Appendix A:

Goose Airstrip Design Memo
By SRK Consulting (Canada) Inc.
August 3, 2011

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Memo

To:	John Laitin	**Date:**	August 3, 2011
Company:	Sabina Gold and Silver Corporation	**From:**	Megan Miller Lowell Wade
Copy to:	Elizabeth Sherlock, Sabina Gold and Silver Corporation	**Project #:**	1CS020.001
Subject:	Goose Lake Airstrip Design Memo		

1 Introduction

Sabina Gold and Silver Corporation (Sabina) are considering the construction of an all-weather airstrip at their Goose Lake Site. The Goose Lake site is part of the Back River Project and is located approximately 520 km west of Yellowknife in the Kitikmeot region of Nunavut, Canada.

The Goose Lake site is currently accessed by float planes during the summer months and by ice airstrip in the winter months. A scarified tundra airstrip exists on the shore of Goose Lake opposite the Goose Lake camp. This airstrip can only accommodate Twin Otter aircraft on tundra tires and cannot be expanded due to the location. A larger all-weather airstrip is required to allow for site access during the shoulder season and to improve site logistics. The proposed airstrip is 30 m wide and 914 m long (including aprons), located on a ridge approximately 500 m south west of the camp. No all-weather roads exist on the Goose Lake site. An all-weather road would have to be constructed to provide access between the airstrip and camp.

This memo provides details of the airstrip and access road design details and should be read in conjunction with the attached set of engineering drawings (Attachment 1).

2 Foundation Conditions

Two geotechnical investigations have recently been carried out at the Goose Lake site (SRK, 2010a and 2011). The investigations have identified the overburden material along the airstrip alignment as primarily silty sand. The silty sand was noted to have both visible and non-visible ice and the occasional ice lenses greater than 10 cm; however the soil would not be considered ice rich. The average depth of overburden along the airstrip alignment was found to be 14 m and depths greater than 20 m were found in some areas. A review of thermistor data in the location of the Goose Lake pit has identified that permafrost in this region extends beyond 300 m and that there is an active layer of approximately 1 m (SRK, 2010b). The average permafrost temperature within the active layer is -7°C.

3 Design Concept

Ideally the Goose Lake airstrip would be a rock-fill airstrip constructed of quarried rock; however due to site constraints and the available equipment that will not be possible at this time. Therefore a basic cut-and-fill airstrip of the native overburden material has been designed. The airstrip will not be paved or topped with gravel material; as such the airstrip payload capacity will be limited for a portion of the year. The functionality of the cut-and-fill airstrip is discussed in the Preliminary Design Analysis Memo (Attachment 2). The airstrip will be designed in accordance with Transport Canada's Aerodrome Standards and Recommended Practices (Transport Canada, 2005).

The all-weather access road would also be a cut fill structure closely following ground contours. The access road is assumed to be for light vehicle traffic and not to be used as a haul road. The road will be for single lane traffic only with turn outs to allow for passing.

An area of wetted tundra, which has the potential to be fish habitat, has been identified along the access road alignment (Rescan, 2010). The low-lying wetted area has a width of approximately 30 m. Due to the width of the low-lying area, culverts were deemed to be more suitable than bridges. Habitat restoration work will be required unless the area is determined not to be fish habitat by additional aquatic studies.

4 Design Criteria

4.1 Airstrip

The airstrip is for private use and will be used to support year round operations of the site. Normal use would include routine crew change, cargo capability and emergency medical support. The airstrip will be a non-instrumented runway in accordance with the Aerodrome Standards and Recommended Practices (Transport Canada, 2005) and the visual approach procedures would be utilized.

The design aircraft for the Goose Lake airstrip are the De Havilland Dash 7 and the De Havilland Dash 8 100 series. However, due to foundation conditions the Dash 7 cannot be utilized with the Transport Canada standard tire pressure when the ground is thawed (Attachment 2). Aircraft which are able to land on the airstrip year round with standard tire pressure and payload include the de Havilland Twin Otter, Dash 8, and Buffalo and the Shorts Skyvan. Design aircraft properties are summarized in Table 1.

Ditches shall be constructed on either side of the airstrip when in cut to prevent ponding water on the airstrip surface. The ditches will be sized to accommodate a 100 year, 24 hour storm event when 25% of the mean annual snowfall is on the ground. The 200 year storm event used is based on weather data from Lupin, Nunavut.

Table 1: Properties of the Goose Lake Airstrip Design Aircraft

Design Aircraft	Shorts Skyvan	De Havilland Twin Otter	De Havilland Dash 7	De Havilland Dash 8
Length	12.2 m (40')	15.8 m (52')	24.5 m (80.5')	22.3 m (73')
Wing Span	19.8 m (65')	19.8 m (65')	27.4 m (93')	25.9 m (85')
Payload	1,060 kg (4,600 lbs)	1,815 kg (4,000 lbs)	5,135 kg (11,300 lbs)	4,000 kg (8,818 lbs)
Standard Tire Pressure	280 kPa (41 psi)	260 kPa (38 psi)	520 kPa (75 psi)	440 kPa (64 psi)
Suitable for Year Round Access	Yes	Yes	No	Yes

The design geometry of the Goose Lake airstrip is summarized in Table 2 below.

Table 2: Geometry Design Criteria of the Goose Lake All-Weather Airstrip

Design Component	Design Criteria
Aircraft	DHC-7 (Dash 7), DHC-8 (Dash 8)
Runway Length	914 m (2,998')
Runway Width	30 m (98').
Taxiway	Single airstrip, no Taxiway.
Ramp/Apron	Aprons located at each end of the airstrip. Apron dimensions are 30 m x 30 m.

Design Component	Design Criteria
Slope	Maximum longitudinal slope of the runway of 2.0% up or down. Maximum longitudinal slope change of 2.0%. A minimum radius of 7,500 m shall be used to connect changes in slope. Symmetrical 1.0% crown for drainage on airstrip and aprons. 2H:1V side slopes for both cut and fill.
Waviness	The runway is designed so that no undulations occur, if undulations occur over time they should be filled in during regular maintenance.
Obstacle Clearance Requirements	All buildings, cargo or other obstructions must be below the obstacle limitation surface which rises with a slope of 5H:1V (20.0%) to an outer surface 45 m above the runway reference point. The outer surface of the obstacle limitation surface extends 4000 m from the centerline of the runway 360°. The crest off all roads must be 4.3 m below the obstacle limitation surface to be trafficable during take-off/landing.
End Clearance Requirements	At the end of the runway (not including aprons) there is a 30 m of level surface beyond which the end clearance surface of the airstrip rises with a slope of 20H:1V (5%) to a distance of 2500 m.
Drainage	In cut areas drainage shall be provided by ditches a bulldozer width (~3.5 m) wide by 0.3 m deep on either side of the runway.

4.2 Access Road

The access road shall be a single lane road with a design speed of 50 km/hour. The design vehicles for the access road include a crew cab pickup truck, as well as various pieces of equipment. A list of the design vehicles and dimensions can be found in Table 3 below.

Table 3: Design Vehicles for the Goose Lake Airstrip Access Road

Design Vehicle	Exterior Dimensions (m)	
	Length	Width
Crew Cab Truck (Ford Super Duty Crew Cab Long Box)	6.65	2.03
CAT D6N LGP Dozer	5.37	3.36
CAT D7G Dozer	5.28	4.19
CAT 277B Skid Steer	4.08	1.27
CAT IT28G Integrated Tool Carrier	7.56	2.54

The geometric design criteria for the Goose Lake Airstrip access road are summarized below:

- Final road width (crown width) will be 6 m in fill areas and 7 m in cut sections, the additional width in cut sections is provided to act as a ditch for surface water runoff.
- As the access road is designed to be a single lane road, turnouts 3 m wide by 30 m long will be provided at a minimum spacing of 300 m along the road.
- Maximum longitudinal slope of 10%. Preferred longitudinal slope of 4% or less.
- Minimum radius of curvature of 200 m for horizontal curves.
- Road crest sloped at 0.5% to be free draining.
- No safety berms or barriers will be placed along the road alignment.
- A maximum side slope of 2H:1V in both cut and fill.
- In areas where the wet area has been identified culverts must be installed. A minimum fill thickness of 0.5 m is required above culverts. Hydraulic studies have not been conducted to determine the

size of culverts needed in this area; therefore it was assumed that two 0.5 m diameter culverts would be utilized.

- A single 0.5 m diameter culvert shall be installed where the road meets the South Apron to prevent ponding between the airstrip and the road. A minimum fill of 0.5 m is required above the culvert. This culvert is sized to accommodate runoff from a 200 year, 24 hour storm event.
- Culverts shall have a minimum slope of 0.5%.

4.3 Construction Materials

A single construction material has been identified for the construction of both the airstrip and the access road. Silty sand overburden material from the cut sections of the airstrip and access road shall be utilized to construct the fill sections of the alignment. Vegetation and organic material shall be removed from the alignments prior to construction. All construction material shall be free of organic matter, snow and ice.

5 Design

5.1 Design Geometry

5.1.1 Airstrip

The horizontal alignment of the airstrip has been shifted from the previous conceptual design drawings to allow for potential future expansion. The vertical alignment of the airstrip has been sloped for drainage; the airstrip south of station 0+424 slopes south at 0.71% while the north end of the airstrip slopes northward at 1.24%. The two slopes are connected with a vertical curve with a radius of 7,500 m. The airstrip consists of an approximately 300 m long section of cut and 614 m of fill. The maximum fill thickness in the airstrip is 1.2 m, which includes the assumed 0.3 m thick organic layer which is to be removed prior to airstrip construction. The maximum cut depth including the removal of the organic layer is approximately 1.1 m.

The side slopes of the airstrip in the cut sections have been increased to 3H:1V along the outer edge to ensure that the airstrip obstacle limitation surface can be met. All other side slopes remain at 2H:1V.

5.1.2 Access Road

The horizontal alignment of the airstrip access road has been slightly altered from the previous conceptual design drawings; the alignment was shifted to correspond with the shift in the airstrip location. The road has been located such that it is the most direct route possible between the camp and the south apron of the airstrip that does not impinge on the boundaries of the pit.

The vertical alignments of the road follows the contours of the ground, with some cut and fill to smooth the surface. An approximately 125 m long section between stations 0+050 and 0+175 has been designed to be 1 m thick; due to the wetter nature of the tundra in this area. Two culverts shall be installed in this area at approximately station 0+125; the exact location of the culverts shall be determined in the field. The access road joins the south apron of the airstrip by means of a ramp.

5.2 Materials and Quantities

A list of material quantities is provided in Table 4. The quantities of construction material are approximate in-place values based on neat lines.

Table 4: Materials List and Quantities

Item	Quantity/Area/Volume	
1. Organics (0.3 m thick)	Airstrip & Aprons	11,450 m^3
	Access Road	1,900 m^3
	Total	13,350 m^3
2. Overburden Material (Cut)	Airstrip & Aprons	12,000 m^3
	Access Road	750 m^3
	Total	12,750 m^3
2. Overburden Material (Fill)	Airstrip & Aprons	11,650 m^3
	Access Road	750 m^3
	Total	12,400 m^3
3. Culverts	Road Culverts (2)	12 m
	Road Culvert	12 m
4. Thermistors	Thermistor Cables (2)	36 m
	Thermistor Cables (2)	15 m
	Thermistor Readout box	3
	Treated Timber Posts(2)	2 m

5.3 Construction Methodology

Construction of the airstrip and access road will be limited by the equipment and personnel available on site and the construction methodology described herein accounts for these limitations. It is assumed that the airstrip and access road will be constructed by Sabina personnel and using only the equipment available on site. A list of available construction equipment on the Goose Lake site was identified during the site investigation (SRK, 2010a) and is listed in Table 5. It is assumed that the bulk of the airstrip construction will be performed with either the CAT D6N or CAT D7G Bulldozer.

Table 5: Construction Equipment Inventory at Goose Lake Site, September 2010 (SRK, 2010a)

Type	Quantity	Location
CAT D6N Dozer	1	Goose Lake
CAT D7G Dozer	1	Goose Lake
CAT 277B Skid Steer	2	2 at Goose Lake
CAT IT28G Integrated Tool Carrier	1	1 at Goose Lake

At the commencement of construction all vegetation and organic material must be stripped from the access road and airstrip alignments and stockpiled. The stockpile material must not be above the obstacle limitation surface of the airstrip, therefore the maximum height of the stockpile shall be 2.5 m. The overburden material should be stockpiled with a maximum slope of 3H: 1V; the foot print of this stockpile is approximately 6,600 m^2.

Material from the cut sections will be excavated with a bulldozer and pushed to the fill zones. In-situ density testing will be required to ensure the relocated overburden is compacted to 98% of the maximum dry density. To achieve this compaction specification, a compactor will be required. Depending on the size of the compactor available, overburden material shall be placed in lifts ranging from 0.15 to 0.3 m.

Best management practices should be utilized to control silt from the airstrip, road and organics stockpile. Silt fences should be installed as required.

5.4 Design Limitations and Constraints

5.4.1 Bearing Capacity

The cut-and-fill airstrip cannot achieve allowable bearing capacity to support the design loads of all design aircraft under thawed conditions (Attachment 2). During thawed conditions, the heavier aircraft would have to use reduced tire pressures and reduced loads to use the airstrip. When the ground is frozen during the winter and shoulder seasons, the airstrip would support the weight of the heavier aircraft using standard tire pressures. This would extend the operations of Goose Lake camp prior to and after an ice airstrip is in operation.

Should the overburden material of the airstrip become saturated the bearing capacity of the airstrip would be reduced to the point where no aircraft can safely land. Saturation of the airstrip will have to be evaluated after freshet and rainfall events. The airstrip should not be utilized in saturated conditions.

5.4.2 Maintenance

Due to the nature of the airstrip construction material regular monitoring and maintenance will be required. Re-grading and compaction will be required on an ongoing basis throughout the year.

Some local settlement is to be expected of the airstrip and road. Settlement would be caused by permafrost degradation as the thermal regime of the soil profile will be disrupted by cut and fills operations.

Immediately following the first freshet the airstrip and access road should be inspected for local ponding of surface water. If necessary some additional culverts may have to be installed at these locations to allow surface water to pass and prevent permafrost degradation and saturation of the road and airstrip. During the first freshet following construction, sediment control may be required at some sections of the airstrip and access road to trap fine grained sediment released from construction material. This can best be done by installing silt fences in the areas of concern. This should not be a concern in subsequent years.

5.4.3 Monitoring

The surface of the airstrip should be regularly monitored year round for settlement, erosion and general surface conditions. In addition, during the spring and fall months the surface of the airstrip should be visually monitored to determine if the airstrip is experiencing thawed conditions; thereby restricting the aircraft able to land.

Four thermistors are to be installed in the airstrip to determine the effects of the airstrip on the active layer and the freeze back of the disturbed overburden fill. Thermistor strings SRK11-A1 and SRK11–A2 shall be installed vertically on both edges of the airstrip in the areas of maximum cut. Thermistor strings SRK11-A3 and SRK11–A4 shall be installed horizontally in the area of maximum fill. SRK11-A3 shall be installed at a minimum depth of 0.5 m below the surface of the airstrip and SRK11-A4 shall be installed on the surface stripped of organics. Thermistor monitoring should be carried out regularly.

5.4.4 Wind

The proposed Goose Lake airstrip is not oriented ideally with regard the prevailing wind direction, due to the topography and ground conditions. As a result there is a percentage of time in which the airstrip will not be accessible due to excessive winds. For the proposed orientation excessive crosswinds will be experienced 11.6% of the time for all design aircraft. The total time in which the Dash 7 and Dash 8 will be unable to land due to excessive winds is 14.0% and 17.9% respectively.

Given the constraints applied to the airstrip the final determination of airstrip usability will be by the charter company(s) chosen by the client.

Regards

SRK Consulting (Canada) Inc.

Megan Miller, E.I.T.
Staff Consultant

Lowell Wade, M.Sc., P.Eng.
Senior Consultant

Reviewed By:

Maritz Rykaart, Ph.D., P.Eng.
Principal

6 References

Rescan Environmental Services Ltd. 2010. Goose Lake Fish Habbitat Assessment of Proposed Airstrip, Access Roads, and Quarries. Memorandum Prepared for Sabina Gold and Silver Corporation, September 29, 2010.

SRK Consulting (Canada) Inc. 2010a. Sabina Gold and Silver Corporation: Goose Lake Project Airstrip 2010 Site Investigation. Technical Memorandum Prepared for: Sabina Gold and Silver Corporation. Project Number: 1CS020.000. October 25, 2011.

SRK Consulting (Canada) Inc. 2010b. Sabina Gold and Silver Corporation: Goose Lake Project Airstrip Desktop Study. Memorandum Prepared for: Sabina Gold and Silver Corporation. Project Number: 1CS020.000. October 25, 2011.

SRK Consulting (Canada) Inc. 2011. All-Weather Airstrip and Access Road Geotechnical Field Investigation, Draft. Report Prepared for Sabina Gold and Silver Corp. Project Number 1CS020.001. July 4, 2011 Draft.

Transport Canada, 2005. Aerodrome Standards and Recommended Practices. Air Navigation System Requirements Branch. 4th Edition, March 1, 1993, revised March, 2005. Document TP 312E.

Attachment 1: Goose Lake Airstrip Issued for Discussion Drawings

Engineering Drawings for the Goose Lake Airstrip Goose Lake Project, Nunavut, Canada

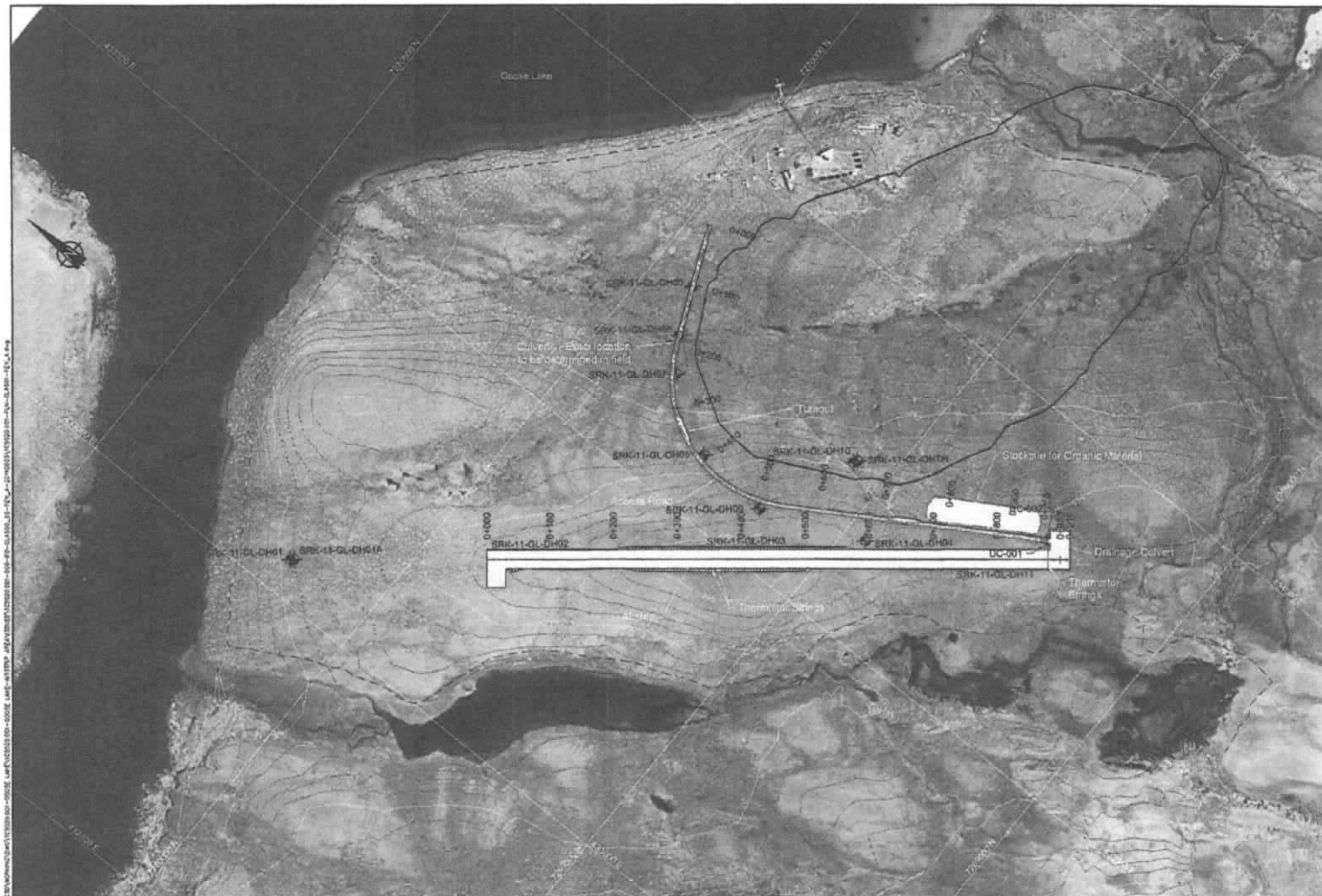
ACTIVE DRAWING STATUS

SRK DWG NUMBER	DRAWING TITLE	REVISION	DATE	STATUS
GL-AS-00	Engineering Drawings for the Goose Lake Airstrip	A	Aug. 3, 2011	Issued for Discussion
GL-AS-01	General Arrangement	A	Aug. 3, 2011	Issued for Discussion
GL-AS-02	Airstrip - Plan and Profile	A	Aug. 3, 2011	Issued for Discussion
GL-AS-03	Typical Airstrip Sections	A	Aug. 3, 2011	Issued for Discussion
GL-AS-04	Typical Thermistor Installation and Design	A	Aug. 3, 2011	Issued for Discussion
GL-AS-05	Access Road - Plan and Profile	A	Aug. 3, 2011	Issued for Discussion
GL-AS-06	Typical Airstrip Access Road Sections	A	Aug. 3, 2011	Issued for Discussion
GL-AS-07	Material Specifications	A	Aug. 3, 2011	Issued for Discussion

SABINA GOLD AND SILVER CORP.

srk consulting

PROJECT NO: 1CS020.001
ISSUED FOR DISCUSSION
Revision A
August 3, 2011
GL-AS-00



LEGEND

——	Pit Outline
— — —	30m offset from edge of water
SRK-11-GL-DH06	Boreholes

NOTE

1. The Owner shall be responsible to obtain all appropriate licenses and/or permits pertaining to the execution of the works. The engineer will not be responsible for any infringements.
2. Topographical contour data for the terrain model were provided by Sabina Gold and Silver Corporation, and is based on 2005 and 2010 surveys.
3. The coordinate system UTM, NAD83, Zone 13.
4. Orthophoto provided by Sabina Gold and Silver Corporation.
5. Organic material within the airstrip and access road foot print shall be removed and stockpiled at a designated location. The stockpiled organic material shall have a minimum height of 2.5m and maximum side slopes of 3H:1V.
6. The Contractor shall employ best practices to ensure sediment control and prevent erosion.

0 40 80 120 160 200
Scale in Meters

NO.	DESCRIPTION	DWN	CHK'D / APP'D	DATE
A	ISSUED FOR DISCUSSION	MMM	EMR	03AUG11

REVISIONS

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REFERENCE DRAWINGS

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Sabina

Goose Lake

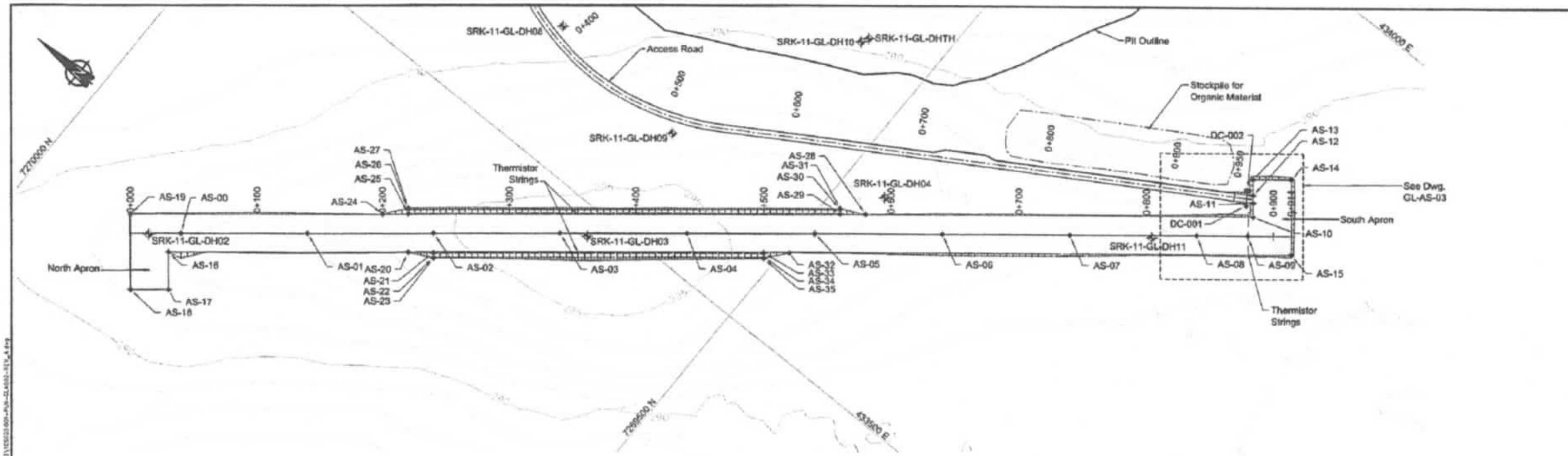
SRK JOB NO.: 1CS020.001

All-Weather Airtrip & Access Road

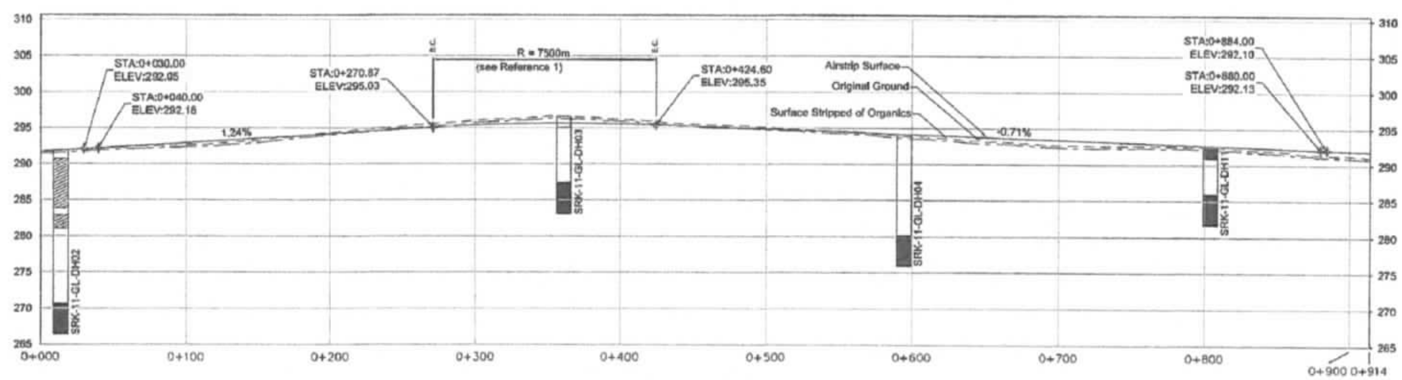
DRAWING TITLE:

General Arrangement

DRAWING NO.: GL-AS-01
SHEET: 2 OF 8
REVISION NO.: A



AIRSTRIP PLAN



AIRSTRIP LONGITUDINAL SECTION

LEGEND

- Original Ground Surface
- Surface stripped of Organics
- Airstrip Surface
- Thermistor String
- Well Graded Silty Sand
- Poorly Graded Silty Sand
- Well Graded Sand
- Bedrock

NOTE

1. Transport Canada, 2005. Aerodrome Standards and Recommended Practices: Air Navigation System Requirements Branch. 4th Edition. March 1, 1993, revised March, 2005. Document TP 312E.
2. SRK Consulting (Canada) Inc. 2011. All-Weather Airstrip and Access Road Geotechnical Field Investigation. Report Prepared for Sabina Gold and Silver Corp. Project Number 1CS020.001. July 4, 2011 Draft.

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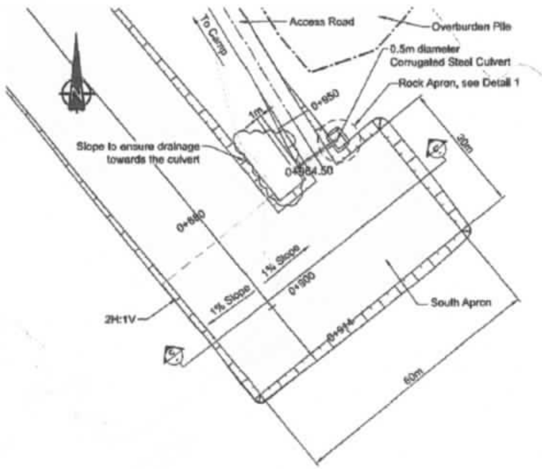
Goose Lake

All-Weather Airtrip & Access Road

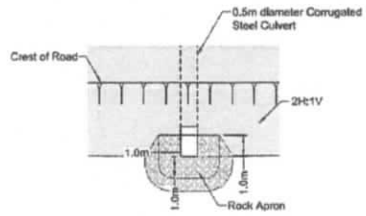
DRAWING TITLE: Airstrip Plan & Profile

DRAWING NO.: GL-AS-02 | SHEET: 3 OF 8 | REVISION NO.: A



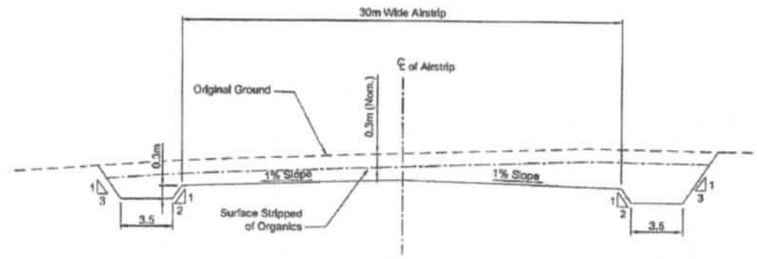
South Apron Layout

Scale 1:500(m)



Detail 1 - Rock Apron

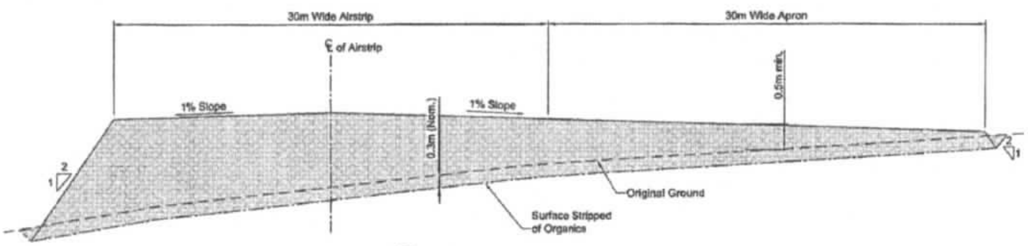
Scale 1:100(m)



Typical Airstrip Section - Cut

Horizontal Scale 1:150(m)

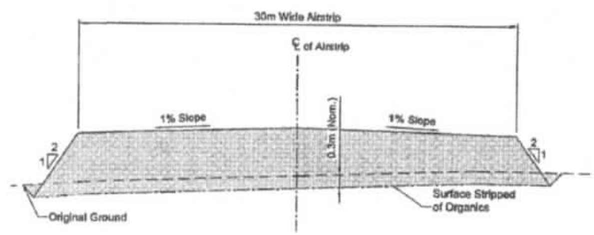
Vertical Scale 1:50(m) (3X Exaggeration)



Airstrip Apron Section C-C'

Horizontal Scale 1:150(m)

Vertical Scale 1:50(m) (3X Exaggeration)



Typical Airstrip Section - Fill

Horizontal Scale 1:150(m)

Vertical Scale 1:50(m) (3X Exaggeration)

LEGEND

Disturbed Overburden

NOTE

1. The drainage ditch on either side of the cut airstrip sections shall be 3.5m wide or the width of the bulldozer blade.

DRAWING NO.	DRAWING TITLE	DRAWING NO.	DRAWING TITLE
REFERENCE DRAWINGS			

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Sabina

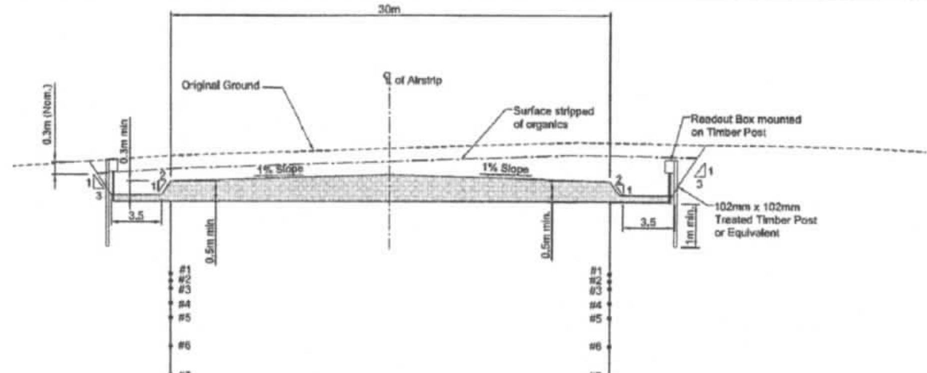
Goose Lake

SRK JOB NO.: 1CS020.001

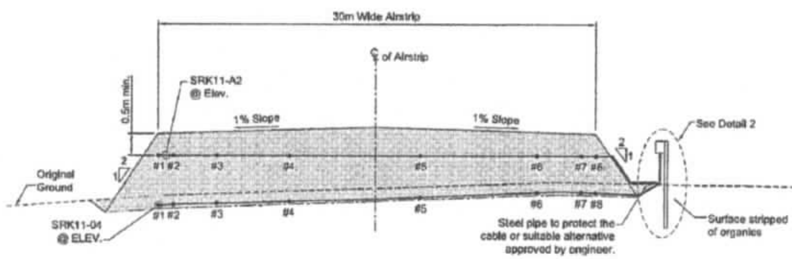
All-Weather Airtrip & Access Road

DRAWING TITLE: Typical Airstrip Sections

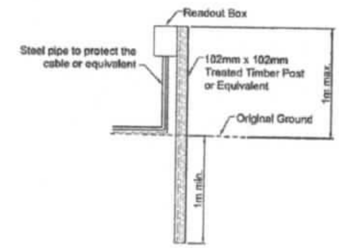
DRAWING NO.: GL-AS-03 | SHEET: 4 OF 6 | REVISION NO.: A



Thermistor Installation in Cut Zone



Thermistor Installation in Fill Zone



(2) **Thermistor Readout Box Detail**

LEGEND

Disturbed Overburden

NOTES

1. The thermistors shall be RST Instruments (or equivalent approved by the engineer) Standard Precision thermistor strings with 5 beads and two readout boxes.
2. The supplies required for installation will be supplied by the Contractor and can be field fitted with approval by the Engineer. The Contractor will be responsible for the instrument installation with aid and approval by the Engineer.
3. The locations of the thermistors can be adjusted within the limits of the cable length with approval by the Engineer.
4. One thermistor should be installed in area of max fill and one should be installed in area of max cut. Thermistor location may be adjusted as required in the field.

THERMISTOR STRING INFO:

Thermistor ID	Description	Overall Cable Length (m)	Thermisor Location (Bead 1)			Bead Location in meters (measured from the end)							
			Northing	Easting	Elevation	#1	#2	#3	#4	#5	#6	#7	#8
SRK11-A1	Cut Zone	15.00	7,269,592.87	433,489.66	294.96	10.00	9.50	9.00	8.00	7.00	5.00	3.00	0.00
SRK11-A2	Cut Zone	15.00	7,269,642.83	433,487.75	294.96	10.00	9.50	9.00	8.00	7.00	5.00	3.00	0.00
SRK11-A3	Fill Zone	36.00	7,269,216.01	433,795.59	291.48	0.00	1.00	4.00	9.00	18.00	26.00	29.00	30.00
SRK11-A4	Fill Zone	36.00	7,269,216.01	433,795.59	291.22	0.00	1.00	4.00	9.00	18.00	26.00	29.00	30.00

REFERENCE DRAWINGS				REVISIONS					
DRAWING NO.	DRAWING TITLE	DRAWING NO.	DRAWING TITLE	NO.	DESCRIPTION	CHK'D	APP'D	DATE	
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Sabina

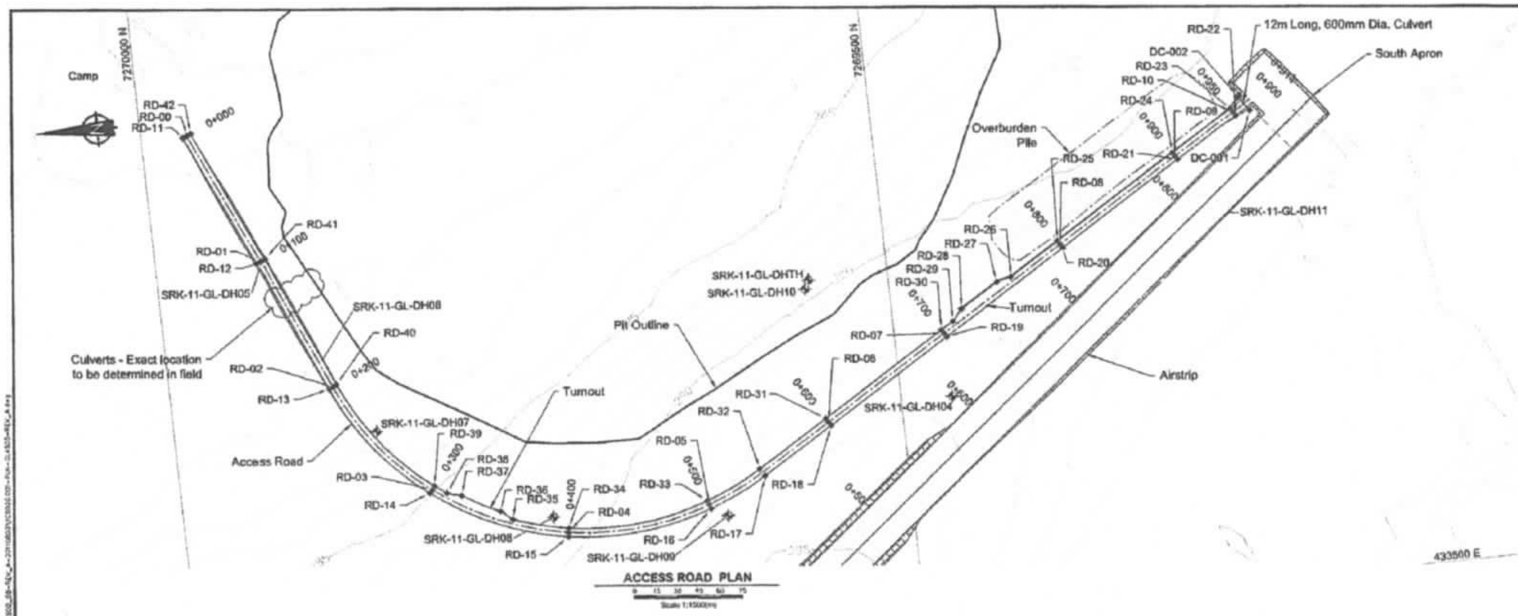
Goose Lake

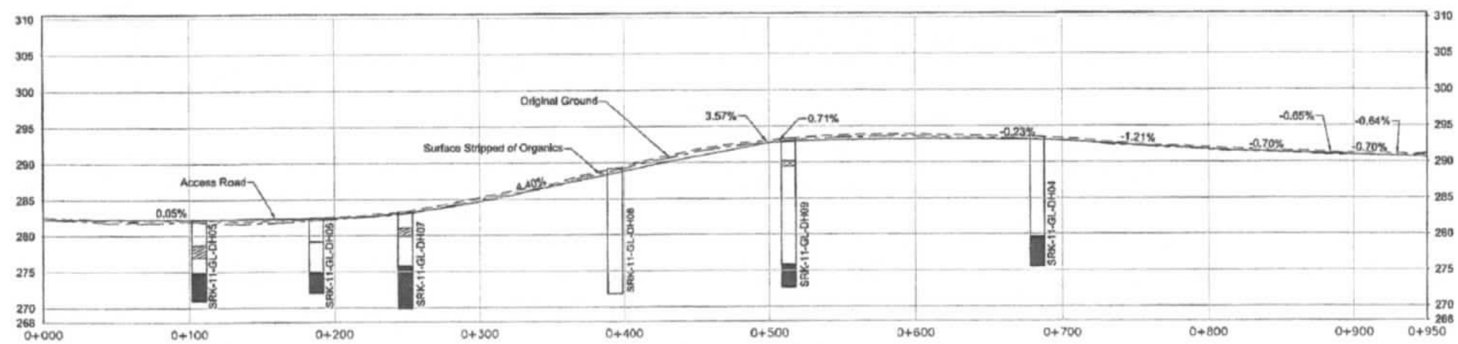
SRK JOB NO.: 1CS020.001

All-Weather Airtrip & Access Road

DRAWING TITLE: Typical Thermistor Installation Layout and Design

DRAWING NO.: GL-AS-04 | SHEET: 5 of 6 | REVISION NO.: A





LONGITUDINAL SECTION ACCESS ROAD

LEGEND

- Original Ground Surface
- Surface stripped of Organics
- Airstrip Surface
- Thermistor String
- Well Graded Silty Sand
- Poorly Graded Silty Sand
- Bedrock

NOTE

1. Transport Canada, 2005. Aerodrome Standards and Recommended Practices; Air Navigation System Requirements Branch. 4th Edition, March 1, 1993, revised March, 2005. Document TP 312E.

REVISIONS				
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Sabina

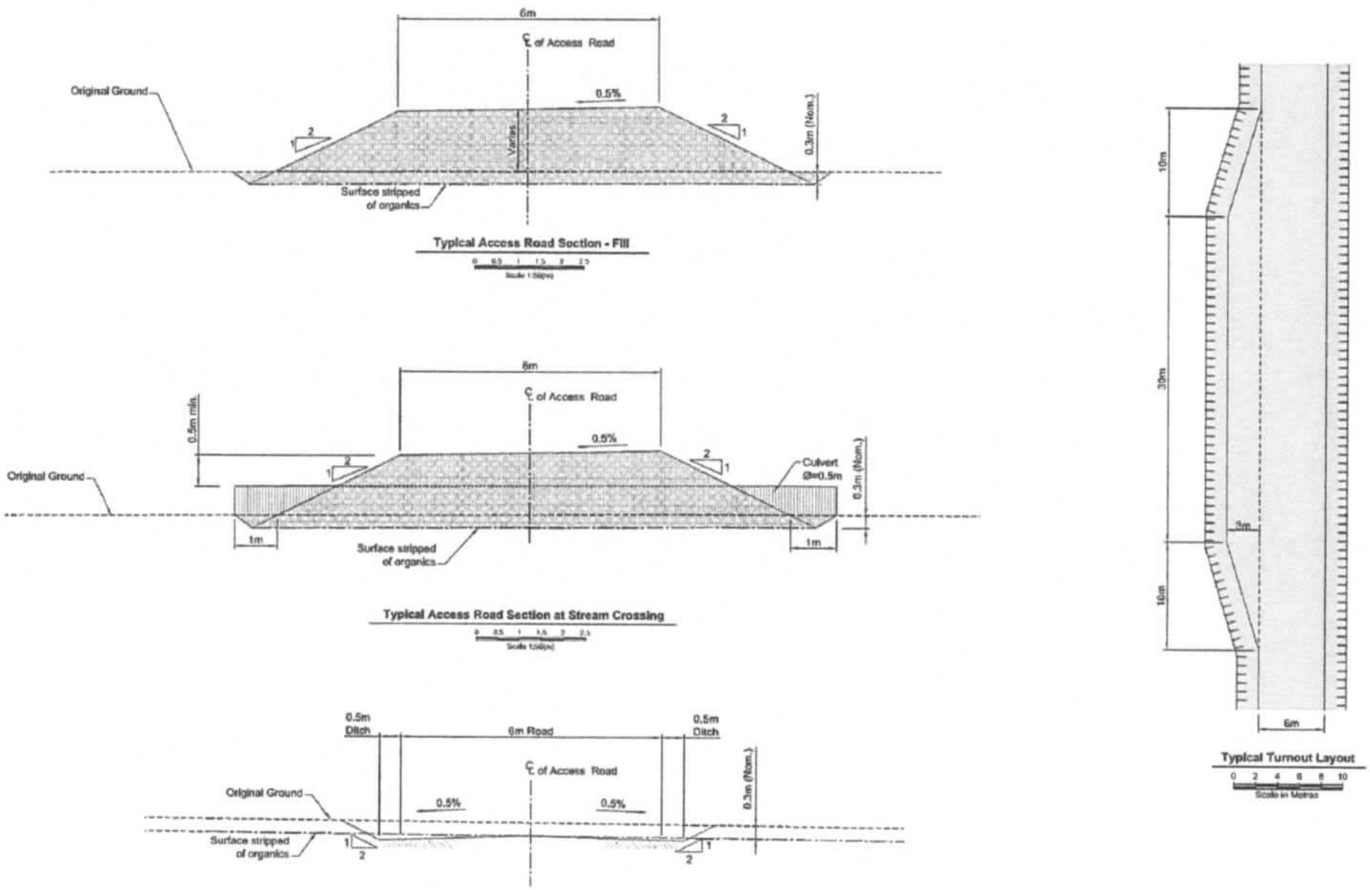
Goose Lake

SRK Job No.: 1CS020.001

All-Weather Airtrip & Access Road

Drawing title: Access Road Plan & Profile

Drawing No.: GL-AS-05 | Sheet: 8 of 8 | Revision No.: A



Typical Access Road Section - Fill

Scale 1:50(m)

Typical Access Road Section at Stream Crossing

Scale 1:50(m)

Typical Access Road Section - Cut

Scale 1:50(m)

Typical Turnout Layout

LEGEND

Disturbed Overburden

DRAWING NO.	DRAWING TITLE	DRAWING NO.	DRAWING TITLE
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FILE NAME: 1CS020.001-SEC-GLAS06-REV_A.dwg

Sabina

Goose Lake

SRK JOB NO.: 1CS020.001

All-Weather Airtrip & Access Road

DRAWING TITLE: Typical Airstrip Access Road Sections

DRAWING NO.: GL-AS-06 | SHEET: 7 OF 8 | REVISION NO.: A

AIRSTRIP - STAKEOUT POINTS			
ID	Northing	Easting	Elevation (m)
AS-00	7269877.633	433277.821	292.18
AS-01	7269796.994	433340.847	293.41
AS-02	7269722.355	433403.872	294.65
AS-03	7269644.716	433466.897	295.56
AS-04	7269567.077	433529.922	295.24
AS-05	7269489.438	433592.948	294.53
AS-06	7269411.799	433655.973	293.83
AS-07	7269334.160	433718.998	293.12
AS-08	7269256.521	433782.023	292.41
AS-09	7269225.465	433807.234	292.13
AS-10	7269231.813	433821.400	291.90
AS-11	7269238.936	433830.175	291.79
AS-12	7269242.718	433834.833	291.73
AS-13	7269250.721	433844.692	291.60
AS-14	7269227.429	433863.600	291.44
AS-15	7269189.614	433817.016	291.74
AS-16	7269875.943	433259.873	291.80
AS-17	7269857.035	433236.581	291.60
AS-18	7269880.327	433217.674	291.23
AS-19	7269918.142	433264.257	291.53
AS-20	7269728.380	433379.560	294.21
AS-21	7269712.523	433391.760	294.20
AS-22	7269710.317	433389.043	294.20
AS-23	7269709.797	433388.402	294.47
AS-24	7269762.942	433390.484	293.94
AS-25	7269747.714	433403.379	293.95
AS-26	7269749.920	433406.096	293.95
AS-27	7269750.533	433406.851	294.27
AS-28	7269468.076	433630.100	293.91
AS-29	7269483.742	433617.664	293.94
AS-30	7269485.948	433620.382	293.94
AS-31	7269486.464	433621.018	294.22
AS-32	7269495.267	433568.395	294.33
AS-33	7269510.661	433555.626	294.37
AS-34	7269508.455	433552.909	294.37
AS-35	7269507.933	433552.265	294.64

ACCESS ROAD - STAKEOUT POINTS			
ID	Northing	Easting	Elevation (m)
RD-00	7269968.354	433885.372	282.25
RD-01	7269928.231	433793.774	282.30
RD-02	7269888.108	433702.176	282.44
RD-03	7269827.564	433623.896	284.65
RD-04	7269736.903	433584.223	288.88
RD-05	7269638.320	433592.872	292.71
RD-06	7269551.054	433641.248	293.22
RD-07	7269465.916	433693.701	292.98
RD-08	7269380.778	433746.156	291.76
RD-09	7269295.840	433798.611	291.01
RD-10	7269253.071	433824.839	291.26
RD-11	7269971.102	433884.168	282.26
RD-12	7269930.979	433792.571	282.32
RD-13	7269890.856	433700.973	282.46
RD-14	7269829.409	433621.530	284.66
RD-15	7269737.388	433581.262	288.89
RD-16	7269637.326	433590.041	292.73
RD-17	7269598.063	433608.758	293.08
RD-18	7269549.480	433638.692	293.24
RD-19	7269464.342	433691.147	292.99
RD-20	7269379.204	433743.602	291.78
RD-21	7269294.066	433796.057	291.03

ACCESS ROAD - STAKEOUT POINTS			
ID	Northing	Easting	Elevation (m)
RD-22	7269251.497	433822.285	291.27
RD-23	7269254.645	433827.393	291.24
RD-24	7269297.214	433801.165	291.00
RD-25	7269382.352	433748.710	291.75
RD-26	7269416.407	433727.728	292.23
RD-27	7269426.494	433725.037	292.34
RD-28	7269452.036	433709.300	292.71
RD-29	7269458.976	433701.500	292.84
RD-30	7269467.489	433696.255	292.96
RD-31	7269552.627	433643.800	293.21
RD-32	7269601.211	433613.867	293.05
RD-33	7269639.313	433595.703	292.70
RD-34	7269736.417	433587.183	288.86
RD-35	7269774.427	433597.399	287.17
RD-36	7269782.320	433603.860	286.72
RD-37	7269808.006	433617.478	285.41
RD-38	7269817.804	433620.399	285.01
RD-39	7269825.718	433626.261	284.63
RD-40	7269885.380	433703.380	282.43
RD-41	7269925.483	433794.978	282.29
RD-42	7269965.606	433886.576	282.24

NOTES

1. Soil classification for these works are based on the Unified Soil Classification System (USCS).
2. On all surfaces complete snow removal is required prior to fill placement. The Engineer must approve all surfaces prior to placement of any construction material.
3. Snow and ice on construction material must be removed prior to loading for construction use.
4. Due care must be taken when placing fill materials such that no damage occurs to the subgrade Thermistors and/or culverts. Any damage must be immediately reported to the Engineer.
5. The maximum lift thickness of Overburden material shall be 0.3m. Staged construction will be required where fill thickness exceeds 0.3m.
6. The Contractor shall conduct Insitu density testing for all placed overburden material to ensure compaction exceeds 98% of the standard proctor value.
7. Overburden material for use in construction fill shall be mineral soil free from ice vegitation and organic material.
8. The Contractor shall collect samples from the excavated overburden material and submit for laboratory testing including but not limited to grain size distribution, and moisture content at least 1 sample every 250m³. The Engineer may conduct additional sampling and testing as deemed necessary.

DRAINAGE CULVERTS - STAKEOUT POINTS			
ID	Northing	Easting	Elevation (m)
DC-001	7269241.720	433835.083	289.80
DC-002	7269244.350	433834.393	289.70

Materials List and Quantities

Item	Quantity / Area / Volume		Description
1. Organics (0.3m Thick)	Airstrip & Aprons	11,450 m³	Calculated (Civil 3D 2011) Volumes from neat lines and constant fill thickness.
	Access Road	1,900 m³	
	Total Cut:	13,350 m³	
2. Overburden Material (Cut)	Airstrip & Apron Cut	12,000 m³	
	Access Road	750 m³	
	Total Cut:	12,750 m³	
3. Overburden Material (Fill)	Airstrip & Apron Cut	11,650 m³	Calculated (Civil 3D 2011) in place neat line volumes.
	Access Road	750 m³	
	Total Fill:	12,400 m³	
4. Culverts	Road culverts (2)	12 m	Corrugated (68x13mm), 0.5m diameter circular pipe culverts
	Road Culverts (1)	12 m	
5. Thermistors	Thermistor cables (2)	38 m	102mm x 102mm treated timber post
	Thermistor cables (2)	15 m	
	Thermistor read out box	3	
	Treated Timber post (2)	2 m	

DRAWING NO.	DRAWING TITLE	DRAWING NO.	DRAWING TITLE
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A	ISSUED FOR DISCUSSION	LW	EMR	03AUG11
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FILE NAME: 1CS020.001-MSP-GLAS07-REV_A.dwg

Sabina

Goose Lake

SRK JOB NO.: 1CS020.001

All-Weather Airtrip & Access Road

DRAWING TITLE: Material Specification

DRAWING NO.: GL-AS-07 | SHEET: 6 OF 8 | REVISION NO.: A

Attachment 2: Preliminary Design Analysis Memo- UPDATED

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Memo

To:	John Latin	**Date:**	August 2, 2011
Company:	Sabina Gold and Silver Corporation	**From:**	Murray McGregor, Lowell Wade
Copy to:	Elizabeth Sherlock, Sabina Gold & Silver Corp.	**Project #:**	1CS020.001
Subject:	Preliminary Design Analysis - UPDATED		

1 Introduction

Sabina Gold and Silver Corporation (Sabina) propose to construct an all-weather airstrip near the Goose Lake camp. Access to the Goose Lake camp is currently restricted to Twin Otter float planes during the summer and Hercules aircraft during the winter. In August 2010, a preliminary site investigation was conducted to evaluate the possibility of constructing an all-weather airstrip which would allow year round re-supply using de Havilland Dash 7 or Dash 8 aircraft. Following the site investigation, a desktop study was carried out and a conceptual design was prepared (SRK 2010a, b, c).

Based on recommendations from the desk top study, SRK carried out a geotechnical field investigation in March, 2011 to further characterize foundation conditions along the proposed airstrip (SRK 2011a). While waiting for the results of the geotechnical laboratory program, SRK made a preliminary evaluation of the functionality of a simple cut-and-fill airstrip using basic indicator properties of the soils in question; using comparative data from similar soils; and by applying engineering judgement (SRK, 2011b).

The laboratory test data from the geotechnical field program are now available and have been used to re-evaluate the functionality of a simple cut-and-fill airstrip. The results of the re-evaluation is presented in this memo.

A key finding of the 2011 geotechnical investigation was the overburden soils are significantly thicker than originally anticipated. Furthermore, the laboratory test data has confirmed that these soils are silty sand. These soils are not conducive to constructing a long term high quality all-weather airstrip and therefore Sabina would have to construct a proper rock fill airstrip to ensure proper functionality. Considering practical constructability and regulatory constraints it would not be possible to construct such an airstrip in 2011 and therefore Sabina would like to know what the functionality of a basic cut-and-fill airstrip in the native silty sand would be. This updated memo provides this information.

2 Preliminary Foundation Assessment

The performance of a simple cut-and-fill airstrip in the native soils at Goose Lake has been assessed in terms of the following candidate aircraft:

- de Havilland Dash-7;
- de Havilland Dash-8;
- de Havilland Buffalo;
- de Havilland Twin Otter;
- Dornier 228;
- Beech King Air 200;
- Shorts Skyvan.

For airstrip foundation design, two elements must be satisfied. The first is that the California Bearing Ratio (CBR) of the airstrip must be greater than the required value of the particular aircraft under relevant subgrade conditions. The second is that a bearing capacity of the airstrip needs to be greater than the applied pressure of the aircrafts landing gear.

The CBR is a test developed to evaluate the strength of subgrades. The test involves measuring the pressure required to penetrate the soil with a piston of standard area. The result compares the pressure required to achieve a given deflection with the pressure to achieve the same penetration on a standardized crushed rock material. Higher values of CBR indicate more competent subgrades.

Information gathered from Transport Canada provides aircraft classification numbers for aircraft landing on a variety of subgrades (Transport Canada 2001). For the silty sand subgrades (flexible subgrade) in the Goose Lake area, the Transport Canada guide indicates that compaction must be carried out to achieve a CBR of 3 to 13, depending on the design aircraft. Table 1 shows the necessary minimum CBR values to land each aircraft evaluated in this assessment.

Table 1: Required California Bearing Ratios for Flexible Airstrip Subgrades by Aircraft Type

Aircraft	Required California Bearing Ratio
de Havilland Dash-7	12-13
de Havilland Dash-8	6-8
de Havilland Buffalo	8-10
de Havilland Twin Otter	3
Dornier 228	6
Beech King Air 200	3
Shorts Skyvan	3-4

3 Predicted CBR Values

Basic indicator (moisture content, Atterberg limits and gradation) and Proctor density tests have been completed on samples collected from the Goose Lake geotechnical investigation. This data confirms that the soils along the airstrip range from a sandy silt (ML) to a silty sand (SM). For most areas along the airstrip alignment, the primary material is a well graded silty sand (SM). In addition, the low moisture contents in the in surficial soils indicate that the area is well drained. Standard moisture density relationships state an average maximum dry density of 2,130 kg/m^3 with an average optimal moisture content of 8.0%.

Site specific strength testing has been completed. It has been determined the fine grained soils at Goose Lake will have an average effective friction angle of 32.71 degrees and an average apparent cohesion of 24.25 kPa (ASTM D4767).

Tables that correlate soil type and CBR (U.S. Army 1960; www.pavers.nl 2011) suggest that Goose Lake foundation soils would have CBR values that range from 10 to 40. Two empirical correlations used in a study by MAK WAI KIN (2006) comparing CBR with soil index properties are shown below:

$$CBR_{TOP} = 28.09\,(D_{60})^{0.358} \quad (1)$$

$$CBR_{TOP} = OMC\,(MDD/19.3)^{20} \quad (2)$$

Where; CBR_{TOP} = the maximum achievable California Bearing Ratio
D_{60} = particle size of 60% material passing measured in millimeters
OMC = the optimum moisture content for compaction
MDD = the maximum dry density of the soil kN/m^3

For the Goose Lake soils the D_{60} is 0.1mm, the average dry density is 20.89 kN/m^3, and the average OMC is 8%. Using this data, Equation (1) yields a CBR value of 12.3 and Equation (2) yields a CBR value of 39.

4 Preliminary Bearing Capacity

The bearing capacity of unpaved roads can be idealised as a strip footing with width equal to tire set width (Simon *et al.* 1997). This yields the following relationship.

$$Q = c' N_c + \tfrac{1}{2} B \gamma_1 N_\gamma \qquad (3)$$

Where; c' = *effective cohesion*
B = *width of tire set*
γ_l = *unit weight of the soil*
N_c = *cohesion bearing capacity factor*
N_γ = *surcharge bearing capacity factor*

Based on the test results the for Goose Lake foundation soils, an average unit weight of 22.27 kN/m^3; an average effective cohesion of 24.25 kPa; and an average friction angle of 32.71 degrees can be applied to the above equation. The bearing capacity factors are constants as stipulated by Simon *et al.* (1997).

Transport Canada (2001) list standard operating tire pressures for all aircraft assuming a full payload. Using Equation (3) we can calculate the ultimate bearing capacity that the foundation soils at Goose Lake can carry and compare that to the bearing capacity exerted by the aircraft. Applying Limit State Design, we should ideally have a Factor of Safety of at least 2 between what the soil can bear as compared to what the plane load exerts. Table 2 summarizes the results of these analyses. With a couple of exceptions, the airstrip will have sufficient bearing capacity to land all the design aircraft with a FOS of 2.0. The exceptions are, a de Havilland Dash-7, with Transport Canada Standard Tire Pressures of 740 kPa (FOS of 1.91), a Dornier 228, with Transport Canada Standard Tire Pressures of 900 kPa (FOS of 1.44), and a Beech King Air 200, with Transport Canada Standard Tire Pressures of 730 (FOS of 1.79).

Table 2: Aircraft Safety Factors for Standard Tire Pressures (Transport Canada, 2001)

Aircraft	FOS >		
	1.0	1.5	2.0
de Havilland Dash-7	✓	✓	
de Havilland Dash-8	✓	✓	✓
de Havilland Buffalo	✓	✓	✓
de Havilland Twin Otter	✓	✓	✓
Dornier 228	✓		
Beech King Air 200	✓	✓	
Shorts Skyvan	✓	✓	✓

Attachment 1 presents the results of a sensitivity analysis that was carried out to demonstrate the elements that control the analysis. First consideration was given to operating with reduced tire pressure as is common practice when conditions are not favourable. Secondly, the payload of larger aircraft was reduced to half payload.

Although not demonstrated in the sensitivity analysis, the bearing capacity is highly sensitive to soil properties. For example, immediately after a rainfall event, the airstrip may be near saturation, meaning that the apparent cohesion would be near zero. This would reduce the bearing capacity of the soil by almost 50%, which would mean that some aircraft would no longer be able to land safely.

5 Conclusion

Generally two foundation conditions must be met; (1) appropriate CBR values and, (2) suitable bearing capacity. The results from the two laboratory programs suggest that CBR values quoted in the Transport Canada guide can likely be met and the expected bearing capacity of the soil suggests most of the design aircraft can safely use a simple cut-and-fill airstrip.

The bearing capacity of the soil is strongly dependant on the tire pressure of the aircraft and the width or diameter of the tire's contact area with the ground surface. Although the analyses provided here indicate all of the design aircraft can use the all-weather airstrip it would be prudent to use lighter planes with lower tire pressures. The de Havilland Buffalo should be able to use a strip of this design since it has larger tires at low pressure. Also an excess of water would reduce the matric suction and effective stresses in the soil, which would greatly reduce the bearing capacity. It is highly important that the airstrip is free draining and does not have an excess of pore water. Compaction would need to be done seasonally since freeze-thaw will loosen the soil.

It may be possible to land planes at less than full payload with reduced tire pressure. It is ultimately up to the aircraft charter companies to make the final decision as to which planes they will land on the airstrip. It is recommended that the owner work closely with the aircraft charter company to confirm which aircraft they are willing to land.

For a large portion of each year, the airstrip will remain frozen. During this time all the aircraft assessed will be able to land safely. With close monitoring of ground temperature cables, the airstrip could be used as a frozen airstrip into the spring and summer when the ground has not yet thawed.

Regards

SRK Consulting (Canada) Inc.

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Attachments

Attachment 1

Effective Soil Properties

					w =	0.08 Average Value
c' =	24.25 Average Value	N_c =	37.69		γ_w =	9.80 kN/m^3
ϕ' =	32.71 Average Value	N_q =	25.21		G_s =	2.70 Average Value
γ =	22.27 Average Value	N_γ =	33.66		e =	0.30 Average Value

Plane	Plane Weight (kN)	Tire Pressure (kPa)	Bearing Capacity (kN)	FOS	FOS > 1	FOS > 1.5	FOS > 2
Dash-7	209	740	1412.90	1.91	✓	✓	
	209	600	1437.74	2.40	✓	✓	✓
	209	520	1456.26	2.80	✓	✓	✓
	209	400	1493.84	3.73	✓	✓	✓
	209	300	1541.13	5.14	✓	✓	✓
	165	740	1387.54	1.88	✓	✓	
	165	600	1409.58	2.35	✓	✓	✓
	165	500	1430.72	2.86	✓	✓	✓
	165	400	1459.35	3.65	✓	✓	✓
	165	300	1501.31	5.00	✓	✓	✓
Dash-8	147	440	1432.59	3.26	✓	✓	✓
	147	350	1462.22	4.18	✓	✓	✓
	147	300	1484.18	4.95	✓	✓	✓
	147	250	1512.44	6.05	✓	✓	✓
	119	440	1407.62	3.20	✓	✓	✓
	119	350	1434.22	4.10	✓	✓	✓
	119	300	1453.94	4.85	✓	✓	✓
	119	250	1479.31	5.92	✓	✓	✓
Buffalo	187	410	1473.76	3.59	✓	✓	✓
	187	350	1497.27	4.28	✓	✓	✓
	187	300	1522.04	5.07	✓	✓	✓
	187	250	1553.91	6.22	✓	✓	✓
	151	410	1444.80	3.52	✓	✓	✓
	151	350	1465.93	4.19	✓	✓	✓
	151	300	1488.18	4.96	✓	✓	✓
	151	250	1516.82	6.07	✓	✓	✓
Dornier 228	63	900	1300.03	1.44	✓		
	63	400	1355.98	3.39	✓	✓	✓
	63	300	1381.94	4.61	✓	✓	✓
	63	200	1425.50	7.13	✓	✓	✓
Twin Otter	56	260	1384.41	5.32	✓	✓	✓
	56	240	1392.43	5.80	✓	✓	✓
	56	220	1401.51	6.37	✓	✓	✓
	56	200	1411.93	7.06	✓	✓	✓
King Air 200	56	730	1305.28	1.79	✓	✓	
	56	500	1329.68	2.66	✓	✓	✓
	56	400	1346.38	3.37	✓	✓	✓
	56	300	1370.86	4.57	✓	✓	✓
	56	250	1388.30	5.55	✓	✓	✓
Shorts Skyvan	67	280	1395.02	4.98	✓	✓	✓
	67	250	1407.08	5.63	✓	✓	✓
	67	200	1432.92	7.16	✓	✓	✓
	67	150	1470.79	9.81	✓	✓	✓
	76	260	1416.79	5.45	✓	✓	✓

Transport Canada standard tire pressure

Charter quoted typical tire pressure