Travers

PROPOSAL

AN INVESTIGATION OF THE POTENTIAL FOR GROUNDWATER CONTAMINATION CAUSED BY PAST AND PRESENT MINING, MILLING AND METALLURGICAL PROCESSING ACTIVITIES IN NOVA SCOTIA AND NEW BRUNSWICK

Proposal No. 141-86-P

Submitted to:

Environment Canada - Environmental Protection Service

By:

Nolan, Davis & Associates (N.S.) Limited

January 1987

NOLAN, DAVIS & ASSOCIATES
(NS) LIMITED
CONSULTING ENGINEERS AND GEOLOGISTS

January 9, 1987
Proposal No. 141-86-P

Ms. D. Vautour
Material Management Supervisor
Environment Canada - EPS
5th Floor, Queen Square
45 Alderney Drive
Dartmouth, N.S.
B2Y 2N6

Dear Ms. Vautour:

Re: An Investigation of the Potential for Groundwater Contamination Caused by Past and Present Mining, Milling, and Metallurgical Processing Activities in Nova Scotia and New Brunswick

Nolan, Davis & Associates (N.S.) Limited is pleased to submit our proposal for the above project as per the Statement of Work attached to your December 19, 1986 letter. As requested by Mr. I. Travers, we are enclosing five (5) copies of our proposal.

If you have any questions regarding our proposal, please contact me at your convenience.

Yours very truly

NOLAN, DAVIS & ASSOCIATES
(NS) LIMITED

Harold LeBlanc

Harold LeBlanc, M.Sc.
Senior Hydrogeologist

HLB/jmd

Encls.

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TABLE OF CONTENTS

1.0 SCIENTIFIC AND TECHNICAL PROPOSAL

The following sections provide a Terms of Reference that can be used to issue a firm price contract. To this end, Nolan, Davis & Associates (N.S.) Limited (NDAL) have defined the scope of work, our methodology to complete the work, and the products that will be provided to the Client.

1.1 Objectives

The objectives, based on the Statements of Work given in the Request for Proposal dated December 19, 1986, are as follows:

i) Identify sites in Nova Scotia and New Brunswick containing solid or liquid wastes or product storage piles form past or present mining, milling, and metallurgical processing activities and which, through direct discharge, seepage, or runoff would be or could become sources or groundwater contamination.

ii) Identify and rank in order to priority specific mining, milling, and metallurgical processing waste disposal or product storage sites or areas at or in which future investigations, including monitoring and water well sampling and/or protective or treatment measures, could be required to ascertain or protect the quality of groundwater and recipient surface water bodies.

iii) Recommend the types of field investigations which would be required to ascertain the remedial measures required to protect or restore groundwater or recipient surface water

quality in the vicinity of sites identified in objective ii).

1.2 Background

It is understood that the concept for this project arose as a result of the 1986 Beak study * which assessed the status of aquifer contamination in Canada. As a result of the Beak study, Environment Canada personnel have decided to deal specifically with groundwater contamination associated with mining and related developments.

We understand this study is being undertaken as a "pilot" study which may be subsequently conducted in other regions of Canada. Given its "pilot" nature, NDAL, if chosen to undertake this project, is willing to make an extra effort which will ensure production of high quality final report.

1.3 Approach

Nolan, Davis & Associates feels this project can be best undertaken by an experienced hydrogeological consulting firm with extensive related mining experience, whose staff are familiar with many of the mining operations (current and past) in both Nova Scotia and New Brusnwick. We propose a scope of work which recognizes the extent of existing information, the variety

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* Nolan, Davis & Associates were responsible for Atlantic Canada's component of this national study.

of potential groundwater contaminants, and a study team with extensive experience at mine sites throughout both provinces.

1.4 Technical Proposal

We propose that the work be undertaken in eight tasks as out lined in the Statement of Work, each dealing with a specific aspect of the study.

1.4.1 Task 1 - Identify, Locate, Characterize, Quantify, and Describe Deposits Containing Wastes and Stored Products

In undertaking this Task, NDAL will rely upon proprietary information gained from previous studies, knowledge of study team members, regulatory agency contacts, and knowledge of existing pertinent reports.

Within Nova Scotia, NDAL has recently completed an "Environmental Constraints Study" for Nova Scotia Department of Mines and Energy (NSDME). This study involved visiting our mine and major quarry operations in the province (40 total) and an evaluation of the environmental inplications of each property and the impact of regulatory requirements on each operation. NDAL staff are thus familiar with the current status of environmental conditions, including potential/current groundwater contamination problems at all mine sites in Nova Scotia. These proprietary field insights will add significantly to the documentation of current/potential groundwater problems within Nova Scotia at no

additional study cost. These insights would include specific information on waste disposal practices, treatment systems, and monitoring programs.

Besides these current operations, we know that substantial numbers of abandoned operations exist in Nova Scotia, primarily related to past gold, coal, gypsum, and barite mining activities. Fortunately, in each case, previous compilation studies exist as follows:

- gold - Montreal Engineering Company, 1978 - Assessment of Water Quality at Abandoned Gold Properties in Nova Scotia
- coal - NSDOE/EPS - Abandoned Landfill Program - Phase I report for Nova Scotia
- gypsum - NSDME - Currently have a compilation study in progress for all existing/former gypsum and anhydrite operations
- barite - NSDME, 1978 - Bulletin No. 4 - Barite, Celestite, and Fluorite in Nova Scotia

For other abandoned mineral/metallurgical operations, we will rely upon our staff knowledge, regulatory agency files, available reports, and industry contacts. Our current information suggests iron, tungsten, potash, vermiculite, pyrophyllite, and asbestos were not produced in Nova Scotia and will not have to be considered.

In New Brunswick, NDAL staff are familiar with the existing mining/metallurgical operations as well as many of the pertinent abandoned operations. The major operations include the following:

OPERATION	PRODUCT	STATUS
Brunswick Mines	Base Metals	Active
Heath Steele	Base Metals	Inactive
Nigigoo River	Base Metals	Closed
Anaconda Caribou	Base Metals	Inactive
Mount Pleasant	Tungsten	Inactive
Consolidated Durham	Antimony	Active
Minto Coal	Coal	Active
Potash Company of America	Potash	Active
Denison Mines	Potash	Active

As in Nova Scotia, NDAL will rely upon regulatory agency contacts (e.q. Mr. Vaclav Kresta - New Brunswick Department of Municipal Affairs and Environment, New Brunswick Department of Forestry, Mines and Energy (NBDFME) published reports and personal contacts to identify abandoned and existing producers. The New Brunswick Phase I - Abandoned Landfill report (Crandal & Associates, 1982) will provide useful information on prominent waste sites.

We anticipate no difficulty in identifying, the existing or recent mines/processors in either province. However, the level of information on abandoned operations will likely be less detailed.

We propose to utilize a tabular format for provision of most of the Task 1 data. For major existing, inactive or abandoned operations (i.e. the priority sites) additional summary descriptions of potential/existing contamination problems may be

undertaken. It is anticipated these descriptions will be half to one page in length and, as stated, deal specifically with contaminant problems at these sites.

The Task 1 Statement of Work stipulates a "2 km" radius between producers and existing/potential ground or surface water users. It has been NDAL's experience that significantly different interpretations can be placed on what constitutes a "user". For the purposes of this study, we propose to adopt the criteria that either "known" (i.e. to regulatory agency, mine officials, etc.) users exist or habitation identifiable from 1:50,000 scale maps be found within this 2 kilometre radius.

1.4.2 Task 2 - Identify, Characterize, and Delineate Known Aquifers Underlying Waste and Storage Piles

We will utilize existing regional water resources reports produced by NSDOE and NBDMAE in conjunction with available geological (bedrock and surficial) maps to provide this information. We are intimately familiar with all the regional reports produced by these agencies and have used these reports on numerous previous studies. Groundwater flow directions will be extrapolated from 1:50,000 topographic maps, while gradient information will be presented if available from previous reports for the site. For those sites which are not covered by such regional reports, aquifer characteristics will be extrapolated from existing bedrock and surficial geology maps.

Given the likely number of sites which will be considered, NDAL proposes to use a tabular format.

1.4.3 Task 3 - Characterize and Assess Groundwater Quality in the Aquifers

For many of the major active or recently abandoned sites, it is anticipated that site specific groundwater quality data may exist. In most cases, the regional groundwater quality will be characterized in NSDOE and NBDMAE reports discussed previously. In either case, the most appropriate and representative groundwater quality data will be collected and summarized in tabular format for all operations for which it is available. Sites for which no specific or regionally representative data exists will be identified. The assessment of groundwater quality will be based upon the Guidelines for Canadian Drinking Water Quality 1978 (Health and Welfare, 1979).

1.4.4 Task 4 - Identify and Characterize Adjacent WaterUsers

Most operations will be located within rural areas and adjacent users will rely upon.

source users
farm - livestock

- deep drill wells
- shallow dug wells
- springs
- surface water

Since NSDOE and NBDMAE do not list dug well, spring, or small surface water users, there is no means by which the distribution of the above supply sources can be calculated. Without

undertaking site specific water use surveys, it will not be possible to complete this Task as outlined.

As an alternative, we would propose to broadly define the number of adjacent water users within a 2 kilometer radius of the operation. This would be done using 1:50,000 scale topographic maps. Except in rare situations where proportionate distribution may exist, no attempt would be made to estimate the type (i.e. source) of water supply utilized. Operations within water supply watershed areas will be identified.

For the highest priority sites an attempt will be made, through discussions with regulatory agency personnel, site operators, etc., to define the predominant sources of water supply by adjacent users. This would produce qualitative information on utilization of adjacent sources of supply. Important users, particularily sensitive to potential impacts could be identified.

1.4.5 Task 5 - Identify and Summarize Incidents of Groundwater Contamination

Based upon earlier Tasks and utilizing NDAL's knowledge, documented instances of contamination will be summarized. These descriptions will follow a format similar to that presented in the aforementioned Beak report and will probably be a quarter to half a page in length. These sites will be plotted on "key" (i.e. page size, large scale) maps for each

province. The potential impact on possible adjacent water users will be discussed by the consultant for each documented incident.

These summaries will deal with groundwater contamination as well as that attributable to direct site runoff into adjacent surface waters.

1.4.6 Task 6 - Site Ranking

Utilizing the information gained in Tasks 1 to 5 and NDAL's expertise, a ranking scheme will be developed. This will be used to develop separate lists of ranked sites for Nova Scotia and New Brunswick. A major criteria we propose to use in ranking these sites will be their existing or potential impact on adjacent water users and the sensitivity of these water users to contamination. The highest priority sites will be plotted on a key map for each province with their ranking order denoted.

1.4.7 Task 7 - Future Work

Based upon the result of both Task 5 and 6, recommendations, will be made for future work at specific sites in either province as appropriate. Currently, NDAL is involved in undertaking this type of work and is very familiar with the field methods necessary to investigate such problems. Our extensive environmental work for the mining industry has also provided opportunities to conceptually develop and undertake

need to stay at conceptual level

remedial programs related to mining developments and instances of related contamination.

1.4.8 Task 8 - Report

Given the large number of active and abandoned sites in both Nova Scotia and New Brunswick, we propose to make extensive use of tabular formats for Tasks 1 to 4. Our efforts within these four Tasks will be devoted to gathering the required information. Significant portions of text will likely be associated with Task 5.

Work on the report will proceed following completion of Task 1. Five draft copies of the final report will be presented to the Steering Committee for their review. Six copies of the final report, including the original, will be submitted to the Client.

1.4.8 Work Plan

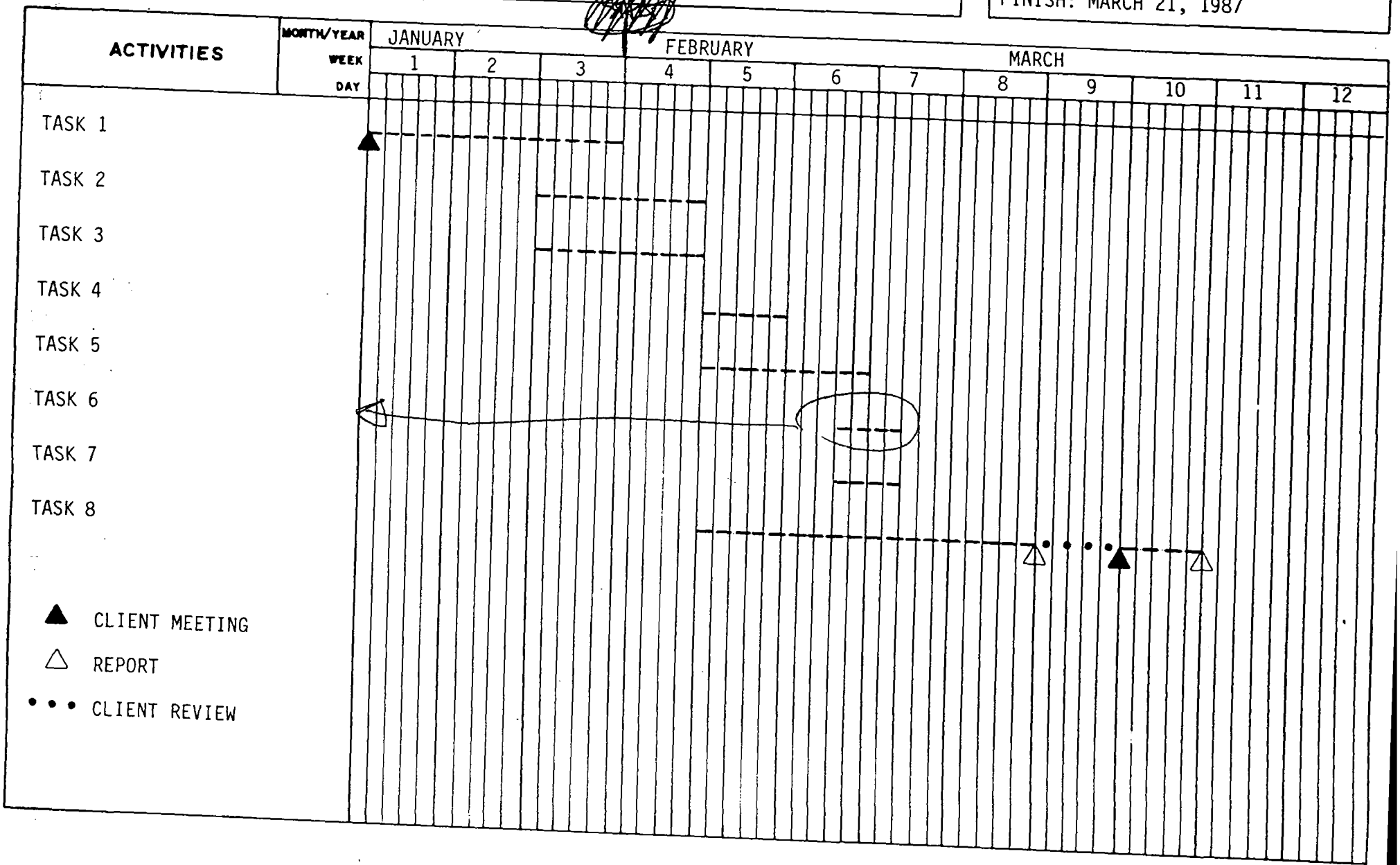
Nolan, Davis & Associates propose to complete this project by March 31, 1987. The list of major activities and their schedule for completion during the project are given in Figure 1-1.

FIGURE 1-1 ACTIVITY SCHEDULE

NOLAN, DAVIS & ASSOCIATES

CLIENT: ENVIRONMENT CANADA
PROJECT: AN INVESTIGATION OF THE POTENTIAL... AND NEW BRUNSWICK

START: JANUARY 19, 1987 (Assume)
FINISH: MARCH 21, 1987



2.0 MANAGEMENT PROPOSAL

2.1 Project Team

This project will be entirely conducted by Nolan, Davis & Associates through its offices in Halifax and Fredericton using the following key staff:

H. LeBlanc, M.Sc.: A Senior Hydrogeologist with Nolan, Davis & Associates, will have overall responsibility for this project. Mr. LeBlanc has substantial experience in groundwater contamination studies, many related to former or existing mining developments. He has been primarily/partially involved in a variety of mining related studies that have addressed mine wastes or product storage. This work has included:

- Environment Canada - Participated with Beak Consultants in providing the Atlantic Canadian component to their national assessment of groundwater contamination in Canada.
- Cape Breton Development Corporation (CBDC) - Responsible for an EIA that addressed potential groundwater problems related to their coal storage facility (i.e. Lifting Banking Center - LBC) at the Victoria Junction Facility.
- Yava Mines - Undertook a preliminary assessment for a 1 million cubic metre lead-zinc tailings disposal facility adjacent to the now abandoned base metal mine.
- Novaco Limited - As a component to a larger EIA study, he was responsible for addressing existing and potential water quality problems related to existing acidic groundwater discharges and waste disposal piles associated with the abandoned No. 25 Gardiner Mines Colliery.

A. Bell, P.Eng.: A Principal of Nolan, Davis & Associates, will assist in defining existing and potential groundwater problems in both Nova Scotia and New Brunswick. He has extensive practical experience in mine waste management, in Nova Scotia and New Brunswick, including a recent revview of all Nova Scotia mine properties and the New Brunswick Mine Water Quality Program. He was responsible for the design of the National Reactive Acid Tailings Program and the Sulfide Tailings Report which preceded the program design. He was also responsible for updating the Environment Protection Service (EPS) manual on Mine Wastewater Treatment, submitted during the Spring of 1986. Prior to this, he was retained by the British Columbia Ministry of Environment to advise on the long-term management of acid-generating wastes at the Equity Silver Mine near Houston, B.C. His current projects include:

- NSDME - Responsible for an Environment Constraint Study designed to assess the status of legislative and environmental concerns associated with existing mining and quarry operations in Nova Scotia; during this study, 40 active operations were visited and the nature of the operations were reviewed.

- CBDC - He was responsible for the design of a long-term management plan for the Victoria Junction coal preparation plant coarse waste pile relative to the control of acid seepage and long-term reclamation; presently he is providing specialist advice during the installation of control measures.

- Heath Steele Mines - He is currently reviewing alternative reclamation plans for mine wastes generated during past operations.

- Inco-Scominex Limited, Coxheath Mines and Potter Mines - Responsible for provision of environmental advice as it relates to gold development and exploration work for these three companies on properties throughout Nova Scotia.

- CANMET - He is currently undertaking a national program to determine the extent of problems associated with acid-generating waste rock at base metal mines throughout Canada and to recommend action designed to provide practical solutions to disposal, storage, and reclamation of acid-generating waste rock.

N. McLeod, M.Sc.: A Senior Hydrogeologist with Nolan, Davis & Associates in Fredericton, New Brunswick, he will be responsible for data collection for the New Brunswick component of the study.

H. Hutchinson, B.Sc.: A Geologist with Nolan, Davis & Associates Limited, will be responsible for collection of data in Nova Scotia and compilation of all study data for both provinces. Over the past four years, since joining the Firm, he has been involved in numerous hydrogeologic projects throughout Atlantic Canada. He has considerable experience in mineral exploration and geologic mapping throughout Nova Scotia and Eastern Canada. He was also involved in various environmental and geotechnical studies related to mining developments throughout Nova Scotia and Newfoundland. This work focused on reconnaissance and bedrock mapping and groundwater sample collection. Mr. Hutchinson is thoroughly familiar with personnel at NSDME, as well as regulatory agency (NSDOE and EPS) library facilities. He has considerable experience in data compilation and reduction during previous studies.

Manhours to be spent by those team members are given in Table 2-1, with reference to the project activities shown in

Figure 1-1. The study team will be supported by a variety of highly skilled technical staff, as required.

TABLE 2-1

Project Manhours

Activity	Manhours						
	HLB	AVB	NSM	HEH	DRAFT.	SECT.	TOTAL
Task 1	2	2	12	40	-	-	56
Task 2	0.5	-	3	8	-	-	11.5
Task 3	0.5	-	3	8	-	-	11.5
Task 4	1	-	6	16	-	-	23
Task 5	2	4	12	35	-	-	55
Task 6	4	2	4	20	-	-	30
Task 7	4	-	4	8	-	-	16
Task 8	8	2	2	12	12	12	48
TOTALS	22	10	~~48~~ 46	147	12	12	249

2.2 Project Control

To undertake this project, Nolan, Davis & Associates will be using an integrated, experienced, and well-qualified study team which has substantial expertise in the areas of project management. Mr. H. LeBlanc, a Senior Hydrogeologist with the firm will be Project Manager.

Time charges, costs, and progress will be monitored on a weekly basis with deviation (if any) to be discussed and resolved at that time.

Mr. H. LeBlanc will provide experienced direction for the project and will be aided by Messers. Bell and McLeod in successful project completion.

Curricula vitae for key members of the study team are presented in Appendix A.

3.0 COMPANY EXPERIENCE

Nolan, Davis & Associates has been providing earth science services in Atlantic Canada for over eighteen years. The firm is recognized as a leader in the field of earth science, including geology and hydrogeology projects. More that one thousand projects of an earth science nature have been completed. The firm has provided these specialist consultant services to both government and private clients throughout all four Atlantic Provinces. The company has grown steadily in size and range of services offered. In recent years, for example, the company has provided environmental services to the mining sector in Atlantic Canada and has been responsible for more mining-related environmental projects than any other company in the region.

The company has been responsible for environmental work associated with base metal, coal, gold, and gypsum mining

operations. In many cases, this work focused on groundwater contamination problems related to either liquid or solid mine wastes or product storage areas. Consequently, the company is very familiar with varied groundwater contamination problems that can result from particular types of mine wastes.

In March 1986, Mr. A.V. Bell, P.Eng., joined the company as a principal and general manager. Mr. Bell has almost two decades of direct involvement in mine waste management and thus complements the previous experience of the company, providing a broader national perspective to the firm's technical area of operations.

Current mining related projects being undertaken by the company include:

- Suncor Pictou County Coal Mine - Waste rock disposal planning, including acid generation/ consumption testing, layout, etc.
- Supervision of construction of acid seepage cutoff trench for pyritic waste dump at Victoria Junction coal Preparation Plant for Cape Breton Development Corporation.
- Permit applications and waste management planning for exploration gold leaching trials (including control and treatment of mine waste material) for the Inco-Scominex Cochrane Hill property, Nova Scotia.
- EIA and ongoing monitoring of Georgia Pacific Sugar Camp Lake gypsum mine near Port Hawkesbury, Nova Scotia.
- Determination of environmental constraints on mines and quarries in Nova Scotia for NSDME.
- Review of 4 to 5 years of groundwater monitoring data for CBDC's Kilkenney Lake coal tailings disposal basin to assess both baseline conditions and potential groundwater contamination.

- A national study for CANMET to assess the status of acid waste rock associated with mining operations throughout Canada.

- An EIA for CBDC's proposed Carbogel facility at their Victoria Junction plant site which focuses on groundwater contamination potential.

- Delineation of an acid leachate plume associated with CBDC's coarse waste rock disposal area near their Victoria Junction coal preparation plant.

- Provision of mine waste management expertise to Heath Steele Mines in relation to reclamation of existing mine waste material.

- Supply of environmental expertise to both Coxheath Mines and Potter Mines in relation to gold exploration and development activities proposed in Nova Scotia.

The following fact sheets are included in Appendix B to provide further information on the capabilities of the Company:

- Company Profile
- Mining Service
- Environmental Services
- Partial Listing of Clients

4.0 FINANCIAL PROPOSAL

Nolan, Davis & Associates Limited will complete the project, including all Tasks detailed and delivery of 6 copies of the final report, for a firm price of $9,524.00.

Task 1:	Fees (56 manhours - Table 2-1)	$ 2,022.00
Task 2:	Fees (11.5 manhours - Table 2-1)	$ 410.50
Task 3:	Fees (11.5 manhours - Table 2-1)	$ 410.50
Task 4:	Fees (23 manhours - Table 2-1)	$ 821.00
Task 5:	Fees (55 manhours - Table 2-1)	$ 2,012.00

Task 6:	Fees (30 manhours - Table 2-1)	$ 1,144.00
Task 7:	Fees (16 manhours - Table 2-1)	$ 644.00
Task 8:	Fees (48 manhours - Table 2-1)	$ 1,560.00
	SUBTOTAL	$ 9,024.00
	EXPENSES (LUMP SUM)	$ 500.00
	FIRM TOTAL PRICE	$ 9,524.00

Note: These prices are based on the following assumption:

- 2 client meetings (orientation, and draft review) in Dartmouth, Nova Scotia.

The rates for personnel we propose to utilize on the project are detailed as follows:

Senior Hydrogeologist (Project Manager)	$53/hr.
Senior Engineer	$70/hr.
Senior Hydrogeologist	$48/hr.
Geologist	$30/hr.
Draftsperson	$25/hr.
Clerical	$25/hr.

5.0 METHOD OF PAYMENT

We propose to undertake the project on a lump sum basis with the following progress payments:

Progress Payment	Milestone	Amount
1	Completion of Task 1, 2, and 3	$ 2,843.00
2	Completion of Task 4, 5, 6, and 7	$ 4,621.00
3	Completion of Task 8	$ 2,060.00
TOTAL		$ 9,524.00

APPENDIX A

Curricula Vitae of Key Personnel

HAROLD G. LEBLANC

Senior Hydrogeologist

EDUCATION:

1980	M.Sc. (Hydrogeology) - University of Waterloo
1975	B.Sc. (Geology) - Dalhousie University

PROFESSIONAL ASSOCIATIONS:

Association of Groundwater Scientists and Engineers (NWWA)
Geological Association of Canada
International Water Resources Association
International Association of Hydrogeologists
International Mine Water Association

EXPERIENCE:

1984 - present

Nolan, Davis & Associates. As a Senior Hydrogeologist, he has assumed increasing responsibility for numerous projects throughout Atlantic Canada. Experience includes:

Project Management

- Sharing responsibility with the Principals for earth science business development throughout Atlantic Canada
- Responsibility for most major hydrogeological and environmental project proposals (RFPs) sought from industry and government clients
- Support of other earth science staff members throughout Atlantic Canada
- Project Manager for several successful EIA studies with multidisciplinary study teams with as many as 12 members
- Project Manager on numerous hydrogeological and environmental studies produced for Industrial and Government Clients

Typically on projects, he is responsible for proposal development through to final project reporting, including client contact and cost control.

HAROLD G. LEBLANC

Senior Hydrogeologist

EXPERIENCE:

1984 - present (contd.)

Contaminant Hydrogeology

. Responsible for an intensive major geologic and hydrogeologic program to select and field assess approximately 90, 40 hectare, specialized waste disposal sites throughout New Brunswick
. Responsible for two pesticide projects involving monitoring design/sampling and regional survey design in New Brunswick and Prince Edward Island
. Design, installation, and sampling of a monitoring network within complex surficial materials at the Antigonish Regional Landfill.
. Development of an extensive groundwater monitoring network and provision of hydrogeologic design criteria for a major expansion of the Truro Regional Landfill.
. Responsible for Atlantic Canadian content of a national PCB assessment program for Transport Canada.
. Participated in defining groundwater and major aquifer contamination throughout Canada for Environment Canada.

Environmental Assessments

. Environmental Project Manager for all work, within five disciplines and completion of EIA Phases I and II for the proposed one million tonne/year Suncor underground coal mine in Nova Scotia
. Responsible for an intensive five month surface water quality and biological baseline data collection program for the proposed Suncor coal mine
. Responsible for assessment of blasting and dewatering impacts on adjacent groundwater users by a proposed major rock quarry near Moncton, New Brunswick
. Responsible for development potential assessment of surplus watershed lands held by the City of Halifax

HAROLD G. LEBLANC

Senior Hydrogeologist

EXPERIENCE:

1984 - present (contd.)

Water Supply/Water Resources

. Responsible for the water resource component of a feasibility study to establish a geothermal energy source in Nova Scotia
. Responsible for several groundwater supply projects involving both surficial and bedrock aquifers for municipal and commercial use in Atlantic Canada

1979 - 1984

Nolan, Davis & Associates Limited. As a Project Hydrogeologist has been principally responsible for a wide variety of contaminant, water supply, and environmental projects including:

Contaminant Hydrogeology

. Assessed the impact by trace organics from two major abandoned industrial/municipal landfill sites in New Brunswick on adjacent groundwater resources within fractured rock
. Responsible for design of a groundwater monitoring network around a special waste disposal site at the Esso Petroleum Canada refinery in Nova Scotia
. Assessment of hydrogeologic suitability and design of testing and monitoring programs at the Municipality of St. Mary's Regional Landfill in Nova Scotia
. Assessment of geologic and hydrogeologic suitability, related to expansion, of two regional landfill sites in Victoria County, Nova Scotia
. Responsible for site selection for the District of Clare Regional Landfill
. Assessment of soil suitability for large scale septic disposal systems in Southern Nova Scotia

Environmental Assessments

. Responsible for a multi-disciplinary EIA of a $70 million coal storage/shipping facility
. Responsible for a multi-disciplinary EIA of a one million ton surface coal mine
. Responsible for geologic and water resource components of a multi-disciplinary EIA for a $22 million expansion of the St. John's Airport

HAROLD G. LEBLANC

Senior Hydrogeologist

EXPERIENCE:

- Responsible for geologic and hydrogeologic impact assessment of 16 swine waste disposal operations in New Brunswick on surrounding groundwater users
- Responsible for preliminary site assessment of a one million cubic meter base metal tailings basin
- Responsible for developing techniques to avoid or minimize environmental impacts from naturally acid producing slates in Halifax County
- Responsible for assessing and developing mitigative techniques to prevent acid drainage along a proposed 600 kilometre natural gas pipeline through sulfide mineralized rocks

Water Supply Investigations

- Delineation and development of a 235 IGPM (17.8 L/s) production well in a new major granitic aquifer at the Eskasoni Indian Reservation
- Responsible for site selection of a fish hatchery requiring 600 - 1,200 IGPM (46-91 L/s) on Prince Edward Island
- Responsible for a major well drilling program designed to provide the Town of Carmenville with a groundwater supply system
- Field testing and assessment of a municipal well field in Southern Newfoundland
- Responsible for development of an additional production well within the sand and gravel Caribou Well Field at Pictou
- Responsible for numerous groundwater site selection, well installation and testing programs throughout Atlantic Canada

Water Resource Evaluation

- Responsible for three published hydrogeologic resource evaluation projects covering an area of 16,500 square kilometres in Northwestern and Eastern Newfoundland
- Shared responsibility for field supervision of a multi-million dollar groundwater/geotechnical drilling and sampling program for a major hydroelectric development site in Labrador

HAROLD G. LEBLANC

Senior Hydrogeologist

EXPERIENCE:

- Responsible for a hydrogeological investigation of low grade geothermal waters within the Carboniferous Stellarton Basin using oxygen, sulfur, and carbon environmental isotopes
- Responsible for defining hydrogeologic resources and potential impacts along a proposed 600 kilometre gas pipeline route in Eastern Canada
- Assisted NHRI personnel in the collection of Carbon-14 samples used to define the origin of water supply resources

1975 - 1979 Nova Scotia Department of Environment - As a Geologist, major projects included:

- Documenting the occurrence and significant activity of radon gas in four major water supply aquifers within Nova Scotia
- Responsible for reassessment of two major oily waste disposal sites used during the Arrow oil tanker spill.
- Assessment of aquifer dewatering impact on adjacent wells caused by development of a major underground coal mine.
- Responsible for establishing a drilled well database for all of Cape Breton Island which contained well locations and driller's logs
- Responsible for surficial and structural geology mapping components of two regional water resource projects in Cape Breton

ALAN V. BELL, P.Eng.

Principal and General Manager

EDUCATION

1970	M.Eng. (Environmental Eng.) - University of Western Ontario
1962	B.Sc.(Eng.) (Honours in Civil Engineering) - London University, U.K.
	MBA Credits - McGill University, Quebec

PROFESSIONAL ASSOCIATIONS:

Association of Professional Engineers of Nova Scotia
Association of Professional Engineers of New Brunswick
Institution of Civil Engineers, London
Mining Society of Nova Scotia

SUMMARY:

Mr. Bell has twenty-four (24) years of experience in progressively responsible positions relating to design, construction supervision and project management for water resource and environmental projects. His experience centres on interdisciplinary management, with emphasis on environmental projects for the mining-related industry sectors. He acts as a national specialist in acid drainage control and mine waste management.

EXPERIENCE:

1986 - present: Nolan Davis & Associates Limited - Principal. Responsible for general management of the company and for coordinating all projects of an environmental nature.

Specialist assignments have included:

- Study on the Management of Acid Generating Waste Rock at Canadian Mines (ongoing)
- Report to Nova Scotia Department of Mines and Energy on the implications of environmental requirements to mineral development in Nova Scotia

ALAN V. BELL

Principal and General Manager

EXPERIENCE:

1986 - Present

. Environmental advisory services to Suncor Pictou County Coal Project, Cape Breton Development Corporation, Coxheath Gold Holdings Limited, Inco-Scominex and Potter Mines Inc.

1981 - 1986

Monenco Maritimes Limited. Vice President - Operations and previously Regional Manager, Monenco Limited, Maritime Region, responsible for the operations of the Company in Nova Scotia, New Brunswick and Prince Edward Island. Professional responsibility for projects in the fields of water resource development, waste management and environment.

Personal assignments have included:

. Update of EPS manual on mine and mill wastewater treatment
. Consultant to BC Ministry of Environment on acid generation and reclamation planning for Equity Silver project near Houston, British Columbia
. Design of national Reactive Acid Tailings Program for CANMET
. Design of long-term management plan (including reclamation) for pyrite containing coarse waste pile at Victoria Junction Coal Preparation Plant (Cape Breton Development Corporation).

1976 - 1981

Montreal Engineering Company Limited. Manager, Environmental Division, responsible for mangement of the Company's activities in the environmental and waste management fields. Division responsibilities embraced a wide range of projects, particularly for major power and mining developments in Canada and overseas. Services included biophysical baseline studies, interdisplinary site selection procedures, impact assessments, design of waste control measures and treatment systems, assistance with regulatory approvals, reclamation and monitoring. Personally acted in a senior advisory capacity on mining environmental design, effects of hydro developments and interdisciplinary site/ corridor selection projects.

ALAN V. BELL

Principal and General Manager

EXPERIENCE:

1973 - 1976 Montreal Engineering Company Limited. Assistant Manager, Resources and Environmental Division, responsible for projects in the field of waste management and for assistance in the management of water resource-related projects. Also responsible for the management and operation of the Company's Fredericton office, New Brunswick. Personal inputs and management of mining-related projects including:

- conceptual design and feasibility assessment of water supply, tailings disposal, power supply and waste management for major lead-zinc development in Yukon; also included biophysical surveys and impact report;
- as above, for a molybdenum-tungsten property in New Brunswick;
- design of 2 heavy-metal-removal treatment plants for mining development in New Brunswick, including site drainage segregation and collection systems;
- Environment Canada/Industry task force; personal review and preparation of working papers instrumental in development of mining industry guidelines;
- development of surface coal mine reclamation plan and impact statement for New Brunswick coal property.

1970 - 1973 Montreal Engineering Company Limited. Senior Environmental Engineer, Resources Department, working as Project Manager for the following:

- Mine Wastewater Pilot Treatment Project aimed at development and demonstration of mine waste treatment technology;
- preliminary survey of cyanide-bearing liquid wastes in Canada;
- water quality assessment for the Saint John River Basin, New Brunswick;
- evaluation of the impact of mineral development on water management in the Saint John River Basin, New Brunswick;
- Assistant Project Coordinator, Northeastern New Brunswick Mine Water Quality Program, New Brunswick - a comprehensive multidisciplinary program to develop waste control and treatment methods for base metal mining developments, consistent with the preservation of valuable fisheries resources in the region;
- Project Coordinator for a water quality and biological survey of the Churchill Falls Reservoir, Labrador.

ALAN V. BELL

Principal and General Manager

EXPERIENCE:

1966 - 1970 Montreal Engineering Company Limited. Senior Design Engineer, Civil Engineering Department, working on the following projects:

- Maritime Provinces Water Resources Study, responsible for the study and analysis of the demand and supply relationships in ten study areas and river basins throughout the region; also responsible for the analysis of public utility systems and the estimation of present and future levels of water demand on a per capita basis for the region;
- Charlotte River Hydro Development (12,000 hp), Northwest Territories, responsible for preliminary design;
- on loan for three months to Tidal Power Consultants Ltd. for Minas Basin Feasibility Study, Phase A, including design and costing of various Tidal Power barrages of about 4000 MW capacity;
- Karachi Nuclear Power Project (137 MW), responsible for design of reinforced concrete for reactor buildings.

1963 -1966 Department of Water Affairs, South Africa, Engineer Grade III, second-in-charge of construction of Kougha Dam (260 foot high cupola arch) for irrigation and water supply, built by direct labor force of 600. Also responsible for all aspects of construction and in sole charge for six months. Prior to construction, was located in design office, Pretoria, engaged in structural and hydraulic design of various ancillary structures for dams, and also in the design of several small water and sewage treatment works for communities associated with dam construction and operations.

1962 - 1962 John Taylor & Sons, Consulting Engineers London, U.K., Design Assistant, responsible for structural and hydraulic design of 0.2 mgd sewage purification works using filtration as secondary treatment, assisting in the design of 60 mgd works using high intensity aeration activated sludge process.

ALAN V. BELL

Principal and General Manager

PAPERS & PRESENTATIONS

"Waste Management on Offshore Rigs" prepared for Workshop on Process and Utility Design for offshore oil and gas production in cold ocean environment, Halifax, 1985.

"An Approach to Interdisciplinary Site Selection", presented to the Canadian Electrical Association Annual Meeting, Vancouver, 1979.

"Prescribed Burning as a Reservoir Preparation Technique", presented to the Canadian Electrical Association Annual Meeting, Toronto, 1978 (co-author).

"Waste Controls at Base Metal Mines", Environmental Science and Technology, Vol. 10, No. 2, pages 130-135, February, 1976.

"Some Recent Experiences in the Treatment of Acidic, Metal-Bearing Mine Drainages", Bulletin CIMM, April, 1974 (co-author).

"Salmon and Mining in Northeastern New Brunswick", Bulletin CIMM, November, 1974.

"Base Metal Mine Waste Management in Canada", Proceedings of the International Symposium of Minerals and the Environment, Inst. Minerals and Metallurgy, London, June 1974.

BUSINESS AFFILIATIONS

Director, Halifax Board of Trade
Director, Petroleum Society (CIM Affiliate), Halifax
Director, Nova Scotia Chamber of Mineral Resources
Past-Chairman, Energy Resources Committee, Halifax Board of Trade
Member, APENS Act Enforcement Committee
Member, NSCEA Consultants Selection Committee
Previous Member, ACEC Environmental Affairs Committtee
Ex-director, Martec Limited

NORMAN MCLEOD

Senior Hydrogeologist

EDUCATION

1982	Master of Science (Hydrogeology) University of Waterloo, Ontario (Specializing in Contaminant Hydrogeology)
1979	Bachelor of Environmental Studies University of Waterloo

PROFESSIONAL ASSOCIATIONS

Member, International Association of Hydrogeologists
Member, National Water Well Association

EXPERIENCE

1986 to present	Senior Hydrogeologist, Nolan, Davis & Associates, Fredericton, New Brunswick Responsible for planning and implementation of hydrogeologic investigations including assessments, aquifer restoration and monitoring, site selection and design of landfill projects, well field design and assessment.
1982 to 1986	Hydrogeologist, Nova Scotia Department of the Environment, Halifax, Nova Scotia Carried out investigation of well and aquifer contamination, assessment of hydrogeologic characteristics of landfills, pump test evaluations, and well location assessments.

PUBLICATIONS

McLeod, N.S. and Lee, D.R., "Monitoring of Contaminant Behaviour in Discharging Groundwater in Lakebeds or Streambeds," to be published in the Journal of Hydrology, Fall, 1986.

McLeod, N.S. and Farrell, D., "Well Water Quality and Treatment in Nova Scotia," Nova Scotia Department of the Environment, 1986. 75 pp.

HARLEY E. HUTCHINSON

Geologist

EDUCATION:

1982 B.Sc. - Honors (Geology) - Dalhousie University

PROFESSIONAL ASSOCIATIONS:

Atlantic Geoscience Society - member
Halifax Field Naturalists Society - member

LANGUAGES:

English and French

EXPERIENCE:

1983 - present

Geologist, Nolan, Davis & Associates Limited, Halifax, Nova Scotia.
As a Geologist, has been involved in projects throughout Atlantic Canada, including:

Environmental Assessments

- Responsible for geological reconnaissance, drilling supervision and seismic survey operation/interpretation of more than 35 potential specialized landfill sites throughout New Brunswick.
- Responsible for researching and reporting geological aspects of acidic drainage for Sable Gas System's proposed 600 km natural gas pipeline route.
- Field supervision of drilling, piezometer installation, and surficial/bedrock mapping associated with environmental/geotechnical studies at Aerotech Park, near the Halifax Airport.
- Involved in defining geological and environmental constraints to mining developments in Nova Scotia.

1983 - present

Contaminant Hydrogeology

- Field supervision of contaminant hydrogeology drilling program designed to assess trace organics in groundwater at 2 abandoned landfill sites near Saint John, New Brunswick.

HARLEY E. HUTCHINSON

Geologist

EXPERIENCE: (contd.)

- Field collection of inorganic, trace metal, organic and isotopic samples, and field measurement of various inorganic water quality parameters.
- Responsible for installation of groundwater monitoring network within a complex series of surficial materials downgradient of a regional landfill site.
- Field supervision of drilling program, piezometer installation and collection of water samples designed to access pesticide (aldicarb) contamination in New Annan, Prince Edward Island.

Water Supply Investigations

- Field supervision of reconnaissance drilling program to assess the potential for additional production wells within the Town of Pictou sand and gravel Caribou Well Field.
- Responsible for various groundwater site selections and supervision of pump tests in Newfoundland and Nova Scotia.

Geological/Geotechnical Investigations

- Responsible for geological assessment of over 4000 acres of land in Halifax County as part of a marketing study by a local real estate firm.
- Performed detailed structural analysis of a rock face as part of a geological hazard/slope stability study for a small community in Newfoundland.
- Reviewed and assimilated all available geological, geotechnical, and geophysical data for the offshore portion of a pipeline route proposed by a major oil company.
- Drill supervision and geotechnical borehole logging for a proposed Government of Canada office building in downtown Halifax.
- Responsible for laboratory analysis of geological materials, computerized water quality, and geological data bases.

HARLEY E. HUTCHINSON

Geologist

EXPERIENCE: (contd.)

1982 - 1983 Contract work with Federal Department of Energy, Mines and Resources and Nova Scotia Department of Mines and Energy

- indexing/cataloging government publications for GEOSCAN data base systems.
- map preparation and computer work.

1982 Field geologist with Saarberg Interplan of Canada Ltd.

- Reconnaissance geology and air-borne radiometric survey in northern Quebec and Labrador.

1981 Field geologist with Shell Canada Resources Ltd.

- Involved in tin-tungsten exploration and extensive overburden drill program at East Kemptville tin deposit, Yarmouth County, Nova Scotia.

1980 Field assistant with Esso Minerals Canada Ltd.

- Involved in various base metal exploration programs in northern Nova Scotia and Quebec.

1979 Field assistant with Minorex Ltd.

- Reconnaissance uranium exploration program in northern New Brunswick, involving magnetometer/scintillometer grid surveys, and field determination of Radon gas in water and soil samples.

APPENDIX B

Company Fact Sheets

COMPANY PROFILE

History

Nolan, Davis & Associates was founded in 1968 by Frank J. Nolan, current President of the Company, to provide geological and geotechnical consulting services to industry and government in Atlantic Canada. The Company has grown steadily in size and has expanded its professional capabilities to the point where it now offers the following range of services:

Services

Engineering Geology	Offshore Geotechnical Investigations	Hydrogeology
Foundation Engineering	Materials Testing & Quality Control	Hydrology
Soil and Rock Mechanics	Contaminant Assessment/Remediation	Water Resource Management
Slope Stability and Earthworks	Environmental Assessment & Monitoring	Waste Management

Offices

The Company maintains permanent offices in Halifax and Sydney, Nova Scotia; St. John's, Newfoundland, and through associated consultants, Fredericton, New Brunswick.

Staff

The Company has a total staff of approximately thirty, more than half of which are professional earth scientists, hydrogeologists, and engineers. The professional staff are complemented by experienced technologists, technicians, draftspersons and office support personnel.

Associations

Nolan, Davis & Associates complements its own staff resources through association with other companies and specialists on both a continuing and project-specific basis. Established associations include:

- The Earth Technology Corporation, California - Mine Planning, offshore geotechnical services
- R. Currie, Fredericton, New Brunswick - Biological Services
- John Franklin Associates, Orangeville, Ontario - Rock mechanics
- Dr. W. D. Liam Finn, Consultant, Vancouver, British Columbia - Earthquake/soil dynamics

MINING SERVICES

Nolan Davis & Associates have been closely associated with mining exploration and development in Atlantic Canada for more than 18 years. This exposure to the industry has enabled the Company to develop the following range of integrated services for mining:

Subsurface Investigations - Drilling, Geophysics, In-Situ Testing and Sampling

Rock Mechanics*

Mine Planning*

Pit Slope Stability

Hydrogeology/Dewatering

Foundation Engineering

Dams and Embankments

Tailings System Design

Mine Waste Management - incl. Treatment System Design

Acid Drainage Control & Treatment

Environmental Assessment & Monitoring

Regulatory Approvals & Liaison

Reclamation

Nolan, Davis & Accociates has a controlling interest in Nolan-Ertec Limited, a joint venture with The Earth Technology Corporation and has access to this Company's extensive experience with major resource developments in the U. S.. Specialist Services in mine waste management have been provided to mining clients across Canada by the principals of Nolan, Davis. These capabilities, coupled with the long-established experience of the Company in geology and geotechnical engineering, enable Nolan, Davis to offer to the mining sector a depth and range of capabilities unparalleled in Atlantic Canada.

* - through associated consultants

ENVIRONMENTAL SERVICES

Nolan, Davis & Associates offer a complete range of services in environmental protection, investigation and waste management. These services include:

- Site Selection
- Environmental Impact Assessment
- Biological Studies*
- Monitoring and Bioassays*
- Treatment Plant Process Design*
- Mine Waste Management
- Acid Drainage Control and Treatment
- Environmental Audits
- Emergency Spill Response
- Contaminant Hydrogeology/Hydrology
- Landfill Projects - Siting, Impact & Development
- Site Decommissioning

Nolan, Davis has a philosophy of working closely with its clients to achieve practical and professionally sound results for environmental projects. These range from small field assignments to contingency planning and auditing for large corporations.

The Company's staff and associated consultants constitute an experienced team of professional geologists, hydrologists, hydrogeologists, soil scientists, chemists, environmental engineers and biologists supported by the necessary field technicians and equipment. Senior personnel have the experience to manage multi-disiplinary projects so as to produce well-balanced results and define priorities. They are also accustomed to working as part of an integrated team on larger engineering projects.

* - Through associated consultants

PARTIAL CLIENT LIST

Acres International Limited
Accord Construction Services Ltd.
Antigonish, Municipality of, County of, NS
APEX Development Ltd.
Architectural & Engineering Services Limited
Atlantic Aggregate Limited
Atlantic Geoscience Centre
Atlantic Petroleum Associates

BAE Group Ltd.
Bank of Nova Scotia
Bayswater Development Limited
Beak Consultants
BFL Consultants Limited
Bowaters Newfoundland Company Ltd.
Bridgewater, Town of, NS

Campbell Consultants Limited
Canada Supply and Services
Canadian Coast Guard
Canadian Liquid Air
Canadian National Railways
Canadian Pittsburg Industries
Cape Breton, County of, NS
Cape Breton Development Corporation
Carmanville, Town of, NS
Cartier - McNamara Construction
CBCL Limited
Clayton Realty Limited
CN Real Estate
Cobi Foods Limited
Coca-Cola Limited
Corner Brook, City of, Nfld.
Creson Investments Limited

Defense Construction (1951) Ltd.

Earth Technology Corporation
Environment Canada
Environment New Brunswick
Environment, Dept of, Nova Scotia
Environment, Dept. of, Newfoundland
Energy, Mines & Resources Canada
ERCO Industries Limited
Esso Petroleum Canada Limited

Fenco Consultants Limited
Foodex Systems Limited
Foundation Co. of Canada Ltd.
Fuller Construction Ltd.

Georgia Pacific Corporation Ltd.
Getty Mines Limited
Giffels Associates Limited
Golden Eagle Canada Ltd.
Government Services, Depart of, NS

Halifax County Industrial Commission
Harvey, A. & Co. Ltd.
Hammond & Son Limited
Health, Dept. of, Newfoundland
Highgate Development Limited
Highways, Dept. of, NS

Hiltz & Seamone
Holyrood, Town of, Newfoundland
Horner, W.N. & Associates
Housing, Dept. of, NS

Irving Oil Limited
Indian Affairs & Northern Development, Dept. of, Canada
Interprovincial Engineering Ltd.
Inverness, County of, NS

Jeffries, R. A., Architects
Jost Architects

Kentville, Town of, NS
Kilborn Limited

Labatts Brewery of Nfld. Limited
Lavalin
Lindsay, J. W.
Lundrigan Group Limited

Mallett & Associates Engineering Ltd.
Memorial University of Nfld.
Mobil Oil Canada Ltd.
Monenco Maritimes Limited
Municipal Affairs, Dept. of, Nova Scotia
Municipal Affairs, Dept. of, Newfoundland
Municipal Contractors Ltd.

National Defense, Dept. of, Canada
National Hydrology Research Centre
Neill and Gunter Limited
New Brunswick Electric Power Commission
Newfoundland Design Associates
Newfoundland & Labrador Hydro
Newfoundland Light and Power
Newfoundland Telephone Company Ltd.
Newton, Town of, Nfld
NODECO
Nordic Construction Limited
North Atlantic Contractors
Northland Developments Limited
Nova Scotia Forest Industries
Nova Scotia Power Corporation
Nova Scotia Research Foundation
Novaco Limited

Ojolick Associates Architects

Parks Canada
Parsons Engineering and Construction
Penny Paving Limited
Petro-Canada Limited
Petro-Drilling Limited
Pictou, Town of, NS
Port Blandford, Town of, NS
Pratt & Whitney Canada Limited
Public Works Canada
Public Works and Services, Dept. of, Nfld

Reid Newfoundland Co. Ltd.
Roberts, W., Engineering Limited
Royal Bank of Canada
Royal Insurance Company of Canada l
Roycom Realty Limited

Sable Gas Systems Limited
Saysf Development Limited
Shawmont Newfoundland Limited
SNC Inc.
Sperry Associates
St. Alban's, Town of, Newfoundland
St. John's, City of, Newfoundland
Suncor Inc.
Supply and Services, Dept. of, Canada
Swan Wooster Engineering Service Company Ltd.
Sydney Mines, Town of, NS

Taecon Limited
Terra-Joli Farms
Terratech Limited
Transport Canada
Transportation, Dept. of, Nova Scotia
Truro, Town of, NS

Ultramar Canada Ltd.
UMA Engineering Limited
Underwriters Adjustment Bureau

Venture Task Force
Viking Construction
Vaughan, J. Phillip, Engineering Associates Ltd.

Washburn & Gillis Associates Ltd.
Whitman Benn & Associates Ltd.
Whycocomagh Band Council

Yava Mines Limited

Zibara, M., Structural Consultants Limited