APPENDIX C
Air Emission Risk Analysis Data

(Note: Color versions of figures in this Appendix are included in the file posted at the DOE NEPA website: http://www.eh.doe.gov/nepa/docs/deis/deis.html)

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Air Emission Risk Analysis

Excelsior Energy Inc.
Mesaba Energy Project

Taconite, Itasca County, Minnesota

SEH No. A-EXENR0502.03

June 2006

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Air Emission Risk Analysis

Excelsior Energy Inc.
Mesaba Energy Project
Taconite, Itasca County, Minnesota

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Excelsior Energy Inc.
Mesaba Energy Project
Air Emission Risk Analysis
June 2006

(Signature) (Date)

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List of Abbreviations/Terms

AERA	Air Emissions Risk Analysis
AERMOD	a steady-state plume air dispersion model
AP-42	Compilation of Air Pollutant Emission Factors
benzo(a)phenanthrene	chrysene
bis(2-ethylhexyl)phthalate	DEHP
bromoethane	methyl bromide
butanone, 2-	methyl ethyl ketone
CD-ROM	compact disc
chloroethane	ethyl chloride
chloromethane	methyl chloride
chrysene	benzo(a)phenanthrene
cm/yr	centimeters per year
COPC	contaminants of potential concern
CTG	combustion turbine generator
DEHP	bis(2-ethylhexyl)phthalate
EC	exposure concentration
ELCR	excess lifetime cancer risk
dibromoethane	ethylene dibromide
dichloroethane, 1,2-	ethylene dichloride
dichloromethane	methylene chloride
ethyl chloride	chloroethane
ethylene dibromide	dibromoethane
ethylene dichloride	dichloroethane 1,2-
Excelsior	Excelsior Energy Inc.
ft	feet
g/s	grams per second
g/yr	grams per year
Hg^0	elemental mercury
HI	hazard index
HHRAP	Human Health Risk Assessment Protocol
HRV	health risk value
HVTL	high voltage transmission line
hydrofluoric acid	hydrogen fluoride
hydrogen fluoride	hydrofluoric acid
HQ	hazard quotient
I	inhalation exposure concentration
IGCC	Integrated Coal Gasification Combined Cycle
IHB	inhalation health benchmarks
IRAP	Industrial Risk Assessment Program – Human Health
lb/yr	pounds per year
kg	kilogram
kg/day	kilogram per day
km	kilometer

m	meters
methyl bromide	bromoethane
methyl chloride	chloromethane
methyl chloroform	trichloroethane, 1,1,1-
methyl ethyl ketone	butanone, 2-
methylene chloride	dichloromethane
MDNR	Minnesota Department of Natural Resources
mg/kg-day	milligram per kilogram per day
mi	miles
MDH	Minnesota Department of Health
MN	Minnesota
MNDOT	Minnesota Department of Transportation
MPCA	Minnesota Pollution Control Agency
m/s	meters per second
MWe	megawatts of electricity
m/yr	meters per year
m^3/yr	cubic meters per year
NAAQS	National Ambient Air Quality Standards
NE	northeast
ng/m^2-yr	nanograms per square meter per year
PBT	persistent, bioaccumulative, and toxic chemical
perchloroethylene	tetrachloroethylene
pg/m^3	picograms per cubic meter
ppm	parts per million
Project	Mesaba Energy Project
Q	COPC emission rate
Q/CHI	Q (Emission Rate)/Critical Health Index
RASS	Risk Assessment Screening Spreadsheet
T	COPC inhalation health benchmark (IHB)
tetrachloroethylene	perchloroethylene
trichloroethane, 1,1,1-	methyl chloroform
TVB	tank vent boiler
μg/m^2-yr	micrograms per square meter per year
μg/m^3	micrograms per cubic meter
U of M	University of Minnesota
UR	chemical specific unit risk
U.S. EPA	United States Environmental Protection Agency
UTM	Universal Transverse Mercator mapping coordinates
yr	year
10^{-5}	1 in 100,000
10^{-6}	1 in 1,000,000 or one millionth

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Air Emission Risk Analysis

Excelsior Energy Inc.
Mesaba Energy Project

Taconite, Itasca County, Minnesota

Prepared for Excelsior Energy Inc.

1.0 Introduction

Excelsior Energy Inc. (Excelsior), an independent energy development company based in Minnetonka, MN, is proposing to build, own and operate (potentially under agreement with an operating company) the Mesaba Energy Project (the "Project"), an Integrated Coal Gasification Combined Cycle (IGCC) power plant located on Minnesota's Iron Range. The Project consists of a proposed two-phase generating station, each phase of which would nominally generate 600 megawatts of electricity (MWe) for export to the electrical grid. The commercial in-service date for Phase I is scheduled for 2011; Phase II is scheduled for 2013.

Figure 1, "Site Location Map" is a general location map showing the area within which Excelsior has focused its search for potential Project sites. The Project search area is located within a larger region in Northern Minnesota identified as the Taconite Assistance Area. Figure 2, "Facility Plan - Aerial View" provides a local aerial view of this site, the Project's current site layout plan and the infrastructure required to support Project operation.

2.0 Process and Sources Description

Excelsior's corporate vision is to bring to Minnesota, via the application of advanced technologies, energy, innovation and economic development. Excelsior has chosen IGCC as the vehicle to achieve this mission. The Project would use ConocoPhillips' E-Gas™ Technology for solid feedstock gasification. A full description of the facility and emission units is included in the Mesaba Energy Project Prevention of Significant Deterioration Permit to Construct Application dated June 2006 (Excelsior, 2006).

3.0 AERA Methodology

An Air Emissions Risk Analysis (AERA) is conducted on the Mesaba Energy Project to identify the sources or groups of sources, chemicals and associated pathways that may pose an unacceptable risk to the public as a result of air emissions. In general, the term risk refers to the excess risk of developing cancer and the potential for non-cancer health effects as the result of exposure to air emissions. The AERA, as developed by the Minnesota Pollution Control Agency (MPCA), includes both a quantitative and qualitative evaluation of emissions and potential pathways. The AERA is conducted in general accordance with the procedures contained in the MPCA Air Emissions Risk Analysis (AERA) Guide viewed on-line (MPCAa).

Because emission source stacks are less than 100 meters in height, AERA evaluation was completed for the area within a three-kilometer radius of the proposed facility emission points (MPCAa.) The three-kilometer buffer radius for both Phase I and Phase II can be seen on Figure 2.

MPCA AERA forms are included in Appendix A, "AERA Forms."

3.1 Quantitative Evaluation

The quantitative analysis is conducted using several methods as follows.

3.1.1 RASS and Q/CHI

Risk Assessment Screening Spreadsheets (RASS) are risk assessment screening tools developed by MPCA which are sometimes used as a preliminary evaluation of risk for a proposed project. With the RASS, dispersion factors found on "look-up" tables are used to predict pollutant concentrations (i.e. off-site impacts) at specific locations. Excelsior has elected to conduct detailed risk evaluations that use more sophisticated dispersion modeling techniques to better refine the evaluations. Because the more detailed risk evaluations are completed, the RASS screening evaluation is not necessary and therefore not included in this AERA. However, toxicity values and other risk information included in the RASS are used in the detailed evaluations (see Section 4.0).

One method Excelsior uses to evaluating risk is called the Q/CHI method (Q = emission rate and CHI = Critical Health Index). With this method, risk is estimated at each emission source stack by computing a Q/CHI quotient for the chemicals of concern. A Q/CHI quotient is arrived at by dividing the chemical emission rates by the individual chemical inhalation health benchmarks (IHBs). The combined Q/CHI quotients are then evaluated at specific receptor locations by inputting the quotients into a refined dispersion model. The Q/CHI approach calculates risk while correlating both time and space for each location. The Q/CHI method is also used to predict both acute and sub-chronic risks associated with the facility.

With the Q/CHI method, risk due to the inhalation pathway is estimated for chemicals causing carcinogenic and non-carcinogenic effects. For chemicals contributing to non-carcinogenic effects, risk is evaluated for acute (1-hour emission average) and sub-chronic (1-month average) time periods. Risks for chemicals contributing to carcinogenic effects are based on the probability that an individual will develop cancer over a lifetime.

Risk at a specific location is additive for all sources. Chemicals having cancer endpoints are considered to have an acceptable risk level if an individual chemical produces a cancer risk less than one in one million (10^{-6}) and an individual chemical, having non-cancer endpoints, produces a hazard index less than 0.1. Also, if the sum of the individual chemical cancer risks is less than one in 100,000 (10^{-5}) and the sum of the individual non-cancer hazard quotients (hazard index) is less than 1, risk is also considered at an acceptable level for a facility.

3.1.2 IRAP

A third method using the Industrial Risk Assessment Program – Health (IRAP) View model is used to predict chronic risks. IRAP was developed by Lakes Environmental Software, Inc. to comply with the requirements of the *U.S. EPA Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities* (HHRAP) guidance document (U.S. EPA, 2005).

This complex protocol was developed to estimate human health risk at hazardous waste combustion facilities from multi-pathway exposure to chemicals released to the ambient air. With IRAP, risk is predicted via direct (inhalation) and indirect (ingestion of or contact with soil, plants, fruits, vegetables, beef and milk, chicken and eggs, and fish) pathways for each scenario (resident adult, resident child, farmer adult, etc.) specified. Worst-case annual emission rates are used in the IRAP evaluation.

3.1.3 Fish Consumption

Risk associated with ingestion of fish tissue potentially contaminated with mercury is evaluated using the MPCA's *Mercury Risk Estimation Method for the Fish Consumption Pathway (Local Impacts Assessment),* (MPCA, 2006). This method assumes that there is a linear relationship in a given lake between the atmospheric mercury deposition rate and fish tissue methylmercury concentrations. The relationship is used to estimate the non-cancer oral hazard quotients due to fish tissue ingestion based on increases in mercury deposition as a result of facility emissions.

The method combines current fish tissue mercury concentrations with potential increases in atmospheric deposition to arrive at an estimate of future methylmercury tissue concentrations. Risk associated with ingestion of fish tissue potentially affected by other contaminants of concern associated with the facility is evaluated using the IRAP model.

3.2 Qualitative Evaluation

Because many issues that could potentially impact health cannot be readily quantified, a qualitative analysis is conducted that provides supplementary information to the quantitative assessment. Information that may be included in the qualitative assessment include among others: land use and receptor information; sensitive populations; persistent, bioaccumulative, and toxic chemicals (PBTs); farmers, resident and fisher populations; emissions related to shutdowns or breakdowns; internal combustion engines; and chemicals emitted but not assessed quantitatively. At times, chemicals may not have readily available IHBs, may have a closely related chemical toxicity value as a surrogate, or a PBT may not have multimedia factors developed. These issues may be discussed in the qualitative evaluation.

4.0 Quantitative Analysis

4.1 Chemicals of Potential Concern

Chemicals of potential concern (COPC) are chemicals that could be released from a facility, regardless of their toxicity or emission rate. The COPCs included in the AERA are the HAPs listed in the Mesaba Energy Project Prevention of Significant Deterioration Permit Application. Emission rates for these compounds are estimated using the following sources (listed in order of preference):

- Results of regulatory test programs at the existing Wabash River, Indiana, E-Gas IGCC facility - adjusted, if appropriate, for the expected worst-case feeds to the Mesaba Energy Project
- Equipment supplier information
- Published emission factors and reports applicable to IGCC facilities
- Engineering calculations and judgment
- U.S. EPA emission factors (AP-42)

COPC emissions at the IGCC Power Station will be reduced by the inherently low polluting IGCC technology and many of the same process features that control criteria emissions. A large portion of the heavy metals and other undesirable constituents of the feed will be immobilized in the non-hazardous, vitreous slag by-product and prevented from causing adverse environmental effects. Gaseous and particle-bound COPCs that may be contained in the raw syngas exiting the gasifiers will be totally or partially removed in the syngas particulate matter removal system, water scrubber and AGR systems described above. In addition, the mercury removal carbon absorption beds will ensure that mercury emissions from the IGCC Power Station will be less than 10 percent of the mercury present in the feedstock, as received.

Dioxin and furan emissions are expected to be negligible from the plant. Dioxins and furans are formed as a by-product of combustion when hydrocarbons are burned in the presence of chlorine. Dioxin and furan formation is an issue at medical waste and municipal waste incinerators where chlorine from plastics or other sources are burned with organic wastes. We expect the chlorine concentration in the product syngas to be low. Data from the Wabash River plant shows chorine concentrations to be below test detection limits.

Emissions of total chromium are estimated using emission data available from the Wabash River plant. However, emission data is not available to show the fraction of total chromium in the hexavalent state. Table 1.1-18 from AP-42 Section 1.1 (Bituminous and Subbituminous Coal Combustion) shows a hexavalent chromium emission factor being 30 percent of the total chromium emission factor. We use this factor, 30 percent, to estimate the hexavalent fraction of total chromium from the Mesaba Energy Project.

Table 1, “Chemicals Evaluated in the AERA” presents a summary of estimated COPC emissions for the Phase I and Phase II IGCC Power Station. Additional detail regarding the sources and calculation methods used to estimate facility emissions are found in the Mesaba Energy Project Prevention of Significant Deterioration Permit to Construct Application dated June 2006 (Excelsior, 2006). (Note: the emissions presented in Table 1 may differ slightly from those presented in the current Prevention of Significant Deterioration Permit to Construct Application. The emissions in Table 1 were used in the draft Permit Application and AERA submitted to MPCA in April 2006. Some comments on the AERA by the MPCA have been made, but the AERA review process has not been completed. Since that time, adjustments have been made in the Permit Application, including emissions of chemicals contained in Table 1. These changes will be included in future revisions to the AERA after technical comments have been received.)

4.2 Exposure Assessment

The exposure assessment quantifies the intake and uptake by the body of COPCs by several exposure pathways. In the Q/CHI Method, potential risk via the inhalation pathway only is evaluated. Health risks are assessed for short-term (acute) and mid-term (sub-chronic) exposures.

After importing dispersion model files specific for the facility, IRAP indicates the grid locations having the highest modeled unitized concentration or deposition rates for user specified areas of concern. Exposure scenarios are then selected at the maximum grid locations. Exposure scenarios available include adult and child farmer, adult and child resident, and adult and child fisher. Risk for various exposure pathways is calculated by IRAP for each exposure scenario selected at a grid location. Table 2, "IRAP Receptors and Scenarios Evaluated" identifies the maximum grid receptors for this facility and the pathways chosen for risk estimation using IRAP. Table 3, "IRAP Exposure Pathways Evaluated" identifies the exposure pathways evaluated as recommended by HHRAP (U.S. EPA, 2005). Figure 3 "IRAP Receptor Locations" indicates the locations of the receptors evaluated.

4.3 Toxicity Assessment

Inhalation toxicity values are used to calculate potential facility-specific inhalation risks from COPCs emitted to the air. Toxicity values compiled by MPCA and the Minnesota Department of Health (MDH) from readily available and acceptable sources and included in the RASS are used as IHBs for the Q/CHI Method. The various sources of the IHB are referenced in the RASS (MPCAa, MPCAb). U.S. EPA HHRAP default toxicity information included in IRAP is used for the IRAP evaluation method (U.S. EPA, 2005).

For risk assessment purposes, COPCs fall into either or both of two categories: those having the potential for producing carcinogenic (cancer) effects and those that may produce non-carcinogenic effects. Some chemicals are capable of producing both responses.

The dose-response assessment for COPCs producing carcinogenic effects assumes that there is no toxicity threshold dose. In other words, there is no dose of carcinogenic compounds that is not associated with risk. The IHBs found in RASS and IRAP are specified so the additional lifetime cancer risk to an individual exposed for a lifetime to the COPC is expected to be equal to or less than 10^{-5} of developing cancer (MPCAa).

The dose-response assessment for COPCs producing non-carcinogenic effects assumes that an exposure level exists below which no adverse health effects would be expected. This threshold dose, in theory, is protective of all receptors that may be exposed at that level, including sensitive populations. The IHBs found in RASS and IRAP for COPC producing non-carcinogenic effects are expected to be below this threshold dose.

4.4 Risk Characterization

Risk characterization summarizes the exposure and toxicity assessment outputs to describe the risks from COPCs emitted to the air from the facility. This includes assessment of cancer risk in excess of that expected over a lifetime of exposure and acute, sub-chronic and chronic non-cancer risk.

Based on MPCA guidance, if the cancer risk for each COPC evaluated is less than or equal to one in one million (10^{-6}), or the individual COPC non-cancer hazard quotient is less than 0.1 the risk is considered acceptable. In addition, if the sum of the individual COPC cancer risks is less than 10^{-5} and the sum of the individual non-cancer hazard quotients (hazard index) is less than 1, quantitative risk associated with the facility is considered acceptable. However, a qualitative analysis must still be conducted.

Health risk calculation for the inhalation of COPCs producing carcinogenic effects is as follows:

$$ELCR = (EC)(UR)$$

where:
ELCR = Excess Lifetime Cancer Risk
EC = Exposure concentration in the air ($\mu g/m^3$)
UR = Chemical Specific unit risk, $(\mu g/m^3)^{-1}$

Health risk for the inhalation of COPCs producing non-carcinogenic effects is evaluated by comparing an exposure concentration in the air with the IHB, also referred to as the hazard quotient, as follows:

$$HQ = \frac{I}{IHB}$$

where:
HQ = Hazard Quotient
I = exposure concentration ($\mu g/m^3$)
IHB = Inhalation Health Benchmark ($\mu g/m^3$)

To express the overall potential for non-carcinogenic effects posed by exposure to more than one chemical or to more than one pathway, the U.S. EPA has developed an approach which assumes that simultaneous exposures to multiple chemicals could result in an adverse health effect assuming the same mechanism of action, or target organ. This approach is called the hazard index and is expressed as follows:

$$HI = \sum_{i=1}^{n} HQ_i$$

where:
HI = Hazard Index
HQ_i = Hazard quotient for the *i*th chemical
N = number of chemical HQs

4.5 Quantitative Results – Q/CHI

The Q/CHI approach to calculating risk from air emission contaminants estimates risk at each stack by computing chemical-specific air toxic Q/CHI quotients for COPCs having both carcinogenic and non-carcinogenic endpoints. Q/CHI quotients are calculated as follows:

$$Q/CHI\ Quotient = \frac{Q}{T}$$

where:
Q = COPC emission rate (grams/second)
T = corresponding COPC IHB ($\mu g/m^3$)

Toxicity values or IHBs, as supplied by MPCA in the RASS spreadsheet, are used in this process (MPCAb). A combined Q/CHI quotient of COPCs for each emission point is then calculated for acute (hourly) and sub-chronic (30-day) non-cancer endpoints.

4.5.1 Dispersion Modeling

The Q/CHI quotients are then evaluated at multiple receptors on a grid using AERMOD, a refined dispersion model. AERMOD input files, receptor grids, meteorological data and assumptions are the same as those used for the ambient air quality modeling conducted for the

Mesaba Energy Project Prevention of Significant Deterioration Permit to Construct Application dated June 2006 (Excelsior, 2006). The acute and sub-chronic Q/CHI quotients are modeled for five years of meteorological data (1972, 1973, 1974, 1975, and 1976). The result is a prediction of combined hazard indices, correlated for time and space, at each receptor location.

Supporting documentation for the Q/CHI dispersion model input and output is included in Appendix B, "Electronic Submittals.".

4.5.2 Air Toxics Screen

The acute and sub-chronic health risks attributable to facility emissions as calculated by the Q/CHI method indicate the following:

1. The maximum-modeled inhalation acute non-cancer hazard index is 0.52.
2. The maximum-modeled sub-chronic non-cancer index is 0.13.

Both modeled Q/CHI hazard indices are below the MPCA acceptable total hazard index of 1.0.

The following chemicals do not have IHB values in RASS and are therefore also not evaluated by the Q/CHI method: acetophenone, biphenyl, cobalt, dimethyl sulfate, methyl hydrazine, and proprionaldehyde. Risk associated with acetophenone is evaluated by the IRAP method.

A summary of the Q/CHI modeled air toxics acute and sub-chronic pollutant screen is found on Table 5, "Q/CHI COPC Screen Results". The maximum-modeled Q/CHI acute values occur south and east of the proposed facility. The maximum modeled Q/CHI sub-chronic values occur north of the proposed facility. An iso-concentration plot of Q/CHI modeled values indicates a bi-modal pattern consistent with the wind rose pattern for the meteorological time period used. Q/CHI impacts are shown on Figure 4, "Acute Q/CHI Impacts" and Figure 5, "Sub-chronic Q/CHI Impacts".

4.6 Quantitative Results – IRAP

The IRAP method of estimating risk associated with the proposed facility is conducted at six representative areas of concern. The areas of concern are chosen to represent rural residents, small or hobby farm residents, a working farm, lake area residents and fishers. Eleven receptor locations are evaluated within the three-kilometer buffer radius from the proposed facility sources. The receptors are placed at the grid nodes within each area of concern having the highest contribution from all the sources combined for each air parameter. Receptor locations can be seen on Figure 3.

4.6.1 Dispersion Modeling

Air dispersion modeling of the site using a unit emission rate of 1 g/sec is conducted using AERMOD. AERMOD input files, receptor grids, meteorological data and assumptions are the same as those used for the ambient air quality modeling analysis, with one exception. For the IRAP risk assessment dispersion modeling, deposition is included. Actual discrete emission rates for each pollutant are entered into the IRAP model. For the vapor phase, wet vapor deposition and wet depletion are specified. The particulate phase modeling included wet and dry-vapor deposition, and wet and dry-vapor depletion. It is assumed that all particulate matter is less than 2.5 microns in diameter. Modeling is conducted using five years of meteorological data (1972, 1973, 1974, 1975, and 1976). The maximum of all the air parameter values for the grid nodes is specified in the IRAP model.

Dispersion model input and plot files are imported into IRAP and all sources, as described in Section 2.0, are included to complete the IRAP risk assessment.

Supporting documentation for dispersion modeling used for the IRAP method is included in Appendix B.

4.6.2 IRAP Set-up

Default assumptions for site parameters and exposure scenario assumptions used in IRAP are those recommended in the U.S. EPA HHRAP guidance document (U.S. EPA, 2005). Default assumptions used are summarized on Table 6, “IRAP Site Parameter Assumptions” and Table 7, “IRAP Exposure Scenario Assumptions.”

Site specific assumptions used for all receptors in the IRAP evaluation include the following:

- Big Diamond Lake chosen as the water body evaluated
- Big Diamond Lake watershed chosen as the watershed evaluated. The Big Diamond Lake watershed boundary is determined using the Metadata for Minnesota Watershed Boundaries database available from the Minnesota Department of Natural Resources website. We modified the watershed boundary near some mining pits to reflect current topography.
- USLE cover management factor = 0.1 (USEPA recommendation for grass and agricultural cover as default. HHRAP B-4-13) (U.S. EPA, 2005)
- USLE rainfall (erosivity) factor = 75 yr^{-1} (U.S. EPA Fact Sheet 3.1 833-F-00-014 - Storm Water Phase II Final Rule - Erosivity Index Zone Map (U.S. EPA, 2001))
- Depth of water column = 9 m (MDNR Lake Finder)
- Current velocity = 0 (Not used in the equation for lakes - HHRAP p.4-9) (U.S. EPA, 2005)
- Average volumetric flow rate through Big Diamond Lake = 387,000 m^3/yr (watershed area * 0.5 * average annual surface run-off from HHRAP p. 4-9 (U.S. EPA, 2005)

  Ave. annual run-off = 0.23 m/yr - MPCA “Detailed Assessment of Phosphorus Sources to Minnesota Watersheds” Figure 3-2 (MPCA, 2004); Techniques for Estimating Peak Flow on Small Streams in Minnesota, Water-Resources Investigations Report 97-4249 (MNDOT, 1997))
- Average annual evapotranspiration = 48.26 cm/yr (Climate of Minnesota Technical Bulletin 322 (U of M, 1979))
- Average annual irrigation = 0 (no irrigation assumed)
- Average annual precipitation = 71.4 cm/yr (MPCA “Detailed Assessment of Phosphorus Sources to Minnesota Watersheds” Figure 3-1 (MPCA, 2004)
- Average annual runoff = 23 cm/yr (MPCA “Detailed Assessment of Phosphorus Sources to Minnesota Watersheds” Figure 3-2 (MPCA, 2004); Techniques for Estimating Peak Flow on Small Streams in Minnesota, Water-Resources Investigations Report 97-4249(MNDOT, 1997))

- Wind velocity = 3.9 m/s (Default - HHRAP Table B-4-20 and Table B-4-21 (U.S. EPA, 2005))

Exposure scenarios selected for receptors in the working farm area of concern include adult and child resident, adult and child farmer, and adult and child fisher. Exposure scenarios selected for receptors in the lake, rural resident and hobby farm areas of concern include adult and child resident, and adult and child fisher.

The following chemicals do not have toxicity information included in IRAP, but are evaluated by and Q/CHI method: 2-chloracetophenone, hexane, hydrogen fluoride, manganese, methyl methacrylate, methyl tert butyl ether, 5-methylchrysene, and sulfuric acid. These chemicals are addressed in Section 5.8, “Miscellaneous Chemicals.”

Biphenyl, cobalt, dimethyl sulfate, methyl hydrazine, and proprionaldehyde do not have toxicity information included in IRAP and they also are not evaluated by the Q/CHI method.

4.6.3 IRAP Results

Chronic health risk attributable to facility emissions are calculated by the IRAP method at each separate receptor location. IRAP results indicate that the predicted carcinogenic risk from all combined facility emission sources and COPCs are less than 10^{-5} and non-carcinogenic hazard indices are less than 1.0 at all representative locations.

Cancer risk ranges from 9.1×10^{-7} to 5.0×10^{-8} with the highest total facility cancer risk predicted at receptor RI_1 for an adult fisher, within the Big Diamond Lake Resident area of concern. Location RI_1 is southeast of the site. Non-cancer hazard indices range from 0.032 to 0.0028 with the highest total facility hazard index predicted at receptor RI_3 for a child fisher, within the Big Diamond Lake Resident area of concern. Receptor locations can be seen on Figure 3. Individual receptor cancer risk and hazard indices can be found in Table 8 “IRAP Risk Summary by Exposure Scenarios”; Table 9 “IRAP Cancer Risk Summary by Exposure Pathways”; and Table 10 “IRAP Hazard Index Summary by Exposure Pathways” breaks down the individual receptor risks by intake pathways.

The chemicals contributing to the majority of predicted carcinogenic impact to residents, fishers and farmers are cadmium (worst case is 7.2 x 10^{-7}), indeno(1,2,3-cd)pyrene (worst case is 1.8 x 10^{-7}), and arsenic (worst case is 1.1 x 10^{-7}). While the chemical contributing to the majority of predicted non-carcinogenic impact is acrolein (worst case is 0.0031). However, all are below the acceptable MPCA risk values.

4.7 Fish Consumption Pathway – Mercury

4.7.1 Fishable Bodies of Water

The tallest stacks at the facility are the tank vent boiler stacks at 64.01m (210 ft). Based on AERA guidance (MPCAa), for facilities with stack heights less than 100 meters, fishable lakes within a 3 km radius should be considered under the fish consumption pathway. “Fishable” bodies of water are those that contain water year-round in a year that receives at least 75 % of the normal annual precipitation for that area. Four fishable bodies of water lie, at least in part, within 3 km of the proposed facility stacks: Dunning Lake, Big Diamond Lake, Little Diamond Lake and the Canisteo Mine Complex. These bodies of water can be seen on Figure 2.

Dunning Lake is located approximately 4,300 feet (0.8 mi) east, Big Diamond Lake is located approximately 4,800 feet (0.9 mi) southeast, Little Diamond Lake is located approximately 7,000 feet (1.3 mi) south, and the Canisteo Complex is approximately 6,200 feet (0.2 mi) south. Biologists from SEH conducted a site reconnaissance and determined that no fishable streams are located within 3 km of the proposed facility. Water from Big Diamond Lake flows through a wetland system to Little Diamond Lake, which in turn flows to Holman Lake to the south.

Approximately nine property owners currently have seasonal homes on Big Diamond Lake; one or two properties have residents living on the lake year around. The other three bodies of water within 3 km of the facility have fewer, if any, residences located on their shores. Dispersion modeling for mercury indicates Big Diamond Lake is within the release plume of future facility emissions. In addition, Big Diamond Lake had the most readily available lakes data including a fish species survey. Figure 6, “Mercury Emissions Dispersion Model Isoconcentrations” shows the isoconcentrations resulting from the dispersion modeling of mercury in relation to the vicinity bodies of water. Based on the above information, Big Diamond Lake is the body of water chosen to evaluate consumption of potentially contaminated fish tissue.

4.7.2 Mercury Risk Estimation for Subsistence Fish Consumption

The methodology used to estimate human health risk for subsistence fish consumption is based on the *Summary of MPCA's Mercury Risk Estimation Method for the Fish Consumption Pathway (Local Impacts Assessment): April 7, 2006* (MPCA, 2006). The estimation of risk is completed using the MPCA Local Mercury Assessment spreadsheet, "Calculation of Local Mercury Hazard Quotients (HQ) from Mercury Emissions from a Project", version 1.4, dated April 13, 2006.

4.7.2.1 Fish Consumption Model Input

The source of specific input information required for the estimation of risk associated with fish consumption is as follows:

- Background mercury deposition:
  - wet-plus-dry ambient deposition (flux) = 12.5 $\mu g/m^2$-yr – Minnesota default to lake surfaces and 33.6 $\mu g/m^2$-yr to rest of the watershed
  - 10 % watershed deposition transported to water body
  - Lake Finder database lake area for Big Diamond Lake = 122 acres (MNDR Lake Finder)
  - Watershed area for Big Diamond Lake determined using IRAP = 760 acres
- Mercury mass deposited to lake and watershed due to facility emissions
  - Determined by site-specific air dispersion modeling in AERMOD
  - Concentration over lake and watershed = 1.3×10^{-5} ug/m^3
  - Hg^0 Depositional Velocity = 0.01 cm/sec over the lake and 0.05 cm/sec over the rest of the watershed
  - All mercury emissions are assumed to be elemental mercury (Hg^0)
- Methylmercury estimation in fish fillet
  - Reference species of fish is Northern Pike

- Database used to determine the current fish tissue concentration = "Allfish 04 NE lakes only" provided electronically as an Excel spreadsheet by MPCA

- Risk assumptions
  - Daily fish consumed = 0.142 kg/day
  - Adult body weight = 70 kg
  - Reference dose for methyl mercury = 1.0 x 10^{-4} mg/kg-day

4.7.2.2 Current Total Mercury in Fish Tissue Estimation

Because no actual mercury in fish tissue data are available for fish residing in Big Diamond Lake, the database for all lakes in northeast Minnesota is used to determine the total mercury fish tissue concentration from a fish at the 90th percentile. The "Allfish 04 NE Lakes only" database is first narrowed down to consider only Northern Pike. The database is further narrowed down by removing all entries for Northern Pike that are incomplete for either fish length or mercury concentration.

The database was apparently developed on a "per sampling event" basis, so it often includes multiple fish for a given length and mercury concentration. For example, for a given sampling date, the database may include '4' for the number of fish sampled (designated under 'NOFISH' in the spreadsheet) and then include one value each for length (LENGTHIN) and mercury concentration (HGPPM). The assumption is made that the length and mercury concentration values in the database represented average values for all fish collected on that date.

Because the database was apparently configured on a 'per sampling event' basis and includes averages for sampling events, it does not allow an accurate determination of the true 90th percentile and average length based on a total number of fish. To accommodate this shortcoming, SEH modified the database to best approximate a database developed on a 'per fish' basis. To accomplish this, the database is expanded to include an individual entry for each fish collected. Where multiple fish are collected on a given day, the average values given for length and mercury concentration are entered as the 'true' value for each fish. Although this modification likely produces a lower standard deviation than the true population, it is judged to be the best solution given the available data.

Statistics are run on the modified database to produce the following results:

N = Total fish in the modified database = 9,375 Northern Pike

Minimum length = 6.7 inches

Maximum length = 45.5 inches

4.7.2.2.1 *Determination of Mercury Concentration in the 90th Percentile Length Fish*

90th percentile length fish = 27.8 inches

Number of fish of 27.8 inches = 33 fish

Mean mercury concentration of all 27.8 inch fish = 0.56 ppm (standard deviation = 0.40)

As a check on the sensitivity of the data, the mean is also calculated on all fish within 0.5 inches from the 90th percentile length (i.e. – in the range 27.3 - 28.3 inches). There are 379 fish in that range with a mean mercury concentration of 0.56 ppm (standard deviation = 0.35).

4.7.2.2.2 *Determination of Mercury Concentration in the Average Length Fish*

Average length fish = 21.8 inches

Number of fish of 21.8 inches = 105 fish

Mean mercury concentration of all 21.8 inch fish = 0.39 ppm (standard deviation = 0.26)

As a check on the sensitivity of the data, the mean is also calculated on all fish within 0.5 inches from the average length (i.e. – in the range 21.3 - 22.3 inches). There are 1,259 fish in that range with a mean mercury concentration of 0.38 ppm (standard deviation = 0.21).

4.7.3 Mercury in Fish Tissue Risk Results

Estimation of risk associated with fish consumed by adult subsistence fishers on Big Diamond Lake as conducted with the MPCA Local Mercury Assessment spreadsheet indicates the following:

- Mercury Loading Summary:
  - Mercury loading to the lake from the project = 0.08 g/yr
  - Background mercury loading to the lake = 16.51 g/yr
- Incremental increase in mercury in fish tissue from the project - average fish size = 0.002 ppm
- Incremental increase in mercury in fish tissue from the project – 90th percentile fish size = 0.003 ppm
- Water quality Standard Hazard Quotient:
  - Average fish size

    Ambient Hazard Quotient relative to water quality standard = 1.95

    Incremental Hazard Quotient relative to water quality standard from the project = 0.01
  - 90th percentile fish size-

    Ambient Hazard Quotient relative to water quality standard = 2.80

    Incremental Hazard Quotient relative to water quality standard from the project = 0.01
- Subsistence Fisher Hazard Quotient:
  - Average fish size

    Ambient Subsistence Fisher Hazard Quotient = 8.5

    Incremental Subsistence Fisher Hazard Quotient from the project = 0..04
  - 90th percentile fish size

    Ambient Subsistence Fisher Hazard Quotient = 12.2
    Incremental Subsistence Fisher Hazard Quotient from the project = 0.06

4.7.4 Discussion of Results of Mercury in Fish Tissue

Predicted concentrations of mercury in fish tissue under ambient conditions, assuming no significant local sources of mercury, indicates that a subsistence adult fisher consuming 0.142 kg per day of fish caught in Big Diamond Lake would have a hazard quotient of 8.5 to

12.2. The range is dependent upon the size of the fish being in the range of average (21.8 inches) to the 90^{th} percentile (27.8 inches).

The predicted increment attributable to proposed facility emissions results in a hazard quotient ranging from 0.04 to 0.06 (again, the values are size of fish dependent.) Thus risk to a subsistence fisher due to ingestion of fish tissue after the facility is constructed is roughly increased by 0.5 percent. The predicted non-carcinogenic hazard quotient is less than the acceptable MPCA risk value of 1.0 via the fish ingestion pathway of fish caught from Bid Diamond Lake

An electronic copy of the MPCA Local Mercury Assessment spreadsheet for both the 90^{th} percentile and average fish size as well as the northeast Minnesota lakes "Allfish 04" database is included in Appendix B.

The MPCA Hg-2003 evaluation can be found in the Mesaba Energy Project Prevention of Significant Deterioration Permit to Construct Application dated June 2006 (Excelsior, 2006).

4.8 Fish Consumption Pathway - PBTs

Risk associated with ingestion of fish tissue with potential concentrations of COPCs, including mercury, is evaluated using the IRAP model. IRAP results indicate that the predicted carcinogenic risk from all combined facility emission sources and COPCs is less than 10^{-5} and non-carcinogenic hazard indices is less than 1.0 via the fish ingestion pathway of fish caught from Big Diamond Lake. In order to assess the impact of contaminants other than mercury on fish tissue ingestion, Hg^0 emissions were removed from IRAP and re-modeled. IRAP results for the fish ingestion pathway without mercury were similar to the results that included Hg^0 emissions. This suggests that the contribution from Hg^0 to fish tissue in Big Diamond Lake is minimal.

Cancer risk for an adult fisher is 2.9×10^{-7} and for a child fisher is 3.8×10^{-8}. The non-cancer hazard index is 0.00013 for an adult fisher and 0.00085 for a child fisher. Risk results for the fish ingestion pathway for both the IRAP and MPCA methods are summarized on Table 11, "Risk Summary by Fish Consumption Pathway."

5.0 Qualitative Analysis

The qualitative analysis provides supplementary information to the quantitative risk assessment. This information provides a description of the facility location, potential receptors at risk and facility emissions that could not be evaluated in the quantitative evaluation.

5.1 Land Use/General Neighborhood Information

The project site includes approximately 1,260 acres of mostly undeveloped property for which Excelsior has obtained, from RGGS Land & Minerals, LTD., L.P., an option to purchase surface rights. The site is currently unoccupied by any residential dwellings and has no direct access. Figure 2 provides a close-up location map of this site, the Project's current site layout plan and the infrastructure required to support Project operations. Figure 7, "Existing Land Use/Land Cover" shows current land use near the Project site.

The Mesaba Energy Project is located in Town 56, Range 24, Section 10, Itasca County, Minnesota. The site is generally bounded by County Road No. 7 to the west, the city limits of Taconite to the south, a high voltage transmission line (HVTL) corridor to the north, and the Township boundary to the east. The site is zoned industrial according to the Iron Range Township Zoning map.

Grand Rapids, Minnesota (Itasca County, population 7,764) (City-Data.com) is located approximately 15 km (9 mi) to the southwest and Hibbing, Minnesota (St. Louis County, population 17,071) (City-Data.com) is approximately 32 km (20 mi) to the east of the proposed facility. The area within 1 km (0.6 mi) of the proposed facility stacks is rural and not populated. The land is rocky, hilly and boggy. There are no structures within 1 km of the facility stacks.

Itasca County has a population density of 16.5 persons per square mile (based on the 2000 census.) There are no cities or towns are located within 3 km of the facility stacks. The town of Marble (population 695 in year 2000) (City-Data.com) is located 6.5 km (4 mi) southeast of the proposed facility. The towns of Taconite (population 315) (City-Data.com) and Bovey (population 662) (City-Data.com) are located 4.4 km (2.7 mi) and 6.3 km (4 mi), respectively southwest of the facility stacks.

The poverty rate in Itasca County, is approximately 8.6 percent of the population.

The Envirofacts database (U.S. EPA) lists one source of potential air pollutants in the 55709 zip code area where the facility will be located. Wm J. Schwartz & Sons Inc., a non-metallic crushed and broken limestone mining and quarrying facility is listed in this zip code area (Bovey, MN, approximately 4.4 miles southwest of the proposed facility.) An additional source of air pollutants is found in the 55786 zip code area (Taconite, MN, approximately 2.7 miles southwest of the proposed facility). This listing is for Troumbly Bros. Inc., a non-metallic crushed rock and broken limestone construction sand and gravel facility. No toxic releases are noted within either zip code area.

5.2 Receptor Information

5.2.1 Sensitive Receptors

No sensitive receptors, such as residences, schools, daycares, recreation centers, playgrounds, nursing homes or hospitals are located within 1 km of the proposed facility stacks.

5.2.2 Farmers and Residents

The plant site is fairly remote and the land Excelsior Energy has optioned provides more than one-quarter mile buffer between the nearest residential dwelling and the fenced area enclosing the generating facilities. No farms or residences are located within 1 km of the proposed facility stacks. The nearest residence is located approximately 1.1 km (0.7 mi) to the west. A hobby farm and horse riding recreation facility is located approximately 1.7 km (1.1 mi) west-southwest of the proposed Mesaba Energy facility. The nearest farm is located approximately 3 km (1.9 mi) northwest of the facility. Cattle, horses and ponies appear to be raised on this farm with hay as a crop.

5.3 Mixtures and Surrogate Values

Similar chemicals or chemicals within a mixture may be grouped to evaluate risk. When grouped, an IHB for a specific chemical within that group may be applied to the compounds, groups or mixtures containing a fraction of that specific chemical. The IHB applied to the group or mixture is known as a surrogate value.

All chemicals included in the Mesaba Energy Project AERA, with the exception of cyanide and nickel, are evaluated using their own respective IHBs. The toxicity value for hydrogen cyanide is used as a surrogate for cyanide in the acute risk evaluation and the toxicity value for nickel subsulfide is used as a surrogate for nickel in the long term cancer risk evaluation in Q/CHI.

5.4 Sensitizers

Chemical sensitizers are those that may cause sever reactions to those persons who may have been exposed to the chemical previously and have become sensitized to that chemical. A person may also have a sensitized reaction to chemicals that may be structurally similar to the original exposure chemical. Chemicals that are known respiratory sensitizers that are included in the AERA and have an IHB are beryllium, formaldehyde and nickel. Any persons sensitive to the above chemicals could be affected by emissions from the proposed facility.

5.5 Developmental Toxicants

Several chemicals evaluated in the Mesaba Energy Project AERA have been assigned Health Risk Values (HRVs) by the Minnesota Department of Health and California Reference Exposure Levels as known developmental toxicants. These chemicals may have an adverse effect on a developing fetus and therefore, should be given special consideration. The chemicals listed in Table 1 as a developmental toxicant include arsenic, benzene, carbon disulfide, chloroform, ethyl benzene, ethyl chloride and mercury.

The acute hazard index for mercury is low at 0.39, yet above the acceptable MPCA risk limit for an individual COPC. Chronic risk as determine by IRAP for mercury is negligible.

The acute HRVs are considered to be ceiling values, which should not be exceeded for developmental toxicants. The acute or ceiling value is exceeded for arsenic.

5.6 Persistent, Bioaccumulative, and Toxic Chemicals

All PBTs identified as COPCs from the proposed facility and found on Table 1 have been evaluated in the AERA. No additional PBTs have been identified.

5.7 Additivity by Toxic Endpoint

Risk predicted by the Q/CHI method indicated that acute and sub-chronic non-carcinogenic inhalation risks are at acceptable levels for the proposed facility. IRAP modeling predicted that both carcinogenic and non-carcinogenic chronic risks within a 3 km radius of the proposed facility are also at acceptable levels.

The risk conclusions are arrived at by adding individual chemical hazard quotients across all pathways and COPCs regardless of the organs or body systems affected (toxic endpoints). This is a very conservative approach to evaluating risk to human health because in reality, different chemicals may impact different systems or toxic endpoints. A refined risk evaluation would allow for determining risk by focusing on the risk related to individual body systems.

Since the risk evaluations based on the Q/CHI and IRAP methods using the conservative approach has determined that human health risk is at acceptable levels, a refined evaluation by toxic endpoints is not be conducted.

5.8 Miscellaneous Chemicals

A number of chemicals do not have toxicity information included in IRAP, and are therefore, not evaluated in IRAP. The following chemicals, however, are included in the Q/CHI method for characterizing risk to human health: 2-chloracetophenone, hexane, hydrogen fluoride, manganese, methyl methacrylate, methyl tert butyl ether, 5-methylchrysene, and sulfuric acid.

Hexane, hydrogen fluoride, methyl methacrylate, and methyl tert butyl ether have hazard indices across all exposure routes as calculated by RASS that are 0.1 or less and are considered to have relatively low risks (MPCAa). 2-Chloracetophenone, manganese, 5-methylchrysene, and sulfuric acid have acceptable risk ratios as evaluated by the Q/CHI method.

6.0 AERA Summary

An AERA is conducted on the Mesaba Energy Project to identify the sources or groups of sources, chemicals and associated pathways that may pose an unacceptable health risk to the public as a result of the proposed facility air emissions.

The AERA is completed using several methods. Acute and sub-chronic risks are determined by the Q/CHI methodology. Chronic risks are determined using the IRAP model methodology. Risk associated with fish tissue ingestion is determined using the MPCA Draft Mercury Risk Estimation Method for ingestion of mercury in fish tissue and IRAP is used to determine risk associated with fish contaminated by contaminants other than mercury. Because detailed risk evaluations are completed for this project, MPCA's screening evaluation using the RASS process is not included in the AERA.

The acceptable MPCA risk level for chemicals producing carcinogenic effects from all combined facility emission sources is less than one in 100,000 (10^{-5}). For chemicals producing non-carcinogenic effects, a hazard index less than 1.0 is acceptable.

The acute and sub-chronic health risks as determined by the Q/CHI method are 0.52 and 0.13, respectively. Both hazard indices are below the acceptable MPCA total hazard index of 1.0.

Chronic health risks as determined by IRAP at 11 receptors representing rural residents, hobby and working farmers, and lakeshore residents indicate that the following:

- Cancer risk ranges from 9.1×10^{-7} to 5.0×10^{-8}
- Non-cancer hazard indices range from 0.032 to 0.0028

Both ranges are below the acceptable MPCA health risk levels.

Predicted risk associated with the ingestion of fish tissue caught from Big Diamond Lake indicates that the hazard quotient incremental contribution of mercury in fish tissue ranges from 0.04 to 0.06 (dependant on fish size).

The predicted cancer risks from all combined facility emission sources and COPCs range from 2.9×10^{-7} to 3.8×10^{-8}. The predicted non-cancer hazard indices range from 0.00013 to 0.00085. Health risks predicted by both methods indicate results that are below acceptable MPCA risk levels.

7.0 References

City-Data.com. Viewed 3 October 2005, <www.city-data.com>

Excelsior, 2006. Mesaba Energy Project Application to the Minnesota Pollution Control Agency for a Prevention of Significant Deterioration Permit to Construct. Excelsior Energy Inc. June 2006.

MDNR Minnesota Department of Natural Resources Lake Finder, Viewed 1 September 2005, <www.dnr.state.mn.us/lakefind/index.html>

MNDOT, 1997. Techniques for Estimating Peak Flow on Small Streams in Minnesota, U.S. Geological Survey Water-Resources Investigations Report 97-4249, Figure 2.

MPCAa. Air Emissions Risk Analysis (AERA) Guide, viewed 21 April 2005, < www.pca.state.mn.us/air/aera-guide.html>

MPCAb. Air Emissions Risk Analysis (AERA) - Risk Assessment Screening Spreadsheet (RASS), viewed 4 January 2006, <www.pca.state.mn.us/air/aera-risk.html>2-U.S. Census Bureau. State and County Quick Facts, viewed 3 October 2005, <quickfacts.census.gov/qfd/states/27/27061.html>

MPCA, 2003. HG-2003 Assessing the Impacts of Mercury Releases to Ambient Air, November 24, 2003, <www.pca.state.mn.us/publications/forms/hg-2003.pdf>

MPCA, 2004. Detailed Assessment of Phosphorus Sources to Minnesota Watersheds," Figure 3-2., <www.pca.state.mn.us/hot/legislature/reports/phosphorus-report.html>

MPCA. 2006. Summary of Minnesota Pollution Control Agency's Mercury Risk Estimation Method for the Fish Consumption Pathway (Local Impacts Assessment), Draft: April 7, 2006.

U.S. EPA. Envirofacts Data Warehouse, viewed, 3 October 2005, www.epa.gov/enviro/html/qmr.html

U.S. EPA, 2001. U.S. EPA Fact Sheet 3.1 833-F-00-014 - Storm Water Phase II Final Rule – Construction Rainfall Erosivity Waiver, Figure 1. Erosivity Index Zone Map. January 2001.

U.S. EPA, 2005. Human Health Risk Assessment Protocol (HHRAP) for Hazardous Waste Combustion Facilities. September 2005. EPA530-R-05-006. <www.epa.gov/combustion/risk.htm>

List of Tables

Table 1
Chemicals Evaluated in the AERA
(Phase 1 plus Phase 2)

CAS or MPCA No.	Compound	Annual HAP Emission (ton/year)			Total Phase 1 Ton/year	Phase 1 and Phase 2 Ton/year
		CTGs	TVB	Flare		
75-07-0	Acetaldehyde	0.046	1.6E-04	3.9E-04	0.046	0.092
98-86-2	Acetophenone	0.023	7.9E-05	2.0E-04	0.023	0.046
107-02-8	Acrolein	0.44	1.5E-03	3.8E-03	0.448	0.896
7440-36-0	Antimony	0.028	2.6E-04	6.6E-04	0.029	0.058
7440-38-2	Arsenic	0.061	1.4E-03	3.5E-03	0.066	0.131
71-43-2	Benzene	0.061	0.026	0.066	0.153	0.307
100-44-7	Benzyl chloride	1.07	3.7E-03	9.2E-03	1.081	2.162
7440-41-7	Beryllium	0.0066	7.9E-06	2.0E-05	0.007	0.013
92-52-4	Biphenyl	0.0026	9.0E-06	2.2E-05	0.003	0.005
117-81-7	Bis(2-ethylhexyl)phthalate (DEHP)	0.11	3.9E-04	9.6E-04	0.113	0.225
75-25-2	Bromoform	0.06	2.0E-04	5.0E-04	0.059	0.118
7440-43-9	Cadmium	0.24	5.3E-05	1.3E-04	0.243	0.486
75-15-0	Carbon disulfide	1.16	4.0E-03	1.0E-02	1.178	2.356
463581	Carbonyl sulfide				0.000	0.000
532-27-4	Chloroacetophenone, 2-	0.0106	3.7E-05	9.2E-05	0.011	0.022
108-90-7	Chlorobenzene	0.033	1.1E-04	2.8E-04	0.033	0.067
67-66-3	Chloroform	0.091	3.2E-04	7.9E-04	0.092	0.184
0-00-5	Chromium, total	0.013	9.8E-04	2.5E-03	0.017	0.033
7440-47-3	Chromium, (trivalent)	0.01	6.9E-04	1.7E-03	0.012	0.023
18540-29-9	Chromium, (hexavalent)	0.0039	2.9E-04	7.4E-04	0.005	0.010
7440-48-4	Cobalt	0.0066	1.1E-03	2.8E-03	0.011	0.021
98-82-8	Cumene	0.0081	2.6E-05	6.6E-05	0.008	0.016
57-12-5	Cyanide (Cyanide ion, Inorganic cyanides, Isocyanide)	0.144	4.4E-03	1.1E-02	0.160	0.319
77-78-1	Dimethyl sulfate	0.073	2.5E-04	6.3E-04	0.074	0.148
121-14-2	Dinitrotoluene, 2,4-	4.3E-04	1.5E-06	3.7E-06	0.000	0.001
100-41-4	Ethyl benzene	0.14	0.030	0.074	0.248	0.496
75-00-3	Ethyl chloride (Chloroethane)	0.063	2.2E-04	5.5E-04	0.064	0.128
106-93-4	Ethylene dibromide (Dibromoethane)	0.0018	6.3E-06	1.6E-05	0.002	0.004
107-06-2	Ethylene dichloride (1,2-Dichloroethane)	0.061	2.1E-04	5.3E-04	0.061	0.123
50-00-0	Formaldehyde	0.43	1.5E-03	3.7E-03	0.435	0.871
110-54-3	Hexane	0.10	3.5E-04	8.8E-04	0.102	0.205
7647-01-0	Hydrochloric acid	0.099	3.0E-04	7.4E-04	0.100	0.199
7664-39-3	Hydrogen fluoride (Hydrofluoric acid)	1.3	5.3E-05	1.3E-04	1.266	2.531
78-59-1	Isophorone	0.88	3.1E-03	7.6E-03	0.894	1.788
7439-92-1	Lead	0.014	6.3E-05	1.6E-04	0.014	0.029
7439-96-5	Manganese	0.026	2.2E-03	5.5E-03	0.034	0.068

CAS or MPCA No.	Compound	Annual HAP Emission (ton/year) CTGs	TVB	Flare	Total Phase 1 Ton/year	Phase 1 and Phase 2 Ton/year
7439-97-6	Mercury	0.013	6.1E-04	1.5E-04	0.013	0.027
74-83-9	Methyl bromide (Bromomethane)	1.21	0.011	0.027	1.245	2.490
74-87-3	Methyl chloride (Chloromethane)	0.81	5.5E-03	1.4E-02	0.827	1.653
71-55-6	Methyl chloroform (1,1,1 - Trichloroethane)	0.030	1.1E-04	2.6E-04	0.031	0.061
78-93-3	Methyl ethyl ketone (2-Butanone)	0.59	2.1E-03	5.1E-03	0.602	1.204
60-34-4	Methyl hydrazine	0.26	9.0E-04	2.2E-03	0.262	0.525
80-62-6	Methyl methacrylate	0.030	1.1E-04	2.6E-04	0.031	0.061
1634-04-4	Methyl tert butyl ether	0.053	1.8E-04	4.6E-04	0.054	0.108
75-09-2	Methylene chloride (Dichloromethane)	0.056	5.2E-04	1.3E-03	0.057	0.115
91-20-3	Naphthalene	0.063	7.5E-04	1.9E-03	0.066	0.132
7440-02-0	Nickel	0.0099	3.9E-03	9.8E-03	0.024	0.047
108-95-2	Phenol	0.93	1.1E-02	2.8E-02	0.970	1.940
123-38-6	Proprionaldehyde	0.579	2.0E-03	5.0E-03	0.586	1.173
7784-49-2	Selenium	0.014	2.2E-04	5.5E-04	0.015	0.030
100-42-5	Styrene	0.038	1.3E-04	3.3E-04	0.039	0.077
127-18-4	Tetrachloroethylene (Perchloroethylene)	0.066	2.3E-04	5.7E-04	0.066	0.133
108-88-3	Toluene	0.00084	0.0104	0.0261	0.037	0.075
108-05-4	Vinyl acetate	0.012	4.0E-05	1.0E-04	0.012	0.024
1330-20-7	Xylenes	0.056	0.012	0.030	0.098	0.196
	Total federal HAPs	***11.6***	***0.1***	***0.4***	***12.1***	***24.2***
	Other Emissions					
56-55-3	Benz[a]anthracene	5.8E-05	2.0E-07	5.0E-07	5.9E-05	1.2E-04
207-08-9	Benzo(k)fluoranthene	1.7E-04	5.8E-07	1.4E-06	1.7E-04	3.4E-04
50-32-8	Benzo[a]pyrene	5.8E-05	2.0E-07	5.0E-07	5.9E-05	1.2E-04
218-01-9	Chrysene (Benzo(a)phenanthrene)	1.5E-04	5.3E-07	1.3E-06	1.5E-04	3.1E-04
193-39-5	Indeno(1,2,3-cd)pyrene	9.4E-05	3.2E-07	8.1E-07	9.5E-05	1.9E-04
3697-24-3	Methylchrysene, 5-	3.3E-05	1.1E-07	2.8E-07	3.3E-05	6.7E-05
7664-93-9 14808-79-8	Sulfuric acid and sulfates	64.0	0.2	1.4	65.7	131.4
	Total Volatile Organic Compounds (VOC)	9.8	0.1	0.3	10.3	20.6

(Note: the emissions presented in Table 1 may differ slightly from those presented in the current Prevention of Significant Deterioration Permit to Construct Application. The emissions in Table 1 were used in the draft Permit Application and AERA submitted to MPCA in April 2006. Some comments on the AERA by the MPCA have been made, but the AERA review process has not been completed. Since that time adjustments have been made in the Permit Application, including emissions of chemicals contained in Table 1. These changes will be included in future revisions to the AERA after technical comments have been received.)

Table 2
IRAP Receptors and Scenarios Evaluated

Receptor #	Area of Concern	UTM X	UTM Y	Exposure Scenario Evaluated					
				Adult Resident	Child Resident	Adult Farmer	Child Farmer	Adult Fisher	Child Fisher
RI_1	Lake Resident	473,500.00	5,242,275.00	X	X			X	X
RI_2	Lake Resident	473,300.00	5,241,475.00	X	X			X	X
RI_3	Lake Resident	473,500.00	5,242,175.00	X	X			X	X
RI_4	Riding Stable	470,500.00	5,242,675.00	X	X			X	X
RI_5	Riding Stable	469,900.00	5,242,875.00	X	X			X	X
RI_6	NE Hobby Farm	473,100.00	5,246,075.00	X	X			X	X
RI_7	Farm	470,200.00	5,246,375.00	X	X	X	X	X	X
RI_8	Rural Resident	470,900.00	5,244,675.00	X	X			X	X
RI_10	Rural Resident	470,900.00	5,244,575.00	X	X			X	X
RI_11	Rural Resident	470,800.00	5,244,675.00	X	X			X	X
RI_12	Rural Resident	470,500.00	5,244,275.00	X	X			X	X

Table 3
IRAP Exposure Pathways Evaluated

Exposure Pathways	Exposure Scenarios (Receptors)					
	Adult Farmer	Child Farmer	Adult Resident	Child Resident	Adult Fisher	Child Fisher
Inhalation of vapors and particulates	X	X	X	X	X	X
Incidental ingestion of soil	X	X	X	X	X	X
Ingestion of drinking water from surface water sources	X	X	X	X	X	X
Ingestion of homegrown produce	X	X	X	X	X	X
Ingestion of beef	X	X				
Ingestion of milk from homegrown cows	X	X				
Ingestion of homegrown chicken	X	X				
Ingestion of homegrown pork	X	X				
Ingestion of fish	X	X	X	X	X	X

Table 4
Q/CHI COPC Screen Results
Phase I and Phase II

Inhalation Q/CHI	Averaging Period	Totals – Two Phases	Acceptable Value	Passed/Failed
Acute Non-Cancer	1-hour	0.52	1.0	Passed
Sub-Chronic Non-Cancer	30-day	0.13	1.0	Passed

Table 5
IRAP Site Parameter Assumptions

Site Parameters	Value	Symbol	Units
Soil dry bulk density	1.5	bd	g/cm^3
Forage fraction grown on contam. soil eaten by CATTLE	1.0	beef_fi_forage	--
Grain fraction grown on contam. soil eaten by CATTLE	1.0	beef_fi_grain	--
Silage fraction grown on contam. eaten by CATTLE	1.0	beef_fi_silage	--
Qty of forage eaten by CATTLE each day	8.8	beef_qp_forage	kg DW/day
Qty of grain eaten by CATTLE each day	0.47	beef_qp_grain	kg DW/day
Qty of silage eaten by CATTLE each day	2.5	beef_qp_silage	kg DW/day
Grain fraction grown on contam. soil eaten by CHICKEN	1.0	chick_fi_grain	--
Qty of grain eaten by CHICKEN each day	0.2	chick_qp_grain	kg DW/day
Average annual evapotranspiration	48.26	e_v	cm/yr
Fish lipid content	0.07	f_lipid	--
Fraction of CHICKEN's diet that is soil	0.1	fd_chicken	--
Universal gas constant	8.205e-5	gas_r	atm-m^3/mol-K
Average annual irrigation	0	i	cm/yr
Plant surface loss coefficient	18	kp	yr^-1
Fraction of mercury emissions NOT lost to the global cycle	0.48	merc_q_corr	--
Fraction of mercury speciated into methyl mercury in produce	0.22	mercmethyl_ag	--
Fraction of mercury speciated into methyl mercury in soil	0.02	mercmethyl_sc	--
Forage fraction grown contam. soil, eaten by MILK CATTLE	1.0	milk_fi_forage	--
Grain fraction grown contam. soil, eaten by MILK CATTLE	1.0	milk_fi_grain	--
Silage fraction grown contam. soil, eaten by MILK CATTLE	1.0	milk_fi_silage	--
Qty of forage eaten by MILK CATTLE each day	13.2	milk_qp_forage	kg DW/day
Qty of grain eaten by MILK CATTLE each day	3.0	milk_qp_grain	kg DW/day
Qty of silage eaten by MILK CATTLE each day	4.1	milk_qp_silage	kg DW/day
Averaging time	1	milkfat_at	yr
Body weight of infant	10	milfat_bw_infant	kg
Exposure duration of infant to breast milk	1	milkfat_ed	yr
Proportion of ingested dioxin that is stored in fat	0.9	milkfat_f1	--
Proportion of mothers weight that is fat	0.3	milkfat_f2	--
Fraction of fat in breast milk	0.04	milkfat_f3	--
Fraction of ingested contaminant that is absorbed	0.9	milkfat_f4	--
Half-life of dioxin in adults	2555	milkfat_h	days
Ingestion rate of breast milk	0.8	milkfat_ir_milk	kg/day

Site Parameters	Value	Symbol	Units
Viscosity of air corresponding to air temp.	1.81e-04	mu_a	g/cm-s
Average annual precipitation	71.4	p	cm/yr
Fraction of grain grown on contam. soil eaten by PIGS	1.0	pork_fi_grain	--
Fraction of silage grown on contam. soil and eaten by PIGS	1.0	pork_fi_silage	--
Qty of grain eaten by PIGS each day	3.3	pork_qp_grain	kg DW/day
Qty of silage eaten by PIGS each day	1.4	pork_qp_silage	kg DW/day
Qty of soil eaten by CATTLE	0.5	qs_beef	kg/day
Qty of soil eaten by CHICKEN	0.022	qs_chick	kg/day
Qty of soil eaten by DAIRY CATTLE	0.4	qs_milk	kg/day
Qty of soil eaten by PIGS	0.37	qs_pork	kg/day
Average annual runoff	23	r	cm/yr
Density of air	1.2e-3	rho_a	g/cm^3
Solids particle density	2.7	rho_s	g/cm^3
Interception fraction - edible portion ABOVEGROUND	0.39	rp	--
Interception fraction - edible portion FORAGE	0.5	rp_forage	--
Interception fraction - edible portion SILAGE	0.46	rp_silage	--
Ambient air temperature	298	t	K
Temperature correction factor	1.026	theta	--
Soil volumetric water content	0.2	theta_s	mL/cm^3
Length of plant expos. to depos. - ABOVEGROUND	0.164	tp	Yr
Length of plant expos. to depos. - FORAGE	0.12	tp_forage	Yr
Length of plant expos. to depos. - SILAGE	0.16	tp_silage	Yr
Average annual wind speed	3.9	u	m/s
Dry deposition velocity	3	vdv	cm/s
Wind velocity	3.9	w	m/s
Yield/standing crop biomass - edible portion ABOVEGROUND	2.24	yp	kg DW/m^2
Yield/standing crop biomass - edible portion FORAGE	0.24	yp_forage	kg DW/m^2
Yield/standing crop biomass - edible portion SILAGE	0.8	yp_silage	kg DW/m^2
Soil mixing zone depth	1.0	z	cm

Table 6
IRAP Exposure Scenario Assumptions

DESCRIPTION	Resident Adult	Resident Child	Farmer Adult	Farmer Child	Fisher Adult	Fisher Child	UNITS
Averaging time for carcinogens	70	70	70	70	70	70	yr
Averaging time for noncarcinogens	30	6	40	6	30	6	yr
Consumption rate of BEEF	0.0	0.0	0.00114	0.00051	0.0	0.0	kg/kg-day FW
Body weight	70	15	70	15	70	15	kg
Consumption rate of POULTRY	0.0	0.0	0.00061	0.000425	0.0	0.0	kg/kg-day FW
Consumption rate of ABOVEGROUND PRODUCE	0.0003	0.00042	0.0003	0.00042	0.0003	0.00042	kg/kg-day DW
Consumption rate of BELOWGROUND PRODUCE	0.00014	0.00022	0.00014	0.00022	0.00014	0.00022	kg/kg-day DW
Consumption rate of DRINKING WATER	1.4	0.67	1.4	0.67	1.4	0.67	L/day
Consumption rate of PROTECTED ABOVEGROUND PRODUCE	0.00057	0.00077	0.00057	0.00077	0.00057	0.00077	kg/kg-day DW
Consumption rate of SOIL	0.0001	0.0002	0.0001	0.0002	0.0001	0.0002	kg/d
Exposure duration	30	6	40	6	30	6	yr
Exposure frequency	350	350	350	350	350	350	day/yr
Consumption rate of EGGS	0.0	0.0	0.00062	0.000438	0.0	0.0	kg/kg-day FW
Fraction of contaminated ABOVEGROUND PRODUCE	0.25	0.25	1.0	1.0	0.25	0.25	--
Fraction of contaminated DRINKING WATER	1.0	1.0	1.0	1.0	1.0	1.0	--
Fraction contaminated SOIL	1.0	1.0	1.0	1.0	1.0	1.0	--
Consumption rate of FISH	0.0	0.0	0.0	0.0	0.00117	0.000759	kg/kg-day FW
Fraction of contaminated FISH	1.0	1.0	1.0	1.0	1.0	1.0	--
Inhalation exposure duration	30	6	40	6	30	6	yr
Inhalation exposure frequency	350	350	350	350	350	350	day/yr
Inhalation exposure time	24	24	24	24	24	24	hr/day
Fraction of contaminated BEEF	1	1	1	1	1	1	--
Fraction of contaminated POULTRY	1	1	1	1	1	1	--
Fraction of contaminated EGGS	1	1	1	1	1	1	--
Fraction of contaminated MILK	1	1	1	1	1	1	--
Fraction of contaminated PORK	1	1	1	1	1	1	--
Inhalation rate	0.63	0.30	0.63	0.30	0.63	0.30	m^3/hr
Consumption rate of MILK	0.0	0.0	0.00842	0.01857	0.0	0.0	kg/kg-day FW
Consumption rate of PORK	0.0	0.0	0.00053	0.000398	0.0	0.0	kg/kg-day FW
Time period at the beginning of combustion	0	0	0	0	0	0	yr
Length of exposure duration	30	6	40	6	30	6	yr

Table 7
IRAP Risk Summary by Exposure Scenarios

Location	Risk	Exposure Scenario Evaluated						
		Resident		Farmer		Fisher		Risk Acceptance Criteria Ca = 1E05 HQ = 1
		Adult	Child	Adult	Child	Adult	Child	
RI_1 – Lake Resident	Cancer Risk	6.2E-07	2.5E-07	N/A	N/A	9.1E-07	2.9E-07	Passed
	Hazard Index	0.015	0.032	N/A	N/A	0.015	0.032	Passed
RI_2 – Lake Resident	Cancer Risk	5.2E-07	2.1E-07	N/A	N/A	8.1E-07	2.4E-07	Passed
	Hazard Index	0.013	0.028	N/A	N/A	0.013	0.028	Passed
RI_3 – Lake Resident	Cancer Risk	6.2E-07	2.5E-07	N/A	N/A	9.1E-07	2.9E-07	Passed
	Hazard Index	0.015	0.032	N/A	N/A	0.015	0.032	Passed
RI_4 – Riding Stable	Cancer Risk	1.6E-07	6.5E-08	N/A	N/A	4.6E-07	1.0E-07	Passed
	Hazard Index	0.0036	0.0079	N/A	N/A	0.0037	0.0080	Passed
RI_5 – Riding Stable	Cancer Risk	1.3E-07	5.0E-08	N/A	N/A	4.2E-07	8.8E-08	Passed
	Hazard Index	0.0028	0.0062	N/A	N/A	0.0029	0.0063	Passed
RI_6 – NE Hobby Farm	Cancer Risk	2.6E-07	1.1E-07	N/A	N/A	5.6E-07	1.4E-07	Passed
	Hazard Index	0.0064	0.014	N/A	N/A	0.0065	0.014	Passed

Location	Risk	Exposure Scenario Evaluated						
		Resident		Farmer		Fisher		Risk Acceptance Criteria Ca = 1E05 HQ = 1
		Adult	Child	Adult	Child	Adult	Child	
RI_7 – Working Farm	Cancer Risk	1.9E-07	7.4E-08	9.1E-07	2.3E-07	4.8E-07	1.1E-07	Passed
	Hazard Index	0.0047	0.010	0.0050	0.011	0.0048	0.010	Passed
RI_8 – Rural Resident	Cancer Risk	4.0E-07	1.6E-07	N/A	N/A	6.9E-07	2.0E-07	Passed
	Hazard Index	0.0093	0.021	N/A	N/A	0.0095	0.021	Passed
RI_10 – Rural Resident	Cancer Risk	4.0E-07	1.6E-07	N/A	N/A	6.9E-07	2.0E-07	Passed
	Hazard Index	0.0093	0.021	N/A	N/A	0.0094	0.021	Passed
RI_11 – Rural Resident	Cancer Risk	3.7E-07	1.5E-07	N/A	N/A	6.7E-07	1.9E-07	Passed
	Hazard Index	0.0088	0.019	N/A	N/A	0.0089	0.020	Passed
RI_12 – Rural Resident	Cancer Risk	3.2E-07	1.3E-07	N/A	N/A	6.2E-07	1.7E-07	Passed
	Hazard Index	0.0076	0.017	N/A	N/A	0.0077	0.017	Passed

Table 8
IRAP Cancer Risk Summary by Exposure Pathways

Location	Scenario	Pathway									Total Risk	Acceptance Criteria = 1E-5
		Inhalation	Produce	Beef	Poultry	Eggs	Fish	Milk	Pork	Soil		
RI_1 – Lake Resident	Fisher Adult	2.7E-07	3.3E-07				2.9E-07			1.9E-08	9.1E-07	Passed
	Fisher Child	1.2E-07	9.2E-08				3.8E-08			3.5E-08	2.9E-07	Passed
	Resident Adult	2.7E-07	3.3E-07							1.9E-08	6.2E-07	Passed
	Resident Child	1.2E-07	9.2E-08							3.5E-08	2.5E-07	Passed
RI_2 – Lake Resident	Fisher Adult	2.3E-07	2.7E-07				2.9E-07			1.5E-08	8.1E-07	Passed
	Fisher Child	1.0E-07	7.5E-08				3.8E-08			2.9E-08	2.4E-07	Passed
	Resident Adult	2.3E-07	2.7E-07							1.5E-08	5.2E-07	Passed
	Resident Child	1.0E-07	7.5E-08							2.9E-08	2.1E-07	Passed
RI_3 – Lake Resident	Fisher Adult	2.7E-07	3.3E-07				2.9E-07			1.9E-08	9.1E-07	Passed
	Fisher Child	1.2E-07	9.2E-08				3.8E-08			3.5E-08	2.9E-07	Passed
	Resident Adult	2.7E-07	3.3E-07							1.9E-08	6.2E-07	Passed
	Resident Child	1.2E-07	9.2E-08							3.5E-08	2.5E-07	Passed
RI_4 – Riding Stable	Fisher Adult	6.9E-08	9.0E-08				2.9E-07			5.1E-09	4.6E-07	Passed
	Fisher Child	3.1E-08	2.5E-08				3.8E-08			9.5E-09	1.0E-07	Passed
	Resident Adult	6.9E-08	9.0E-08							5.1E-09	1.6E-07	Passed
	Resident Child	3.1E-08	2.5E-08							9.5E-09	6.5E-08	Passed
RI_5 – Riding Stable	Fisher Adult	5.3E-08	6.9E-08				2.9E-07			3.9E-09	4.2E-07	Passed
	Fisher Child	2.4E-08	1.9E-08				3.8E-08			7.3E-09	8.8E-08	Passed
	Resident Adult	5.3E-08	6.9E-08							3.9E-09	1.3E-07	Passed
	Resident Child	2.4E-08	1.9E-08							7.3E-09	5.0E-08	Passed
RI_6 – NE Hobby Farm	Fisher Adult	1.2E-07	1.4E-07				2.9E-07			8.0E-09	5.6E-07	Passed
	Fisher Child	5.1E-08	3.9E-08				3.8E-08			1.5E-08	1.4E-07	Passed
	Resident Adult	1.2E-07	1.4E-07							8.0E-09	2.6E-07	Passed
	Resident Child	5.1E-08	3.9E-08							1.5E-08	1.1E-07	Passed
RI_7 – Working Farm	Farmer Adult	1.1E-07	5.2E-07	6.5E-08	8.7E-09	7.6E-10		2.0E-07	2.1E-09	7.3E-09	9.1E-07	Passed
	Farmer Child	3.7E-08	1.1E-07	4.3E-09	9.1E-10	8.1E-11		6.5E-08	2.4E-10	1.0E-08	2.3E-07	Passed
	Fisher Adult	8.4E-08	9.7E-08				2.9E-07			5.5E-09	4.8E-07	Passed
	Fisher Child	3.7E-08	2.7E-08				3.8E-08			1.0E-08	1.1E-07	Passed
	Resident Adult	8.4E-08	9.7E-08							5.5E-09	1.9E-07	Passed
	Resident Child	3.7E-08	2.7E-08							1.0E-08	7.4E-08	Passed

Location	Scenario	Pathway									Total Risk	Acceptance Criteria = 1E-5
		Inhalation	Produce	Beef	Poultry	Eggs	Fish	Milk	Pork	Soil		
RI_8 – Rural Resident	Fisher Adult	1.7E-07	2.1E-07				2.9E-07			1.2E-08	6.9E-07	Passed
	Fisher Child	7.7E-08	5.9E-08				3.8E-08			2.3E-08	2.0E-07	Passed
	Resident Adult	1.7E-07	2.1E-07							1.2E-08	4.0E-07	Passed
	Resident Child	7.7E-08	5.9E-08							2.3E-08	1.6E-07	Passed
RI_10 – Rural Resident	Fisher Adult	1.7E-07	2.1E-07				2.9E-07			1.2E-08	6.9E-07	Passed
	Fisher Child	7.6E-08	5.9E-08				3.8E-08			2.3E-08	2.0E-07	Passed
	Resident Adult	1.7E-07	2.1E-07							1.2E-08	4.0E-07	Passed
	Resident Child	7.6E-08	5.9E-08							2.3E-08	1.6E-07	Passed
RI_11 – Rural Resident	Fisher Adult	1.6E-07	2.0E-07				2.9E-07			1.1E-08	6.7E-07	Passed
	Fisher Child	7.2E-08	5.5E-08				3.8E-08			2.1E-08	1.9E-07	Passed
	Resident Adult	1.6E-07	2.0E-07							1.1E-08	3.7E-07	Passed
	Resident Child	7.2E-08	5.5E-08							2.1E-08	1.5E-07	Passed
RI_12 – Rural Resident	Fisher Adult	1.4E-07	1.8E-07				2.9E-07			1.0E-08	6.2E-07	Passed
	Fisher Child	6.0E-08	4.9E-08				3.8E-08			1.9E-08	1.7E-07	Passed
	Resident Adult	1.4E-07	1.8E-07							1.0E-08	3.2E-07	Passed
	Resident Child	6.0E-08	4.9E-08							1.9E-08	1.3E-07	Passed

Note: Blank cells indicate pathway was not evaluated for the scenario.

Table 9
IRAP Hazard Index Summary by Exposure Pathways

Location	Scenario	Pathway									HQ Total	Acceptance Criteria = 1
		Inhalation	Produce	Beef	Poultry	Eggs	Fish	Milk	Pork	Soil		
RI_1 – Lake Resident	Fisher Adult	0.014	0.0003				0.0001			0.000005	0.015	Passed
	Fisher Child	0.032	0.0005				0.0001			0.000042	0.032	Passed
	Resident Adult	0.014	0.0003							0.000005	0.015	Passed
	Resident Child	0.032	0.0005							0.000042	0.032	Passed
RI_2 – Lake Resident	Fisher Adult	0.012	0.0003				0.0001			0.000004	0.013	Passed
	Fisher Child	0.028	0.0004				0.0001			0.000033	0.028	Passed
	Resident Adult	0.012	0.0003							0.000004	0.013	Passed
	Resident Child	0.028	0.0004							0.000033	0.028	Passed
RI_3 – Lake Resident	Fisher Adult	0.014	0.0003				0.0001			0.000004	0.015	Passed
	Fisher Child	0.032	0.0005				0.0001			0.000042	0.032	Passed
	Resident Adult	0.014	0.0003							0.000004	0.015	Passed
	Resident Child	0.032	0.0005							0.000042	0.032	Passed
RI_4 – Riding Stable	Fisher Adult	0.004	0.0001				0.0001			0.000001	0.004	Passed
	Fisher Child	0.008	0.0001				0.0001			0.000011	0.008	Passed
	Resident Adult	0.004	0.0001							0.000001	0.004	Passed
	Resident Child	0.008	0.0001							0.000011	0.008	Passed
RI_5 – Riding Stable	Fisher Adult	0.003	0.0001				0.0001			0.000001	0.003	Passed
	Fisher Child	0.006	0.0001				0.0001			0.000008	0.006	Passed
	Resident Adult	0.003	0.0001							0.000001	0.003	Passed
	Resident Child	0.006	0.0001							0.000008	0.006	Passed
RI_6 – NE Hobby Farm	Fisher Adult	0.006	0.0001				0.0001			0.000002	0.006	Passed
	Fisher Child	0.014	0.0002				0.0001			0.000017	0.014	Passed
	Resident Adult	0.006	0.0001							0.000002	0.006	Passed
	Resident Child	0.014	0.0002							0.000017	0.014	Passed
RI_7 – Working Farm	Farmer Adult	0.005	0.0004	0.00001	0.0000	0.0000		0.00001	0.0000	0.000001	0.005	Passed
	Farmer Child	0.010	0.0006	0.00001	0.0000	0.0000		0.00002	0.0000	0.000012	0.011	Passed
	Fisher Adult	0.005	0.0001				0.0001			0.000001	0.005	Passed
	Fisher Child	0.010	0.0002				0.0001			0.000012	0.010	Passed
	Resident Adult	0.005	0.0001							0.000001	0.005	Passed
	Resident Child	0.010	0.0002							0.000012	0.010	Passed

Location	Scenario	Pathway									HQ Total	Acceptance Criteria = 1
		Inhalation	Produce	Beef	Poultry	Eggs	Fish	Milk	Pork	Soil		
RI_8 – Rural Resident	Fisher Adult	0.009	0.0002				0.0001			0.000003	0.009	Passed
	Fisher Child	0.020	0.0003				0.0001			0.000027	0.021	Passed
	Resident Adult	0.009	0.0002							0.000003	0.009	Passed
	Resident Child	0.020	0.0003							0.000027	0.021	Passed
RI_10 – Rural Resident	Fisher Adult	0.009	0.0002				0.0001			0.000003	0.009	Passed
	Fisher Child	0.020	0.0003				0.0001			0.000027	0.021	Passed
	Resident Adult	0.009	0.0002							0.000003	0.009	Passed
	Resident Child	0.020	0.0003							0.000027	0.021	Passed
RI_11 – Rural Resident	Fisher Adult	0.009	0.0002				0.0001			0.000003	0.009	Passed
	Fisher Child	0.019	0.0003				0.0001			0.000025	0.019	Passed
	Resident Adult	0.009	0.0002							0.000003	0.009	Passed
	Resident Child	0.019	0.0003							0.000025	0.019	Passed
RI_12 – Rural Resident	Fisher Adult	0.007	0.0002				0.0001			0.000002	0.008	Passed
	Fisher Child	0.017	0.0003				0.0001			0.000021	0.017	Passed
	Resident Adult	0.007	0.0002							0.000002	0.008	Passed
	Resident Child	0.017	0.0003							0.000021	0.017	Passed

Note: Blank cells indicate pathway was not evaluated for the scenario.

Table 10
Risk Summary by Fish Ingestion Pathway

Location	Risk	IRAP – Total COPCs		MPCA – Mercury only
		Adult	Child	Adult
Big Diamond Lake Fisher	Cancer Risk	2.9E-07	3.8E-08	N/A
	Hazard Quotient	0.00013	0.000085	Ambient = 8.5 – 12.2* Facility increment = 0.04 – 0.06*

***Note – Hazard quotient for ambient mercury in fish tissue concentrations and facility increments are dependant upon the size of the fish.**

List of Figures

Appendix A

AERA Forms

AERA-01: Deliverable Checklist
AERA-02: Maps Form
AERA-03: Dispersion Factor Analysis
AERA-04: Emergency Internal Combustion Engine Certification
AERA-05: Emissions

Permit Forms
(See Mesaba Energy Project Prevention of Significant Deterioration Permit to Construct Application)

GI-01: Facility Information
GI-02: Process Flow Diagram
GI-03: Facility and Stack/Vent Diagram
GI-04: Stack/Vent Information
MI-01: Building and Structure Information
CR-01: Certification

Mercury Guidance and Form
(See Mesaba Energy Project Prevention of Significant Deterioration Permit to Construct Application)

Hg-2003: Assessing the Impacts of Mercury Release to Ambient Air

Appendix B

Electronic Submittals –

Q/CHI Spreadsheet

Q/CHI Modeling Input/Output

IRAP

IRAP Dispersion Modeling Input/Output

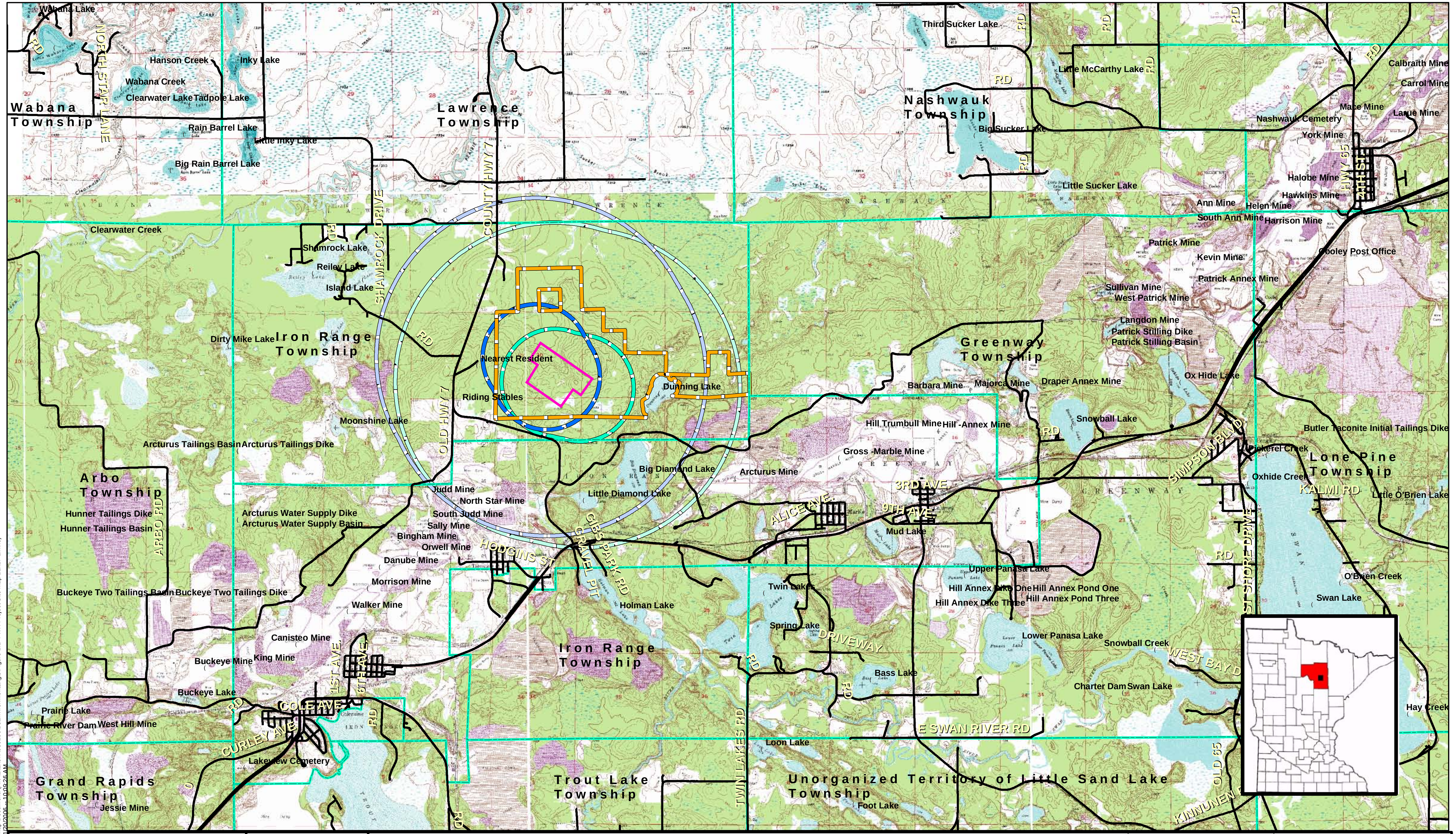
Mercury Dispersion Modeling Input/Output

MPCA Local Mercury Assessment Spreadsheet – 90th Percentile

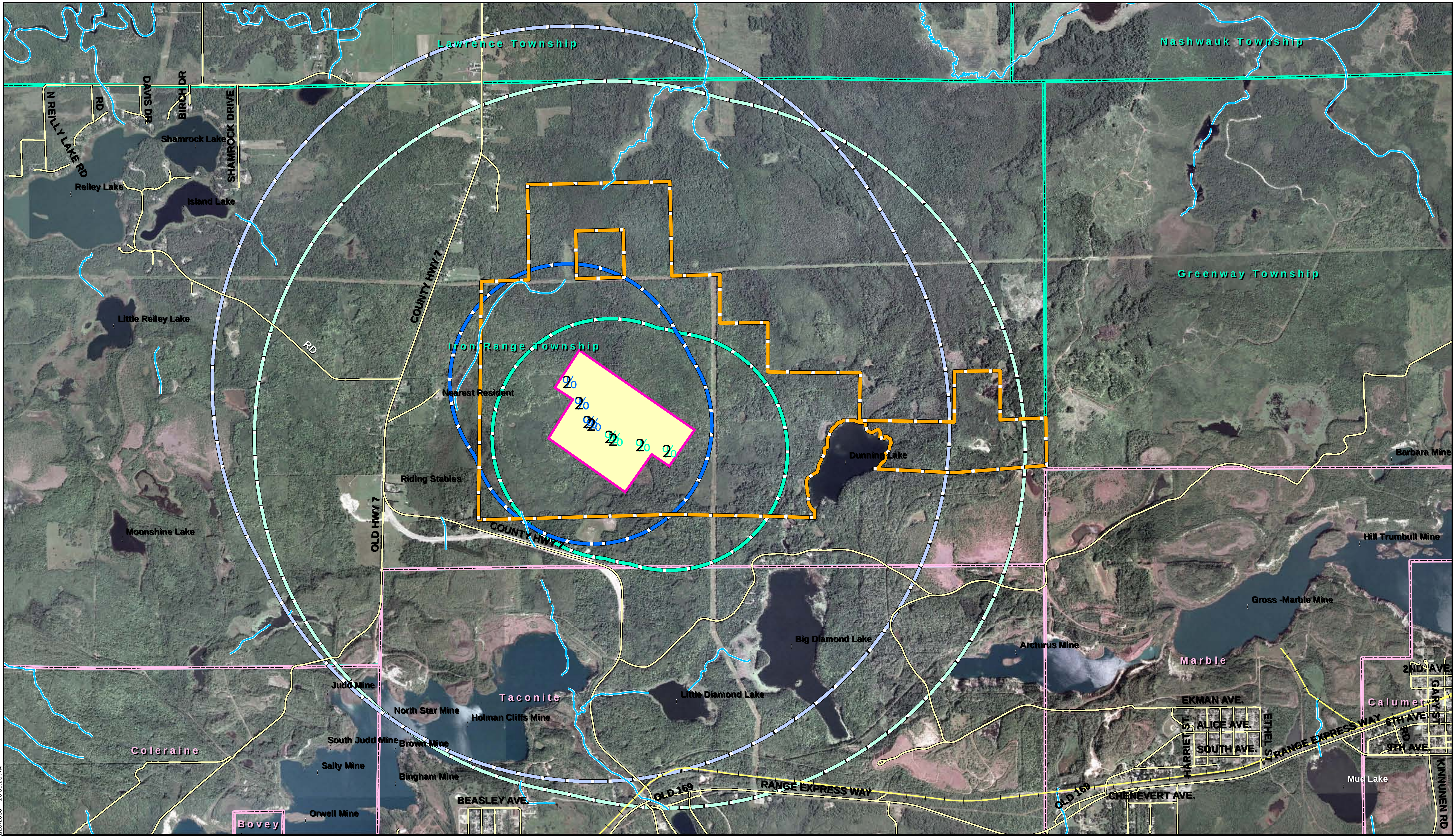
MPCA Local Mercury Assessment Spreadsheet – Average Length

“Allfish 04 NE Lakes only” Database

The electronic Submittal CD will be included when the Prevention of Significant Deterioration Permit to Construct is submitted to the MPCA.



Excelsior Energy Inc. Mesaba Energy Project Energy, Innovation, and Economic Development for Minnesota 11100 Wayzata Boulevard Suite 305 Minneapolis, MN 55305 Phone 952.847.2360 Fax 952.847.2373	***West Range Site*** *Feb. 2006*	**Legend** West Range Site Geographic Names Civil Township Phase 1 Stack (1 km Buffer) Phase 1 Stack (3 km Buffer) Phase 2 Stack (1 km Buffer) Phase 2 Stack (3 km Buffer) Existing Roads Fence Line Source: USDA 2003 DOQQs, Itasca County, MNDNR, Mn/DOT, USGS, Fluor, Excelsior Energy, and SEH. © 2005 SEH	***Figure 1 of 7*** ***Site Location Map*** Itasca County - South Coordinate System 4



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Energy, Innovation, and Economic Development for Minnesota

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West Range Site

Feb. 2006

Legend

- West Range Site
- Plant Layout
- Phase 1 Stacks
- Phase 2 Stacks
- Phase 1 Stack (1 km Buffer)
- Phase 1 Stack (3 km Buffer)
- Phase 2 Stack (1 km Buffer)
- Phase 2 Stack (3 km Buffer)
- Geographic Names
- Municipal Boundaries
- Civil Township
- Streams
- Existing Roads
- Existing Railroads
- Fence Line

Source: USDA 2003 DOQQs, Itasca County, MNDNR, Mn/DOT, USGS, Fluor, Excelsior Energy, and SEH.

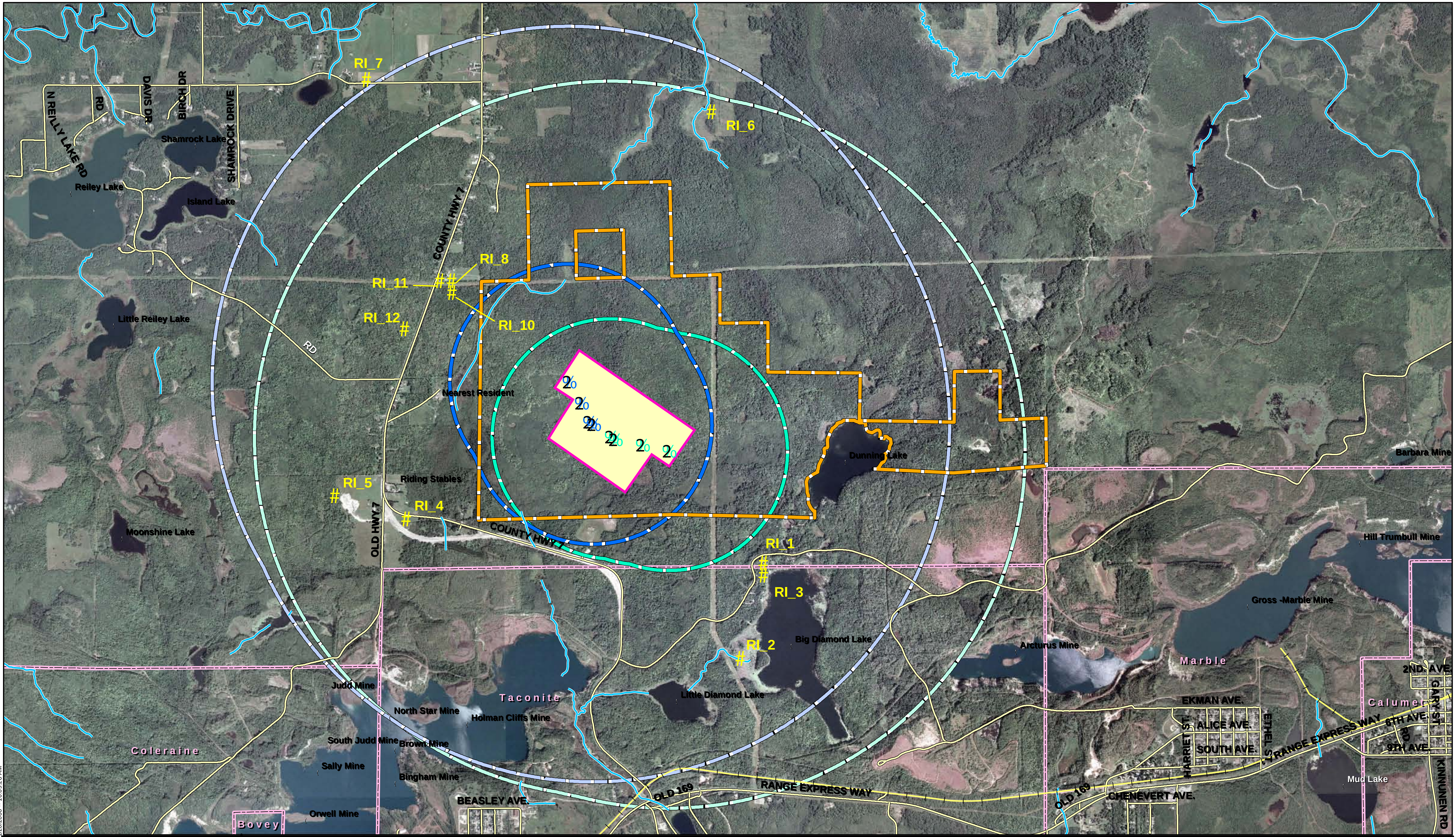
Figure 2 of 7

Facility Plan Aerial View

Itasca County - South Coordinate System

4

0 2,500 Feet



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West Range Site

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Legend

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- Phase 2 Stack (1 km Buffer)
- Phase 2 Stack (3 km Buffer)
- Geographic Names
- Municipal Boundaries
- Civil Township
- Streams
- Existing Roads
- Existing Railroads
- Fence Line
- IRAP Receptors

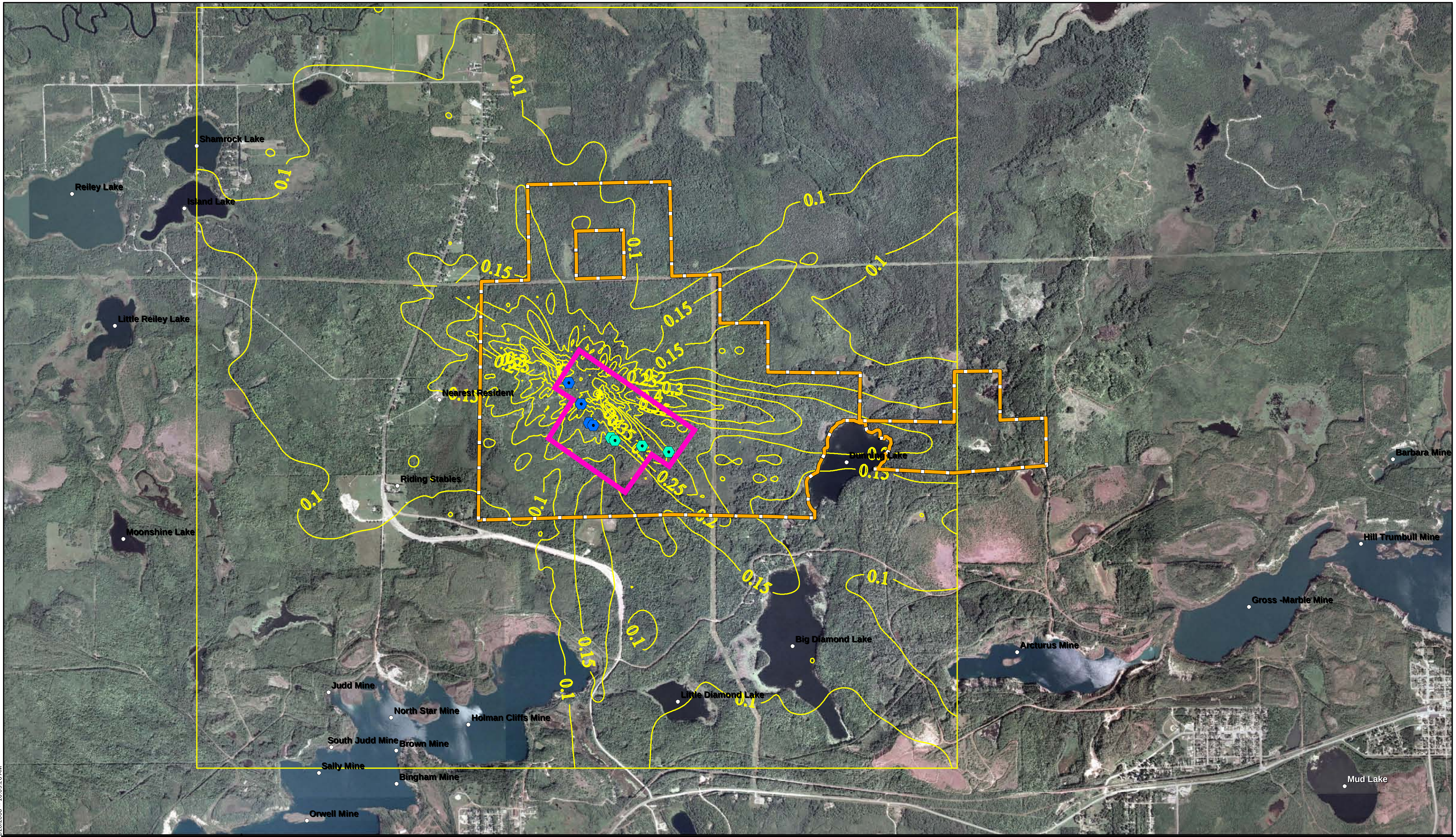
Source: USDA 2003 DOQQs, Itasca County, MNDNR, Mn/DOT, USGS, Fluor, Excelsior Energy, and SEH.

Figure 3 of 7

IRAP Receptor Locations

Itasca County - South Coordinate System

0 2,500 Feet



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West Range Site

Feb. 2006

Legend

- West Range Site
- Phase 1 Stacks
- Phase 2 Stacks
- Geographic Names
- Fence Line
- ERER Impact Contours
- 0.15 Acute Risk Hazard Quotient

Source: USDA 2003 DOQQs, Itasca County, MNDNR, Mn/DOT, USGS, Fluor, Excelsior Energy, and SEH.

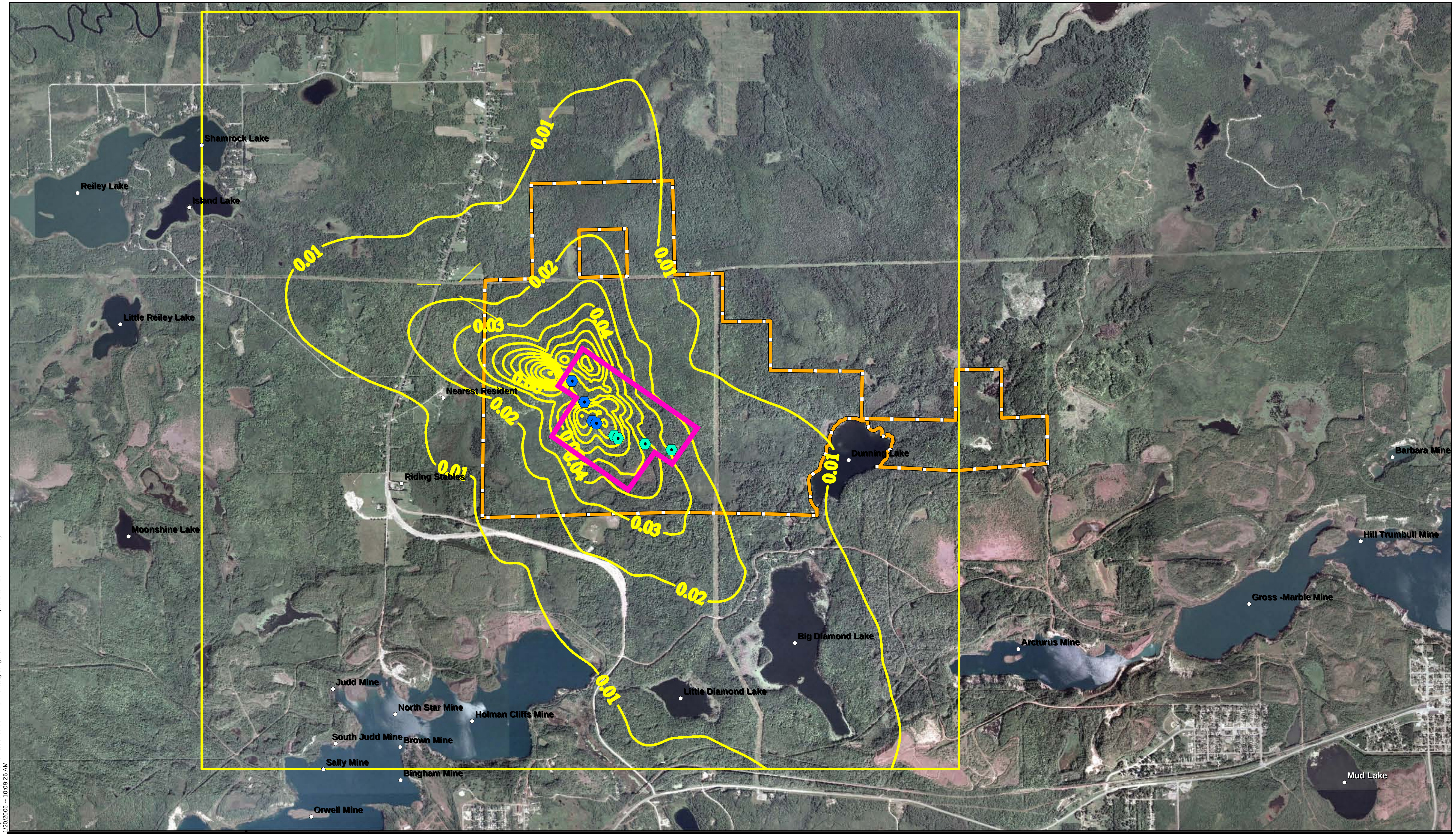
Figure 4 of 7

Acute Q/CHI Impacts

Itasca County - South Coordinate System

N
W E
S

0 2,500 Feet



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West Range Site

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Legend

- West Range Site
- Phase 1 Stacks
- Phase 2 Stacks
- Geographic Names
- Fence Line
- ERER Impact Contours
- 0.03 Subchronic Risk Hazard Quotient

Source: USDA 2003 DOQQs, Itasca County, MNDNR, Mn/DOT, USGS, Fluor, Excelsior Energy, and SEH.
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Figure 5 of 7

Sub-chronic Q/CHI Impacts

Itasca County - South Coordinate System

N
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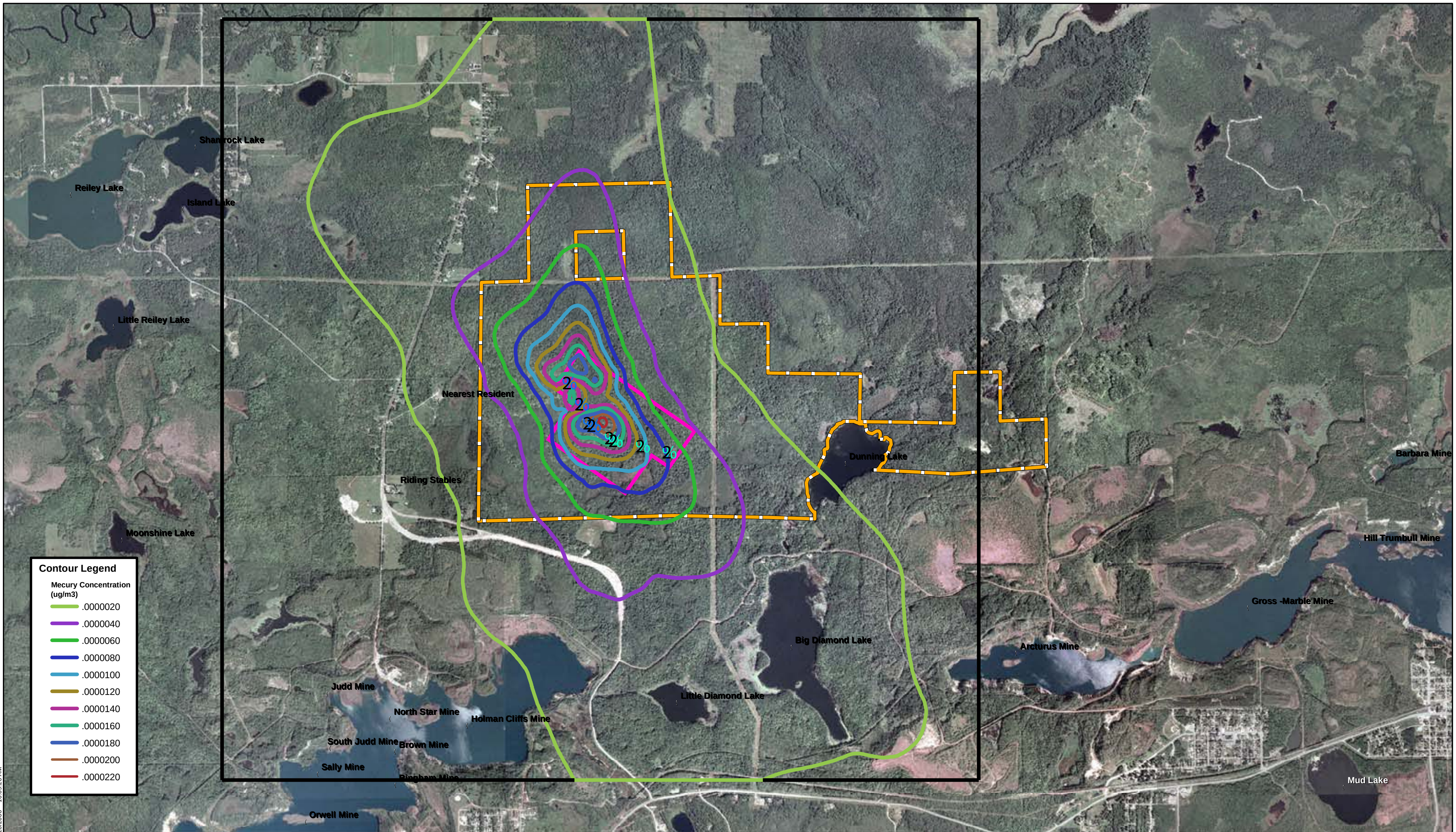
0 2,500 Feet



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West Range Site

Feb. 2006

Legend

- West Range Site
- Geographic Names
- Fence Line
- Phase 1 Stacks
- Phase 2 Stacks

Source: USDA 2003 DOQQs, Itasca County, MNDNR, Mn/DOT, USGS, Fluor, Excelsior Energy, and SEH.
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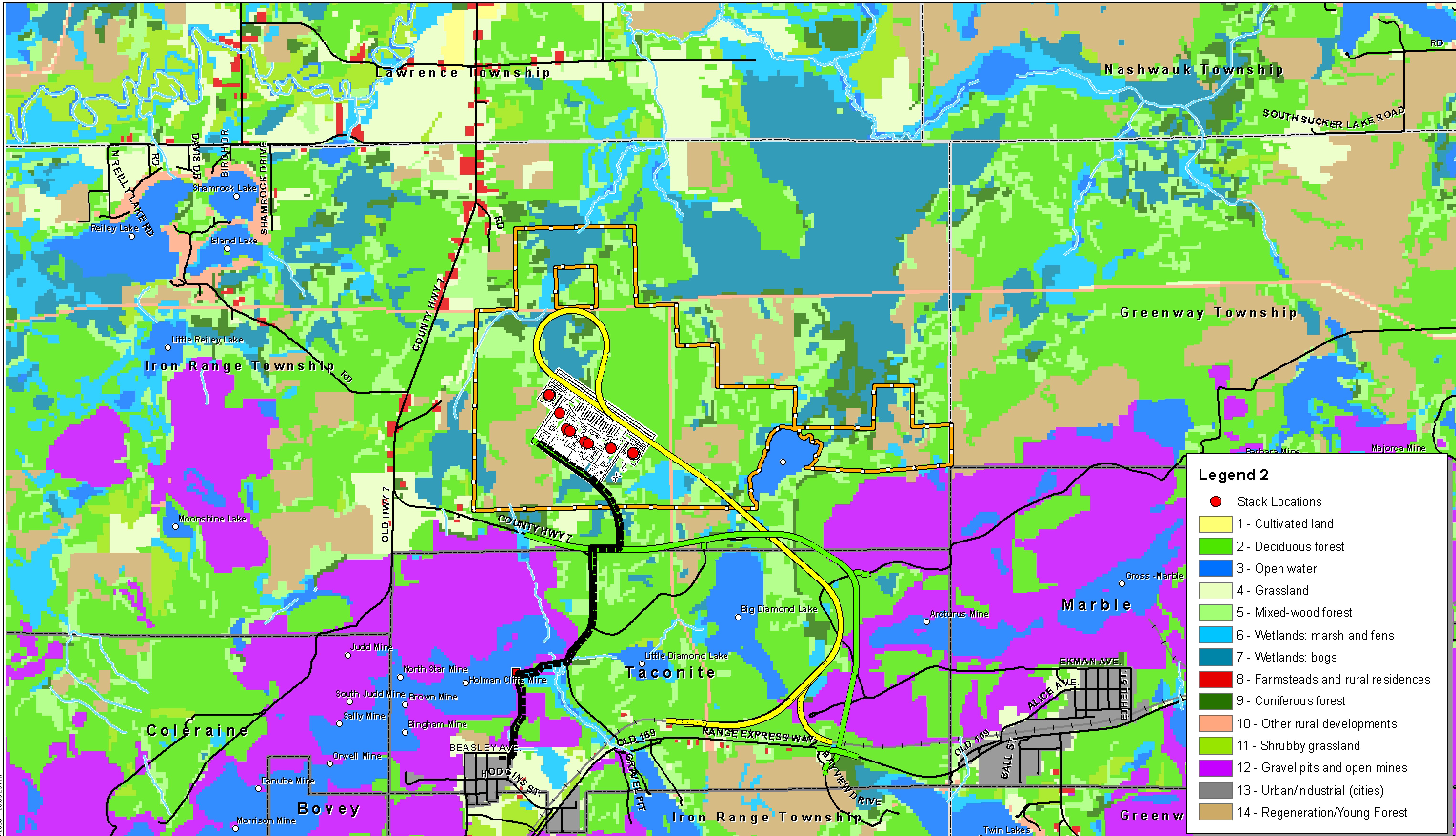
Figure 6 of 7

Mercury Emissions Dispersion Model Isoconcentrations

Itasca County - South Coordinate System

4

0 2,500 Feet



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West Range Site

Feb. 2006

Legend

- Plant Layout
- West Range Site
- Rail Alt 2
- Proposed Roads

Proposed Utilities

- Sanitary Sewer
- Potable Water
- Sanitary Pump Station

- Geographic Names
- Municipal Boundaries
- Civil Township
- Existing Roads
- Existing Railroads
- Streams

Source: Manitoba Remote Sensing Centre, Itasca County, MNDNR, MN/DOT, USGS, Fluor, Excelsior Energy, and SEH.

Figure 7 of 7

Existing Land Use Land Cover

Itasca County - South Coordinate System

4