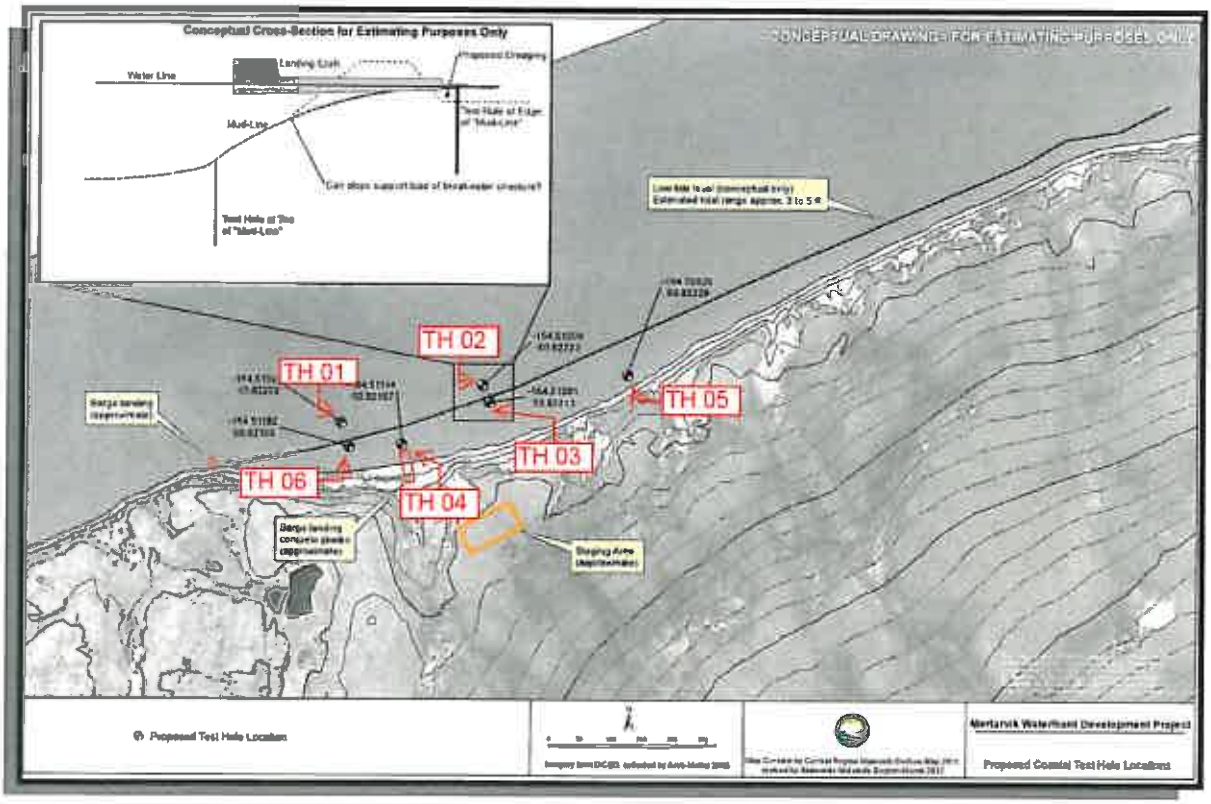


Mertarvik Waterfront
Hydrographic Survey Lines

Drilling and Materials Testing

A field crew consisting of a geologist and drilling crew traveled to Mertarvik on and began drilling on August 2, 2012; they drilled six holes. Drilling from a landing craft, they moved on high tide and drilled on low tide, when the craft was aground.

Generally they found dark gray silt with fine sand and sandy silt overlying weathered volcanic bedrock. The silt and sand generally ranged from 5 to 15 feet in depth in the western three borings, i.e. those nearest the barge landing and concrete planks, and from 20 to 25 feet in the eastern 3 borings. The silt and sand ranged from loose to medium with occasional dense layers containing gravel.



The weathered volcanic bedrock generally ranged from dense to very dense.

All the borings reached at least 30 feet, except for one which refused at 26.8 feet.

Unfortunately all borings were drilled in shallower areas; however, the borings were consistent with local geology on Nelson Island and local riverine and coastal influences. All material drilled consisted primarily of silt, sand and gravel, with cobbles and boulders. There are areas of highly weathered bedrock as well. There are visible boulders on the mudflats at low tides. The presence of bedrock and boulders affect the location and suitability of sheet pile structures as well as navigation and dredging.

Environmental Considerations

The community will need to coordinate with all state and federal environmental agencies on the harbor and associated upland development. Fish, birds, and wetlands are expected to be of greatest concern in all development in the Ninglick River. Every effort has been made in the design process to minimize impacts by considering water quality and circulation, fish passage and other environmental aspects while addressing the local need for safe moorage and access to traditional use fishing and hunting.

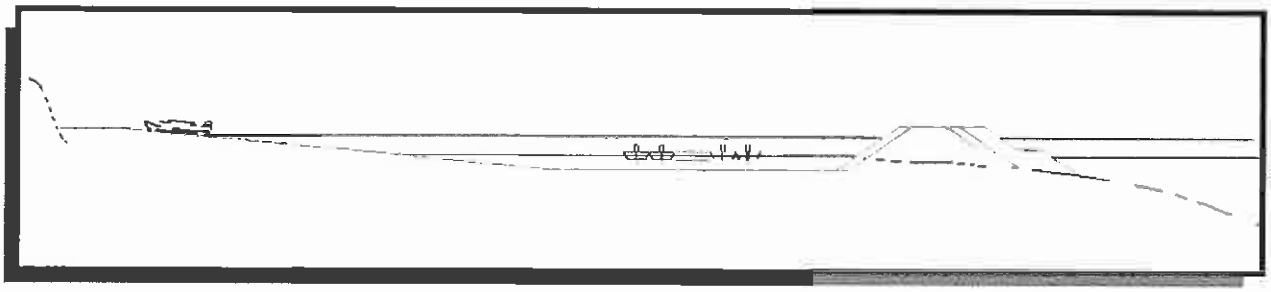
Mertarvik is located between the two main streams on Nelson Island. Takikchak Creek is west of the proposed harbor site flows directly into the Ninglick River; Chakchak Creek is eight miles south of the site and flows east to Kolavinarak River. The Ninglick River, Takikchak Creek and Chakchak Creek are anadromous fish streams and considered Essential Fish Habitat (EFH).

All development of the waterfront in the Ninglick River and could impact EFH. The harbor layout and design has undertaken to minimize impacts; however, this will need to be considered in the permitting and review process *(*from *Relocation Report: Newtok to Mertarvik, Final Draft Issued for Review, by the Community of Newtok and the Newtok Planning Group, August 2011).*

Minimal impacts to birds and waterfowl are expected; no impacts to threatened or endangered species are anticipated. However, along with other permitting, a United States Fish and Wildlife Service Section 7 consultation will need to be conducted.

Conceptual Harbor Design

Cross-section showing breakwater and mooring basin; it is anticipated that the fleet will remain unchanged. The vessels are shallow draft requiring about 4-feet. Rock for the breakwater would be designed to withstand waves, currents and ice-picking. A road on top of the structure would allow access potential for a future dock structure and reduce construction costs.

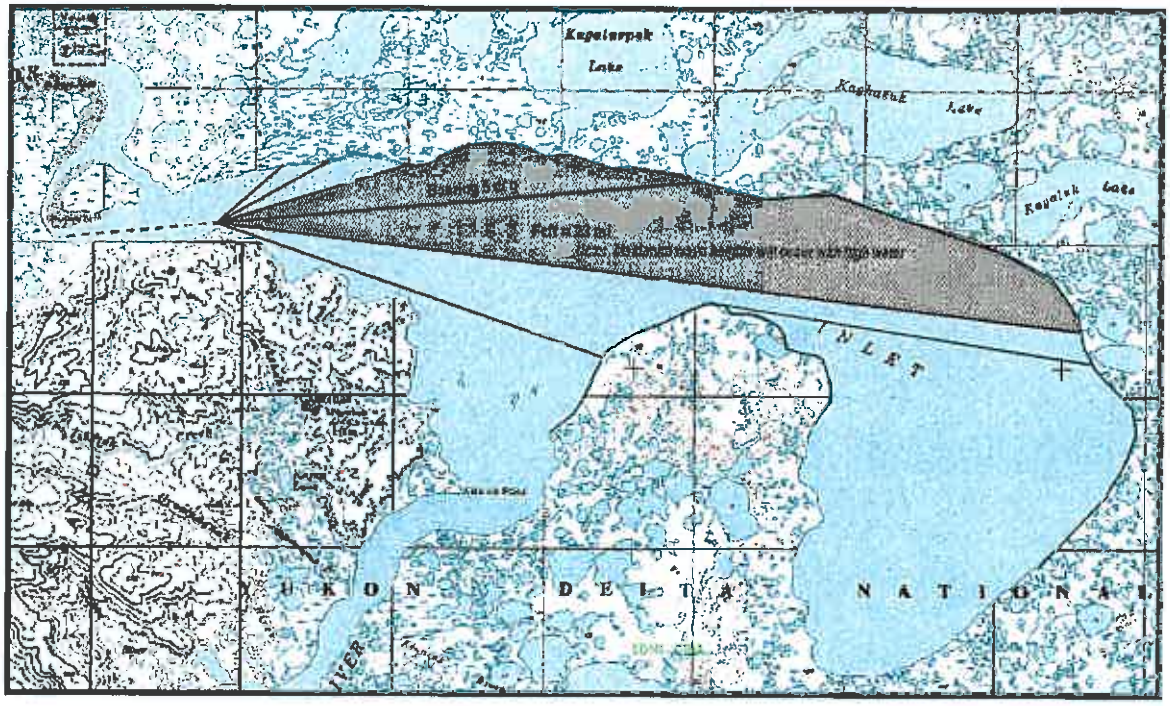


Fetch Analysis

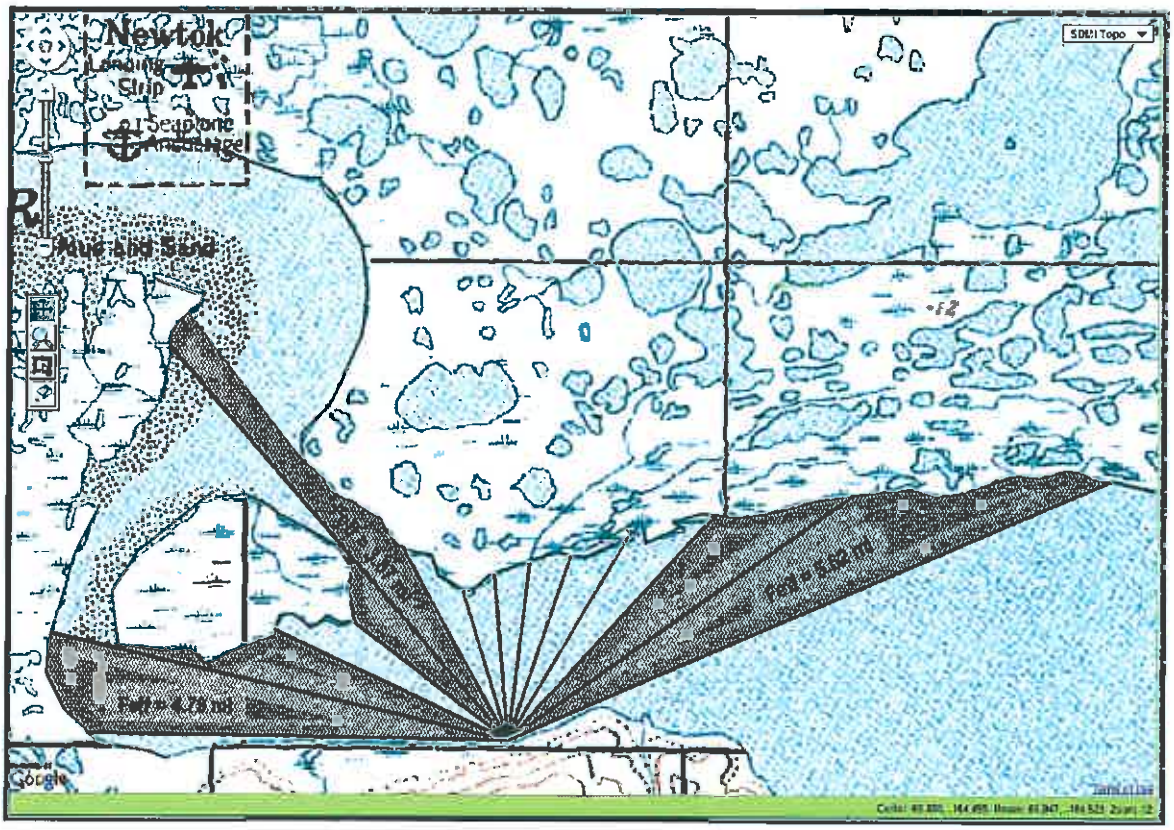
Wave exposure is determined by looking at local fetches; a fetch is the distance over which the wind can blow unobstructed by land before reaching the observer along a given compass heading. Nine, radials at 3 degree increments are the standard used to calculate the effective fetches, as shown nautical charts below.

There is a twenty-three (23) mile, open-water fetch in Baird Inlet, which may create long period waves that may diffract into the area of the Mertarvik Waterfront. All breakwaters considered

were therefore designed to include an east arm to protect the harbor from this wave exposure and associated sediment transport.



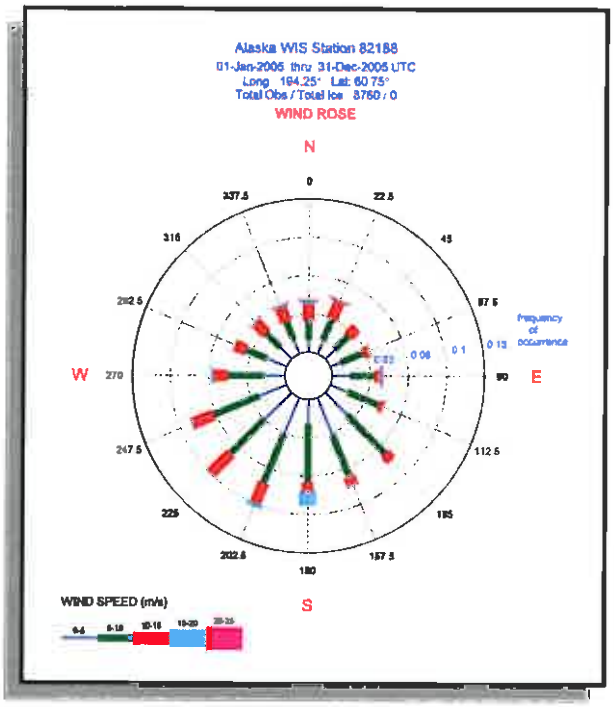
The proposed Mertarvik harbor is also exposed to direct fetches of 4.79, 3.87 and 5.62 miles from the west, northwest and northeast, respectively.



Wind and Wave Analysis

The fetches are used with a 50-knot one-minute wind to determine wave exposure that will be used for calculating the rock size for the breakwater.

Wind data is not available at the site, but there was a Newtok Airport Relocation Reconnaissance Study that summarized anecdotal information for surrounding facilities. Local area winds vary widely, so local wind data will be collected at Mertarvik for the airport project. There is also data available through the Wave Information Studies (WIS), USACE (http://wis.usace.army.mil/wis.shtml); a typical wind rose from this site is shown here.



According to the Newtok Reconnaissance Report, PDC INC. ENGINEERS

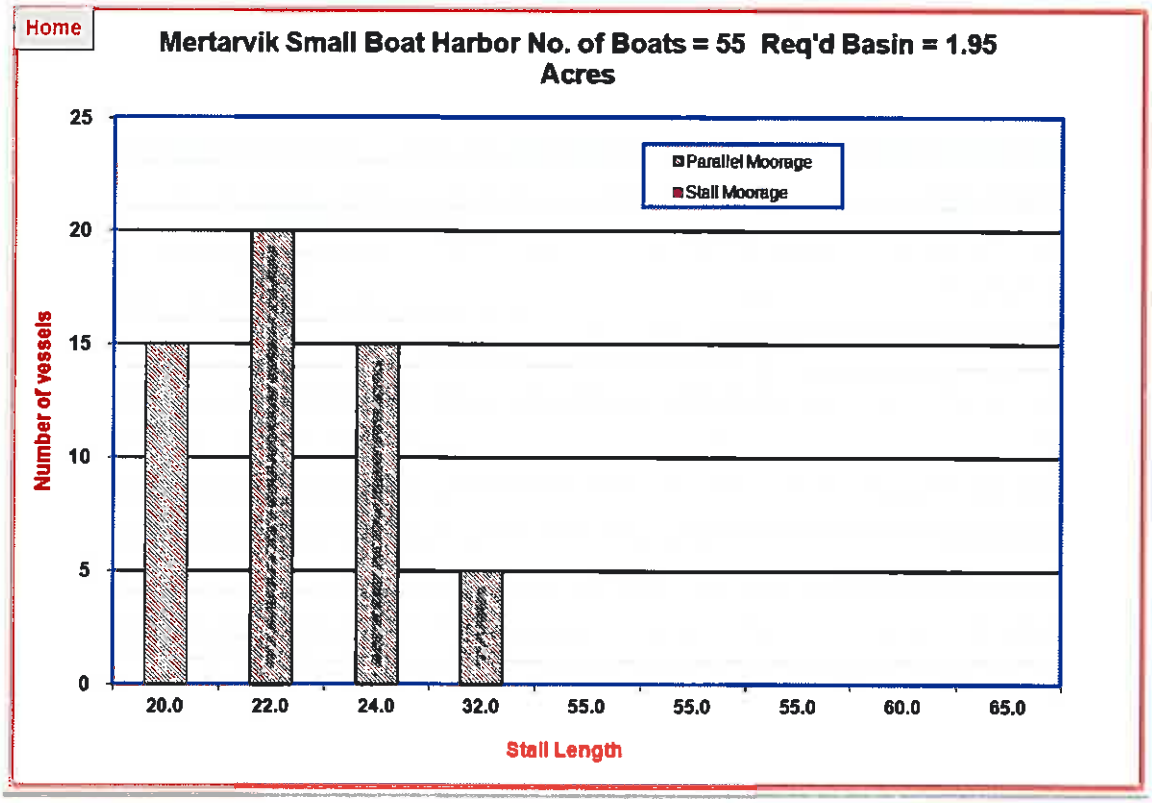
> Pilots indicate that the north side of Nelson Island has prevailing winds from the southeast in the fall and north-northeast to east in the winter. These winds can be 20 knots or higher. High winds predominantly occur in the fall-winter season, coinciding with the storms from Japan.
>
> A pilot who has been flying the Y-K area out of Bethel for several years reported that the typical weather for the island is breezy from June through August, foggy in August through November, and fairly nice with some rain from December to May. This pilot reported the low ceiling cloud cover occurs 40 percent of the time and can be as low as 200 feet in the Toksook Bay and Newtok area. When the ceiling is this low, clouds cover the tops of the hills.
>
> A different pilot, also familiar with the area, stated whiteout conditions are not uncommon, especially during winter. This pilot felt an east–west oriented runway would be best for the strong northeast winds in the area. He stated the strongest winds occur during break-up and freeze-up.
>
> Both pilots have cautioned that winds vary between communities and are influenced by local topography.

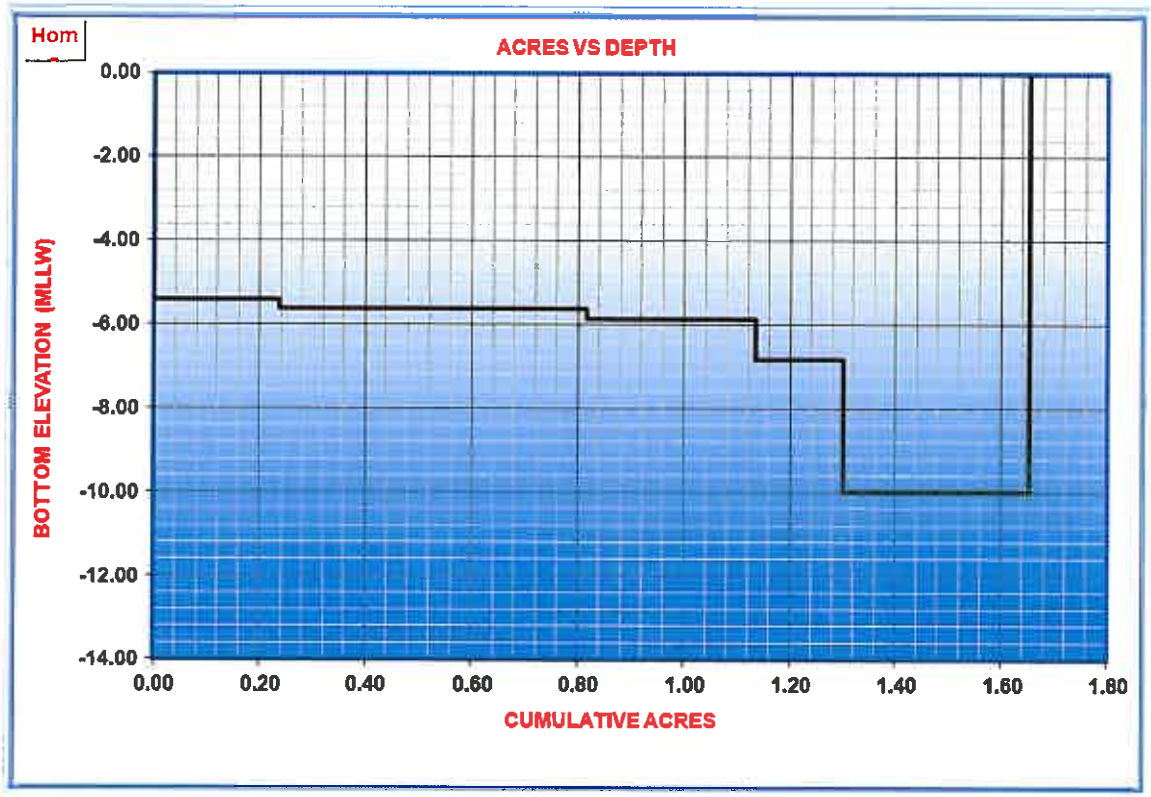
For this design, we are using a 50 knot, 1 minute wind.

MERTARVIK HARBOR WAVE ANALYSIS (Assumes 50 knot, 1-minute wind)			
Direction	Fetch (miles)	Wave Height (H10, feet)	Wave Period (seconds)
WEST	4.8	6.0	3.9
NORTHWEST	3.9	5.4	3.7
NORTHEAST	5.6	6.4	4.1
EAST (Baird Inlet)*	23.0	12	6.4
(*Swell that may diffract into the harbor area)			

Engineering Design of Basin and Planform Requirements for Fleet

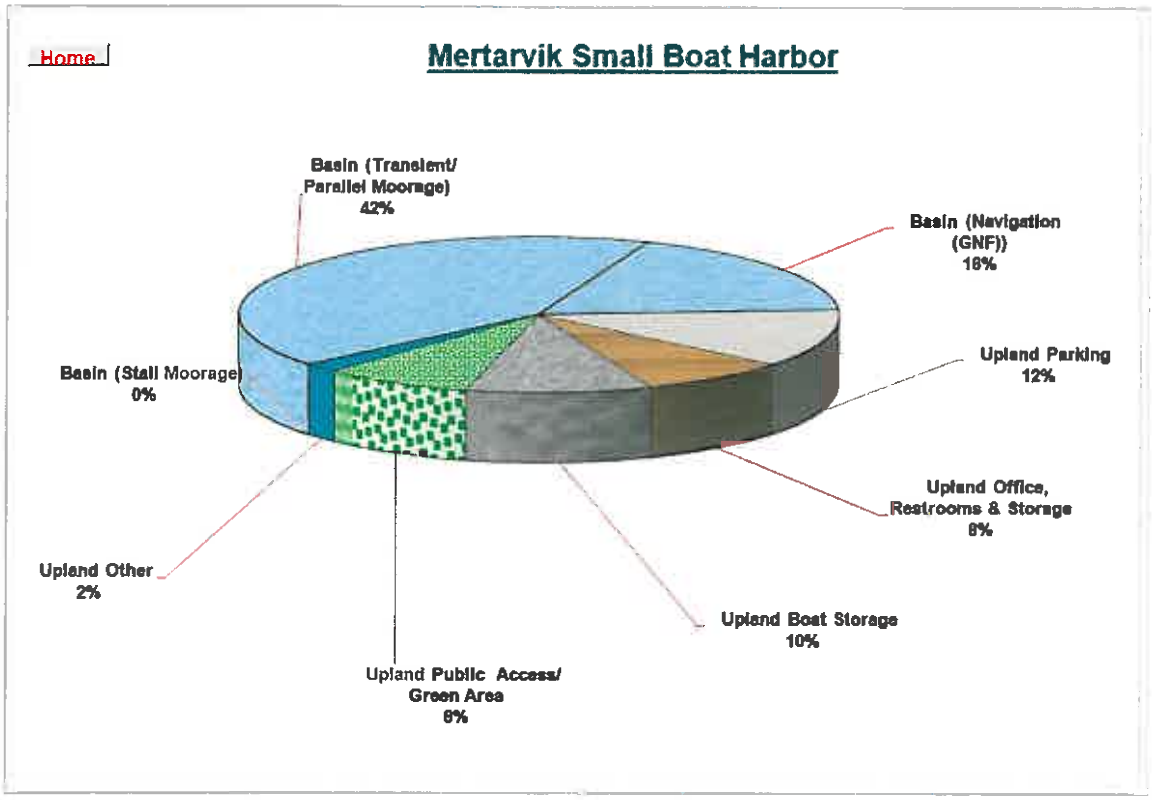
We used a 55 vessel fleet ranging from 16 to 32 feet, based on length overall (LOA). Design vessels ranging from less than 20 to 32 feet LOA were used to estimate the required basin size. Basin depths would be stepped from -7.5 to -9 feet; the navigation channel would be slightly deeper (shown as -10 feet in the graphic on the following page). Only parallel moorage would be provided to facilitate removal of the inner harbor float system each winter.





Community needs

- Based on fleet, need 1.95 acre basin for moorage and navigation
- Floats need to be removable in winter due to icing conditions
- Safe access to shore
- Upland support areas for boat storage and staging areas
- Project may be phased (for example)
    - Phase I – construct breakwaters
    - Phase II – float construction
    - Phase III – dock
    - Phase IV – separate landing for commercial activities
- Relocate existing concrete plank ramp
- Separate barge landing and quarry access for commercial activities



Local Quarry Investigation

A field Trip Report by Craig Boeckman, CPG, Regional Geologist, is provided in Appendix B; it includes observations of the IRT work and Rock quarry development and access. Craig identified prominent joint faces in the quarry with some rounded rock; at about 40-foot in depth the rock became "soft and red" indicating that there is a harder basalt cap on top of an oolitic iron mudstone rock. Additional basalt layers may lie beneath the mudstone.

Three types of rock were identified: Rounded and Tabular Basalt, and Oolitic Iron Mudstone. Only the basalt would be useful in construction.

Estimated Yield (based on visible rock and geotechnical report)

- 5% Large Rock (2 to 3-foot)
  (More could be produced with different blasting pattern, per memo Appendix G)
- 20% 8 to 12-Inch Rock
- 65% smaller than 6-Inch Minus

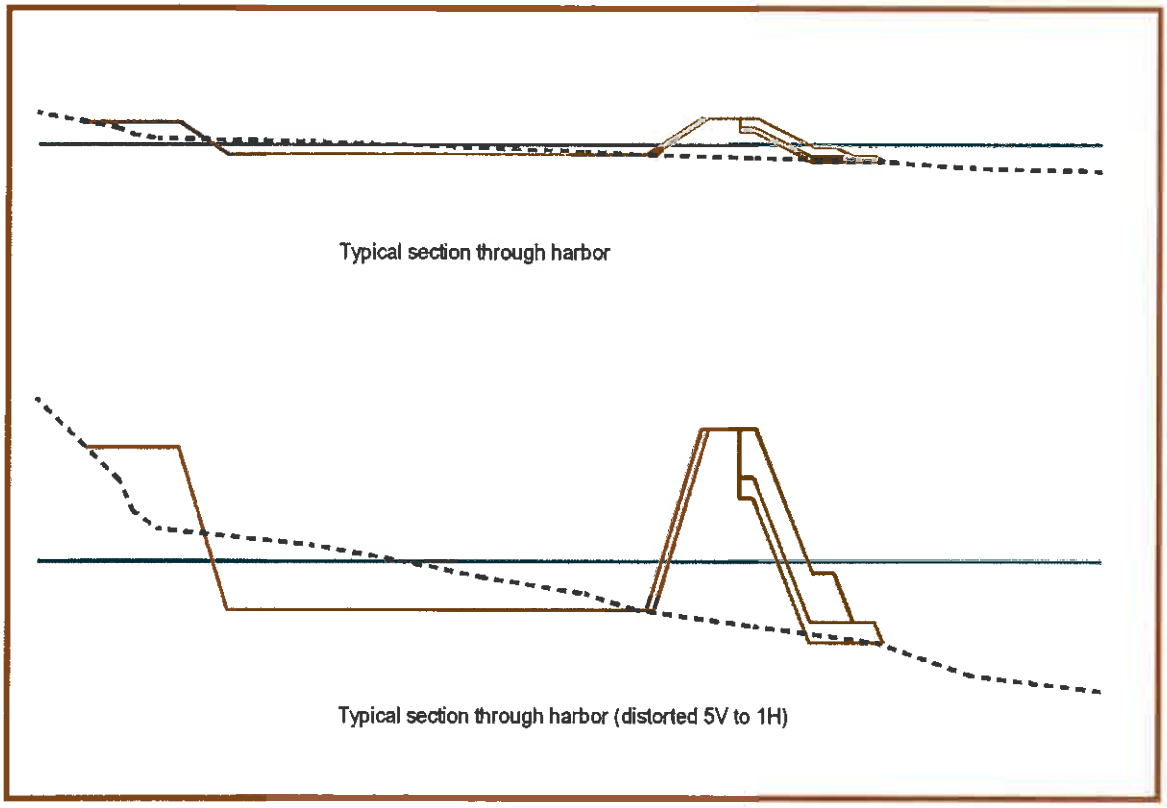
General Observations from the field and memorandum

- 4-foot overburden
- Shallow permafrost
- Not uniform throughout
- Basalt is layers with softer mudstone.

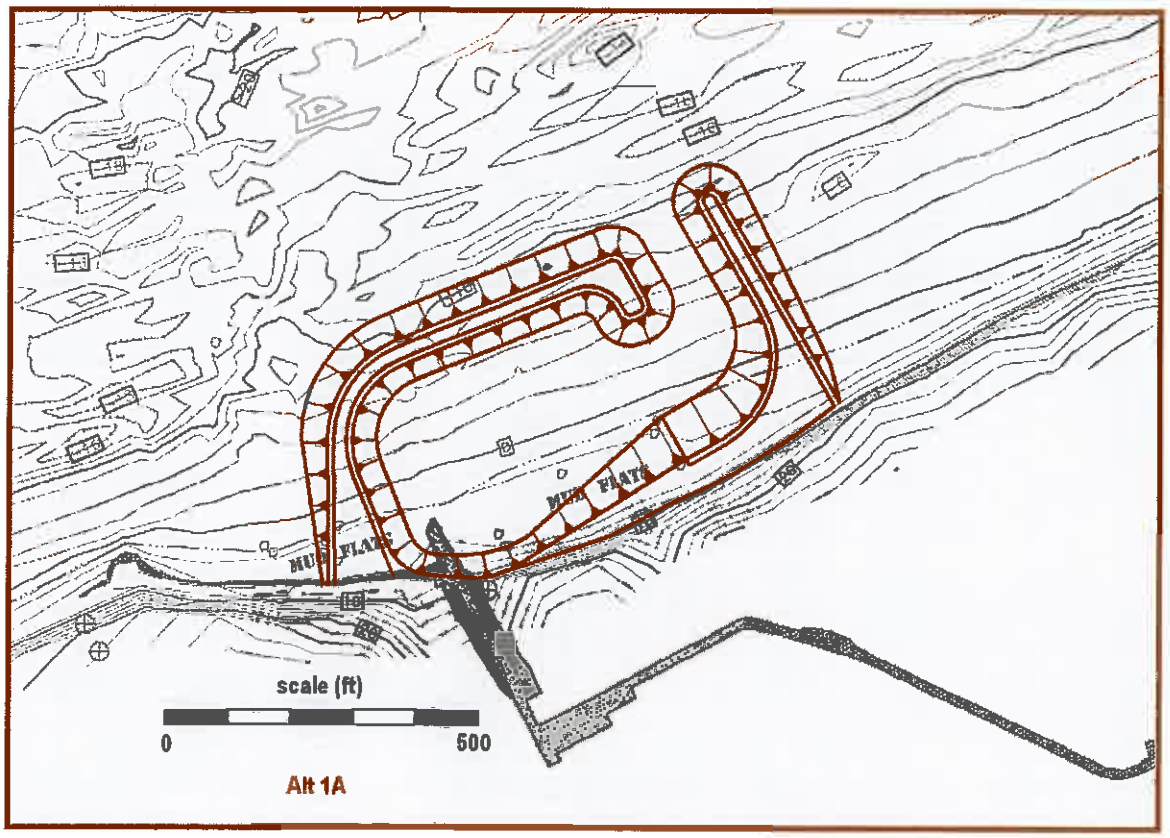
Additional testing and exploration might be required for commercial development of this quarry. If properly developed, should produce core and filter material; it might also produce small armor stone if correctly blasted and mined.

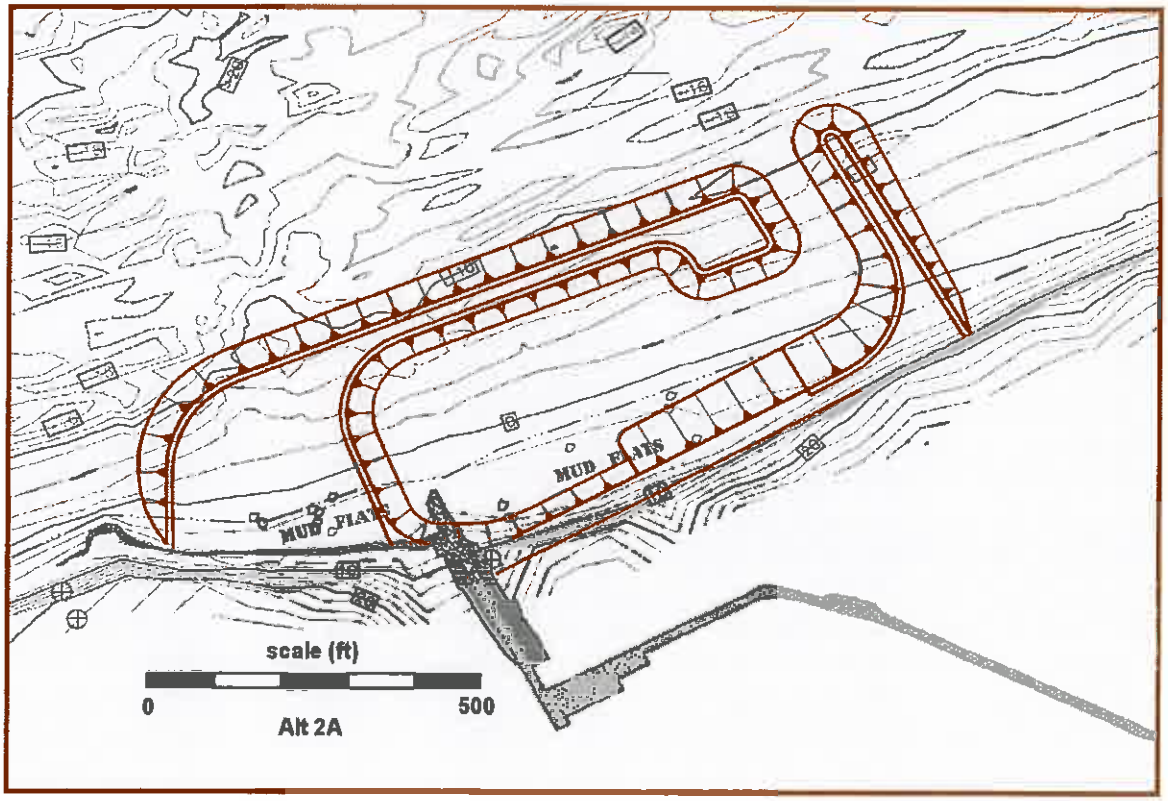
Conceptual Harbor Designs Considered

Among the alternatives developed for this study, six are shown here for consideration by the community. The alternatives provide a range of sizes and configurations to accommodate the local needs. A cross-section of the proposed harbor basin and breakwaters are shown below. The dashed line depicts the original ground as measured by the hydrographic survey.



The alternatives are shown on bathymetric contours.





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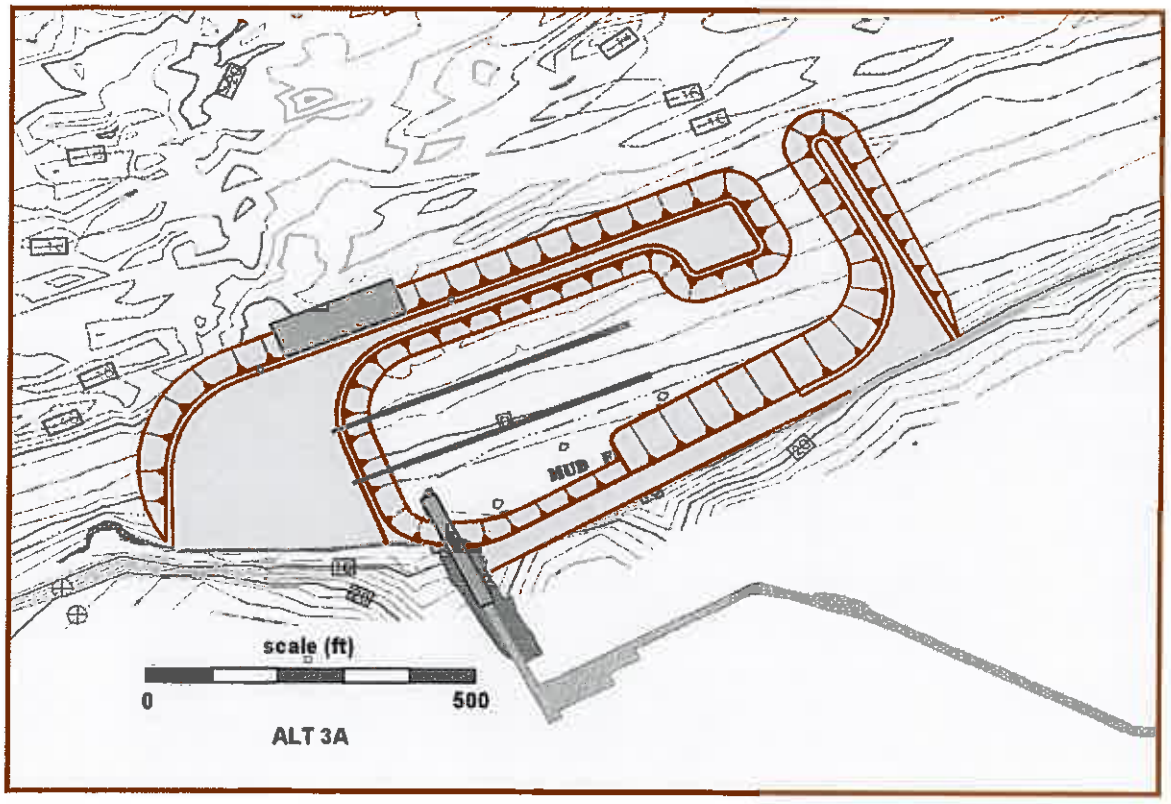
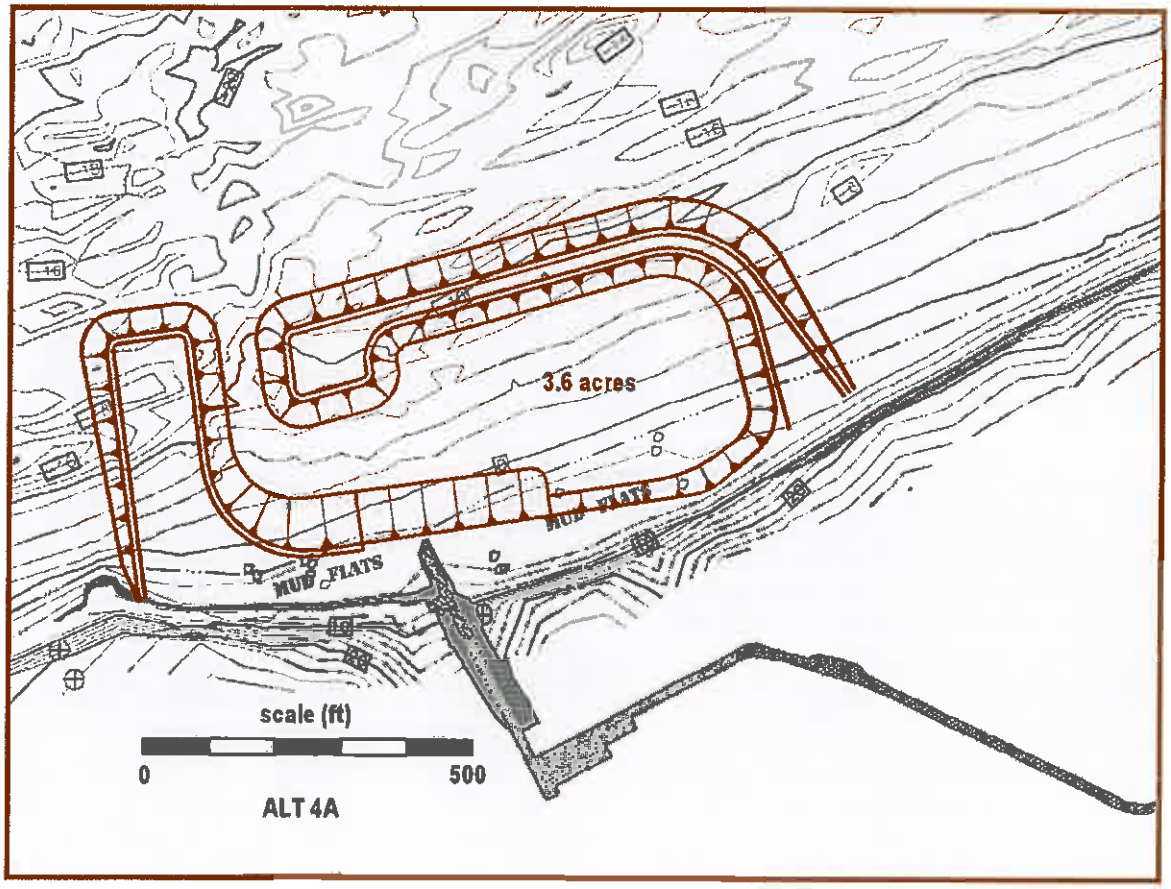

scale (ft)
0
500
ALT 3A


3.6 acres
MUD FLATS
scale (ft)
0
500
ALT 4A

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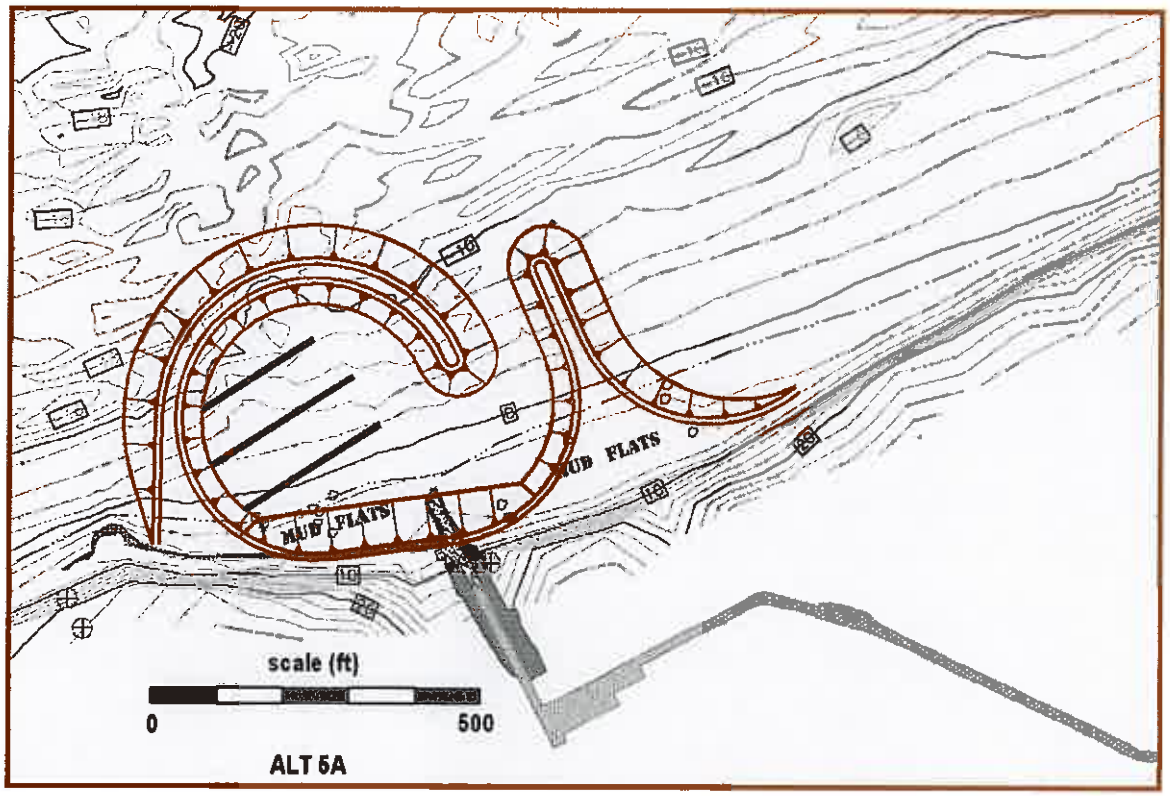
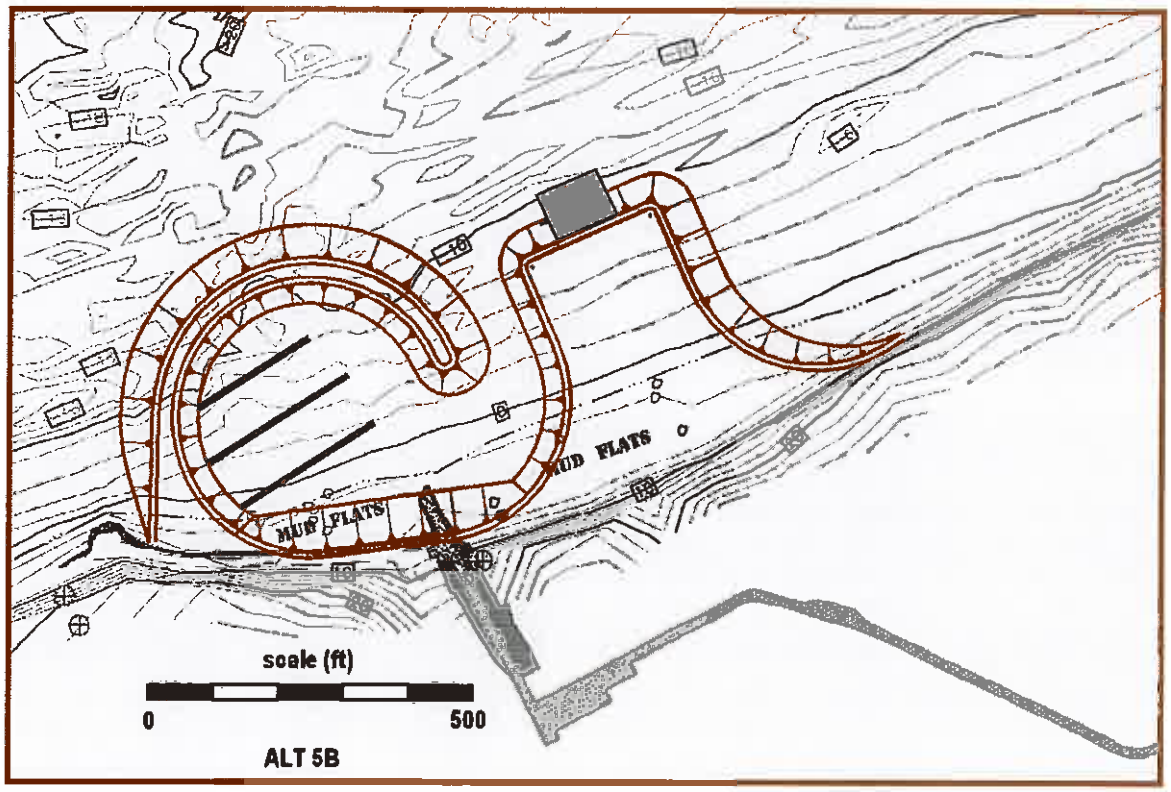

MUD FLATS
MUD FLATS
scale (ft)
0
500

ALT 5A


MUD FLATS
MUD FLATS
scale (ft)
0
500

ALT 5B

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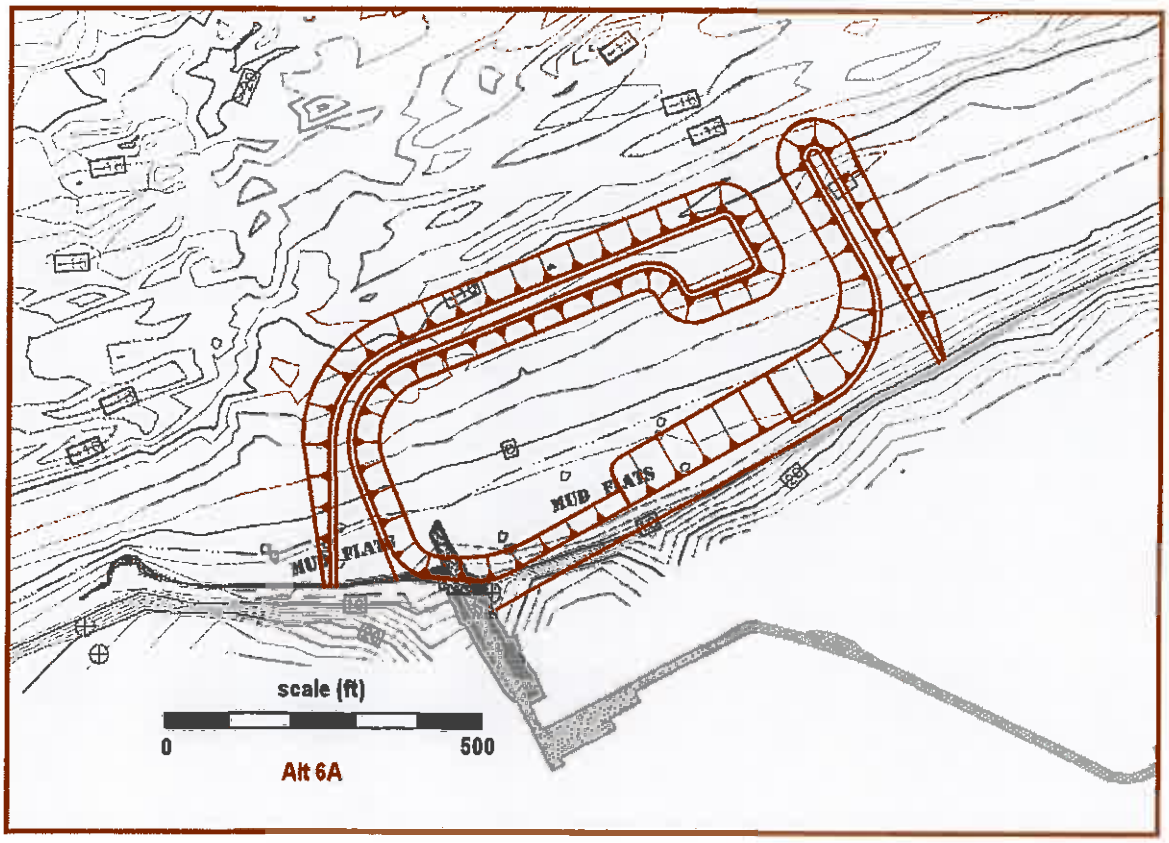

Comparison of Alternatives

There are a number of factors to consider when selecting a preferred alternative.

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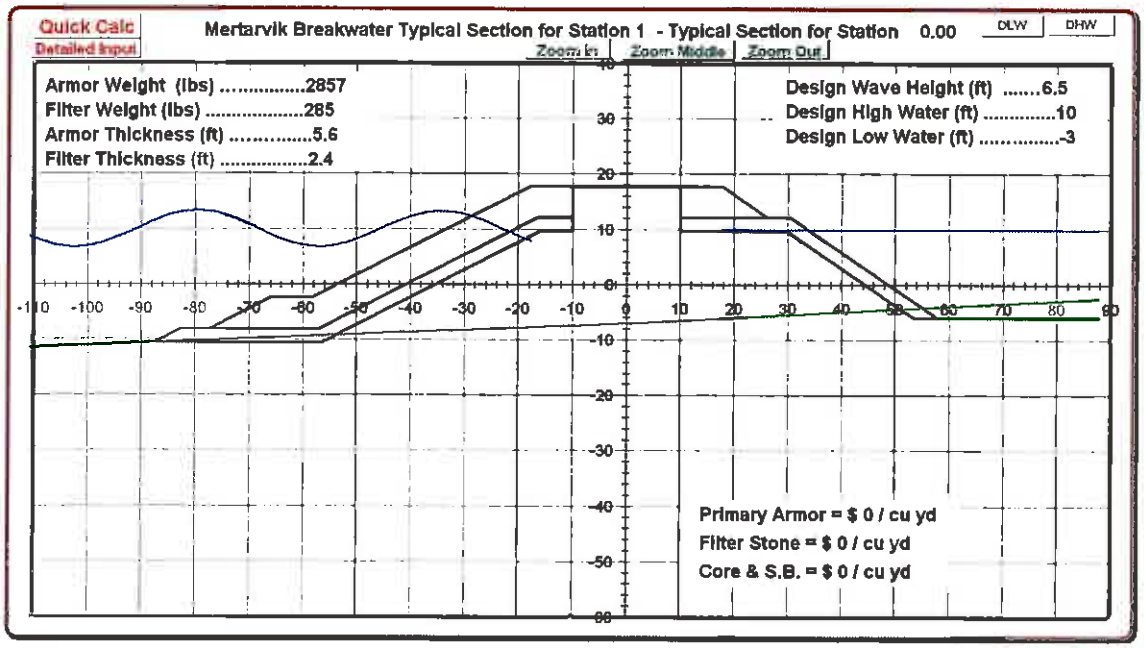
Locally Preferred Breakwater Design

To be determined by NTC and community in cooperation with ADOT&PF.

Detailed Breakwater Cross-Sections

Based on field observations and preliminary analyses, the following breakwater cross-section is proposed.

Using a 2:1 slope on the outside and 1:5:1 on the inside, 3000-pound armor stone is recommended.



Here is a preliminary rock gradation.

Primary Armor	Weights (lbs)	Primary Armor Diameters (in)
Minimum	1000	25
Average	3000	36
Maximum	5000	43
Filter Stone Weights		Filter Stone Diameters (in)
Minimum	14	6
Average	150	13
Maximum	286	17
Core Stone Weights		Core Stone Diameters (in)
Minimum	0.3	1.7
Average	30	8
Maximum	60	10

Estimated Quantities

Breakwater Features	Minimum	Maximum
Total Breakwater Length (feet)	800	1200
Area (acres)	2	3

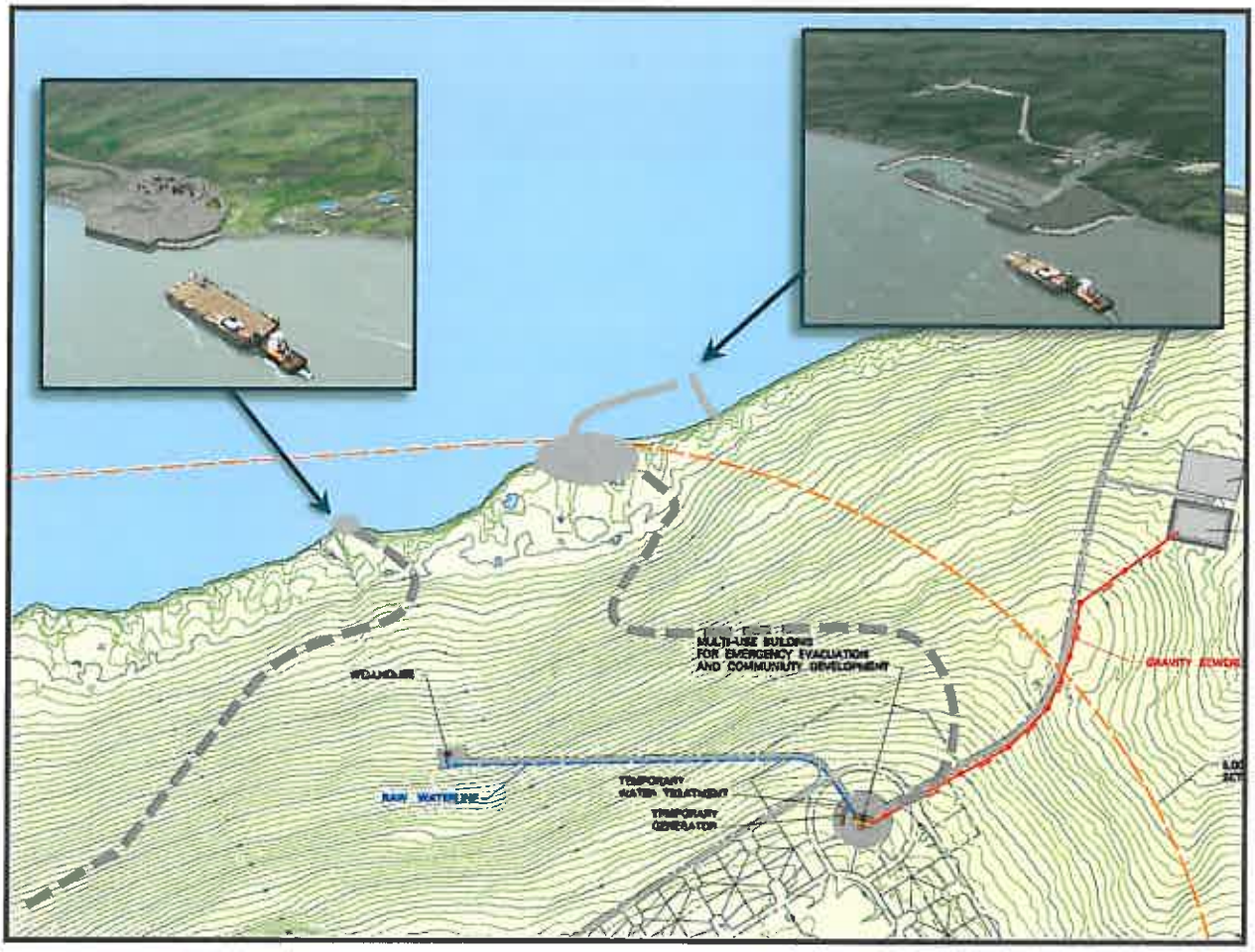
Estimated Costs

TBD

Additional Waterfront Development

Once the community is relocated, additional infrastructure may be desirable along the Mertarvik Waterfront. This may include a commercial dock for exporting material from the local quarry. It would be undesirable to have rock or gravel hauled through the community, so a road would be needed to access a commercial dock and barge landing directly from the quarry site. We looked at a site near the first homes constructed at Mertarvik. The development would need to be laid out to minimize impact to the spring.

This shows the relative locations of the proposed commercial dock with the small boat harbor.



Work Schedule Considerations

1. Baird Inlet and Ninglick River are iced in from November through April; note in the summer of 2012, work could not commence until July due to the presence of ice
2. There may be fish windows for in-water work
3. Recommend following guidelines set out in the "RELOCATION REPORT: Newtok to Mertarvik (August 2011)" and "Mertarvik Strategic Management Plan (March 2012)" by the Community of Newtok and the Newtok Planning Group (Prepared by Agnew::Beck Consulting with PDC Engineers and USKH Inc. for the State of Alaska Department of Commerce, Community, and Economic Development (DCCED), Division of Community and Regional Affairs).
4.

Observations related to permits

1. The Land Ownership shows Plat uplands belonging to XXX, but the tidelands have been retained by the state. ??? A Materials Sale Agreement will be required with ADNR, division of Mining, Land and Water and probably a Tidelands Permit.
2. Wildlife and Fish
3. USF&WS Section 7
4.

Permits that will likely be required

1. A **DNR Tidelands Permit** from ADNR Division of Mining, Land and Water
2. A **DNR-OHMP Fish Habitat Permit** for work below OHW.
3. An individual **Corps of Engineers Section 10/404** for dredging below high tide of navigable waters (tidal).
4. **Coastal Consistency Review**

Next steps and additional work

1. Funding
2. Detailed Plans and Specifications
    a. If sheet pile dock is proposed recommend supplementing geotechnical investigation with Geophysical Survey to identify presence of bedrock or large boulders
3. Permits and Environmental
4. Construction

Appendices

A. Memorandum of Agreement
B. Hydrographic Survey
    a. Consultant Contract 2012
    b. Survey Results (DRAFT, to be finalized)
C. Geotechnical
    a. ADOT&PF, Rock Quarry Reconnaissance, Mertarvik Townsite, Nov. 2011
    b. Consultant Contract (2012, Re-Scoped and Rebid)
    c. Consultant Test Hole Logs and Test Results (DRAFT, to be finalized)
    d. ADOT&PF Geotechnical Report (DRAFT, to be finalized)
D. Trip Photographs
    a. June 2011
    b. November 2011
    c. August 2012 – may be added
E. Correspondence
    a. Status and Draft Report cover sheet
    b. Letter to Stanley Tom with revised schedule

Distribution

via e-mail only

Sally Russell Cox, Planner, Division of Community and Regional Affairs
Michael Lukshin, Department of Transportation and Public Facilities
Julie Stoneking, Bureau of Indian Affairs
Norma Jean, Bureau of Indian Affairs

via e-mail and hard copy

Moses Carl, President, Newtok Traditional Council
Stanley Tom, Tribal Administrator, Newtok Traditional Council