

**Shubenacadie River - Cobequid Bay**

**Mineral Sands Project**

**Colchester and Hants County, Nova Scotia, Canada**

**Assessment Report**

**for**

**Exploration Licenses #09186, #09187, #09198 & #09201**

**Year 2011 Program**

Maritime Titanium Ltd.

NTS: 11-E-03-C, 11-E-05-A, 11-E-06-B

W.G. Shaw & Associates Ltd.  
Consulting Geoscientists  
July 26, 2011

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## **1.0 Introduction**

### **1.1 Introduction**

The Shubenacadie River – Cobequid Bay Mineral Sands Project (The Project) is located in north-central Nova Scotia, Canada ( Figures #1, #2 and #3). The Project encompasses 593 contiguous claims (9,488 Hectares, 94.8 square kilometres), that are held by under 35 exploration licenses by Maritime Titanium Ltd. (MTL), based in Hantsport, Nova Scotia.

Between 1997 and 2005, a company called Titanium Corporation Inc. conducted an extensive evaluation of the titanium potential of the sand deposits within the Shubenacadie River and Cobequid Bay. On the basis of 490 drill holes and associated sample analyses, Titanium Corporation published a resource of 330 million tonnes of sand having 1.936% heavy minerals in the Shubenacadie River and Cobequid Bay. The heavy mineral fraction contains 16.27% ilmenite, 16.51% leucosene, 19.57% rutile, 4.24% garnet and 41.40% ferromagnetic minerals. The exploration licenses covering this area were not renewed by Titanium Corporation in 2006.

Due to improving market conditions for titanium, during the winter and summer of Year 2010, Maritime Titanium Ltd. (MTL) acquired the mineral rights to 400 claims in the Shubenacadie River and Cobequid Bay for the purpose of augmenting the historical knowledge of the titanium potential within the mineral sands. A limited amount of sampling was done on sand bars at low tide by means of percussion and vibratory drilling (Pionjar and Vibracore), bulk sampling and channel sampling (Mitchell, 2010 and 2011).

In October 2010, NSDNR announced they had tested sand samples from the Shubenacadie River for rare earth elements (REEs) and the samples were found to be anomalous for REEs. Based on this new discovery, MTL obtained an additional 193 claims in Cobequid Bay and included the testing for REEs in its exploration program.

This assessment report describes the resource evaluation work that was conducted on Exploration Licenses #09186 and #09187 with an anniversary date of July 28 (Figure #3). The appended report “Shubanacadie River Mineral Sands, Environmental Review” by Envirosphere Consultants Ltd. is intended to apply to Exploration Licenses #09198 and #09201, held by MTL (Appendix C).

This report was prepared by W.G. Shaw & Associates Ltd. at the request of Mr. James White of Maritime Titanium Ltd., a Nova Scotia registered company with its corporate office at:

P.O. Box 351  
Hantsport, Nova Scotia  
Canada, B0P 1P0

This report is intended to fulfill the requirements for an Assessment Report for submission to the Nova Scotia Department of Natural Resources in support of the renewal of Exploration Licenses #09186, #09187, #09198 and #09201, held by MTL (Figures #1, #2 and #3).

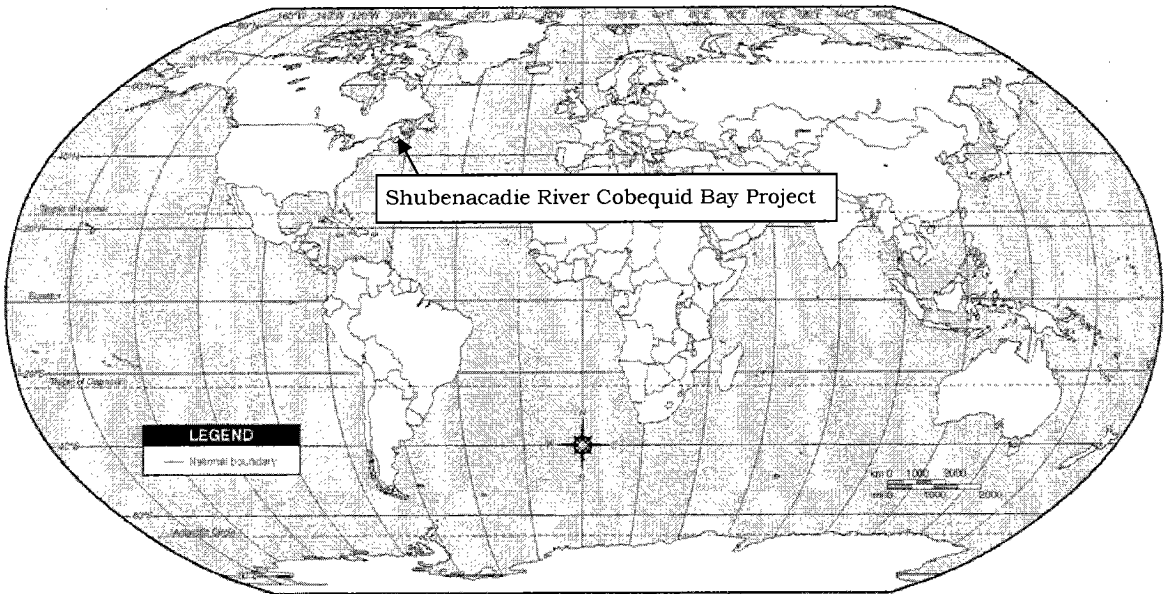


Figure #1 – World Location Map

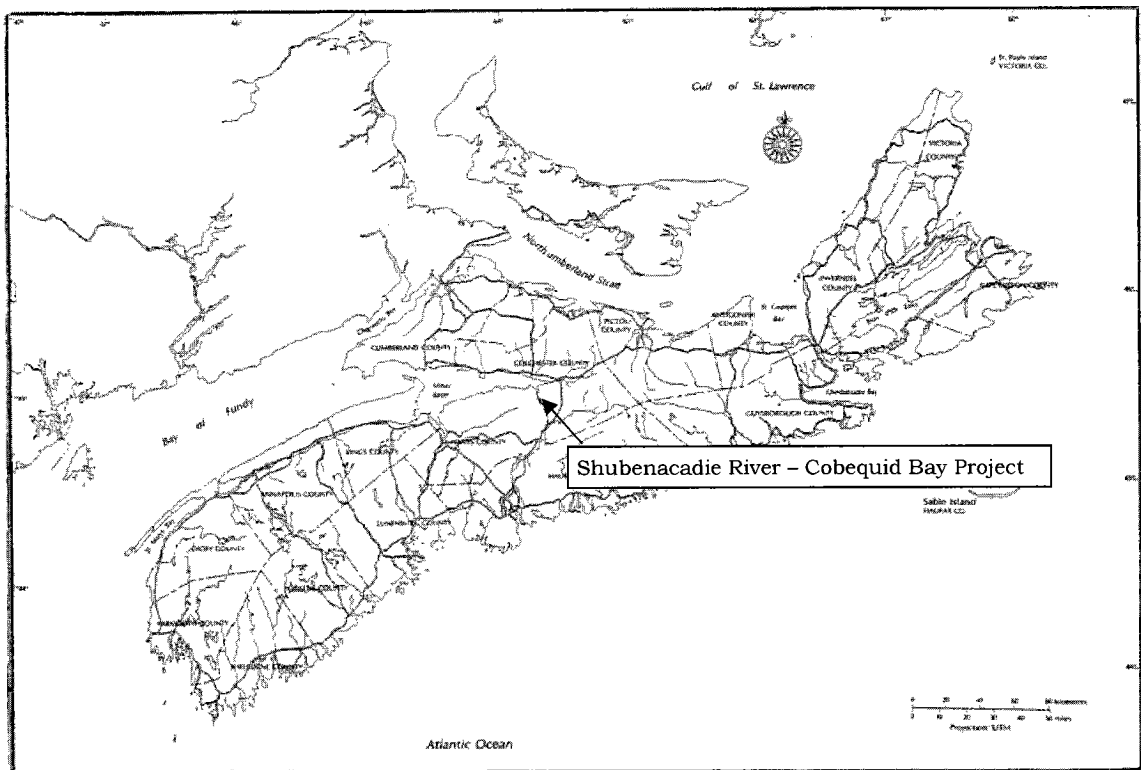


Figure #2 Location of Shubenacadie River – Cobequid Bay Mineral Sands Project on Map of Nova Scotia

## 1.2 Summary

During the winter and summer of Year 2010, Maritime Titanium Ltd. (MTL) acquired the mineral rights to 400 claims in the Shubenacadie River and Cobequid Bay. Sampling was done on sand bars at low tide by means of percussion and vibratory drilling (Pionjar and Vibracore), bulk sampling and channel sampling.

In July of 2010, Mitchell (2010) produced a Summary Report (Appendix 3) which compiled past work and recommended more drilling and mineral process testing with the intention of producing an updated and potentially larger resource.

In January of 2011 samples were again collected on License #09092 (Figure #3). These samples were analyzed at Dalhousie University - MEC for basic elements and REEs. Sink-float analysis was also done and the sink portion of sample R#1 was separated into magnetic and non-magnetic fractions (Mitchell, 2011). Based on the results, Cyril Cole suggested that monazite was the mineral containing the REEs. Following the analysis, Erwin Shutfort interpreted the REE results and indicated there are two phases of REEs, both light and heavy where REEs are concentrated in the heavy mineral suite.

The results of major oxide and REE analyses of the nine (9) samples are provided in Appendix B. Some of the more significance conclusions of the analyses are as follows:

- 1) The heavy mineral content of the nine (9) samples (MT-A to MT-I) ranges from 0.43% (MT-I) to 7.27% (MT-A) with an average of 2.11%.
- 2) The heavy mineral fraction of the nine (9) samples (MT-A to MT-I) contain anomalous concentrations of titanium with  $\text{TiO}_2$  concentrations from 8.2 to 27.9 wt %.
- 3) Within the heavy mineral fraction, rare earth element concentrations are anomalous especially with respect to cerium, lanthanum and neodymium (Appendix B and Figure #3).

Maritime Titanium Ltd. and earlier explorers have discovered and characterized a large resource of mineral sands that contains potentially valuable resources of titanium, zircon and REEs.

Until October, 2010, the focus of the Project was on titanium and zircon. With increasing prices for the two commodities there is greater mining potential now than 10 years ago when the resource was investigated in a systematic manner.

The discovery of REEs associated with the heavy mineral fraction of the sand deposits within the Shubenacadie River – Cobequid Bay enhances the potential commercial value of the mineral sands. Initial sampling has indicated there is a 100 to 1,000 times enrichment of REEs in the heavy mineral fraction of the raw samples.

The following persons constitute the professional and technical personnel who conducted the activities of sample collection, sample processing, sample analysis and reporting.

Shubenacadie River - Cobequid Bay Project

Personnel List

Name	Title	Residence	Dates Worked
Cole, Cyril	Sample Processing	Halifax, Nova Scotia	June 12 to 13, 2011
Dalhousie University	Analytical Laboratory	Halifax, Nova Scotia	July 01 to 12, 2011
Kirkby, Troy	Manager	Windsor, Nova Scotia	June 11 to 13, 2011
Shubenacadie Wave Runners Ltd.	Boat Contractors	Windsor, Nova Scotia	June 12, 2011
White, James	Manager	Windsor, Nova Scotia	June 11 to 13, 2011
W.G. Shaw & Assoc. Ltd.	Consulting Geoscientists	Antigonish, Nova Scotia	July 18 to August 22, 2011

## **2.0 Location, Access, and Physiography**

The Shubenacadie River Project is located in Colchester and Hants Counties, Nova Scotia, approximately 15 kilometres west of Brookfield and Highway #102 (Figures #1, #2 and #3). The Claim Block encompasses approximately 30 kilometres of the Shubenacadie River and thence 20 km east and west in Cobequid Bay.

The Claim Block can be reached by car by travelling 15 kilometres west from Brookfield, along Highway 289 to the Goss Bridge. Roads parallel the River on both sides but access to the sand bars is difficult due to cliffs, steep banks and mud. Access to the Cobequid Bay can be had at Maitland and Selma. For exploration purposes the best method is by Zodiac from Maitland and thence into the Cobequid Bay or up the river. For the southerly section of the river, access is best from Stewiacke via small boat. Care must be taken when travelling on the river or walking the sand bars in both the river and the bay. The area is subject to twice daily tides which are as high as 15 metres in the Bay and 2 to 3 metres upstream. On incoming tides, a tidal "bore" or standing wave up to 3 metres high can rush up the river and swamp small craft. Maritime has recently purchased riverfront property near the southern extent of the claims for purposes of accessing the sand bars and as a possible processing site.

At low tide sand bars are exposed in the bay and river. These bars change shape on a small scale with every tide but generally retain their basic shape over time. Bars in the river are elongate, flat and with cross cutting ripples. Those in the bay are similar but can be mound shaped and have larger ripples.

There are no grocery stores, tourist accommodations or shopping areas within the claims. The nearest towns for supplies and lodging are Maitland, adjacent and west and Brookfield 15 kilometres east. There are power lines servicing the rural communities and high-speed internet and cellular phone service are available in some areas. A rail service and a 100 series highway is 15 kilometres east.

Industry is limited to forestry operations, tourist operations (several river rafting outfits), greenhouse operations and farming.

The Project Area has a humid, temperate, continental climate that is somewhat modified by the proximity to the Bay of Fundy and the Gulf of St. Lawrence. The mean annual temperature is 6.8 C°. The mean annual temperature is 6.8 C°. The warmest temperatures are generally in July, with a

mean of 18 C°, and the coldest temperatures are in February with a mean of -6°.

The area receives total annual precipitation of 120 to 150 centimetres with a mean annual figure of 138 centimetres. Much of the precipitation and moisture surplus occurs within one distinct wet season from mid-November to mid-March. Snowfall events occur between late November to early April with typical total yearly snowfall accumulations in the order of 3.1 metres. A warming trend from March through April releases the snow pack, and eliminates the frost cover to generate a major surface water runoff and groundwater recharge event from March to May. There is generally a significant dry season that lasts from June to mid-September. The summer season is generally relatively dry with rainfall accumulations of less than 10 centimetres common for the months of June, July and August.

### 3.0 Claim Status (License Tabulation)

The Shubenacadie River Project consists of 593 claims which aggregates a total area of 9,488 Hectares (94.8 square kilometres). This assessment report provides a description of the methods and results of work conducted on Exploration Licenses #09186, #09187, #09198 and #09201 that include a total of 126 claims (Figure #3). These licenses are 100% owned by Maritime Titanium Ltd. and are in their 2<sup>nd</sup> Year of issue.

The surface rights belong to various private landowners and the Province of Nova Scotia. All of the work conducted in Year 2011 was conducted on Crown Land.

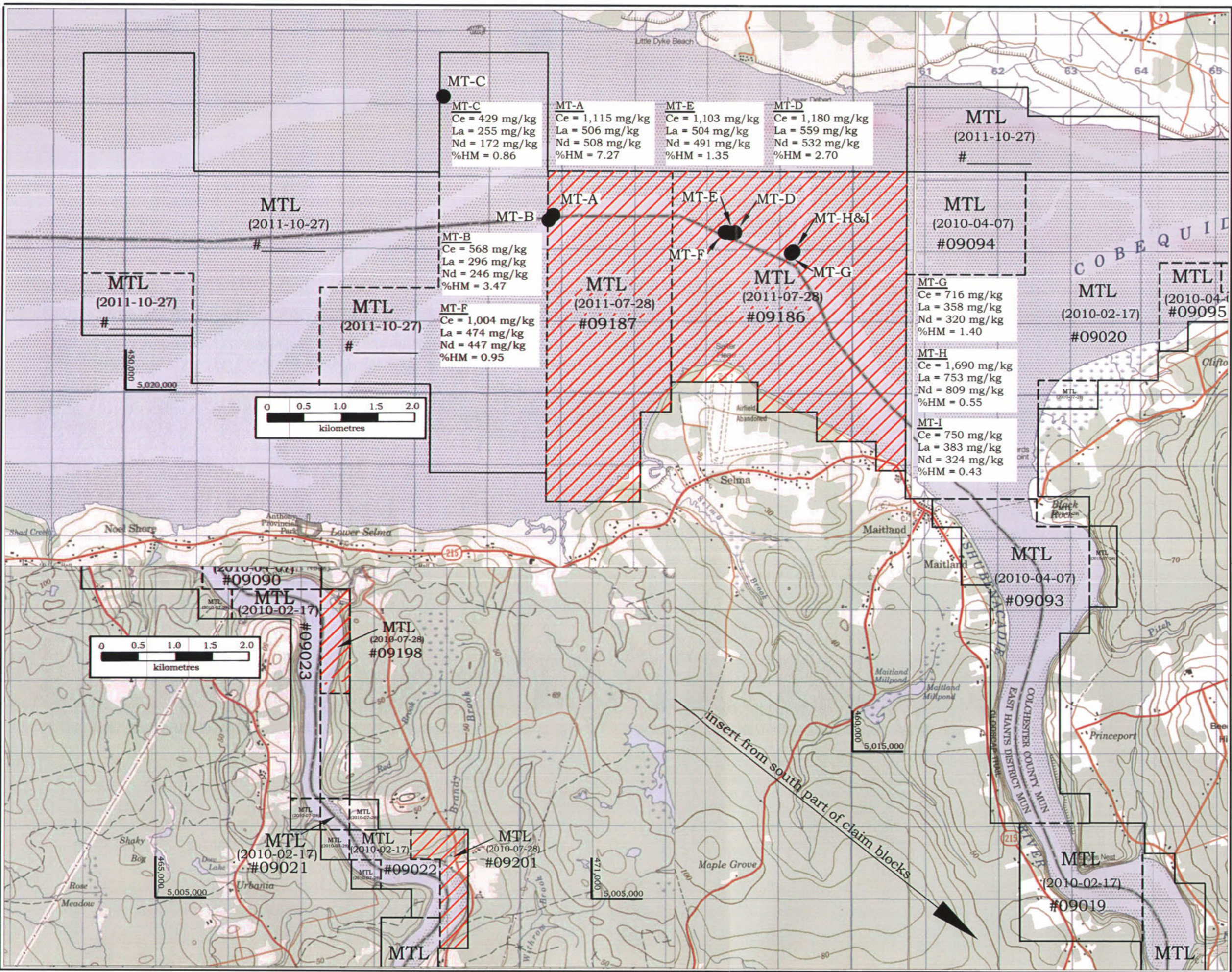
#### Maritime Titanium Ltd.

July 18, 2011

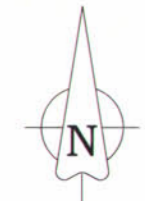
#### Shubenacadie River Project

Exploration Licenses with July 28 Anniversary Date

License Number	Anniversary Date	Reference Map	Tract Number	Claims		Work Required to Renew	
				Claims	Number of Claims	Each Tract \$	Total License \$
09186	2011-07-28	11-E-05-A	71	Q	1	200	14,600
			72	HUKL NOPQ	8	1,600	
			73	All Claims	16	3,200	
			74	All Claims	16	3,200	
			95	All Claims	16	3,200	
			96	All Claims	16	3,200	
09187	2011-07-28	11-E-05-A	70	BCDE FGKL MNOP	12	2,400	8,800
			75	All Claims	16	3,200	
			94	All Claims	16	3,200	
09198	2011-07-28	11-E-03-C	89	DEMN	4	800	800
09201	2011-07-28	11-E-03-C	55	N	1	200	1,000
			65	J	1	200	
			66	DEM	3	600	



**Explanation**



Grid North (NAD 83)

————— Claim Group Boundary

- - - - - Exploration License



July 28 Claims To Be Renewed



Sample Location

**REE Concentration in HM Fraction**

Ce = 429 mg/kg (Cerium)  
 La = 255 mg/kg (Lanthanum)  
 Nd = 172 mg/kg (Neodymium)  
 %HM = 2.70 (Heavy Min. Fraction)

W.G. Shaw & Assoc. Ltd.  
 Consulting Geoscientists



4546 Highway No.7  
 Antigonish, Nova Scotia  
 Canada B2G 2L3

Scale = 1:50,000

**Maritime Titanium Ltd.**

**Shubenacadie River - Cobequid Bay  
 Mineral Sands Project**

Nova Scotia, Canada

Figure #3

Topographic, Claims and Sample Locations

August, 2011

## **4.0 Previous Work**

### 1980s

Interest in the mineral resource value of the sand deposits within the Shubenacadie River and Cobequid Bay began 1980s when the Nova Scotia Department of Natural Resource conducted some preliminary studies of the mineral content of the sands.

### 1997 – 2003

The first commercial investigation of the sands was initiated in 1997 by Titanium Corporation that held the mineral rights to approximately 50 square kilometres and conducted extensive drilling, logging and testing of sand samples. The work consisted of:

- 1) field sampling programs to determine the size and grade of the resource and provide material for lab tests;
- 2) Sonar and seismic surveys to establish sand volumes and sand-gravel-bedrock horizons;
- 3) technical valuation to assess the project's economic viability;
- 4) pre-feasibility study including environmental, biological and groundwater aspects;
- 5) mineralogical studies to determine mineral content and mineral process procedures to upgrade and separate the desired mineral components,
- 6) establishing a gravity, electromagnetic and electrostatic test facility at Daltech in Halifax, Nova Scotia to concentrate and separate the minerals and

During this time, Titanium Corporation reported the presence of a resource of 330 million tonnes containing 1.936% Heavy Minerals in 12 sand bars within these claims. The heavy minerals of interest consist of the titanium minerals ilmenite (16.27%), leucoxene (16.51%) and rutile (19.57%). Added value may be gained from zircon (1.67%), garnet (4.24%) and ferromagnetic minerals (41.40%).

## 2010 to 2011

In January, Maritime Titanium Ltd. gathered additional samples from the same general areas that was worked by Titanium Corporation. These samples were sent to the Minerals Engineering Centre (MEC) in Halifax for REEs, sink-float and elemental analysis (Mitchell, 2011). Testing was done on raw samples and magnetic separation fractions from heavy mineral sinks. Cyril Cole detailed the process. Erwin Shutfort then interpreted the MEC data and produced a report detailing the nature of the light and heavy REE's (Mitchell, 2011).

In July of 2010, Mitchell (2010) produced a Summary Report (Appendix 3) which compiled past work and recommended more drilling and mineral process testing with the intention of producing an updated and potentially larger resource.

In January of 2011 samples were again collected on License #09092 (Figure #3). These samples were analyzed at Dalhousie University - MEC for basic elements and REEs. Sink-float analysis was also done and the sink portion of sample R#1 was separated into magnetic and non-magnetic fractions (Mitchell, 2011). Based on the results, Cyril Cole suggested that monazite was the mineral containing the REEs. Following the analysis, Erwin Shutfort interpreted the REE results and indicated there are two phases of REEs, both light and heavy where REEs are concentrated in the heavy mineral suite.

## **5.0 Work Conducted In 2010 and 2011**

### **5.1 Summary Report (Mitchell, B; 2010)**

In July and August of 2010 a summary report of historical and recent work was generated by Bruce Mitchell (2010) which includes Exploration Licences #09186, #09187, #09198 and #09201. This report presents a compilation of past work and recommending future work to further define the titanium-zircon resource. It was suggested the resource could be increased and better defined with more drilling.

### **5.2 Sampling of Sands, Analytical Results and Interpretation**

In June of 2011, eight (8) samples of river sands were collected on Licences #09186 and #09187; these samples are labelled MT -A, -B, -D, -E, -F, -G, -H and -I on Figure #3. An additional sample (MT-C) was collected on the exploration license to the northwest of Exploration License #09187. The samples were collected from emergent sand bars at low tide which were reached by boat. The samples were collected by hand digging small pits with a hand shovel to depths of 0.30 metres from which 2 to 3 kilograms of sand were extracted and placed in plastic buckets which were then transported to Dalhousie University, Minerals Engineering Centre for testing. At Dalhousie, the samples were analyzed for heavy mineral content, major oxides and rare earth elements (REEs)(Appendix B). The analyses for major oxides and REEs were conducted on the heavy mineral fraction which was generated from the raw sample by heavy liquid separation using tetrabromomethane (SG = 2.95).

The analytical method for all parameters was a Li-metaborate/Li-tetraborate fusion with a ICP OES finish, except for L.O.I were a sample was heated to 1000 C° (Appendix B).

## **6.0 Results**

The results of major oxide and REE analyses of the nine (9) samples are provided in Appendix B. Some of the more significance conclusions of the analyses are as follows:

- 1) The heavy mineral content of the nine (9) samples (MT-A to MT-I) ranges from 0.43% (MT-I) to 7.27% (MT-A) with an average of 2.11%.
- 2) The heavy mineral fraction of the nine (9) samples (MT-A to MT-I) contain anomalous concentrations of titanium with  $TiO_2$  concentrations from 8.2 to 27.9 wt %.
- 3) Within the heavy mineral fraction, rare earth element concentrations are anomalous especially with respect to cerium, lanthanum and neodymium (Appendix B and Figure #3).

## **7.0 Conclusions**

Maritime Titanium Ltd. and earlier explorers have discovered and characterized a large resource of mineral sands that contains potentially valuable resources of titanium, zircon and REEs.

Until October, 2010, the focus of the Project was on titanium and zircon. With increasing prices for the two commodities there is greater mining potential now than 10 years ago when the resource was investigated in a systematic manner.

The discovery of REEs associated with the heavy mineral fraction of the sand deposits within the Shubenacadie River – Cobequid Bay enhances the potential commercial value of the mineral sands. Initial sampling has indicated there is a 100 to 1,000 times enrichment of REEs in the heavy mineral fraction of the raw samples.

## **8.0 Recommendations**

The following recommendations are Project could be advanced by augmenting historical resource evaluation work by the following:

- 1) Conduct a broad-spectrum, scoping study of the Shubenacadie River - Cobequid Bay Mineral Sands Project with the objective of determining the most promising areas for iron, titanium and REEs exploration. Focus future investments on the most promising areas.
- 2) Once the most promising areas have been determined, collect additional sand samples by utilizing a 43-101-compliant drilling method to depths of 4 to 8 metres. Analyze samples for titanium, zircon and REEs.
- 3) Research the various commercial processing methods for mineral sands containing titanium, zircon and REEs. Collect a bulk sample (200 tonnes) and have the sample tested for recovery of titanium, zircon and REEs.

## **Selected References**

Lines, A.

2002A: Titanium, Cobequid Bay, Hants and Colchester Counties, Nova Scotia. Report on Pionjar Drilling of Sand Bars [Assessment Report - Exploration License 04714, for Year Ended October 10, 2002], by Lines, A, Titanium Corporation Incorporated, Assessment Report ME 2002-071, 2002, 13 page(s), 1 map(s). ISN: 20567

Lines, A.

2002B: Titanium, Shubenacadie River, Salmon River and Cobequid Bay, Hants and Colchester Counties, Nova Scotia. Report on Pionjar and Vibracorer Drilling of Sand Bars, and Chemical and Metallurgical Analyses of Heavy Minerals Concentrates [Assessment Report - Exploration Licenses 04713, 03252, 03253 & 04715, for Year Ended October 10, 2002], by Lines, A, Titanium Corporation Incorporated, Assessment Report ME 2002-072, 2002, 110 page(s), 3 map(s). ISN: 20568

Lines, A.

2002C: Titanium, Shubenacadie River, Hants and Colchester Counties, Nova Scotia. Report on Drilling and Bulk Sampling of Sand Bars, and Analysis of Heavy Minerals Content of the Sands [Assessment Report - Exploration License # 03151 for Year Ended August 18, 2002], by Lines, A, Titanium Corporation Incorporated, Assessment Report ME 2002-062, 2002, 30 page(s), 3 map(s). ISN: 20071

Mitchell, B.

2004: Titanium, Cobequid Bay, Hants and Colchester Counties, Nova Scotia. Report on Pionjar Drilling of Sand Bars, Drill Core Logging, Drill Core Sampling, Heavy Minerals Analyses of Drill Core Samples, and Mineralogical Analyses of Heavy Minerals Concentrates [2004 Assessment Report for Exploration Licenses 04714, 04769, 05278, 05279, 05280 and 05281]; for Titanium Corporation Incorporated, Assessment Report ME 2004-110, 2004, 62 page(s), 2 map(s).

Mitchell, B.

2010: Maritime Titanium Ltd., Shubenacadie River Project, Colchester and Hants Counties; Summary Report; Assessment Report submitted to NSDNR; NTS: 11E/03A and 11E/06B; 25 p.

Mitchell, B.

2011A: Maritime Titanium Ltd., Shubenacadie River Project, Colchester and Hants Counties; Assessment Report submitted to NSDNR, Exploration Licenses Nos. 09019 to 09025; NTS: 11E/03A and 11E/06B; 52 p.

Mitchell, B.

2011B: Maritime Titanium Ltd., Shubenacadie River Project, Colchester and Hants Counties; Assessment Report submitted to NSDNR, Exploration Licenses Nos. 09090 to 09096; NTS: 11E/03A and 11E/06B; 56 p.

Po, A.Y.

2003: Titanium, Cobequid Bay, Hants and Colchester Counties, Nova Scotia. Report on Pionjar Drilling, Drill Core Sampling and Heavy Minerals Analyses of Sand Bars [Assessment Work Report for Exploration License 04713 ....], by Po, A Y, Titanium Corporation Incorporated, Assessment Report ME 2003-053, 2003, 20 page(s), 1 map(s). ISN: 20429

Po, A.Y.

2003: Titanium, Shubenacadie River, Hants and Colchester Counties, Nova Scotia. Report on Pionjar and Vibracorer Drilling and Surface Sampling of Sand Bars, and Chemical and Metallurgical Analyses of Heavy Minerals Concentrates [Assessment Work Report for Exploration Licenses 03118A and 03189], by Po, A Y, Titanium Corporation Incorporated, Assessment Report ME 2002-066, 2002, 33 page(s), 1 map(s). ISN: 20547

Stanley, C.R.

2003: Titanium, Shubenacadie River, Hants and Colchester Counties, Nova Scotia; Summary Report of Findings from Acadia University Sedimentology Research on the Shubenacadie River, Nova Scotia; Assessment Work Report for Exploration License 05182] for Titanium Corporation Incorporated; Assessment Report ME 2003-057, 2003, 24 page(s), 4 map(s).

## Appendix A

### Certificate of Qualifications

I, William G. Shaw of 4546 Highway No.7, Antigonish, Nova Scotia, hereby certify that:

- 1) I am currently president of W.G. Shaw & Associates Ltd. the office of which is located at 4546 Highway No.7, Antigonish, Nova Scotia, Canada.
- 2) I graduated with a B.Sc. in geoscience from St. Francis Xavier University at Antigonish, Nova Scotia in 1978 and M.Sc. in geoscience from Dalhousie University, Halifax, Nova Scotia in 1982.
- 3) I am a Professional Geoscientist registered in the Province of Nova Scotia (RN #0055).
- 4) I have been employed in my profession for a total of twenty nine (29) years. This work has included employment with major oil companies, junior oil companies, junior mining companies, consulting engineering firms, and municipal governments.
- 5) I am the principle author of this technical report titled "Shubenacadie River - Cobequid Bay Mineral Sands Project; Assessment Report for Exploration Licenses #09186, #09187, #09198 & #09201, Year 2011 Program; for Maritime Titanium Ltd.; NTS: 11-E-03-C, 11-E-05-A, 11-E-06-B; 23 p.
- 6) I have not visited the property for the purpose of evaluating mineral sand resources; however, I have interviewed Mr. Bruce Mitchell who provided me with a description of the field conditions, sampling methods and all relevant information related to the project.
- 7) I have not had any prior involvement with the property that is the subject of this report.
- 8) I am not aware of any material fact or material change with respect to the subject matter of the Technical Report that is not reflected in the Technical Report.

Dated this 24<sup>th</sup> day of August, 2011

*William G. Shaw*

William G. Shaw, P.Geo.  
President, W.G. Shaw & Associates Ltd.

Shubenacadie River – Cobequid Bay Project  
Assessment Report  
August 24, 2011

Appendix B

Laboratory Reports from Dalhousie University

12-Jul-11

minerals.engineering.dal.ca  
Tel: 902.494.3955  
Fax: 902.494.3506  
Email: mec@dal.ca

Maritime Titanium  
PO Box 351  
Hantsport, NS  
BOP 1P0  
Attention: Elwood Dillman

Re: Results of analysis on submitted samples.  
Li-metaborate/Li-tetraborate fusion, ICP OES finish.

Analyte (Wt. %)	MT-A (HM)	MT-B (HM)	MT-C (HM)	MT-D (HM)	MT-E (HM)
Al <sub>2</sub> O <sub>3</sub>	4.75	5.43	9.93	4.10	3.47
BaO	0.04	0.03	0.04	0.05	0.03
CaO	2.83	3.96	8.59	2.14	1.41
Cr <sub>2</sub> O <sub>3</sub>	0.03	0.03	0.03	0.03	0.03
Fe <sub>2</sub> O <sub>3</sub>	38.54	27.11	26.16	37.95	41.11
K <sub>2</sub> O	0.44	0.57	0.72	0.49	0.40
MgO	1.81	2.84	4.81	1.59	1.08
MnO	2.57	1.87	1.04	2.47	2.45
Na <sub>2</sub> O	0.41	0.58	1.07	0.57	0.49
P <sub>2</sub> O <sub>5</sub>	0.48	0.55	0.40	0.47	0.37
SiO <sub>2</sub>	21.95	30.17	38.16	21.72	19.04
SrO	0.02	0.02	0.04	0.01	0.01
TiO <sub>2</sub>	26.95	24.28	8.18	24.36	25.16
V <sub>2</sub> O <sub>5</sub>	0.07	0.05	0.06	0.07	0.07
ZrO <sub>2</sub>	0.39	0.20	0.07	0.56	0.33
LOI (1000°C)					
Total	101.29	97.69	99.31	96.57	95.45

Analyte (Wt. %)	MT-F (HM)	MT-G (HM)	MT-H (HM)	MT-I (HM)
Al <sub>2</sub> O <sub>3</sub>	4.26	5.14	3.64	5.08
BaO	0.03	0.03	0.08	0.05
CaO	2.47	3.30	1.71	3.28
Cr <sub>2</sub> O <sub>3</sub>	0.03	0.03	0.04	0.03
Fe <sub>2</sub> O <sub>3</sub>	34.83	28.83	41.95	27.16
K <sub>2</sub> O	0.52	0.60	0.45	0.60
MgO	1.97	2.44	1.33	3.05
MnO	2.21	2.12	2.54	1.60
Na <sub>2</sub> O	0.65	0.44	0.36	0.48
P <sub>2</sub> O <sub>5</sub>	0.46	0.49	0.45	0.55
SiO <sub>2</sub>	22.69	30.77	18.99	31.25
SrO	0.01	0.02	0.01	0.01
TiO <sub>2</sub>	27.88	23.68	23.59	19.14
V <sub>2</sub> O <sub>5</sub>	0.06	0.06	0.08	0.06
ZrO <sub>2</sub>	0.30	0.33	0.75	0.67
LOI (1000°C)				
Total	98.37	98.26	95.98	93.01

Daniel Chevalier  
 Manager, Minerals Engineering Centre

Digitally signed  
 by Daniel  
 Chevalier  
 Date: 2011.07.12  
 11:07:36 -03'00'

11-Jul-11

Maritime Titanium  
PO Box 351  
Hantsport, NS  
B0P 1P0  
Attention: Elwood Dillman

minerals.engineering.dal.ca  
Tel: 902.494.3955  
Fax: 902.494.3506  
Email: mec@dal.ca

Re: results of REE analysis on submitted samples.  
Li-metaborate/Li-tetraborate fusion, ICP OES finish.

Sample	mg/kg									
	Ce	Dy	Er	Eu	Gd	Ho	La	Lu	Nd	Pr
MT-A( HLS)	1115	45	17	17	109	<10	506	11	508	96
MT-B( HLS)	568	30	10	8	72	<10	296	8	246	38
MT-C( HLS)	429	20	7	6	55	<10	255	7	172	29
MT-D( HLS)	1180	43	16	16	117	<10	559	11	532	98
MT-E( HLS)	1103	32	11	16	106	<10	504	10	491	89
MT-F( HLS)	1004	36	11	13	102	<10	474	10	447	75
MT-G( HLS)	716	39	10	11	79	<10	358	8	320	54
MT-H( HLS)	1690	54	21	26	150	<10	753	13	809	151
MT-I( HLS)	750	38	14	9	86	<10	383	14	324	51
TRM-2 (RE Standard)	29930	227	73	210	598	31	19884	10	8416	2765
Expected Value	29000	206	80	212	553	37	19300	8	8900	2800
Confidence Level	± 1200	± 32	± 8.5	± 16.2	± 83	± 7.4	± 1000	± 1.1	± 800	± 300

Sample	mg/kg						
	Sc	Sm	Tb	Th	Tm	Y	Yb
MT-A( HLS)	31	104	44	94	<10	179	24
MT-B( HLS)	35	50	36	<50	<10	138	19
MT-C( HLS)	46	27	15	<50	<10	100	13
MT-D( HLS)	28	105	43	50	<10	189	25
MT-E( HLS)	25	113	43	95	<10	137	20
MT-F( HLS)	30	80	43	52	<10	147	20
MT-G( HLS)	33	60	32	<50	<10	150	20
MT-H( HLS)	28	173	43	<50	<10	226	29
MT-I( HLS)	37	48	29	<50	<10	170	23
TRM-2 (RE Standard)	10	1158	62	182	<10	1017	59
Expected Value	NA	900	55	217	NA	959	55
Confidence Level	NA	± 300	± 14.2	± 40	NA	± 40	± 5.24

Daniel Chevalier, MASc  
Manager, Minerals Engineering Centre

*Daniel Chevalier*

Digitally signed  
by Daniel  
Chevalier  
Date: 2011.07.11  
09:54:43 -03'00'

## Results of Heavy Liquid Separation on Cobequid Bay Samples

**Date Collected:** 12 June 2011

The samples were the top 30.5 cm (1 ft). The average percent of 2.109% heavy minerals in the sands compares with Titanium Corporation results. Their work indicated the sands contained 1.74% heavy minerals and the first 1.5m (5 ft) had the higher heavy mineral content, averaging 2.09%. These numbers were derived from analysis for heavy mineral content on 414 samples collected from 95 drill holes.

Sample location, % Heavy Minerals and ppm Ce, La & Nd

Sample	Location	% Heavy Minerals	Ce (PPM) in HM	La (PPM) in HM	Nd (PPM) in HM
MT-A	45°21.277N 63°33.887W	7.27	1115	506	508
MT-B	45°21.232N 63°33.926W	3.47	566	296	246
MT-C	45°22.150N 63°35.004W	0.86	429	255	172
MT-D	45°21.153N 63°31.891W	2.70	1180	559	532
MT-E	45°21.149N 63°31.929W	1.35	1103	504	491
MT-F	45°21.154N 63°31.985W	0.95	1004	474	447
MT-G	45°21.002N 63°31.298W	1.40	716	358	320
MT-H	45°21.017N 63°31.276W	0.55	1690	753	809
MT-I	45°21.025N 63°31.251W	0.43	750	383	324
Average		2.109	950	454	394

% REE's in Sand & kg REE'S in 1000 kg

Sample	Ce (%)	La (%)	Nd (%)	Ce (kg)	La (kg)	Nd (kg)
MT-A	0.0084	0.0037	0.0037	0.084	0.037	0.037
MT-B	0.0020	0.0010	0.0009	0.020	0.010	0.009
MT-C	0.00037	0.0002	0.0002	0.0037	0.002	0.002
MT-D	0.0032	0.0015	0.0014	0.032	0.015	0.014
MT-E	0.0015	0.0007	0.0007	0.015	0.007	0.007
MT-F	0.0010	0.0005	0.0004	0.010	0.005	0.004
MT-G	0.0010	0.0005	0.0005	0.010	0.005	0.005
MT-H	0.0024	0.0011	0.0011	0.024	0.011	0.011
MT-I	0.0011	0.0005	0.0005	0.011	0.005	0.005
Average	0.0023	0.0010	0.0010	0.023	0.010	0.010

Kg REE's in 1 Million Metric Tons

Sample	Ce (kg)	La (kg)	Nd (kg)
MT-A	84000	37000	37000
MT-B	20000	10000	9000
MT-C	3700	2000	2000
MT-D	32000	15000	14000
MT-E	15000	7000	7000
MT-F	10000	5000	4000
MT-G	10000	5000	5000
MT-H	24000	11000	11000
MT-I	11000	5000	5000
Average	23300	10778	10444

Sample MT-C was collected on the Great Village side of the Cobequid Bay and the sand was of a coarser material than the other locations in the Bay and in the Shubenacadie River.



## Oxide Analysis – Whole Rock Geochemistry

(SiO<sub>2</sub>, Al<sub>2</sub>O<sub>3</sub>, TiO<sub>2</sub>, Fe<sub>2</sub>O<sub>3</sub>, CaO, MgO, Na<sub>2</sub>O, K<sub>2</sub>O, BaO, MnO, SrO)

Samples (0.1000g) are mixed with a flux of lithium metaborate and lithium tetraborate (1.000g). The mix is placed in graphite crucibles and fused at 1050°C for one hour. The fusion is allowed to cool to room temperature, and is then leached with 40 ml of 1:9 nitric acid in a plastic 250ml vessel. The solution is filtered through ashless filter paper into a 100ml volumetric flask. The flasks are made up to the 100ml mark, topped, and shaken. Dilutions may be required for analysis of some elements. The elements are determined by ICP OES. Reference samples from CANMET are analyzed with the samples to ensure that the fusions, digestions, and ICP OES analysis are complete and accurate.

Loss on Ignition (LOI) is performed using porcelain crucibles and a muffle furnace. A 0.5000 to 1.0000 gram sample is weighed into the porcelain crucible and heated to 1000 °C for one hour. The weight loss is calculated and reported as % LOI.

Reference: U.S. Geological Survey Bulletin 1401  
Rapid Analysis of Silicate, Carbonate  
and Phosphate Rocks-Revised Edition  
By Leonard Shapiro

Geological Survey of Canada Paper 74-19  
Analysis of Rocks and Minerals using  
an Atomic Absorption Spectrophotometer  
By Sydney Abbey, Naomi J.Lee and J.L.Bouvier

## Detection Limits for Quantitative Whole Rock Analysis

Li-Borate fusion, ICP OES (Radial) finish.

Oxide	Detection Limit (%)
Al <sub>2</sub> O <sub>3</sub>	0.01
BaO	0.01
CaO	0.01
Cr <sub>2</sub> O <sub>3</sub>	0.01
Fe <sub>2</sub> O <sub>3</sub>	0.01
K <sub>2</sub> O	0.01
MgO	0.01
MnO	0.01
Na <sub>2</sub> O	0.01
P <sub>2</sub> O <sub>5</sub>	0.01
SiO <sub>2</sub>	0.01
SrO	0.01
TiO <sub>2</sub>	0.01
V <sub>2</sub> O <sub>5</sub>	0.01
ZrO <sub>2</sub>	0.01
LOI (1000°C)	0.01

Daniel Chevalier  
Manager, Minerals Engineering Centre



## Detection Limits for Rare Earth Elements

Li-Borate fusion, ICP OES (Radial) finish.

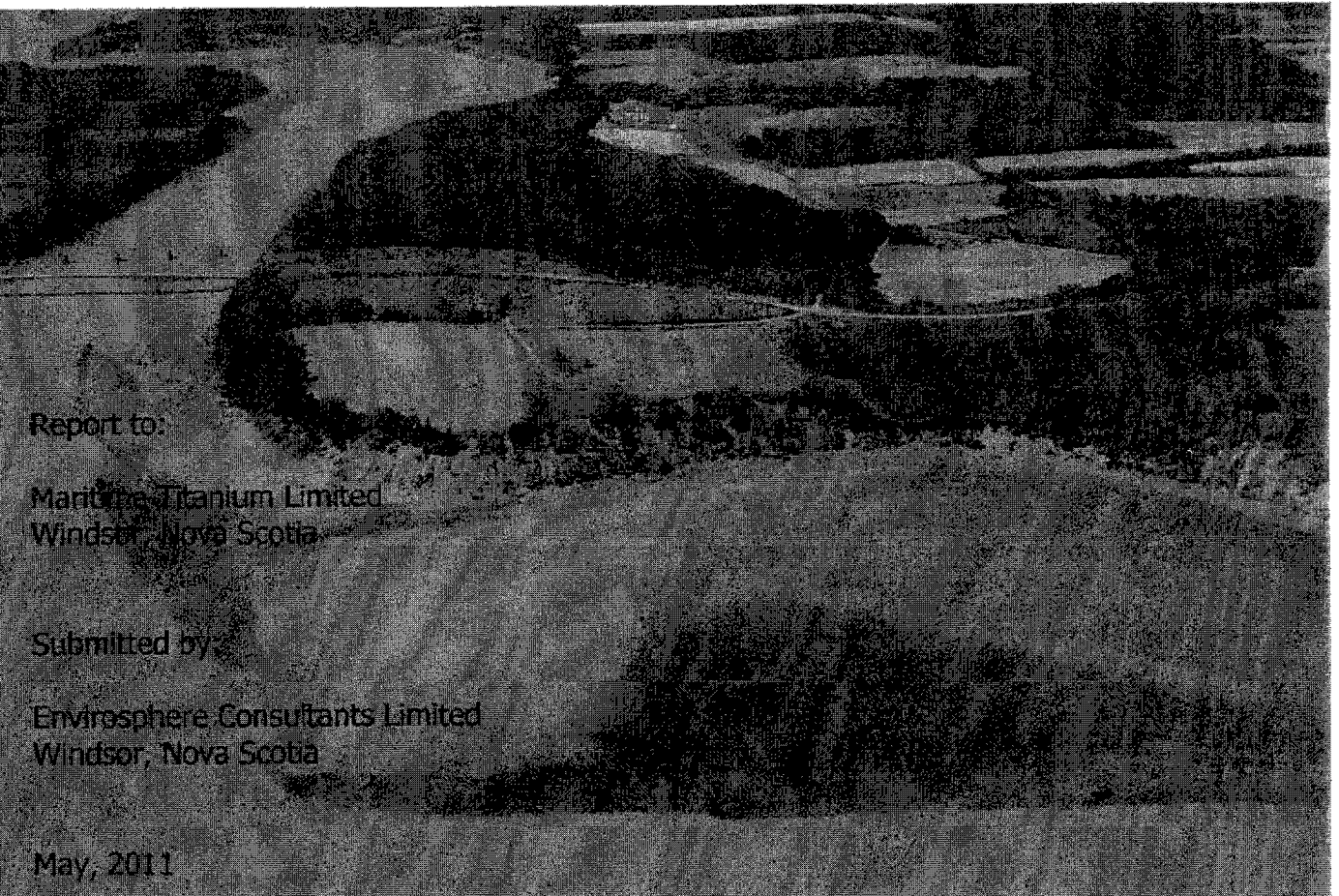
<u>Element</u>	<u>Detection Limit (mg/kg)</u>
Ce	5
Dy	10
Er	5
Eu	5
Gd	5
Ho	10
La	5
Lu	5
Nd	5
Pr	5
Sc	5
Sm	5
Tb	5
Th	50
Tm	10
Y	5
Yb	5

Daniel Chevalier  
Manager, Minerals Engineering Centre

Appendix C

Shubanacadie River Mineral Sands, Environmental Review; by Envirosphere  
Consultants Ltd.

# Shubenacadie River Mineral Sands Project— Environmental Background Review



Report to:

Maritime Titanium Limited  
Windsor, Nova Scotia

Submitted by:

Envirosphere Consultants Limited  
Windsor, Nova Scotia

May, 2011

Envirosphere Consultants Limited  
Unit 5—120 Morison Drive  
P.O. Box 2906  
Windsor, Nova Scotia B0N 2T0

Tel: (902) 798-4022 Fax: (902) 798-2614  
email: [enviroco@ns.sympatico.ca](mailto:enviroco@ns.sympatico.ca)  
[www.envirosphere.ca](http://www.envirosphere.ca)

**Envirosphere** CONSULTANTS  
LIMITED

Information contained in this report is confidential and may contain proprietary information and is intended solely for the use of Maritime Titanium Limited.

*Envirosphere Consultants Limited*  
P.O. 2906, Unit 5 – 120 Morison Drive  
Windsor, Nova Scotia B0N 2T0  
Tel: (902) 798-4022  
Fax: (902) 798-2614  
Email: [enviroco@ns.sympatico.ca](mailto:enviroco@ns.sympatico.ca)  
[www.envirosphere.ca](http://www.envirosphere.ca)

## Summary

Sand bars in the tidal portions of the Shubenacadie River and Cobequid Bay, Nova Scotia, contain economically viable concentrations of heavy minerals containing titanium dioxide, zircon, and rare earth compounds, which are increasingly important in the world economy. Maritime Titanium Limited of Nova Scotia is undertaking a pilot project to recover the minerals with a focus on rare earth compounds. With suitable environmental management, the project is not likely to result in significant environmental impacts, based on a review of present regulatory requirements and the findings of environmental assessments and resource inventories conducted in the Shubenacadie River up to 2007.

## Approach

Maritime Titanium Limited has commissioned EnviroSphere Consultants Limited, a Nova Scotia environmental consulting and research firm, to review and summarize potential environmental issues associated with recovery of heavy minerals from sand bars on the Shubenacadie Rive, based on an earlier environmental assessment (Martec 1999) and other unrelated assessments done in the river in the past decade. Since the first assessment in 1999, the regulatory environment both in Canada and Nova Scotia has changed, with the enactment of the Federal *Species at Risk Act* and the Provincial *Endangered Species Act*, which place additional emphasis on several fish species at risk which occur in the Shubenacadie River, including the American Eel, Striped Bass, Atlantic Sturgeon and Atlantic Salmon. In general, assessment of projects in Nova Scotia today also increasingly emphasizes the role of the First Nations—the Mi'kmaq people—in environmental assessment and stresses engagement and archaeological assessment. The approach taken by EnviroSphere has been to examine the earlier assessments and issues and present them in the modern context.

## Heavy Mineral Sands

The Shubenacadie River is the longest river in Nova Scotia, has the largest watershed<sup>1</sup>, and has the distinction of being a tidal river, in particular with a high tidal range over a large proportion of its length. The tides are driven by the high tides of the Bay of Fundy, into which the river flows, and result in regular reversals of flow, sometimes at extremely high velocities, twice each day. The tidal action over thousands of years has reworked natural sand deposits, sorting them to concentrate minerals containing metals including titanium, zirconium and various rare earth elements in sand bars in the lower reaches of the river and at its mouth. Commercially exploitable levels of these minerals are found in sand bars along a 20 km stretch of the river where it meets the Bay of Fundy tides and in the adjacent mouth of the Salmon River in Cobequid Bay. Originally recognized for the potential of the sands as a source of titanium dioxide, the sands also contain minerals containing zircon and rare earth elements, which are becoming increasingly commercially important to meet global demand in electronics and environmental applications. The potential of the heavy mineral sands has been promoted for its environmentally benign footprint, the quality of the deposits, and the proximity of the resource to international markets, as well as its economic development potential in a comparatively undeveloped part of Nova Scotia.

## Previous Heavy Mineral Sands Recovery Efforts

From 1999 to 2005, Titanium Company of Canada Limited (now Titanium Corporation Inc.) in a joint venture with NAR Resources Ltd, held mineral leases on the heavy mineral sands and pursued the

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<sup>1</sup> The drainage basin formed by the Shubenacadie River and the Stewiacke which flows into it, is the largest in Nova Scotia.

development of the Shubenacadie resource, conducting resource exploration and assessment, as well preliminary environmental investigation and recovery technology development. In 2005 the company abandoned the project based on a corporate decision to focus on alternate projects, in particular to develop the titanium potential of Alberta Tar Sands wastes<sup>2</sup>. Subsequently, a Nova Scotia private company, Maritime Titanium Limited, acquired the leases held by Titanium Company of Canada, including additional leases at the mouth of the Shubenacadie River in Cobequid Bay<sup>3</sup> and has undertaken to proceed with a pilot-scale project with a view to long-term commercial scale development of the resource.

### Technology Development—Recovery of the Minerals

Recovery of the heavy mineral sands from sand bars in the Shubenacadie River or in Cobequid Bay will be accomplished by a two-part process in which primary collection and separation of minerals will take place *in situ*—either on the river or in the bay—and secondary separation and concentration will occur on land at a dry mill plant. Of the material collected, less than 10% will be kept for onshore processing and in excess of 90% will be returned to the bar. Technology for mineral separation has been developed, but an important technical challenge of the project is the design of the barge with mounted equipment and approach to allow the equipment to work in the periodically high currents and changing water levels in the river; and to develop adequate docking and transfer facilities on shore. Primary collection will be accomplished on a barge supporting spiral concentrator towers roughly 10 m in height, a suction dredge, and a discharge pipe for the waste mineral stream. The suction dredge (~45 cm diameter) will be used to collect material from exposed mineral-bearing sand bars at low tide. Sand deposits found on the surface of sand bars have a high water content and are relatively fluid to permit suctioning, but if necessary additional water will be mixed with the sand to form a slurry which will be pumped to the top of the separators. The sand will flow through the separators and be separated on the basis of density into a dark, heavy stream containing the titanium- and rare-earth-bearing minerals which will be collected, and a less dense stream containing pale brown silicates, the latter which will immediately be discharged back onto the sand bar. From an environmental perspective, the sand bars have extremely low concentrations of fine particulates and consequently the disposal of the waste stream will not elevate suspended sediment levels when the tidal waters return to cover the bar at high tide. In addition, the separation process does not involve chemicals and consequently the composition of the material deposited on the bar will be largely unchanged over its natural state.

The recovered heavy mineral fraction will be transported to shore by a dedicated boat/barge, unloaded, and then shipped via truck or rail to a dry mill plant. At the plant, gravity, electrostatic, and electromagnetic separation of the high-grade mineral sand will occur through use of rotary dry density-based separation techniques. At this point, concentrated titanium dioxide, zircon, and rare earth minerals will be ready for shipping to North American or global markets.

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<sup>2</sup> Titanium Corporation was created in 2001 through the amalgamation of privately owned Titanium Company of Canada and publicly traded NAR Resources Ltd. Prior to amalgamation, the two companies, through a joint venture, held a 100% interest in titanium-bearing heavy mineral sands leases in the Shubenacadie River, near Truro, Nova Scotia, Canada. Titanium Corporation Inc.'s focus subsequently shifted to developing technology to recover heavy minerals, bitumen, solvent and water contained in the waste tailings streams from oil sands mining operations near Fort McMurray, Alberta. In 2005 the company decided not to undertake additional work or expenditures in Nova Scotia in favour of focusing on the oil sands development. [www.titaniumcorporation.com](http://www.titaniumcorporation.com).

<sup>3</sup> The Shubenacadie River flows into Cobequid Bay in the Minas Basin of the Bay of Fundy.

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## Overview—Environmental and Social Importance of the Shubenacadie River

The natural environment of the Shubenacadie River, Cobequid Bay, and mouth of the Salmon River, form an integrated biological and physical system unique in Nova Scotia—one that is a valuable and sustainable resource for Nova Scotian. It supports extensive biological resources of fish and wildlife, and has distinctive physical features including unique tidal bores, reversing river flows, and distinctive scenery. In addition to being a unique tidal river system, it is as well an estuary, which has particular importance for a productive biological ecosystem including marine, estuarine and freshwater fish species. In comparison to other Nova Scotian rivers, the Shubenacadie is distinctive for its length—its source is nearly 70 kilometres from its mouth. This connection fostered early use of the river as a waterway for movements by the Mi'kmaq and early development by European settlers of a canal system on the river to link the Halifax area to the Bay of Fundy. It is still used as a recreational and historic canoe route and the lower reaches for whitewater rafting. Of particular importance biologically, the extent of the river, as well as its major tributary, the Stewiacke River, means that many of the fish species found throughout a large area of Nova Scotia, pass through the lower Shubenacadie River and Cobequid Bay on their way to and from the ocean.

Fisheries is perhaps the main resource, with the many fish species supporting recreational (mostly) as well as commercial fishing activities; however the river still supports untouched shorelines which are important for wildlife. The Bay of Fundy into which the Shubenacadie River flows is an important summering and feeding area for migratory fish such as American shad for the entire east coast of North America south of Nova Scotia. The shores and waters of the Shubenacadie River also have expanses of forest stands, significant wildlife populations including raptors such as Bald Eagles and Osprey which along the shore, and seals and marine mammals including harbour porpoise can also enter with the tide. The scenic nature as well as the unusual high tides and tidal bore of the river make the area an attraction for tourists.

Like many other watersheds in Nova Scotia, the Shubenacadie-Stewiacke River Basin is also subject increasingly to environmental threats including increasing urban development, water withdrawal, changes in the flow regime, and pollution. In past the tidal portions of the river were also impacted by reclamation of saltmarshes along the shoreline to create dykeland which is still used for farming.

In contrast to these activities, the proposed project will have a small environmental footprint and be localized in the lower part of the watershed. Most of the potential environmental concerns of the present project involve potential interactions with human and biological uses of the environment. Environmental issues involving the Shubenacadie River, which will be important in assessing the impacts and guiding the responsible execution of the project are summarized in Tables 1 & 2.

## Previous Environmental Assessment Studies

Two environmental assessments of the biophysical and socioeconomic environment of the Shubenacadie River have been carried out since 1999, and provide detailed environmental background against which an assessment of the potential impacts of the project can be made. The scope and outcomes of the assessments are presented in Table 1. The first was the pre-development environmental assessment carried out for Titanium Corporation in 1999 by Martec Limited of Halifax, Nova Scotia<sup>4</sup>. The Martec

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<sup>4</sup> The environmental assessment was carried out in association with ADI Limited (hydrogeology), biological consultants (Dave Scarratt and Associates, Dr. David Scarratt (aquatic biology); Dr. Michael Dadswell, Acadia

study presented a physical, hydrological, and biological overview of the Shubenacadie including the results of modeled sediment movement and suspended sediment levels on bars in the river.

The Martec study concluded that the environmental impact of the proposed mineral recovery project would be negligible. The river in portions proposed for recovery was highly dynamic and any physical disturbance caused by the recovery project, including changes to sandbars and suspended sediment levels in the river would be negligible when compared with the natural variation at the site; in addition, there was little potential for impact of the project on the biological resources. Public consultation and interviews carried out, in particular with operators of ecotourism businesses who conduct local tidewater rafting activities, indicated that there were no impediments from a socioeconomic perspective.

A second and more extensive environmental assessment on another type of project on the Shubenacadie River in the vicinity of the mineral sands project, but which had the potential to affect similar resources, was carried out by Jacques Whitford Environment Limited of Dartmouth, Nova Scotia, in 2007 as part of a major project to create underground salt caverns for natural gas storage<sup>5</sup>. The project required the use of water from the river, would use the river discharge of salty brine, and included the construction of an intake and outfall structure on the river. An addendum to the assessment at the request of the regulators included a review of fisheries issues in the Shubenacadie River by Thaumass Environmental (Bob Rutherford) a local expert in fish biology. The project assessed potential impacts on all the same resources, in particular on fisheries resources, which are the biggest potential environmental issue for operations in the Shubenacadie; included a Mi'kmaq ecological knowledge study which covered a 10 km radius of the study, and therefore including much of the river in the project area for the present project; and addressed *Species at Risk Act* concerns<sup>6</sup>. The project was eventually approved by the Province of Nova Scotia with requirements for the monitoring of fish eggs and larvae in the vicinity of the intakes and outfalls; as well as requiring consultation with the Mi'kmaq during the development of the project, to ensure their input and participation as the project proceeded.

In addition to these assessments, research on the dynamics of sand bars was carried out in a BSc. Honours thesis supervised by Dr. Cliff Stanley of Acadia University, Department of Geology, supported by Titanium Corporation. The study, carried out in the summer and fall of 2002, documented the dynamic nature and lack of biological communities on the bars, but also suggested consideration would have to be given to the turbulence generated by anchored barges [if these were used] and its role in disturbing the steady-state conditions on the bar, and perhaps re-distributing sand elsewhere. Although not a major environmental issue, the development of an adequate technological approach to the recovery process, which takes into account these potential changes, should be undertaken to ensure success of the project.

The information developed for these two environmental assessments and the Acadia University Thesis is probably sufficient with minor updating to assess the present project, and give an indication that the

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University, Department of Biology (fish and fisheries); and Envirosphere Consultants (Mr. Patrick Stewart, M.Sc.) (wildlife, commercial fisheries, benthic communities and sediments).

<sup>5</sup> The Alton Natural Gas Project pursued by Alton Natural Gas Storage LP (Limited Partnership) proposed to create storage caverns for natural gas by dissolving natural salt deposits located northeast of Stewiacke, Nova Scotia, and piping the dissolution water and brine approximately 10 km to and from the Shubenacadie River. The project was given an approval to proceed in December 2007.

<sup>6</sup> The Canadian *Species at Risk Act* came into effect in 2002, after the Martec environmental assessment had been done, and therefore presented additional requirements of projects in the river in relation to species at risk. In particular, it placed particular emphasis on protecting several fish species including Atlantic salmon and candidate species, striped bass (which is found in a local population in the Shubenacadie River) and American eel. In addition, Atlantic Sturgeon, also known to occur within the bay and river, is a provincially protected *red status* species.

Since both previous EAs described above were confined to the river upstream of its mouth in Maitland, additional scope for the assessment will need to include the biophysical and socioeconomic environment of Cobequid Bay and associated Bay of Fundy rivers; however it is expected that the project will be sufficiently benign to receive regulatory approvals under the present regulatory regime. A comprehensive overview of issues likely to be included in the environmental assessment for the project is presented in Table 2.

## Public Consultation

As part of the earlier environmental process surrounding the development of the Shubenacadie River mineral sands deposits, citizens in the community including the First Nations were consulted over potential interests and concerns over the project. One of the present proponents, Mr. Elwood Dillman, has met with the community and did not find any substantial negative opposition to the project. The public, including legislators, municipal governments, and local economic development agencies recognize the economic development potential of a project such as this in the area and fully support it. A similar consensus was found for the Alton Gas Storage Project.

## Conclusion

In conclusion, if the technological and logistical challenges of operating the project in the highly tidal conditions in the river can be solved, there will be negligible impacts of the project on the biological and physical environment of the Shubenacadie River and Cobequid Bay. As in other projects of its scope, the challenge for the proposed project is not so much the activities that will take place on the bars in the river, but the political issues of ensuring acceptance of the project by stakeholders, in particular in ensuring the cooperation of the Mi'kmaq. Involvement and cooperation of the community, as well as sound environmental management, should be a major long-term objective in the further development of this project.

## References

- Martec Limited. 1999. Nova Scotia Mineral Sands Project—Shubenacadie river. Phase I: Pre-Feasibility Study. Report to Titanium Corporation of Canada Ltd. Martec Limited, Halifax, Nova Scotia, Report TR-99-25, August 18, 1999.
- Jacques Whitford Environment Limited (JWEL). 2007. Final Report. Environmental Registration for the Proposed Alton Natural Gas Storage Project. Report to: Alton Natural Gas Storage LP. Project Number: 1012229. June 14, 2007.

## Tables:

Table 1. Environmental Assessments for the Shubenacadie River.		
Valued Environmental Components (VECs)	Martec (1999)	Alton Natural Gas Storage (2007) <sup>1</sup> (JWEL 2007)
<b>SCOPE OF ENVIRONMENTAL ASSESSMENT</b>		
Spatial Extent	Shubenacadie River estuary seaward from the Town of Shubenacadie including Salmon River mouth and Cobequid Bay.	Within 5 km of the project including upper estuary of Shubenacadie River. Mi'kmaq Ecological Knowledge study covered 10 km radius of the Town of Shubenacadie.
Environmental Components	Hydrology and Hydrogeology, Sediment Dynamics and Suspended Sediment Modeling, Biological Components (Fish and Fisheries, Benthic Invertebrates, Birds and other Wildlife), Tourism and Recreational Boating	Physical Oceanography of the upper estuary; Biological Components (Fish and Fisheries, Benthic Invertebrates, Birds and other Wildlife, Species at Risk); Tourism and Recreational Boating [also included terrestrial botany and wildlife as a pipeline was involved].
<b>Socioeconomic VECs</b>		
Mi'kmaq Community	Not considered	Current and traditional hunting and fishing sites in the area. Fishing for striped bass, salmon, eels. Project will not affect Mi'kmaq activities.
Recreational Fishing	No potential effects.	Project activities are localized and unlikely to conflict with recreational fishing to a significant extent.
Commercial Fishing	No potential effects. Schedule to avoid seasonal drift net fishery.	Net fisheries for gaspereau and American shad in spring (April-May). Impact not assessed.
Recreational Boating/ Ecotourism	No conflict predicted.	Not assessed
<b>Biological VECs</b>		
Fish	Small level of effects. Possible entrainment of small numbers of fish if hydraulic cutter dredge is used.  Most fish will simply pass by the equipment on the ebb and flood tide.	Adults, juveniles, eggs and larvae of a range of fish occur in the river throughout the year. Adults and juveniles unlikely to be affected by entrainment. Presence of eggs and larvae can be monitored and activities managed to avoid conflicts.

Table 1. Environmental Assessments for the Shubenacadie River.		
Valued Environmental Components (VECs)	Martec (1999)	Alton Natural Gas Storage (2007) <sup>1</sup> (JWEL 2007)
Wildlife	<p>Limit extent of activities to avoid eagle nesting and avoid critical periods.</p> <p>Wouldn't affect shorebird feeding activity or food resources.</p>	<p>Conduct activities with sufficient separation from nesting raptors.</p> <p>Marine mammals stay in channels and wouldn't be affected.</p> <p>Project wouldn't affect food resources (i.e. fish and invertebrates).</p>
Species at Risk	Not a key issue at the time due to absence of pertinent legislation.	Federally listed or candidate Atlantic Salmon and American eel; and provincially red-listed salmon, Striped Bass and Atlantic Sturgeon. Species not likely to be affected.
Physical VECs		
Groundwater	Activities will not affect groundwater resources.	Not Assessed
Shoreline Structure and Erosion	Not assessed.	Project a small area in a large river. No effect.
1. The effects on the river are considered. The structure assessed was an intake and outfall set in a side channel of the Shubenacadie River.		

Table 2. Updated Environmental Issues and Assessment – Shubenacadie Heavy Mineral Sands Project	
Environmental Concern	Assessment
<b>Accidents</b>	
Use of new recovery technology and vessels in a macrotidal (high-tidal range) river can lead to vessel accidents.	Equipment design and project planning for safe and reliable operation will minimize the likelihood of accidents. Threat of a major accident is unlikely.
Accidental spills of fuel and other chemicals	Hydrocarbon spills (fuels, hydraulic fluids, oil and grease) potentially can have significant impacts on wildlife, particularly water-associated birds. Environmental management planning will reduce possibility of spills of hydrocarbons and other chemicals.
Spills of product during transfer	Recovered heavy minerals originate in the river, have not been changed in chemical characteristics, and would not be a hazard if released accidentally, and therefore they would not be expected to impact the local environment.
<b>Socioeconomic Environment</b>	
Mi'kmaq Activities	The mineral sand bars have not been identified as having particular significance to Mi'kmaq peoples, although sandbars in the Stewiacke river were once used to cross the river. Use of the area for hunting and fishing, medicinal and artisanal plants and materials is possible. Potential to involve the Mi'kmaq in the project could be a positive aspect of the project.
Recreational Boating (Fishermen and River Rafters)	Some recreational hook-and-line fishing may occur. Interference of anchor lines for the recovery operation with vessel traffic. Scale and extent of projects may be limited to accommodate coexistence of multiple uses.
Recreational Fishing	Recreational hook-and-line fishing may occur from shore and is not expected to be impacted by the project.
Commercial Fishing	Net fisheries for gaspereau and American shad in spring (April-May). Project activities can be scheduled to avoid peak periods.
Ecotourism	Project not likely to interfere with ecotourism activities such as river rafting, nature viewing and appreciation, in the area.
<b>Physical Environment and Hydrology</b>	
River Flow	Project Structures will not interfere to a significant extent with flow in the river, and effects will be small relative to other structures (e.g. bridges).
Groundwater	Project will not interfere with groundwater resources on shore.
Sand Bar Structure	Creation of eddies, and erosion of footings and anchor points could affect local sand bar configuration and movement. Effect would be small in relation to natural turnover and movement of bottom sediments.
Ice Conditions	Build-up of ice and ice floes on the Shubenacadie occurs in winter and will prevent operations in the river from approximately December through February.
Shoreline Erosion and Accretion	Wharf or landfall interferes with flow and causes local sedimentation/accretion and/or erosion; effect would be localized and small in relation to overall river.
<b>Biological Environment</b>	

Table 2. Updated Environmental Issues and Assessment – Shubenacadie Heavy Mineral Sands Project	
Environmental Concern	Assessment
Survival of Fish Eggs and Larvae	<p>Redistribution and sorting of materials on sand bars could raise suspended sediment levels turbidity; however effect is small in relation to naturally high levels found in tidal portions of the Shubenacadie and fish are adapted to elevated turbidity and suspended sediment.</p> <p>If hydraulic cutter dredge is used, water drawn into the system could entrain fish and fish eggs and larvae. Adult fish unlikely to be affected due to avoidance, and a small proportion of larvae and eggs of various species may be affected.</p>
Fish Spawning	<p>Several fish species spawn in the river but activities are unlikely to conflict with them [Striped bass and sturgeon spawn at head of tide in Stewiacke River but eggs and larvae could occur downstream; Atlantic tomcod spawn in estuary in Jan-Feb and unlikely to conflict with project because activities would be curtailed at that time due to ice conditions].</p>
Benthic Community	<p>Bottom animals which are food for fish and shorebirds occur on sand bars and flats. Distribution is patchy and generally abundance is low, but could still offer a significant localized food source. The project will likely utilize only a small area of the available habitat at a given time and therefore will have a small overall impact on the benthic community. Dredging could be focused on the more erosional portions of sand bars rather than depositional areas.</p>
Fish Passage	<p>Fish pass through the river and potentially could encounter and be diverted or harmed by project equipment but the area occupied, and the consequent likelihood of encounter, is small. Project activity may be limited to low tide periods when fish are not present, and to seasons of low fish activity.</p>
Species at Risk	<p>Several fish species with conservation status occur in the Shubenacadie River and pass the site during their migrations and normal movements; although effects are likely to be negligible, the scale of commercial developments (e.g. concurrent recovery from multiple bars) which are permitted may be limited to moderate levels.</p> <p>A rare clam (Atlantic Mud Piddock) occurs in the waters of Minas Basin near the mouth of the Shubenacadie River. The species occurs in exposed sandstone outcrops and is threatened by by burial and physical damage to it's outcrop habitat. The project will not result in additional sedimentation and will not be occurring in the vicinity of the Piddock, and therefore will not impact on the clam's population.</p>
Water-Associated Birds	<p>No localized concentrations of activities (nesting/feeding) of water-associated birds occur in the vicinity of the project, and these groups would not be affected by project activities. Accidents resulting in spills of hydrocarbons and other materials are an important consideration and would be mitigated by proper environmental management.</p>

Environmental Concern	Assessment
Shorebirds	Shorebirds would feed on mudflats associated with some of the sand bars; however the numbers interacting with the project would be small due to the generally small area occupied by the project and the small proportions of shorebirds affected.
Disturbance of Raptors (Eagles & Osprey)	Activities and noise could disturb nesting eagles and feeding osprey. The footprint of the project is small in relation to the area of landscape in the area and it is unlikely that species would be disturbed.
Wetlands	Activities on sand bars would not affect wetlands; wharves and associated transfer structures may interfere with salt marsh vegetation along the shore, but sites could be selected to avoid salt marshes.

**Form 10 - Statement of Assessment Work Expenditure**  
(pursuant to the *Mineral Resources Act*, S.N.S. 1990, c. 18, s. 43(1))

(Complete as necessary to substantiate the total claimed.)

Re: Licence No. 09186 Date of issue July 28, 2010

Type of Work		Amount Spent
1. Prospecting	_____ days	
2. Geological mapping	_____ days	
3. Trenching/stripping/refilling	_____ m <sup>2</sup> / _____ m <sup>3</sup>	
4. Assaying & whole rock analysis	_____ #	2300.00
5. Other laboratory	_____ #	1800.00
6. Grid:		
(a) Line cutting	_____ km	
(b) Picket setting	_____ km	
(c) Flagging	_____ km	
7. Geophysical surveys		
Airborne:		
(a) EM/VLF	_____ km	
(b) Mag or Grad	_____ km	
(c) Radiometric	_____ km	
(d) Combination	_____ km	
(e) Other	_____ km	
8. Geophysical surveys		
Ground:		
(a) EM/VLF	_____ km	
(b) Seismic soundings	_____ #	
(c) Magnetic/telluric	_____ km	
(d) IP/resistivity	_____ km	
(e) Gravity	_____ km	
(f) Other	_____ km	
9. Geochemical surveys		
(a) Lake, stream, spring		
(i) Water	_____ samples	
(ii) Sediments	_____ samples	
(b) (i) Rock	_____ samples	
(ii) Core	_____ samples	
(iii) Chips	_____ samples	
(c) (i) Soil	_____ samples	
(ii) Overburden	_____ samples	
(d) Gas	_____ samples	
(e) Biogeochemistry	_____ samples	
(f) Sample collection	_____ samples	
(g) Other	_____ days	3525.00
10. Drilling:		
(a) Diamond (# holes/m)	_____ / _____ m	
(b) Percussion (# holes/m)	_____ / _____ m	
(c) Rotary (# holes/m)	_____ / _____ m	
(d) Auger (# holes/m)	_____ / _____ m	
(e) Reverse circulation (# holes/m)	_____ / _____ m	
(f) Logging, supervision, etc.	_____ days	
(g) Sealing (# holes)	_____ #	
11. Other (describe)		
<u>Environmental Report</u>		4125.00
Subtotal		
<b>Overhead costs</b>		
12. Secretarial services		900.00
13. Drafting services		
14. Office expenses (rent, heat, light, etc.)		450.00
15. Field supplies		300.00
16. Compensation paid to landowners		
17. Legal fees		412.50
18. Other (describe)		825.00
Subtotal		
Grand total		14,637.50



**Form 10 - Statement of Assessment Work Expenditure**  
(pursuant to the *Mineral Resources Act*, S.N.S. 1990, c. 18, s. 43(1))

(Complete as necessary to substantiate the total claimed.)

Re: Licence No. 09187 Date of issue July 28, 2000

Type of Work		Amount Spent
1. Prospecting	_____ days	
2. Geological mapping	_____ days	
3. Trenching/stripping/refilling	_____ m <sup>2</sup> / _____ m <sup>3</sup>	
4. Assaying & whole rock analysis	_____ #	1500.00
5. Other laboratory	_____ #	1200.00
6. Grid:		
(a) Line cutting	_____ km	
(b) Picket setting	_____ km	
(c) Flagging	_____ km	
7. Geophysical surveys		
Airborne:		
(a) EM/VLF	_____ km	
(b) Mag or Grad	_____ km	
(c) Radiometric	_____ km	
(d) Combination	_____ km	
(e) Other _____	_____ km	
Ground:		
(a) EM/VLF	_____ km	
(b) Seismic soundings	_____ #	
(c) Magnetic/telluric	_____ km	
(d) IP/resistivity	_____ km	
(e) Gravity	_____ km	
(f) Other _____	_____ km	
9. Geochemical surveys		
(a) Lake, stream, spring		
(i) Water	_____ samples	
(ii) Sediments	_____ samples	
(b) (i) Rock	_____ samples	
(ii) Core	_____ samples	2511 10.00
(iii) Chips	_____ samples	
(c) (i) Soil	_____ samples	
(ii) Overburden	_____ samples	
(d) Gas	_____ samples	
(e) Biogeochemistry	_____ samples	
(f) Sample collection	_____ samples	2935.00
(g) Other _____	_____ days	
10. Drilling:		
(a) Diamond (# holes/m)	_____ / _____ m	
(b) Percussion (# holes/m)	_____ / _____ m	
(c) Rotary (# holes/m)	_____ / _____ m	
(d) Auger (# holes/m)	_____ / _____ m	
(e) Reverse circulation (# holes/m)	_____ / _____ m	
(f) Logging, supervision, etc.	_____ days	
(g) Sealing (# holes)	_____ #	
11. Other (describe)		
<u>Environmental Report</u>		3450.00
Subtotal		
<b>Overhead costs</b>		
12. Secretarial services		750.00
13. Drafting services		
14. Office expenses (rent, heat, light, etc.)		375.00
15. Field supplies		425.00
16. Compensation paid to landowners		
17. Legal fees		350.00
18. Other (describe)		690.00
Subtotal		
Grand total		11,675.00



**Form 10 - Statement of Assessment Work Expenditure**  
(pursuant to the *Mineral Resources Act*, S.N.S. 1990, c. 18, s. 43(1))

(Complete as necessary to substantiate the total claimed.)

Re: Licence No. 09198 Date of issue July 28, 2010

Type of Work		Amount Spent
1. Prospecting	_____ days	
2. Geological mapping	_____ days	
3. Trenching/stripping/refilling	_____ m <sup>2</sup> / _____ m <sup>3</sup>	
4. Assaying & whole rock analysis	_____ #	135.00
5. Other laboratory	_____ #	105.00
6. Grid:		
(a) Line cutting	_____ km	
(b) Picket setting	_____ km	
(c) Flagging	_____ km	
7. Geophysical surveys		
Airborne:		
(a) EM/VLF	_____ km	
(b) Mag or Grad	_____ km	
(c) Radiometric	_____ km	
(d) Combination	_____ km	
(e) Other	_____ km	
8. Geophysical surveys		
Ground:		
(a) EM/VLF	_____ km	
(b) Seismic soundings	_____ #	
(c) Magnetic/telluric	_____ km	
(d) IP/resistivity	_____ km	
(e) Gravity	_____ km	
(f) Other	_____ km	
9. Geochemical surveys		
(a) Lake, stream, spring		
(i) Water	_____ samples	
(ii) Sediments	_____ samples	
(b) (i) Rock	_____ samples	
(ii) Core	_____ samples	
(iii) Chips	_____ samples	
(c) (i) Soil	_____ samples	
(ii) Overburden	_____ samples	
(d) Gas	_____ samples	
(e) Biogeochemistry	_____ samples	
(f) Sample collection	_____ days	
(g) Other		
10. Drilling:		
(a) Diamond (# holes/m)	_____ / _____ m	
(b) Percussion (# holes/m)	_____ / _____ m	
(c) Rotary (# holes/m)	_____ / _____ m	
(d) Auger (# holes/m)	_____ / _____ m	
(e) Reverse circulation (# holes/m)	_____ / _____ m	
(f) Logging, supervisor, etc.	_____ days	
(g) Sealing (# holes)	_____ #	
11. Other (describe)		
<u>Environmental Report</u>		305.00
Subtotal		
<b>Overhead costs</b>		
12. Secretarial services		666.00
13. Drafting services		
14. Office expenses (rent, heat, light, etc.)		35.00
15. Field supplies		37.00
16. Compensation paid to landowners		
17. Legal fees		30.00
18. Other (describe)		610.00
Subtotal		
Grand total		1034.00



**Form 10 - Statement of Assessment Work Expenditure**  
(pursuant to the *Mineral Resources Act*, S.N.S. 1990, c. 18, s. 43(1))

(Complete as necessary to substantiate the total claimed.)

Re: Licence No. 09201 Date of issue July 28, 2010

Type of Work		Amount Spent
1. Prospecting	_____ days	
2. Geological mapping	_____ days	
3. Trenching/stripping/refilling	_____ m <sup>2</sup> / _____ m <sup>3</sup>	
4. Assaying & whole rock analysis	_____ #	165.00
5. Other laboratory	_____ #	125.00
6. Grid:		
(a) Line cutting	_____ km	
(b) Picket setting	_____ km	
(c) Flagging	_____ km	
7. Geophysical surveys		
Alrborne:		
(a) EM/VLF	_____ km	
(b) Mag or Grad	_____ km	
(c) Radiometric	_____ km	
(d) Combination	_____ km	
(e) Other	_____ km	
8. Geophysical surveys		
Ground:		
(a) EM/VLF	_____ km	
(b) Seismic soundings	_____ #	
(c) Magnetic/telluric	_____ km	
(d) IP/resistivity	_____ km	
(e) Gravity	_____ km	
(f) Other	_____ km	
9. Geochemical surveys		
(a) Lake, stream, spring		
(i) Water	_____ samples	
(ii) Sediments	_____ samples	
(b) (i) Rock	_____ samples	
(ii) Core	_____ samples	
(iii) Chips	_____ samples	
(c) (i) Soil	_____ samples	
(ii) Overburden	_____ samples	
(d) Gas	_____ samples	
(e) Biogeochemistry	_____ samples	
(f) Sample collection	_____ samples	
(g) Other	_____ days	325.00
10. Drilling:		
(a) Diamond (# holes/m)	_____/_____/_____ m	
(b) Percussion (# holes/m)	_____/_____/_____ m	
(c) Rotary (# holes/m)	_____/_____/_____ m	
(d) Auger (# holes/m)	_____/_____/_____ m	
(e) Reverse circulation (# holes/m)	_____/_____/_____ m	
(f) Logging, supervision, etc.	_____ days	
(g) Sealing (# holes)	_____ #	
11. Other (describe)		
<u>Environmental Report</u>		380.00
Subtotal		
Overhead costs		
12. Secretarial services		85.00
13. Drafting services		
14. Office expenses (rent, heat, light, etc.)		45.00
15. Field supplies		50.00
16. Compensation paid to landowners		
17. Legal fees		40.00
18. Other (describe)		75.00
Subtotal		
Grand total		1290.00

