Material Site Alternatives

12/18/24

The Current Project Design (11/30/24) proposes to construct a 24' wide gravel with 2:1 side slopes, requiring 648,597 tons of borrow. Out of the total borrow needed, 108k will be sourced from the Noatak River source and is not part of this analysis. For the remainder of borrow, this memo compares sourcing borrow from Iggy Hill vs. Nimiuk Point. This memo also discusses the possible use of silt in the embankment to reduce project costs.

The table below summarizes the analysis in this memo.

	Quality	Borrow Price (540,597 tons)	*Savings if Overburden is used to build side slopes from 1:1 to 2:1 (35k cy)	Savings if Overburden is additionally used for a leveling course beneath insulation (56k cy) (not recommended)
Iggy Hill	20%-30% P200	$54,648,541	-$875,000	-$1,400,000
Nimiuk Point	<10% P200	$42,889,057	-$700,000	*n/a, insufficient overburden

**Using overburden for alternatives that involve flattening the sideslopes beyond 2:1, would further reduce the unit price of borrow.*
**Nimiuk Point only has 70k estimated overburden, most of which will get used in temporary access and stockpile pads at the pit.*

Iggy Hill vs Nimiuk Point: Iggy Hill was evaluated as a potential source of borrow for the project. Iggy Hill contains the quantity of material needed for the project, however it does not contain the quality of material. The 2011 Geotechnical Report shows that the useable gravel is an average of 30' below a high silt overburden, the gravel is at an inconsistent depth, and the gradation would still average 20%-30% fines with selective mining. The Stage I road was constructed using borrow containing fines in the 20% range, and has shown signs of differential settlement and shoulder cracking, therefore the dirtier material from Iggy Hill is not recommended for quality reasons. In contrast, Nimiuk Point gravel is consistently below 10% fines and a superior road building material.

A price estimate was also completed for borrow sourced from Iggy Hill. That estimate is attached and summarized here. The cost of borrow from Iggy Hill is estimated at $54.6M to construct the 11-30-24 design (Alt 1). This would result in an increase in cost of the construction contract by approximately $11.8M when compared with using the Nimiuk Point Source. This is due to the significant additional haul length, and significant overburden removal needed. Therefore Iggy Hill is not recommended for cost reasons.

Other considerations include there is no existing USACE permit for the site, and associated risk of delays. Nimiuk Point does have an existing USACE permit obtained by the owner. For the reasons cited above, Iggy Hill is not recommended for the project and **Nimiuk Point is the preferred site for its lower cost and higher quality material.**

Cape Blossom Offshore Silts: Cape Blossom Offshore silts were evaluated for suitability for use in the project. The 2011 Geotech Report shows that the quantity of suitable borrow material for road embankment is inconsistent, not quantifiable, and primarily consist of organic silts not suitable for road embankment. The quality of material at this site is not proposed to be used within the road embankment, with the exception of using it for slope flattening (further discussion below). If the material were to be considered for slope flattening, the maximum volume needed for slope flattening would be small (35k cy for 2:1, and 55k cy for 3:1 outside of a 1:1 slope).

Material extraction would require mobilization of specialized equipment for either a suction dredge, and/or a barge supported excavator. Due to the high cost to mobilize this equipment and the comparatively low volume of material that could be used from the site, the costs would far outweigh the benefits and more detailed estimating was not pursued.

Silt in the Road embankment: the possibility of using silt in the road embankment was discussed internally with the DOT CMGC team and the NR Materials Engineer. Using silt in the road embankment was determined to be suitable for slope flattening outside of the structural prism of the road, defined as outside of the 1:1 embankment slope limits. The team did not recommend using silt in the lower portions of the structural portion of the road embankment due to the heaving potential and differential settlement that would result in higher maintenance costs. Therefore, silt/overburden material could be used to flatten sideslopes to improve thaw stability and improve roadside safety without compromising road quality.

The volume of overburden that could be used to construct 2:1 slopes is estimated at 35000 cy. The volume of overburden that could be used to construct 3:1 slopes is estimated at 55,000 cy.

Quantifying the potential cost savings from the use of silt/overburden depends on the material source used.

If sourced from **Nimiuk Point**, the total estimated overburden to be scraped off the pit is 70,000 cy, therefore approximately 50% of the overburden could be used to construct to 2:1 slopes. Cost savings is estimated at $700,000, for a reduction in unit price of borrow of $1.29/ton. The savings is not considerable due to the small quantity, and the majority of the cost is in hauling the material and double handling material to allow it to drain in advance of placement. It's already assumed that overburden would be used for temporary construction of the pit access road and stockpile pad.

If sourced from **Iggy Hill,** the total estimated overburden to be scraped off the pit is 360,000 cy, therefore approximately 10% of the overburden could be used to construct to 2:1 slopes. Cost savings is estimated at $875,000, for a reduction in unit price of borrow of $1.62/ton. The savings is not considerable due to the small quantity, and the majority of the cost is in hauling the material and double handling material to allow it to drain in advance of placement. It's already assumed that overburden would be used for temporary construction of the pit access road and stockpile pad.

Other Alternatives not recommended:

Use Silt in Structural portion of road embankment: It's possible to consider the use of silt within the core of the road embankment (within the footprint of 1:1 slope limits) for an initial lift of material below the insulation board. If this were considered, the estimated additional volume of overburden of an initial lift would be estimated at 56k cy. Sourced from Iggy Hill, this alternative would be estimated to reduce borrow costs by an additional $1.4M. This is not currently recommended due to the small savings in comparison to the likelihood of increased differential settlement from using a highly frost susceptible material. The material would also need to be placed in frozen conditions, which would be a deviation from the current design philosophy of placing the initial lift in late Fall to get immediate settlement and minimize long term settlement.

There is insufficient overburden at Nimiuk Point to use overburden in both the sideslopes and an initial lift scenario, as any remaining overburden would be used in the temporary pit access road and stockpile pad.

Reduce Insulation Board to just the outer 8' of the embankment: This alternative is still being evaluated for thermal performance, though is not anticipated to provide a significant cost savings to the project, and is anticipated to reduce thermal stability of the road.

This compares the cost to source and place borrow from Igyg Hill compared to Nimiuk Point, based on the quantity of borrow in the 11/30/24 design AKA Alternative #1, for the 24' wide road concept.

	Quality	Borrow Price (540,597 tons)	Savings if Overburden is used to build sideslopes from 1:1 to 2:1 (35k cy)	Savings if Overburden is additionally used for a leveling course beneath insulation (56k cy) (not recommended)
Iggy Hill	20%-30% P200	$54,648,541	-$875,000	-$1,400,000
Nimiuk Point	<10% P200	$42,889,057	-$700,000	n/a, insufficient overburden

Using overburden for alternatives that involve flattening the sideslopes beyond 2:1, would further reduce the unit price of borrow.
Nimiuk Point only has 70k estimated overburden, most of which will get used in temporary access and stockpile pads at the pit.

Borrow, Estimate Iggy Hill

Item	Quantity	Unit	Unit Price	Subtotal Price	
Ice Road Season 1	7.3	Miles	$320,000.00	$2,336,000	Ice Road- Kivalina was 7 miles at $1.6M = 228.6k/mile, add 30% inflation
Ice Road Season 2	7.3	Miles	$320,000.00	$2,336,000	Ice Road- Kivalina was 7 miles at $1.6M = 228.6k/mile, add 30% inflation
Build Access Road to Pit	7500	Tons	$15.00	$112,500	500 x 30x6' road (7.5k tons). Use overburden, mine/haul place
Build staging pad	80000	tons	$18.00	$1,440,000	500x500x4' (80k tons) use overburden, mine/haul place
Pit Royalty	300332	CY	$3.00	$900,996	Royalty price to purchase site. Assumed $5/CY
Overburden removal	360000	CY	$13.00	$4,680,000	15'-30' overburden, blasting required. 360k cy overburden, subtract 80k tons for pad and 7500 tons for access road
Mine/stockpile gravel	300332	CY	$25.00	$7,508,300	blasting/ripping requried, assumed frozen. Blasting @ Kivalina 6.5/cy, add 30% inflation, load/haul and stockpile.
Load/Haul/Place	540597	Tons	$64.90	$35,084,745	$13/ton Kivalina, 3 mile haul. Add 30% inflation. Add $1.5/ton/mile haul distance (32 mile additional rt haul from stockpile).
Reclamation	1	LS	$250,000.00	$250,000	seeding pile when done, move overburden back into pit
			Total Price	$54,648,541	$11,759,484
			Unit Price	**101.0892426**	1.62

Alternative, if Overburden is used to flatten to 3:1

Mine/Stockpile Gravel	-35000	CY	$25.00	-875000	Savings if overburden is used to flatten sideslopes to 3:1 (35k cy)
			Total Price	$53,773,541	Total Borrow estimate if overburden is used to flatten sideslopes.
			Unit Price	**99.47**	

Borrow Assumptions

19 mile one way haul
8 miles on Ice road, then down Ted Steven's
blasting overburden, down 15' to 30'
360k cy overburden to be removed.
pit royalty assumed at $3/cy
Use overburden to build staging pad and pit site road

Borrow, Estimate Nimiuk Point

Item	Quantity	Unit	Unit Price	Subtotal Price	
Ice Road Season 1	11.3	Miles	$320,000.00	$3,616,000	Ice Road- Kivalina was 7 miles at $1.6M = 228.6k/mile, add 30% inflation
Ice Road Season 2	11.3	Miles	$320,000.00	$3,616,000	Ice Road- Kivalina was 7 miles at $1.6M = 228.6k/mile, add 30% inflation
Build Access Road to Pit	20000	Tons	$15.00	$300,000	1500 x 30x6' road (20k tons). Mine/haul/place
Build staging pad	80000	tons	$18.00	$1,440,000	500x500x4' (80k tons), Mine/haul/place
Pit Royalty	1	LS	$5,000,000.00	$5,000,000	Royalty price to purchase site. To be given to KIC/drake after
Overburden removal	70000	CY	$10.00	$700,000	2' overburden over 20 acre site
Mine/Stockpile gravel	300332	CY	$20.00	$6,006,640	summer extraction, load/haul/stockpile. Kivalina $16/cy to load/haul 3 miles/place
Load/Haul/Place	540597	Tons	$40.90	$22,110,417	$13/ton Kivalina, 3 mile haul. Add 30% inflation. Add $1.5/ton/mile haul distance (16 mile additional rt haul).
Reclamation	1	LS	$100,000.00	$100,000	seed pad/access road
			Total Borrow Price	$42,889,057	
			Unit Price	**79.34**	

Alternative, if Overburden is used to construct to 2:1

Mine/Stockpile Gravel	-35000	CY	$20.00	-700000	Savings if overburden is used to flatten sideslopes to 3:1 (35k cy)
			Total Borrow Price	$42,189,057	Total Borrow estimate if overburden is used to flatten sideslopes.
			Unit Price	**78.04**	

Notes:

All of the 108k tons initial lift tons from Drake.
92k of the 450k tons is sourced
from Drake.
Construct stockpile pad at the Azar/Nimiuk Point pit, including a 1500 x 30 x 6' road (20,k tons). Pad is 200x1000x6'
Summer Borrow bailing operation, allow to drain
Anticipated 1'-2' overburden
11 mile ice road construction 2 seasons.
Ice Road risks may need to be pulled out separate.
250k tons moved to cover the foam in spring (includes 108k initial lift in fall)
200k moved over ice road then stockpiled at end pad, for placement in summer 2027
Purchasing pit from Azar for approximately $5M, property to be transferred to Drakes at end.