

Technical Summary

November 2021

Pit Name: Gnat Lake Summit Pit

Provincial Pit Number: 2088

Location: Gnat Lake Summit Pit is located on Highway 37, approximately 26km south of Dease Lake, BC (Figure 1).

Legal Land Description: The site is currently a Section 17 Designated Use Area Map Reserve (LF# 6401055) held by the British Columbia Ministry of Transportation and Infrastructure (BC MoTI). The legal description of the Map Reserve is “All that Unsurvey Crown Land in the vicinity of Gnat Creek, Cassiar District, containing 15.0 hectares, more or less.” The layout of the Map Reserve boundary is shown in the Pit Plan (Figure 2).

2018 Investigation: In October 2018, BC MoTI conducted a test pitting program at the Gnat Lake Summit Pit. Nine (9) test pits were excavated to depths ranging from 4.2 to 5.5m. During the test pitting, subsurface soil and groundwater conditions were logged and representative samples of the granular materials were collected for laboratory testing and future reference. Laboratory testing was carried out on seven (7) of these samples at Wood’s laboratories located in Prince George, to assess the gradation and durability characteristics. The tests completed were wet sieve analysis, micro deval, sand equivalent, relative density, and absorption.

Based on the results of the 2018 investigations, one granular area - Area A has been defined (Figure 3). The detailed results of the subsurface testing are provided in the Test Pit Summaries and test pit locations are shown on the Pit Plan (Figure 2).

Material Gradation: Table 1 shows the gradation as a percentage by weight of the fines (silts and clays), sand and gravel components as well as the Unified Soil Classification (USC [included after test pit summary]) for the samples tested from Area A.

Table 1: Pit Run Gradation

Test Pit	Depth (m)	Fines (%)* <0.075mm	Sand (%)* 0.075-4.75mm	Gravel (%)* 4.75-75mm	USC
Area A					
TP18-01	0.0-5.3	2	33	66	GP
TP18-02	0.0-4.8	1	28	72	GW
TP18-03	0.1-4.5	1	34	65	GP
TP18-05	0.1-4.2	1	29	70	GW
TP18-07	0.1-5.1	1	23	76	GW
TP18-08	0.0-5.3	1	21	78	GP
TP18-09	0.1-5.5	1	31	68	GW
Average – Area A		1	28	71	-

* Values are rounded to the nearest whole number so may not add exactly to 100%

Table 2 shows the estimated percent by weight of small and large boulders as well as the percentages of fines, sand and gravel corrected to approximately 100%. The gravel is also divided into fine and coarse portions.

Table 2: Corrected Pit Run Gradation with Oversize Estimates

Test Pit	Fines (%)* <0.075mm	Sand (%)* 0.075-4.75mm	Gravel (%)*		Oversize (%)* (>75mm)	USC
			Fine 4.75-25 mm	Coarse 25-75 mm		
Area A						
TP18-01	1	29	25	32	13	GP
TP18-02	1	21	25	35	18	GW
TP18-03	1	25	23	25	27	GP
TP18-05	1	20	21	27	31	GW
TP18-07	1	17	19	37	25	GW
TP18-08	1	18	22	43	14	GP
TP18-09	1	21	20	28	26	GW
Average	1	22	22	33	21	-

* Values are rounded to the nearest whole number so may not add exactly to 100%

Material Durability: Table 3 shows the results of the durability tests as well as the specifications as required in the Standard Specifications for Highway Construction.

Table 3: Durability Test Results

Test Pit	Sand Equivalent	Micro Deval (% loss)	Relative Density		Absorption	
			Coarse	Fine	Coarse	Fine
Area A						
TP18-02	-	-	2.572	2.577	1.22	1.21
TP18-03	82	5.9	-	-	-	-
TP18-05	83	6.3	-	-	-	-
TP18-07	-	-	2.599	2.591	1.01	1.13
TP18-08	-	-	2.591	2.607	1.01	0.98
TP18-09	77	7.1	-	-	-	-
BC MoTI Specifications						
Sand Equivalent	≥40 for base coarse and fine asphalt mix aggregate ≥20 for surfacing, sub-base and bridge end fill aggregates					
Micro Deval	≤30% for sub-base and bridge end fill aggregates ≤25% for surfacing & base course aggregates ≤18% for Class 1 Pavement asphalt mix aggregates ≤20% for Class 2 Pavement asphalt mix aggregates					
Absorption	<2.0% for coarse paving aggregates ≤1.0% for coarse and ≤1.5% for fine graded aggregate seals					
Relative Density	~2.65 for all aggregate products					

Material Suitability: Based on the 2018 investigation results, the material in Area A is judged to be suitable for the following purposes:

Table 4: Suitability

	Pit Run	Crush
Area A	Bridge End Fill SGSB	25mm and 50mm WGB 25mm IGB Asphalt Mix Aggregates HFSA ¹

¹ Additional fine material may need to be blended during production to produce HFSA.

The samples tested meet the gradation, sand equivalent, and micro-deval specifications for sub-base, bridge end fill, and base course and asphalt mix aggregate. Based on the absorption results the samples were marginal for coarse paving aggregates, coarse and fine graded aggregate seals. With additional processing, such as crushing the limited oversize rocks (>75 mm diameter) with the gravel, absorption values may improve. Should the quality improve, the material may then be suitable for other aggregate products and graded aggregate seal.

Although Area A meet specifications for HFSA, alternate sources which may not be capable of producing cleaner aggregates should be used for HFSA prior to utilizing Gnat Lake Summit Pit.

Sulphate and Chloride Testing

Table 5 shows the sulphate and chloride test results for select samples from the pit. These results are provided for information and have not been considered for material suitability.

Table 5: Sulphate and Chloride Test Results

Sample	Water-Soluble Sulphate	Water-Soluble Chloride
Sa#1	<0.050	<0.002
Sa#2	<0.050	<0.002

Volume Estimates: Table 6 shows the volume estimates that can be expected for topsoil, overburden and gravel from Area A. This is based on the measured depths encountered during the subsurface investigation. The potential volumes of granular material were calculated by averaging the total thickness of granular material encountered in test pits and multiplying by the estimated surface area. Many of the test pits bottomed in gravel and therefore the gravel volumes could be higher that what is calculated here. Area A is approximately 3.9ha.

Table 6: Volume Estimates

Area A ~3.9ha.	Topsoil	Overburden	Granular Material
Average Layer Thickness (m)	0.1	0	4.8
Volume (m³)	3,900	0	187,200

Pit Development Notes

- All development must be carried out in accordance with the Health, Safety, and Reclamation Code for Mines in British Columbia, BC Ministry of Energy and Mines (2021, or later edition), the Standard Specifications for Highway Construction, BC Ministry of Transportation and Infrastructure (2020, or later edition) and the Aggregate Operators Best Management Practices Handbook for BC.
- The pit can be accessed from Highway 37.
- Water table was not encountered in the test pits at the time of the investigation.
- Area A does not require logging but will require clearing, grubbing and stripping of overburden prior to extraction of granular materials.
- All trees, vegetation, and overburden are to be removed within 2m of the top of the pit faces. Topsoil, overburden, and aggregate cannot be removed within five meters of the reserve boundary.
- Development in Area A shall be from the existing pit faces and be directed towards the east as shown in the Development Plan (Figure 3).
- An archaeological Chance-Find Plan shall be in place during clearing and extraction activities.
- No dumping of debris or petroleum products will be permitted, and the site must be left in a clean and safe condition.
- At the completion of the pit development operations, but prior to the depletion of the pit, the sides of the pit faces, waste piles, and overburden stockpiles must be trimmed to a 1.5H:1V slope. Active pit faces must be reshaped with native granular materials.
- Upon depletion of the pit, all disturbed areas are to be reclaimed. The minimum reclamation procedure should include re-sloping of the pit faces and waste piles to a 2H:1V slope, contouring the area for appropriate drainage, spreading of overburden followed by topsoil, and seeding.
- Should any of the above conditions conflict with the Health, Safety, and Reclamation Code for Mines in British Columbia, then the Code will prevail.

Closure

The findings of this report and the soil conditions noted above are inferred from the extrapolation of limited surface and subsurface data collected during the site investigation. It should be noted that different and possibly poorer soil conditions may exist between the test pit locations and volume estimates may vary from those reported in this report.

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Enclosures

Figures:

Figure 1 - Location Plan

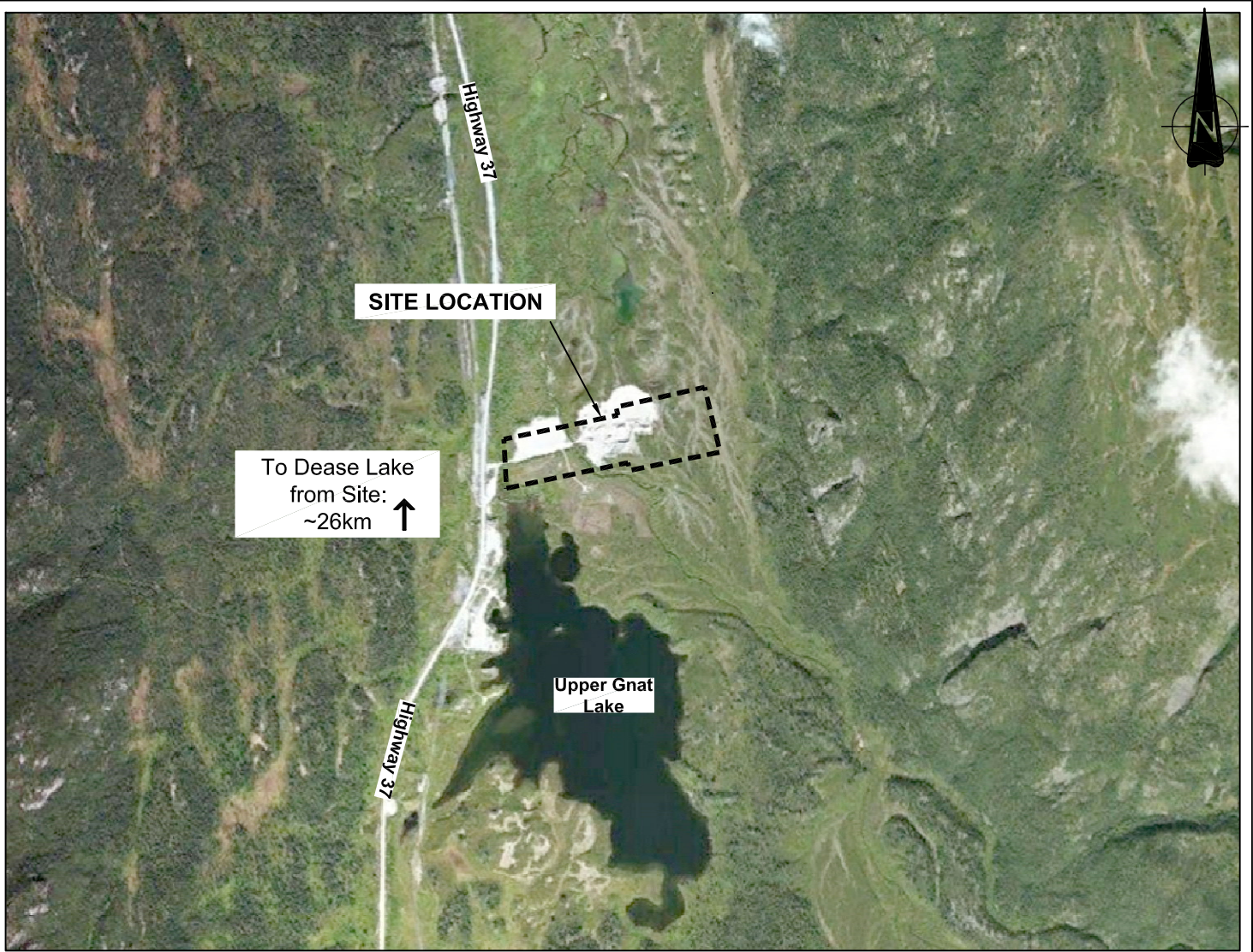
Figure 2 - Pit Plan

Figure 3 - Development Plan

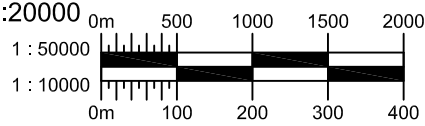
Test Pit Summary

Photos

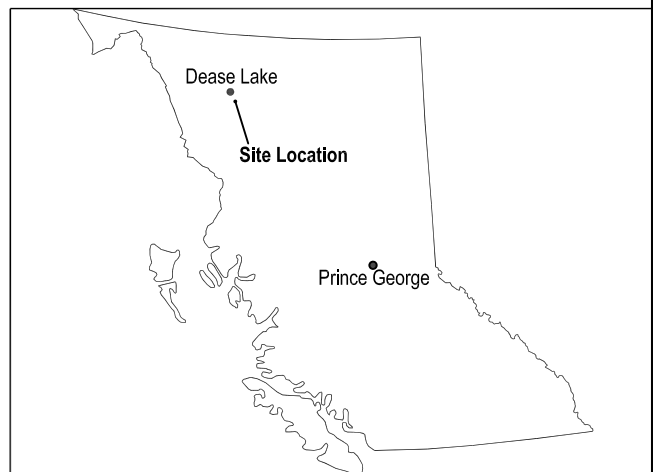
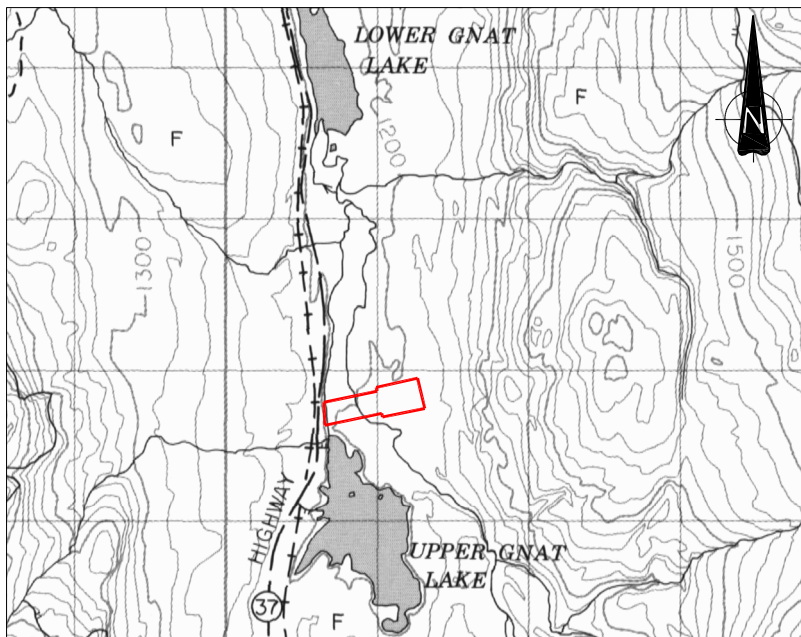
Figures



Google Earth Image: Scale 1:20000



Location Plan: NTS Mapsheet 104I04 (1984)
Scale 1:10000



Ministry of Transportation and Infrastructure
Northern Region
Geotechnical and Materials Branch



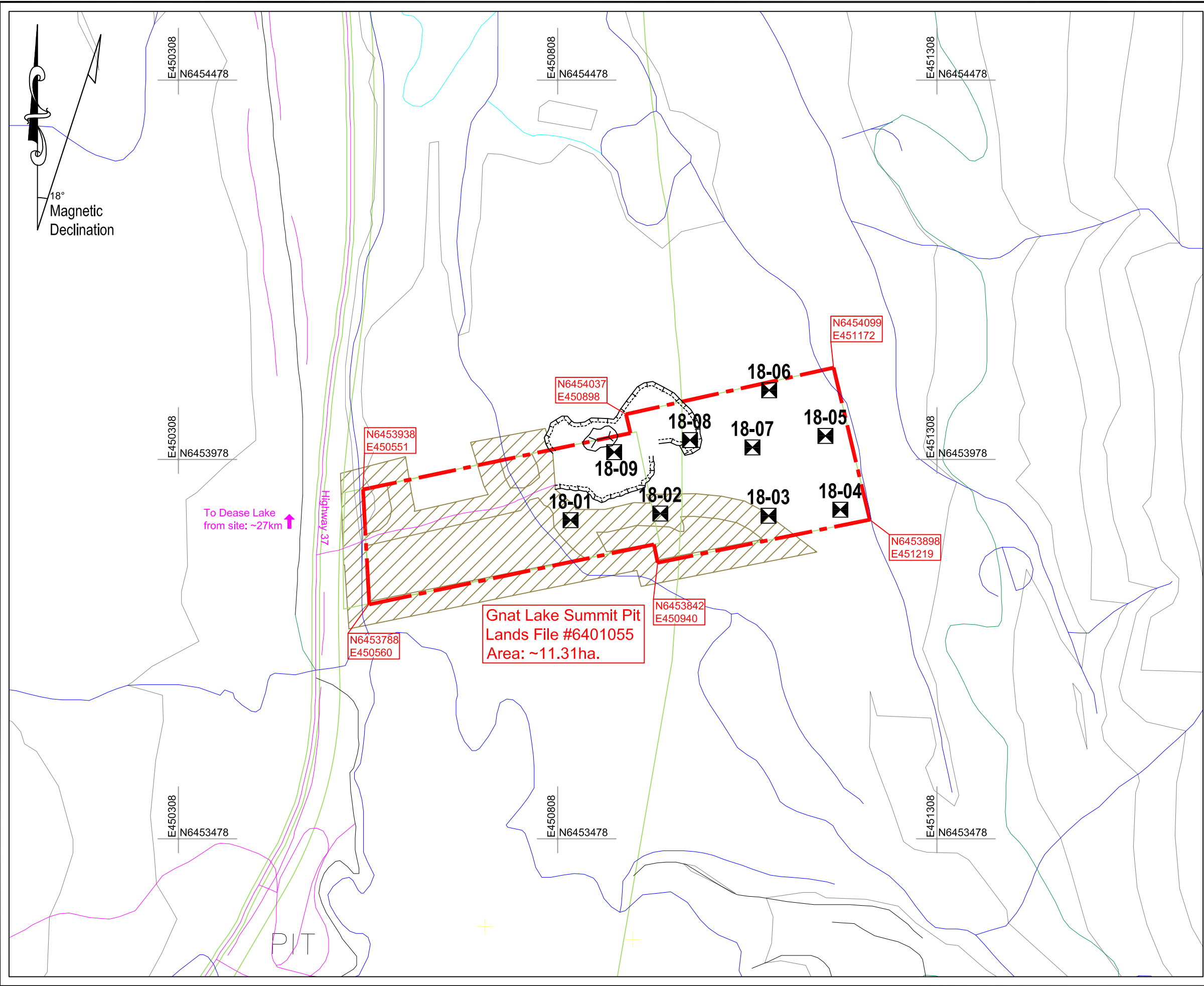
LOCATION PLAN (2021)
GNAT LAKE SUMMIT PIT #2088
SA28 - BULKLEY-STIKINE DISTRICT

DRAWN BY: D.Amor	PROJECTION: UTM Zone 9	SCALE: AS SHOWN
CHECKED BY: S.Carlson	DATUM: NAD83	DATE: 2 December 2021
FILE No. gnatlksummitpit_locplan_2021-12-02.dwg	PROJECT No. -	REG. NR
		DRAWING No. FIGURE 1

This drawing was originally produced in colour.

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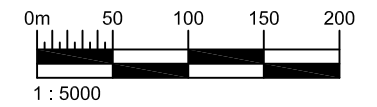
PIT DEVELOPMENT LEGEND

	NATURAL EMBANKMENT		TREELINE
	PIT FACE		CONTOURS
	TEST PIT		BUILDING (symbolic)
	TEST HOLE		IRON PIN
	TEST PIT (DEPLETED)		SWAMP
	ROAD		STOCKPILE
	CREEK		NO DISTURBANCE
	TRAIL		DEVELOPMENT DIRECTION
	CADASTRE		POTENTIAL DEVELOPMENT
	TANTALUS		OVERBURDEN STOCKPILE
	GRAVEL RESERVE BOUNDARY		DEVELOPMENT AREA A
	PROPOSED GRAVEL RESERVE BOUNDARY		

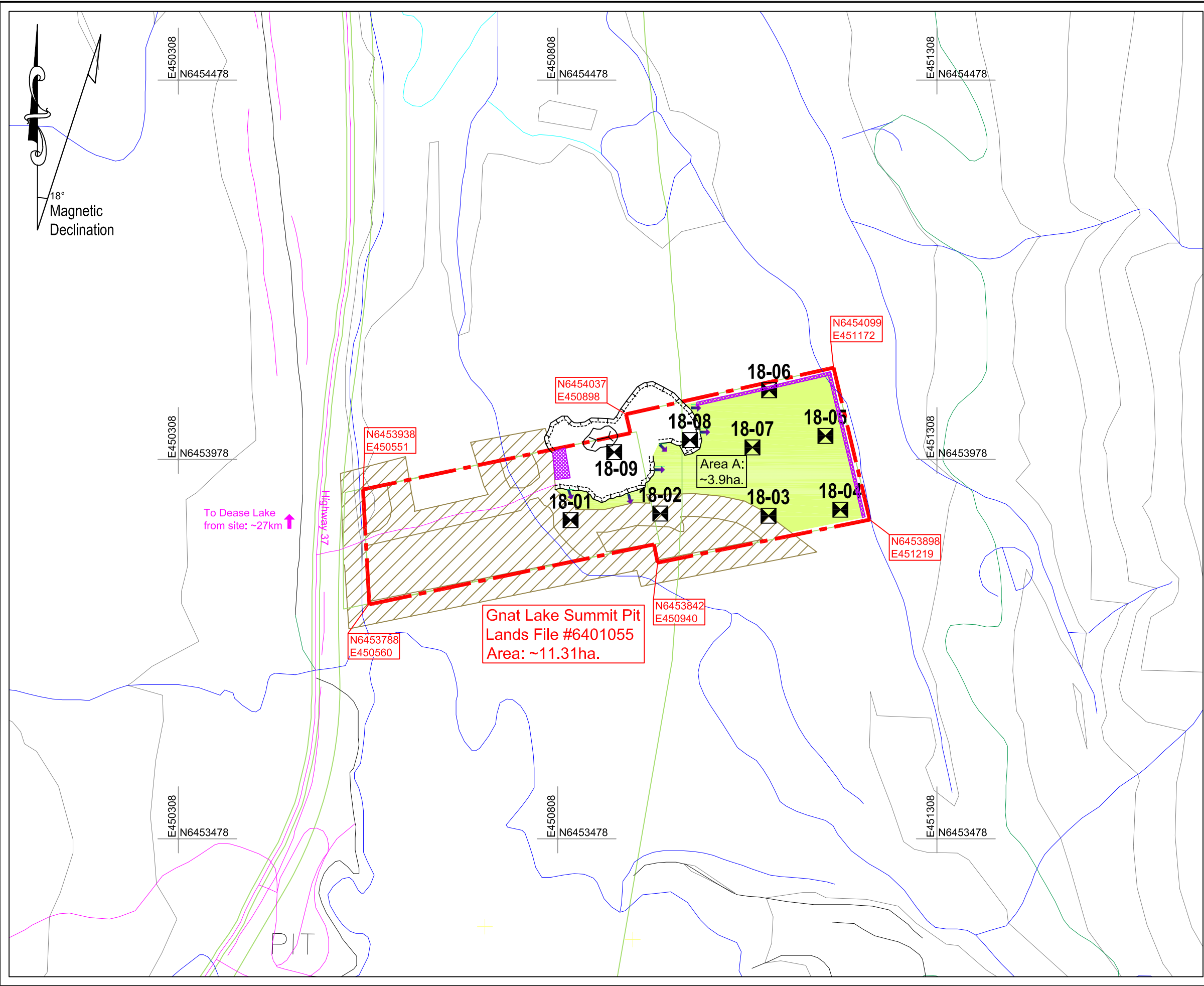
TRIM NOTE:
 1. Contour Interval 20 metres
 2. Base Map derived from Trim Map 1041021

LEGAL NOTE:
 District Lot Lines are derived from digital Crown Cadastral reference mapping supplied by CROWN LAND REGISTRY, Victoria

DRAWING NOTES:
 1. Some testpits and/or testholes may not be representative of current conditions due to development and excavation done after testing was conducted.
 2. Some works may have occurred since the last GPS survey of the pit was undertaken, therefore pit faces, treeliines and stockpiles may not be representative of current conditions.



Ministry of Transportation and Infrastructure Northern Region Geotechnical and Materials Branch		
PIT PLAN (2021) GNAT LAKE SUMMIT PIT #2088 SA28 -BULKLEY-STIKINE DISTRICT		
DRAWN BY: D.Amor	PROJECTION: UTM Zone 9	SCALE: AS SHOWN
CHECKED BY: S.Carlson	DATUM: NAD83	DATE: 2 December 2021
FILE NAME: gnat_2088_pitplan_2021-12-02.dwg	REG. NUMBER: NR	DRAWING NUMBER: FIGURE 2



PIT DEVELOPMENT LEGEND

	NATURAL EMBANKMENT		TREELINE
	PIT FACE		CONTOURS
	TEST PIT		BUILDING (symbolic)
	TEST HOLE		IRON PIN
	TEST PIT (DEPLETED)		SWAMP
	ROAD		STOCKPILE
	CREEK		NO DISTURBANCE
	TRAIL		DEVELOPMENT DIRECTION
	CADASTRE		POTENTIAL DEVELOPMENT
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	GRAVEL RESERVE BOUNDARY		DEVELOPMENT AREA A
	PROPOSED GRAVEL RESERVE BOUNDARY		

TRIM NOTE:

1. Contour Interval 20 metres
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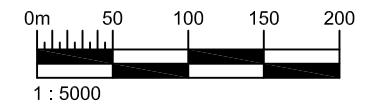
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2. Some works may have occurred since the last GPS survey of the pit was undertaken, therefore pit faces, treelines and stockpiles may not be representative of current conditions.

PIT DEVELOPMENT NOTES:

1. Pit development must be carried out in accordance with the Health, Safety, and Reclamation Code for Mines in BC, the current Standard Specifications for Highway Construction, and the Aggregate Operations Best Management Practices Handbook for BC.
2. Development Area A does require logging but will require clearing, grubbing and stripping.
3. Development of Area A should commence from the existing pit face and directed towards the east.
4. The contractor must ensure that all materials passing through 375mm x 450mm slotted openings shall be used in the production of the crushed aggregates.
5. An archaeological Chance-Find Plan shall be in place during clearing and extraction activities.
6. Pit excavations must not take place to within a minimum distance of 2m from the edge of clearing & stripped areas.
7. When the contractor discontinues operations in the pit, all working pit faces and stockpiles must be trimmed to 1.5H to 1V slope. Working pit faces must be reshaped with native granular materials. All other permanent slopes must be re-sloped to no steeper than 2H:1V.
8. No dumping of debris or petroleum products is permitted. The pit must be left in a clean and safe condition.



Ministry of Transportation and Infrastructure
 Northern Region
 Geotechnical and Materials Branch

DEVELOPMENT PLAN (2021)		
GNAT LAKE SUMMIT PIT #2088		
SA28 -BULKLEY-STIKINE DISTRICT		
DRAWN BY: D.Amor	PROJECTION: UTM Zone 9	SCALE: AS SHOWN
CHECKED BY: S.Carlson	DATUM: NAD83	DATE: 2 December 2021
FILE NAME: gnat_2088_devplan_2021-12-02.dwg	REG. NUMBER: NR	DRAWING NUMBER: FIGURE 3

Test Pit Summary

MATERIALS CLASSIFICATION LEGEND

MAJOR DIVISIONS	SYMBOL	SOIL TYPE						
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	GW	WELL GRADED GRAVELS OR GRAVEL-SAND MIXTURES, < 5% FINES					
		GP	POORLY-GRADED GRAVELS OR GRAVEL-SAND MIXTURES, < 5% FINES					
		GM*	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES					
		GC*	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES					
	SAND AND SANDY SOILS	SW	WELL-GRADED SANDS OR GRAVELLY SANDS, < 5% FINES					
		SP	POORLY-GRADED SANDS OR GRAVELLY SANDS, < 5% FINES					
		SM*	SILTY SANDS SAND-SILT MIXTURES					
		SC*	CLAYEY SANDS SAND-CLAY MIXTURES					
FINE GRAINED SOILS	SILTS AND CLAYS $w_L < 50$	ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY					
		CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS					
		OL	ORGANIC SILTS AND ORGANIC SILT-CLAYS OF LOW PLASTICITY					
	SILTS AND CLAYS $w_L > 50$	MH	INORGANIC SILTS, MICACEOUS OR DIATOM-ACEOUS FINE SANDY OR SILTY SOILS, PLASTIC SILTS					
		CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS					
		OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS					
ORGANIC SOILS	Pt	PEAT AND OTHER HIGHLY ORGANIC SOILS						
TOPSOIL	TS	TOPSOIL WITH ROOTS, ETC.						
COBBLES	SB	ROCK FRAGMENTS AND COBBLES, PARTICLE SIZE 75mm TO 300mm						
LARGE BOULDERS	LB	BOULDERS, PARTICLE SIZE OVER 300mm						
BEDROCK	BR	BEDROCK						
FOR SOILS HAVING 5 - 12% PASSING .075 SIEVE, USE DUAL SYMBOL <table style="width: 100%; border: none;"> <tr> <td style="border: none;">*GM1; GC1; SM1; SC1; 12 - 20%</td> <td rowspan="4" style="border: none; font-size: 3em; vertical-align: middle;">}</td> <td rowspan="4" style="border: none; vertical-align: middle;">PASSING .075mm SIEVE</td> </tr> <tr> <td style="border: none;">GM2; GC2; SM2; SC2; 20 - 30%</td> </tr> <tr> <td style="border: none;">GM3; GC3; SM3; SC3; 30 - 40%</td> </tr> <tr> <td style="border: none;">GM4; GC4; SM4; SC4; 40 - 50%</td> </tr> </table>			*GM1; GC1; SM1; SC1; 12 - 20%	}	PASSING .075mm SIEVE	GM2; GC2; SM2; SC2; 20 - 30%	GM3; GC3; SM3; SC3; 30 - 40%	GM4; GC4; SM4; SC4; 40 - 50%
*GM1; GC1; SM1; SC1; 12 - 20%	}	PASSING .075mm SIEVE						
GM2; GC2; SM2; SC2; 20 - 30%								
GM3; GC3; SM3; SC3; 30 - 40%								
GM4; GC4; SM4; SC4; 40 - 50%								

REV. 90-04-26



PROVINCE of BRITISH COLUMBIA
MINISTRY OF TRANSPORTATION & HIGHWAYS
Geotechnical & Materials Engineering

UNIFIED SOIL CLASSIFICATION LEGEND

Drawn: LU	Date: JULY'97	Scale:
File No.:	ACAD File: ACADSTD5 C:\STD5\SOIL-APP	

Photos

Hammer used as scale is ~30cm.



TP18-01



TP18-02



TP18-04



TP18-06



TP18-09



Typical vegetation conditions in Area A.