3.8 KINIKTUURAQ

3.8.1 Location and Site Description – Kiniktuuraq

Kiniktuuraq was selected as the preferred site in 2000, prior to TNH's 2004 on-site investigation of the area. Located at the south end of the lagoon near the mouth of the Wulik River, the Kiniktuuraq site is approximately a mile southeast of the existing village. The site fronts the Chukchi Sea on its southwest side, and is separated from the lagoon by Kiniktuuraq Creek, a tributary of the Wulik River, and a small island.

This site shares many of the same characteristics of Kuugruaq and Igrugaivik. It is wet to the point of being swampy, underlain by unstable, ice-rich, fine-grained soils, and subject to destruction of the existing thermal regime without the addition of a minimum of 9 ft of gravel over the site.

This site is relatively flat, with the exception of two distinct elevations separated by a sharp incline between them. Reference the geotechnical report for discussion of these areas.

The site is essentially devoid of trees and brush. The major forms of flora are arctic plants that flourish in wet environments, such as arctic moss, sedges, arctic cotton and grasses.

3.8.2 Site Development – Kiniktuuraq

Kiniktuuraq was observed in the fall of 2004 to be flooded by storm driven tides. The site is at an elevation of 10 feet and would need to be raised above the projected storm surge elevation of 13.5 feet to facilitate development as a town site. In addition to protecting from storm surge, the site must be developed to protect the thaw unstable permafrost.

To protect against permafrost degradation, a gravel pad would have to be constructed a minimum of 9 feet thick. Reference the geotechnical report for more information about gravel requirements for the site.

Grading should maximize the utilization of swales and roadside ditching as much as possible. Where lengths of grade and slopes combine to make swales and ditches too deep, drainage structures such as culverts, manholes, catch basins and subsurface piping shall be employed.

Because the Kiniktuuraq site is fronted by water on two sides, the Chukchi Sea to the west and a channel of the Wulik River on the north, the site is vulnerable to erosion and must be armored using armor rock and riprap on those sides.

3.8.2.1 Construction Considerations – Kiniktuuraq

Construction considerations for the Kiniktuuraq site can be referenced from R&M (2000) and R&M (2002). Test Borings were drilled during 1999 to investigate potential borrow material along the beach. Test Borings were also drilled in 2002 to investigate potential borrow material underlying the Kivalina Lagoon.

R&M (2000 and 2002) states that foundation soils encountered were thaw-unstable, ice-rich, fine-grained materials. Significant settlement should be expected if thawing occurs. However, very little thaw settlement should be expected along the beach areas. Permafrost was encountered within all test borings except for those drilled along the beach and those drilled under the lagoon.

In 2000 and 2002, R&M observed massive ice in test borings drilled within the upper terrace (upland) area. Many other borings encountered considerable visible ice as stratified or distinctly oriented formations. Saline groundwater was encountered as far upstream along the Wulik River as the northwest portion of Igrugaivik.

R&M (2000 and 2002) suggests use of pile foundations or a granular fill pad with a post-on-pad foundation to protect from settlement due to thawing of ice-rich soil. Insulated post-on-pad foundations can be used in this situation, but require periodic leveling due to settling. Another option would be insulated and/or refrigerated shallow foundations (thermosyphons). This method is generally used for large heavy loads such as water storage tanks and not used for light-load conditions.

R&M (2000 and 2002) states that embankments for roads and runways should be protected from settlement due to permafrost degradation. An estimated embankment thickness of 9 feet should reduce the depth of thaw penetration into the ice-rich soil to nearly zero. Rigid board insulation or allowing for some settlement can reduce embankment thickness. The settlement would occur mostly within the first few years of service. Culverts beneath the embankments are expected to settle due to permafrost degradation, and may need to be re-leveled periodically during the first few years of service. Insulation beneath the culverts may reduce the magnitude of settlement.

S&W (2004) states there is a potential for an increase in soil salinity and soil temperature due to the proximity of the site to the ocean. Increased soil salinity and soil temperatures would reduce the unit capacity of pile foundation systems in ice-rich soils. Pile foundation systems at this site could be deeper and refrigeration requirements greater than at the Igrugaivik site.

S&W (2004) also states that although the thermal integrity of the permafrost could be maintained by insulating the land surface with a thick fill, maintaining the integrity of ice-rich permafrost exposed at the coast would be more difficult. Both thermal degradation and mechanical erosion of these soils along the coast could undermine site fills unless adequately protected. In addition to mechanical stabilization, ice-rich soil along the coast would require thermal protection and protection from saline seawater.

3.8.3 Infrastructure Development – Kiniktuuraq

3.8.3.1 Water – Kiniktuuraq

No test wells have been drilled at the Kiniktuuraq site. A test well drilled about 1 mile inland at the Igrugaivik site in May 2002 produced saline water from a thaw bulb along the Wulik River (R&M 2002). Based on this finding, a well placed in similar deposits at the Kiniktuuraq site will likely produce salt water.

The Kiniktuuraq site is covered by a number of small tundra ponds a few hundred square feet in area, none of which appear large enough to provide a sustainable raw water source (TNH 2004).

Due to the lack of nearby freshwater from either surface or groundwater sources, a collection, treatment, and distribution arrangement similar to the existing Kivalina site would be required. Water would be withdrawn through a hose and pipe transmission line placed in the Wulik River and pumped to a raw water storage tank. If the Wulik River could be tapped with an infiltration gallery year round, the transmission line would have to be heated with a glycol loop to avoid freezing.

An underground distribution system is infeasible at this site due to massive ice wedges and unstable thaw conditions (R&M 2000, 2002; S&W 2004). If an aboveground distribution system were used, continuous grade adjustments would be needed.

3.8.3.2 Wastewater – Kiniktuuraq

The unstable thaw conditions at the Kiniktuuraq site present a large problem for

a sewage collection system. The Kiniktuuraq site is situated on low elevation and flat terrain. Soils consist of ice-rich permafrost and large ice wedges. A vacuum collection system and an above ground utilidor are recommended for development of this site. DOWL (1994) stated a sewage lagoon could be built on this site but would require special considerations.

R&M (2000 and 2002) states that degradation of permafrost is expected beneath and around any proposed sewage lagoon placed on the perennially frozen fine-grained soils. This may result in significant thaw settlements, particularly under the lagoon dikes. The lagoon dikes should be constructed sufficiently high to account for settlement, or periodically evaluated in order to maintain the required lagoon capacity.

3.8.3.3 Solid Waste – Kiniktuuraq

No developable possible solid waste site was identified during the August 2004 fly-over. Assuming a potential site existed near the village site, great amounts of gravel fill would be required to raise the area above the flood plain. A minimum of 9 ft of gravel would be required to preserve the thermal regime under the proposed town site. Small quantities of sand and gravel could potentially be mined from the beach and along the edges of the Wulik River for small projects, as sand and gravel quantities are limited to volumes of 1,000 to 3,000 cubic yards per deposit pocked (DOWL/BBFM, 1998). Permitting a gravel mining operation in the river may be difficult. Transporting the gravel/sand cover soil to the potential landfill site would be very difficult.

Kiniktuuraq is the location of the old dumpsite, presenting permitting issues.

3.8.3.4 Fuel – Kiniktuuraq

Except for the location of marine headers and fill pipeline routings, the information in 3.2.6 Fuel applies equally to all potential sites.

3.8.3.5 Heating – Kiniktuuraq

The information in 3.2.7 Heating applies equally to all sites.

3.8.3.6 Electricity – Kiniktuuraq

The information in 3.2.8 Electricity applies equally to all sites.

3.8.4 Access – Kiniktuuraq

Since it is bordered on two sides by water, site access would be primarily by boat. The landward side of this site to the west and south abuts terrain that is a continuation of the wet conditions of the subject site.

3.8.4.1 Access for Subsistence Activities – Kiniktuuraq

Access to the lagoon and to the Chukchi Sea for hunting sea mammals and fishing should be direct as the site fronts the sea and abuts the lagoon. Safe boat moorage would be on the lagoon side of the site or along Kiniktuuraq Creek. The sea can be reached in less than 5 minutes from any point along the lagoon side of the parcel.

The mouth of the Wulik River is located less than a mile northeast of the north side of the site. Access to this river should be by boat from the boat-staging pad at the north side of the property, or from Kiniktuuraq Creek to the Northeast.

The Kivalina River near the north end of the lagoon can be accessed by boat from the lagoon.

Beach access from the Kiniktuuraq site is immediate along the southwest face of the site. This site affords miles of beach to the south that can be accessed by foot for beachcombing, wood gathering, hunting or more easily accessing areas inland of the beach. Beach access to the north side of Singauk Inlet should be by boat across the lagoon.

Subsistence activities such as gathering berries and greens and small game can be easily performed from the site by foot or on four-wheeler. The wet, unstable nature of the terrain should make travel by four-wheeler slow.

3.8.4.2 Goods & Supplies – Kiniktuuraq

Barge access to the Chukchi Sea can be direct from the southwest side of the site. The barge landing for this site would be a beach landing next to the village site, which would not require construction of an access road.

An airstrip could be located approximately 3.5 miles to the northeast of the village site and connected to the village via a road.

3.8.4.3 Air Transportation – Kiniktuuraq

Because the new airstrip must be located 10,000 feet from the landfill, we recommend that the airstrip should instead be located approximately 3.5 miles northeast of the village to accommodate distance requirements.

A new airport should be constructed prior to occupancy of the new village site. Refer to Section 3.1 for general recommendations.

3.8.4.4 Roads & Streets within Community – Kiniktuuraq

The road layout within the community is expected to closely reflect the plan in Appendix G for the Phase I study report. Roads should be designed on a grid system to maximize flow of traffic and access to all portions of the new community.

3.8.4.5 Roads Outside the Community – Kiniktuuraq

The location of the Kiniktuuraq site and the soil conditions of the terrain surrounding it make road construction difficult and expensive. There should be as few roads as possible outside the village; therefore we have recommended that the airstrip, landfill, and sewage treatment plant all be located along the same road. A 0.3 mile road to the barge landing may be necessary to facilitate loading and offloading of supplies.

3.8.5 Native Allotments

There are no Native allotments in the vicinity of the Kiniktuuraq townsite (see Figure 13). Use of this site and associated facilities are not constrained by Native allotments.

3.8.6 Relocation Costs – Kiniktuuraq

Design and construction administration are not included in the construction cost estimate. The cost estimate to build a new village site at Kiniktuuraq is **$248.2 million**. Detailed costs are included in Appendix A. A summary is included below:

Site work and Airport Construction	$163,700,000
Erosion Protection	$2,613,600
Construction Camp	$606,000
Power and Fuel	$5,292,000
Move Buildings	$1,125,000
New Buildings	$52,690,000
Water/Sewer System and Landfill	$22,125,007
Transportation System	N/A
Total Cost	**$248,200,000**

3.8.7 Recommended Plan for Kiniktuuraq

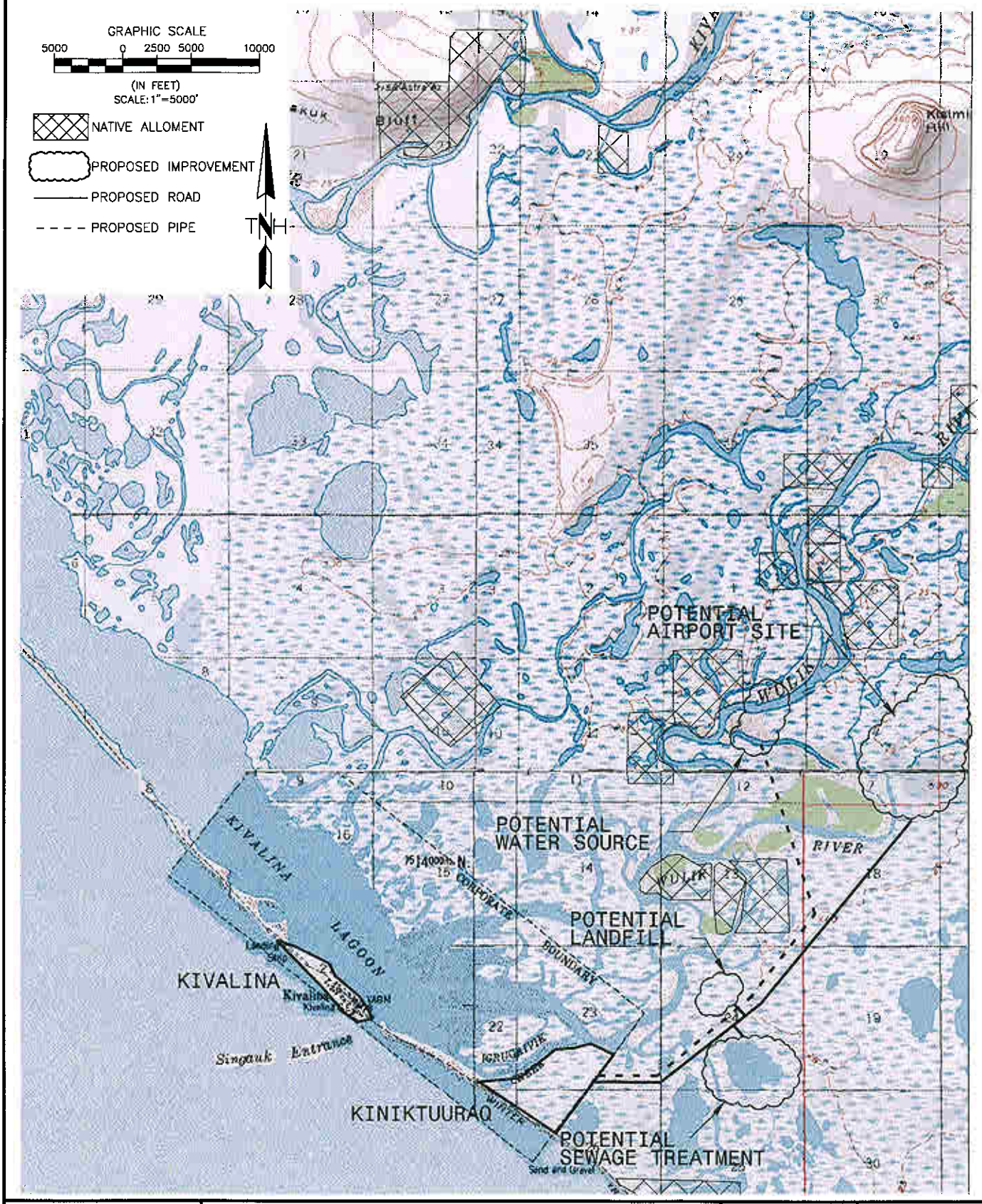
The barge access landing and boat storage pad should be sited on the west side of the spit, on the north edge of the proposed

village site. This should provide the storage and staging areas with relatively level areas, and facilitate ease of loading and unloading the barge. The road from the barge landing to the village should be less than 300 ft long.

The new runway for the village site at Kiniktuuraq should be located about 3.5 miles northeast of the site. The landfill would be located along the access road to the airport, about 7,500 feet northeast of the village and over 10,000 feet from the airport.

The most likely raw water source for the Kiniktuuraq Site is the Wulik River. Potential sources of raw water may be investigated in the water study that is currently pending publication. There are no other known sources of water in the Kiniktuuraq Site area.

The sewage lagoon may be located east of the town site between the gravel pad for the new village and the new runway (approximately 7,500 feet from the village site). A surface discharge should be established to dispose of the treated lagoon effluent onto the surrounding wetlands.



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LAYER MGR: *.lay CTB FILE: *.ctb

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FIGURE 13

KINIKTUURAQ CONCEPTUAL LAYOUT

DESIGN BY: MEW	DATE: 6/16/06
DRAWN BY: JT	PROJECT No: 03003.007
SCALE: 1" = 5000'	REV. –
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FIELD BOOK: –	SHEET 1 OF 1
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Kiniktuuraq, Photo 1

View of gully near beach at Kiniktuuraq

Kiniktuuraq, Photo 4

Beach at W side of Kiniktuuraq looking N

Kiniktuuraq, Photo 2

Trash on Kiniktuuraq site

Kiniktuuraq, Photo 5

View N from near landing site showing cold storage den

Kiniktuuraq, Photo 3

View of cold storage dens at Kiniktuuraq site looking NE, Kivalina in background

Kiniktuuraq, Photo 6

Aerial view of Kiniktuuraq site

KIVALINA VILLAGE
RELOCATION PROJECT

FIG 12 KINIKTUURAQ

PHOTOS BY TRYCK NYMAN HAYES, INC., AUGUST 24, 2004
KIVALINA, ALASKA

SHEET 1 of 1

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