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APPENDICES

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1.0 INTRODUCTION

The Environmental Protection Division of the Department of Renewable Resources of the Government of the Northwest Territories ("Environmental Protection Division") and Royal Oak Mines Inc. ("Royal Oak") require plume dispersion modelling of sulphur dioxide and arsenic trioxide emissions from Royal Oak's Giant Yellowknife Mine roaster stack. This roaster stack is the primary source of sulphur dioxide and arsenic trioxide in the Yellowknife area. Modelling results will be compared to measured air quality in the Yellowknife area and a sensitivity analysis will be conducted, under the direction of the Environmental Protection Division and Royal Oak, to assess possible control options for the roaster exhaust gases.

Plume dispersion modelling of emissions from the roaster stack is to be conducted using U.S. Environmental Protection Agency (EPA) models. The request for proposals identifies that site specific meteorology and topography is to be included in the model. Stanley Associates Engineering Ltd. suggests that the appropriate model to be used for this project is the All Terrain Dispersion Model (ATDM) Version 1.0. This model incorporates both the U.S. EPA's Industrial Source Complex Short Term Version 2 (ISCST2, Version 93109) and the COMPLEX I (Version 92290) atmospheric dispersion models. This model can incorporate site specific hourly meteorology and local topography. Stanley has a licensed copy of this model and personnel experienced with its use.

Stanley

2.0 OBJECTIVES

The request for proposals clearly identifies overall objectives for this investigation. These are as follows:

a) to create U.S. EPA atmospheric dispersion model input files. These files will include actual data collected from stack tests, conducted by Royal Oak, on the roaster stack, and will incorporate site specific topography for the Yellowknife area;

b) to create meteorological files suitable for use by U.S. EPA atmospheric dispersion models. These files will use hourly meteorological data collected from the Yellowknife area and will reflect the presence of Great Slave Lake to the south of the Giant Yellowknife Mine;

c) to conduct atmospheric dispersion modelling using the above mentioned files;

d) to compare atmospheric modelling results to actual air quality measurements taken, by the Environmental Protection Division, in downtown Yellowknife;

e) to evaluate contaminant removal control options for arsenic trioxide and sulphur dioxide; and

f) to evaluate the sensitivity of ground level concentrations of the pollutants to changes in roaster exhaust gas temperature or velocity, or to roaster stack height.

After preliminary atmospheric dispersion modelling is conducted and the results of this modelling are compared to actual ambient air pollutant measurements an interim report will be provided to the contract managers. Following the submission of this interim report there will be a project meeting in order that the contract managers can provide comments to Stanley on their review of the data and provide direction for the sensitivity analysis. Following the contaminant removal assessment and the sensitivity analysis all information will be consolidated in the form of a draft report for review by the contract managers. Comments made on the draft report will be incorporated into a final report.

3.0 METHODOLOGY

A work program specific to the Atmospheric Dispersion Modelling in the Yellowknife Area project, consisting of a series of distinct tasks, has been developed to meet the objectives specified previously. By pre-planning these activities through these tasks, it is possible to define the level of effort, required personnel, and project fee to a suitable level of accuracy and detail. The task format also provides the client with a clear understanding of Stanley's approach to the project.

The work program for this project is currently visualized as follows:

Task 1: Project Initialization and Preliminary Modelling

- Startup Meeting
- Model File Creation and Atmospheric Dispersion Modelling
- Comparison of Model Results to Actual Air Quality Data
- Submission of Interim Report

Task 2: Initial Emission Control Review and Project Meeting

- Review of Contaminant Removal Control Technologies
- Initial Sensitivity Review
- Contract Managers/Stanley Project Review Meeting

Task 3: Finalize Control Review and Draft Report Submission

- Finalize Sensitivity Analysis and Control Option Review
- Completion and Submission of Draft Report and Electronic Files

Task 4: Contract Managers Review of Draft Report

Task 5: Final Report Preparation and Submission

- Incorporation of Contract Managers comments
- Submission of Final Report

Each of these tasks will be elaborated on in the following sections.

Task 1: Project Initialization and Preliminary Modelling

Following the award of the contract, the first item of the work program is a project initiation meeting. This meeting would be useful in that the contract managers will familiarize themselves with the Stanley project team members. This initial project meeting would also facilitate the transfer of information needed to start the model file creation. Royal Oak contract manager will provide copies of stack testing reports for the Yellowknife Giant Mine roaster stack and the Environmental Protection Division contract manager will provide copies of ambient air quality testing data for sulphur dioxide and arsenic trioxide for the Yellowknife area. This initial project meeting will also ensure that all the objectives that the contract managers require of this project are clearly outlined.

Following the project meeting Stanley will begin work on the preparation of model and meteorological input files. The model that is suggested for use in this project is the All Terrain Dispersion Model (ATDM) Version 1.0. This model incorporates both the U.S. EPA's Industrial Source Complex Short Term Version 2 (ISCST2, Version 93109) and the COMPLEX I (Version 92290) atmospheric dispersion models. Due to varying terrain in the study area it was deemed necessary that a model that could handle simple, intermediate and complex terrain be used for this project. In simple terrain, ATDM uses the ISCST2 algorithms to calculate ground level concentrations of pollutants. In complex terrain, ATDM utilizes the COMPLEX I algorithms for the calculations of ground level concentrations of pollutants. In intermediate terrain, the model uses both algorithms and selects the most conservative result. This model incorporates site specific hourly meteorology and local topography. The U.S. EPA has extensively tested the components of ATDM and has also verified that ATDM produces equivalent results to ISCST2 and COMPLEX I. Stanley has a licensed copy of this model. It should be noted that the model and meteorological input files created can be used by the ATDM model or by the ISCST2 model. Information on this model and a letter from the U.S. EPA verifying the testing of the model are included in Appendix A.

Stack testing data from the Yellowknife Giant Mine roaster stack along with the physical dimensions of the stack and surrounding buildings will be incorporated into the model.

This data must be provided by the Royal Oak contract manager. Site specific topographical inputs will also be included in the model input file. Topographical information for the area surrounding the mine and for the Yellowknife area will be included. The areas to be included in the modelling will be finalized at the project startup meeting.

Hourly meteorological data from the Atmospheric Environment Service (AES) weather station at the Yellowknife Airport will be used in the creation of the input meteorological files. Five years of data (1989 through 1993) will be processed for this project. The hourly data available from the Yellowknife Airport includes windspeed, wind direction, ambient temperature, cloud cover and opacity. Additional items needed for the meteorological input file are atmospheric stability and mixing layer heights. Atmospheric stability can be calculated using windspeed, the time of day, cloud cover and/or opacity. Mixing layer heights are not available from the Yellowknife Airport. E. Wilson, of the Air Quality Assessment Section, Atmospheric Environment Services, Environment Canada published a study in July, 1979, entitled, "Regional Frequency Distribution of Mixing Depth Parameters in Canada: A Climatological Study of Air Pollution Potential". This study provides seasonal mixing layer heights for each separate region of Canada. In addition to the data from this study, data from the Ft. Smith, N.W.T. AES station (nearest weather station to collect mixing layer data) can be examined, if the contract managers deem this necessary.

The Yellowknife Giant mine model input file and the Yellowknife meteorological files will be used by the ATDM model to calculate ground level concentrations of both sulphur dioxide and arsenic trioxide at a variety of locations in the Yellowknife area. These outputs from the atmospheric modelling will be compared to actual monitoring data collected by the Environmental Protection Division for sulphur dioxide and arsenic trioxide collected at locations in downtown Yellowknife. The Environmental Protection Division will provide Stanley with copies of this data. This assessment will indicate the reliability of the model estimates.

Following the completion of the assessment of model predictions versus actual air quality data, an interim report will be prepared for the contract managers. This report will include copies of the input files used for modelling, a summary of the output from the ATDM model, and an assessment of how this output compares with actual measured air quality data.

Task 2: Initial Emission Control Review and Project Meeting

Following the submission of the interim project report and prior to the project meeting additional work will be undertaken. A literature review, using a variety of databases, of air emission control technologies for sulphur dioxide and arsenic trioxide will be undertaken. Discussions with engineers at Royal Oak's Giant Yellowknife Mine will be initiated in order to determine which technologies may be feasible for the particular operating situation. Data obtained from these discussion and the literature review will be used when contacting technology suppliers. These technology suppliers will be contacted in order to determine specific information regarding the use of specific technologies in the Yellowknife Giant Mine operational scenario.

Initial work on the sensitivity of the model outputs to changes in stack gas temperature, stack gas flowrates and stack height will be also be conducted. This work will not be detailed in nature but will provide an initial indication of the gross sensitivity of the model outputs to each specific input. This information will be provide to the contract managers at the project meeting.

At a time convenient to the contract managers, a project meeting will be held. The purpose of this meeting will be to review the atmospheric modelling work conducted, and to review with the contract managers the assessment of how the modelling outputs compare to actual air quality data. The contract managers will also be provided with an initial indication of the sensitivity of the model to various input parameters as well as contaminant removal control technologies investigated. The contract managers will provide direction at this meeting as to the direction that further sensitivity/control technology review work should take.

Task 3: Finalize Control Review and Draft Report Submission

Stanley will finalize the control technology review and the sensitivity analysis based on the direction provided by the contract managers. At this point, a draft report will be completed that clearly and concisely encompasses all the work completed to date. The draft report will contain specific recommendations for control of emissions from the roaster stack. Five copies of this document will be provided to the contract managers prior to the date specified in the request for proposals. Included with the draft report will be electronic copies of all model input files and meteorological files used in the project.

Task 4: Contract Managers Review of Draft Report

The contract managers will be provided sufficient time to thoroughly review the draft report and provide comments to Stanley.

Task 5: Final Report Preparation and Submission

Following the contract managers review of the draft report and the receipt by Stanley of their comments relating to the draft report, a final report will be created. This report will incorporate all the comments made by the contract managers. A total of five bound copies and one unbound copy will be provided to the contract managers prior to the date specified in the request for proposals.

4.0 PROJECT TEAM

4.1 STANLEY ASSOCIATES ENGINEERING LTD.

The Stanley Technology Group of Companies is a Canadian, publicly traded, integrated multi-disciplinary firm established in 1954. The Stanley Technology Group offers a very broad base of environmental professionals that includes environmental engineers, chemical engineers, air emission specialists, soil scientists, hydrogeologists, water quality and wastewater treatment specialists, wildlife and aquatic biologists, toxicologists, social scientists and regulatory analysts. This breadth of expertise enables us to provide our clients with the skills and experience necessary to tackle a wide variety of environmentally based projects.

Stanley Associates Engineering Ltd. has an office in Yellowknife, N.W.T, with other offices located in B.C., Alberta, Saskatchewan and the Yukon. The head office is located in Edmonton, Alberta.

4.2 PERSONNEL

Stanley has formulated a team of professionals that will provide The Department of Renewable Resources and Royal Oak Mines Ltd. with a well trained, experienced project team for the successful completion of this project. The project will be managed out of the Yellowknife office with specialist services provided by the Edmonton office. Resumes for all project team members are provided in Appendix B of this proposal.

Colin Anderson, P.Eng. **Project Team Leader**

Mr. Anderson has over 17 years engineering experience in a variety of civil engineering projects in the Northwest Territories and Alberta. He is currently Manager, NWT Operations for Stanley Associates Engineering Ltd., which is based in Yellowknife. As the project team leader Mr. Anderson will responsible for liaison with the contract managers, review of all reports submitted and maintaining schedules and budgets.

Jim Dixon, M.Eng. P.Eng. **Environmental Engineer**

Mr. Dixon is an Environmental Engineer with extensive experience in atmospheric dispersion modelling. He has received academic training in the area through undergraduate and graduate course work and from industry training courses. In addition to this academic training, Mr. Dixon has been involved in a variety of environmental projects involving atmospheric dispersion modelling. Most recently, Mr. Dixon provided atmospheric dispersion modelling services as part of the environmental approvals process for two large oriented strand board facilities located in Alberta and Manitoba. Both of these facilities were successfully permitted. In addition to these projects, Mr. Dixon has provided dispersion modelling expertise to pulp and paper facilities, to oil refining facilities and to fertilizing producing facilities. Mr. Dixon also has experience in fugitive emissions estimation, site remediation projects, water and wastewater engineering, and environmental assessment and auditing.

Mr. Dixon will coordinate all model and meteorological data file compilation and will conduct all atmospheric dispersion modelling. He will also be responsible for the comparison of model results to actual air quality data and the control technology search. Mr. Dixon will prepare all reports for this project.

Stanley will use appropriate support staff as required for data management and word processing in order that the project is effectively completed on time and on budget.

4.3 RELATED WORK EXPERIENCE

Project titles where Stanley has direct experience involving atmospheric dispersion modelling and/or air emissions control technology evaluation are listed below:

- Environmental Impact Assessment, Louisiana-Pacific Canada Ltd.
  Swan River, Manitoba (1994)
- Environmental Screening Document, Tolko Industries
  High Prairie, Alberta (1994)
- Proposal for the Grande Prairie Timber Allocation, Louisiana-Pacific Canada Ltd.
  Grande Prairie, Alberta (1994)

- Odour Impacts Study, Client Confidential
  Alberta (1993).
- Air Emissions Impact of Stack Replacement, Turbo Resources Ltd.
  Edmonton, Alberta (1993)
- City of Edmonton Separation Distance Study, City of Edmonton
  Edmonton, Alberta (1993)
- Goldbar Sewage Treatment Plant Odour Study, City of Edmonton
  Edmonton, Alberta (1992)

An example of the type of air quality work conducted during one of the above mentioned projects is provided below:

Environmental Impact Assessment, Louisiana-Pacific Canada Ltd.
Swan River, Manitoba (1994)

The air quality work associated with this project included meteorological data file compilation for five years of data, ATDM model input file creation using topographical inputs, providing input to the client regarding stack flowrates and stack heights required for proper dispersion and contacting pollution control equipment vendors to determine capabilities and applicability of different pollution control devices for this project. Stanley (Mr. Dixon among others) was also required to appear before Manitoba's Clean Environment Commission to provide expert testimony regarding the air quality work and to defend the modelling work to the public.

In addition to the above mentioned projects, Stanley has experience working in the Yellowknife area on environment matters relating to the Giant Yellowknife Mine. In April, 1986 Stanley completed the "Sampling and Analysis of Snow Cores in the Yellowknife Area" project. This project, conducted for the Pollution Control Division of the Department of Renewable Resources, Government of the Northwest Territories, involved the collection and analysis of snow cores for arsenic concentrations. It was noted in this report that the Giant Yellowknife Mines Limited was one of the sources of arsenic emissions (arsenic trioxide) in the Yellowknife area.

Specific reference contact phone numbers and addresses can be provided to the contract managers on request.

5.0 SCHEDULE

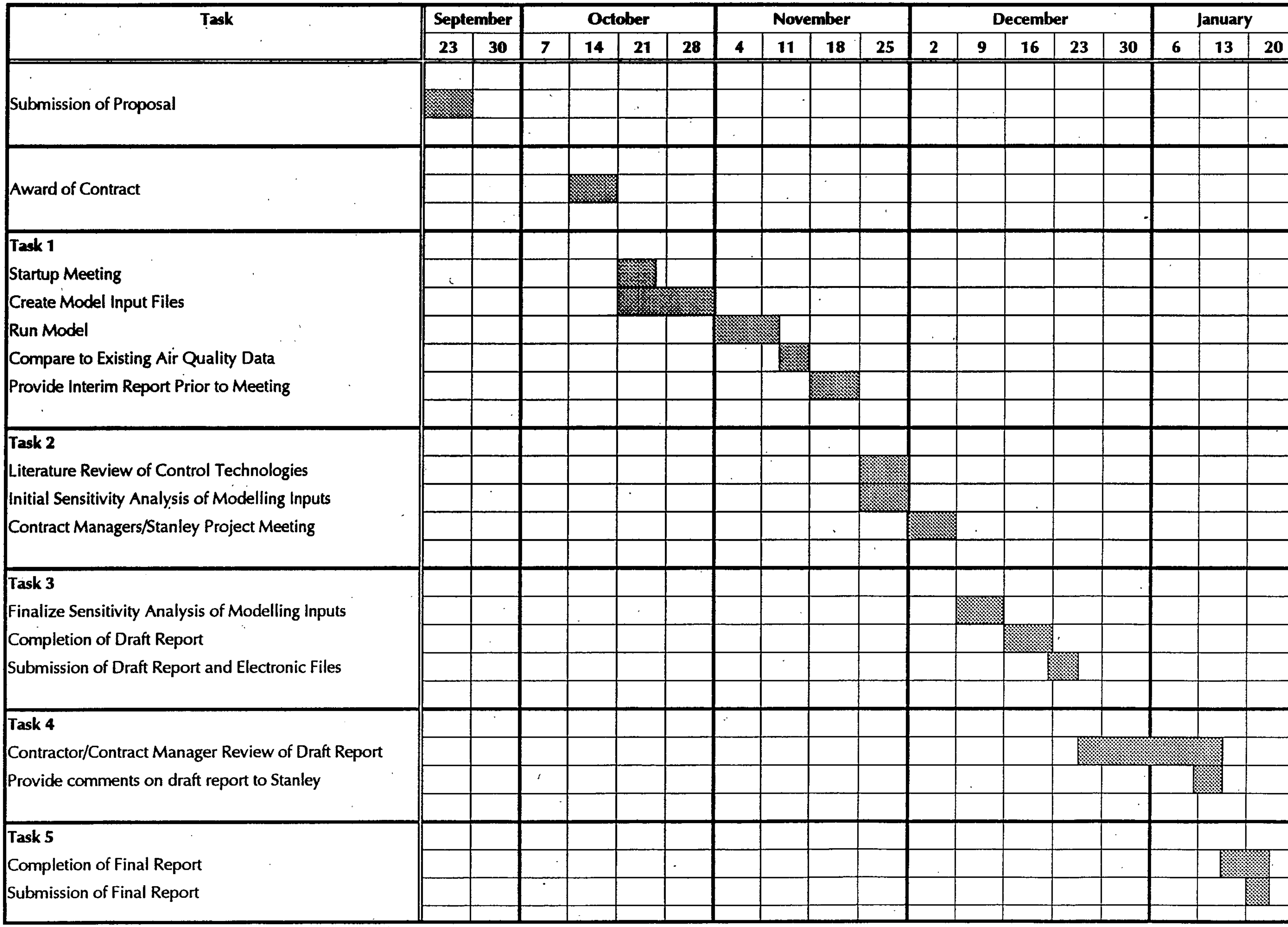
Stanley is prepared to begin work on this project immediately upon receipt of a signed contract agreement. The following set of dates and deliverables is tentative based on the award of the contract:

September 23, 1994	Submission of Proposal
October 14, 1994	Award of Contract
October 20, 1994	Project Initiation Meeting (optional)
November 18, 1994	Submission of Modelling Input Files and Interim Report
December 1, 1994	Project Meeting
December 21, 1994	Submission of Draft Report and Electronic Files
January 9, 1995	Receipt of Contract Managers Comments on Draft Report
January 16, 1995	Submission of Final Report

The submission of the draft report will include five bound copies of the report and copies of the electronic files used for the atmospheric dispersion modelling. The final report submission will include five bound copies and 1 unbound copy of the report.

A timeline indicating approximate scheduling of the project work and including the above mentioned dates is provided in Figure 1. This schedule contains some flexibility and may be adjusted to fit the contract managers requirements. Stanley anticipates no difficulty in meeting the January 16, 1995 date for final reporting. If the contract is awarded earlier than October 14, 1994 it may be possible to provide a final report prior to January 16, 1995.

Figure 1: Project Schedule



6.0 PROJECT BUDGET

The bid price for the consulting work stated within this proposal is $19,900 CDN (excluding GST). Stanley recognizes and accepts the terms and conditions for payment as set out in the request for proposals, which are:

> Upon satisfactory completion of the final report, the Contractor shall invoice the Government of the Northwest Territories for 50% and Royal Oak Mines for 50% of the contract price. Payment shall be made in accordance with the Government of the Northwest Territories payment directives and Royal Oak Mines payment practices.

Fee and disbursement estimates for each of the tasks outlined in Section 3.0 and for all of the project team members are provided in Table 1. The billing rates and estimated person hours for each team member are also provided in Table 1.

The above mentioned bid price are exclusive of GST, or any municipal, territorial or federal taxes or levies of fees for services. GST will be identified separately on the invoices provided to the contract managers.

Table 1: Engineering Service Budget

Government of The Northwest Territories
Department of Renewable Resources
Environmental Protection Division
and
Royal Oak Mines Inc.

Task	Personnel			Total Fees	Disbursements	Task Total
	Colin Anderson	Jim Dixon	Support Staff			
Task 1 - Startup Meeting/Model Setup	2	90	40	$7,556	$1,650	$9,206
Task 2 - Control Technologies/Sensitivity Anaylsis/Meeting	2	50	10	$3,856	$1,250	$5,106
Task 3 - Finalize Sensitivity/Draft Report	2	40	5	$3,016	$550	$3,566
Task 4 - Contract Managers Review of Draft	0	0	0	$0	$0	$0
Task 5 - Final Report Completion	1	20	5	$1,593	$400	$1,993
Total Hours	7	200	60			
Hourly Rate	$83	$67	$34			
Total Fees	$581	$13,400	$2,040	$16,021	$3,850	$19,871

APPENDIX A
ALL TERRAIN DISPERSION MODEL INFORMATION

PC PRODUCT UPDATE

January 1994

HIGHLIGHTS

- ATDM - All Terrain Modeling
- BPIP - Regulatory BREEZE WAKE
- HOT SPILLS - Hazard Assessment
- New On-Site Meteorological Processor
- Update to Trinity BBS

This newsletter discusses Trinity's new and enhanced software products to improve your modeling productivity.

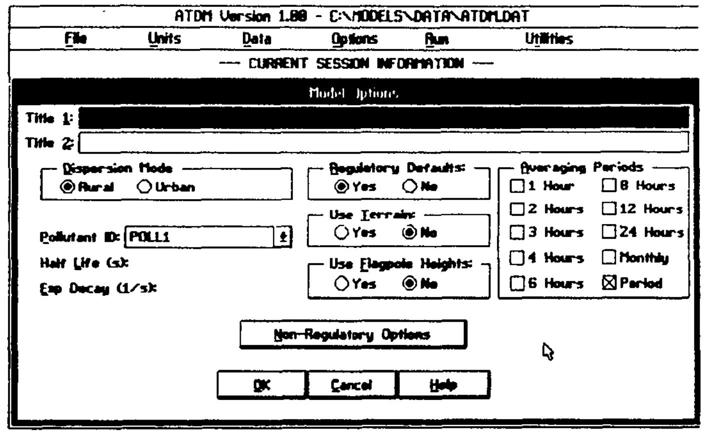
BREEZE AIR

ATDM: All Terrain, All the Time

Trinity's new All Terrain Dispersion Model (ATDM) makes modeling in simple, complex, and intermediate terrain a *BREEZE*. In the past, modeling in varied terrain regimes required using a combination of models and comparing the results to determine the most conservative estimate at each receptor point. With ATDM, these calculations are performed automatically using a single data-input file.

The ATDM Approach

ATDM is a 32-bit program for modeling all terrain regimes in accordance with EPA guidelines. For receptors located in simple terrain, ATDM uses the ISCST2 dispersion algorithms. For receptors located in complex terrain, the model uses the dispersion algorithm from COMPLEX I. For receptors located in intermediate terrain (receptors at elevations between stack height and plume height) or receptors that lie in simple terrain with respect to one source and complex terrain with respect to another, ATDM compares the results from the two models and reports the higher concentration in the output file. The U.S. EPA has verified that ATDM produces equivalent results to ISCST2 and COMPLEX I in simple and complex terrain, respectively, and properly implements EPA guidelines for intermediate terrain modeling.



ATDM includes many options to enhance your modeling analysis.

Data Entry

Entering data with ATDM couldn't be easier. Trinity's Windows™-like interface leads you through every step of the modeling process, from creating data input files to running the model to accessing utilities such as BREEZE AIR GRAPHICS. ATDM includes all of the options of ISCST2 and COMPLEX I, with the exception of gravitational settling and deposition calculations.

Model Output

ATDM produces an output file listing concentration values at each receptor location. For each concentration, it also includes a terrain regime indicator. To enhance the graphical representation of your scenario, ATDM provides an additional output file for producing a post plot indicating the terrain regime at each receptor.

BREEZE WAKE/BPIP
New Building Downwash Program

With the impending release of the Building Profile Input Program (BPIP), the U.S. EPA has codified the calculation of direction-specific building dimensions for input to the ISC2 air dispersion models. Trinity is in the process of updating our BREEZE WAKE program to be fully compatible with BPIP, and adding a 32-bit version that allows users to enter data for up to 500 buildings and 200 sources.

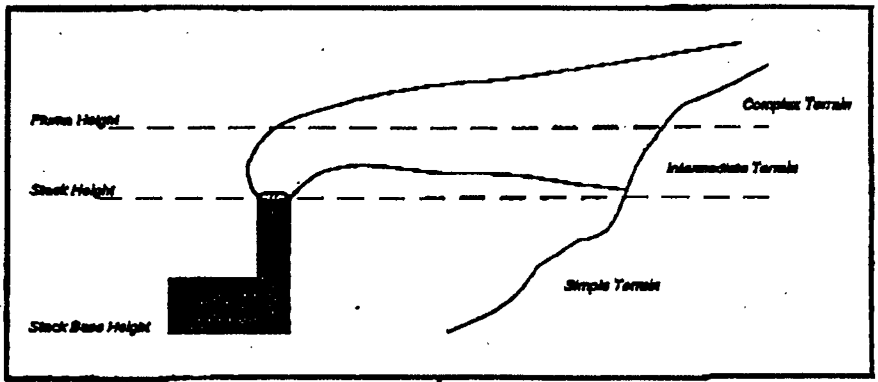
BREEZE AIR
ATDM

Calculates pollutant concentrations in all terrain regimes

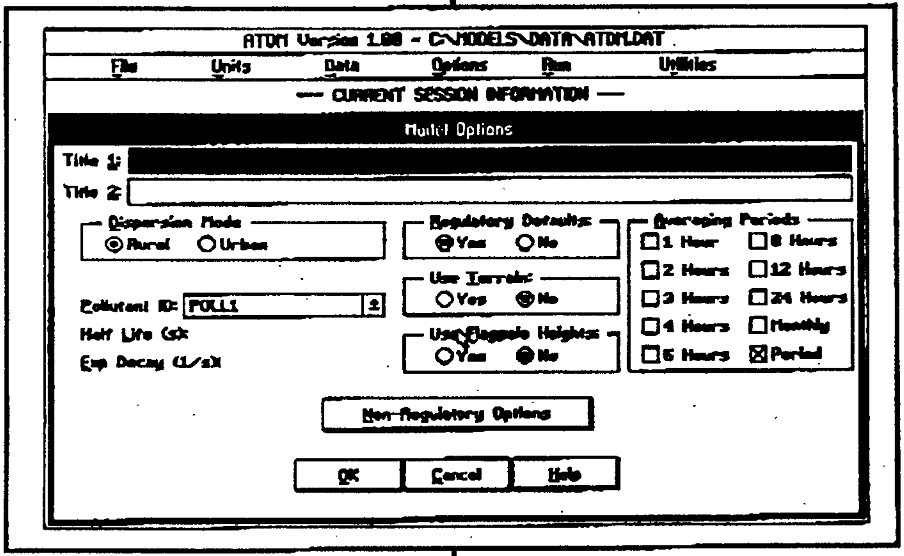
Trinity's All Terrain Dispersion Model (ATDM) simplifies the process of predicting concentrations from continuous releases in simple, intermediate, and complex terrain. The U.S. EPA has verified that ATDM produces equivalent results to ISCST2 and COMPLEX I in simple and complex terrain, respectively, and properly implements EPA guidelines for intermediate terrain modeling.

ATDM streamlines the process of varied terrain modeling by combining the ISCST2 and COMPLEX I algorithms into one easy-to-use program. EPA guidance requires the use of both ISCST2 and COMPLEX I for calculating pollutant concentrations at receptors located in intermediate terrain (the area between stack top and plume centerline). An hour-by-hour comparison of the output from the two models is then required to determine the highest value at each receptor location. ATDM automates this process, determining the applicable terrain regime and selecting the appropriate algorithm for each source and receptor combination.

For receptors located in intermediate terrain, ATDM calculates concentrations using both the ISCST2 and COMPLEX I algorithms and reports the higher value for each averaging period. The model also performs summation for multiple sources and averaging periods. The ATDM output format includes a terrain indicator flag to identify the dispersion algorithm used at each receptor point.



The terrain regime at a receptor location is defined by its elevation relative to the plume height of a particular source.



ATDM includes many options to enhance your modeling analysis.

ATDM MODEL OPTIONS

Sources: Up to 200 point sources can be entered with up to 12 pollutant emission rates. Sources can be grouped to calculate concentrations from individual sources, specific groups of sources, or all sources. Volume and area sources can be used in simple terrain.

Meteorological Data: ATDM calculates concentrations using either historical or user-input meteorological data. ATDM accepts hourly meteorological data preprocessed by MPRM or RAMMET, as well as user-specified ASCII formats.

Receptors: Receptor grids can be created automatically or manually using Cartesian or polar coordinates. Discrete and boundary receptors can also be defined. Up to five separate receptor grids can be entered.

ADDITIONAL BENEFITS OF *BREEZE AIR* ATDM

1. Efficient pull-down menus with full-screen data entry

Trinity's Windows-like desktop offers direct access to entering data, running the model, and generating graphics. All model parameters are supplemented with on-line help.

2. Easy access to BREEZE WAKE and BREEZE AIR GRAPHICS

You can access BREEZE WAKE and BREEZE AIR GRAPHICS directly from the desktop to calculate direction specific building dimensions and illustrate your results. ATDM produces a unique output file that summarizes the terrain elevation and terrain regime indicator for each receptor location.

3. Advanced file management

ATDM allows you to create separate source, receptor, and downwash files to add flexibility when using other compatible *BREEZE AIR* programs.

4. Comprehensive user's manual

ATDM includes full documentation that provides modeling insights as well as software instructions. We also recommend the EPA user's manuals for ISCST2 and MPTER, for a complete technical reference to model calculations.

[illegible]

		Dispersion Algorithm ISCST2	Dispersion Algorithm COMPLEX I
Source Types	Point	✓	✓
	Area or Volume	✓	
Dispersion Coefficients	Pasquill Gifford (rural)	✓	✓
	Briggs Urban	✓	
Building Downwash	Huber-Snyder/Schulman-Scire	✓	
Receptors	Cartesian, Polar, or Discrete	✓	✓
Met Data	Hourly Preprocessed or ASCII	✓	✓
Averaging Period	1-4, 6, 8, 12, 24 hr., Month, Period	✓	✓
Plume Rise Equations	Stack-Tip Downwash	✓	✓
	Gradual Plume Rise	✓	✓
	Buoyancy-Induced Dispersion	✓	✓

HARDWARE REQUIREMENTS

ATDM requirements include:

- IBM PC-compatible 386 or 486 computer with 2 MB of RAM
- Hard disk and math coprocessor
- DOS 5.0 or higher
- Mouse recommended
- 132-column printer capability

OTHER TERRAIN MODELS

Trinity offers several other *BREEZE AIR* programs for modeling analyses in complex terrain. Both are EPA Guideline models for screening.

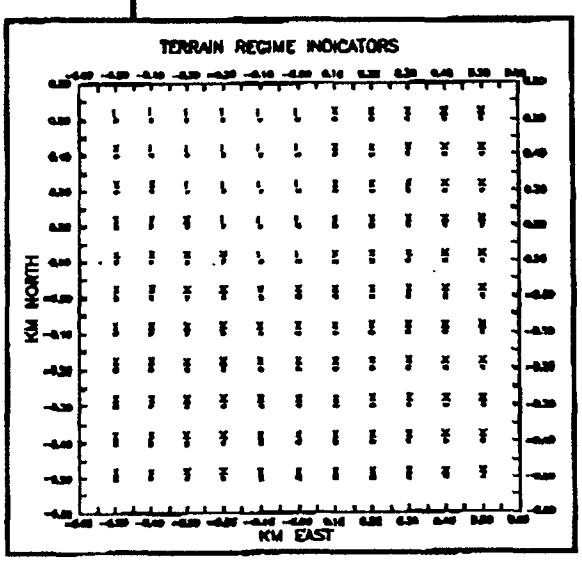
SCREEN2

SCREEN2 calculates concentrations from a single point source. In intermediate terrain, SCREEN2 calculates and displays concentrations using both flat terrain and VALLEY screening methods and reports the higher value at each receptor location.

RTDM

RTDM, the Rough Terrain Dispersion Model, determines whether a plume will take a path over or around an obstacle. RTDM accepts additional meteorological data, including hourly, on-site measurements of turbulence intensity, vertical temperature difference, horizontal wind shear, and wind speed profile exponents.

You can illustrate the terrain regime at each receptor location using ATDM and BREEZE AIR GRAPHICS. In this plot, "X" at the receptor location represents complex terrain and "I" represents intermediate terrain.



For more information on *BREEZE AIR* models, contact Trinity Consultants at (214) 661-8100 or fax (214) 385-9203. For pricing information or to order software, please refer to the *BREEZE* order form.

Trinity Consultants
INCORPORATED
Air Quality Specialists

Printed in the U.S.A.
January 1994

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Office of Air Quality Planning and Standards
Research Triangle Park, North Carolina 27711

DEC 20 1993

Mr. Scott R. Humphrey
General Manager, Software
Trinity Consultants, Inc.
12801 North Central Expressway
Suite 1200
Dallas, Texas 75243

Dear Mr. Humphrey:

We have reviewed your submittal of the All Terrain Dispersion Model (ATDM), Version 2.1, for generic equivalence to Environmental Protection Agency (EPA) models and procedures for intermediate terrain. ATDM is intended: 1) to replicate the Industrial Source Complex Short Term (ISCST2) model, 2) to replicate the Complex I model, and 3) to implement the EPA policy for intermediate terrain.

We find that ATDM has been adequately demonstrated to be equivalent to the ISCST2 simple terrain model; to be equivalent to the Complex-I complex terrain model, and to properly implement the EPA intermediate terrain procedures (memorandum from Joseph A. Tikvart to Alan J. Cimorelli, dated 6/8/89, attached) in its use of ISCST2 with Complex-I. ATDM may be used as equivalent to those EPA models and procedures.

The demonstration of equivalence can be divided into three parts: 1) equivalence to the regulatory flat terrain model (ISCST2), 2) equivalence to one or more regulatory complex terrain models (COMPLEX-I), and 3) correct implementation of the EPA Intermediate Terrain Guidance.

First, ATDM was tested for equivalence to ISCST2 for flat and rolling terrain, using model to model comparisons for an area source, a volume source and point sources in flat terrain having stack heights of 35, 100, and 200 meters, for a point source of 200 meter stack height and rolling terrain below stack height, and a 35 meter stack with terrain exceeding stack height. The last test was included to verify that "terrain chopping" is properly implemented. This is essential for the correct implementation of the intermediate guidance. One year each of meteorological data for Pittsburgh (1964) and Oklahoma City (1984) were used.

Second, ATDM was tested for equivalence to Complex I using the data set with the 35 meter stack with terrain. This is the same data set as was used for the "terrain chopping test" which was conducted for ISCST2 (see above). This particular data set includes receptors at a range of elevations. Some receptors are below stack top which, under intermediate terrain procedures, are modeled using ISCST2. Others are slightly above stack top; these are modeled using ISCST2 with terrain chopping. Others are well above stack top; these are modeled using COMPLEX-I. These last receptors provide the comparison with the COMPLEX-I model.

Third, ATDM was tested to be certain it correctly implemented the EPA Intermediate Terrain Policy. In addition to comparing the results obtained from using the 35 meter stack data set, several hours of individual data output from each part of the model were reviewed on an hour by hour basis to verify that the correct value was selected in each case by ATDM consistent with EPA policy regarding intermediate terrain.

Sincerely,

Russell F. Lee

Russell F. Lee
Meteorologist
Source Receptor Analysis Branch

Attachment

cc: J. Tikvart
D. Wilson
Regional Modeling Contact, Regions I-X

APPENDIX B
RESUMES

Stanley

COLIN D. ANDERSON

EDUCATION

Bachelor of Science in Civil Engineering;
University of Alberta, Edmonton, 1977

PROFESSIONAL AFFILIATIONS

Association of Professional Engineers, Geologists and Geophysicists of the Northwest Territories
Association of Professional Engineers, Geologists and Geophysicists of Alberta

EXPERIENCE

Manager of the Stanley Technology Group Yellowknife Office. Responsibilities concentrate on project management and engineering tasks for Municipal, Territorial and Federal Governments, Indian Bands and private industry clients throughout the Northwest Territories.

Mr. Anderson's previous experience includes employment as Town Engineer in Northern Alberta. Responsibilities included engineering services for capital works programs, development of engineering standards and specifications, contract administration providing technical assistance to operating staff and development of maintenance management systems. The position also included Financial/Administrative duties, preparation of annual operating and capital budgets, budget control and expenditure monitoring, and preparation of technical reports to the Town Manager, Council and ad hoc committees.

Prior to joining municipal government, Mr. Anderson was a Senior Project Engineer with the Government of the Northwest Territories responsible for northern community infrastructure development. Included were design and technical review of engineering plans, specifications and budgets, project management, contract preparation and administration, liaison with client representatives, evaluation of existing systems. Mr. Anderson travelled to the Soviet Union as a Water Supply Specialist under the Canadian/Soviet Arctic Sciences Exchange Program.

Previous to employment in the Government Sector, Mr. Anderson spent several years as Project Engineer in the engineering consulting industry. Responsibilities included subdivision development, design and construction of underground utilities, surface improvements, design and construction of arterial roadways, contract administration, and construction supervision, field inspection and layout.

Additional experience includes employment as a Resident Highway Engineer involved in all aspects of highway design and construction surveying and materials testing and control for the Province of Alberta.

SPECIFIC PROJECT EXPERIENCE

MUNICIPAL INFRASTRUCTURE DEVELOPMENT

- Design Engineer for Eastview Estates, Anders East and Clearview Estates, Red Deer, Alberta
- Design Engineer/Resident Engineer Bruns Park Subdivision, Lacombe, Alberta
- Predesign Engineer Pangnirtung Water Supply and Reservoir
- Project Manager Water Supply System
  - Holman Water Supply Truck Fill
  - Gjoa Haven Water Treatment Plant
  - Coral Harbour Water Supply Truckfill
  - Coppermine Water Intake
  - Tuktoyaktuk Water Supply Truck Fill and Reservoir
  - Pelly Bay Water Supply Truck Fill
- Project Manager Solid Waste Management
  - Pangnirtung Incinerator Plant
  - Tuktoyaktuk, Holman, Coppermine, Gjoa Haven Solid Waste Sites
- Project Manager for the design of Holman Sewage Lagoon, Tuktoyaktuk Sewage Lagoon, Coppermine Sewage Lagoon, Gjoa Haven Sewage Lagoon
- Project Manager for installation of stand-by generators at Rae Water Treatment Plant, Rae Sewage Lift Station; Senior Review Engineer numerous locations
- Senior Review Engineer for Town of Iqaluit Servicing, Rankin Inlet Water & Sewer Upgrading Replacement
- Project experience in municipal infrastructure in the following communities:
  - Inuvik Region: Inuvik, Norman Wells, Arctic Red River, Fort McPherson, Tuktoyaktuk
  - Kitikmeot Region: Cambridge Bay, Holman, Spence Bay, Gjoa Haven, Pelly Bay, Coppermine
  - Keewatin Region: Rankin Inlet, Baker Lake, Coral Harbour
  - Baffin Region: Iqaluit, Pangnirtung, Resolute Bay, Igloolik, Broughton Island
  - Fort Smith Region: Edzo, Rae, Kakisa (Powerline), Pine Point
- Project Manager for Forrest Park Utilities Upgrading in Yellowknife

RECREATION

- Westlock and District Athletic field
- Westlock Recreational Centre

PROJECT MANAGEMENT

- Westlock sanitary sewer outfall
- Service road reconstruction
- Westlock sewage lagoon upgrading
- Westlock arena upgrading
- RR Warehouse GNWT

TRANSPORTATION

- Design and construction Truck Route Extension - City of Red Deer
- Project Engineer for base and grade construction
- Resident Engineer for pavement overlay projects (highways)
- Resident Engineer Secondary Highway reconstruction

FUEL STORAGE FACILITIES

- Project Manager for design and construction of bulk fuel storage facilities in Sachs Harbour, Coppermine, Paulatuk, Gjoa Haven, Rankin Inlet, Cape Dorset, Pangnirtung

Stanley

JAMES V. L. DIXON

EDUCATION

Bachelor of Science in Chemical Engineering;
University of Alberta, Edmonton, 1990
Master of Engineering in Environmental Engineering;
University of Alberta, Edmonton, 1992

PROFESSIONAL AFFILIATIONS

Association of Professional Engineers, Geologists and Geophysicists of Alberta
American Water Works Association
Air and Waste Management Association

INDUSTRY TRAINING COURSES

Air and Waste Management Association Training Institute Air Dispersion Computer Modelling Laboratory, April, 1993
Fundamentals of Health Risk Assessment for Environmental Risk Management, March, 1994

EXPERIENCE

Mr. Dixon is an Environmental Engineer with experience in site remediation, water and wastewater engineering, air pollutant dispersion modelling, fugitive emissions and other similar areas of environmental concerns. He has worked on projects involving environmental auditing, air quality concerns, and site remediation. Most recently, Mr. Dixon has been involved in the air quality aspects of obtaining environmental permits for two oriented strand board facilities in western Canada. In addition to his environmental experience, Mr. Dixon has experience working in the oil industry, as both a reservoir engineering technician and a field operator.

Mr. Dixon has also worked on safety and loss management projects and has WHMIS training.

SPECIFIC PROJECT EXPERIENCE

ENVIRONMENTAL AUDITS

- Field assistant for an environmental audit of a major international airport located in western Canada, (1992).
- Project Manager for a Phase II environmental audit of a plastic container manufacturer in St. Albert, Alberta, (1992).
- Field assistant for a project involving the sampling of 200 barrels containing unknown compounds, (1991).
- In charge of logistics for an environmental audit of several oil and gas production and refining facilities in Alberta and Saskatchewan, (1992).
- Air quality review portion of a property and facilities transfer audit for a large fertilizer production facility with a transfer value in excess of $300 million (1994).
- Various Phase 1 environmental property audits for locations in and around Edmonton, Alberta (1992-1994).

LEAKING UNDERGROUND STORAGE TANK AUDITS

- The Grocery People (TAGS Bars, 26 locations throughout Alberta, British Columbia, and the Yukon Territories), in charge of logistics for audit, (1992).
- Preparation of M.U.S.T. documentation for an industrial complex located near Gibbons, Alberta, (1992).

AIR QUALITY

- Completed annual air emissions reports for a chemical production facility located near Gibbons, Alberta, (1992, 1993, 1994).
- Worked as odour dispersion modeler for the Goldbar Sewage Treatment Plant odour study, (1992).
- Worked as an air contaminant dispersion modeler for a fluoride emissions study at a large industrial complex near Redwater, Alberta, (1990).
- Determined total fugitive ammonia emissions from a large industrial complex near Redwater, Alberta, (1990).
- Provided air dispersion modelling services to several industrial facilities in Edmonton, Alberta (1993).
- Provided odour dispersion modelling for an Alberta pulpmill odour study, (1993).
- Assisted with air quality assessment work for an industry-residential separation distance study for a large city in Alberta (1993).
- Conducted air pollutant dispersion modelling as part of the environmental approval process for an oriented strand board facility in north-central Alberta (1994).
- Conducted air quality impact assessment for an oriented strand board facility to be located in Manitoba. This project also involved providing testimony regarding air quality impacts to Manitoba's Clean Environment Commission (1994).
- Conducted fugitive ammonia emissions estimation for a Saskatchewan fertilizer company (1994).
- Conducted odour dispersion modelling for a western Alberta pulp mill (1994).
- Completed H_2S measurement program for crude oil off-loading facility near Grande Prairie, Alberta in order to provide clarification of OH&S and Truckers Association requirements (1994).

REMEDIATION PROJECTS

- Supervised the excavation and removal of 50 tonnes of contaminated soils at a chemical production facility near Gibbons, Alberta, (1990).
- Determined a remediation process for an industrial wastewater, contaminated with several metals, (1991).
- Supervised the remediation of a boiler blowdown pond for a power generating station near Edmonton, Alberta (1993).
- Assisted with ongoing remediation investigation for a PCB contaminated wastewater pond for large industrial facility in northern Alberta (1993-).

WATER AND WASTEWATER

- Provided sampling services, analysis and technical advice for a central Alberta town with drinking water disinfection problems, (1992).
- Field program manager for a comprehensive storm and sanitary sewer sampling program for two government complexes in Edmonton, Alberta, (1992).
- Assisted Fort Saskatchewan, Alberta client with a feasibility study involving reduction of ammonia from wastewater stream (1993-1994).

OTHER

- Coordinated a field program to provide data to meet Alberta Environment Clean Water license requirements for a chemical production facility in Fort Saskatchewan, Alberta, (1992).
- Conducted experiments into extraction of contaminants from soils for a decommissioned facility in Edmonton, Alberta, (1992).
- Produced a report detailing the current state of scrap glass recycling in Alberta as part of a feasibility study for a potential scrap glass upgrading facility, (1993).
- Assisted with information collection to produce a regional waste management plan for a northern Alberta Improvement District, (1993).