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TECHNICAL MEMORANDUM

TO: Erik Carlson, MNDNR

FROM: Steve Menden, Wenck Associates, Inc.

DATE: Updated November 13, 2009

SUBJECT: Keetac Expansion Project – Alternative Stockpile Location Analysis
Wenck File #1472-04

1.0 Introduction

U.S. Steel Corporation's (Project Proposer) development of the Keetac Expansion Project (Proposed Project) includes new stockpile locations (Figure SA-1) for the excess overburden which consists of rock and surface material. The Project Proposer based the stockpile locations on maximizing the efficiency of the mining operation while minimizing environmental impacts. This Alternative Stockpile Location Analysis Technical Memorandum was completed to focus on the potential impacts of alternative stockpile locations, in an effort to determine if a viable alternative stockpile location exists and should be carried through the EIS process.

Purpose of Analysis

The purpose of this Alternative Stockpile Location Analysis is to determine if an alternative stockpile location exists that could still meet the underlying need and purpose of the Proposed Project while minimizing potential environmental impacts.

The process of developing and evaluating stockpile location concepts for consideration in this memorandum was developed through several meetings and discussions with the Project Proposer, MNDNR, MPCA, and the USACE. Based on these discussions, several alternative stockpile concepts and evaluation criteria were identified. Alternative stockpile location concepts are identified on Figure SA-1 as Concepts A-D. The evaluation criteria identified within Sections 4 and 5 of this memo discuss the results of the evaluation for each criterion.

Regulatory Framework

Minnesota Rules, part 4410.2300, subpart G states that the EIS shall compare the potentially significant impacts of the proposal with those of other reasonable alternatives to the proposed project. The EIS must address one or more alternatives of each of the following types of alternatives or provide a concise explanation of why no alternative of a particular type is included in the EIS: 1) alternative sites, 2) alternative technologies, 3) modified designs or layouts, 4) modified scale or magnitude, and 5) alternatives incorporating reasonable mitigation measures identified through comments received during the comment periods for EIS scoping or for the EIS.

Minnesota Rules part 4410.2300, subpart G directs that an alternative may be excluded from analysis in the EIS if, "it would not meet the underlying need for or purpose of the project, it would likely not have any significant environmental benefit compared to the project as proposed, or another alternative, of any type, that will be analyzed in the EIS would likely have similar environmental benefits but substantially less adverse economic, employment or sociological impacts."

Final Scoping Decision Document

The FSDD states that,

> *Positioning of stockpiles is crucial to minimizing impacts to wetlands and potentially other natural resources. The EIS will evaluate the potential environmental effects of the proposed stockpile locations as well as alternative stockpile locations. In addition, the EIS will evaluate in-pit stockpile opportunities; in-pit stockpiles can help create future shallow-water habitat when pits are abandoned and reclaimed. This stockpile location analysis will consider not only potential wetland impacts, but also air emissions from haul truck and wind erosion, haul road location, lease fee-holder requirements, in-pit stockpile opportunities and other operational and environmental issues.*

2.0 Concept Development

The Project Proposer evaluated several concepts contiguous to current mining operations prior to preparation of their proposed stockpile location. The various concept iterations were located in the approximate area of the current proposed east stockpile location. Initial concepts were refined when more information was gathered regarding the location of the ore deposit. Air dispersion modeling was completed establishing the ambient air quality boundary and associated setbacks, and wetland boundaries were determined to minimize wetland impacts within the general area. Concepts evaluated as part of the Project Proposer's planning are located in Appendix A of this memo.

Once the Project Proposer presented their proposed stockpile plan, a preliminary concept development analysis was completed by the Project Proposer, MNDNR, and USACE. The purpose of this effort was to determine which concepts were not deemed feasible and which concepts should be further analyzed.

Preliminary Concept Development

Meetings were held with the Project Proposer, MNDNR, MPCA, and USACE to discuss ideas for stockpiling concepts to ensure all potentially feasible stockpile alternatives would be evaluated. This section describes the concepts that were believed to need additional analysis.

Several concepts were explored and excluded from further consideration. These locations included areas requiring haulage beyond areas that are not currently contiguous to existing stockpiles or would require hauling by rail. The reasons for elimination of these locations are threefold. First, there are the adverse environmental impacts associated with roadway or rail construction through undisturbed areas. Second, air emissions (particulates, NO_x and Greenhouse Gases) associated with hauling are proportional to the hauling distance, meaning that stockpiles that are closer to the actual mining operation would have less air quality related impacts. Lastly, the economics of the additional roadway or rail construction and associated haulage costs would make recovery of the ore uneconomical. Most definitions of "ore" imply that it be economically viable to extract and process. For example the following citation is taken from the Encyclopedia Columbia: "ore, metal-bearing mineral mass that can be profitably mined."

Stockpile Concepts Considered

Several evaluation criteria were established and applied to each stockpile location concept. (See Figure SA-1 for proposed and concept stockpile locations.)

Proposed Location: Proposed stockpile locations include a 40.7 acre south stockpile, and a 539.2 acre east stockpile. The total acreage of new stockpiles is 539.2 acres. In-pit stockpiling of excess rock and surface materials in accordance with Minnesota Rules part 6130.1400, and current mineral rights agreements would be included in the proposed locations.

Existing Stockpiles: The existing out-of-pit stockpile locations to the northwest and southeast of the pit will be considered. The existing in-pit stockpiles would also be utilized.

Concept A: This is an area of approximately 160 acres located south of the railroad tracks and current southeast stockpile area. This area is also bordered by Highway 169 on the south. This concept does not contain adequate area alone to accommodate the Proposed Project stockpile needs.

Concept B: This is an area of approximately 487 acres located north of the east end of the current northwest stockpile. Concept B is bound by the existing Permit to Mine area on the north and east and O'Brien Creek on the west. This concept has approximately equivalent area to the proposed east stockpile and would not replace the proposed south stockpile.

Concept C: This is an area equivalent to the proposed stockpile locations located northwest of the current northwest stockpile area.

Concept D: This is an area equivalent to the proposed stockpile locations located north and east of the current northwest stockpile area.

3.0 Analysis Assumptions

Described below are the general assumptions used in this analysis.

Location Relative to Iron Formation

The current Proposed Project does not propose to mine to the known extent of the ore deposit. However, future economic and technological conditions may allow this to be considered viable ore. For this reason, impediments to future access to this potential ore are discouraged by mineral rights owners including the MNDNR.

Preliminary Concept Screening

Alternative stockpile concepts were eliminated during preliminary screening as discussed in Section 2.0 of this memo.

The Project Proposer has also indicated that they do not intend to plan project activities on property outside their ownership. In their opinion moving forward, during the permitting stage, with the assumption that property would be acquired when needed must be counteracted with a contingency plan in the event that the needed property cannot be acquired. This risk adds uncertainty to their confidence in the viability of the Proposed Project.

For the purpose of this analysis the assumption made by the Project Proposer, related to property ownership, is that analysis of properties that are not under the control of the Project Proposer have not been carried forward. Concept D is located partially on land outside the ownership control of the Project Proposer.

Existing and In-pit Stockpiling

The Project Proposer intends to maximize the use of in-pit stockpiling and the use of the existing stockpiles to the extent possible. This would be done for several reasons. First, Minnesota Rules, part 6130.1400 encourages maximization of in-pit stockpiling. Minnesota Rules, part 6130.1400 IN-MINE DISPOSAL Subpart 1 states:

> *Mining shall be conducted to maximize use of past, present, and future mining areas so as to minimize the amount of land disturbed by mining and reduce the loss of nonmineral resources.*

Second, it would result in the disturbance of less acreage needed for out-of-pit stockpiles. It is the most economical for the Project Proposer, as in-pit stockpiling would result in less haulage distance and possible wetland mitigation costs. Lastly, there would be air quality benefits, as the reduced hauling would result in less particulate emissions, which is related to the hauling distance, and less NO_x and GHG emissions related to less fuel consumption by the hauling vehicles.

Limitations to in-pit stockpiling are related to the sequence of mine pit development, existing mineral rights agreements and stockpile dimension requirements which are discussed in Minnesota Rules, parts 6130.1400 through 6130.3000. Relevant rule quotations related to the Project Proposers in-pit stockpiling activities within the context of this analysis are as follows.

Minnesota Rules, part 6130.1400. IN-MINE DISPOSAL, Subpart 2.D.
Mine waste which is placed within an open pit mine below the ultimate pit water elevation shall be exempted from the requirements of Minnesota Rules, parts 6130.2000 to 6130.3600. These shall be designed and constructed to prevent adverse environmental effects.

This means that the portions of the in-pit stockpiles above the ultimate pit water level elevation are **not** exempt from the requirements of Minnesota Rules, parts 6130.2000 to 6130.3600 and must comply with those rules.

Minnesota Rules, part 6130.2400. STANDARDS FOR ROCK, LEAN ORE, AND COARSE TAILINGS STOCKPILES,
Rock, lean ore, and coarse tailings stockpiles, unless they are an integral part of a tailings impoundment, shall be designed and constructed according to either of the following standards:

A. The final exterior slopes shall consist of benches and lifts as follows:

(1) No lift shall exceed 30 feet in height;

(2) No bench width shall be less than 30 feet wide, measured from the crest of the lower lift to the toe of the next lift;

(3) The sloped area between benches shall be no steeper than the angle of repose;

Minnesota Rules, part 6130.2700 STANDARDS FOR SURFACE OVERBURDEN STOCKPILE DESIGN AND CONSTRUCTION.

Surface overburden stockpiles shall be designed and constructed according to either of the following standards:

A. The final exterior slopes shall consist of benches and lifts as follows:

(1) No lift shall exceed 40 feet in height.

(2) No bench width shall be less than 30 feet wide, measured from the crest of the lower lift to the toe of the next lift.

(3) The sloped area between benches shall be no steeper than 2.5:1.

(4) Benches shall be sloped toward the interior to control runoff. They shall be large enough to handle runoff water until it can be infiltrated into the stockpile, or a drainage control system shall be constructed to remove water consistent with Minnesota Rules, part 6130.2100, items B and C.

(5) Rock, lean ore, or coarse tailings shall not be used to cover surface overburden stockpiles in order to avoid compliance with sloping and vegetation requirements. This shall not preclude the abutting of rock, lean ore, or coarse tailings stockpiles with surface overburden stockpiles, or the placement of rock, lean ore, or coarse tailing lifts atop surface overburden pads or lifts.

Minnesota Rules, part 6130.2800 SEPARATION OF MATERIALS IN STOCKPILES

Iron Formation and Duluth Formation materials of varying grades and types shall be segregated within the same stockpile or placed in separate stockpiles. Materials which require different means of beneficiation shall not be co-mingled.

Currently, in-pit stockpiles exist. In the Proposed Project, these in-pit stockpiles would be utilized to their maximum capacity. Expanding the footprint of these existing in-pit stockpiles or constructing new in-pit stockpiles at other locations within the pit would be evaluated near mid-life of the Proposed Project. A complex evaluation, in-pit disposal is limited by land ownership, stockpile ownership, type of material in stockpile, mineral rights, and mine sequencing. For instance, due to economic and technological conditions, the Proposed Project cannot mine the entire extent of the known ore deposit. If future conditions change, the remaining deposit may be considered viable ore. For this reason, impediments (such as in-pit stockpiles) to future access of this potential ore are discouraged by mineral rights owners. U.S. Steel is only one of many mineral rights owners of the Proposed Project.

The timing of the development of the pit impacts the in-pit stockpiling due to the fact that the economic viability of the mining process depends on moving the excess rock and overburden once into its final stockpile location. Moving the material into a temporary stockpile and then back into a final stockpile location is not only uneconomical, but also results in additional, unneeded air and dust emissions related to the additional haulage and placement. For in-pit stockpiling, this means that in-pit stockpiles are restricted to those areas of the mine that have already been mined to their planned limits.

Another important concept to understand when considering the volumes of materials is the concept of "swelling". When the overburden is mined, it undergoes swelling. This swelling is due to the fact that the stockpiled density of the surface material is less than the in-situ density and when intact rock is blasted into smaller fragments, a pile is less dense than the original intact mass. The swelling factor the Project Proposer is using based on historical mining data at this mine, is 1.25. As an example, 100 million bank cubic yards (Mbcy) of overburden removal requires a stockpile with 125 Million cubic yards (Mcy) of capacity. A bank cubic yard is one cubic yard in its original in-situ condition before excavating or blasting.

The Project Proposer has a phased development plan for the in-pit stockpiling that correlates to the timing of the mining activities that is broken into four time periods and is summarized on the next page.

Period 1 (2012-2016)

During this period there is an estimated 92 Mbcy of surface overburden material and 42.1 Mbcy of excess rock that would be stockpiled. During this period, the west zone of the mine would continue to expand and a small portion of the north edge of the east zone of the mine would be at final development, allowing additional placement of material in existing in-pit stockpiles. 10.7 Mbcy of surface overburden and 15.4 Mbcy of rock would be stockpiled in in-pit during this period.

Period 2 (2017-2021)

During this period there is an estimated 51.3 Mbcy of surface overburden material and 67.4 Mbcy of excess rock to be stockpiled. During this period, a large portion of the west zone of the mine would be at its final development, and 11.2 Mbcy of surface overburden and 29 Mbcy of rock would be stockpiled in in-pit stockpiles.

Period 3 (2022-2026)

During this period there is an estimated 43.1 Mbcy of surface overburden material and 59.5 Mbcy of excess rock to be stockpiled. During this period, the west zone of the mine development would be nearly complete and the western half of the east zone would be nearly complete. During this period, all of the rock removed would be placed into in-pit stockpiles, and the surface material would be placed in stockpiles outside the pit.

Period 4 (2027-2037)

During this period there is an estimated 2.8 Mbcy of surface overburden material and 99.1 Mbcy of excess rock to be stockpiled. During the first few years of this period, the overburden and rock removal would be complete, and the final ore removal and processing would be ongoing throughout the remainder of this period. All but 0.1 Mbcy of material removed during this period would be placed into in-pit stockpiles.

Summary

Incorporation of drilling data obtained to date and modeling of the mine development through the use of a three dimensional mine planning software package has resulted in the following estimate of material removal and stockpiling needs.

- Surface Overburden 189.3 Mbcy (236.6 Mcy swelled)
- Rock 268.0 Mbcy (335.0 Mcy swelled)
- Total 457.2 Mbcy (571.5 Mcy swelled)

The following presents a summary of in-pit versus out of pit stockpile plans and relative percentages:

- Surface Overburden
  - Out of pit stockpiles 154.3 Mbcy (81.6 %)
  - In-pit stockpiles 34.9 Mbcy (18.4 %)
- Rock
  - Out of pit stockpiles 65.1 Mbcy (24.3 %)

- In-pit stockpiles 202.9 Mbcy (75.7 %)
- Total
  - Out of pit stockpiles 219.4 Mbcy (48 %)
  - In-pit stockpiles 237.8 Mbcy (52 %)

Economic viability of mining depends on efficient handling of waste and byproducts of mining, allowing concentrated efforts on ore removal and beneficiation. In order to facilitate this, the rock and surface overburden removal must occur only once, (i.e., removed from original location, moved to final stockpiled location, and stockpiled). An interim step, such as out-of-pit stockpiling and moving it to in-pit, in the process not only adds significant costs that are not accounted for in the economic mine model, but there is also additional dust and air quality related emissions from the additional steps involved in the second loading, hauling, and placement. It is the timing of the mine development and the need to avoid double handling of materials that makes areas of the mine that may otherwise appear to be feasible locations for in-pit stockpiling, unviable.

In addition to timing and placement issues, several entities have mineral rights to material within the pit. Each mineral rights owner has different requirements for setbacks from the mine pit walls, segregation of materials, etc that have to be considered. Typical mineral rights agreements state that the toe of an in-pit stockpile must remain 200 feet from the edge of a completed mine pit shear wall and that the residual products of greater potential future value (rock and unexcavated ore) must be placed on top of residual products of lesser value (surface overburden). This means that rock is the only material allowed in an in-pit stockpile in areas where the Project Proposer doesn't control the mineral rights.

There are also mineland reclamation rules the Project Proposer must follow. The pertinent Minnesota Rules the Project Proposer follows for stockpiling include.

- Minnesota Rules, part 6130.1400 applies to in-pit stockpiling
- Minnesota Rules, part 6130.2400 Rock, Lean Ore, and Coarse Tailings Stockpiles
- Minnesota Rules, part 6130.2700 outlines the requirements of Surface Overburden Stockpiles.
- Minnesota Rules, part 6130.2800 requires that Iron Formation and Duluth Formation materials of varying grades and types shall be segregated within the same stockpile or placed in separate stockpiles. Materials which require different means of beneficiation shall not be co-mingled.

Quantity and Duration of Stockpile Activity

The Project Proposer estimates that even with maximization of in-pit stockpile and existing stockpile options, there would still be a need to stockpile an additional 118 Mbcy of excess surface material. Surface material would need to be removed over 21.5 years to allow mining of the ore to continue uninterrupted. Total Proposed Project out of pit stockpile requirements are estimated at 220 Mbcy, including materials planned for placement in existing surface material and rock stockpiles.

Due to the swelling of the materials discussed earlier, there is actually an anticipated need to stockpile a total of 275 Mcy in the existing and proposed stockpiles, with 147 Mcy in the proposed stockpile location.

Haul Route Configurations

Potential haul routes were configured from the approximate geometric center of the proposed east mine expansion to the approximate geometric center of each of the concept stockpile locations, with the exception of the existing stockpile locations and the in-pit stockpile locations.

For each of the three concepts located northwest of the pit (Concepts B-D), two potential haul routes were considered. One route (B-1, C-1 and D-1) passes through the existing crusher area and utilizes existing haul roads to the extent practical. A second route (B-2, C-2 and D-2) is more direct, avoiding the crusher area, and requiring additional new haul road construction. Haul routes for the proposed stockpile (P-1 and P-2) are shown on Figure SA-2, and the haul routes for Concepts A-D are shown on Figures SA-3 through SA-6 respectively.

For open pit mining in a cold climate, the maximum slopes considered safe for downhill loaded travel are 8 percent. Given this constraint, a haulage profile was developed for each potential haul route.

Haulage profiles were used to estimate the round trip cycle time for each truck, which then determined how many trucks would be needed to ensure that the target production rate is met based on the removal of the 118 Mbcy in 21.5 years. Round trip cycle times for each haulage profile were estimated using the appropriate retarding performance (downhill) and gradeability/speed/rimpull (uphill) curves from the Caterpillar 793D Mining Truck performance specifications, provided in Appendix B. Round trip cycle times were all increased slightly to account for the large number of turns and grade changes which would be required.

Haul routes and the number of round trips required are also used to calculate the Vehicle Miles Traveled (VMT), which are used in air emission calculations described in Section 4 Haulage Profiles and tabulated round trip cycle times are provided in Appendix C of this memo. All concepts require the construction of some new haul road, whether it’s an entirely new haul road, or an addition to an existing haul road.

The Project Proposer has estimated the costs of new haul road construction to be $400,000 per mile which is based on the following assumptions.

- 4 foot thick base placed 150 feet wide
- 4-inch thick coarse crushed aggregate road base course placed 100 feet wide
- 4-inch thick fine crushed aggregate surfacing course placed 100 feet wide.

To verify the Project Proposer’s haul road construction cost/mile estimate, itemized quantities were calculated and unit costs for processed and placed materials were estimated, and confirm the Project Proposer’s estimate as shown below.

- 4-foot thick base (117,300 cy per mile) at $2.80/cy = $328,440 per mile
- 4-inch thick coarse crushed aggregate (6,500 cy pre mile) at $5.20/cy = $33,800
- 4-inch thick fine crushed aggregate (6,500 cy per mile) at $5.20/cy = $33,800
- Total cost/mile using unit price estimates = $396,040

Haul Truck Operation and Economic Considerations

Based on the proposed production rate, the number of round trips can be estimated. When taken over 21.5 years, and assuming a 365 day/year operation, a daily production rate can be calculated. Typical operations run three 8-hour shifts per day and it is assumed that each truck is hauling for 6 of the 8 hours. The remaining time is for fueling, safety inspections, etc.

Daily production rate needed, operating hours/truck/day, and the capacity of each truck (132 bcy), are factored to determine the gross number of trucks required. Assuming that in a given year a truck would be operable for 80 percent of the time (i.e. it takes 5 trucks to have 4 running constantly) the gross number of trucks required is divided by 0.8 to establish the total number of trucks needed to move the material within the timeframe.

Based on information provided by the Project Proposer, an average daily fuel consumption rate of 670 gallons/day was used and is based on an hourly consumption rate of 31 gallons/hour for 21.6 hours/day (truck runs 90 percent of day). Fuel consumption and total running time are used in the estimation of greenhouse gas and nitrogen oxides (NO_x) being emitted for each concept.

For this analysis, an operating cost/truck of $250/hr was used, which includes fuel, maintenance, and labor. The capital expense of each truck would be $2.8M in 2008 dollars, and the expected life is 6 years. Using straight line depreciation, the annual capital cost of each truck would therefore be estimated to be $470,000.

Appendix D of this memo contains tabulated data on VMT, life cycle operation costs, capital costs, and air quality emissions from mobile sources (mine trucks). Maintenance equipment and other minor vehicles were omitted to simplify this analysis.

The Project Proposer incurs road maintenance costs that are directly proportional to the length of haul road maintained. Calculated below are the annual costs per mile for road maintenance.

- Grade roads
  - Grade every other day
  - Grader speed = ~ 5 mph
  - 11 passes needed to grade 100 foot wide road
  - Grading totals ~ 390 hours per year at $175/hour operating cost = $68,250/year/mile

- Dress roads
  - Add 1 inch of fine crushed aggregate every 4 weeks (including wintertime "sanding")
  - Road dressing totals ~1,600 cy per mile every 4 weeks, which works out to be 20,800 cy/mile/year at $5.20/cy = $108,160/year/mile
- Water roads
  - 3 times/day for 7 months/year = 640 waterings/year
  - 2 passes to water entire road = 1280 passes/year
  - 15 mph average speed – includes filling, and empty return runs = 85 hours/year x $200/hour = $17,000/year/mile

The total annual road maintenance costs are estimated at $193,410 per mile.

Air Quality

The current air dispersion modeling indicates that the applicable ambient air quality standards would be met along the ambient air quality boundary established for the Proposed Project. For the four concepts it is assumed that a revised ambient air quality boundary could be established to meet ambient air quality standards.

Mineral Rights

The Project Proposer would need additional land to stockpile surface overburden material. Concepts were selected to ensure the location would not infringe on known mineral rights related to the existing ore body or the mineral rights related to the existing waste rock stockpiles. For this analysis, mineral rights associated with stockpiling surface overburden are negligible and not considered further.

4.0 Evaluation Criteria

Several criteria to evaluate and compare the various concepts have been identified. Criteria have been divided into three major categories: Environmental factors, Community Factors, and Feasibility Factors. A summary of the actual values produced by the evaluation criteria are included in the two Evaluation Criteria Matrices included in Appendix E of this memo.

4.1 Environmental Factors

Environmental factors taken into consideration are further subdivided into two general topic areas: Natural Habitat and Air Quality. They are described in detail in Section 4.0.

Natural Habitat

- Wetland Acreage – Figure SA-1 and Appendix E of this memo identifies the total direct wetland acreage to be impacted within the proposed stockpile locations and concept stockpile locations. Indirect wetland impacts due to stockpiles have been assumed to be equivalent for the proposed stockpiles and the various concepts considered herein.

- Wetland Condition – For this analysis, the wetland condition is being characterized as either or Artificial/Degraded (wetlands that have enlarged or developed due to previous excavation or impoundment) or natural (naturally established and no significant change identified since establishment) as determined through existing available data including: wetland delineation reports, National Wetland Inventory Maps, and historical aerial photographs. Figure SA-1 and Appendix E of this memo illustrate the total wetland acreage for undisturbed and altered wetlands impacted within the proposed stockpile locations and concept stockpile locations.

- Upland Acreage – Figure SA-1 and Appendix E of this memo identify the amount of upland acreage impacted with the proposed stockpile locations and concept stockpile locations. It is assumed that the function and value of all upland is equivalent.

- Rare Species – The presence of Endangered, Threatened, Proposed Endangered, or Special Concern species have been identified in an Index Report from a review of the MNDNR's Natural Heritage Information System database, (Appendix F of this memo). Figure SA-7 shows locations of identified rare plant species in the general vicinity of the proposed stockpile area, as identified in field survey completed by the Project Proposer. Figure SA-8 shows locations of rare species from the NHIS Database Detailed report, but due to restrictions contained within the license from the MNDNR, the specific species at each location cannot be identified.

Air Quality

The Air Quality topic area considered the following; PM, PM_{10} and $PM_{2.5}$ emissions in tons emitted over the life of the stockpiling activities (21.5 years) was estimated as described below. The emission factors were provided by the Project Proposer and taken from their Air Quality Emissions Inventory, part of the Air Permit Application currently in progress. The factors used are summarized in Table 1 on the next page.

TABLE 1 - PARTICULATE EMISSION FACTORS

Haul Vehicle	PM Emission Factor	PM_{10} Emission Factor	$PM_{2.5}$ Emission Factor
Cat 265 T Truck	23.590 lb/VMT	6.244 lb/VMT	0.624 lb/VMT
Cat 240 T Truck	23.572 lb/VMT	6.239 lb/VMT	0.624 lb/VMT*
Average	**23.581 lb/VMT**	**6.242 lb/VMT**	**0.624 lb/VMT**

lb/VMT = pounds per Vehicle Mile Traveled

* Taken as 10% of the PM10 factor

Individual haulage related emissions are directly proportional to the total VMT. It is assumed that hauling would be done by a mix of trucks of either capacity, and therefore the average of the two was used for this comparison. The methodology used in estimating the VMT was previously discussed in Section 3.0 of this memo.

NO_x emissions in tons emitted over the life of the stockpiling activities (21.5 years) was calculated using the emission standards that the mine truck engines will be required to meet in 2011 as recommended in Table 1 of the EPA Regulatory Announcement F-04-032, May 2004 concerning Clean Air Non-Road Diesel Rule, provided in Appendix G of this memo. The factor used is 2.6 g/hp-hr. The method of determining the operating hours was previously discussed in Section 3.

Trucks proposed to be used to haul the stockpiled materials are Caterpillar 793D mine trucks which have a gross power rating of 2,415 hp. This horsepower rating is multiplied by the hours of use and the emission factor to determine the tons of NO_x emitted.

Greenhouse Gas (GHG) Emissions in tons were estimated from the following emission factors for a large mobile diesel engine, as provided by the Project Proposer in their Air Quality Emission Inventory.

- CO_2 22.38 lbs per gallon – CO_2 equivalency factor = 1
- CH_4 1.28 x 10^{-3} lbs per gallon – CO_2 equivalency factor = 25
- N_2O 5.73 x 10^{-4} lbs per gallon – CO_2 equivalency factor = 298

The proximity to the nearest residence was identified to take into account that not only is the amount of particulate generated a concern, but the location relative to prevailing winds and local residences is also a concern. The distance is a straight line from the approximate geometric center of the various options to the nearest residence on the westernmost edge of Kelly Lake.

Community Factors

Community factors taken into consideration are divided into two general topic areas: Noise and Visual Impacts. They are described in detail below.

<u>Noise</u>
A noise assessment was completed for the proposed stockpile locations and indicated a night time exceedance at the proposed stockpile location. The Project Proposer then evaluated mitigation measures such as a noise reduction package available from Caterpillar for the dozers used in the stockpile. The modeling indicates that the noise reduction package would still result in exceedance of the night time noise standards, so the Project Proposer would monitor the actual noise emitted at the compliance boundary and stay an appropriate distance away from the edges of the stockpiles during the nighttime hours to meet the noise standards. Appendix H of this memo contains a summary memo from the Project Proposer outlining the specific offset strategy.

<u>Visual Impacts</u>
There is no quantifiable means of identifying visual impacts of the stockpile locations to a given residence, so for the purposes of establishing a baseline comparison, ArcGIS software was used. The three dimension analyst extension tools Viewshed and Line of Sight were used for each concept. The software can identify specific features that can be seen along a specific line of sight. The software used a Digital Elevation Model (DEM) provided by MNDNR Division of Lands and Minerals for the base elevation data. The resident view point (Kelly Lake) was set to have an elevation of 10 feet higher than the base elevation and the stockpile concepts were set to have an elevation of 200 feet higher than the base elevation. The software simulates the line of sight from

the westernmost residence in Kelly Lake based on the DEM. This residence was chosen for the comparison baseline, as Kelly Lake is the area most likely to incur visual impacts of the proposed stockpile location.

Concept A and the proposed east stockpile locations are expected to be seen from the western edge of Kelly Lake. The proposed south stockpile area between the City of Keewatin and the mine pit is not addressed here, as there is an existing stockpile immediately adjacent to this proposed area with a similar visual impact to the residents in Keewatin.

Feasibility Factors

Several factors are considered to compare the actual feasibility of each concept. The factors compared include Space Considerations, Surface Ownership Control, Safety and Economics. The following sections give a description of each factor.

<u>Space Considerations</u>
Stockpile requirements identified in Section 3.0 are in excess of the maximum anticipated amount that the Project Proposer would be able to place in a combination of the existing stockpiles and in-pit stockpiling. Concept A and Concept B would not provide enough capacity to accommodate the stockpiling need and would require a combination of locations. Concept C and Concept D provide approximately equivalent area to the two proposed stockpile locations.

<u>Surface Ownership Control</u>
A review of available records provided by the Project Proposer indicates that the Project Proposer either owns or has leasing control of the surface property of all concepts with the exception of Concept D. The Project Proposer, Ontario Iron, and Hibbing Land Company all own portions of the land under consideration for Concept D.

<u>Safety</u>
Hauling safety concerns are identified. Due to the size and weight of the hauling vehicles used, it is not practical to provide engineered solutions to some of the potential safety issues. For example, in steep terrain in the western states, runaway ramps are provided on long steep (> 6 percent) grades. Runaway ramps are a safety feature such that if a semi truck (usually 40-50 tons) experiences brake failure or the transmission disengages causing the truck to freewheel, the driver can direct the truck to the runaway ramp. Runaway ramps are sloped upward at a significantly higher slope into a mountain/hill face and covered in loose gravel to provide a means of stopping the truck. The size and weight of a typical mine trucks (430 tons loaded weight) and the area/grade required would make a runaway ramp not practical.

Trafficking through the crusher area is also considered. The amount of traffic in and around the crusher area would pose a significant safety concern due to the limited amount of space between buildings, adjacent pit walls, and the number of trucks passing. Stockpile hauling vehicles would be passing through at a rate of approximately one truck every 8-10 minutes. In addition trucks delivering ore to the crusher area would occur at a higher frequency (every 2-3 minutes) if the target ore production rate is to be met. The addition of trucks passing through the crusher area to haul materials to the stockpiles poses safety issues for the Project Proposer that cannot be mitigated within the limits of the underlying need and purpose of the project.

The only concept evaluated that would not have safety issues related to hauling either through the crusher area or because of steep grades without runaway ramps are the proposed stockpile locations.

Economics
Each stockpile concept has an economic impact. Capital costs including annual capital for the haul trucks are detailed in Section 3.0. Road construction capital costs, road maintenance costs, and operational expenses are also detailed in Section 3.0. Applicable mitigation costs have also been included.

5.0 Consideration For Alternatives Analysis

A side by side analysis of the proposed stockpile location is found in the Evaluation Criteria Matrix in Appendix E of this memo. Section 5.0 of this memo provides a summary of the comparison of the stockpile locations within each criterion. Concept A has a land area that would accommodate approximately 11 percent of the total stockpile needs. For this reason Concept A is not presented as a single option within this section, it is combined with one of the remaining concepts or the proposed east stockpile location. Discussions of Concept A are presented as A/B, A/C, etc. representing that Concept A is being fully utilized and the remainder would be a fractional component of another concept.

Environmental Factors

As discussed in Section 4.0, environmental factors taken into consideration are further subdivided into two general topic areas: Natural Habitat and Air Quality. The results of the evaluation are summarized below.

Natural Habitat
Wetland acreages to be directly impacted for each concept (total, Artificial/Degraded, Natural) along with the upland acreage to be disturbed is summarized below in Table 2.

TABLE 2 – HABITAT AREA IMPACTS SUMMARY

Concept	Total Wetland Acreage	Artificial/Degraded Wetland Acreage	Natural Wetland Acreage	Upland Area Acreage
A/B	257.5	22.1	235.4	336
A/C	365.4	168.5	196.9	275.1
A/D	210.4	59.0	151.4	430.0
A/Proposed	352.0	266.3	85.8	288.3
B	204.1	24.9	179.2	282.4
C	325.4	189.5	135.9	213.9
D	151.1	66.4	84.7	388.2
Proposed	310.4	299.5	10.4	228.8

Concept D is the only location showing the presence of a Threatened, Protected, or Endangered Species (Peregrine Falcon).

Air Quality
Air quality considerations for this analysis consist of PM, NO_x , and GHG emissions, each of which are summarized below.

Emissions of PM, PM_{10}, and $PM_{2.5}$ are calculated in tons emitted, and are presented over the life of the stockpiling activities (21.5 years) and on an annual basis. The method of analysis is presented in Section 4.0 and the results of that analysis are presented in Table 3.

TABLE 3 – PARTICULATE EMISSIONS FOR EACH CONCEPT

Concept/Haul Route Option	PM Emissions (Tons)		PM_{10} Emissions (Tons)		$PM_{2.5}$ Emissions (Tons)	
	Over Project Life	*Annually*	*Over Project Life*	*Annually*	*Over Project Life*	*Annually*
B/1	97,064	4,515	25,693	1,195	2,569	119
B/2	76,056	3,537	20,132	936	2,013	94
C/1	109,512	5,094	28,988	1,348	2,899	135
C/2	100,661	4,682	26,645	1,239	2,665	124
D/1	85,438	3,974	22,616	1,052	2,262	105
D/2	66,673	3,101	17,649	821	1,765	82
Proposed-1	43,717	2,033	11,572	538	1,157	54
Proposed-2	63,360	2,947	16,772	780	1,677	78
A/B-1	93,856	4,365	24,844	1,156	2,484	116
A/B-2	75,163	3,496	19,896	925	1,990	93
A/C-1	104,933	4,881	27,776	1,292	2,778	129
A/C-2	97,057	4,514	25,692	1,195	2,569	119
A/D-1	83,511	3,884	22,106	1,028	2,211	103
A/D-2	66,814	3,108	17,686	823	1,769	82
A/Proposed-1	46,387	2,158	12,279	571	1,228	57
A/Proposed-2	63,866	2,971	16,906	786	1,691	79

NO_x emissions emitted over the life of the stockpiling activities (21.5 years) and annually are calculated as described in Section 4.0 and summarized in Table 4.

TABLE 4 – NO_X EMISSIONS FOR EACH CONCEPT

Concept	NOx Emissions for Haul Route 1 (Tons)		NOx Emissions for Haul Route 2 (Tons)	
	Over Project Life	*Annually*	*Over Project Life*	*Annually*
B	3,344	156	4,151	193
C	4,158	193	4,234	197
D	3,680	171	3,433	160
Proposed	1,693	79	2,014	94
A/B	3,264	152	3,981	185
A/C	3,988	185	4,055	189
A/D	3,562	166	3,342	155
A/Proposed	1,794	83	2,080	97

GHG emissions estimated as described in Section 4.0 are summarized in Table 5.

TABLE 5 – GHG EMISSIONS FOR EACH CONCEPT

Concept	GHG Emissions for Haul Route 1 (Tons)		GHG Emissions for Haul Route 2 (Tons)	
	Over Project Life	*Annually*	*Over Project Life*	*Annually*
B	254,251	11,826	322,703	15,009
C	322,703	15,009	322,703	15,009
D	279,676	13,008	262,196	12,195
Proposed	129,081	6,004	152,551	7,095
A/B	248,249	11,546	309,160	14,380
A/C	309,160	14,380	309,160	14,380
A/D	270,873	12,599	255,319	11,875
A/Proposed	136,869	6,366	157,753	7,337

As discussed in Section 4, Table 6 summarizes the distances from the stockpile center to Kelly Lake.

TABLE 6 – DISTANCE FROM STOCKPILE TO KELLY LAKE

Concept	Distance (miles)
A	0.7
B	4.0
C	5.2
D	3.6
Proposed	1.2

Community Factors

Community factors considered are further subdivided into two general topic areas: Noise and Visual Impacts. The results of the analysis for each topic are summarized in Section 5.0.

<u>Noise</u>
Applicable noise standards can be met at the proposed location with the appropriate offsets during night time operations; therefore, all locations in this analysis would meet the applicable standards.

<u>Visual Impacts</u>
The proposed stockpile location and any combination involving Concept A are the locations that are predicted to be visible from the western edge of Kelly Lake. This analysis indicates Concepts B, C, and D are not visible from Kelly Lake or Keewatin.

Feasibility Factors

Section 4.0 explains in detail the various factors that are considered to compare the actual feasibility of each concept. The factors compared include: Space Considerations, Surface Ownership Control, Safety and Economics. The following sections give a description of each factor.

<u>Space Considerations</u>
The proposed stockpile location, along with Concepts C and D, would meet the underlying capacity needs of the project. Concept B is within 10% of the capacity needs and could likely be configured, with some minor adjustments in the layout, to substantially serve the need. Concept A fulfills approximately 11% of the needed stockpile capacity.

Surface Ownership Control

The proposed stockpile location, Concept A, Concept B, and Concept C are under the ownership or lease control of the Project Proposer. Various other owners, including the Project Proposer, controls parcels within Concept D.

Safety

The proposed stockpile location would not present safety issues related to hauling of surface overburden material. Concepts A – D would present concerns related to haul truck driver safety.

Economics

The total costs calculated for the proposed stockpile location and all concepts indicate the proposed location will cost the Project Proposer approximately half of what the other concepts would cost.

Preliminary Screening of Concepts

In the following section, each concept is qualitatively compared to the proposed stockpile location. Previous information summarized in Section 5 and the Evaluation Criteria Matrices, Tables E-1 and E-2 in Appendix E of this memo provides the data supporting this comparison.

Concept A

Information gathered through this analysis shows Concept A would provide no net environmental benefit when compared to the proposed location. Due to the shape of this concept, spatial inefficiencies occur creating a greater acreage impact due to combining locations. In addition the railroad crossing would pose operational and construction issues. Concept A is estimated to result in an additional cost to the Project Proposer of $7 million to $136 million than for the proposed stockpile location. Based on these considerations, Concept A is not a viable alternative that will provide significant environmental benefit over the proposed stockpile location.

Concept B

Environmental Factors

Concept B would disturb fewer overall wetland acres than the proposed location. The air emissions related to hauling to the stockpiles make Concept B a less favorable concept than the proposed location.

Community Factors

From a noise and visual impact standpoint, Concept B is preferred to the proposed stockpile location due to an increased distance from the residents of Kelly Lake.

Feasibility Factors

Concept B would provide nearly enough stockpile capacity and is under the control of the Project Proposer. Concept B does pose additional safety issues related to hauling vehicles. Concept B is estimated to result in an additional cost to the Project Proposer of $90 million to $106 million than for the proposed stockpile location.

Summary

Concept B would have less of a visual impact, would disturb fewer overall wetlands but it would have a greater environmental impact to natural wetlands, air quality, safety, and to project economics. A more detailed comparison of Concept B to the proposed stockpile location is presented earlier in this memo.

Concept C

Environmental Factors
Concept C would result in the disturbance of approximately 125 additional acres of natural wetland when compared to the proposed stockpile location, while disturbing approximately 15 additional acres of wetlands in total. This concept would disturb approximately the same upland habitat acreage as the proposed stockpile location. The air emissions related to hauling to the stockpiles make Concept C a less favorable option than the proposed location.

Community Factors
From a noise and visual impact standpoint Concept C is preferred to the proposed stockpile location due to an increased distance from the residents of Kelly Lake.

Feasibility Factors
Concept C would provide enough stockpile capacity and is under the control of the Project Proposer. Concept C would pose additional safety issues related to hauling vehicles either passing through the crusher area or due to extended traveling distances, and longer, steeper slopes. Concept C is estimated to result in an additional cost to the Project Proposer of $117 million to $137 million than for the proposed stockpile location.

Summary
Concept C would have less of a visual impact, but it would have a greater environmental impact to natural wetlands, air quality, safety, and to project economics. Therefore it appears Concept C would not provide significant environmental benefit compared to the proposed stockpile location.

Concept D

Environmental Factors
Concept D would disturb approximately 74 additional acres of natural wetland and an additional 160 acres of upland habitat when compared to the proposed stockpile location. It would disturb approximately 160 fewer acres of wetlands in total. The air emissions related to hauling to the stockpiles make Concept D a less favorable option than the proposed location.

Community Factors
From a noise and visual impact standpoint Concept D is preferred to the proposed stockpile location due to an increased distance from the residents of Kelly Lake.

Feasibility Factors
Concept D would provide enough stockpile capacity, but a portion is not under the control of the Project Proposer, and would require additional land acquisition. Concept D would pose additional safety issues related to hauling vehicles. Concept D is estimated to result in an additional cost to the Project Proposer of $67 million to $102 million than for the proposed stockpile location.

Summary
Concept D provides less environmental impact regarding visual impacts, but it would have a greater environmental impact to natural wetlands, air quality, threatened and endangered species, safety, and to project economics. A more detailed comparison of Concept D compared to the proposed stockpile location is presented in Section 5.0 of this memo.

Conclusions of Preliminary Screening of Stockpile Location Concepts

Based on the preliminary screening discussed above, Concepts A and C have been eliminated from further discussion. Concept A would not provide enough capacity and Concept C would not provide a significant environmental benefit when looking at the combined effects of all factors considered in this analysis. The next sections of this memo present a more detailed comparison of the proposed stockpile location to Concept B and Concept D.

6.0 Detailed comparisons of the Proposed Stockpile Locations to Concepts B and D

An underlying theme for the proposed stockpile locations, Concept B and Concept D is mitigation of impacts. Mitigation measures and associated costs have been included in the economic analysis for those items that mitigation is viable and within the economics limitations of the Proposed Project. Mitigation strategies that would pose such a financial burden so as to make the mining of ore unprofitable have not been considered, because at that point, the definition of "ore" would not be met as described in Section 2 of this memo, and therefore, the underlying need and purpose of the project would not be met. Possible mitigation strategies for each criterion considered within this memo are discussed below.

Environmental Factors

Wetlands

Wetland mitigation costs have been estimated at $25,000 per acre and for the purposes of this analysis, the mitigation replacement ratio has been assumed to be 1:1.

Threatened, Endangered and Protected Species

Mitigation measures for threatened and endangered species are not considered, as the only species potentially impacted in any of the concepts is the peregrine falcon. Based on discussions with a wildlife biologist, peregrine falcon habitat near the site is not natural habitat, but it is the cliffs created from previous open pit mining activities and adjacent stockpile areas. Ultimately the development of the pit would provide even more manmade habitat as the peregrine falcon's natural habitat consists of areas with high steep bluffs.

Air Emissions

Potential mitigation measures for air emissions are reducing NO_x and GHG emissions related to fuel consumption of the hauling vehicles and reducing particulate emissions.

Community Factors

Noise

Noise mitigation costs are not considered, as the Project Proposer intends to ensure the noise standards are met by monitoring and then restricting operations as necessary.

Visual

There are no visual mitigation costs considered, as the visibility is related to the stockpile locations themselves. Potential visual screening methods, such as barrier walls would simply add another impediment to current sightlines.

Feasibility Factors

Surface and Mineral Rights Ownership
There are no mitigation measures available for land or mineral rights ownership. These agreements have historically taken years, even decades to negotiate and execute, and the terms and costs associated with them are unpredictable.

Safety
There are two potential measures to mitigate the safety concerns with some of the traffic routes. The first would require the relocation of the crushers and ancillary equipment to accommodate additional traffic flow in these areas that would occur with Concept B, Route 1 and Concept D, Route 1.The second would require re-configuration of the alternate haul roads associated with Concept B, Route 2 and Concept D, Route 2, to add either switchbacks or level plateaus to avoid the long straight downhill stretches. Figures SA-9 and SA-10 depict the current and anticipated traffic patterns in and around the crusher area. Steep pit walls exist and would continue to exist and are identified on the figures. The trucks moving into this area hauling ore would be at a frequency of 1 truck every 2-3 minutes, and the addition of the trucks hauling materials to the stockpiles would result in additional trucks every 8 to 10 minutes.

It should be noted that even if the fueling station were moved, this would not allow more space for truck traffic, as current safety procedures preclude trucks from trafficking in this area, due to the potential issues related to traveling adjacent to the steep pit walls.

To further complicate matters of excessive traffic in the crusher area, the truck drivers have a much smaller field of vision than the driver of a typical passenger vehicle, even with mirrors. Figure SA-11 presents a depiction of the mine haul truck driver's field of vision, and identifies areas with no visibility (blind zones) or reduced visibility (inability to see passenger vehicle sized objects).

The addition of switchbacks would not necessarily be a safety enhancement, as even with the outer safety berm that is constructed on haul roads, there are safety concerns with a loaded truck going downhill and navigating multiple switchback turns. The addition of switchbacks or plateaus would ultimately lengthen the road, and it has been demonstrated earlier in this memo that the additional air quality concerns related to particulate, NO_X and GHG emissions are directly proportional to the length of the haul roads.

Comparison of Concept B to the Proposed Stockpile Location

Table 7 presents a side by side summary of the impacts of the proposed stockpile location and Concept B, and summarizes the magnitude of the difference for each of the criteria evaluated.

Table 7– Proposed Stockpile/Concept B Comparison

CRITERIA (all values represent impacts over the stockpiling duration of 21.5 years)			Proposed Location		Concept B		Change		Change from Proposed as %	
			Haul Route		Haul Route		Haul Route		Haul Route	
			1	2	1	2	1	2	1	2
Environmental Factors										
Habitat										
Wetland Acreage Disturbed		Acres	310.4		204.1		-106.3		-34%	
Artificial/Degraded Wetland Acreage		Acres	299.5		24.9		-274.6		-92%	
Natural Wetland Acreage		Acres	10.4		179.2		168.8		1623%	
Upland		Acres	228.8		282.4		53.6		23%	
Rare Species			None Identified		None Identified		-		-	
Air Quality										
Fugitive Dust Emissions	PM	Tons	43,717	63,360	97,064	76,056	53,347	12,696	122%	20%
	PM10	Tons	11,572	16,772	25,693	20,132	14,121	3,360	122%	20%
	PM2.5	Tons	1,157	1,677	2,569	2,013	1,412	336	122%	20%
NOx Emissions		Tons	1,693	2,014	3,344	4,151	1,651	2,137	98%	106%
GHG Emissions		Tons	129,081	152,551	254,251	322,703	125,170	170,152	97%	112%
Proximity to Residence		Miles	1.2 and meets AAQ Standards		4.0		-		-	
Community Factors										
Noise										
Threshold Exceedences		Y/N	NO (w/ Mitigation)		NO		-		-	
Proximity to Residence		Miles	1.2		4		-		-	
Visual										
Seen by Residences		Y/N	Yes		NO		-		-	
Feasibility Factors										
Capacity Based on Spatial Considerations		%	26.20%		25.70%		-0.50%		-2%	
Surface Ownership Control			US Steel		US Steel		-		-	
Safety			-	-	See text	See text	-	-	-	-
Economics	Capital Expense	$M	$22.8	$27.2	$45.1	$56.4	$22.3	$29.2	98%	107%
	Operational Expenses	$M	$70	$85	$140	$165	$70.0	$80.0	100%	94%
	Mitigation Expenses	$M	$7.8	$7.8	$5.1	$5.1	-$2.7	-$2.7	-35%	-35%
	Total	$M	$100.4	$120.2	$190.2	$226.4	$89.8	$106.2	89%	88%

Summary of Comparison of Concept B with Proposed Stockpile Location

Environmental factors

Wetlands
Concept B would result in the disturbance of approximately 169 additional acres of natural wetland and an additional 54 acres of upland habitat. It would disturb approximately 106 fewer acres of wetland, but the overall value of the wetlands it would impact is greater than that of the proposed stockpile location because of the acreage of natural wetland disturbance. Concept B would impact less overall wetland acreage, however it would disturb more (approximately 16 times) acreage of natural wetlands.

Air Quality
Concept B, Route 1 would result in approximately double the amount of particulate, NO_x, and GHG emissions. Concept B, Route 2 would result in a 20% increase in particulate emissions and again nearly double the NO_x and GHG emissions.

Community factors

Noise
Concept B would not offer a substantial improvement in noise, as the noise standards would be met with the proposed stockpile locations.

Visibility
Concept B would be less visible, as it is three to four times farther away as the proposed stockpile locations, however the regional landscape is dotted with stockpiles from previous and currently active mining activities.

Feasibility factors

Capacity
Concept B could be configured to provide the anticipated necessary capacity.

Surface Ownership
The land within Concept B is owned by the Project Proposer.

Safety
Concept B would pose additional safety issues related to hauling vehicles, due to the need to either pass through the crusher area (Route 1) or the length and grade of the roads if the alternate route identified (Route 2) was used.

Economics
Concept B is estimated to result in an additional cost to the Project Proposer of $90 million to $106 million in comparison to the proposed stockpile location. This results in approximately doubling the economic impact of the stockpile and related haulage activities.

Comparison of Concept D to the Proposed Stockpile Location

Table 8 presents a side by side summary of the impacts of the proposed alternative and Concept D, and summarizes the magnitude of the differences for each of the major criteria evaluated herein.

Table 8 – Proposed Stockpile/Concept D Comparison

CRITERIA (all values represent impacts over the stockpiling duration of 21.5 years)			Proposed Location		Concept D		Change		Change from Proposed as %	
			Haul Route		Haul Route		Haul Route		Haul Route	
			1	2	1	2	1	2	1	2
Environmental Factors										
Habitat										
Wetland Acreage Disturbed		Acres	310.4		151.1		-159.3		-51%	
Artificial/Degraded Wetland Acreage		Acres	299.5		66.4		-233.1		-78%	
Natural Wetland Acreage		Acres	10.4		84.7		74.3		714%	
Upland		Acres	228.8		388.2		159.4		70%	
Rare Species			None Identified		Peregrine Falcon		-		-	
Air Quality										
Fugitive Dust Emissions	PM	Tons	43,717	63,360	85,438	66,673	41,721	3,313	95%	5%
	PM10	Tons	11,572	16,772	22,616	17,649	11,044	877	95%	5%
	PM2.5	Tons	1,157	1,677	2,262	1,765	1,105	88	96%	5%
NOx Emissions		Tons	1,693	2,014	3,680	3,433	1,987	1,419	117%	70%
GHG Emissions		Tons	129,081	152,551	279,676	262,196	150,595	109,645	117%	72%
Proximity to Residence		Miles	1.2 and meets AAQ Standards		3.6		-		-	
Community Factors										
Noise										
Threshold Exceedences		Y/N	NO (w/ Mitigation)		NO		-		-	
Proximity to Residence		Miles	1.2		3.6		-		-	
Visual										
Seen by Residences		Y/N	Yes		NO		-		-	
Feasibility Factors										
Capacity Based on Spatial Considerations		%	26.20%		25.70%		-0.50%		-2%	
Surface Ownership Control			US Steel		GNIOP and Hibbtac		-		-	
Safety			-	-	See text	See text	-	-	-	-
Economics	Capital Expense	$M	$22.8	$27.2	$49.2	$45.9	$26.4	$18.7	116%	69%
	Operational Expenses	$M	$70	$85	$150	$137	$80.0	$52.0	114%	61%
	Mitigation Expenses	$M	$7.8	$7.8	$3.8	$3.8	-$4.0	-$4.0	-51%	-51%
	Total	$M	$100.4	$120.2	$202.8	$186.8	$102.4	$66.6	102%	55%

Summary of Comparison of Concept D with Proposed Stockpile Location

Environmental factors

Wetlands
Concept D would result in the disturbance of approximately 74 additional acres of natural wetland and an additional 160 acres of upland habitat when compared to the proposed stockpile location. It would disturb approximately 160 fewer acres of wetlands, but the overall value of the wetlands it impacts is greater than that of the proposed stockpile location because of the natural wetland disturbance. Concept D would impact less overall wetland acreage; however, it would disturb approximately seven times the acreage of natural wetlands.

Air Quality
Concept D, Route 1 would result in approximately double the particulate, NO_x, and GHG emissions. Concept D, Route 2 would result in a 5% increase in particulate emissions and approximately a 75% increase to the NO_x, and GHG emissions

Community factors

Noise
Concept D would not offer a substantial improvement in noise, as the noise standards would be met with the Proposed Stockpile Locations.

Visibility
Concept D would be less visible, as it is approximately three times farther away than the proposed stockpile locations; however, the regional landscape is dotted with stockpiles from previous and currently active mining activities.

Feasibility factors

Capacity
Concept D would provide enough stockpile capacity, but a portion of the Concept D area is not under the control of the Project Proposer.

Surface Ownership
The land within Concept D is not entirely owned by the Project Proposer. There are parcels of land in this area that would need to be acquired. This would require additional land acquisition, and it is unknown if this land is available for acquisition. Given the uncertainties with this acquisition, it is difficult for the Project Proposer to proceed with the assumption that this land would be available when needed.

Safety
Concept D would pose additional safety issues related to hauling vehicles due to the need to either pass through the crusher area (Route 1) or the length and grade of the roads if the alternate route identified (Route 2) was used.

Economics
Concept D is estimated to result in an additional cost to the Project Proposer of $67 million to $102 million in comparison to the proposed stockpile location. This would result in adding at least 55% additional cost to the economic impact of the stockpile and related haulage activities.

Relative Importance of Factors Used in This Analysis

There are several potential impacts of the various stockpile locations discussed within this memo. Concepts could have a greater impact in one area and a lesser impact in another. For this reason, the relative importance of the factors discussed is important to the decision making process.

Environmental Factors

Two environmental issues that change, due to the selection of the stockpiling location, are wetlands and air quality related impacts.

In order to gain a perspective of the relative impact of the stockpiling activities, within the context of the overall Proposed Project, tables (Table 9-11) were created that summarize impacts. These tables provide information on the proposed stockpiles, Concept B, and Concept D, comparing them to the anticipated impacts of the entire Proposed Project wetland impacts and air quality.

<u>Wetlands</u>
When considering the function of impacted wetlands, two important factors in the wetland impacts are total acreage impacted (including artificial/degraded and natural wetlands) and the acreage of natural wetlands impacted. Natural wetland impacts must be considered in comparing total acreage and could arguably be considered of greater importance. Table 9 summarizes the relative wetland impacts within the scope of the entire project.

Table 9 - Wetland Disturbance Summary

Project	Total Wetlands Disturbed		Artificial/Degraded Wetlands Disturbed		Natural Wetlands Disturbed	
	Acres	% of Entire Project	Acres	% of Entire Project	Acres	% of Entire Project
Total Project	780.8	100%	679.2	100%	101.6	100%
Proposed Stockpile Locations	310.4	40%	299.5	44%	10.4	10%
Concept B	204.1	26%	24.9	4%	179.2	176%
Concept D	151.1	19%	66.4	10%	84.7	83%

Table 9 illustrates that the proposed stockpile locations would disturb 40% of the entire Proposed Project's wetland disturbance area and 10% of the natural wetland disturbance of the entire Proposed Project. The proposed stockpile locations would disturb 44% of the entire projects anticipated disturbance to artificial/degraded wetlands, most of which are located adjacent to existing stockpiles and have been artificially created or degraded by previous mining related activities.

<u>Air Quality</u>
While the entire project has other air quality considerations, the stockpile analysis has focused on particulate, NO_x and GHG emissions. Table 10 summarizes the relative impacts of changes to particulate emissions. Table 11 summarizes the relative impacts of the stockpile concept changes to NO_x and GHG emissions.

Table 10 - Particulate Emission Project Summary

Project	Route	Emissions					
		PM		PM_{10}		$PM_{2.5}$	
		Tons per Year	% of Entire Project	Tons per Year	% of Entire Project	Tons per Year	% of Entire Project
Total Project		9,706	100%	3,358	100%	812	100%
Proposed Stockpile Locations	1	2,033	21%	538	16%	54	7%
	2	2,947	30%	780	23%	78	10%
Concept B	1	4,515	47%	1,195	36%	119	15%
	2	3,537	36%	936	28%	94	12%
Concept D	1	3,974	41%	1,052	31%	105	13%
	2	3,101	32%	821	24%	82	10%

Table 10 shows the relative contributions of the particulate emissions for the stockpile locations result in approximately 10 to 45 percent of the total particulate emissions of the project. This table also illustrates that a greater percentage is realized when considering Concept B or D in relation to the proposed stockpile location.

Table 11 - NO_x and GHG Emission Project Summary

Project	Route	Emissions					
		NO_x		GHG (Direct Only) Alt 1 (No Reductions)		GHG (Direct Only) Alt 2 (With Reductions)	
		Tons per Year	% of Entire Project	Tons per Year	% of Entire Project	Tons per Year	% of Entire Project
Total Project		9,923	100%	264,700	100%	188,500	100%
Proposed Stockpile Locations	Route 1	79	1%	6,004	2%	6,004	3%
	Route 2	94	1%	7,095	3%	7,095	4%
Concept B	Route 1	156	2%	11,826	4%	11,826	6%
	Route 2	193	2%	15,009	6%	15,009	8%
Concept D	Route 1	171	2%	13,008	5%	13,008	7%
	Route 2	160	2%	12,195	5%	12,195	6%

Table 11 shows that the relative contributions of NO_x and GHG emissions are minor in relation to the overall project, but do increase when comparing Concept B and D to the Proposed Stockpile Location.

Community Factors

Community factors do not appear to have a substantial bearing on the results of comparing the different concepts, since noise standards would be met and the regional landscape is dotted with stockpiles from previous and current mining activities.

Feasibility Factors

Land/Mineral right ownership, safety and economics are factors that should be considered in comparing the stockpile locations.

<u>Land/Mineral Rights Ownership</u>
The land for Concept B is under the ownership of the Project Proposer. Land would need to be acquired in order to implement Concept D. The feasibility of acquiring this land is unknown, since it is owned by another mining entity.

<u>Safety</u>
The relative importance of safety must be considered, since feasible mitigation in relation to haul road design and congestion of trucks within the fueling island and around the crusher are not easily implemented or reasonably viable.

<u>Economics</u>
Relative economic impacts must also be considered, since if the economic impacts are too great the beneficiation of ore is no longer economically feasible and therefore the underlying purpose and need of the project is no longer met.

Factors of Greater and Lesser Importance

Based on tables 9-11 and discussion contained within this section, most of the criteria used in the comparison of the proposed stockpile location to Concept B and Concept D have been placed into the following two categories: Factors of Greater Importance and Factors of Lesser Importance.

Some of the criteria have been removed for further consideration in this analysis because either their impacts are equal (or nearly equal) among the proposed stockpile locations (Concept B and Concept D) or their impacts are negligible compared to the magnitude of the potential impacts of the overall project or other factors considered in this analysis.

Table 12 summarizes the various factors and their relative levels of importance within the scope of the entire project.

Table 12 - Summary of Factors of Importance

		Factors of Greater Importance	Factors of Lesser Importance	Comment
Habitat	Total Acreage Disturbed	X		Viable mitigation strategy available
	Artificial/Degraded Wetland Acreage Disturbed		X	Viable mitigation strategy available
	Natural Wetland Acreage Disturbed	X		Viable mitigation strategy available
	Upland Acreage Disturbed		X	
	Threatened, Endangered and Protected Species		X	All concepts are deemed equivalent
Air Quality	Particulate Emissions	X		No viable mitigation strategy available
	NO_x Emissions		X	No viable mitigation strategy available
	GHG Emissions		X	No viable mitigation strategy available
	Proximity to Residence		X	AAQ Standards can be met in all concepts
Noise			X	Noise Standards can be met in all concepts
Surface Ownership		X		No dependable mitigation strategy available
Safety		X		No viable mitigation strategy available
Economics		X		

7.0 Factors of Greater Importance

The identified factors of relative greater importance, total wetland disturbance, natural wetlands disturbance, particulate emissions, surface ownership, safety, and economics are carried forward. The preferred order of the proposed stockpile location and Concepts B and D are illustrated below for each of these factors, mitigation opportunities for each factor are also discussed.

<u>Total Wetlands Disturbed</u>

The preferred order of concept selection based solely on disturbed total wetland acreage would be:

1. Concept D — 151.1 Disturbed Acres
2. Concept B — 204.1 Disturbed Acres
3. Proposed Stockpile Location — 310.4 Disturbed Acres

Natural Wetlands Disturbed

The preferred order of concept selection based solely on natural wetland total acreage would be:

1. Proposed Stockpile Location	10.4 Disturbed Natural Wetland Acres
2. Concept D	84.1 Disturbed Natural Wetland Acres
3. Concept B	179.2 Disturbed Natural Wetland Acres

Particulate Emissions

The preferred order of concept selection based solely on particulate emissions would be:

1. Proposed Stockpile Location	2,000 – 3,000 tpy (PM), 540-780 tpy (PM2.5), 55-80 tpy (PM10)
2. Concept D	3,100 – 4,000 tpy (PM), 820-1,050 tpy (PM2.5), 80-105 tpy (PM10)
3. Concept B	3,500 – 5,500 tpy (PM), 940-1,200 tpy (PM2.5), 95-120 tpy (PM10)

Surface Ownership

The preferred order of concept selection based solely on surface ownership would be:

1. Proposed Stockpile Location and Concept B	Under ownership control
2. Concept D	Not entirely under ownership control

Safety

The preferred order of concept selection based solely on safety would be:

1. The Proposed Stockpile Location	Fewer safety concerns
2. Concept B or Concept D	Additional safety concerns due to hauling location and routes

Economics

The preferred order of concept selection based solely on economics would be:

1. Proposed Stockpile Location	$100M-$120M
2. Concept D	$187M-$203M
3. Concept B	$190M-$226M

Mitigation for Factors of Greater Importance

Total and Natural Wetlands Disturbance

All wetlands impacts can be mitigated and would be mitigated under the Project Proposer's current proposal. A cost of $25,000 per acre was included in the economic analysis and assumes a 1:1 mitigation ratio.

Particulate Emissions

A means of reducing the annual particulate emissions is to reduce production, as it has been demonstrated that the particulate emissions are directly proportional to the haul vehicle miles traveled to the stockpiles. This would however not likely reduce the total air emissions over the life of the project, since the duration of the project would likely need to be extended in order to meet the underlying purpose and need of the project.

Surface Ownership

The proposed stockpile location and Concept B essentially do not require additional actions since they are under the ownership of the Project Proposer. Mitigating the risk of the property needed for Concept D is uncertain, because a portion of the land necessary under that concept is outside the ownership of the Project Proposer.

Safety

It is difficult to provide engineered solutions to some of the potential safety issues. The size and weight of a typical mine truck (430 tons loaded weight) and the area and grade required for their use limit mitigation options.

Economics
Mitigation options related to economics are reducing haul distances and changes in grade to the greatest extent possible.

8.0 Conclusions

Proposed Stockpile Location vs. Concept B
Of the factors of greatest importance, the proposed stockpile location is preferable over Concept B in the following areas: amount of natural wetlands disturbed, particulate emissions, safety and economics. Concept B is preferred over the proposed stockpile location in total wetlands disturbed. The proposed stockpile location and Concept B are preferred equally under the factor of surface ownership since land related to these alternatives is under the control of the Project Proposer.

Proposed Stockpile Location vs. Concept D
Of the factors of greatest importance, the proposed stockpile location is preferable over Concept D in the following areas: amount of natural wetlands disturbed, particulate emissions, surface ownership, safety and economics. Concept D is preferred over the proposed stockpile location in total wetlands disturbed.

Table 13 illustrates were the different stockpile concepts fall in relation to each other and the factors of greater importance

Table 13 - Stockpile Concepts and Factors of Greater Importance

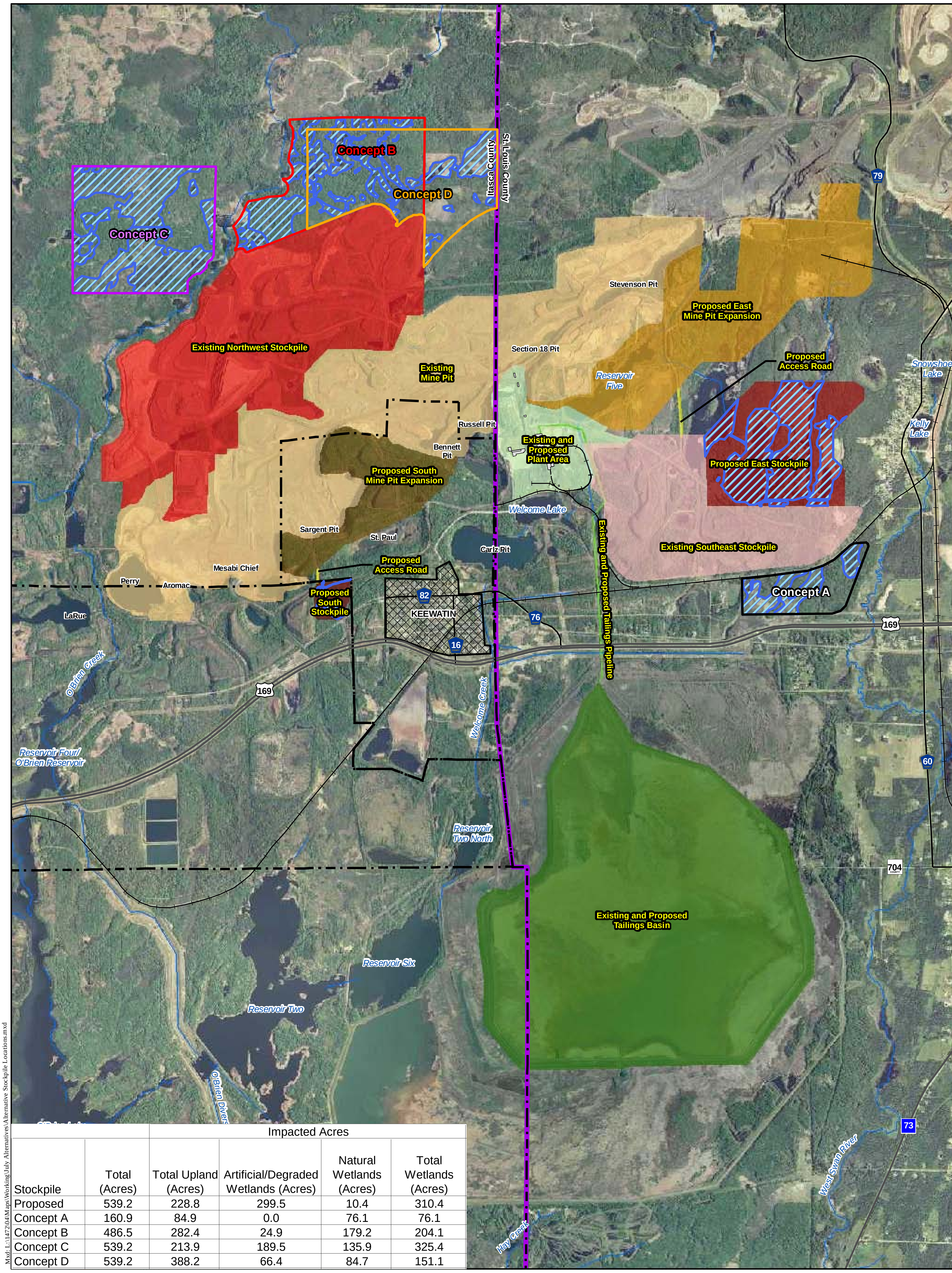
Concepts	Total Wetlands Disturbed	Natural Wetlands Disturbed	Particulate Emissions	Surface Ownership	Safety	Economics
Proposed Stockpile Location		Preferred Concept	Preferred Concept	Preferred Concept	Preferred Concept	Preferred Concept
Concept B				Preferred Concept		
Concept D	Preferred Concept					

Concept B and D would not provide an environmental benefit over the proposed stockpile location. Based on these results, this Alternative Stockpile Location Analysis did not identify a reasonable or practicable alternative to the proposed stockpile location that should be carried forward in the EIS.

FIGURES

APPENDICES

Figures



Stockpile	Total (Acres)	Total Upland (Acres)	Artificial/Degraded Wetlands (Acres)	Natural Wetlands (Acres)	Total Wetlands (Acres)
		Impacted Acres			
Proposed	539.2	228.8	299.5	10.4	310.4
Concept A	160.9	84.9	0.0	76.1	76.1
Concept B	486.5	282.4	24.9	179.2	204.1
Concept C	539.2	213.9	189.5	135.9	325.4
Concept D	539.2	388.2	66.4	84.7	151.1

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Legend

Project Areas
- Additional Stockpile East
- PTM Stockpile Limit
- Existing Northwest Stockpile
- Proposed South Stockpile
- Proposed Stockpile Roads
- Existing Mine Pit
- Proposed East Mine Pit Expansion
- Proposed South Mine Pit Expansion
- Plant Area
- Tailings Basin
- Tailings Pipeline

- Streams

Conceptual Stockpile Locations
- Concept A
- Concept B
- Concept C
- Concept D
- Proposed/Conceptual Stockpile Alternative Wetland Impacts
- Railroad
- City Boundary
- Keewatin Urban Development
- County Boundary

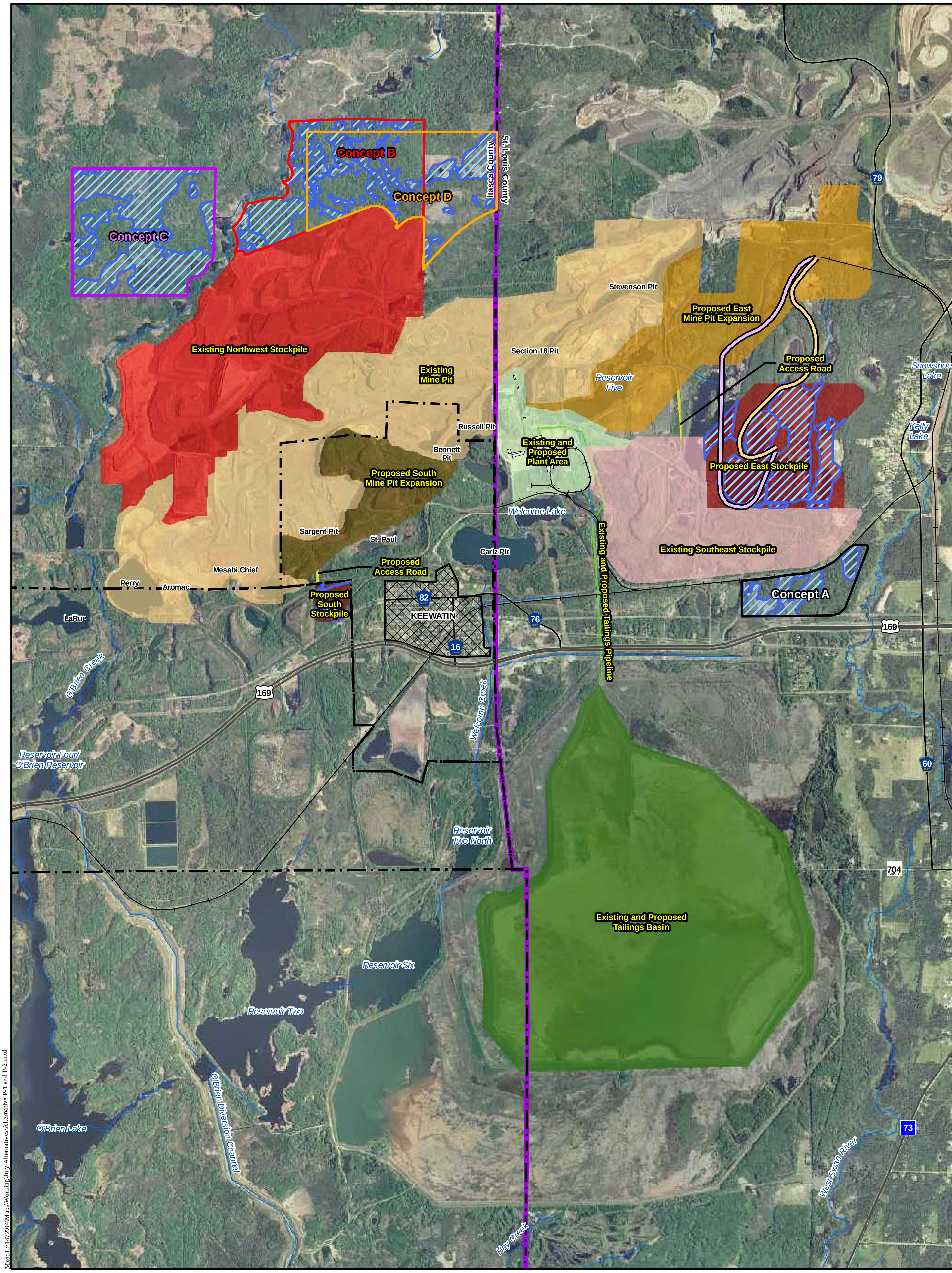
N

0.5 0 0.5 1
Miles

Source: USGS, Barr, LMIC, MNDNR, MPCA, Itasca County, St. Louis County, City of Hibbing, City of Nashwauk, U.S. Steel, and Mn/DOT. 2008 Aerial Photograph

Figure SA-1
Concept Stockpile Locations
U.S. Steel Keetac
Keewatin, MN

Minnesota DEPARTMENT OF NATURAL RESOURCES



Legend

Project Areas
- Additional Stockpile East
- PTM Stockpile Limit
- Existing Northwest Stockpile
- Proposed South Stockpile
- Proposed Stockpile Roads
- Existing Mine Pit
- Proposed East Mine Pit Expansion
- Proposed South Mine Pit Expansion
- Plant Area
- Tailings Basin
- Tailings Pipeline
- Streams
- City Boundary
- Keewatin Urban Development

County Boundary

Conceptual Stockpile Locations
- Concept A
- Concept B
- Concept C
- Concept D
- Proposed/Conceptual Stockpile Alternative Wetland Impacts

Alternative Stockpile Haul Route Options

Option
- P-1
- P-2
- Railroad

N

0.5 0 0.5 1

Miles

Source: USGS, Barr, LMIC, MNDNR, MPCA, Itasca County, St. Louis County, City of Hibbing, City of Nashwauk, U.S. Steel, and Mn/DOT. 2008 Aerial Photograph

Figure SA-2
Concept P-1 and P-2
U.S. Steel Keetac
Keewatin, MN

Minnesota DEPARTMENT OF NATURAL RESOURCES

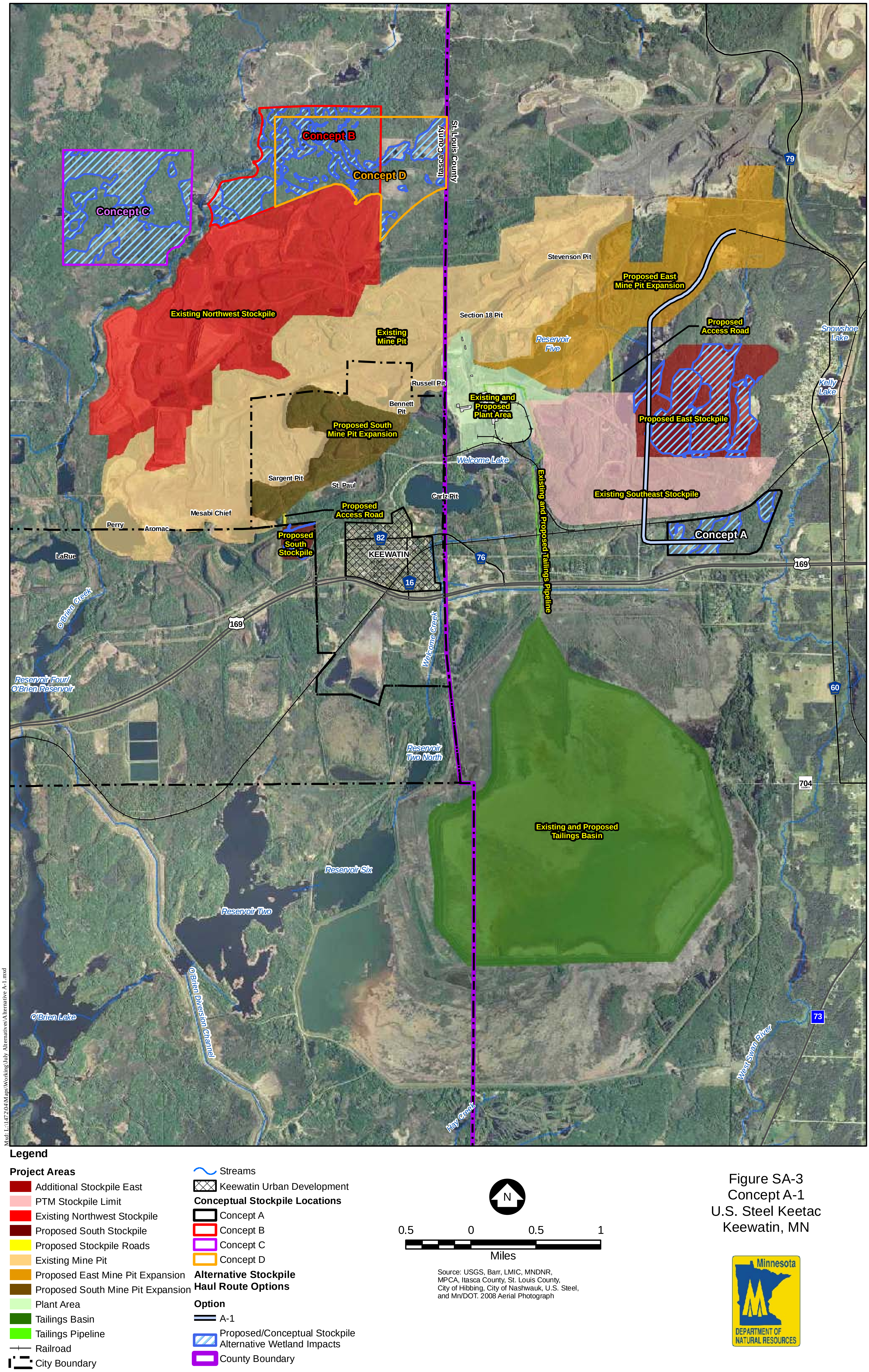
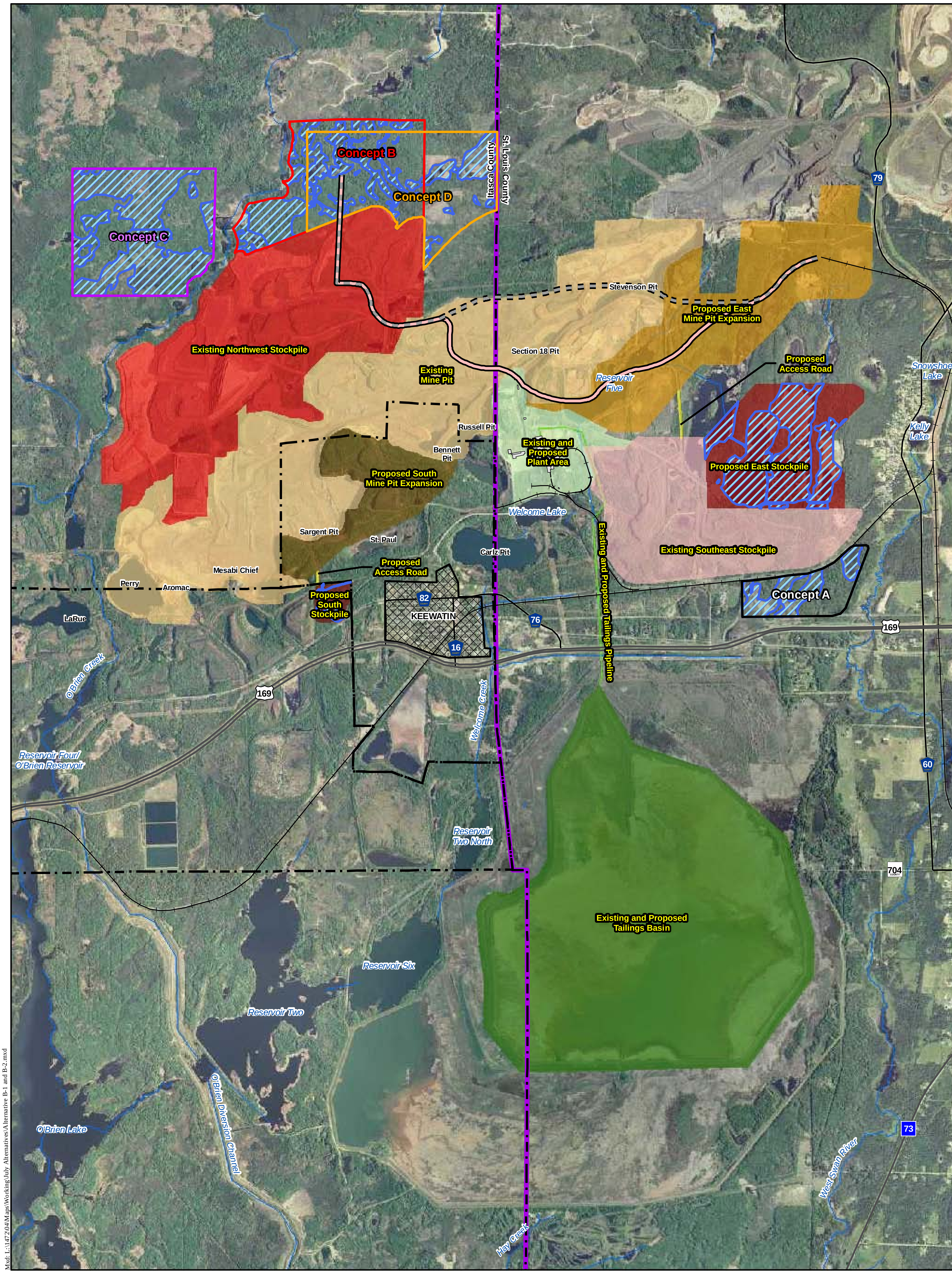


Figure SA-3
Concept A-1
U.S. Steel Keetac
Keewatin, MN

Minnesota Department of Natural Resources



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Legend

Project Areas
- Additional Stockpile East
- PTM Stockpile Limit
- Existing Northwest Stockpile
- Proposed South Stockpile
- Proposed Stockpile Roads
- Existing Mine Pit
- Proposed East Mine Pit Expansion
- Proposed South Mine Pit Expansion
- Plant Area
- Tailings Basin
- Tailings Pipeline
- Streams
- Railroad

- City Boundary
- Keewatin Urban Development
- County Boundary

Conceptual Stockpile Locations
- Concept A
- Concept B
- Concept C
- Concept D
- Proposed/Conceptual Stockpile Alternative Wetland Impacts

Alternative Stockpile Haul Route Options
- B-1
- B-2

N

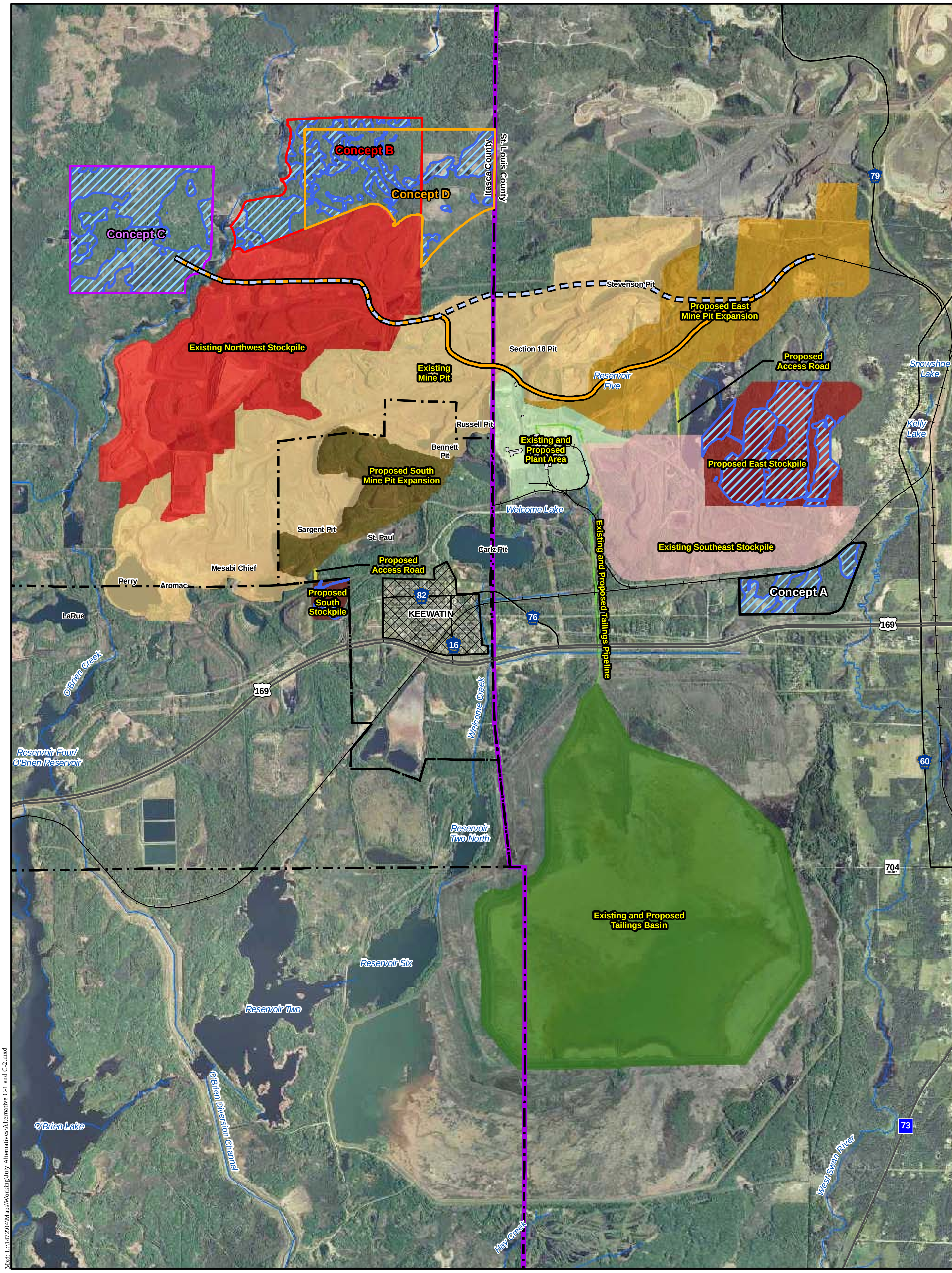
0.5 0 0.5 1

Miles

Source: USGS, Barr, LMIC, MNDNR, MPCA, Itasca County, St. Louis County, City of Hibbing, City of Nashwauk, U.S. Steel, and Mn/DOT. 2008 Aerial Photograph

Figure SA-4
Concept B-1 and B-2
U.S. Steel Keetac
Keewatin, MN

Minnesota Department of Natural Resources



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Legend

Project Areas

- Additional Stockpile East
- PTM Stockpile Limit
- Existing Northwest Stockpile
- Proposed South Stockpile
- Proposed Stockpile Roads
- Existing Mine Pit
- Proposed East Mine Pit Expansion
- Proposed South Mine Pit Expansion
- Plant Area
- Tailings Basin
- Tailings Pipeline
- Streams
- Railroad

- City Boundary
- Keewatin Urban Development
- County Boundary

Conceptual Stockpile Locations

- Concept A
- Concept B
- Concept C
- Concept D

Alternative Stockpile Haul Route Options

Option

- C-1
- C-2
- Proposed/Conceptual Stockpile Alternative Wetland Impacts

N

0.5 0 0.5 1

Miles

Source: USGS, Barr, LMIC, MNDNR, MPCA, Itasca County, St. Louis County, City of Hibbing, City of Nashwauk, U.S. Steel, and Mn/DOT. 2008 Aerial Photograph

Figure SA-5
Concept C-1 and C-2
U.S. Steel Keetac
Keewatin, MN

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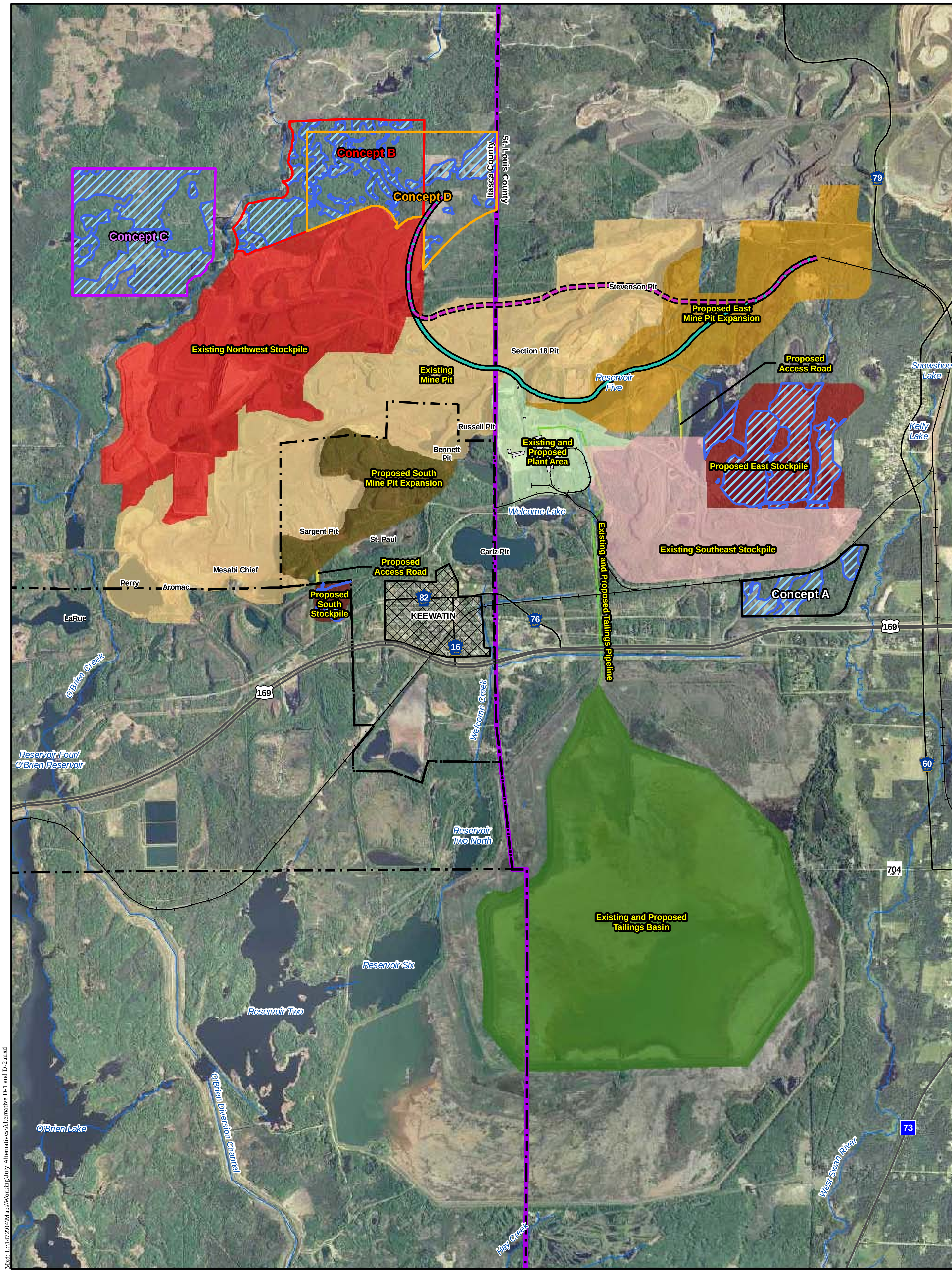

Legend

Project Areas
- Additional Stockpile East
- PTM Stockpile Limit
- Existing Northwest Stockpile
- Proposed South Stockpile
- Proposed Stockpile Roads
- Existing Mine Pit
- Proposed East Mine Pit Expansion
- Proposed South Mine Pit Expansion
- Plant Area
- Tailings Basin
- Tailings Pipeline
- Streams
- Railroad

- City Boundary
- Keewatin Urban Development
- County Boundary

Conceptual Stockpile Locations
- Concept A
- Concept B
- Concept C
- Concept D

Alternative Stockpile Haul Route Options

Option
- D-1
- D-2
- Proposed/Conceptual Stockpile Alternative Wetland Impacts

N

0.5 0 0.5 1

Miles

Source: USGS, Barr, LMIC, MNDNR, MPCA, Itasca County, St. Louis County, City of Hibbing, City of Nashwauk, U.S. Steel, and Mn/DOT. 2008 Aerial Photograph

Figure SA-6
Concept D-1 and D-2
U.S. Steel Keetac
Keewatin, MN

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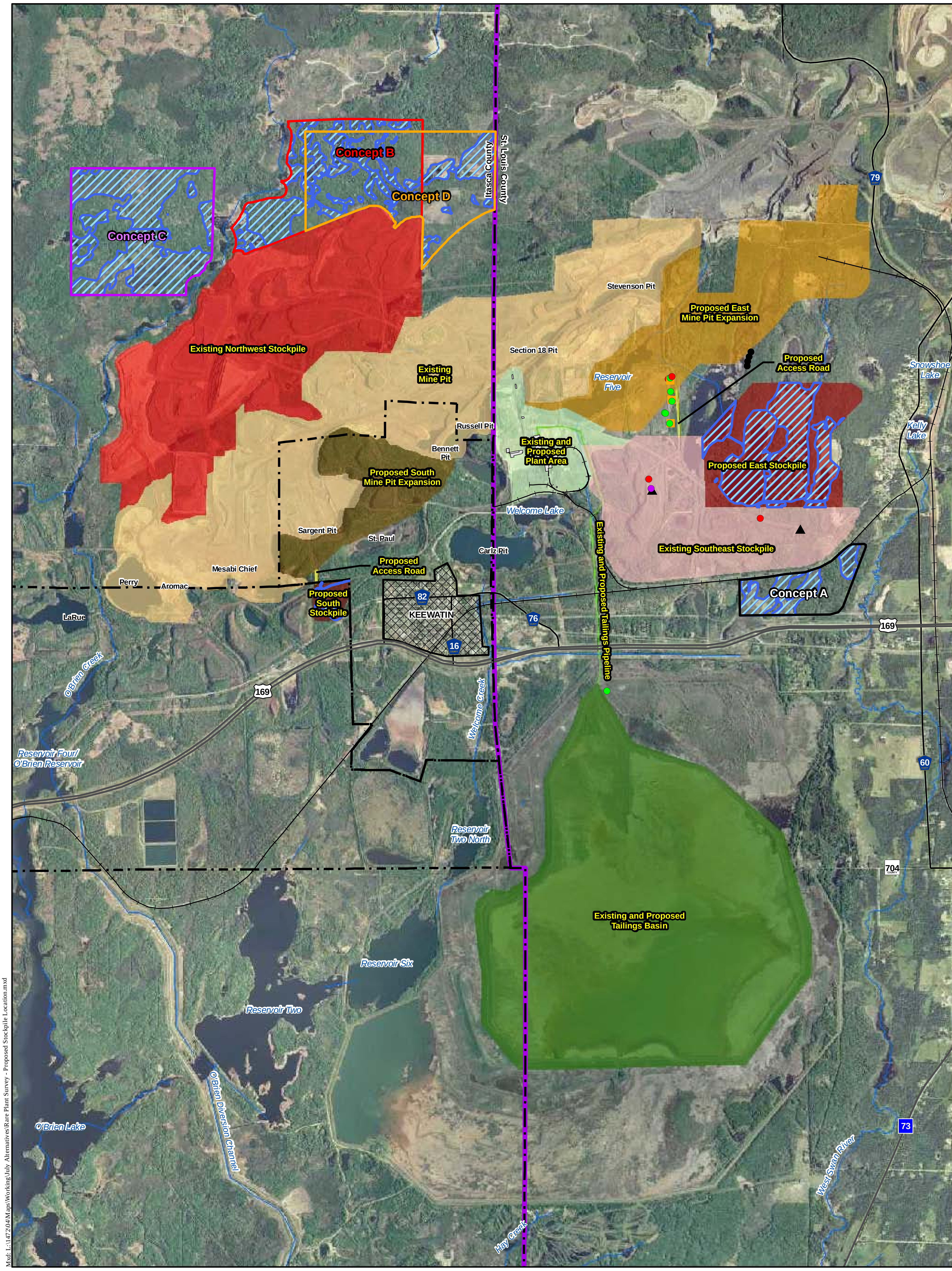

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Legend

Project Areas

- Additional Stockpile East
- PTM Stockpile Limit
- Existing Northwest Stockpile
- Proposed South Stockpile
- Proposed Stockpile Roads
- Existing Mine Pit
- Proposed East Mine Pit Expansion
- Proposed South Mine Pit Expansion
- Plant Area
- Tailings Basin
- Tailings Pipeline
- Streams
- Railroad
- City Boundary
- Keewatin Urban Development

- County Boundary

Conceptual Stockpile Locations

- Concept A
- Concept B
- Concept C
- Concept D
- Proposed/Conceptual Stockpile Alternative Wetland Impacts

Listed Species Locations

Species

- Botrychium ascendens
- Botrychium multifidum
- Botrychium pallidum
- Botrychium rugulosum
- Botrychium spp.
- Sparganium glomeratum

N

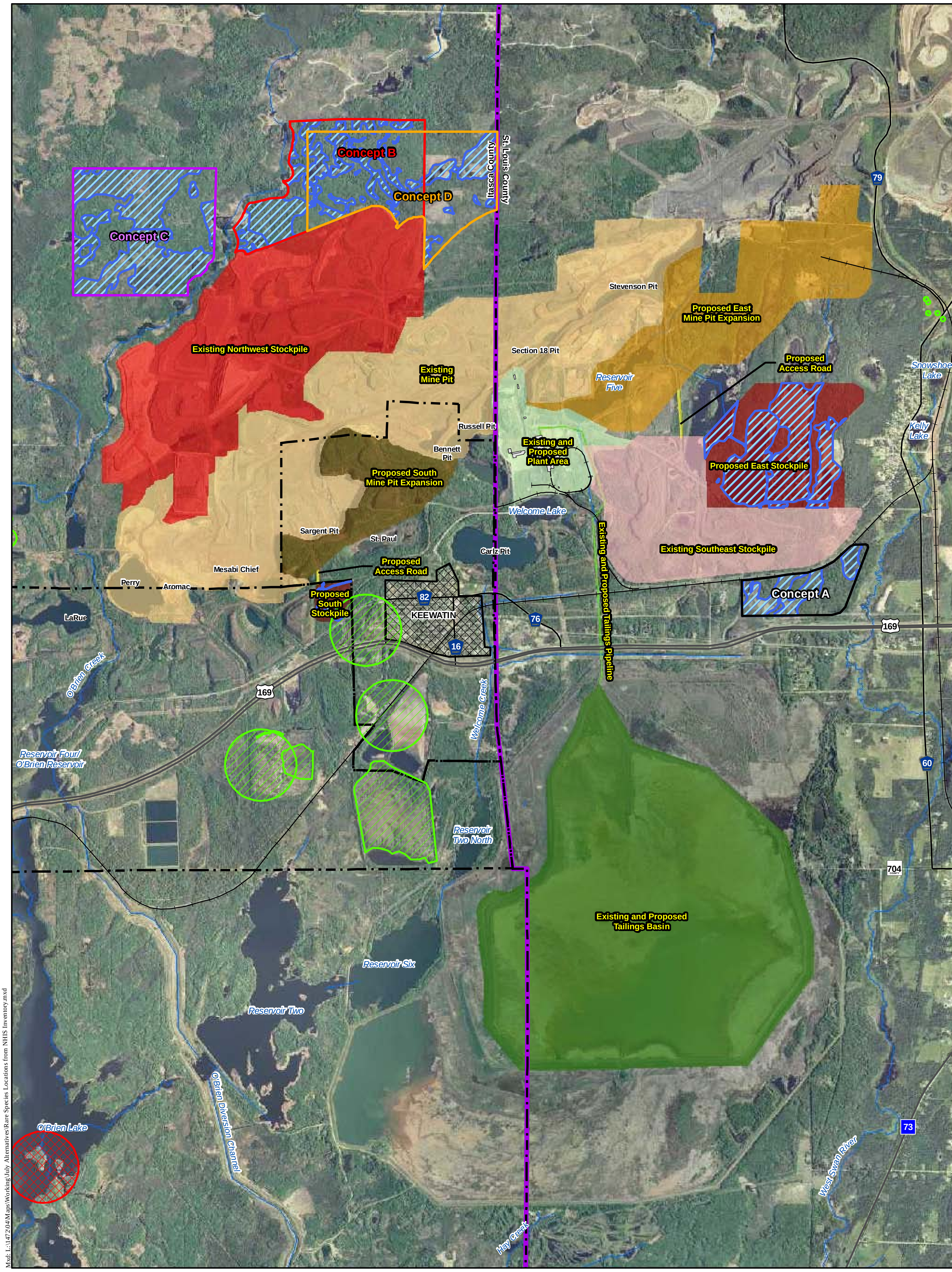
0.5 0 0.5 1

Miles

Source: USGS, Barr, LMIC, MNDNR, MPCA, Itasca County, St. Louis County, City of Hibbing, City of Nashwauk, U.S. Steel, and Mn/DOT. 2008 Aerial Photograph

Figure SA-7
Rare Plant Survey - Proposed Stockpile Location
U.S. Steel Keetac
Keewatin, MN

Minnesota DEPARTMENT OF NATURAL RESOURCES



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Legend

Project Areas
- Additional Stockpile East
- PTM Stockpile Limit
- Existing Northwest Stockpile
- Proposed South Stockpile
- Proposed Stockpile Roads
- Existing Mine Pit
- Proposed East Mine Pit Expansion
- Proposed South Mine Pit Expansion
- Plant Area
- Tailings Basin
- Tailings Pipeline
- Streams
- Railroad
- City Boundary
- Keewatin Urban Development
- County Boundary

Conceptual Stockpile Locations
- Concept A
- Concept B
- Concept C
- Concept D
- Proposed/Conceptual Stockpile Alternative Wetland Impacts

NHIS Database
- Threatened or Endangered Plant
- Threatened or Endangered Animal

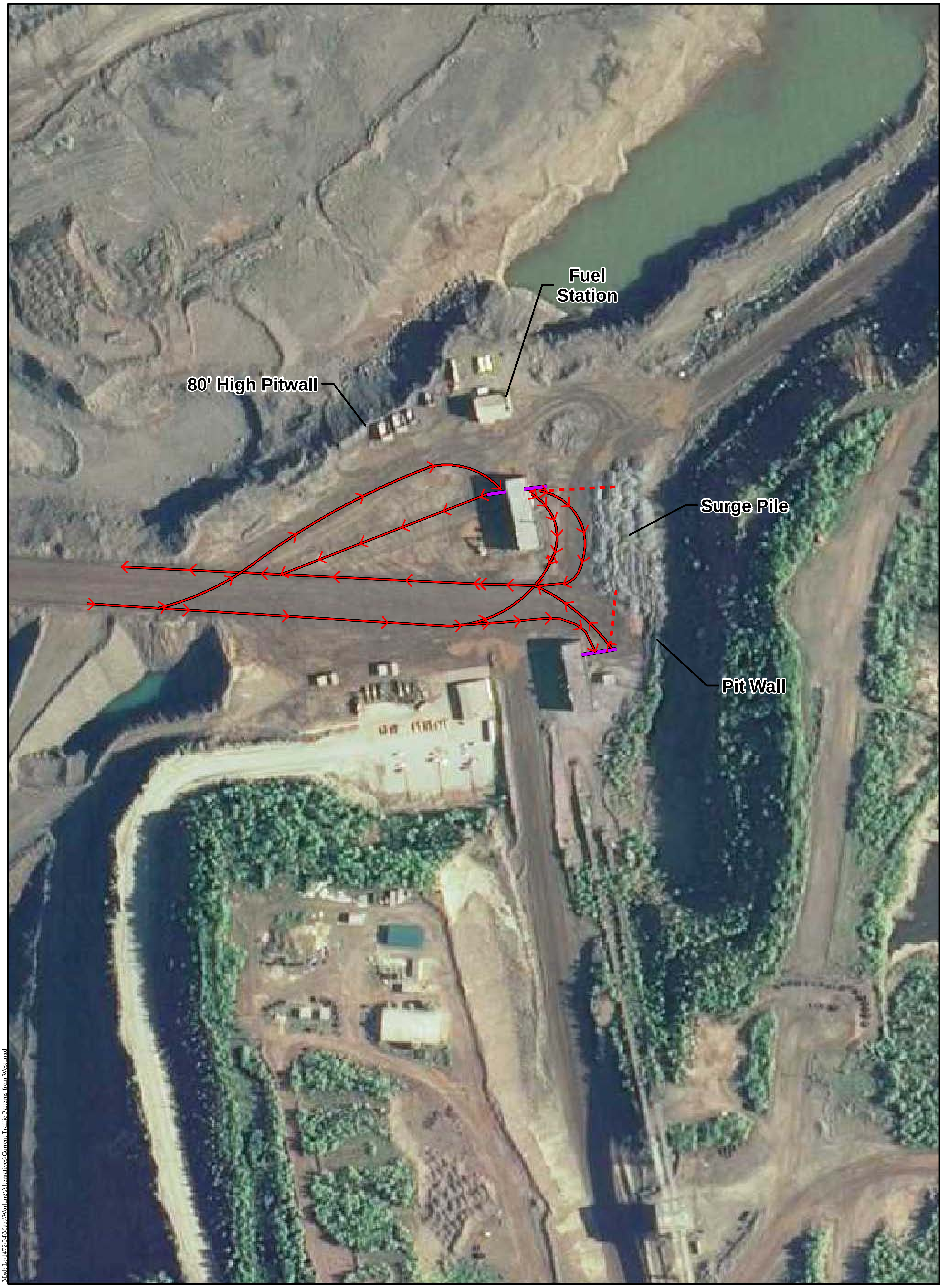
N

0.5 0 0.5 1
Miles

Source: USGS, Barr, LMIC, MNDNR, MPCA, Itasca County, St. Louis County, City of Hibbing, City of Nashwauk, U.S. Steel, and Mn/DOT. 2008 Aerial Photograph

Figure SA-8
Rare Species Locations from NHIS Inventory
U.S. Steel Keetac
Keewatin, MN

Minnesota DEPARTMENT OF NATURAL RESOURCES



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Legend

- - - - Loader Traffic Pattern
>>>> Truck Traffic Pattern
▬ Truck Back-Up Pattern

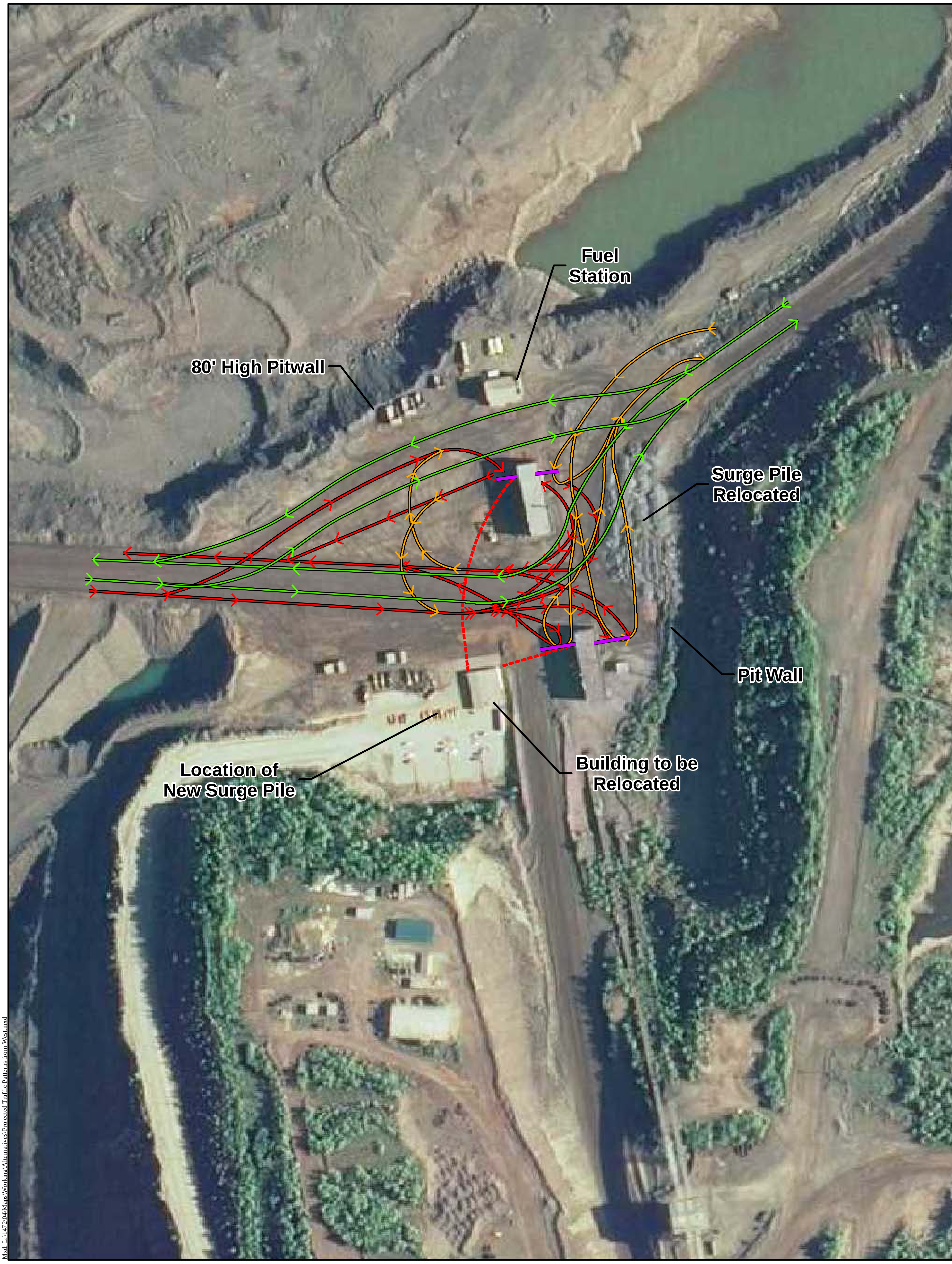
N

200 0 200 400
Feet

Source: USGS, Barr, LMIC, MNDNR, National Hydro Dataset, MPCA, Itasca County, St. Louis County, City of Hibbing, City of Nashwauk, U.S. Steel, and Mn/DOT. 2008 Aerial Photograph

Figure SA-9
Current Truck and
Loader Traffic Patterns
U.S. Steel Keetac
Keewatin, MN

Minnesota DEPARTMENT OF NATURAL RESOURCES



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Legend

- Loader Traffic Pattern
- Future Truck Back-Up Pattern
- Future Truck Traffic Associated with Concepts B-1, C-1 and D-1
- Future Truck Traffic Pattern (From East)
- Future Truck Traffic Pattern (From West)

N

200 0 200 400

Feet

Source: USGS, Barr, LMIC, MNDNR, National Hydro Dataset, MPCA, Itasca County, St. Louis County, City of Hibbing, City of Nashwauk, U.S. Steel, and Mn/DOT. 2008 Aerial Photograph

Figure SA-10
Projected Future Truck and Loader Traffic Patterns
U.S. Steel Keetac
Keewatin, MN

Minnesota DEPARTMENT OF NATURAL RESOURCES

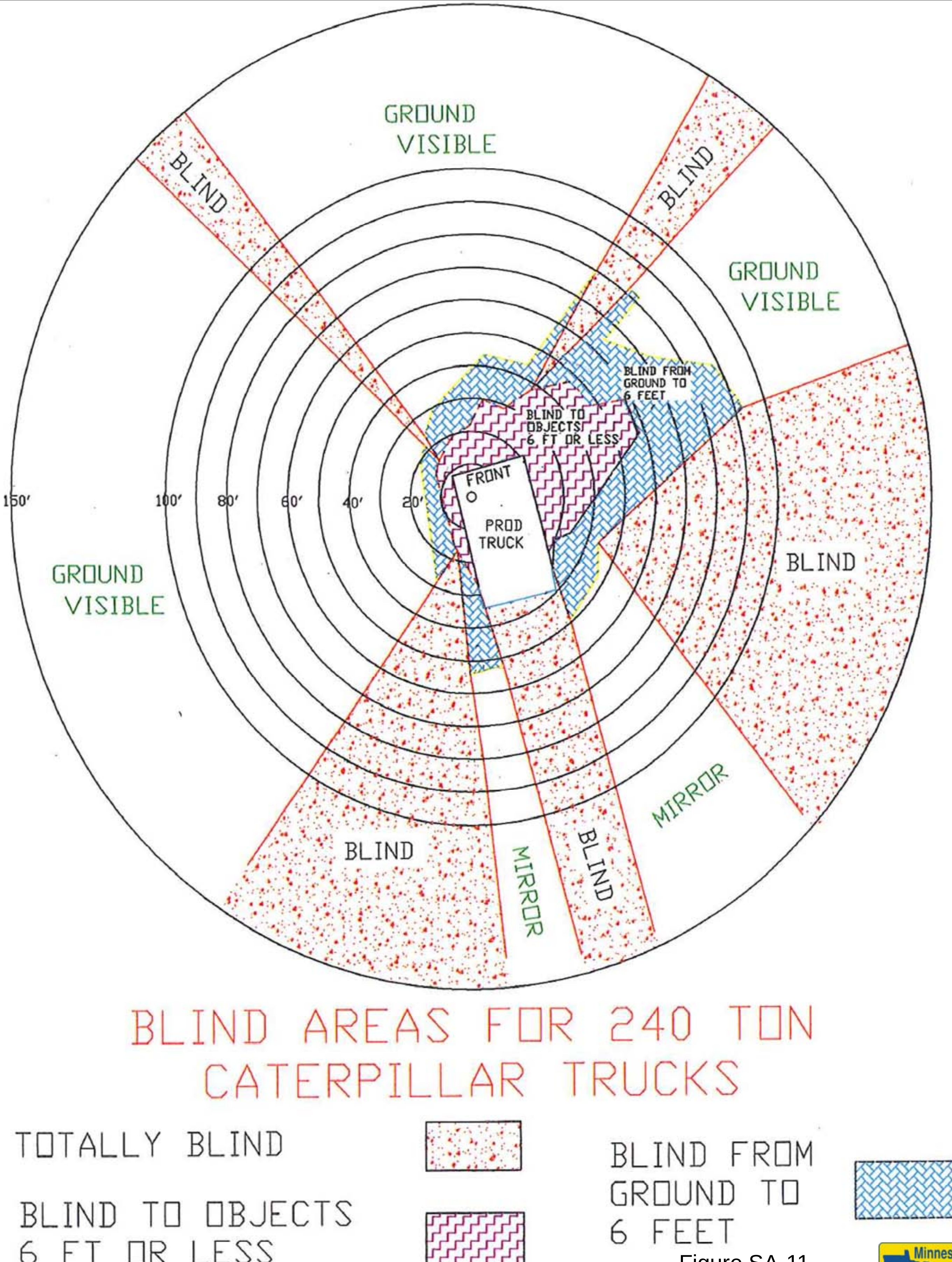

Figure SA-11
Blind Areas for 240 Ton
Caterpillar Trucks
U.S. Steel Keetac
Keewatin, MN

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Appendix A

Project Proposers Preliminary Concepts

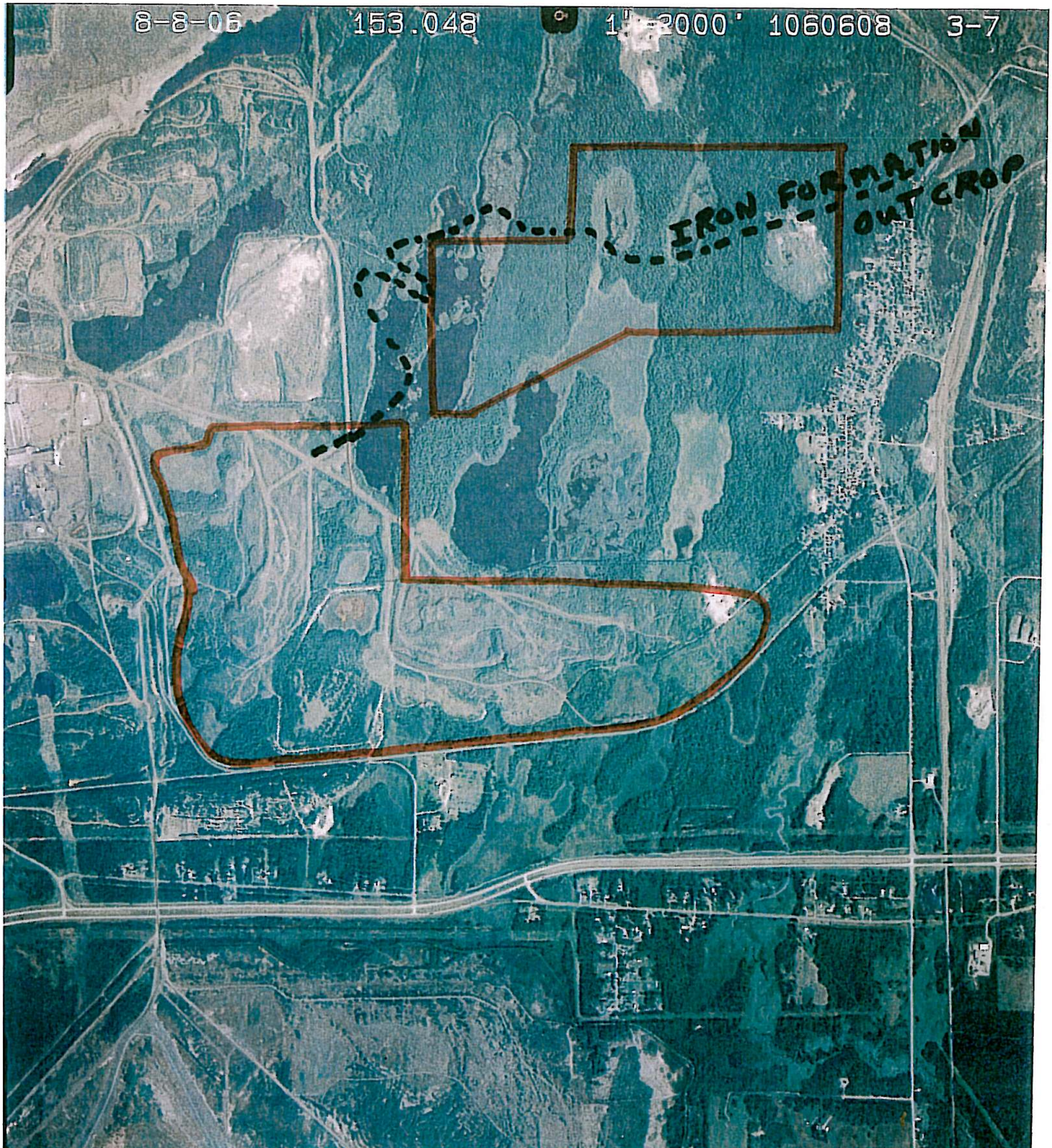
ITEMS AFFECTING POSITION OF WASTE DUMPS

1.) WETLANDS
2.) AMBIENT AIR BOUNDARY
3.) OWNERSHIP OF WASTE
4.) OWNERSHIP OF WASTE DUMP LOCATION
5.) VOLUME OF WASTE
6.) TYPE OF WASTE
7.) TIMING OF MINED OUT BOTTOM OF PIT
8.) ACCESS
9.) ECONOMICS
10.) LOCATION OF IRON FORMATION OUTCROP
11.) RECLAMATION OF DUMP

OBJECTIVES OF STOCKPILE DESIGN

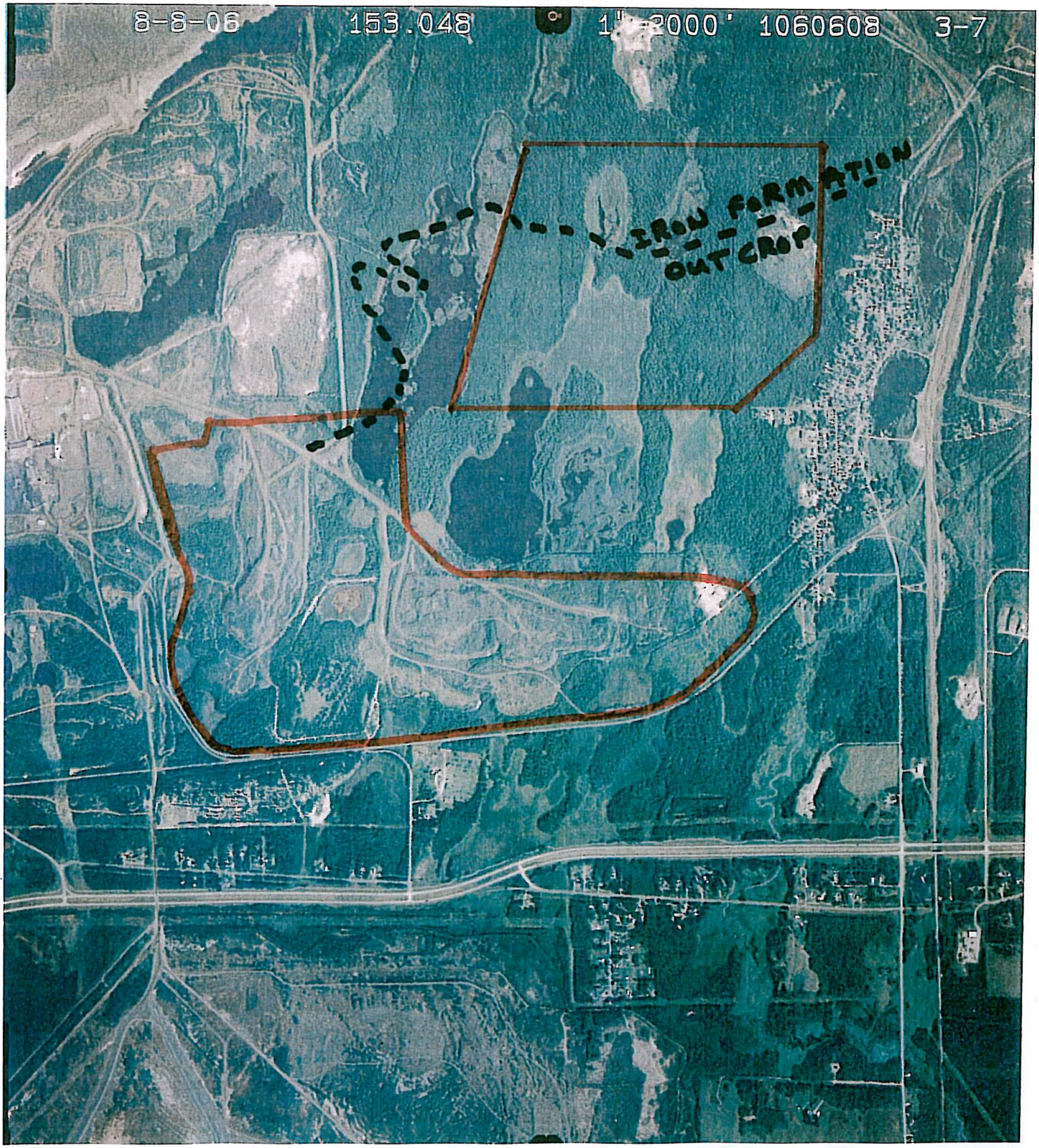
1.) REDUCE WETLAND DISRUPTION
2.) REDUCE EFFECT OF AMBIENT AIR BOUNDARY
3.) ACCESS / HAUL DISTANCE
4.) RECLAMATION
5.) KEEP OFF IRON FORMATION
6.) CONSERVE FOOTPRINT
7.) PLACE ON SAME OWNERSHIP
8.) DEVELOP BY TYPE OF WASTE
9.) MAXIMIZE IN-PIT STOCKPILING

FEB. 29, 2008



MARCH 20, 2008

MARCH 26, 2008



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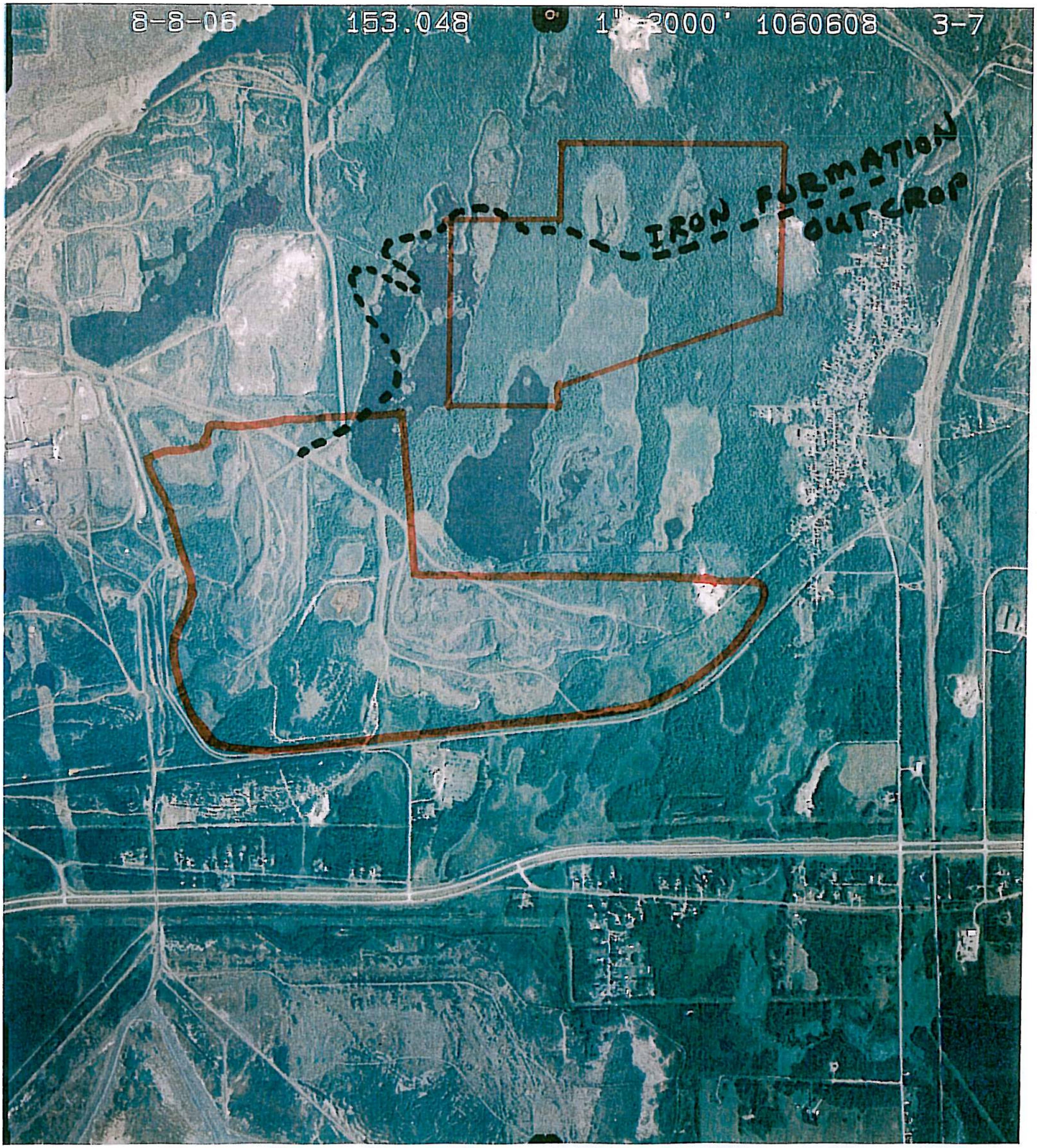

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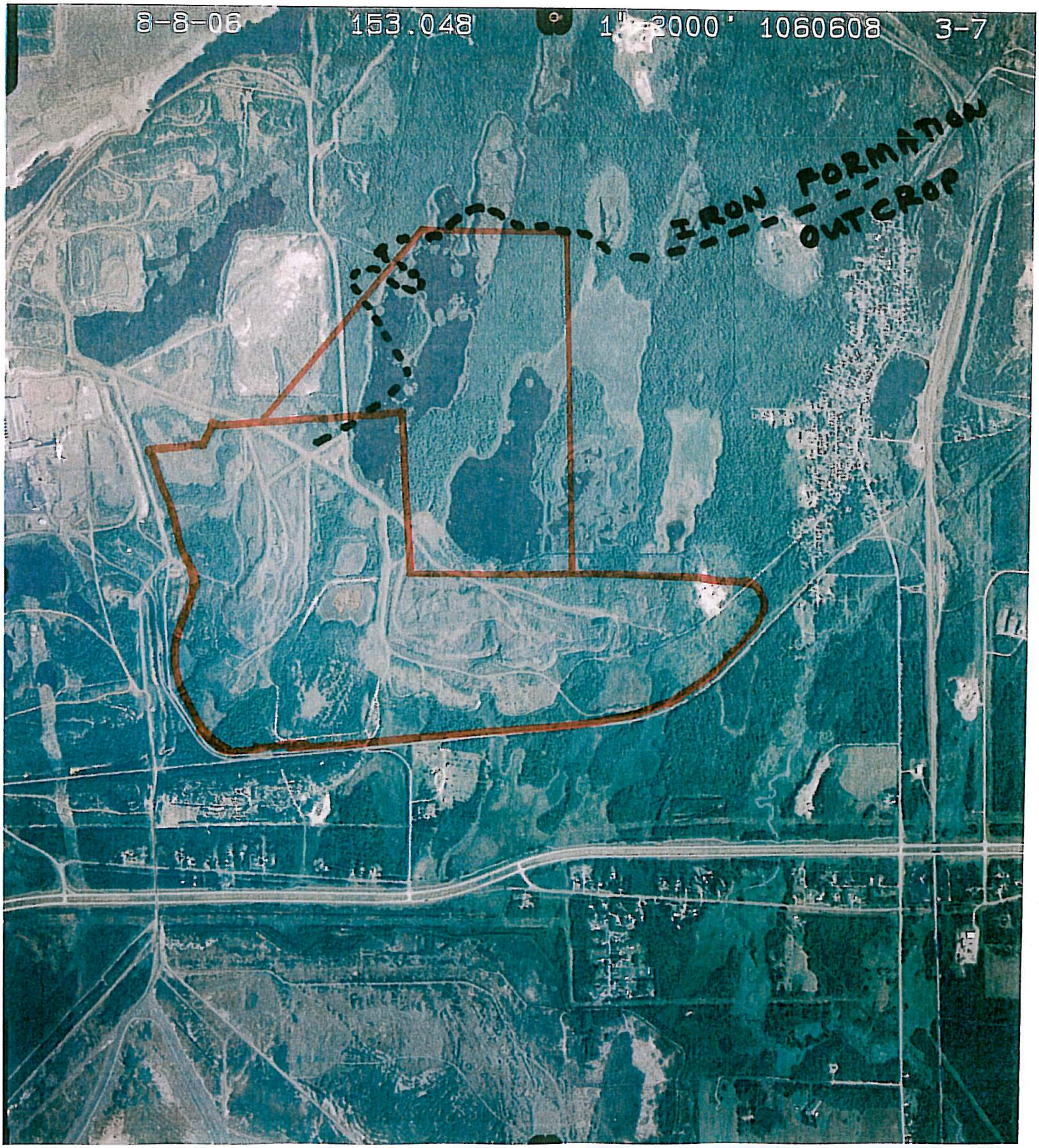

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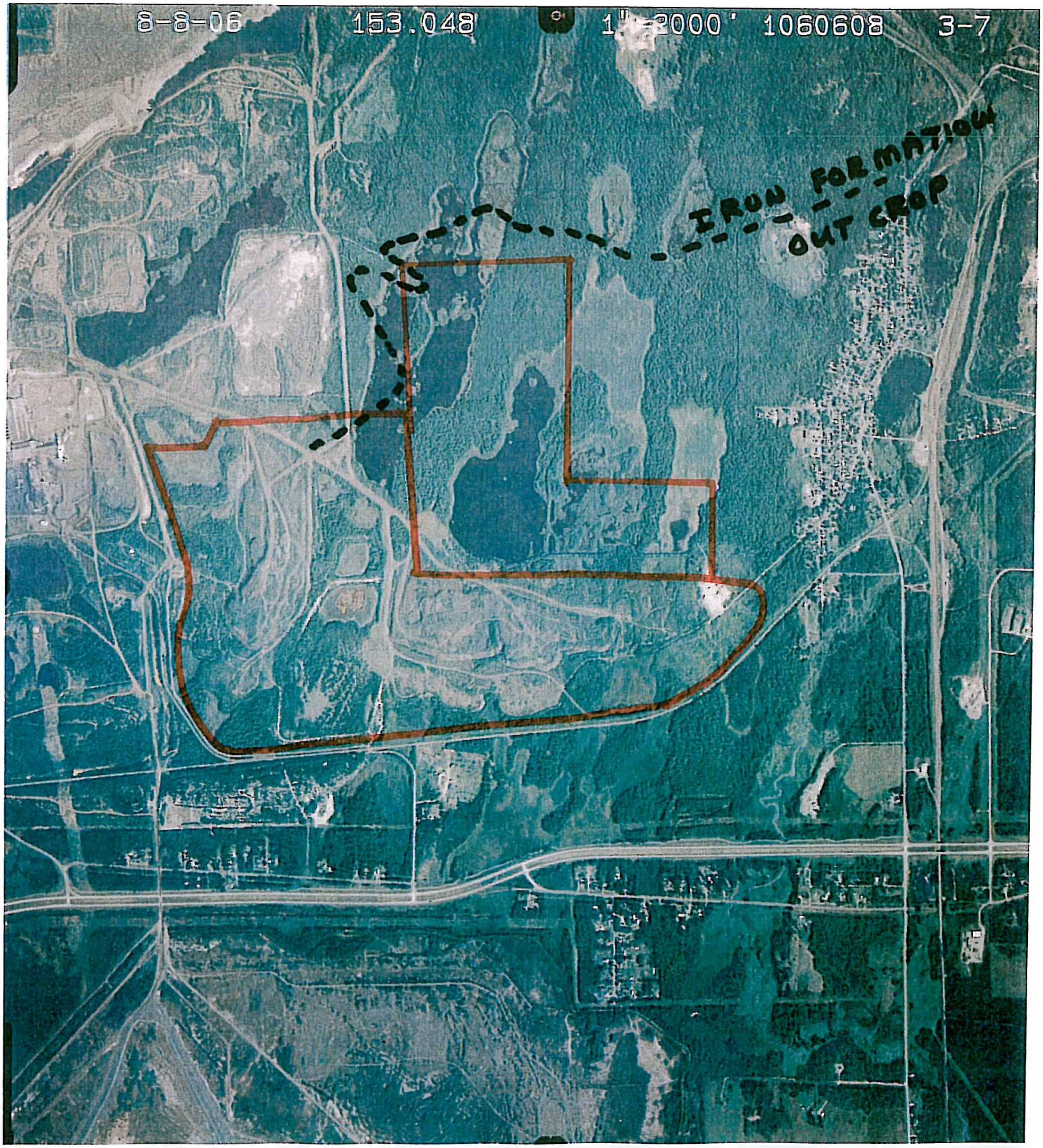
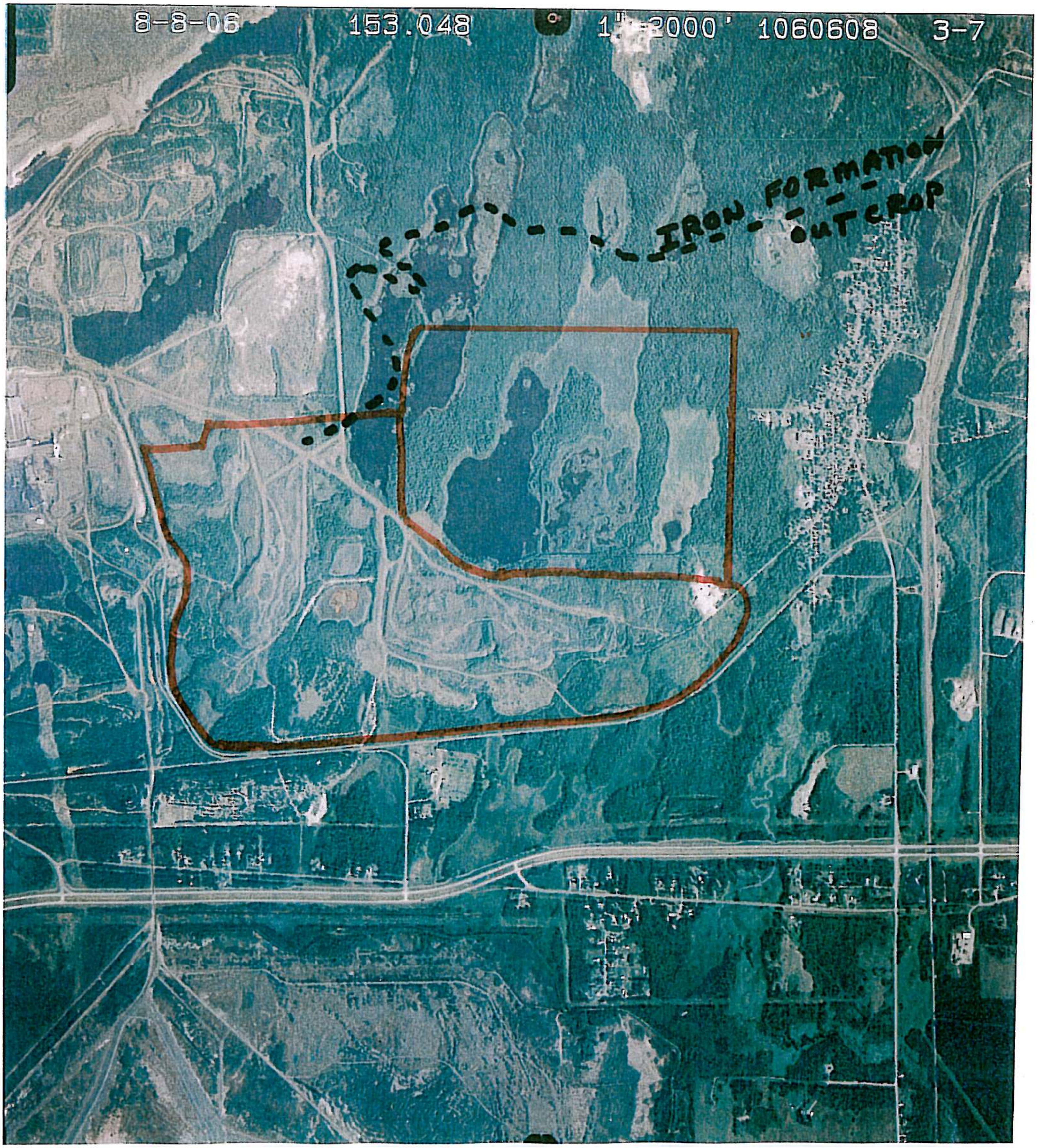


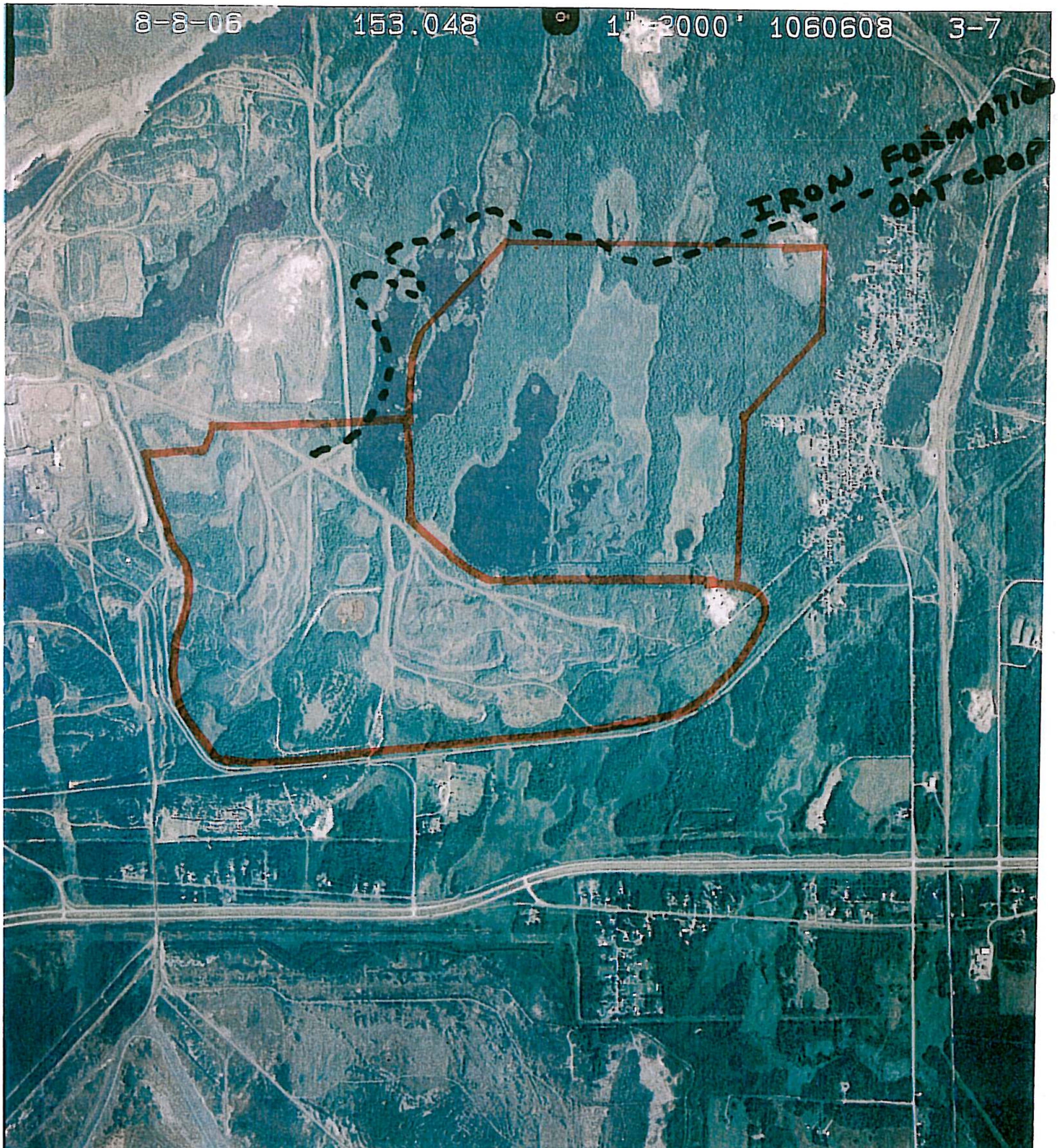
~ APRIL 22, 2008 ALT 1

~ APRIL 22, 2008 ALT. 2



APRIL 23, 2008 ART. 1

~ APRIL 22, 2008 ALT 2



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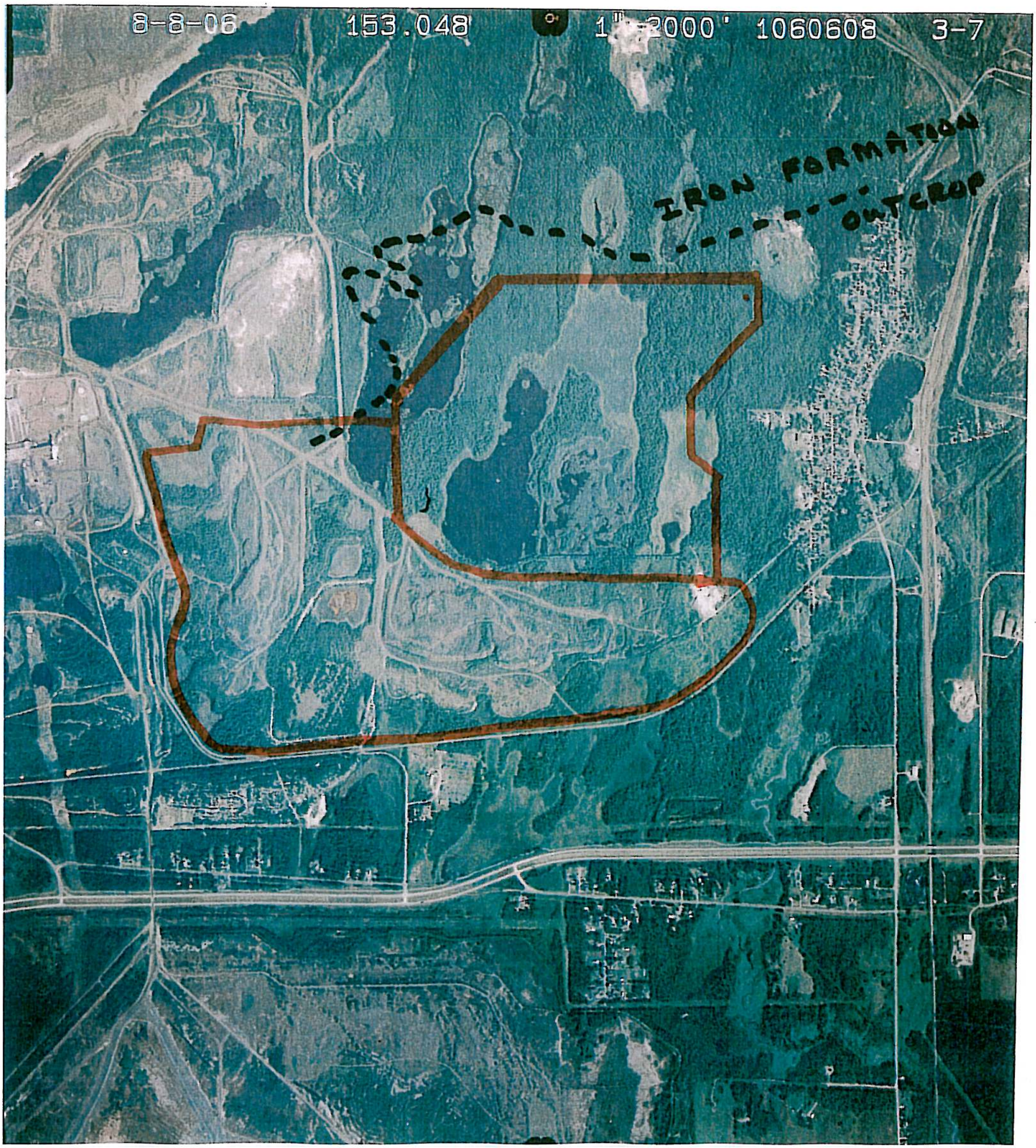


Appendix B

Caterpillar 793D Mining Truck Specifications

793D

Mining Truck

CAT

Engine		
Engine Model	Cat® 3516B HD EUI	
Gross Power – SAE J1995	1801 kW	2,415 hp
Net Power – SAE J1349	1743 kW	2,337 hp
Weights – Approximate		
Gross Machine Operating Weight	383 749 kg	846,000 lb

Operating Specifications		
Nominal Payload Capacity	218 tonnes	240 tons
Body Capacity – Dual Slope		
Struck	96 m^3	126 yd^3
Heaped (SAE 2:1)	129 m^3	169 yd^3

793D Mining Truck

Engineered for performance, designed for comfort, built to last.

Power Train – Engine

The Cat® 3516B High Displacement EUI engine delivers the power and reliability necessary to perform in the most demanding applications. Designed for efficient operation, the 3516B offers excellent fuel efficiency, lower emissions, reduced engine noise and lower operating costs. **pg. 4**

Power Train – Merchandising Arrangements

The 793D is available in four different normal altitude configurations and one arrangement for high altitude operations. All configurations include key components matched to performance requirements in specific applications and conditions. **pg. 5**

Power Train – Transmission

The Cat six-speed power shift transmission and mechanical power train, matched with the electronic unit injection 3516B high displacement engine, provides consistent power and efficiency for peak power train performance. **pg. 6**

Operator's Station

The ergonomic cab is designed for operator comfort and ease of operation to allow the operator to focus on production. Controls and gauges are positioned within easy reach for optimum efficiency and superior control. **pg. 12**

Serviceability

The 793D is designed for quick and easy servicing. Simplified service and maintenance features reduce downtime, allowing the machine to spend less time being serviced and more time on the haul roads. **pg. 13**

Monitoring System

VIMS® monitoring system provides operators, service technicians and mine personnel with vital machine health and payload data to keep the 793D performing at peak efficiency and top production levels while lowering cost-per-ton. **pg. 14**

The 793D Mining Truck is available in five merchandising arrangements:

- ***Standard** – for balanced all-around performance*
- ***Extended Life Wheel Groups** – for long, uphill hauls*
- ***Extra Top Speed** – for long, flat hauls*
- ***Extra Retarding** – for long, downhill loaded hauls*
- ***High Altitude Arrangement** – for operations above 2750 m (9,000 ft)*

Structures

Caterpillar® truck frames are built to optimize torsional load displacement. Mild steel provides flexibility, durability and resistance to impact loads. Castings and forgings in high stress areas provide exceptional strength and durability for long life. **pg. 7**

Engine/Power Train Integration

The Cat Data Link electronically combines engine, transmission, brake and operational information to optimize overall truck performance. Stored diagnostic data can be accessed via the Electronic Technician (Cat ET) to improve troubleshooting and reduce downtime. **pg. 8**

Caterpillar Brake System

Cat oil-cooled, multiple disc brakes offer exceptional, fade-resistant braking and retarding for maximum performance and productivity in all haul road conditions. Integrated Braking Control combines retarding and traction control into one system for optimum braking efficiency. **pg. 10**

Truck Body Systems

A variety of Caterpillar designed and built truck bodies ensure optimal performance and reliability in tough mining applications. Cat dealers can help build an optimum hauling system to maximize truck payloads and extend body and truck wear life. **pg. 16**

Customer Support

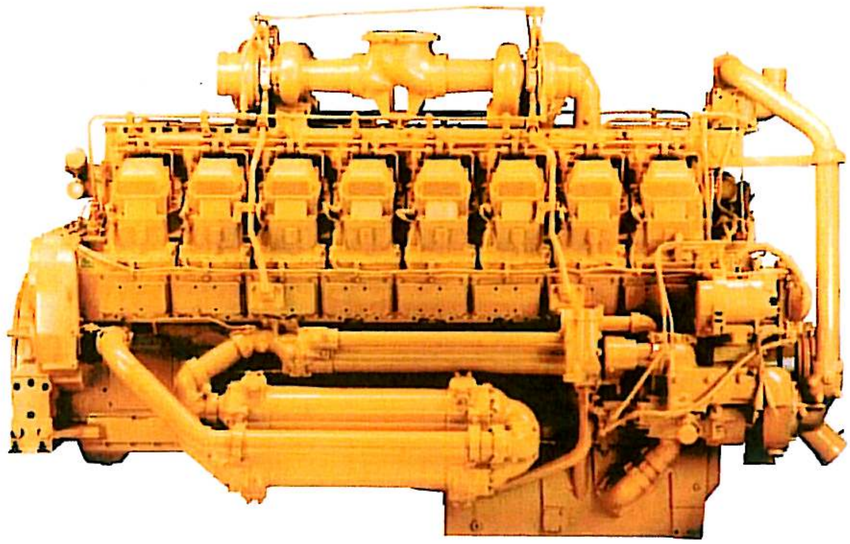
Caterpillar dealers provide unmatched product support, anywhere in the world. With industry-best parts availability and a wide range of maintenance and service options, Cat dealers have what it takes to keep your mining machines productive. **pg. 18**

Safety

Caterpillar sets the standard when it comes to safety in the design and manufacturing of heavy equipment for the mining industry. Safety is not an afterthought at Caterpillar, but an integral part of all machine and systems designs. **pg. 19**

Power Train – Engine

The Cat 3516B High Displacement engine is built for power, reliability and efficiency for superior performance in the toughest applications.



Engine. The Cat 3516B High Displacement EUI quad turbocharged and aftercooled diesel engine produces 5% greater power with enhanced power management capability for maximum hauling performance in the most demanding mining applications.

Design. The 3516B is a 16-cylinder, four-stroke design that uses long, effective power strokes for more complete fuel combustion and optimum efficiency.

EPA Compliant. The Cat 3516B High Displacement engine is compliant with U.S. Environmental Protection Agency Tier I emissions standards.

Altitude Compensation. Designed for maximum operating efficiencies at altitudes under 2750 m (9,000 ft).

High Altitude Arrangement (HAA). The optional Cat 3516B quad and series turbocharged aftercooled short stroke engine provides full power with no deration at altitudes greater than 2750 m (9,000 ft).

High Torque Rise. The 23% net torque rise provides unequalled lugging force during acceleration, on steep grades and in rough underfoot conditions. Torque rise effectively matches transmission shift points for maximum efficiency and fast cycle times.

Enhanced Life. High displacement, low rpm rating and conservative horsepower ratings mean more time on the haul roads and less time in the shop.

Single-Piece Piston Design. New single-piece forged steel pistons with integrated forged steel skirt are more robust to withstand high engine heat and pressure and enable enhanced combustion efficiency, improved fuel efficiency and lower emissions. Corrosion resistant, stainless steel top ring reduces ring, groove and liner wear for greater reliability and longer life.

Electronic Unit Injection (EUI). The electronically controlled unit injection fuel system senses operating conditions and regulates fuel delivery for optimum fuel efficiency. The proven high-pressure fuel system provides improved response times and more efficient fuel burn with lower emissions and less smoke.

Electronic Control Module (ECM). ECM utilizes advanced engine management software to monitor, control and protect the engine utilizing self-diagnosing electronic sensors. The computerized system senses operating conditions and power requirements and adjusts engine for peak performance and most efficient operation and at all times.

Separate Circuit Aftercooler. Allows the aftercooler circuit to operate cooler than jacket water temperature for a denser air charge and greater combustion efficiency.

Cooling System. The new modular higher density cooling system with larger fans is hydraulically driven for more efficient cooling with lower fuel consumption and noise levels.

Oil Renewal System. Optional oil renewal system extends engine oil change intervals from 500 hours to 4,000 hours or more to increase machine availability and reduces costs.

Engine Protection. Computerized system electronically protects the engine during cold starts, high altitude operation, air filter plugging, and high exhaust temperature.

Power Train – Merchandising Arrangements

Five configurations are performance matched to meet specific applications and conditions.

Merchandising Arrangements.
The 793D is available in four different normal altitude configurations, and a high altitude arrangement. All configurations deliver increased speed on grade and include key components that are performance matched to the hauling application and site conditions.

Standard Arrangement. The standard arrangement is designed for exceptional, all-around performance. Three factors combine to produce up to 9% more power at the wheels than the 793C, including: 5% more engine horsepower; a common rail hydraulic system for greater power train efficiency; and a hydraulically driven demand fan that reduces parasitic load by operating only when needed. More power at the wheels reduces cycle times and lowers cost-per-ton.

Extended Life Wheel Groups. Developed for uphill hauling applications, this arrangement is designed to extend wheel life and hauling performance on long uphill hauls. Extended life wheel groups are built with larger, more durable components, including larger spindles, wider wheel bearing spacing, a larger braking surface, and extended life friction disc material for longer brake life and more time between overhauls.

Extra Top Speed. Developed for long, flat haul applications, the extra top speed configuration delivers a 10% increase in maximum speed to 60 km/h (37 mph) via a new input transfer gear group. This arrangement also includes Extended Life Wheel Groups.

Extra Retarding. Developed for downhill loaded applications, this configuration typically delivers an extra gear of retarding capability of 35% more speed on downhill grades. Extra retarding is achieved by adding more robust wheel groups, larger brakes, extended life friction material, and additional cooling capacity.

High Altitude Arrangement. Developed for high altitude applications, the 3516B short stroke engine delivers enhanced power management at higher altitudes – from 2750 to 1600 m (9,000 to 12,000 ft). This arrangement also includes Extra Retarding.

Power Train – Transmission

Cat mechanical power train delivers more power to the ground for greater productivity and lower operating costs.

Mechanical Power Train. The Cat mechanical drive power train and power shift transmission provides unmatched operating efficiency and control on steep grades, in poor underfoot conditions, and on haul roads with high rolling resistance.

1) Transmission. The Cat six-speed planetary power shift transmission is matched with the direct-injection 3516B HD diesel engine to deliver constant power over a wide range of operating speeds.

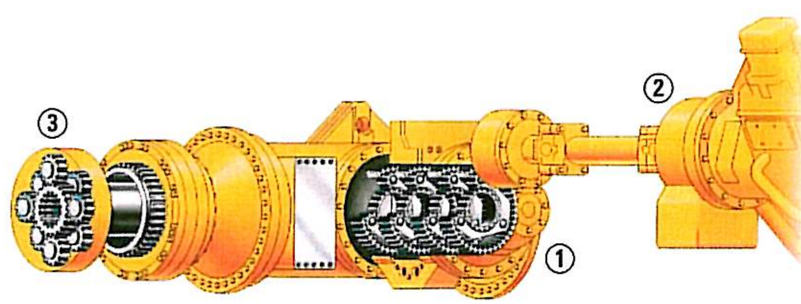
- **Robust Design.** Designed for the higher horsepower of the 3516B HD engine, the proven planetary power shift transmission is built tough for long life between overhauls.
- **Long Life.** A dedicated oil tank and circuit provides cooler, cleaner oil for maximum performance and longer component life.
- **Transmission Chassis Control (TCC).** TCC uses electronically transferred engine rpm data to execute shifts at preset points for optimum performance, efficiency and clutch life.

2) Lock-Up Torque Converter. Combines maximum rimpull and cushioned shifting of torque converter drive with the efficiency and performance of direct drive. The lock-up torque converter engages at approximately 8 km/h (5 mph), delivering more power to the wheels.

- **Lock-Up Clutch.** Quickly releases and re-engages to reduce power train torque loads for smoother shifting, long life and a more comfortable ride.
- **Smooth Shifting.** Individual clutch modulation provides smooth clutch engagements to optimize performance and extend clutch life.

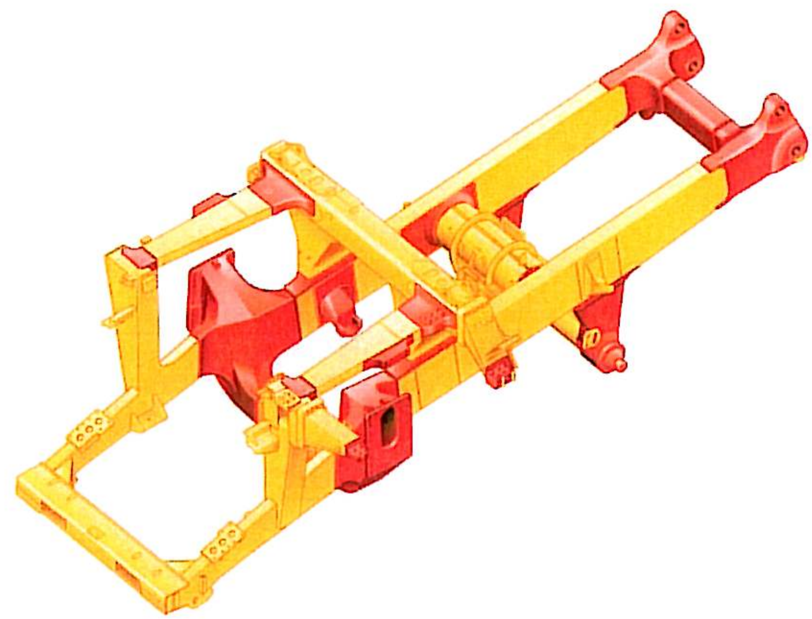
3) Final Drives. Cat final drives work as a system with the planetary power shift transmission to deliver maximum power to the ground. Built to withstand the forces of high torque and impact loads, double reduction final drives provide high torque multiplication to further reduce drive train stress.

- **Rear Axle Filtration.** A new filtration system provides cooler, cleaner oil for longer component life.
- **Steering System.** Hydraulic steering control system is designed for exceptional smoothness and precise control. A separate circuit prevents cross contamination for long life.
- **Supplemental Steering.** Supplemental steering system uses pressure accumulators and allows up to three 90 degree turns in case of engine failure.
- **Wheels and Rims.** Cast rear wheels and Cat center-mount rims are mounted using studs and nuts to minimize maintenance and maximize durability.



Structures

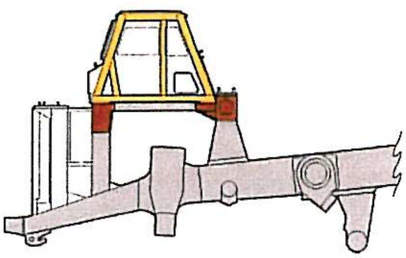
Rugged Cat structures are the backbone of the 793D mining truck's durability.



Box-Section Design. The 793D frame uses a box-section design, incorporating two forgings and 24 castings in high stress areas with deep penetrating and continuous wrap-around welds to resist damage from twisting loads without adding extra weight.

- **Steel Structures.** Mild steel used throughout frame provides flexibility, durability and resistance to impact loads, even in cold climates, and allows for easy field repairs.

- **Castings.** Castings have large radii with internal reinforcing ribs to dissipate stress in areas of high stress concentration. Castings move welds to lower stress areas for greater frame life.



Integral Four-Post ROPS Cab. Resiliently mounted to the main frame to reduce vibration and sound, the integral ROPS is designed as an extension of the truck frame. The ROPS/FOPS structure provides "five sided protection" for the operator.

Suspension System. Designed to dissipate haul road and loading impacts for longer frame life and a more comfortable ride.

- **Cylinders.** Four independent self-contained, oil pneumatic, variable-rebound suspension cylinders are designed to absorb shocks in the most severe applications.

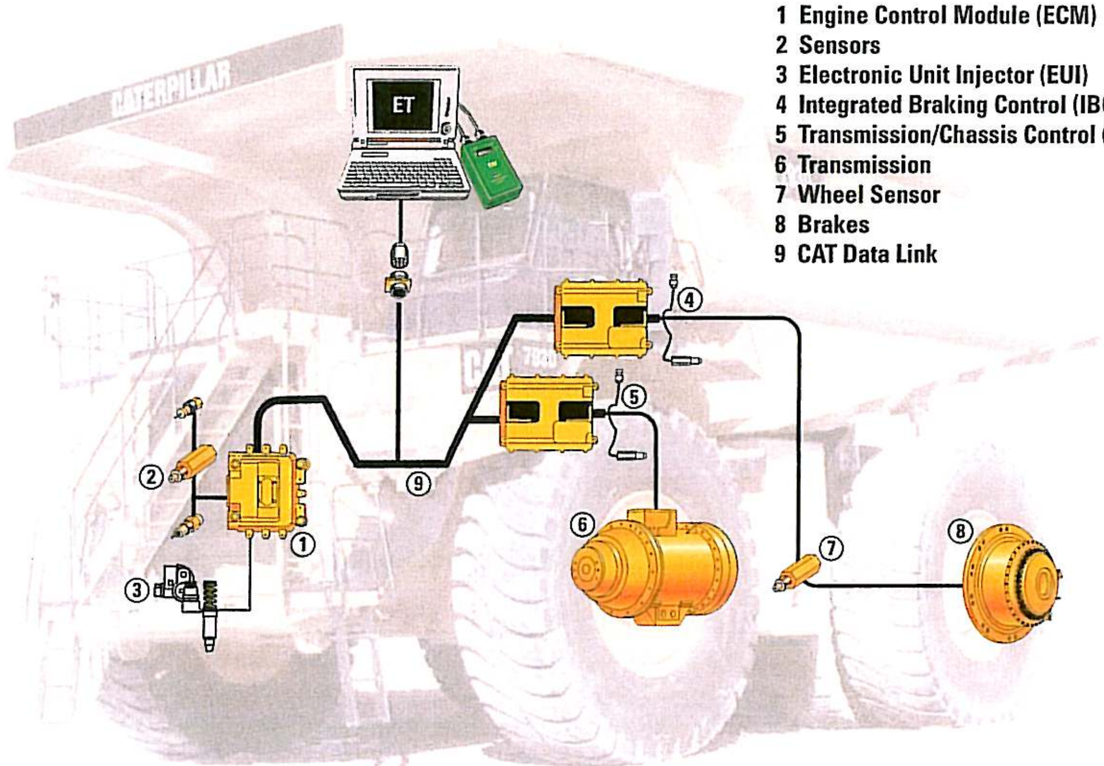
- **Durable Design.** Rugged cylinders utilize large diameter bore and low pressure nitrogen/oil design for long life with minimal maintenance.

– **Front.** Front cylinders with preset caster and camber are mounted to the frame and serve as steering kingpins for a tight turning radius with excellent maneuverability and low maintenance.

– **Rear.** Rear cylinders allow axle oscillation and absorb bending and twisting stresses caused by uneven and rough haul roads rather than transmitting them to the main frame.

Engine/Power Train Integration

Electronically combines critical power train components to work more intelligently and optimize overall truck performance.



1 **Engine Control Module (ECM)**
2 **Sensors**
3 **Electronic Unit Injector (EUI)**
4 **Integrated Braking Control (IBC)**
5 **Transmission/Chassis Control (TCC)**
6 **Transmission**
7 **Wheel Sensor**
8 **Brakes**
9 **CAT Data Link**

Cat Data Link. Electronically integrates machine computer systems to optimize overall power train performance, increase reliability and component life, and reduce operating costs.

Controlled Throttle Shifting. Regulates engine rpm during shifting to reduce power train stress and clutch wear by controlling engine speed, torque converter lock-up and transmission clutch engagement for smoother shifts and longer component life.

Directional Shift Management. Regulates engine speed during directional shifts to prevent damage caused by high speed directional changes.

Neutral Coast Inhibitor. Prevents transmission from shifting to neutral at speeds above 6.5 km/h (4 mph) to protect the transmission from operating with insufficient lubrication.

Body-up Reverse Neutralizer. Automatically shifts the transmission to neutral if the hoist lever is activated while transmission is shifted in reverse.

Body-up Shift Inhibitor. Prevents the transmission from shifting above the pre-programmed gear without the body fully lowered.

Overspeed Protection. The transmission control electronically senses engine conditions and automatically up-shifts one gear to prevent overspeeding. If overspeeding occurs in top gear, the lock-up clutch is disengaged.

Programmable Top Gear. Transmission top gear maximum can be set using the Cat ET service tool to help the operator maintain speed limits.

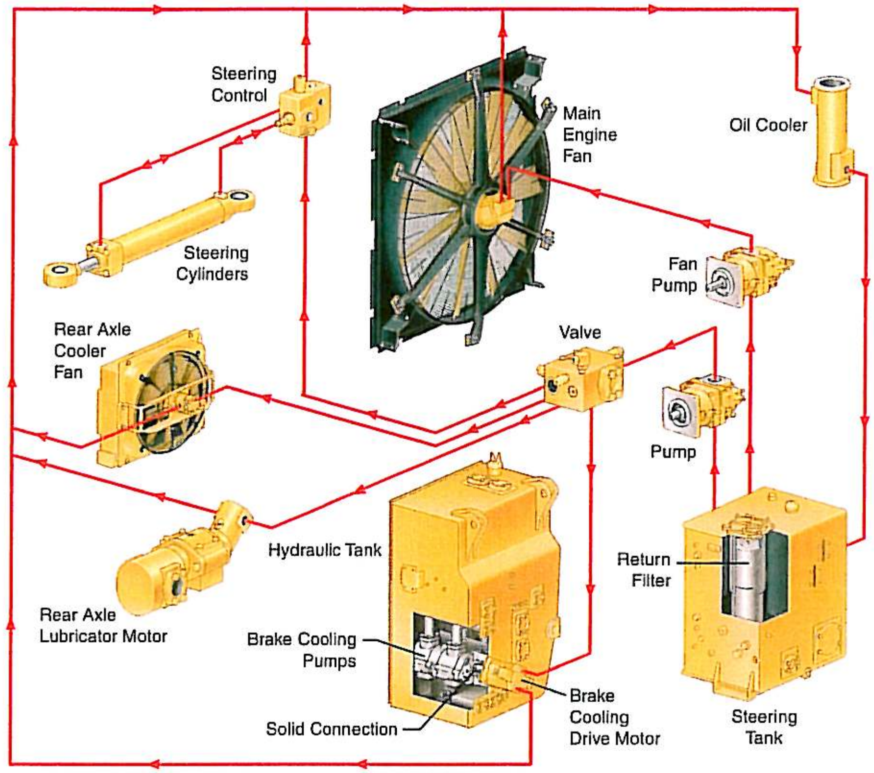
Anti-Hunt Function. Minimizes shifting by not allowing the transmission to up or down shift immediately after a shift has occurred. This prevents gear hunting when operating near a shift point and minimizes transmission shifting for increased component life.

Downshift Inhibitor. Prevents engine overspeeding by keeping the transmission from downshifting until engine speed reaches the downshift point.

Electronic Technician (Cat ET). Cat ET service tool provides service technicians with easy access to stored diagnostic data through the Cat Data Link to simplify problem diagnosis and increase machine availability.

Diagnostic Capability. Critical data from the electronic engine and transmission controls, including transmission shifting, engine speed and fuel consumption, provides service technicians with enhanced diagnostic capability to reduce downtime and operating costs.

Integrated Braking Control (IBC). IBC integrates Hydraulic Automatic Retarder Control and Traction Control into one system for optimum performance and efficiency.

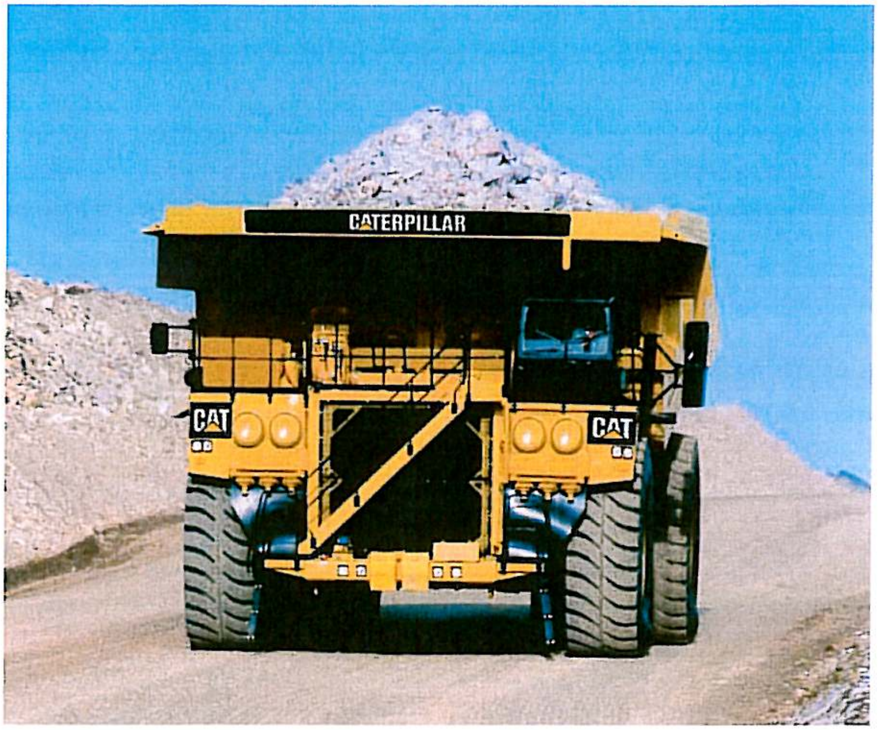


Hydraulic Power Management System

Hydraulic Power Management System. The system, also known as common rail hydraulics, reduces parasitic (unused, wasted) losses in the power management system components and the new hydraulic fan drive system. The system is operated by two new variable displacement piston pumps. These pumps primarily provide for the steering and cooling functions, and are independent of the brake and hoist circuit. One pump is dedicated to a new on-demand hydraulic fan drive system. The other pump feeds a new priority valve and provides hydraulic pressure and flow to feed steering, brake cooling, rear axle filtration (RAX), and the optional RAX cooler systems. The system continues to allow priority for the steering system while using an improved power management scheme for brake cooling and RAX functions. By reducing the losses, the system is able to provide more horsepower to the ground.

Caterpillar Brake System

Reliable braking with superior control gives the operator the confidence to focus on productivity.



Integrated Braking System. The Cat oil-cooled braking system delivers reliable performance and control in the most extreme haul road conditions. The integrated system combines the service, secondary, parking brake and retarding functions in the same robust system for optimum braking efficiency.

Cat Data Link. All control modules communicate via the Cat Data Link and work together as an integrated system to maximize production efficiency and extend component life.

Oil-Cooled Multiple Disc Brakes. Caterpillar four-wheel, forced oil-cooled, multiple disc service brakes are continuously cooled by water-to-oil heat exchangers for exceptional, non-fade braking and retarding performance.

Extended Life Disc Brakes. Extended life friction material has double the wear life of standard brakes and is twice as resistant to glazing for more consistent braking power with less noise.

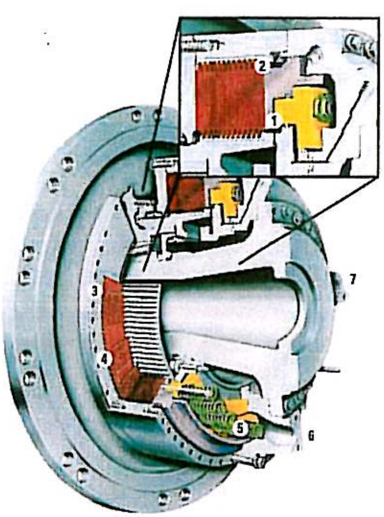
Brake Design. Cat oil-cooled disc brakes are designed with large discs and plates for reliable, adjustment-free operation and performance. Brakes are completely enclosed and sealed to prevent contamination and reduce maintenance.

Long Life. An oil film prevents direct contact between the discs. This design absorbs the braking forces by shearing the oil molecules and carrying heat away to extend brake life.

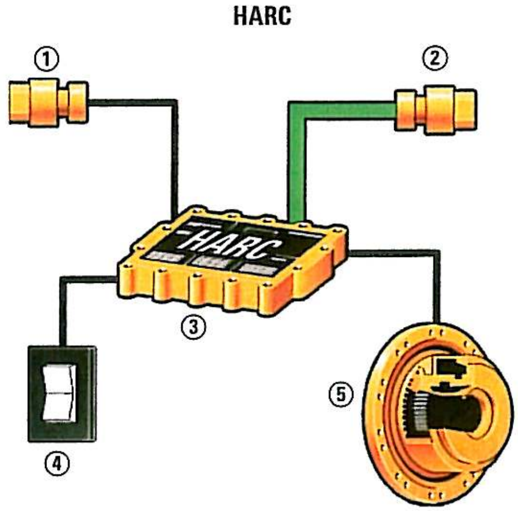
Pistons. The Caterpillar two-piece piston design combines the service, secondary, parking brake and retarding functions in the same system. The primary piston hydraulically actuates both service and retarding functions. The secondary piston is spring-applied and held in the disengaged position by hydraulic pressure. If hydraulic system pressure drops below a specified level, the spring-applied secondary piston automatically applies the brakes.

Parking Brake. Oil-cooled, spring-applied, hydraulically released parking brake is applied to all four wheels for superior parking capability on all grades up to 15 percent.

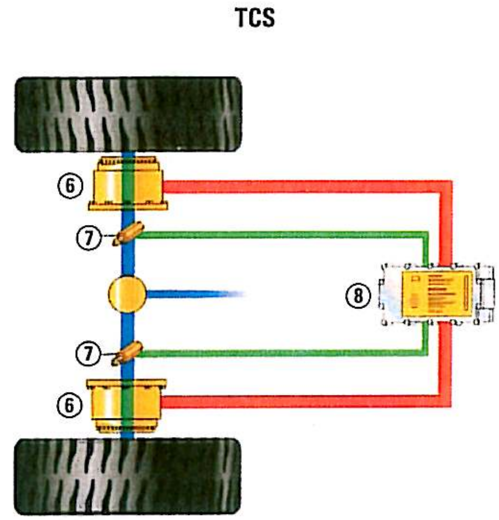
Hydraulic Automatic Retarder Control (HARC). Hydraulically activated automatic retarder control system electronically controls retarding on grade to maintain optimum engine rpm and oil cooling. Additional braking may be applied using the manual retarder or the brake pedal. HARC is deactivated when the operator applies the brake or accelerator controls.



1 Parking/Secondary Piston
2 Service/Retarding Piston
3 Friction Discs
4 Steel Plates
5 Actuating Springs
6 Cooling Oil In
7 Cooling Oil Out



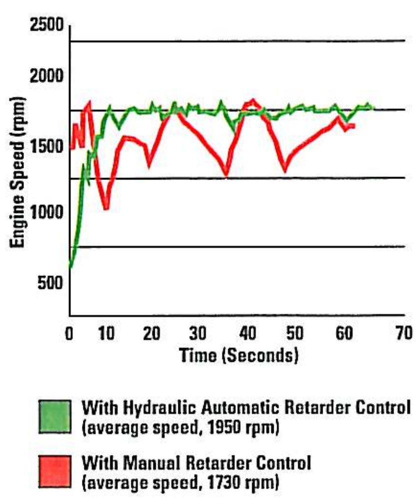
1 **Service Brake Sensor**
2 **Engine Sensor**
3 **HARC**
4 **HARC Switch**
5 **Brakes**
6 **Service Brakes**
7 **Axle Speed Sensor**
8 **TCS**



HARC vs. ARC.

- Less chance for engine overspeed
- Smoother engagement
- No loping
- Less air system demand
- Reduces operating costs

HARC Production Advantages.



Faster Speeds. HARC allows the operator to maintain optimum engine speeds for faster downhill hauls and greater productivity.

Superior Control. Automatic brake modulation offers a smoother ride and better control in slippery conditions, allowing the operator to concentrate on driving.

Ease of Operation. HARC increases operating ease, resulting in greater operator confidence with less fatigue.

Engine Overspeed Protection. Automatically activates HARC when engine speed exceeds factory preset levels, regardless of operator inputs, to avoid potentially damaging engine overspeeds.

Four Corner Retarding. Four corner retarding with 60/40 percent split (rear/front) in braking effort provides superior control in slippery conditions. Balanced front to rear brake torque provides exceptional braking performance and minimizes wheel lock-up, especially during retarding.

Traction Control System (TCS). Electronically monitors and controls rear wheel slippage for greater traction and enhanced truck performance in poor underfoot conditions. If slippage exceeds a set limit, the oil-cooled disc brakes engage to slow the spinning wheel. Torque is then automatically transferred to the wheel with better traction.

Differential Action. Normal differential action provides superior maneuvering and control in slippery conditions.

Integrated Braking Control (IBC). Combines Hydraulic Automatic Retarder Control (HARC) and Traction Control System (TCS) into one integrated brake control system for optimum efficiency, performance and reliability.

Fuel Efficiency. The engine provides additional retarding by running against compression on downhill hauls. During retarding applications the engine ECM does not inject fuel into the cylinders for exceptional fuel economy.

Operator's Station

Ergonomically designed for operator comfort, superior control and high productivity.

Ergonomic Layout. The 793D operator station is ergonomically designed for total machine control in a comfortable, productive and safe environment.
All controls, levers, switches and gauges are positioned to maximize productivity and minimize operator fatigue.

Quiet Cab. Integral, sound-suppressed ROPS/FOPS cab is resiliently mounted to the mainframe to isolate the operator from sound and vibration for a quiet, secure and comfortable ride.

Viewing Area. Designed for excellent all-around visibility and clear sight lines to the haul road, the large viewing area enables the operator to maneuver with confidence for high productivity.

1) Air Suspension Seat w/ Three-Point Operator Restraint. Ergonomically designed, fully adjustable air suspension seat with adjustable armrests provides optimal driving comfort. A wide, retractable 3-point seat/shoulder belt provides a secure, comfortable restraint.

2) Hoist Lever. Four-position, low effort electronic hoist control system with fingertip control is mounted next to the operator's seat for ease of operation.

3) Secondary Brake Pedal. Conveniently located on the floor for easy operator control.

4) Monitoring System. The VIMS system features an easy-to-read display and easy-to-use operator input keypad for precise machine status information.

5) Steering Column. Comfort wheel with tilt and telescoping steering provides a comfortable driving position.

6) Transmission Console. Ergonomic gear shift lever with backlit gear indicators optimize efficiency.

7) Parking Brake Reset Valve. Parking brake cannot be released when air system is drained until valve button is reset.

8) Storage Compartment. Located under the trainer seat for a safe, uncluttered working environment.

9) Trainer Seat. Full-size, fully padded trainer seat features a backrest, wide hip and shoulder room, and seat belt for secure travel. Air suspension, optional.

10) Operator Window. Powered operator window and sliding trainer seat window offer simple operation and an unobstructed view.

11) Operator Controls. Easy to reach turn signal, high beam, intermittent windshield wiper and windshield washer controls are designed for optimum efficiency and comfort.

12) Heating/Air Conditioning. Electronically controlled four-speed fan and eleven vents deliver temperature-controlled air circulation for-a comfortable working environment in any climate. More robust air compressor offers greater durability and longer life.

Communication Systems Ready. Cab is prewired with power converter, speakers, wiring harness, antenna and mounting locations for add-on radio, closed circuit TV, and MineStar® systems.

Serviceability

Less time spent on maintenance means more time on the haul roads.

Servicing Ease. Easy access to daily service points simplifies servicing and reduces time spent on regular maintenance procedures. Enhanced serviceability and 500-hour service intervals are designed to increase machine availability and productivity.

Maintenance Platform. Provides access to engine, air filters, steering hydraulic tank and battery compartment.

In-Frame Access. Permits easy access to major components for easy servicing and removal.

Ground-Level Access. Allows convenient servicing to tanks, filters, drains, and engine shutdown. Ground-level VIMS data port permits easier downloading of information.

Transmission Lockout Switch. Ground level transmission lockout switch allows the truck to be serviced with the engine running, without the risk of accidental motion.

Autolube. Automatic lubrication system reduces maintenance time by automatically lubricating necessary components on a regular basis.

Fast Fill Service Center. Optional Wiggins fast fill service center features high speed fuel and oil exchange.

Oil Renewal System (ORS). Optional on-board engine oil management system is designed to increase availability and productivity by extending oil change intervals and reduce oil disposal labor and costs. ORS meters and injects used engine oil from the crankcase into the engine's fuel return line. New oil is manually added as a part of daily maintenance.

Scheduled Oil Sampling. S·O·S℠ sampling valves speed sampling and analysis reliability.

Pressure Test Points. Disconnect valves are conveniently located throughout the hydraulic systems for easy pressure testing.

Air Filters. Radial seal air filters are easy to change, reducing time required for air filter maintenance.

Sealed Electrical Connectors. Electrical connectors are sealed to lock out dust and moisture. Harnesses are braided for protection. Wires are color coded for easy diagnosis and repair.

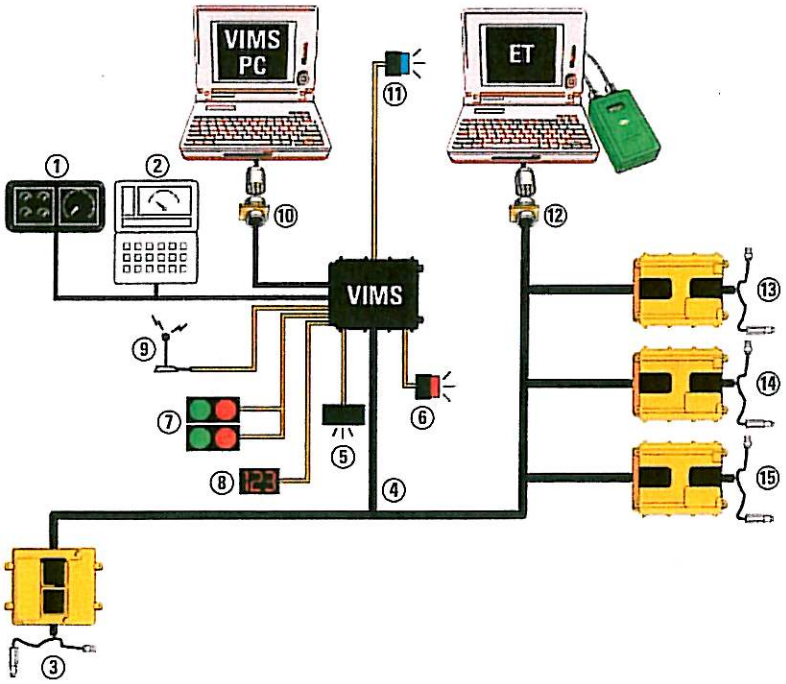
Cylinder Heads. Individual cylinder heads are interchangeable for easy removal and visual inspection of internal parts.

On-Board Diagnostic Systems. The VIMS system continuously checks all critical machine functions and components, and helps locate faults quickly for faster repair. Electronic control system enables quick diagnosis of engine conditions and effective maintenance and repairs utilizing the Electronic Technician (Cat ET) service tool.

Mirrors. The left side mirror mounting bracket is more robust and allows mirror glass to be easily replaced, without the need for a new mirror assembly. New mirror glass slides in and out of the carrier, reducing downtime and maintenance costs.

Monitoring System

Vital machine health and payload data keeps the 793D performing at peak production levels.



1 Gauge Cluster
2 Message Center and Keypad
3 ADEM III Engine Control Module
4 CAT Data Link
5 Action Alarm
6 Action Lamp
7 Payload Lamps
8 Payload Display (optional)
9 Radio System (optional)
10 Data Port (VIMS-PC)
11 Service Lamp
12 Diagnostic Connector (ET)
13 Integrated Brake Control (IBC) and Cooling Fan Control Module
14 Transmission/Chassis Control (TCC) Module
15 Road Analysis Control (RAC) Module (optional)

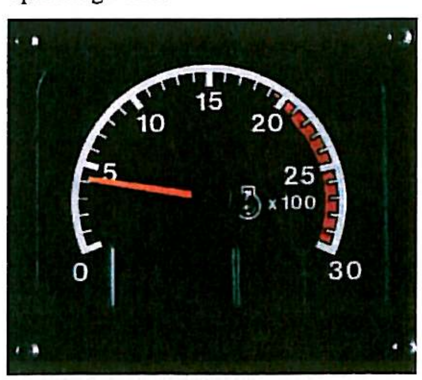
VIMS® Monitoring System. Intelligent Caterpillar designed machine monitoring system provides critical machine health and payload data in real-time to keep the 793D performing at top production levels.

Integrated System Monitoring. Sensors located throughout the machine systems enable the VIMS system to quickly exchange and monitor information from all machine systems for efficient, high performance operation.

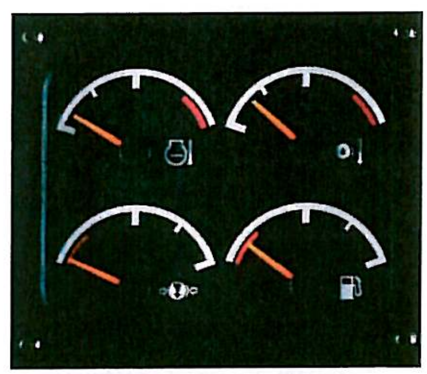
Advanced Diagnostics. VIMS system simplifies troubleshooting, reduces downtime and lowers operating costs by identifying abnormal conditions before they cause extensive damage.

Data Access. Monitoring and diagnostic information is stored on-board until it can be downloaded for analysis. Data can be accessed through the message center, transmitted via optional radio or downloaded onto a computer for detailed analysis.

Machine Management. Service technicians or mine personnel can download data and generate reports for better machine management. Data can be used to improve effectiveness of scheduled maintenance programs, maximize component life, improve machine availability, and lower operating costs.



Speedometer/Tachometer Module. Monitors three systems: engine speed, ground speed and gear indicator.



Gauge Cluster. Conveniently located gauge cluster maintains a constant display of vital machine functions, including:

- engine coolant temperature
- brake oil temperature
- air system pressure
- fuel level

Keypad. Provides operator or service technician immediate access to current machine information, gauge values and stored data through the message center display.

Message Center. Displays messages requested by operator and advises operator of abnormal machine conditions.

Alert System. Three-category warning system alerts operator of abnormal machine health conditions.

- **Category I.** Machine or system needs attention.
- **Category II.** Requires operator to evaluate and correct situation before continuing work.
- **Category III.** Immediate shutdown required to prevent serious damage to machine or system.

Production Management. Production Management enhances truck/loading tool effectiveness, improves fleet productivity and helps extend the life of truck frames, tires, rims and power train components, while lowering operating and maintenance cost.

Payload Management. Max Payload Speed Manager is a feature that aids in managing the Caterpillar 10/10/20 Overload Policy. Based on target payload weight and overload settings, the VIMS system logs and warns the operator when the truck reaches overload after 2nd gear reweigh. The truck will be limited to 2nd gear at 1,750 rpm, and the automatic retarder speed setting is reduced to 1,750 rpm until the load is dumped.

Payload management enables the manager to enhance truck/loading tool effectiveness and productivity levels by preventing overloads that can cause damage to component life and affect operator safety.

The Payload Weight Distribution chart illustrates the benefit of managing payloads with VIMS production management tools.

Data Storage. The VIMS system stores payload information, which is used to manage production. The system stores up to 2,400 production cycles for a complete record of payload weight, cycle times, distances and actual dates/times. It also allows storage of maintenance data such as Events, Trends, Histograms, Cumulatives, Snapshot and Dataloggers. This data allows the user to identify potential problems before they occur, utilizing the efficiency of Preventative Maintenance.

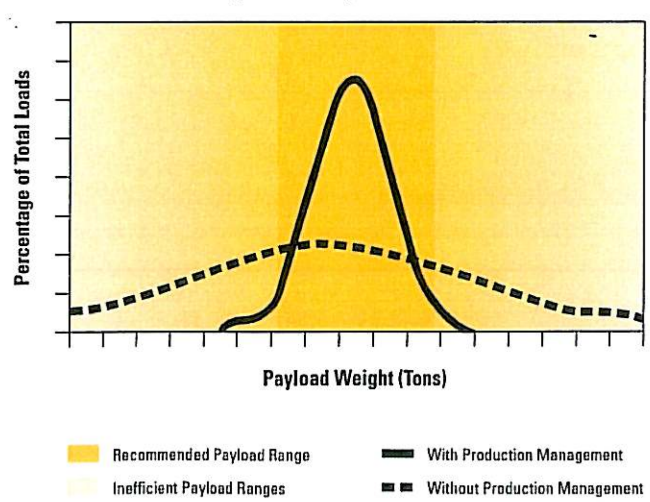
External Payload Indicators. External lights on both sides of the truck signals loading tool operator when to cease loading for optimum payloads without overloading. Optional external payload display with digital numeric monitor are available to replace the standard red/green indicator lamps.

Road Analysis Control (RAC). Optional system monitors haul road conditions by measuring frame rack and pitch to improve haul road maintenance, cycle times, tire life and fuel efficiency.

VIMS-PC. VIMS-PC, the off-board reporting software program, allows service personnel to download a complete record of machine health and productivity data to a laptop computer for diagnosis and analysis. Easy-to-use software enables service technicians and mine personnel to generate health and payload reports for more effective machine management.

VIMS Supervisor. Optional software allows mine personnel to easily manage and interpret VIMS data for optimum fleet management and productivity.

Payload Weight Distribution



Truck Body Systems

Cat designed and built for rugged performance and reliability in the toughest mining applications.

Cat Truck Bodies. Caterpillar offers three specific body styles and custom body options to help customers obtain the lowest cost-per-ton hauling solution.

- Dual-Slope
- Flat Floor
- Mine Specific Design (MSD II)

Body Selection. Selection of the right body depends on material and haul road conditions. The better the match of body to application, the greater the efficiency. Your Cat dealer can help you select the right body system for your site specific applications.

Body/Chassis Integration. Caterpillar truck bodies are designed and matched with the integrated chassis system for optimum structural reliability, durability and long life.

Electronic Hoist Control. Provides the operator with better control of the load when dumping, including over-center load control and modulated control throughout the operating range.
The automatic body snubbing feature reduces impact on the frame, hoist cylinders and operator.

Fast Hoist Cycle Times. Two-stage hoist cylinders provide fast dump cycle times of 20.25 seconds for raise and 17.5 seconds for lower.

Body Liners. A variety of liner options are available to save weight and extend the body system's life. Wear surfaces and liners are equipped to handle tough impact loads while resisting abrasion. Wear plates deliver long life in high wear areas. Modular liner plate packages:

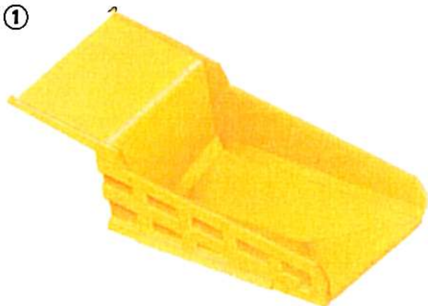
- Smooth plate
- Rock box
- Zipper grid
- Mechanically Attached Wear Plate System (MAWPS)

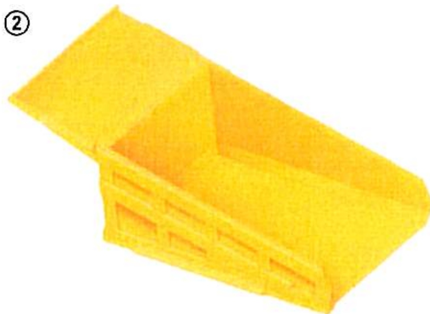
Custom Body Options. Tail extensions, sideboards, tumblebars, rock boxes and rock shedders are available to maintain rated payload, reduce spillage, and improve hauling efficiencies.

- Sideboards are designed to maximize or attain gross machine weight.
- Tail extensions are used to help retain the rear portion of the pile and limit load spillage on haul roads, extending tire life.

Body Design. Cat truck bodies are designed for optimal strength, capacity and durability. Wear surfaces are equipped to handle even the toughest impact and abrasion over the long haul without diminishing capacity.

- Five-Sided Beams tie in the sidewall and floor junctions add increased body rigidity and strength.
- Wide Ribs in body floor provide increased durability and impact support.
- Full-Length Stringers create strength and rigidity throughout the bed.
- Box Section Beams offer increased durability in the floor, sidewall, top rail, corner, and cab canopy areas.

① 

② 

③ 

1) Dual-Slope Body. The dual-slope body design with V-shaped floor provides excellent load retention, maintains a low center of gravity, reduces shock loading, and maintains optimum load distribution on steep inclines and in challenging haul road conditions.

- Reinforced, rolled steel top rail increases body strength and protects the body from damage caused by the loading tool or falling material
- 8 degree "V" reduces shock loading and centers the load.
- 7.5 degree forward body slope and 16 degree ducktail slope helps retain loads on steep grades.

2) Flat Floor Body. The flat floor design with slight incline delivers excellent payload capacity, high dump clearances and smooth, controlled dumping.

- Flat floor design provides consistent wear characteristics on body tail.
- 12 degree forward body slope provides good load retention on better maintained haul roads.
- 400 Brinell steel on surfaces provides excellent wear.

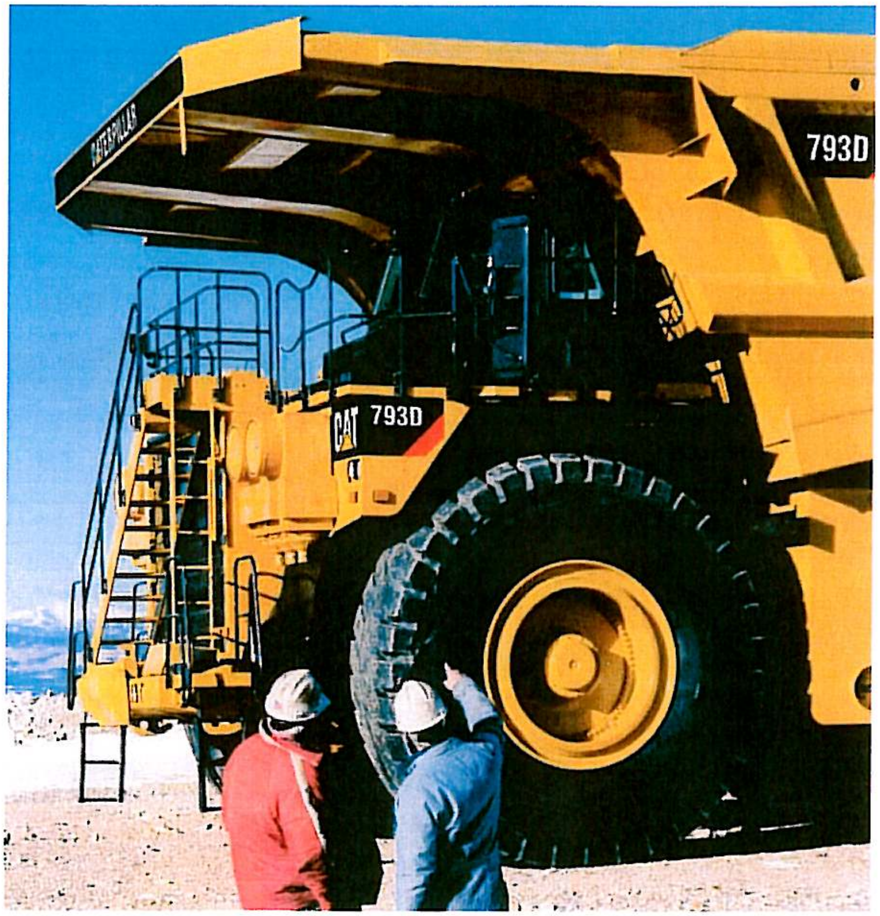
3) Mine Specific Design (MSD II) Body. The lightweight MSD II body is based on the flat floor design and is customized to maximize payload potential and minimize cost-per-ton. Each MSD II body design begins with a detailed mine site profile to develop a body suitable for a mine's individual needs.

Target Payload Strategy. Your Caterpillar Dealer can help you manage to target payload to maximize equipment utilization, ensure safe operation, increase productivity and lower cost-per-ton.

- Underloading increases costs due to lost payloads, underutilizes equipment, and drives cost-per-ton.
- Overloading or surpassing maximum gross machine weight, causes excessive wear on vehicle components such as brakes, tires and drivetrain, reducing component life and increasing maintenance costs and repairs.

Customer Support

Caterpillar dealers have what it takes to keep mining haul trucks productive.



Commitment Makes the Difference. Cat dealers offer a wide range of solutions, services and products that help you lower costs, enhance productivity and manage your operation more efficiently. Support goes far beyond parts and service. From the time you select a piece of Cat equipment until the day you rebuild, trade or sell it, the support you get from your Cat dealer makes the difference that counts.

Dealer Capability. Cat dealers will provide the level of support you need, on a global scale. Dealer expert technicians have the knowledge, experience, training and tooling necessary to handle your repair and maintenance needs, when and where you need them.

Product Support. Cat dealers believe superior products deserve superior support. When Cat products reach the field, they are supported by a worldwide network of parts distribution facilities, dealer service centers, and technical training facilities to keep your equipment up and running. Cat customers rely on prompt, dependable parts availability and expertise through our global dealer network, ready to meet your needs 24/7.

Service Support. Every piece of Cat equipment is designed and built to provide maximum productivity and operating economy throughout its working life. Cat dealers offer a wide range of service plans that will maximize uptime and return on your investment, including:

- Preventive Maintenance Programs
- Diagnostic Programs, such as Scheduled Oil Sampling and Technical Analysis
- Rebuild and Reman Options
- Customer Support Agreements

Application Awareness. Operating and maintenance costs are influenced by many application and site-specific factors, such as: material density, loading position, payload, grades, speeds, haul road design, and maintenance. To optimize total cost of ownership and productivity, your Cat dealer can provide you with a fundamental understanding of the effects application characteristics and operating techniques have on maintenance and operating costs.

Operation. With today's complex products, equipment operators must have a thorough understanding of machine systems and operating techniques to maximize efficiency and profitability. Your Cat dealer can arrange training programs to help operator's improve productivity, decrease downtime, reduce operating costs, enhance safety, and improve return on the investment you make in Cat products.

Technology Products. Cat dealers offer a range of advanced technology products such as VIMS® monitoring system and MineStar® information management system. These products include radio data communications, machine monitoring and diagnostics, fleet management, and haul road maintenance software – all designed to improve fleet efficiency, increase productivity, and lower costs.

www.cat.com. For more complete information on Cat products, dealer services, and industry solutions, visit us on the web at www.cat.com.

Safety

Caterpillar mining machines and systems are designed with safety as the first priority.

Product Safety. Caterpillar has been and continues to be proactive in developing mining machines that meet or exceed safety standards. Safety is an integral part of all machine and systems designs.

SAE and ISO Standards. The 793D is designed to many national and international standards.

Integral ROPS Cab. Resiliently mounted to the main frame to reduce vibration and sound, the integral ROPS structure is designed as an extension of the truck frame. The ROPS/FOPS structure provides "five sided protection" for the operator.

Ladder/Secondary Egress. A wide, stationary stairway allows easy access to and from the machine. The ladder on the left side of the machine permits secondary access or emergency egress.

Brake Systems. Four corner oil-cooled braking system provides excellent control in slippery conditions. The service brakes and retarding system are actuated by modulated hydraulic pressure, while secondary and parking brake functions are spring applied and hydraulic released. This system assures braking in the event of complete hydraulic failure.

Steering System. A twin double-acting cylinder steering system is designed to deliver precise control under all loading and underfoot conditions. The steering hydraulic system is separate from the main hydraulic system to prevent cross-contamination and overheating from other sources.

Engine Shutoff Switch. A secondary engine shutoff switch is located at ground level.

Electrical System Disconnect. A battery disconnect switch, located directly above the front bumper provides ground level lockout of the electrical system.

Overload Policy. Safety is integral to maintaining the highest productivity in mining machine operation. The Caterpillar 10/10/20 Overload Policy assures that steering and braking systems have sufficient capacity to perform, even at 20% overload.

Standard Safety Features.

- Slip resistant surfaces
- 75 mm (3 in) wide orange three-point operator restraint
- Wide-angle mirrors
- Body raised indicator
- Body retaining cable
- Guard rails
- Reverse neutralizer when dumping
- Low interior sound level

SAFETY.CAT.COM™.

Engine

Engine Model	Cat 3516B HD EUI	
Rated Power	1,750 rpm	
Gross Power – SAE J1995	1801 kW	2,415 hp
Net Power – SAE J1349	1743 kW	2,337 hp
Net Power – ISO 9249	1743 kW	2,337 hp
Net Power – 80/1269/EEC	1743 kW	2,337 hp
Torque Rise	23%	
Bore	170 mm	6.7 in
Stroke	215 mm	8.5 in
Displacement	78 L	4,760 in^3

- Power ratings apply at 1,750 rpm when tested under the specified condition for the specified standard.
- Ratings based on SAE J1995 standard air conditions of 25° C (77° F) and 99 kPa (29.61 Hg) dry barometer. Power based on fuel having API gravity of 35 at 16° C (60° F) and an LHV of 42 780 kJ/kg (18,390 Btu/lb) when engine used at 30° C (86° F).
- No engine derating required up to 2750 m (9,000 ft) altitude.
- Compliant with U.S. Environmental Protection Agency Tier I emissions standards.

Weights – Approximate

Gross Machine Operating Weight	383 749 kg	846,000 lb
Chassis Weight	116 707 kg	257,294 lb
Body Weight Range	21 795 – 54 431 kg / 48,050 – 120,000 lb	

- Chassis weight with 100% fuel, hoist, body mounting group, rims and tires.
- Body weight varies depending on how body is equipped.

Operating Specifications

Nominal Payload Capacity	218 tonnes	240 tons
Body Capacity (SAE 2:1)	129 m^3	169 yd^3
Maximum Capacity	Custom	
Top Speed – Loaded	54.3 km/h	33.7 mph
Steer Angle	36°	
Turning Diameter – Front	28.42 m	93 ft 3 in
Turning Circle Clearance Diameter	32.66 m	107 ft 2 in

- Body Capacity (SAE 2:1) with Dual Slope Body.
- Refer to the Caterpillar Mining Truck 10/10/20 Overload Policy for maximum gross machine weight limitations.

Transmission

Forward 1	11.8 km/h	7.3 mph
Forward 2	15.9 km/h	9.9 mph
Forward 3	21.5 km/h	13.4 mph
Forward 4	29 km/h	18.1 mph
Forward 5	39.4 km/h	24.5 mph
Forward 6	54.3 km/h	33.7 mph
Reverse	10.9 km/h	6.8 mph

- Maximum travel speeds with standard 40.00-R57 tires.

Final Drives

Differential Ratio	1:8:1
Planetary Ratio	16:1
Total Reduction Ratio	28.8:1

- Planetary, full-floating.

Suspension

Effective Cylinder Stroke – Front	130.5 mm	5.2 in
Effective Cylinder Stroke – Rear	105.5 mm	4.2 in
Rear Axle Oscillation	±4.9°	

Brakes

Outside Diameter	874.5 mm	34.5 in
Brake Surface – Front	89 817 cm^2	13,921 in^2
Brake Surface – Rear	134 500 cm^2	20,847 in^2
Standards	J-ISO 3450 JAN88, ISO 3450:1996	

- Gross Machine Operating Weight is 383 749 kg (846,000 lb).

Body Hoists

Pump Flow – High Idle	846 L/min	224 gal/min
Relief Valve Setting – Raise	20 370 kPa	2,955 psi
Body Raise Time – High Idle	20.25 Seconds	
Body Lower Time – Float	19.26 Seconds	
Body Power Down – High Idle	17.51 Seconds	

- Twin, two-stage hydraulic cylinders mounted inside main frame; double-acting cylinders in second stage.
- Power raise in both stages; power down in second stage.
- Automatic body-lower modulation reduces impact on frame.

Weight Distributions – Approximate

Front Axle – Empty	46%
Rear Axle – Empty	54%
Front Axle – Loaded	33%
Rear Axle – Loaded	67%

Capacity – Dual Slope – 100% fill factor

Struck	96 m^3	126 yd^3
Heaped (SAE 2:1)	129 m^3	169 yd^3

Service Refill Capacities

Fuel Tank	4354 L	1,150 gal
Fuel Tank (optional)	4922 L	1,300 gal
Cooling System	973 L	257 gal
Crankcase	265 L	70 gal
Rear Axle Housing	1022 L	270 gal
Steering Tank	227 L	60 gal
Steering System (Includes Tank)	341 L	90 gal
Brake/Hoist Hydraulic Tank	769 L	203 gal
Brake/Hoist System (Includes Tank)	1375 L	363 gal
Torque Converter/ Transmission Sump	102 L	27 gal
Torque Converter/Transmission System (Includes Sump)	189 L	50 gal

ROPS

ROPS Standards

- ROPS (Rollover Protective Structure) for cab offered by Caterpillar meets ISO 3471:1994 ROPS criteria.
- FOPS (Falling Objects Protective Structure) meets ISO 3449:1992 Level II FOPS criteria.

Sound

Sound Standards

- The operator sound pressure level measured according to work cycle procedures specified in ANSI/SAE J1166 MAY90 is 76 dB(A) for cab offered by Caterpillar, when properly installed and maintained and tested with doors and windows closed.
- The exterior sound pressure level for the standard machine measured at a distance of 15 m (49 ft) according to the test procedures specified in SAE J88 APR95, mid-gear moving operation is 89 dB(A).
- Hearing protection may be needed when operating with an open operator station and cab (when not properly maintained or doors/windows open) for extended periods or in a noisy environment.

Steering

Steering Standards	SAE J15111 OCT90, ISO 5010:1992

- Gross Machine Operating Weight is 383 749 kg (846,000 lb).

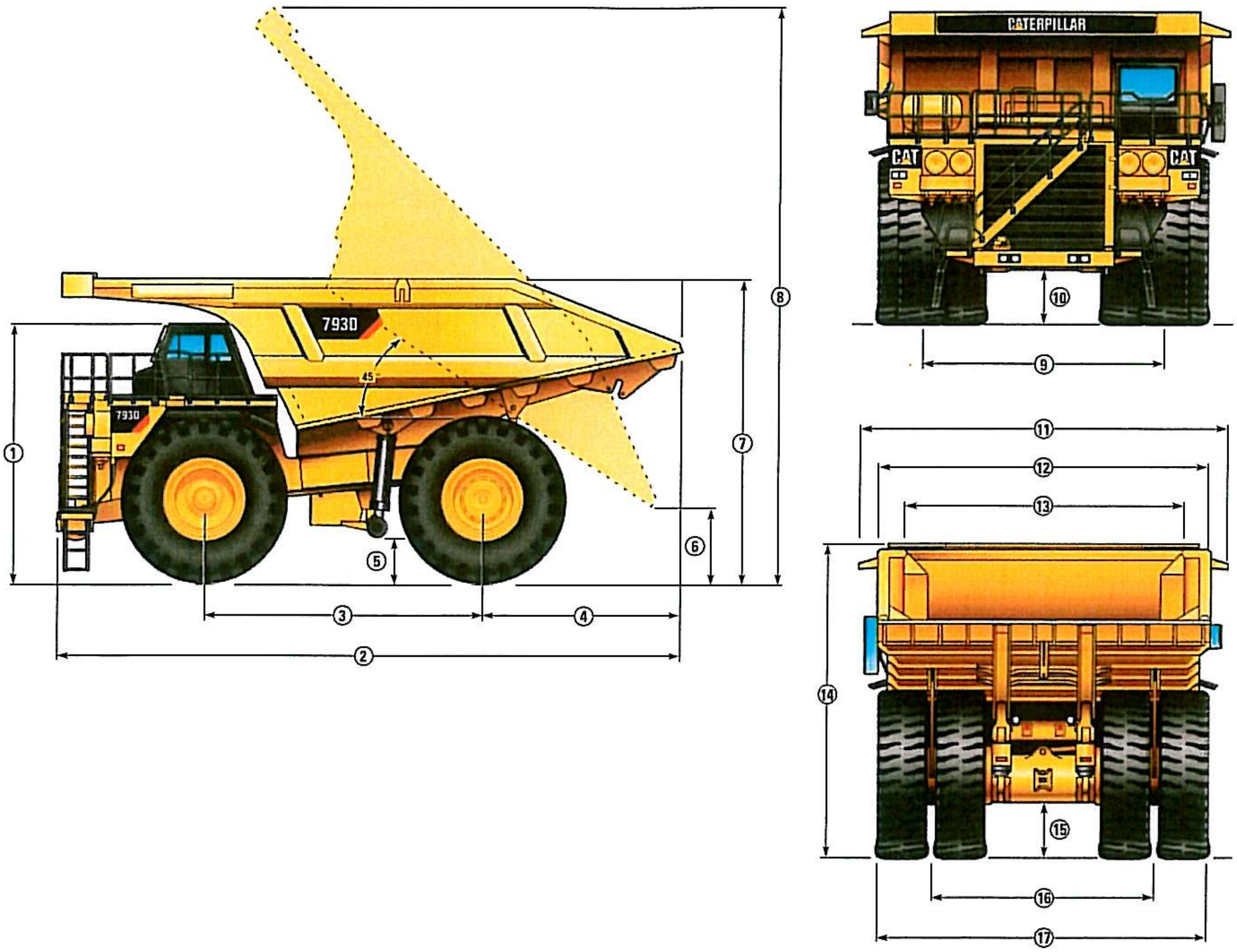
Tires

Standard Tire	40.00R57

- Productive capabilities of the 793D truck are such that, under certain job conditions, TKPH (TMPH) capabilities of standard or optional tires could be exceeded and, therefore, limit production.
- Caterpillar recommends the customer evaluate all job conditions and consult the tire manufacturer for proper tire selection.

Dimensions

All dimensions are approximate. Shown with MSD II Body. Dimensions are with Dual Slope Body.



1	Height to Top of ROPS	5584 mm	18 ft 4 in
2	Overall Length	12 862 mm	42 ft 3 in
3	Wheelbase	5905 mm	19 ft 5 in
4	Rear Axle to Tail	3772 mm	12 ft 5 in
5	Ground Clearance	1005 mm	3 ft 4 in
6	Dump Clearance	1364 mm	4 ft 6 in
7	Loading Height – Empty	5871 mm	19 ft 4 in
8	Overall Height – Body Raised	13 113 mm	43 ft 1 in
9	Centerline Front Tire Width	5610 mm	18 ft 5 in
10	Engine Guard Clearance	1294 mm	4 ft 3 in
11	Overall Canopy Width	7680 mm	25 ft 3 in
12	Outside Body Width	6940 mm	22 ft 10 in
13	Inside Body Width	6500 mm	21 ft 4 in

14	Front Canopy Height	6494 mm	21 ft 4 in
15	Rear Axle Clearance	1128 mm	3 ft 8 in
16	Centerline Rear Dual Tire Width	4963 mm	16 ft 3 in
17	Overall Tire Width	7605 mm	24 ft 11 in

Standard Equipment

Standard equipment may vary. Consult your Caterpillar dealer for details.

- Air Line Dryer (2)
- Air Starter, Vane-type
- Alarm, Back-up
- Alternator (105-amp)
- Automatic Lubrication System (Lincoln)
- Automatic Retarder Control
- Batteries, 93-amp-hour, Low-maintenance, 12-volt (2)
- Body Mounting Group
- Brake Release Motor for Towing
- Brake System
  - Oil-cooled, Multiple-disc, Front and Rear
  - Parking
  - Secondary, Emergency
- Cab, ROPS
  - Air Cleaner Service Indicator
  - Air Conditioner
  - Ashtray
  - Cigarette Lighter
  - Coat Hook
  - Diagnostic Connector
  - Electric Engine Control Fault Indicator
  - Electric Window (Operator Only)
  - Entertainment Radio Ready
  - Glass, Tinted
  - Heater/defroster: 11 070 kCal (43,930 Btu)
  - Horn
  - Insulated and Sound Suppressed
  - Dome Courtesy Light
  - Mirrors, Right and Left
  - Quad-Gauge Panel
    - Air Pressure
    - Brake Oil Temperature
    - Coolant Temperature
    - Fuel Level
  - Seat, Air Suspension w/3-piece compartment
  - Seat, Passenger, Non-suspension
  - Seat Belts, 75 mm (3 in) wide retractable
  - Speedometer
  - Steering, Automatic Supplemental
  - Steering Wheel, Tilt, Padded, Telescopic
  - Storage Compartment
  - Sun Visor
  - Tachometer
  - Transmission Gear Indicator
  - VIMS Keypad
  - VIMS Message Center with Universal Gauge
  - Windshield Wiper and Washer
- Driveline Guard
- Dumping, Auxiliary Quick Connect for "Buddy Dumping"
- Electrical System, 12-volt to 24-volt
- Engine – Caterpillar 3516B HD EUI Diesel Engine
  - Air Cleaner with Precleaner (2)
  - Elevated Low Idle Control
  - Ether Starting Aid, Automatic
  - Multi-Point Oil Pressure Sensing
  - Turbocharger (4)/Aftercooler
- Fast-fill Fuel System, Wiggins
- Ground Level
  - Battery Disconnect
  - Engine Shutdown
  - VIMS Dataports (2)
- Lighting System
  - Back-up Lights, Halogen
  - Direction Signals and Hazard Warning (Rear Halogen)
  - Headlights, Halogen, With Dimmer
  - LH Ladder Light and Service Deck Lights
  - Stop and Tail Lights (LED)
  - Under-hood Light
- Oil Change System, Quick Service
- Reservoirs (Separate)
  - Brake/Hoist
  - Steering/Fan
  - Transmission/Converter
- Rims, Center Mounted for 40.00-R57 Tires
- Rock Ejectors
- Steering, Auxiliary Quick Connect for Towing
- Tie Down Eyes
- Tow Hooks, Front
- Tow Pin, Rear
- Traction Control System
- Transmission
  - 6-speed, Automatic Power Shift
  - Body-up Shift Inhibitor
  - Controlled Throttle Shifting
  - Directional Shift Management
  - Electronic Control and Downshift Inhibitor
  - Lock-up Torque Converter
  - Neutral Coast Inhibitor
  - Neutral Start Switch, Reverse Shift Inhibitor
  - Programmable Top Gear
  - Reverse Neutralizer during Dumping
- Vandalism Protection Locks
- VIMS® Monitoring System with Max Payload Speed Manager

Optional Equipment

With approximate changes in operating weights.
Optional equipment may vary. Consult your Caterpillar Dealer for specifics.

	kg	lb
Air suspension companion seat	12	27
Catwalk and handrail assemblies rear of cab	83	183
External payload display	54	119
Fuel tank (4921 L/1,300 gal)	139	306
Heated mirrors	5	10
Heater, engine coolant and oil 240-volt external power	15	33
Heater, fuel recirculation type, non-electric	17	37
HID lights	14	31
Hub odometer (km or miles)	6	13

	kg	lb
Oil Renewal System (ORS)	8	17
Prelubrication system	30	66
Rear axle filtration cooler	75	165
Retractable visor	1	2
Road Analysis Control (RAC)	6	13
Starting systems:		
Air (IR turbine)	-15	-33
Air (TDI turbine)	-31	-68
Transmission lockout – ground level switch	5	11
Wheel chocks	26	57
Wiggins service center	137	302

Weight/Payload Calculation*

	kg	lb
Chassis**	64 061	141,230
Body Mounting Group	735	1,620
Tires (6) 40.00R57	21 364	47,100
Wheel Arrangement – Standard with 29" Rims	30 547	67,344
TOTAL EMPTY CHASSIS WEIGHT (CLEAN)	**116 707**	**257,294**
4% Debris	4668	10,292
Body Weight*	32 129	70,832
Full Liner	11 025	24,306
Tail Extension	1005	2,215
Side Boards	1332	2,936
Gross Machine Weight (empty)	**166 866**	**367,875**

* With Dual Slope Body.
** Includes standard arrangement, 100% fuel, starting system, seats, fan arrangement, exhaust system, tires, and all mandatory attachments less wheel group.

793D Mining Truck

For more complete information on Cat products, dealer services, and industry solutions, visit us on the web at **www.cat.com**

Materials and specifications are subject to change without notice.
Featured machines in photos may include additional equipment.
See your Caterpillar dealer for available options.

AEHQ5600-01 (11-07)

Replaces AEHQ5600

CATERPILLAR®

Retarding Performance – Standard

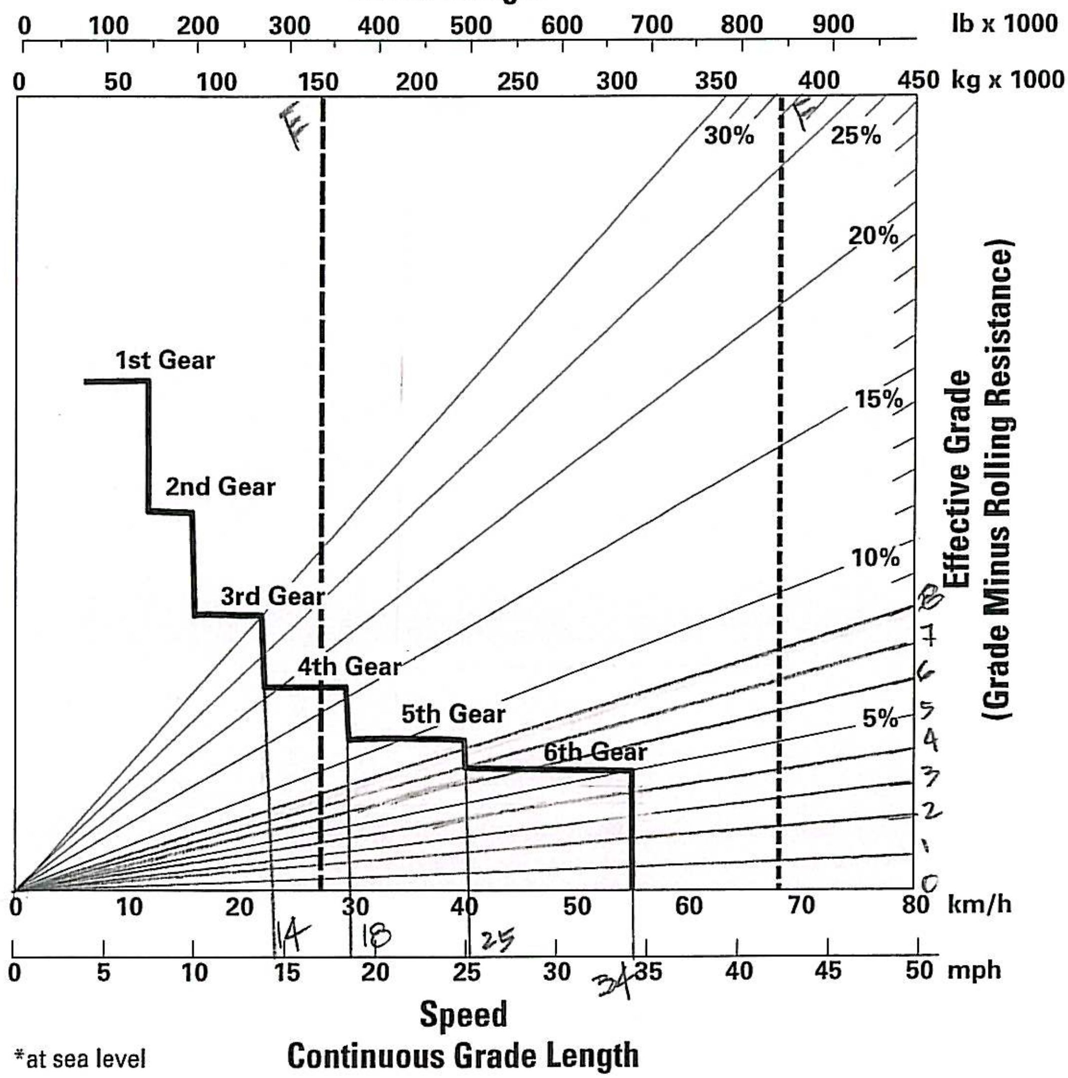
To determine retarding performance: Add lengths of all downhill segments and, using this total, refer to proper retarding chart. Read from gross weight down to the percent effective grade. Effective grade equals actual % grade minus 1% for each 10 kg/t (20 lb/ton) of rolling resistance. From this weight-effective grade point, read horizontally to the curve with the highest obtainable gear, then down to maximum descent speed brakes can properly handle without exceeding cooling capacity. The following charts are based on these conditions: 32° C (90° F) ambient temperature, at sea level, with 40.00R57 tires.

NOTE: Select the proper gear to maintain engine rpm at the highest possible level, without overspeeding the engine. If cooling oil overheats, reduce ground speed to allow transmission to shift to the next lower speed range.

425 K E.
846 LOAD

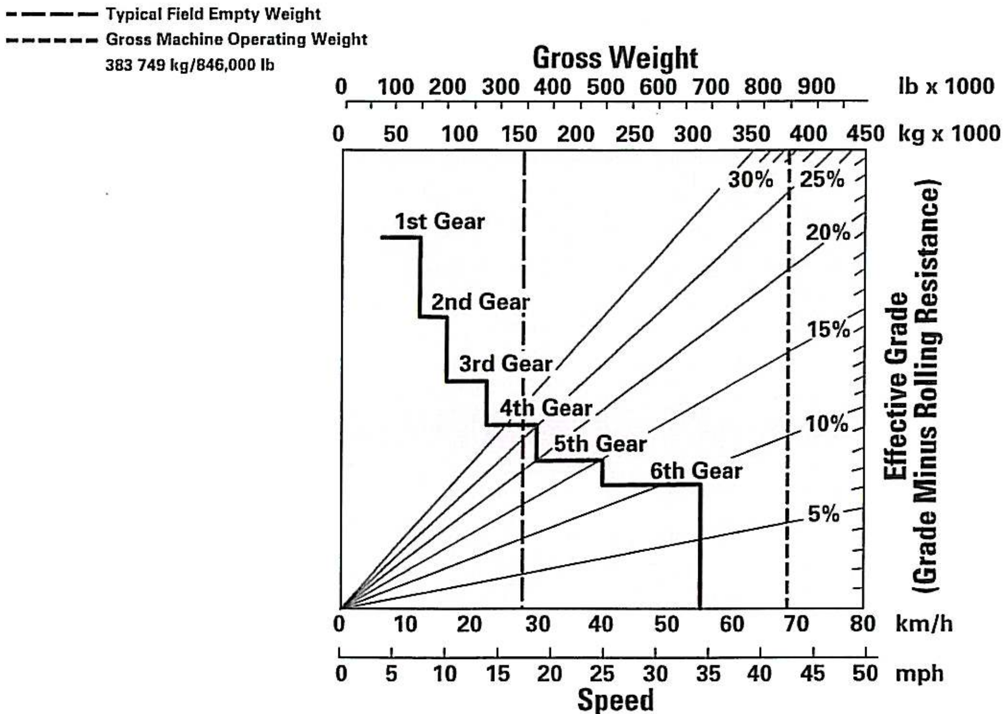
- - - - - Typical Field Empty Weight
- - - - - - - - Gross Machine Operating Weight
383 749 kg/846,000 lb

Standard Retarding*
Gross Weight



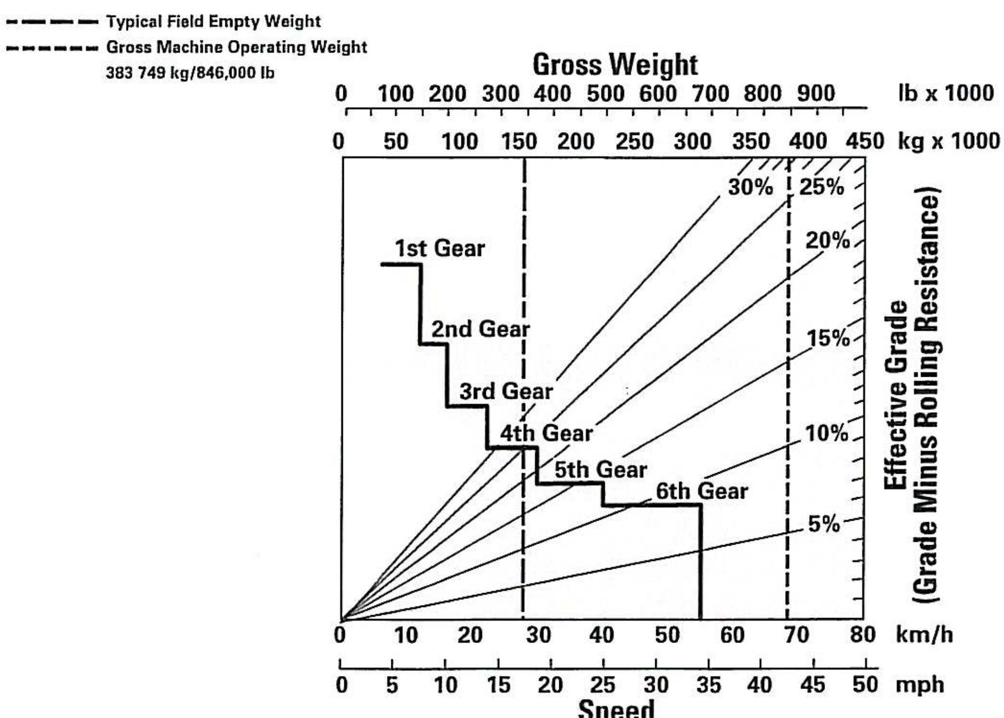
0-8%
Downgrade
Empty: 34mph
Full: 7-8: 14 mph
6: 18
4-5: 25
0-3: 34

Retarding Performance – Standard



Grade Distance — 450 m (1,475 ft.)*

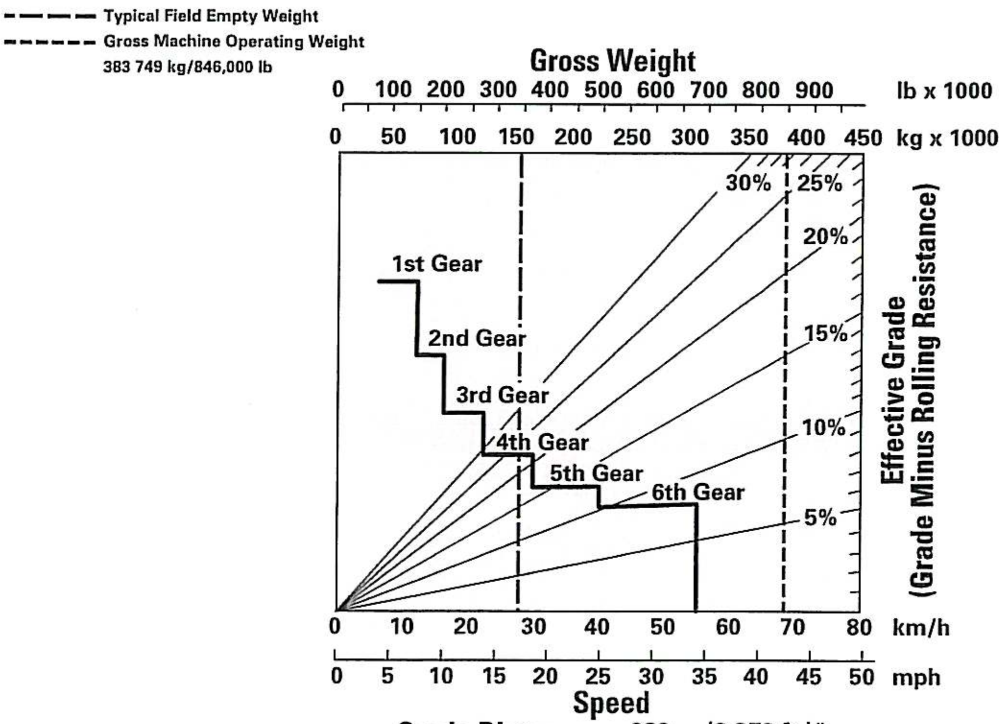
*at sea level



Grade Distance — 600 m (1,975 ft.)*

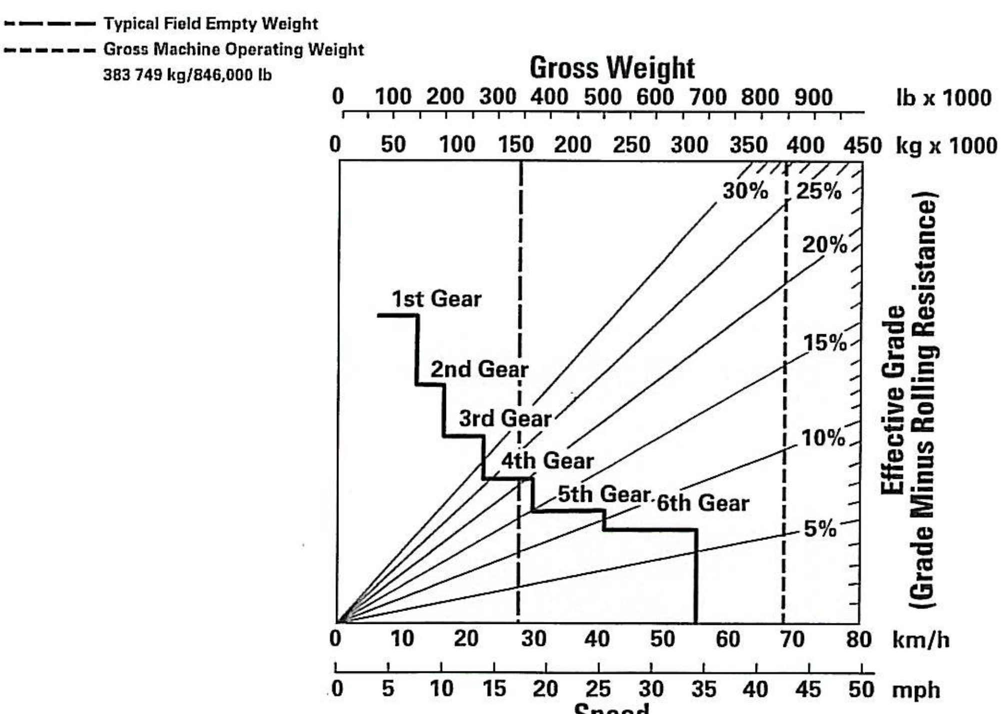
*at sea level

Retarding Performance – Standard



Grade Distance — 900 m (2,950 ft.)*

*at sea level



Grade Distance — 1500 m (4,900 ft.)*

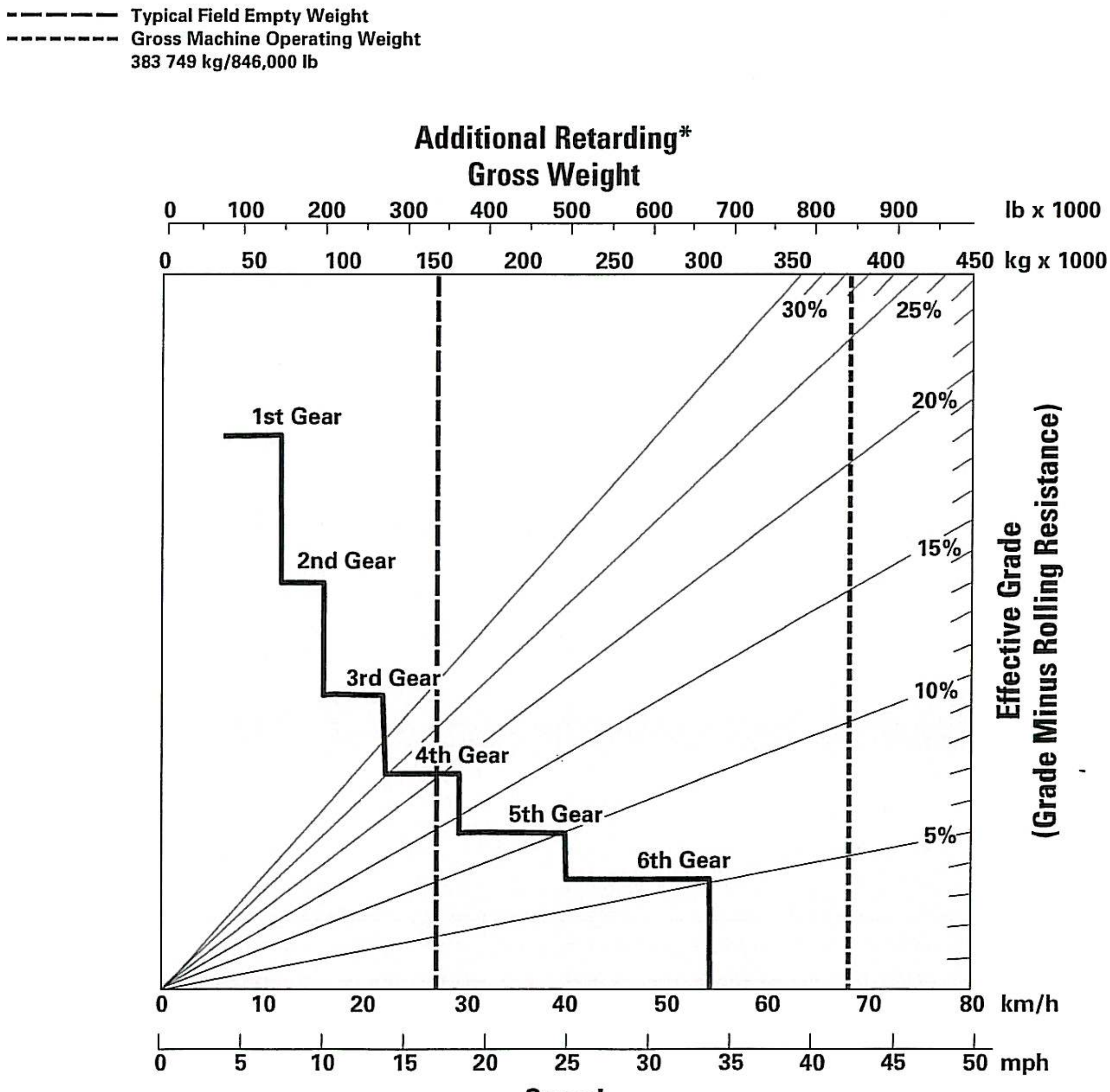
*at sea level

Retarding Performance – Extra Retarding

To determine retarding performance: Add lengths of all downhill segments and, using this total, refer to proper retarding chart. Read from gross weight down to the percent effective grade. Effective grade equals actual % grade minus 1% for each 10 kg/t (20 lb/ton) of rolling resistance. From this weight-effective grade point, read horizontally to the curve with the highest obtainable gear, then down to maximum descent speed brakes can properly handle without exceeding cooling capacity. The following charts are based on these conditions: 32° C (90° F) ambient temperature, at sea level, with 40.00R57 tires.

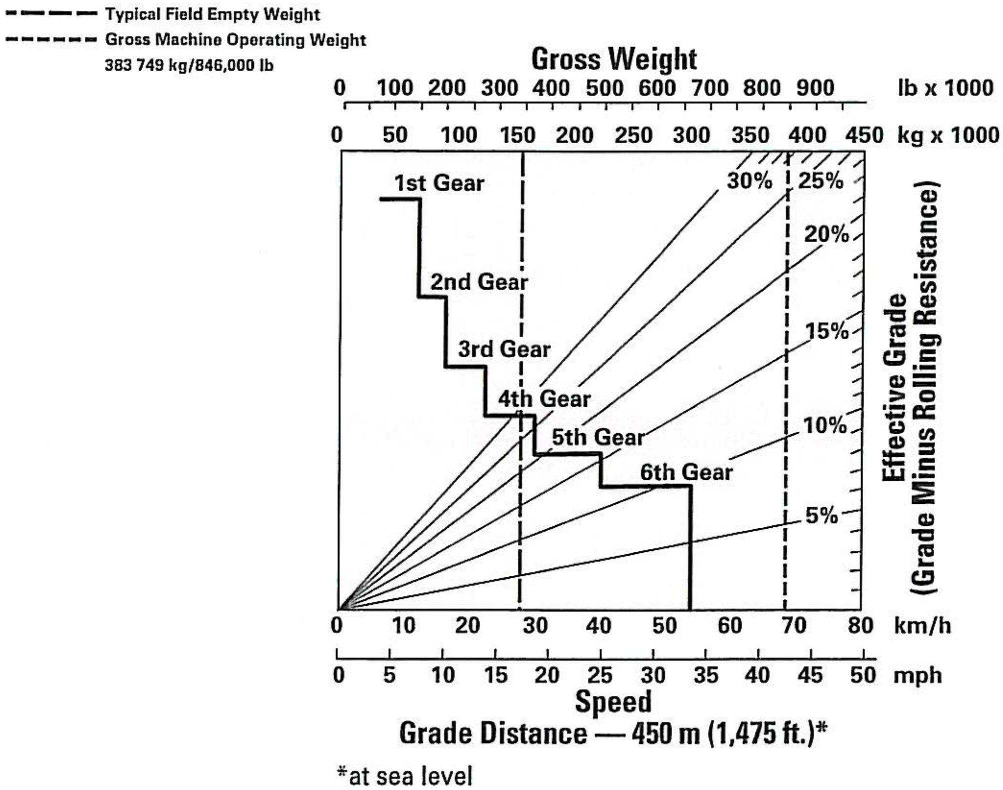
NOTE: Select the proper gear to maintain engine rpm at the highest possible level, without overspeeding the engine. If cooling oil overheats, reduce ground speed to allow transmission to shift to the next lower speed range.

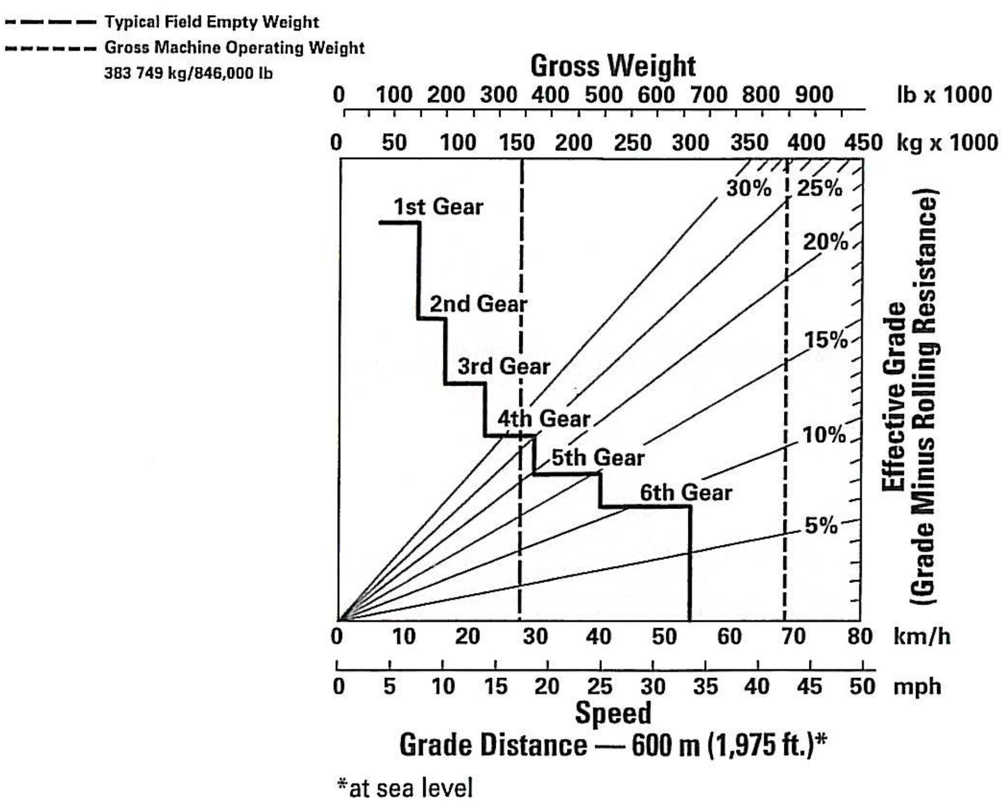
Additional Retarding*



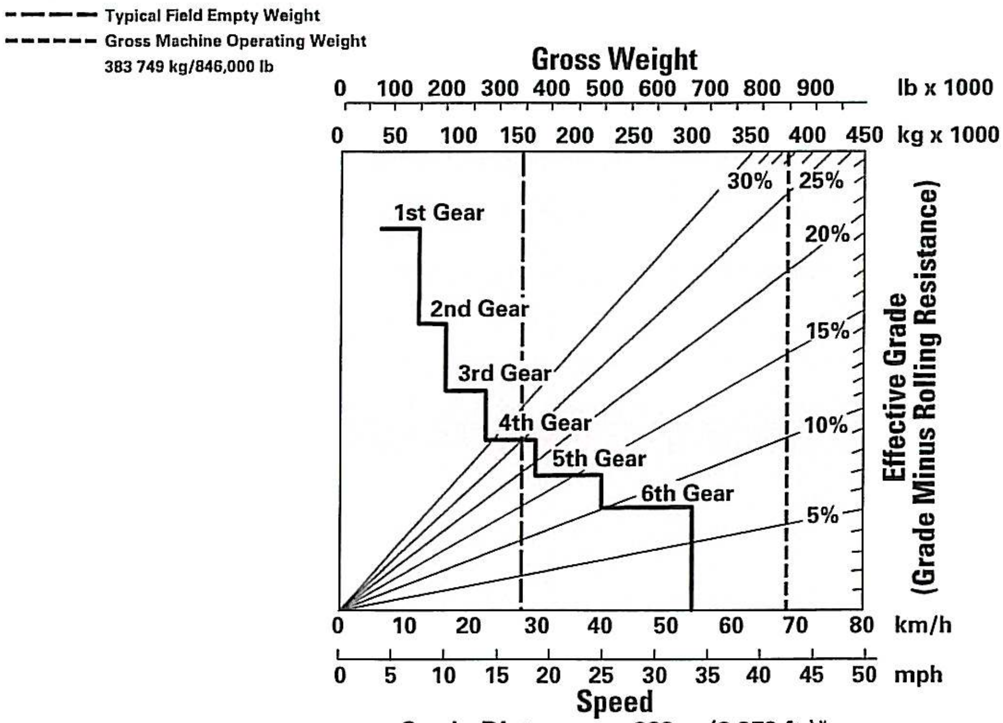
*at sea level

Retarding Performance – Extra Retarding



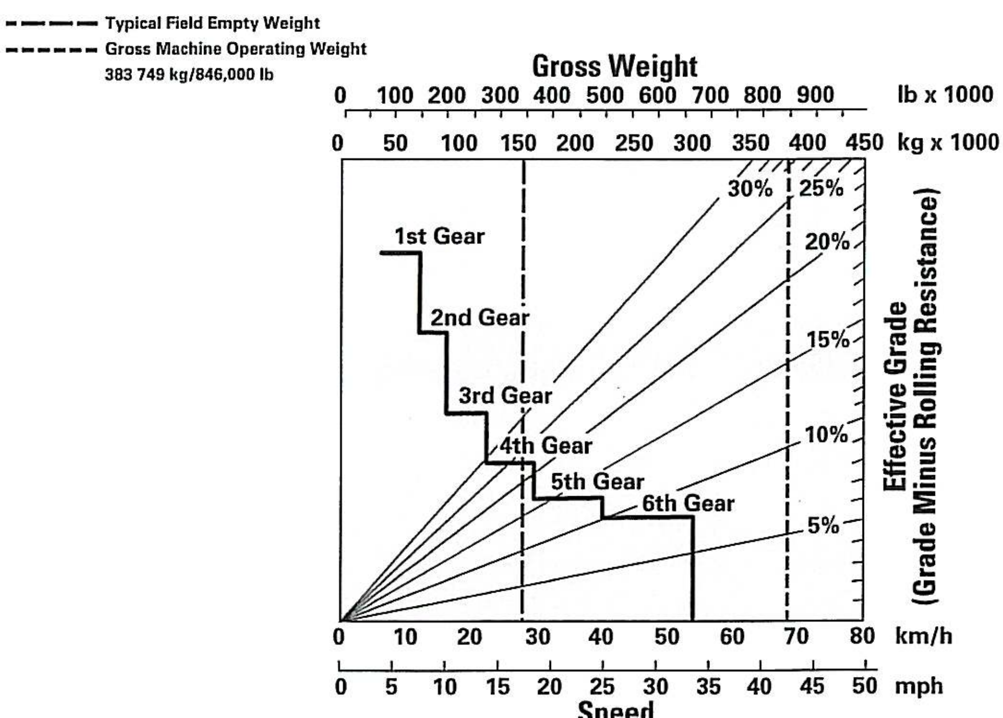


Retarding Performance – Extra Retarding



Grade Distance — 900 m (2,950 ft.)*

*at sea level



Grade Distance — 1500 m (4,900 ft.)*

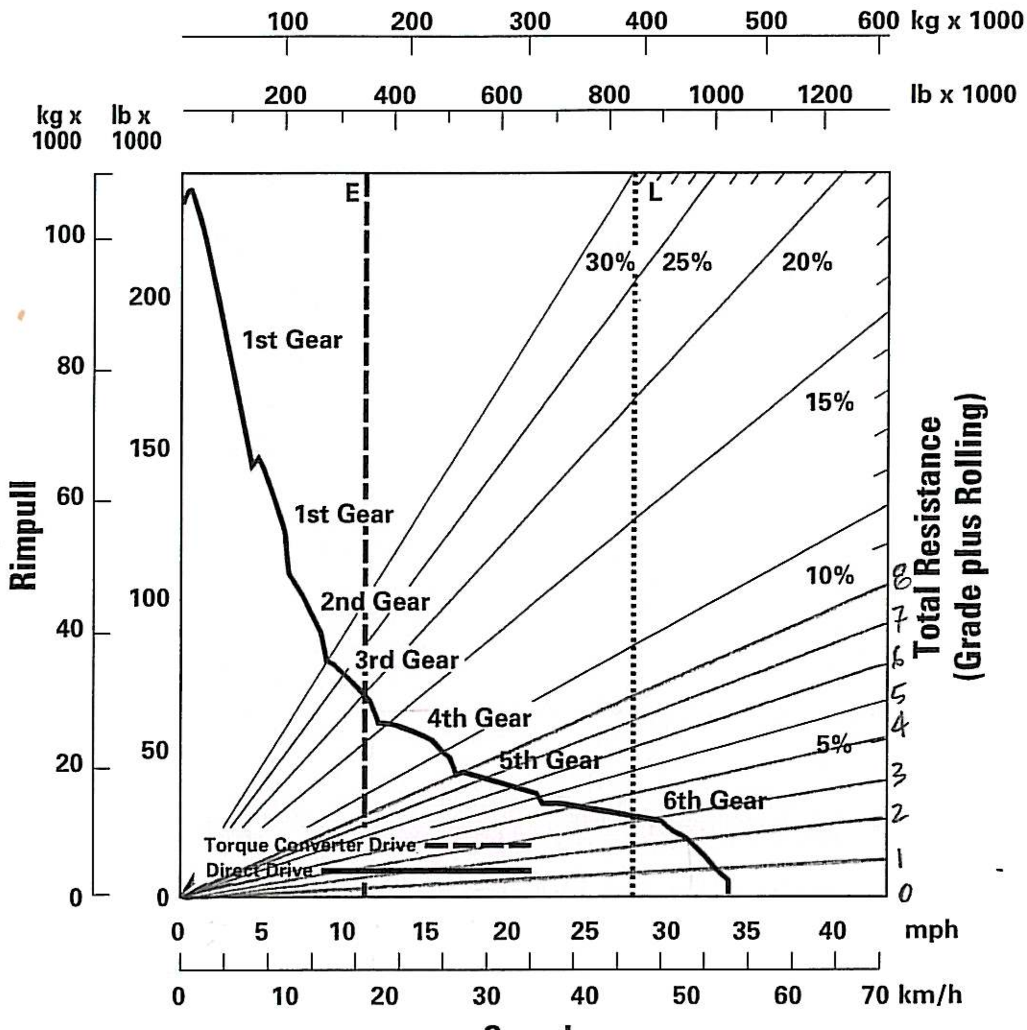
*at sea level

Gradeability/Speed/Rimpull

To determine gradeability performance: Read from gross weight down to the percent of total resistance. Total resistance equals actual percent grade plus 1% for each 10 kg/t (20 lb/ton) of rolling resistance. From this weight-resistance point, read horizontally to the curve with the highest obtainable gear, then down to maximum speed. Usable rimpull will depend upon traction available and weight on drive wheels.

- - - - - Typical Field Empty Weight
.... Gross Machine Operating Weight 383 749 kg/846,000 lb

Standard Arrangement*
Gross Weight



*at sea level

0-8%
Upgrade

	Empty:	Full
0	34	34
1	33	33
2	33	31
3	32	29
4	30	24
5	29	17
6	28	15
7	28	12
8	27	11

Appendix C

Haulage Profiles and Cycle Times

Appendix C - Speed vs Grade Chart

Unloaded Speed Chart

Grade	Speed	
	MPH	FPM
-8.00%	34	2,992
-7.00%	34	2,992
-6.00%	34	2,992
-5.00%	34	2,992
-4.00%	34	2,992
-3.00%	34	2,992
-2.00%	34	2,992
-1.00%	34	2,992
0.00%	34	2,992
1.00%	33	2,904
2.00%	33	2,904
3.00%	32	2,816
4.00%	30	2,640
5.00%	29	2,552
6.00%	28	2,464
7.00%	28	2,464
8.00%	27	2,376

Appendix C - Speed vs Grade Chart

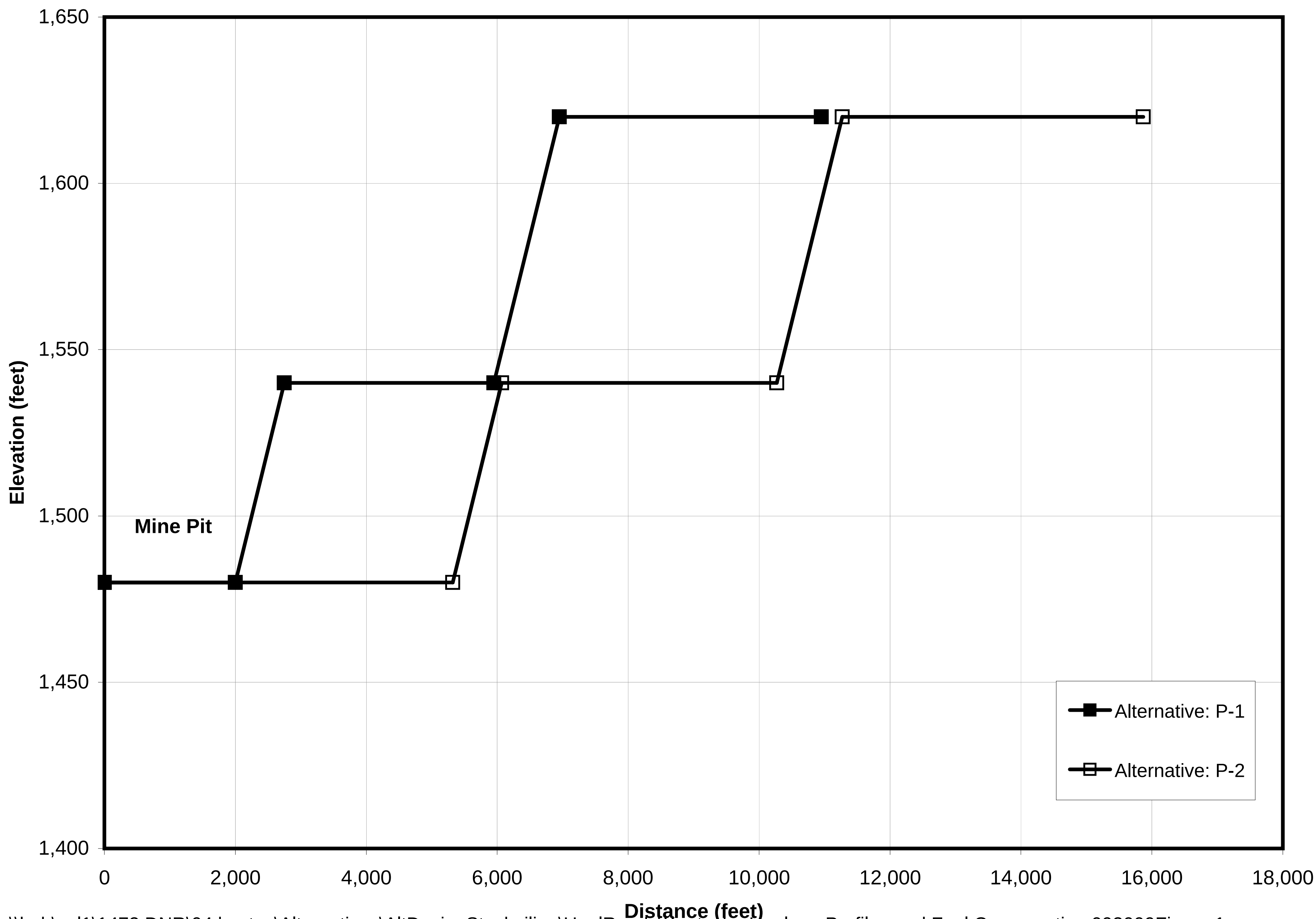
Loaded Speed Chart

Grade	Speed	
	MPH	FPM
-8.00%	14	1,232
-7.00%	14	1,232
-6.00%	18	1,584
-5.00%	25	2,200
-4.00%	25	2,200
-3.00%	34	2,992
-2.00%	34	2,992
-1.00%	34	2,992
0.00%	34	2,992
1.00%	33	2,904
2.00%	31	2,728
3.00%	29	2,552
4.00%	24	2,112
5.00%	17	1,496
6.00%	15	1,320
7.00%	12	1,056
8.00%	11	968

Appendix C-1

Proposed Location Haulage Profiles and Cycle Times

Figure 1. Stockpile Haulage Profiles P-1 and P-2



\\bob\vol1\1472 DNR\04 keetac\Alternatives\AltDesignStockpiling\HaulRoads\Keetack - Haulage Profiles and Fuel Consumption 093009Figure 1

Alternative: P-1

LOADED

Incremental Distance	Total Distance	Elevation	Slope	Speed (fpm)	Time (minutes)
0	0	1,480			
2,000	2,000	1,480	0.00%	2,992	0.67
750	2,750	1,540	8.00%	968	0.77
3,200	5,950	1,540	0.00%	2,992	1.07
1,000	6,950	1,620	8.00%	968	1.03
4,000	10,950	1,620	0.00%	2,992	1.34
				Loaded Delivery Time:	**4.88**

UNLOADED

Incremental Distance	Slope	Speed (fpm)	Time (minutes)
0			
2,000	0.00%	2,992	0.67
750	-8.00%	2,992	0.25
3,200	0.00%	2,992	1.07
1,000	-8.00%	2,992	0.33
4,000	0.00%	2,992	1.34
		Return Time:	**3.66**
		Load time:	**5.00**
		Dump Time:	**1.50**
		Total Time:	**15.04**
		Actual Time (accounting for cuves in road):	**18.80**

Alternative: P-2

LOADED

Incremental Distance	Total Distance	Elevation	Slope	Speed (fpm)	Time (minutes)
0	0	1,480			
5,320	5,320	1,480	0.00%	2,992	1.78
750	6,070	1,540	8.00%	968	0.77
4,200	10,270	1,540	0.00%	2,992	1.40
1,000	11,270	1,620	8.00%	968	1.03
4,600	15,870	1,620	0.00%	2,992	1.54
				Loaded Delivery Time:	**6.53**

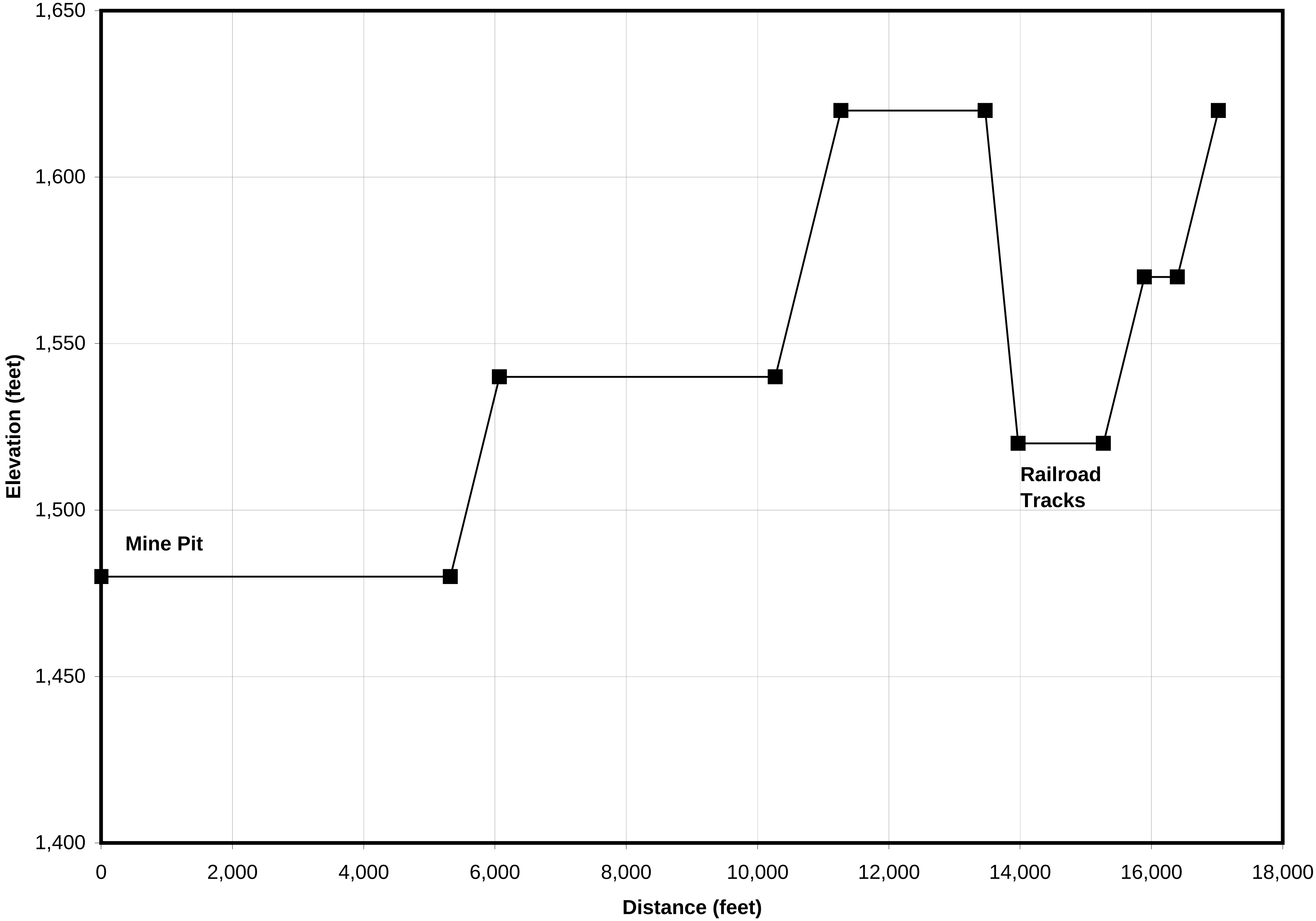
UNLOADED

Incremental Distance	Slope	Speed (fpm)	Time (minutes)
0			
5,320	0.00%	2,992	1.78
750	-8.00%	2,992	0.25
4,200	0.00%	2,992	1.40
1,000	-8.00%	2,992	0.33
4,600	0.00%	2,992	1.54
		Return Time:	**5.30**
		Load time:	**5.00**
		Dump Time:	**1.50**
		Total Time:	**18.33**
		Actual Time (accounting for cuves in road):	**22.91**

Appendix C-2

Concept A Haulage Profiles and Cycle Times

Figure 2. Stockpile Haulage Profile A-1



\\bob\vol1\1472 DNR\04 keetac\Alternatives\AltDesignStockpiling\HaulRoads\Keetack - Haulage Profiles and Fuel Consumption 093009Figure 2

Alternative: A-1

LOADED

Incremental Distance	Total Distance	Elevation	Slope	Speed (fpm)	Time (minutes)
0	0	1,480			
5,320	5,320	1,480	0.00%	2,992	1.78
750	6,070	1,540	8.00%	968	0.77
4,200	10,270	1,540	0.00%	2,992	1.40
1,000	11,270	1,620	8.00%	968	1.03
2,200	13,470	1,620	0.00%	2,992	0.74
500	13,970	1,520	-20.00%	1,232	0.41
1,300	15,270	1,520	0.00%	2,992	0.43
625	15,895	1,570	8.00%	968	0.65
500	16,395	1,570	0.00%	2,992	0.17
625	17,020	1,620	8.00%	968	0.65
				Loaded Delivery Time:	**8.02**

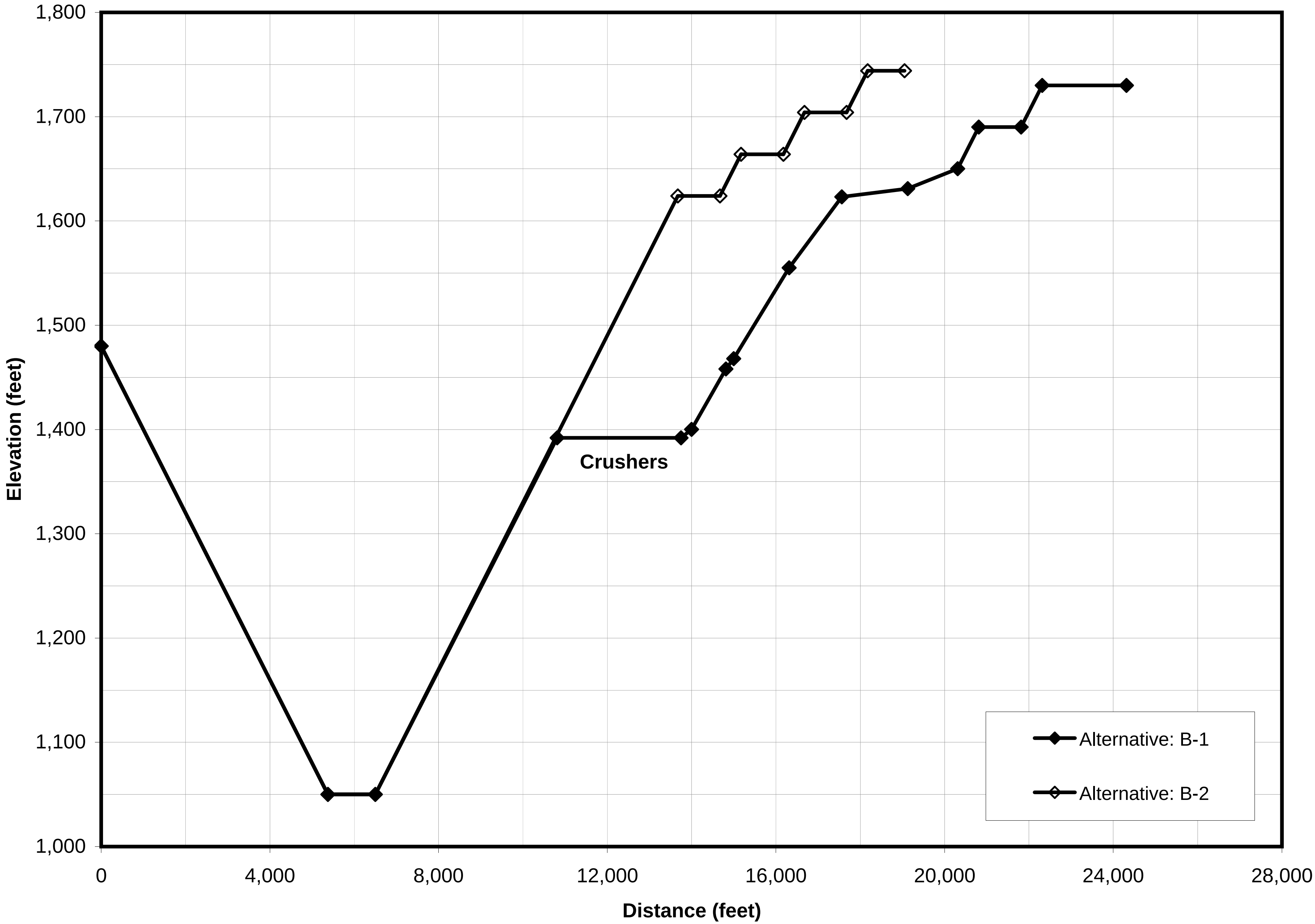
UNLOADED

Incremental Distance	Slope	Speed (fpm)	Time (minutes)
0			
5,320	0.00%	2,992	1.78
750	-8.00%	2,992	0.25
4,200	0.00%	2,992	1.40
1,000	-8.00%	2,992	0.33
2,200	0.00%	2,992	0.74
500	20.00%	2,376	0.21
1,300	0.00%	2,992	0.43
625	-8.00%	2,992	0.21
500	0.00%	2,992	0.17
625	-8.00%	2,992	0.21
		Return Time:	**5.73**
		Load time:	**5.00**
		Dump Time:	**1.50**
		Total Time:	**20.26**
		Actual Time (accounting for cuves in road):	**25.32**

Appendix C-3

Concept B Haulage Profiles and Cycle Times

Figure 3. Stockpile Haulage Profiles B-1 and B-2



\\bob\vol1\1472 DNR\04 keetac\Alternatives\AltDesignStockpiling\HaulRoads\Keetack - Haulage Profiles and Fuel Consumption 093009Figure 3

Alternative: B-1

LOADED

Incremental Distance	Total Distance	Elevation	Slope	Speed (fpm)	Time (minutes)
0	0	1,480			
5,375	5,375	1,050	-8.00%	1,232	4.36
1,125	6,500	1,050	0.00%	2,992	0.38
4,312	10,812	1,392	7.93%	1,056	4.08
2,938	13,750	1,392	0.00%	2,992	0.98
250	14,000	1,400	3.20%	2,552	0.10
812	14,812	1,458	7.14%	1,056	0.77
188	15,000	1,468	5.32%	1,496	0.13
1,312	16,312	1,555	6.63%	1,320	0.99
1,250	17,562	1,623	5.44%	1,496	0.84
1,563	19,125	1,631	0.51%	2,992	0.52
1,187	20,312	1,650	1.60%	2,904	0.41
500	20,812	1,690	8.00%	968	0.52
1,000	21,812	1,690	0.00%	2,992	0.33
500	22,312	1,730	8.00%	968	0.52
2,000	24,312	1,730	0.00%	2,992	0.67
			Loaded Delivery Time:		**10.85**

UNLOADED

Incremental Distance	Slope	Speed (fpm)	Time (minutes)
0			
5,375	8.00%	2,376	2.26
1,125	0.00%	2,992	0.38
4,312	-7.93%	2,992	1.44
2,938	0.00%	2,992	0.98
250	-3.20%	2,992	0.08
812	-7.14%	2,992	0.27
188	-5.32%	2,992	0.06
1,312	-6.63%	2,992	0.44
1,250	-5.44%	2,992	0.42
1,563	-0.51%	2,992	0.52
1,187	-1.60%	2,992	0.40
500	-8.00%	2,992	0.17
1,000	0.00%	2,992	0.33
500	-8.00%	2,992	0.17
2,000	0.00%	2,992	0.67
		Return Time:	**8.59**

Load time:	**5.00**
Dump Time:	**1.50**
Total Time:	**25.95**
Actual Time (accounting for cuves in road):	**32.43**

Alternative: B-2

LOADED

Incremental Distance	Total Distance	Elevation	Slope	Speed (fpm)	Time (minutes)
0	0	1,480			
5,375	5,375	1,050	-8.00%	2,586	2.08
1,125	6,500	1,050	0.00%	2,012	0.56
7,175	13,675	1,624	8.00%	607	11.83
1,000	14,675	1,624	0.00%	2,012	0.50
500	15,175	1,664	8.00%	607	0.82
1,000	16,175	1,664	0.00%	2,012	0.50
500	16,675	1,704	8.00%	607	0.82
1,000	17,675	1,704	0.00%	2,012	0.50
500	18,175	1,744	8.00%	607	0.82
875	19,050	1,744	0.00%	2,012	0.43
				Loaded Delivery Time:	**18.87**

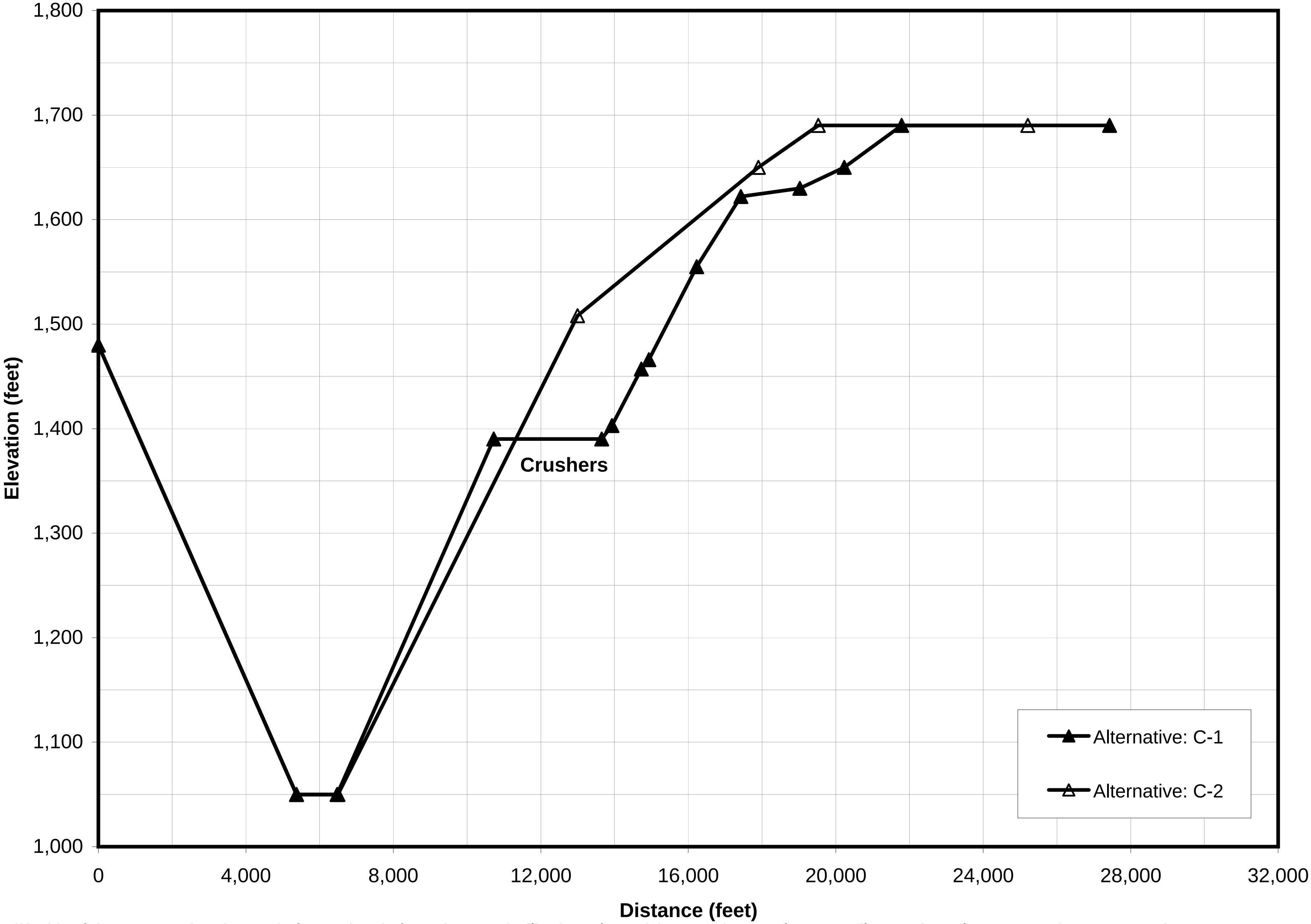
UNLOADED

Incremental Distance	Slope	Speed (fpm)	Time (minutes)
0			
5,375	8.00%	2,376	2.26
1,125	0.00%	2,992	0.38
7,175	-8.00%	2,992	2.40
1,000	0.00%	2,992	0.33
500	-8.00%	2,992	0.17
1,000	0.00%	2,992	0.33
500	-8.00%	2,992	0.17
1,000	0.00%	2,992	0.33
500	-8.00%	2,992	0.17
875	0.00%	2,992	0.29
		Return Time:	**6.83**
		Load time:	**5.00**
		Dump Time:	**1.50**
		Total Time:	**32.20**
		Actual Time (accounting for cuves in road):	**40.25**

Appendix C-4

Concept C Haulage Profiles and Cycle Times

Figure 4. Stockpile Haulage Profiles C-1 and C-2



\\bob\vol1\1472 DNR\04 keetac\Alternatives\AltDesignStockpiling\HaulRoads\Keetack - Haulage Profiles and Fuel Consumption 093009Figure 4

Alternative: C-1

LOADED

Incremental Distance	Total Distance	Elevation	Slope	Speed (fpm)	Time (minutes)
0	0	1,480			
5,375	5,375	1,050	-8.00%	1,232	4.36
1,100	6,475	1,050	0.00%	2,992	0.37
4,250	10,725	1,390	8.00%	968	4.39
2,925	13,650	1,390	0.00%	2,992	0.98
280	13,930	1,403	4.64%	2,112	0.13
800	14,730	1,457	6.75%	1,320	0.61
200	14,930	1,466	4.50%	2,112	0.09
1,300	16,230	1,555	6.85%	1,320	0.98
1,200	17,430	1,622	5.58%	1,496	0.80
1,600	19,030	1,630	0.50%	2,992	0.53
1,200	20,230	1,650	1.67%	2,904	0.41
1,560	21,790	1,690	2.56%	2,728	0.57
5,640	27,430	1,690	0.00%	2,992	1.89
				Loaded Delivery Time:	**16.12**

UNLOADED

Incremental Distance	Slope	Speed (fpm)	Time (minutes)
0			
5,375	8.00%	2,376	2.26
1,100	0.00%	2,992	0.37
4,250	-8.00%	2,992	1.42
2,925	0.00%	2,992	0.98
280	-4.64%	2,992	0.09
800	-6.75%	2,992	0.27
200	-4.50%	2,992	0.07
1,300	-6.85%	2,992	0.43
1,200	-5.58%	2,992	0.40
1,600	-0.50%	2,992	0.53
1,200	-1.67%	2,992	0.40
1,560	-2.56%	2,992	0.52
5,640	0.00%	2,992	1.89
		Return Time:	**9.63**
		Load time:	**5.00**
		Dump Time:	**1.50**
		Total Time:	**32.26**
		Actual Time (accounting for cuves in road):	**40.32**

Alternative: C-2

LOADED

Incremental Distance	Total Distance	Elevation	Slope	Speed (fpm)	Time (minutes)
0	0	1,480			
5,375	5,375	1,050	-8.00%	2,586	2.08
1,125	6,500	1,050	0.00%	2,012	0.56
6,500	13,000	1,508	7.05%	818	7.95
4,900	17,900	1,650	2.90%	1,599	3.06
1,626	19,526	1,690	2.46%	1,669	0.97
5,687	25,213	1,690	0.00%	2,012	2.83
				Loaded Delivery Time:	**17.45**

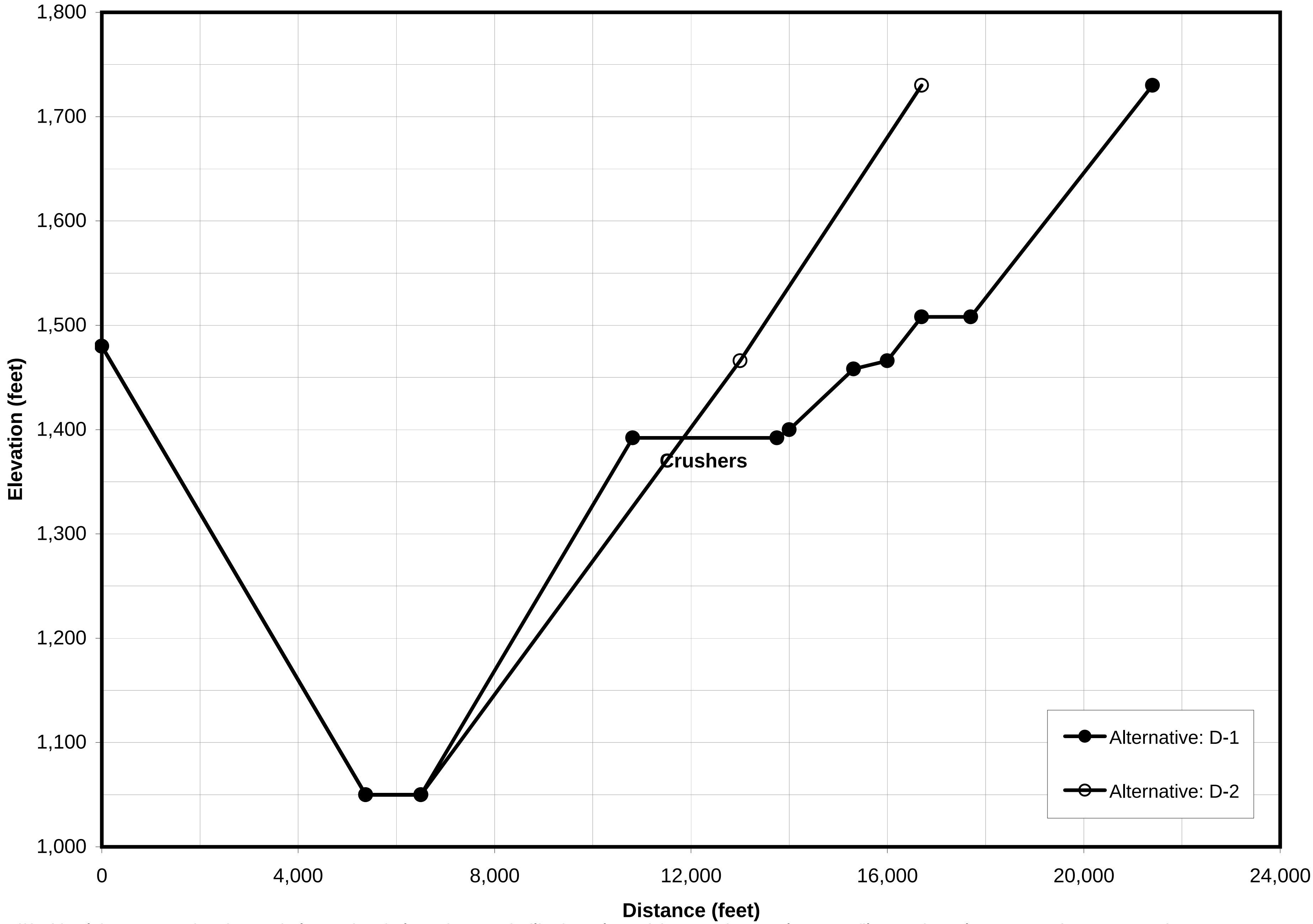
UNLOADED

Incremental Distance	Slope	Speed (fpm)	Time (minutes)
0			
5,375	8.00%	2,376	2.26
1,125	0.00%	2,992	0.38
6,500	-7.05%	2,992	2.17
4,900	-2.90%	2,992	1.64
1,626	-2.46%	2,992	0.54
5,687	0.00%	2,992	1.90
		Return Time:	**8.89**
		Load time:	**5.00**
		Dump Time:	**1.50**
		Total Time:	**32.84**
		Actual Time (accounting for cuves in road):	**41.05**

Appendix C-5

Concept D Haulage Profiles and Cycle Times

Figure 5. Stockpile Haulage Profiles D-1 and D-2



\\bob\vol1\1472 DNR\04 keetac\Alternatives\AltDesignStockpiling\HaulRoads\Keetack - Haulage Profiles and Fuel Consumption 093009Figure 5

Alternative: D-1

LOADED

Incremental Distance	Total Distance	Elevation	Slope	Speed (fpm)	Time (minutes)
0	0	1,480			
5,375	5,375	1,050	-8.00%	1,232	4.36
1,125	6,500	1,050	0.00%	2,992	0.38
4,312	10,812	1,392	7.93%	1,056	4.08
2,938	13,750	1,392	0.00%	2,992	0.98
250	14,000	1,400	3.20%	2,552	0.10
1,312	15,312	1,458	4.42%	2,112	0.62
688	16,000	1,466	1.16%	2,904	0.24
700	16,700	1,508	6.00%	1,320	0.53
1,000	17,700	1,508	0.00%	2,992	0.33
3,700	21,400	1,730	6.00%	1,320	2.80
				Loaded Delivery Time:	**14.43**

UNLOADED

Incremental Distance	Slope	Speed (fpm)	Time (minutes)
0			
5,375	8.00%	2,376	2.26
1,125	0.00%	2,992	0.38
4,312	-7.93%	2,992	1.44
2,938	0.00%	2,992	0.98
250	-3.20%	2,992	0.08
1,312	-4.42%	2,992	0.44
688	-1.16%	2,992	0.23
700	-6.00%	2,992	0.23
1,000	0.00%	2,992	0.33
3,700	-6.00%	2,992	1.24
		Return Time:	**7.62**
		Load time:	**5.00**
		Dump Time:	**1.50**
		Total Time:	**28.55**
		Actual Time (accounting for cuves in road):	**35.68**

Alternative: D-2

LOADED

Incremental Distance	Total Distance	Elevation	Slope	Speed (fpm)	Time (minutes)
0	0	1,480			
5,375	5,375	1,050	-8.00%	2,586	2.08
1,125	6,500	1,050	0.00%	2,012	0.56
6,500	13,000	1,466	6.40%	954	6.81
3,700	16,700	1,730	7.14%	799	4.63
				Loaded Delivery Time:	**14.08**

UNLOADED

Incremental Distance	Slope	Speed (fpm)	Time (minutes)
0			
5,375	8.00%	2,376	2.26
1,125	0.00%	2,992	0.38
6,500	-6.40%	2,992	2.17
3,700	-7.14%	2,992	1.24
		Return Time:	**6.05**
		Load time:	**5.00**
		Dump Time:	**1.50**
		Total Time:	**26.63**
		Actual Time (accounting for cuves in road):	**33.29**

Appendix D

Haulage Operational Data Summary

Bank Cubic Yards Required:	118,000,000
Capacity in CY per Load:	132
Total Loads Required:	893,939

B	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
Site	**One-Way Trip Mileage**	**Round Trip Distance in feet**	**Round Trip Mileage**	**Round Trip Time in minutes**	**Round Trips in 18 hour Day**	**Round Trips in Year**	**Round Trips in 21.5 Years**	**Operating Trucks**	**Total Number of Trucks (assuming 80% Operability)**	**Total Hours of Operation**	**Annual Capital ($470k/truck)**	**Total Additional Capital (over 21.5 Years)**	**Total Operating Costs (at $250/hr)**	**Total Cost**	**Vehicle Miles Traveled**	**Total Gallons of Fuel (31 gal/hr x 21.6 hours/day)**	**New Haul Road Distance in Miles**	**Haul Road Maintenance Cost**	**New Road Construction Cost**
Constant											$466,667	21.5 years	$250			670Gal/Day/Truck		$200,000	$400,000
Formula			E / 5280		(24 x 75% x 60) / G	H x 365	I x 21.5	Total Loads / J	K / 0.80	(G x J x K) / 60	K x Constant	N x Constant	M x Constant	O + P	Total Loads x F	L x 21.5yrs x 365 days/year * Constant	D - 2.8 (where applicable)	D x 21.5 x Constant	D x Constant
A-1	3.22	34,040	6.45	25.32	42	15,330	329,595	2.7	3.4	377,234	$1,582,138	$34,015,959	$94,308,568	$128,324,527	5,763,200	17,825,577	3.22	$13,860,985	$1,289,394
P-1	2.07	21,900	4.15	16.42	65	23,725	510,088	1.8	2.2	244,641	$1,022,304	$21,979,543	$61,160,354	$83,139,896	3,707,817	11,518,065	2.07	$8,917,614	$829,545
P-2	3.01	31,740	6.01	19.53	55	20,075	431,613	2.1	2.6	290,977	$1,208,178	$25,975,823	$72,744,318	$98,720,141	5,373,795	13,612,259	3.01	$12,924,432	$1,202,273
B-1	4.60	48,624	9.21	32.43	33	12,045	258,968	3.5	4.3	483,205	$2,013,630	$43,293,038	$120,801,216	$164,094,254	8,232,369	22,687,098	1.80	$19,799,545	$1,841,818
B-2	3.61	38,100	7.22	40.25	26	9,490	204,035	4.4	5.5	599,667	$2,555,761	$54,948,856	$149,916,706	$204,865,562	6,450,585	28,795,163	3.61	$15,514,205	$1,443,182
C-1	5.20	54,860	10.39	40.32	26	9,490	204,035	4.4	5.5	600,751	$2,555,761	$54,948,856	$150,187,783	$205,136,639	9,288,166	28,795,163	2.40	$22,338,826	$2,078,030
C-2	4.78	50,426	9.55	41.05	26	9,490	204,035	4.4	5.5	611,654	$2,555,761	$54,948,856	$152,913,454	$207,862,310	8,537,460	28,795,163	4.78	$20,533,314	$1,910,076
D-1	4.05	42,800	8.11	35.68	30	10,950	235,425	3.8	4.7	531,632	$2,214,993	$47,622,342	$132,907,902	$180,530,244	7,246,327	24,955,808	1.25	$17,428,030	$1,621,212
D-2	3.16	33,400	6.33	33.29	32	11,680	251,120	3.6	4.4	495,942	$2,076,556	$44,645,946	$123,985,526	$168,631,471	5,654,844	23,396,070	3.16	$13,600,379	$1,265,152

	Concept A	Remainder Used in Proposed and Concepts B-D
Bank Cubic Yards Required:	13,000,000	105,000,000
Capacity in CY per Load:	132	132
Total Loads Required:	98,485	795,455

B		D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
Site	One-Way Trip Mileage in feet	One-Way Trip Mileage	Round Trip Distance in feet	Round Trip Mileage	Round Trip Time in minutes	Round Trips in 18 hour Day	Round Trips in Year	Round Trips in 21.5 Years	Operating Trucks	Total Number of Trucks (assuming 80% Operability)	Total Hours of Operation	Annual Capital ($470k/truck)	Total Additional Capital (over 21.5 Years)	Total Operating Costs (at $250/hr)	Total Operating and Capital Cost	Vehicle Miles Traveled	Total Gallons of Fuel (31 gal/hr x 21.6 hours/day)	New Haul Road Distance in Miles	Haul Road Maintenance Cost	New Road Construction Cost
Constant												$466,667	21.5 years	$250			670Gal/Day/Truck		$200,000	$400,000
Formula				E / 5280		(24 x 75% x 60) / G	H x 365	I x 21.5	Total Loads / J	K / 0.80	(G x J x K) / 60	K x Constant	N x Constant	M x Constant	O + P	Total Loads x F	L x 21.5yrs x 365 days/year * Constant	D - 2.8 (where applicable)	D x 21.5 x Constant	D x Constant
Individual Components of Total Requirements for Entire 118,000,000 CY Moved																				
A-1	17,020	3.22	34,040	6.45	25.32	42	15,330	329,595	0.3	0.4	41,560	$174,303	$3,747,521	$10,389,927	$14,137,448	634,929	1,963,835	3.22	$13,860,985	$1,289,394
P-1	10,950	2.07	21,900	4.15	16.42	65	23,725	510,088	1.6	1.9	217,689	$909,678	$19,558,068	$54,422,348	$73,980,416	3,299,329	10,249,126	2.07	$8,917,614	$829,545
P-2	15,870	3.01	31,740	6.01	19.53	55	20,075	431,613	1.8	2.3	258,920	$1,075,073	$23,114,080	$64,730,114	$87,844,193	4,781,767	12,112,603	3.01	$12,924,432	$1,202,273
B-1	24,312	4.60	48,624	9.21	32.43	33	12,045	258,968	3.1	3.8	429,970	$1,791,789	$38,523,466	$107,492,607	$146,016,074	7,325,413	20,187,672	1.80	$19,799,545	$721,818
B-2	19,050	3.61	38,100	7.22	40.25	26	9,490	204,035	3.9	4.9	533,602	$2,274,194	$48,895,169	$133,400,459	$182,295,628	5,739,928	25,622,815	3.61	$15,514,205	$1,443,182
C-1	27,430	5.20	54,860	10.39	40.32	26	9,490	204,035	3.9	4.9	534,567	$2,274,194	$48,895,169	$133,641,671	$182,536,840	8,264,893	25,622,815	2.40	$22,338,826	$958,030
C-2	25,213	4.78	50,426	9.55	41.05	26	9,490	204,035	3.9	4.9	544,268	$2,274,194	$48,895,169	$136,067,056	$184,962,225	7,596,892	25,622,815	4.78	$20,533,314	$1,910,076
D-1	21,400	4.05	42,800	8.11	35.68	30	10,950	235,425	3.4	4.2	473,062	$1,970,968	$42,375,813	$118,265,506	$160,641,319	6,448,003	22,206,439	1.25	$17,428,030	$501,212
D-2	16,700	3.16	33,400	6.33	33.29	32	11,680	251,120	3.2	4.0	441,304	$1,847,783	$39,727,325	$110,326,103	$150,053,428	5,031,853	20,818,537	3.16	$13,600,379	$1,265,152

Appendix E

Evaluation Criteria Matrix

Keetac Expansion Project
Analysis of Stockpile Location Concepts
Evaluation Criteria Matrix
Table E-1
Summary of Concepts B-D and Proposed Location

Concept	Haul Route	*Environmental Factors*											*Community Factors*			*Feasibility Factors*						
		Habitat					**Air Quality** Fugitive Dust Emissions [5]						**Noise**		**Visual**				Economics			
		Wetland Acreage Disturbed[1]	Artificial/ Degraded Wetland Acreage[2]	Natural Wetland Acreage[2]	Upland[3]	Rare Species[4]	PM	PM10	PM2.5	NOx Emissions[6]	GHG Emissions[7]	Proximity to Residence[8]	Threshold Exceedences[9]	Proximity to Residence[10]	Seen by Residences[11]	Capacity Based on Spatial Considerations[12]	Surface Ownership Control[13]	Safety[14]	Capital Expense[15]	Operational Expenses[16]	Mitigation Expenses[17]	Total
		Acres			Acres		Tons	Tons	Tons	Tons	Tons	Miles	Y/N	Miles	Y/N	%			$M	$M	$M	$M
A	See Table E-2 for Evaluation of Concept A w/ Fractional Remainder of Other Concepts, Such That Stockpile Storage Requirements Are Met																					
B	1	204.1	24.9	179.2	282.4	None Identified	97,064	25,693	2,569	3,344	254,251	4.0	NO	4.0	No	25.7%	US Steel	Traffic Through Crusher Area	$45.1	$140	$5.1	$190.2
	2						76,056	20,132	2,013	4,151	322,703							Steep Downhill Grades w/ Loaded Trucks	$56.4	$165	$5.1	$226.4
C	1	325.4	189.5	135.9	213.9	None Identified	109,512	28,988	2,899	4,158	322,703	5.2	No	5.2	No	26.2%	US Steel	Traffic Through Crusher Area	$57.0	$172	$8.1	$237.0
	2						100,661	26,645	2,665	4,234	322,703							Steep Downhill Grades w/ Loaded Trucks	$56.9	$173	$8.1	$237.8
D	1	151.1	66.4	84.7	388.2	Peregrine Falcon	85,438	22,616	2,262	3,680	279,676	3.6	No	3.6	No	26.2%	Ontario Iron, US Steel, and Hibbing Land Co	Traffic Through Crusher Area	$49.2	$150	$3.8	$202.8
	2						66,673	17,649	1,765	3,433	262,196							Steep Downhill Grades w/ Loaded Trucks	$45.9	$137	$3.8	$186.8
Proposed Location	1	310.4	299.5	10.4	228.8	None Identified	43,717	11,572	1,157	1,693	129,081	1.2 and Meets AAQ Standards	NO (w/ Mitigation)	1.2	Yes	26.2%	US Steel	__	$22.8	$70	$7.8	$100.4
	2						63,360	16,772	1,677	2,014	152,551							__	$27.2	$85	$7.8	$120.2
Existing Stockpiles		144.6	144.6	0.0	--	St Lawrence Grapefern						Meets AAQ Standards			Yes - SE Stockpile	21.8%	US Steel	__				
Maximize In-Pit Stockpiles		--	--	--	--	None Identified						Meets AAQ Standards				52.0%	US Steel	__				

1 total wetland acreage impacted requiring mitigation
2 wetlands by acreage estimated as natural or previously disturbed
3 non-wetland related cover types impacted by acreage and category
4 acreage of impacted critical habitat for T & E species and other rare species per DNR Rare Species Guide
5 quantity of various particulates generated by haulage in tons
6 quantity of NOx generated by haulage in Megagrams
7 quantity of GHG generated by haulage in tons
8 closest distance from stockpile or haul road to a residence
9 day or night standard exceedance anticipated
10 distance from center of stockpile area to closest residence
11 directly seen by residences (yes/no)
12 percentage of total in pit and out of pit stockpiling needs
13 listing of known surface owners
14 known safety issues
15 capital costs for truck replacement and road construction
16 truck operational and road maintenance costs
17 noise and wetland mitigation costs

Keetac Expansion Project
Analysis of Stockpile Location Concepts
Evaluation Criteria Matrix
Table E-2
Concept A Combined With Other Concepts

		Environmental Factors											*Community Factors*			*Feasibility Factors*						
		Habitat					**Air Quality** Fugitive Dust Emissions [5]						**Noise**		**Visual**				Economics			
Concept	Haul Route	Wetland Acreage Disturbed[1]	Artificial/ Degraded Wetland Acreage[2]	Natural Wetland Acreage[2]	Upland[3]	Rare Species[4]	PM	PM10	PM2.5	NOx Emissions[6]	GHG Emissions[7]	Proximity to Residence[8]	Threshold Exceedences[9]	Proximity to Residence[10]	Seen by Residences[11]	Capacity Based on Spatial Considerations[12]	Surface Ownership Control[13]	Safety[14]	Capital Expense[15]	Operational Expenses[16]	Mitigation Expenses[17]	Total
		Acres			Acres		Tons	Tons	Tons	Tons	Tons	Miles	Y/N	Miles	Y/N	%			$M	$M	$M	$M
A/B	1	#REF!	#REF!	#REF!	#REF!	None Identified	93,856	24,844	2,484	3,264	248,249	.7/4.0	NO	.7/4.0	No	26.2%	US Steel	Traffic Through Crusher Area	$61	$136	#REF!	#REF!
	2						75,163	19,896	1,990	3,981	309,160							Steep Downhill Grades w/ Loaded Trucks	$67	$159	#REF!	#REF!
A/C	1	#REF!	#REF!	#REF!	#REF!	None Identified	104,933	27,776	2,778	3,988	309,160	.7/5.2	No	.7/5.2	No	26.2%	US Steel	Traffic Through Crusher Area	$73	$165	#REF!	#REF!
	2						97,057	25,692	2,569	4,055	309,160							Steep Downhill Grades w/ Loaded Trucks	$72	$72	#REF!	#REF!
A/D	1	#REF!	#REF!	#REF!	#REF!	Peregrine Falcon	83,511	22,106	2,211	3,562	270,873	.7/3.6	No	.7/3.6	No	26.2%	Ontario Iron, US Steel, and Hibbing Land Co	Traffic Through Crusher Area	$63	$145	#REF!	#REF!
	2						66,814	17,686	1,769	3,342	255,319							Steep Downhill Grades w/ Loaded Trucks	$57	$134	#REF!	#REF!
A w/ Proposed Location	1	#REF!	#REF!	#REF!	#REF!	None Identified	46,387	12,279	1,228	1,794	136,869	.7/1.2 and Meets AAQ Standards	NO (w/ Mitigation)	.7/1.23	Yes	26.2%	US Steel	__	$32	$74	#REF!	#REF!
	2						63,866	16,906	1,691	2,080	157,753							__	$39	$88	#REF!	#REF!

1 total wetland acreage impacted requiring mitigation
2 wetlands by acreage estimated as natural or previously disturbed
3 non-wetland related cover types impacted by acreage and category
4 acreage of impacted critical habitat for T & E species and other rare species per DNR Rare Species Guide
5 quantity of various particulates generated by haulage in tons
6 quantity of NOx generated by haulage in Megagrams
7 quantity of GHG generated by haulage in tons
8 closest distance from stockpile or haul road to a residence
9 day or night standard exceedance anticipated
10 distance from center of stockpile area to closest residence
11 directly seen by residences (yes/no)
12 percentage of total in pit and out of pit stockpiling needs
13 listing of known surface owners
14 known safety issues
15 capital costs for truck replacement and road construction
16 truck operational and road maintenance costs
17 noise and wetland mitigation costs

Appendix F

Natural Heritage Information System Index Report

Minnesota Department of Natural Resources
Division of Ecological Resources, Box 25
500 Lafayette Road
St. Paul, Minnesota 55155-4025
Phone: (651) 259-5109 Fax: (651) 296-1811 E-mail: lisa.joyal@dnr.state.mn.us

March 21, 2008

Mr. Daniel Jones
Barr Engineering Company
4700 West 77th Street
Minneapolis, MN 55435-4803

Re: Request for Natural Heritage information for vicinity of proposed US Steel Keetac Line 1 Restart, Itasca and St. Louis Counties
NHNRP Contact #: ERDB 20080589

County	Township (N)	Range (W)	Sections
Itasca	55	22	4
Itasca	56	22	1-3, 10-15, 23-26, 32-36
Itasca	57	22	1-3, 9-16, 21-28, 33-36
St. Louis	56	21	4-9, 16-21, 29-32
St. Louis	57	21	7-11, 15-21, 28-33

Dear Mr. Jones,

The Minnesota Natural Heritage Information System has been queried to determine if any rare species or other significant natural features are known to occur within an approximate one-mile radius of the proposed project. Based on this query, there are 17 database records in the area searched (for details, please see the enclosed database reports and the explanation of selected fields). Per the Data Request Form that you submitted, I am providing the database reports only and have not evaluated the potential for the proposed project to negatively impact these rare features. Please note that any environmental assessment should address whether the proposed project has the potential to negatively impact these rare features and, if so, any avoidance or mitigation measures that will be implemented.

The Natural Heritage Information System (NHIS), a collection of databases that contain information about Minnesota's rare natural features, is maintained by the Division of Ecological Resources, Department of Natural Resources. The NHIS is continually updated as new information becomes available, and is the most complete source of data on Minnesota's rare or otherwise significant species, native plant communities, and other natural features. However, the NHIS is not a comprehensive inventory and thus does not represent all of the occurrences of rare features within the state. Therefore, ecologically significant features for which we have no records may exist on the project area.

The enclosed results include an Index Report and a Detail Report of records in the Rare Features Database, the main database of the NHIS. To control the release of specific location information, which might result in the destruction of a rare feature, both reports are copyrighted.

The Index Report provides rare feature locations only to the nearest section, and may be reprinted, unaltered, in an environmental review document (e.g., EAW or EIS), municipal natural resource plan, or report compiled by your company for the project listed above. If you wish to reproduce the index report for any other purpose, please contact me to request written permission. **The Detail Report may include specific location information, and is for your personal use only. If you wish to reprint or publish the detail report for any purpose, please contact me to request written permission.**

Please be aware that this letter focuses only on potential effects to *rare natural features*; there may be other natural resource concerns associated with the proposed project. This letter does not constitute review or approval by the Department of Natural Resources as a whole. If you would like further information on the environmental review process, please contact your Regional Environmental Assessment Ecologist, Dave Holmbeck, at (218) 999-7805.

An invoice in the amount of $140.50 will be mailed to you under separate cover within two weeks of the date of this letter. You are being billed for the database search and printouts, and staff scientist review. Thank you for consulting us on this matter, and for your interest in preserving Minnesota's rare natural resources.

Sincerely,

Lisa Joyal

Lisa Joyal
Endangered Species Environmental Review Coordinator

encl: Rare Features Database: Index Report
Rare Features Database: Detail Report
Rare Features Database Reports: An Explanation of Fields

Printed March 2008
Data valid for one year

Minnesota Natural Heritage Information System: Rare Features Database

Index Report of records within 1 mile radius of:

US Steel Keetac Line 1 Restart
Multiple TRS
Itasca and St. Louis Counties

Element Name and Occurrence Number	Federal Status	MN Status	State Rank	Global Rank	Last Observed Date	EO ID #
Itasca County, MN						
Botrychium minganense (Mingan Moonwort) #40 Location Description: T56N R22W S5		SPC	S3	G4	2005-07-15	32634
Botrychium oneidense (Blunt-lobed Grapefern) #35 Location Description: T57N R22W S21		END	S1	G4Q	1999-08-10	28535
Botrychium pallidum (Pale Moonwort) #36 Location Description: T57N R22W S35, T57N R22W S26		END	S1	G3	1999-06-09	24078
Botrychium rugulosum (St. Lawrence Grapefern) #37 Location Description: T57N R22W S21		THR	S2	G3	2003-10-22	28515
Botrychium rugulosum (St. Lawrence Grapefern) #55 Location Description: T56N R22W S5		THR	S2	G3	2005-07-15	32633
Botrychium simplex (Least Moonwort) #36 Location Description: T57N R22W S25, T57N R22W S26		SPC	S3	G5	1998-06-10	23698
Botrychium simplex (Least Moonwort) #37 Location Description: T57N R22W S35, T57N R22W S26		SPC	S3	G5	1998-06-10	23702
Botrychium simplex (Least Moonwort) #72 Location Description: T57N R22W S25, T57N R22W S36		SPC	S3	G5	1999-06-09	24102
Botrychium simplex (Least Moonwort) #74 Location Description: T56N R22W S5		SPC	S3	G5	1999-06-16	24083
Botrychium simplex (Least Moonwort) #82 Location Description: T57N R22W S29, T57N R22W S28		SPC	S3	G5	2001-06-13	28639
Haliaeetus leucocephalus (Bald Eagle) #1062 Location Description: T56N R22W S9, T56N R22W S16		SPC	S3B,S3N	G5	2005-04-21	14007
Platanthera flava var. herbiola (Tubercled Rein-orchid) #32 Location Description: T57N R22W S36, T57N R22W S35		END	S1	G4T4Q	2003-07-08	25109
Platanthera flava var. herbiola (Tubercled Rein-orchid) #37 Location Description: T56N R22W S6, T56N R22W S5		END	S1	G4T4Q	2005-07-15	28510
Torreyochloa pallida (Torrey's Manna-grass) #36 Location Description: T57N R22W S29		SPC	S3	G5	1999-08-10	28514
St. Louis County, MN						

Printed March 2008
Data valid for one year

Minnesota Natural Heritage Information System: Rare Features Database
Index Report of records within 1 mile radius of:
US Steel Keetac Line 1 Restart
Multiple TRS
Itasca and St. Louis Counties

Element Name and Occurrence Number	Federal Status	MN Status	State Rank	Global Rank	Last Observed Date	EO ID #
St. Louis County, MN						
Botrychium pallidum (Pale Moonwort) #20 Location Description: T57N R21W S14		END	S1	G3	1998-06-15	23753
Botrychium simplex (Least Moonwort) #41 Location Description: T57N R21W S15, T57N R21W S14		SPC	S3	G5	1998-06-15	23747
Falco peregrinus (Peregrine Falcon) #61 Location Description: T57N R21W S1, T57N R20W S7	No Status	THR	S2B	G4	2004	19107

Records Printed = 17

Appendix G

EPA Regulatory Announcement F-04-032, May 2004 Concerning Clean Air Non-Road Diesel Rule

EPA
United States
Environmental Protection
Agency

Office of Transportation
and Air quality

EPA420-F-04-032
May 2004

Regulatory Announcement

Clean Air Nonroad Diesel Rule

On May 11, 2004, the U.S. Environmental Protection Agency (EPA) announced a comprehensive rule to reduce emissions from nonroad diesel engines by integrating engine and fuel controls as a system to gain the greatest emission reductions. Engine manufacturers will produce engines with advanced emission-control technologies similar to those upcoming for highway trucks and buses. Exhaust emissions from these engines will decrease by more than 90 percent.

Closely linked to these engine provisions are new fuel requirements that will decrease the allowable levels of sulfur in fuel used in nonroad diesel engines, locomotives, and marine vessels by more than 99 percent. These fuel improvements will create immediate and significant environmental and public health benefits and will enable the use of new, high-efficiency emission-control devices on nonroad engines. At the same time, the Agency is taking the first step toward proposing more stringent emission standards for engines used in locomotives and marine vessels.

By greatly reducing diesel emissions, this rule will result in large benefits to public health that will be even greater than EPA projected at the time the rule was proposed. These benefits include about 12,000 fewer premature deaths and hundreds of thousands fewer incidences of respiratory problems. The overall benefits of the program in dollars significantly outweigh the costs by a factor of about 40 to 1.

This rule culminates a multi-year collaborative process to reduce nonroad diesel emissions. EPA worked closely with stakeholders from industry, state and local governments, environmental and public health organizations, and others in the design of this program.

The Need to Reduce Emissions from Nonroad Diesel Engines

Nonroad diesel engines contribute greatly to air pollution in many of our nation's cities and towns. Nonroad engines currently meet relatively modest emission requirements and therefore continue to emit large amounts of nitrogen oxides (NOx) and particulate matter (PM), both of which contribute to serious public health problems. Nonroad diesel engines that are affected by the new standards currently account for about 47 percent of diesel PM emissions and about 25 percent of total NOx emissions from mobile sources nationwide. These proportions are even higher in some urban areas.

Health Effects

Ozone can aggravate asthma and other respiratory diseases, leading to more asthma attacks, use of additional medication, and more severe symptoms that require a doctor's attention, more visits to the emergency room, and increased hospitalizations. Ozone can inflame and damage the lining of the lungs, which may lead to permanent changes in lung tissue, irreversible reductions in lung function if the inflammation occurs repeatedly over a long time period and may lead to a lower quality of life. Children, people with heart and lung disease, and the elderly are most at risk.

Fine particles (PM 2.5) have been associated with an increased risk of premature mortality, hospital admissions for heart and lung disease, and increased respiratory symptoms. Long-term exposure to diesel exhaust is likely to pose a lung cancer hazard. In addition, PM, NOx, and ozone adversely affect the environment in various ways including visibility impairment, crop damage, and acid rain.

Description of Nonroad Engines Covered by this Final Rule

The new emission standards apply to diesel engines used in most construction, agricultural, industrial, and airport equipment. The standards will take effect for new engines beginning in 2008 and be fully phased in for most engines by 2014. Larger mobile engines (greater than 750 horsepower) have one year of additional flexibility to meet their emission standards.

These emission standards do not apply to diesel engines used in locomotives and marine vessels. However, fuel requirements for these categories are covered in this rule. The Agency is concurrently issuing an Advance Notice of Proposed Rulemaking announcing the intent to propose more stringent emission standards for engines used in locomotives and marine vessels.

Exhaust Emission Standards

This rule sets emission standards for different sizes of nonroad engines. These standards are similar in stringency to the standards adopted for 2007 and later diesel-powered trucks and buses. The rule also includes new provisions to help ensure that emission-control systems perform as well when operating in actual use as they do in the laboratory. The standards are phased-in over several years to provide adequate lead time to engine and equipment manufacturers. Table 1 shows the new emissions standards.

Table 1

Final Emission Standards in grams per horsepower-hour (g/hp-hr)

Rated Power	First Year that Standards Apply	PM	NOx
hp < 25	2008	0.30	-
25 ≤ hp < 75	2013	0.02	3.5*
75 ≤ hp < 175	2012-2013	0.01	0.30
175 ≤ hp < 750	2011-2013	0.01	0.30
hp ≥ 750	2011-2014 2015	0.075 0.02/0.03**	2.6/0.50† 0.50††

* The 3.5 g/hp-hr standard includes both NOx and nonmethane hydrocarbons.

† The 0.50 g/hp-hr standard applies to gensets over 1200 hp.

** The 0.02 g/hp-hr standard applies to gensets; the 0.03 g/hp-hr standard applies to other engines.

†† Applies to all gensets only.

Benefits of the Program

Reducing NOx and PM emissions from nonroad diesel engines by more than 90 percent will provide a wide range of public health benefits. Controlling these emissions will, by 2030, prevent every year about: 12,000 premature deaths, 8,900 hospitalizations, one million work days lost, 15,000 heart attacks, 6,000 children's asthma-related emergency room visits, 280,000 cases of respiratory problems in children, 200,000 cases of asthma symptoms in children, and 5.8 million days of restricted adult activity due to respiratory symptoms.

In dollars, the health benefits of this rule are estimated to be $80 billion annually once essentially all older engines are replaced. Estimated costs for the engine and fuel requirements are many times less, amounting to about $2 billion annually in that time frame. Thus, the cost-benefit ratio of this program at that time will be approximately 40-to-1.

For More Information

You can access the final rule and related documents on EPA's web site at:

www.epa.gov/nonroad-diesel

You can also contact EPA at:

U.S. Environmental Protection Agency
Assessment and Standards Division
2000 Traverwood Drive
Ann Arbor, MI 48105
Voice-mail: (734) 214-4636
E-mail: asdinfo@epa.gov

Nonroad Diesel Fuel

Just as lead was phased out of gasoline to prevent damage to catalytic converters, decreasing sulfur levels in nonroad diesel fuel will prevent damage to the emission-control systems. In addition, reducing sulfur levels will provide immediate public health benefits by reducing particulate matter from engines in the existing fleet of nonroad equipment, while reducing engine maintenance cost. This rule will reduce current sulfur levels from about 3,000 parts per million (ppm) to 15 ppm when fully implemented (a reduction of greater than 99 percent).

This rule will reduce nonroad diesel fuel sulfur levels in two steps. First, starting in 2007, fuel sulfur levels in nonroad diesel fuel will be limited to a maximum of 500 ppm, the same as for current highway diesel fuel. This limit also covers fuels used in locomotive and marine applications (though not to the marine residual fuel used by very large engines on ocean-going vessels).

Second, starting in 2010, fuel sulfur levels in most nonroad diesel fuel will be reduced to 15 ppm. This ultra-low sulfur fuel will create immediate public health benefits and will make it possible for engine manufacturers to use advanced emission-control systems that will dramatically reduce both PM and NOx emissions. In the case of locomotive and marine diesel fuel, this second step will occur in 2012.

Estimated Costs

The cost of producing 15 ppm sulfur for this program is expected to total seven cents per gallon. Because the use of ultra-low sulfur fuel will significantly reduce engine maintenance expenses, we estimate that this net cost will average about four cents per gallon.

The estimated costs for a nonroad equipment manufacturer to comply with this program vary depending on size and complexity of the equipment. As an example, we estimate that for a typical 175-horsepower bulldozer, the modifications will cost approximately $2,600, compared to the overall price of such a bulldozer of approximately $240,000. The anticipated costs for most categories of nonroad diesel equipment are in the range of 1-3 percent of the total purchase price.

To reduce the economic impact of meeting new emission standards and requirements for low sulfur fuels, the final rule includes a number of flexibility provisions that are primarily aimed at helping small engine manufacturers and refiners meet the requirements.

Appendix H

Noise Assessment Supplement
(Barr Engineering March 26, 2009)

Barr Engineering Company
4700 West 77th Street • Minneapolis, MN 55435-4803
Phone: 952-832-2600 • Fax: 952-832-2601 • www.barr.com *An EEO Employer*

Minneapolis, MN • Hibbing, MN • Duluth, MN • Ann Arbor, MI • Jefferson City, MO • Bismarck, ND

March 26, 2009

Erik Carlson
Minnesota Department of Natural Resources
500 Lafayette Road
St. Paul, MN 55155-4029

Re: Proposed Stockpile Noise Assessment Supplement Draft
U.S. Steel – Keetac Expansion Project
Keewatin, Minnesota

Dear Mr. Carlson,

On behalf of U.S. Steel enclosed is the draft Proposed Stockpile Noise Assessment Supplement for the Keetac Expansion project. This supplement evaluates potential mitigation options for noise impacts on residential areas in the vicinity of the proposed new stockpile area for the Keetac Expansion Project near Keewatin, Minnesota. The study compares projected noise levels with the Minnesota daytime and nighttime noise standards and with the estimated ambient or background sound level at the residential areas.

The supplemental modeling represents a quieting package fitted to the bulldozers used on the stockpile. Under these conditions, some impacts above state noise standards are still modeled at the receptors nearest the proposed stockpile. Because worst case operational assumptions were used it is unlikely that these conditions would actually occur. In addition there are many factors that reduce noise impacts such as ground effect, vegetative shielding, ambient noise generated by wind, and other factors that are not included in the modeled predictions.

Based on these results U.S. Steel proposes to utilize operating offsets to fully mitigate exceedance of the nighttime L10 and L50 standards. U.S. Steel proposes to conduct daytime sound measurements once the stockpile is operational to determine actual noise levels at nearby residences. If these actual measurements demonstrate impacts below state nighttime noise standards, U.S. Steel proposes to eliminate the nighttime operating offset.

Please review the Draft Proposed Stockpile Noise Assessment Supplement and contact myself or Andrew Skoglund from Barr or Mike Rhoads from U.S. Steel with any questions or comments.

Sincerely,

Lori L. Stegink

Lori L. Stegink
Vice President
Barr Engineering Company

Enclosure

c: Mike Rhoads, USS
Chrissy Bartovich, USS
Tischie Woodwell, USS
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Keetac Expansion Project
U.S. Steel

Keewatin, Minnesota

PROPOSED STOCKPILE NOISE ASSESSMENT

✦SUPPLEMENT✦

Prepared for

U.S. Steel

by

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and
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EXECUTIVE SUMMARY TO THE SUPPLEMENT

Study Objectives

This supplemental study evaluates several mitigation methods to achieve compliance with the Minnesota nighttime noise standards at the nearest residences taking into account the benefits of a quieting package on the dozer since the dozer was identified as a major contributor to the overall sound level associated with stockpile operations.

Quieted Dozer Sound Level

The objective for quieting the dozer is to eliminate the large time history peak associated with the dozer there by reducing both the L10 and L50 levels. In addition to evaluation of a "quieting package", a re-evaluation of the un-quieted level estimated earlier was made, due to clarification of assumptions in deriving the earlier level. Based upon this analysis, an un-quieted dozer source level of 89dBA has been assumed in this supplemental assessment.

Extensive sound level measurements on a Cat D9 at the Werris Creek Coal Mine in New South Wales with and without a quieting package have provided the basis for estimating a source sound level for a "quieted" dozer. Sound level reductions from a static test were significant although reductions from a moving passby test with the dozer reversing in 2^{nd} gear showed much lower benefits. For this supplemental assessment, the combined reduction in dozer sound level with a quieting package assumes 50% static reduction and 50% 2^{nd} gear reverse reduction.

Prediction of L10 and L50 with a quieted dozer

At the Kelly Lake residences with the quieted dozer, the maximum L10 exceedance at Residence #3 dropped from 60 dBA to 59 dBA although the predicted L10 exceedances at Receptor 6 have been reduced to only 1 dBA. However, no changes in the L50 exceedances are predicted although these remain at 3 dBA or less for Residence #3 only.

At the south residences with the quieted dozer, the number of L10 exceedances at Residence #6 dropped from six to four, with one exceedance of 2 dBA and the remaining three only 1 dBA. Compliance with the L50 standard is still predicted for all dump/residence pairs**.**

Prediction of L10 and L50 at Kelly Lake Residence #3 without dozer operation

The L10 level does not change when dozer operations are completely eliminated and is still predicted to exceed the Minnesota nighttime L10 standard by 4 dBA. However, the L50 level is lower with no dozer operations and would comply with the Minnesota nighttime L50 standard. The primary sources contributing to the L10 exceedance are the bed lift and dumping process. Remaining sources contributing to the L50 level are truck movement: approach when loaded and departure when empty.

Noise Contours with Quieted Dozer

There is a small reduction in contour distances with the quieted dozer. Predicted contour distances from the stockpile perimeter for nighttime standards are L10 of 55 dBA at 1610 feet and L50 of 50 dBA at 1370 feet.

Offsets to Comply with Nighttime Standards

The objective of this analysis is to estimate the distance from the stockpile perimeter that nighttime activity would need to be offset to achieve compliance with the nighttime noise standards. These will naturally be larger for those dump locations closest to residential receptor sites, smaller for those further away, and not needed at all where compliance is already predicted.

The offset distances are based on the distance from the residence to each dump perimeter and the predicted L10 and L50 levels from each dump at the residence. Using this information, it is possible to calculate the additional distance from the perimeter at which the L10 and L50 standards will be met

The maximum offsets would be about 650 feet at for Dump 5 and 6 at Kelly Lake and 350 feet for Dump 12 at the south residences. Actual monitoring of stockpile noise will provide a more accurate basis for determining if offsets are needed and if so, what these offset distances should be.

As the stockpile increases in height, the necessary offset distance may be decreased due to additional shielding from the edge of the stockpile. Revised offset distances could be calculated based upon stockpile heights.

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1.0 SUPPLEMENTAL STUDY OBJECTIVES

1.1. Purpose of the Study

This supplemental study evaluates several mitigation methods to achieve compliance with the Minnesota nighttime noise standards at the nearest residences taking into account the benefits of a quieting package on the dozer which was identified as a major contributor to the overall sound level associated with stockpile operations.

1.2. Study Objectives

The study objectives were as follows:

- Establish a sound source level for a quieted CAT D10 dozer
- Evaluate the benefits to the L10 and L50 levels at the nearest residences.
- Evaluate the L10 and L50 levels at the closest residence (Kelly Lake Receptor #3) without any dozer operations
- Estimate an offset distance from the proposed stockpile perimeter at which quieted dozer operations can comply with the L10 and L50 nighttime standards.

1.3. Report Structure

This report is structured as follows:

- Section 2 Establish Quieted Dozer Source Level
- Section 3 Estimate L10 and L50 Levels at Kelly Lake with a Quieted Dozer
- Section 4 Estimate L10 and L50 Levels at the South residences with a Quieted Dozer
- Section 5 Estimate the L10 and L50 Level at Kelly Lake Receptor #3 with no Dozer
- Section 5 Stockpile Noise Contours with a Quieted Dozer
- Section 6 Offsets from Stockpile Perimeter needed to Comply with Nighttime Standards

2.0 ESTIMATED QUIETED DOZER SOUND LEVELS

2.1. Revaluation of Monitored Dozer Level

The original contribution of the dozer to the time history at receptor #3 from Dump 8 can be seen in **Figure 2.1.** The high level and duration at this level made a relatively large contribution to both the L10 (length of time over 60 dBA) and the L50 (length of time over 53 dBA). The objective for quieting the dozer is to eliminate this large peak and thereby reducing both the L10 and L50 levels.

The dozer source level assumed in the original report was based upon the assumption that all dozer activity took place in a relatively small zone near the perimeter dump site. Further clarification of dozer movement during sound level measurements with both the Larson-Davis Model 824 and the Casella CEL Model 593 meter indicated that the dozer followed a longer track along with departing trucks.

In a simple theoretical world, the sound levels in **Figure 2.2** representing consecutive points along the dozer track and adjusted to a common distance of 50 feet would be identical. However, factors such as air absorption and ground effect play a role in reducing the level more as distance from the monitoring site increases. Since measurements at the closest approach are not greatly affected by these other factors, they tend to be more representative of the source level. For purposes of this supplemental assessment, an average of the first seven readings has been assumed as the overall dozer sound level at 50 feet (89 dBA). This compares with a level of 94.6 dBA assumed in the original study.

2.2. Review of Caterpillar D9 and D10 Sound Levels

To determine the reasonableness of this assumption, a literature and web search of sound levels reported for Caterpillar D9 and D10 dozers was undertaken. The results of this extensive review are summarized by the bar chart in **Figure 2.3**,

Based upon data contained in the Transport Infrastructure (New South Wales) Construction Noise Strategy for Rail Projects, the maximum allowable A-weighted sound power level for a D10 equivalent dozer is 1 dBA higher than an equivalent D9 Dozer. Thus, extensive sound level measurements on a Cat D9 at the Werris Creek Coal Mine in New South Wales, Australia[1], can be applied to a Cat D10 by adding 1 dB to these data. Those overall dBA levels are shown in **Figure 2.3** by the bars labeled “D9+1”.

Since the dozer observed and measured on the existing Keetac stockpile was backing during the entire measurement, the assumed dozer source level of 89 dBA compares favorably with the 2nd gear reverse level of 88 dBA shown on **Figure 2.3**. The 89 dBA (at 50 ft) Cat D10 source level is used here because it also represents actual activity at an existing Keetac stockpile and compares favorably with the extensive data upon which a “quiet dozer” level can be based.

[1] “Statement of Environmental Effects for Minor Modifications to Werris Creek Coal Mine”; Werris Creek Coal Pty Limited; Werris Creek, New South Wales. Report No. 623/07, June 2008. App. 2-4.

2.3. Benefits of Dozer Quieting Package

The sound measurements from the Werris Creek Coal Mine in New South Wales included both before and after measurements on a “quieting package” installed on the D9 dozer. These data provide a basis for estimating the benefits of a “quieting package” on the D10 dozer used at the Keetac stockpile.

The sound reduction benefits of the quieting package were measured from a static test walk around at a distance of 16 meters (shown in **Figure 2.4)** and a moving passby test at a distance of 10 meters of a dozer reversing in 2nd gear (shown in **Figure 2.5**). The bar charts represent A-weighted spectral levels.

Sound level reductions from the static test (**Figure 2.4**) are significant from the lowest reported frequency (80 Hz) all the way up to 2500 Hz. However, sound level reductions from the moving passby test with the dozer reversing in 2nd gear (**Figure 2.5**) shows much lower benefits, in most cases only one or two dB. Therefore, the level of benefit to be derived from a quieting package will depend heavily upon the mode in which the dozer is operated.

2.4. Establish Quieted Dozer Level for Simulation Model Analysis

A preliminary evaluation of alternative mode combinations were evaluated to help determine the level of sound level reduction that could be expected Keetac with a quieted Cat D10 dozer. The results of two alternative modal mixes at the Kelly Dump 8/Receptor #3 location (closest residence to stockpile activity) are shown in **Table 2.1**. The 50/50 split refers to the assumption of 50% static reduction/50% 2nd reverse reduction while the 70/30 split refers to 70% static reduction/30% 2nd reverse reduction

Table 2.1 Comparison of Sound Level at Kelly Lake Dump 8/ Receptor #3

Metric	Previous Level	50/50 Split	70/30 Split
Leq	57.5	55.5	55.3
L10	60	59	59
L50	53	53	53
L90	53	49	49

It can be seen from this preliminary simulation that, while the Leq (or equivalent sound level) shows a 2 dBA benefit from the originally assumed dozer level, the L10 level shows only 1 dBA benefit wile the L50 shows no change. The L90, however, shows a 4 dBA benefit although this is not used for compliance purposes. What the table does show, however, is that if 50% or more of the dozer operation is backing, the quieting package provides a benefit more similar to the 2nd gear reverse than to the static test. Therefore, the 50/50 split quieting package effectiveness has been assumed in the supplemental simulations.

This small difference between the 50/50 and 70/30 static/2nd gear reverse reductions is also reflected in the octave band spectra for the dozer shown in **Figure 2.6**.

3.0 ESTIMATED NOISE AT KELLY LAKE WITH QUIETED DOZER

3.1. Kelly Lake residential area and noise sources and residences

For the supplemental simulation of stockpile noise levels at Kelly Lake, the previous dump and residences have been assumed. These are included again for reference as **Figure 3.1** in this report

3.2. Projected sound levels at residences

Projected L10 levels with a quieted dozer for the dump and residence pairs are presented in **Figure 3.2**. While there is a slight decrease in the L10 level for Residence #3, the L10 levels are generally above the L10 nighttime standard. There is also a small decrease in L10 levels for Residence #6.

Projected L50 levels with a quieted dozer for the dump and residence pairs are presented in **Figure 3.3**. These show little if any benefit from the quieted dozer.

3.3. Compliance with Minnesota Noise Standards

The maximum L10 exceedance dropped from 60 dBA to 59 dBA at Residence #3.although the predicted L10 exceedances at Receptor 6 have been reduced to only 1 dBA. However, no changes in the L50 exceedances are predicted although these remain at 3 dBA or less for Residence #3 only.

4.0 ESTIMATED NOISE AT SOUTH RESIDENCES WITH QUIETED DOZER

4.1. South residential area and noise sources and residences

For the supplemental simulation of stockpile noise levels at the south residences, the previous dump and residences have been assumed. These are included again for reference as **Figure 4.1** in this report

4.2. Projected sound levels at residences

Projected L10 levels with a quieted dozer for the dump and residence pairs are presented in **Figure 4.2**. There are some significant benefits with the quieted dozer at Residence #6 with exceedances dropping to only 1 dBA for three dump locations and to 2 dBA for Dump 12. Levels from some other dump/residence pairs are also predicted to decrease.

Projected L50 levels with a quieted dozer for the dump and residence pairs are presented in **Figure 4.3**. These are essentially unchanged from the original simulation.

4.3. Compliance with Minnesota Noise Standards

With the quieted dozer, operations at only four dump locations are predicted to exceed the L10 nighttime standard at Residence #6 compared with six dump locations with the previous simulation. Three of these are only 1 dBA with one exceedance of 2 dBA. Compliance with the L50 standard is still predicted for all dump/residence pairs**.**

5.0 L10 AND L50 LEVEL AT KELLY LAKE RESIDENCE #3 WITH NO DOZER

5.1. Estimated L10 and L50 at Residence #3 with No Dozer

Since the Kelly Lake Residence #3 is predicted to experience the highest sound levels from stockpile operation, an evaluation of what would happen to the highest predicted level at this receptor (due to operations at Dump 8) has been made. The results of the analysis are presented in **Table 5.1**.

Table 5.1 Predicted Sound Levels at Residence #3 from Dump 8 with No Dozer

Sound Level Metric	Quieted Dozer	No Dozer
L10	59	59
L50	53	50
L90	49	48

The L10 level, which is due primarily to the actual dumping operation, does not change when dozer operations are eliminated and is still predicted to exceed the Minnesota nighttime L10 standard by 9 dBA. However, the L50 level is lower with no dozer operations and would comply with the Minnesota nighttime L50 standard.

5.2. Evaluation of Time History and Identification of Remaining Contributing Sources

The time history for the Dump 8 and Residence #3 in **Figure 5.1** shows why the L10 level does not change when dozer activity is eliminated. The primary sources contributing to the L10 exceedance are the bed lift and dumping process. Remaining sources contributing to the L50 level are truck movement: approach when loaded and departure when empty.

6.0 SOUND CONTOURS WITH QUIETED DOZER

6.1. Sound contours from single track operation

As in the original report, contour distances perpendicular to the stockpile perimeter have been calculated for both daytime and nighttime periods. The approximate distances of contours from the dump location are listed in **Table 6.1**.

Table 6.1 Daytime and Nighttime Contour Distances

Daytime Contours	Standard (dBA)	Contour Distance (feet)
L10	65	600
L50	60	420
Nighttime Contours	Standard (dBA)	Contour Distance (feet)
L10	55	1610
L50	50	1370

A home would have to be as close as 600 feet to the stockpile perimeter to be exposed to an L10 level of 65 dBA. It would have to be only 420 feet from the perimeter to be exposed to an L50 level of 60 dBA.

For almost continuous or randomly time-varying sound sources, the L50 contour extends further from a source than the L10 contour. However, because the L10 level is well above the L50 level for the assumed operational cycle and time history, the L10 contour is slightly larger in this case than the L50 contour.

6.2. Sound contours for multiple truck operation

Sound contours for multiple truck operation around the perimeter of the proposed stockpile can be developed assuming that the dumping points are continuous along the perimeter. Barr Engineering has developed contours for L10 and L50 with the quiet dozer to show the extent of potential noise impacts from the stockpile. The daytime and nighttime L10 contours are shown in **Figure 6.1**. The daytime and nighttime L50 contours are shown in **Figure 6.2**.

7.0 OFFSETS FROM PERIMETER TO COMPLY WITH STANDARDS

7.1. Kelly Lake Area

The objective of this analysis is to estimate the distance from the stockpile perimeter that nighttime activity would need to be offset to achieve compliance with the nighttime noise standards. These will naturally be larger for those dump locations closest to residential receptor sites, smaller for those further away, and not needed at all where compliance is already predicted.

From **Figure 3.2** (L10 levels at Kelly Lake residences), it can be seen that Residence #1, Residence #3, and Residence #6 are predicted to exceed the nighttime L10 55 dBA standard. Receptor #3 is predicted to have the largest exceedances of the nighttime L10 standard and is the only one at Kelly Lake to exceed the L50 standard. The needed L10 and L50 offsets for this residence are shown in **Figure 7.1**. A maximum offset of about 650 feet is predicted for Dump 5 and Dump 5.

The offset distances are based on the distance from the residence to each dump perimeter and the predicted L10 and L50 levels from each dump at the residence. Using this information, it is possible to calculate the additional distance from the perimeter at which the L10 and L50 standards will be met.

If any residences were located close to or adjacent to the stockpile perimeter, the offset would have to equal the contour distance from the perimeter. However, since the residences are located 1000 feet or more from the stockpile perimeter, the needed offset distances are always smaller than the contour distances.

From **Figure 3.2**, it can be seen that Residence #1 is predicted to exceed the L10 level by 2 dBA only for Dump 1. Residence #6 is predicted to exceed the L10 level by only 1 dBA for Dump 13, Dump 14, and Dump 15.

For completeness the offsets to comply with the L10 standard for all dump/residence pairs are presented in **Table 7.1**.

Table 7.1 Offsets for Dump/Residence Pairs to Comply with Nighttime L10 Standard

	Offset from Stockpile Perimeter (feet)			
Dump	Home 1	Home 3	Home 5	Home 6
1	350	0	0	0
2	0	176	0	0
3	0	333	0	0
4	0	459	0	0
5	0	645	0	0
6	0	651	0	0
7	0	459	0	0
8	0	595	0	0
9	0	615	0	0
10	0	485	0	0
11	0	353	0	0
12	0	168	181	0
13	0	0	0	180
14	0	0	0	173
15	0	0	0	175
16	0	0	0	0

7.2. South Residence Area

From **Figure 4.2** (L10 levels at South Residence receptors), it can be seen that Residence #6 is predicted to exceed the nighttime L10 standard for four of the nearest dump locations and by a maximum of 3 dBA. From **Figure 3.4** (L50 levels at South Residence) receptors) it can be seen none of the receptor sites are predicted to exceed the nighttime L50 standard.

Based upon the distance from receptor #6 to each of the dump location perimeters and the predicted L10 levels from each, the additional distances have been estimated from the perimeter at which the L10 standard will be met. These distances are shown in **Figure 7.2.** A maximum predicted offset of 350 feet is predicted for Dump 12. As expected, these offsets are considerably smaller than for Residence #3 at Kelly Lake. An offset of only 150 feet could be within modeling error. Actual monitoring of stockpile noise will provide a more accurate basis for determining if offsets are needed and if so, what these offset distances should be.

7.3. Effectiveness of Stockpile Height in Reducing Needed Offset Distance

All of the predictions in the original report and this supplement, including the offsets presented above, have assumed a relatively low stockpile height so that no shielding of sound from the operation is provided by the edge of the stockpile itself, which in effect may act as a noise berm.

However, as the stockpile increases in height, this offset distance may be decreased due to this additional shielding which is shown schematically in **Figure 7.3.** Given assumed stockpile heights above ground or at elevations relative to the impacted residences, revised offset distances could be calculated.

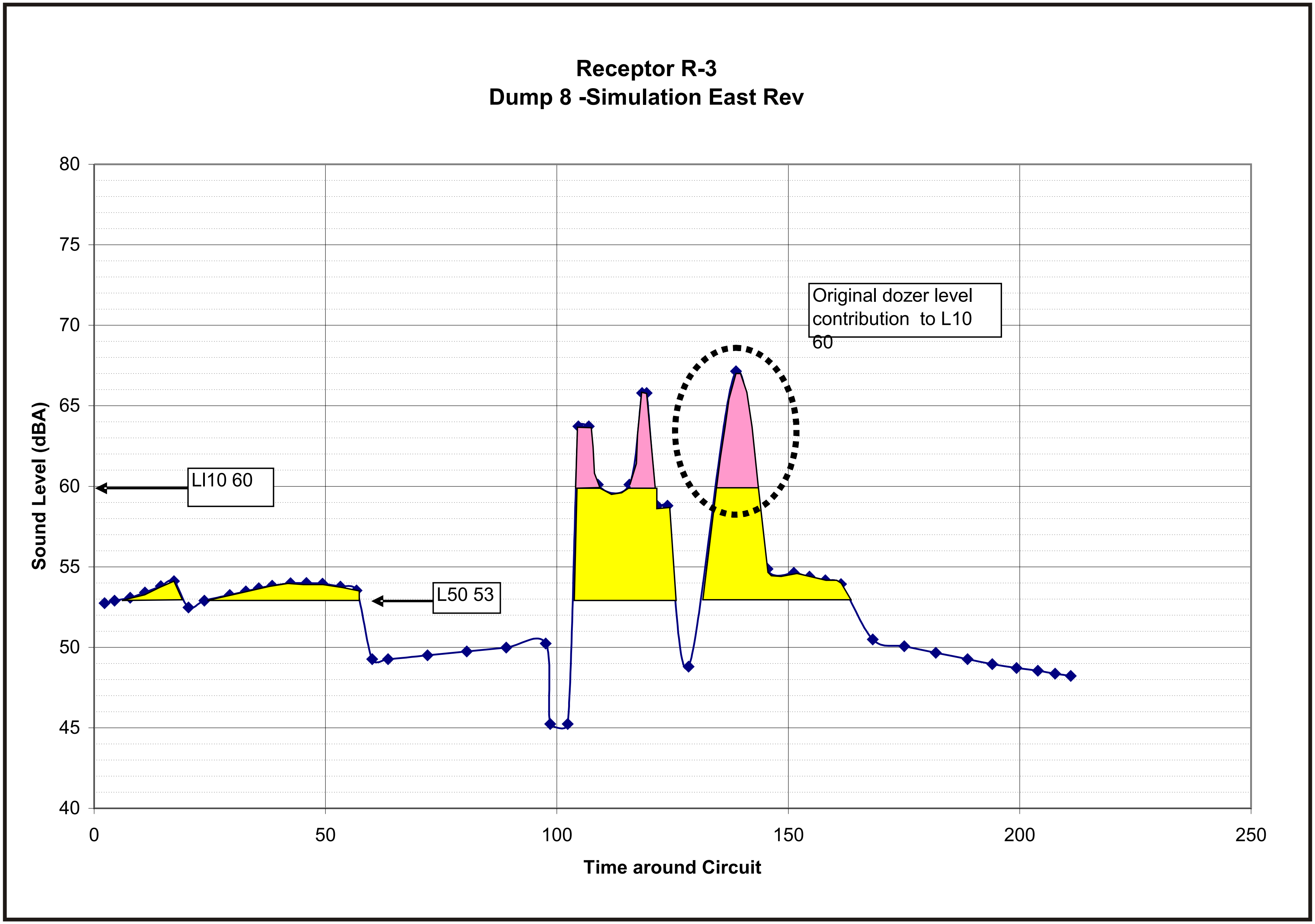

FIGURE 2.1

Relative Contribution of Dozer in Simulation

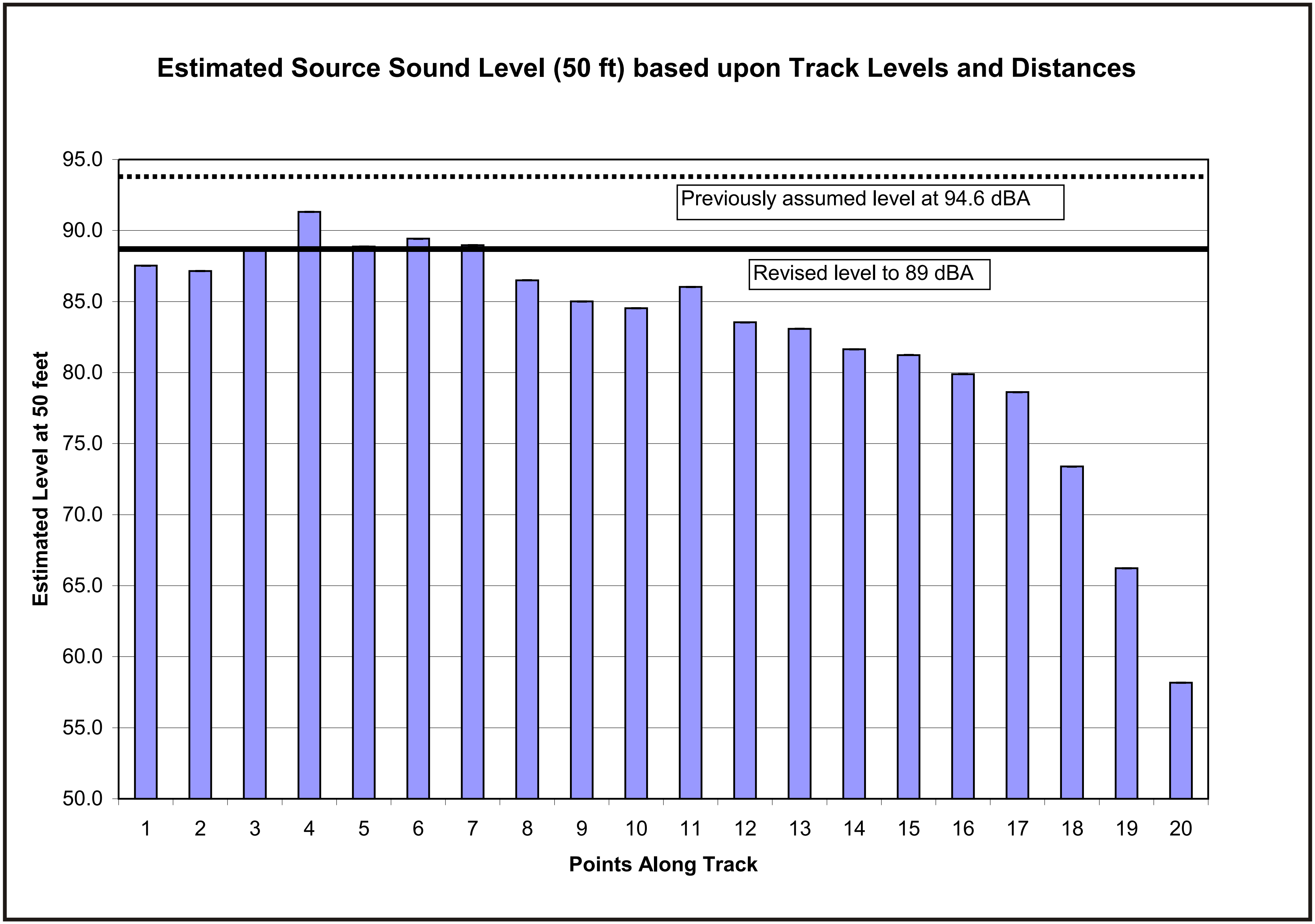

FIGURE 2.2

Estimated Dozer Source Level Based upon Revised Dozer Track

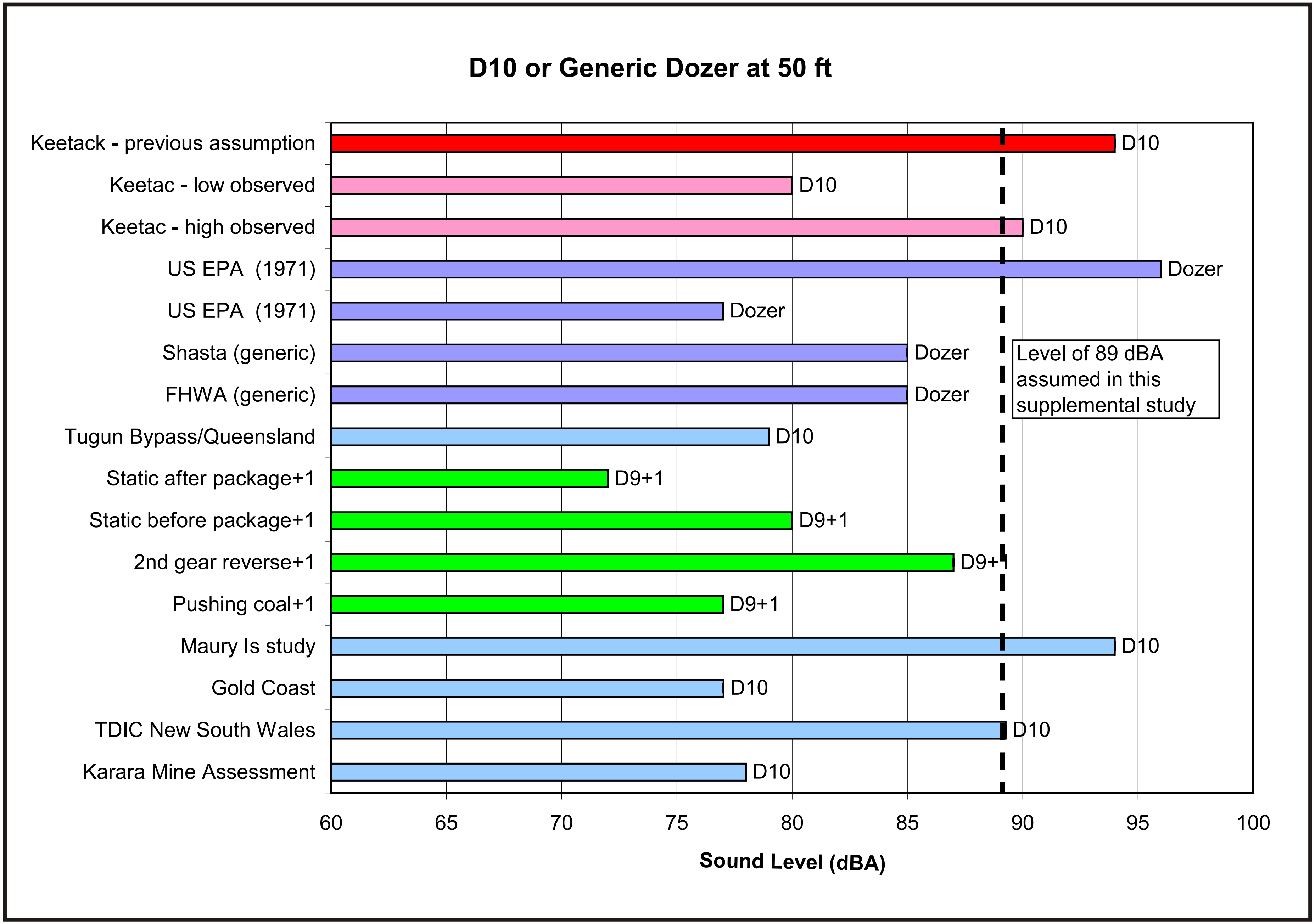

FIGURE 2.3

Comparison of Monitored Dozer Source Levels

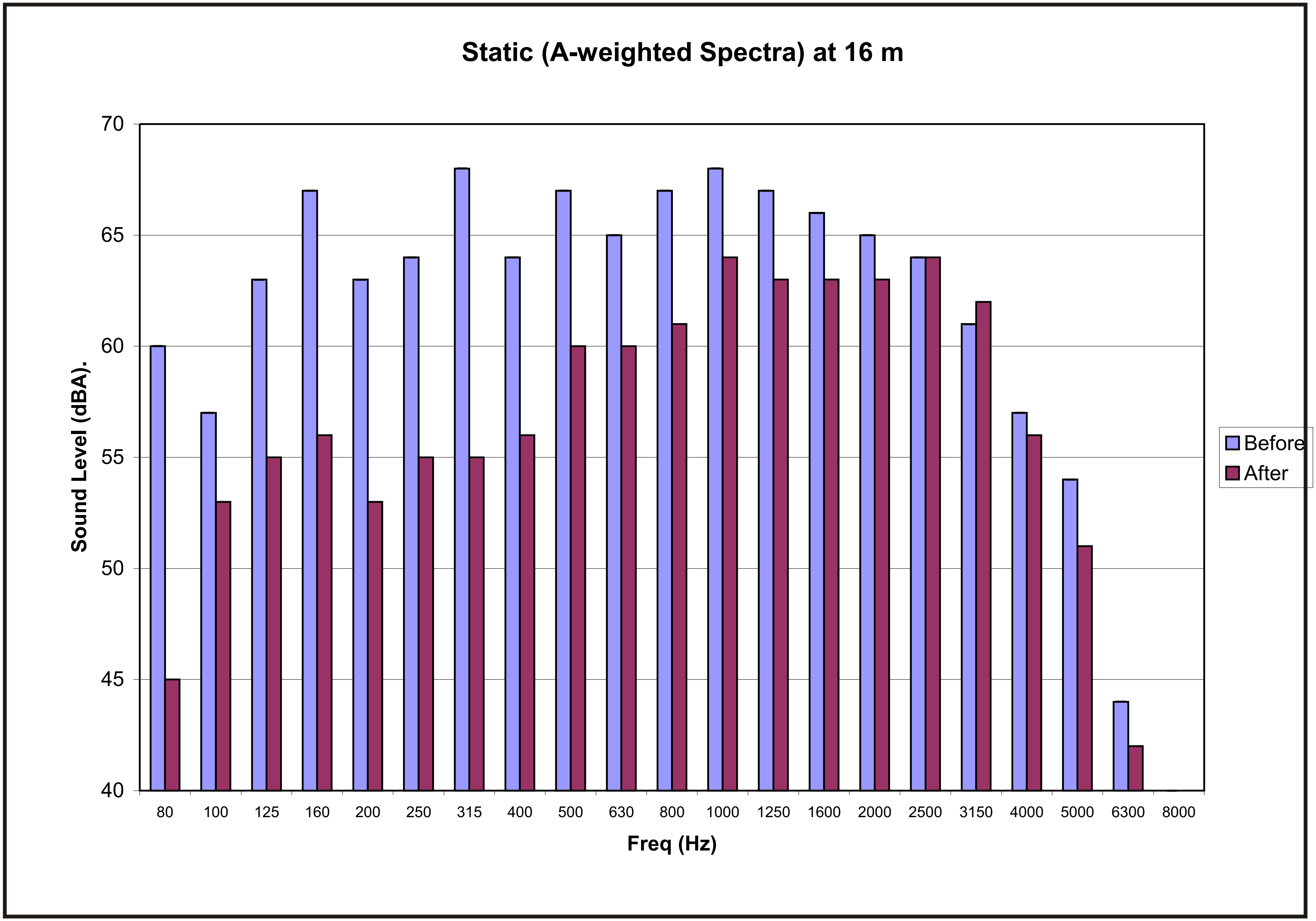

FIGURE 2.4

Dozer Quiet Package Benefit - Static Walk-Around Test at 16 m

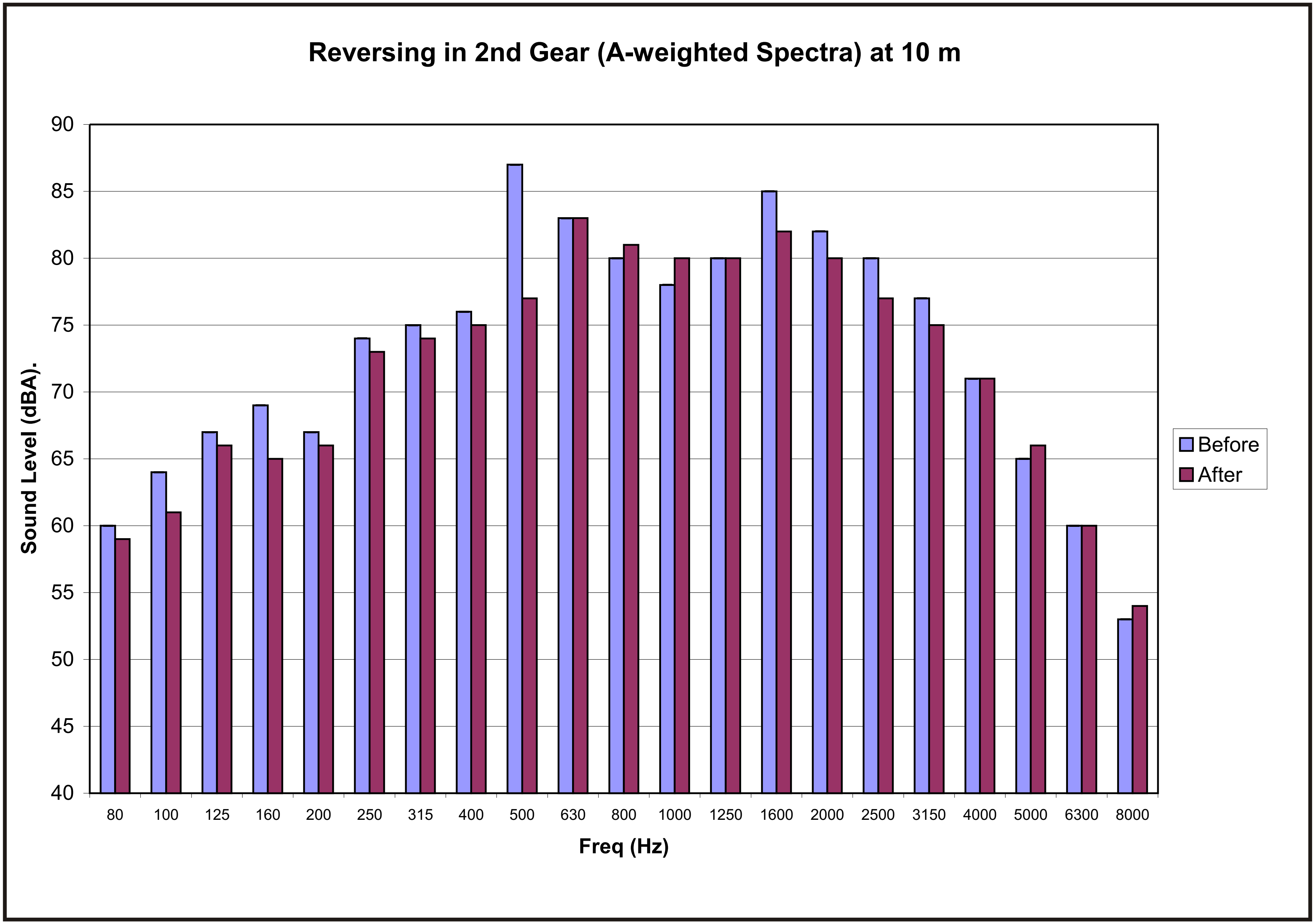

FIGURE 2.5

Dozer Quiet Package Benefit - Reverse in 2nd Gear at 10 m

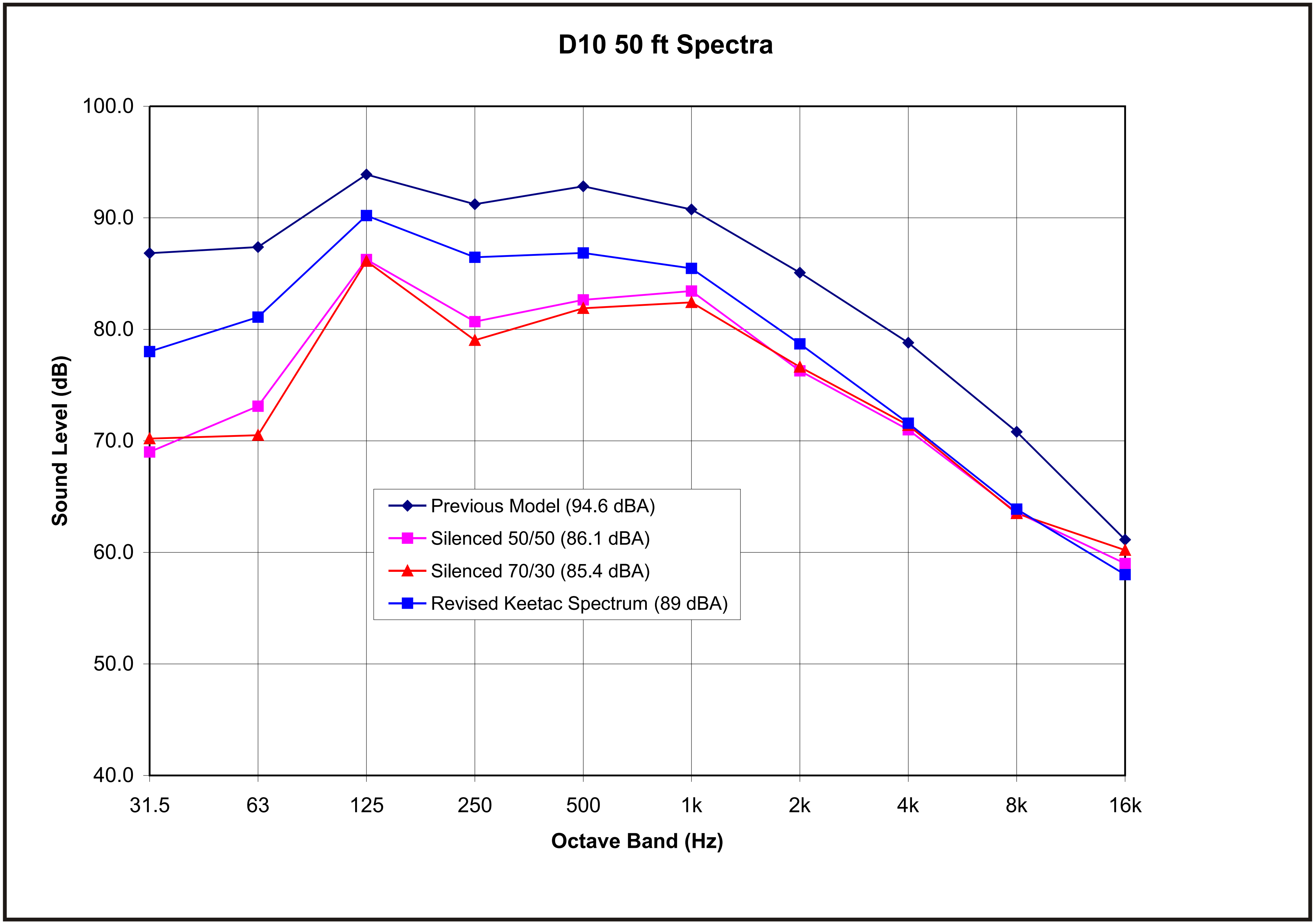

FIGURE 2.6

Selected Octave Band Source Levels for Cat D10 Dozer

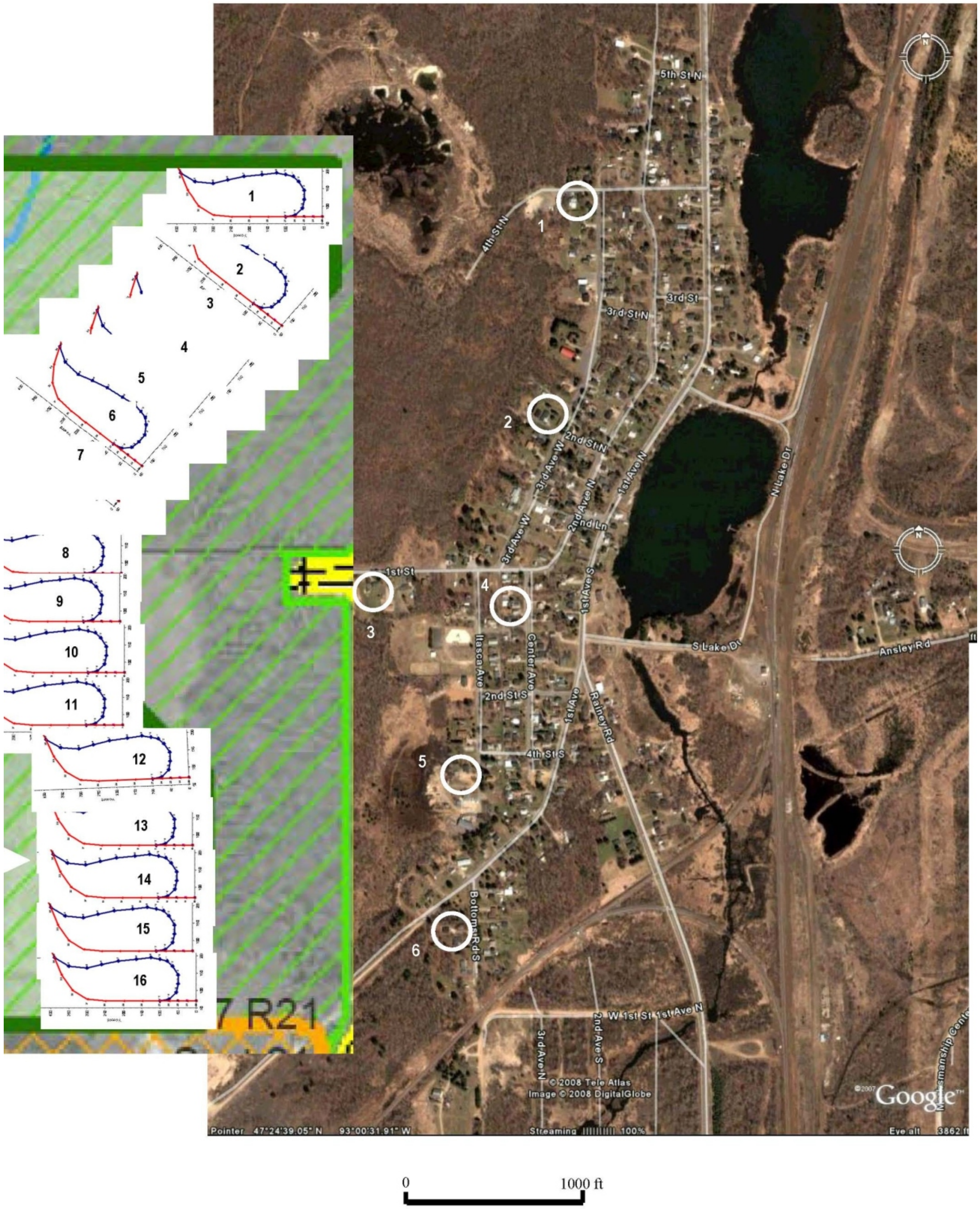

FIGURE 3.1

Kelly Lake Dump Locations and Residential Receptors

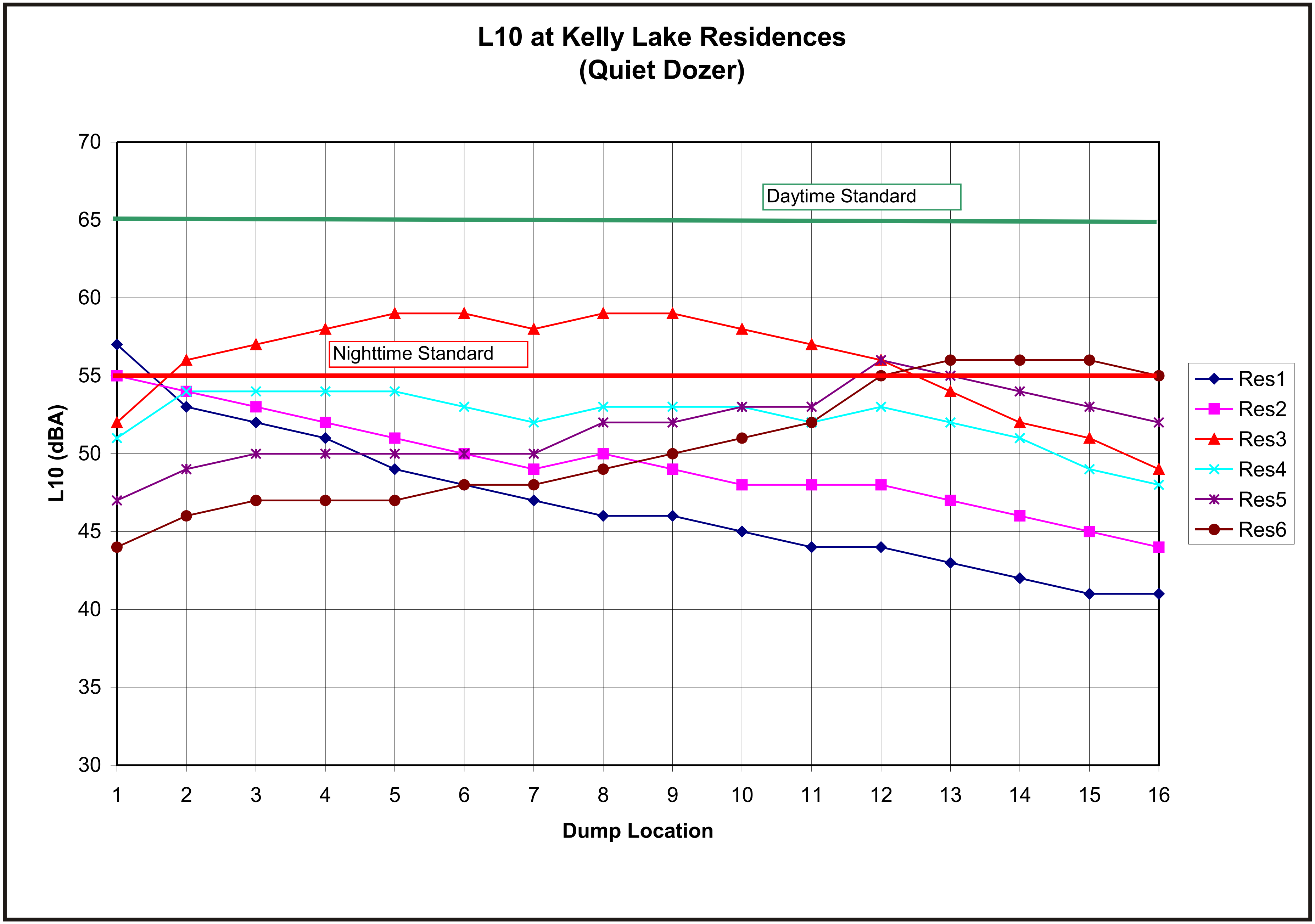

FIGURE 3.2

Estimated L10 Levels at Kelly Lake Residences

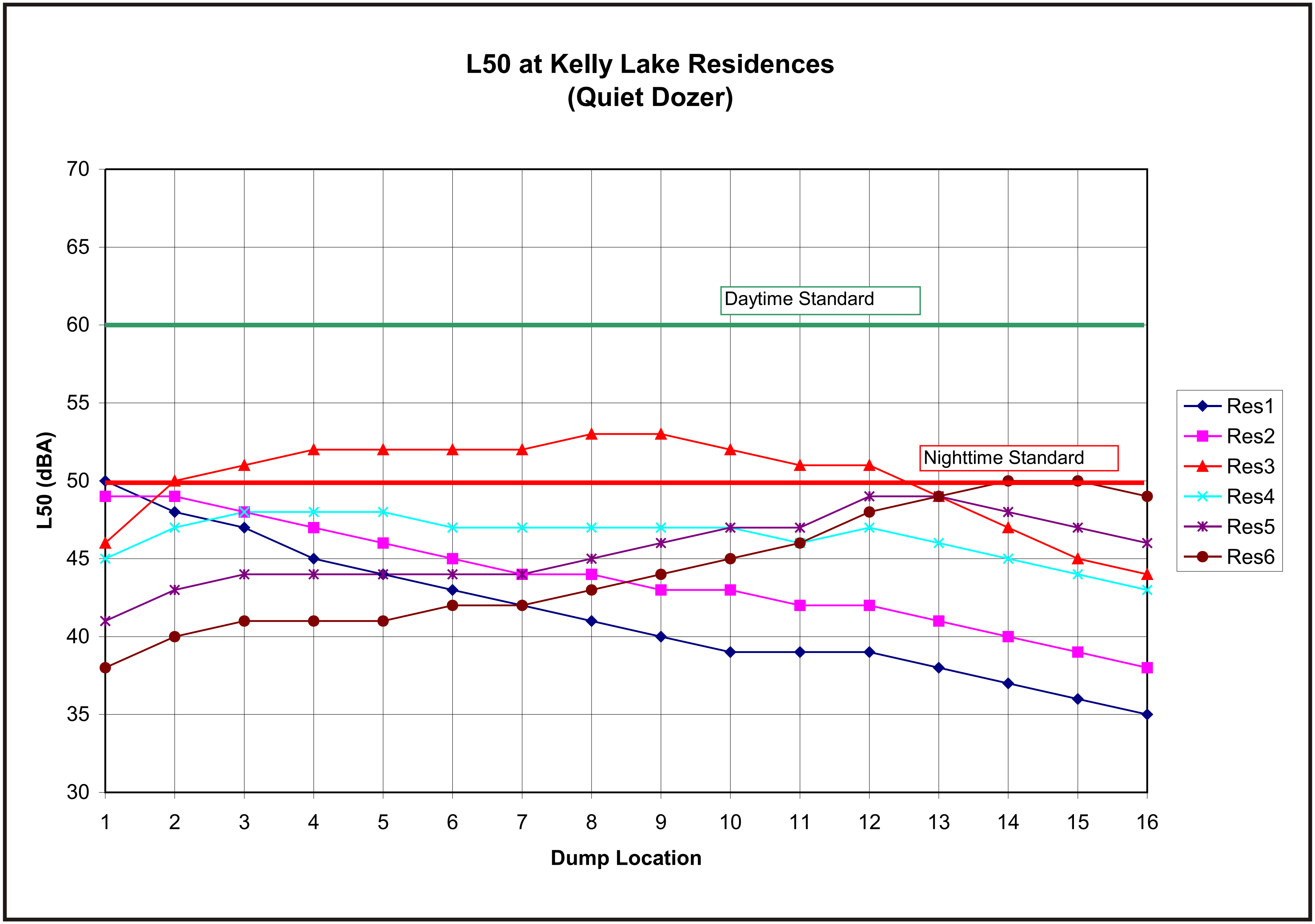

FIGURE 3.3

Estimated L50 Levels at Kelly Lake Residences

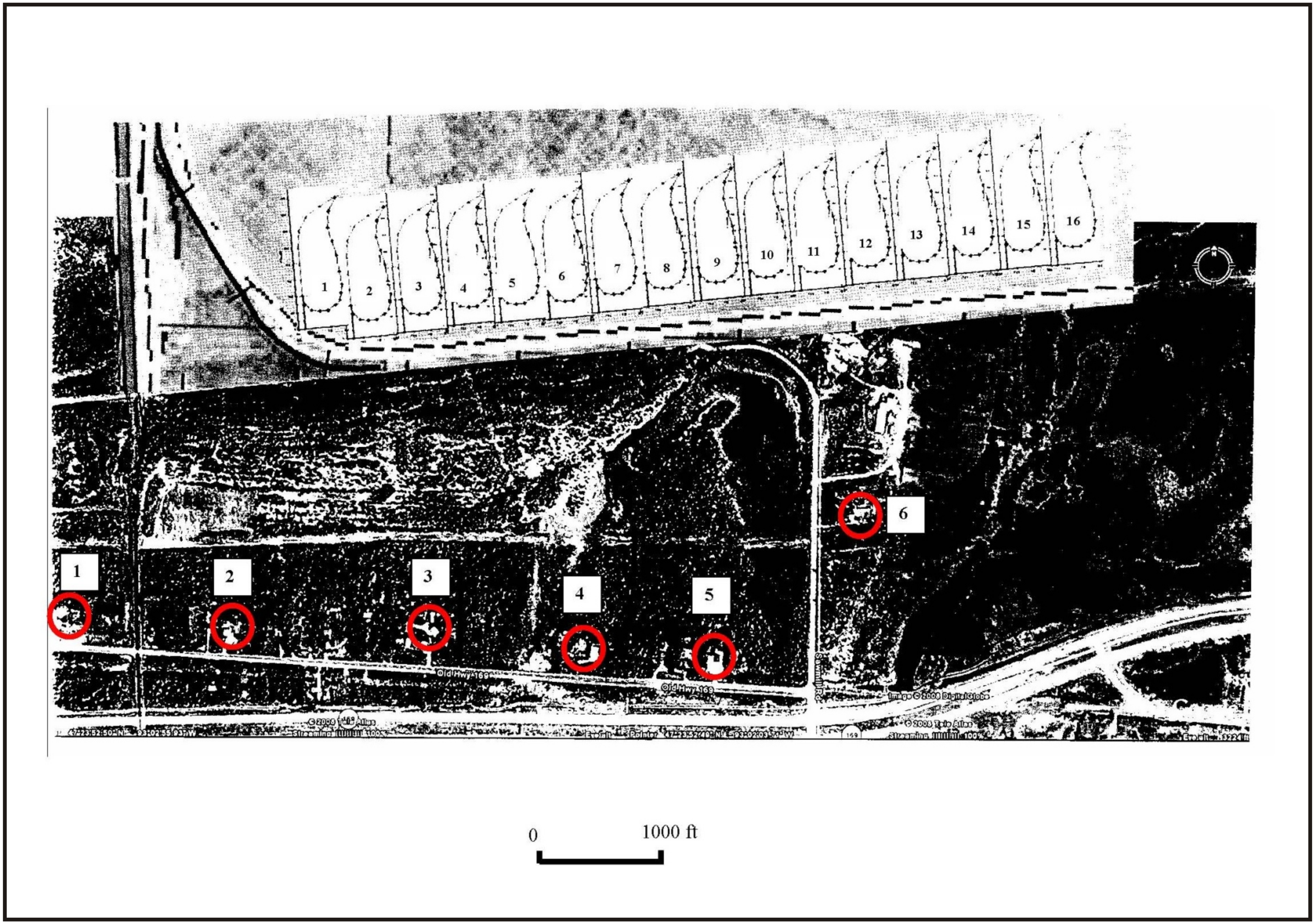

FIGURE 4.1

South Residence Dump Locations and Residential Receptors

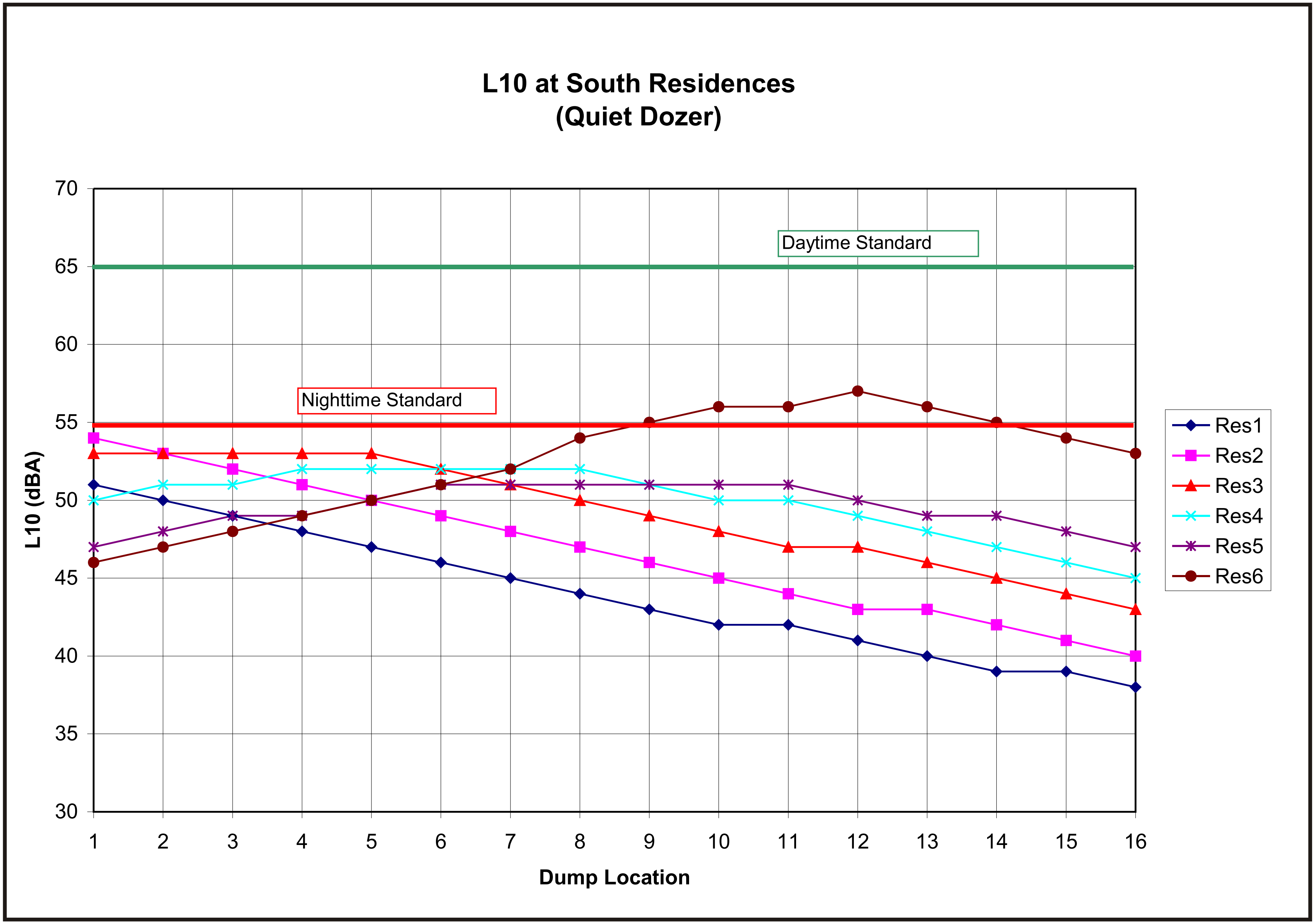

FIGURE 4.2

Estimated L10 Levels at South Residences

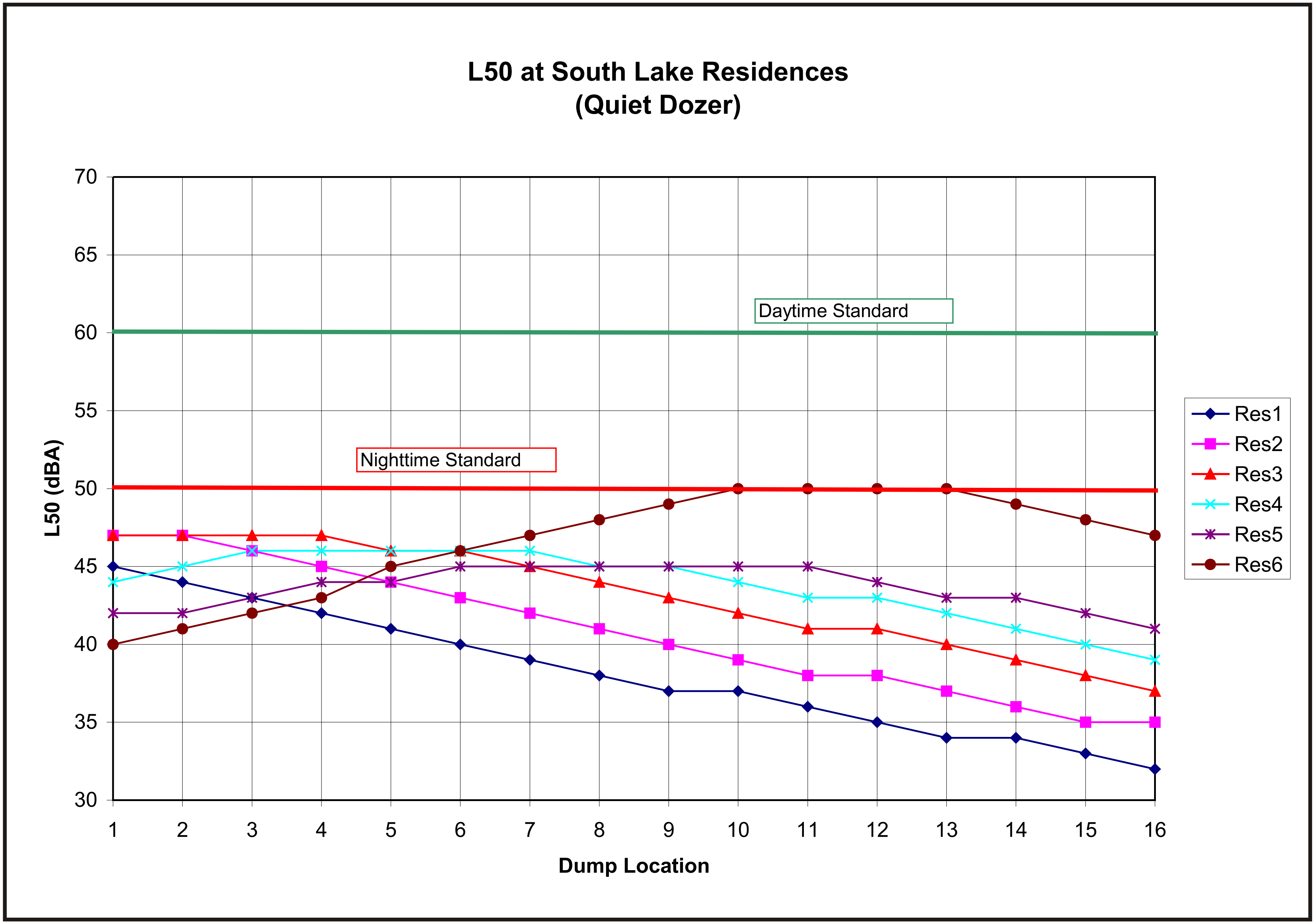

FIGURE 4.3

Estimated L50 Levels at South Residences

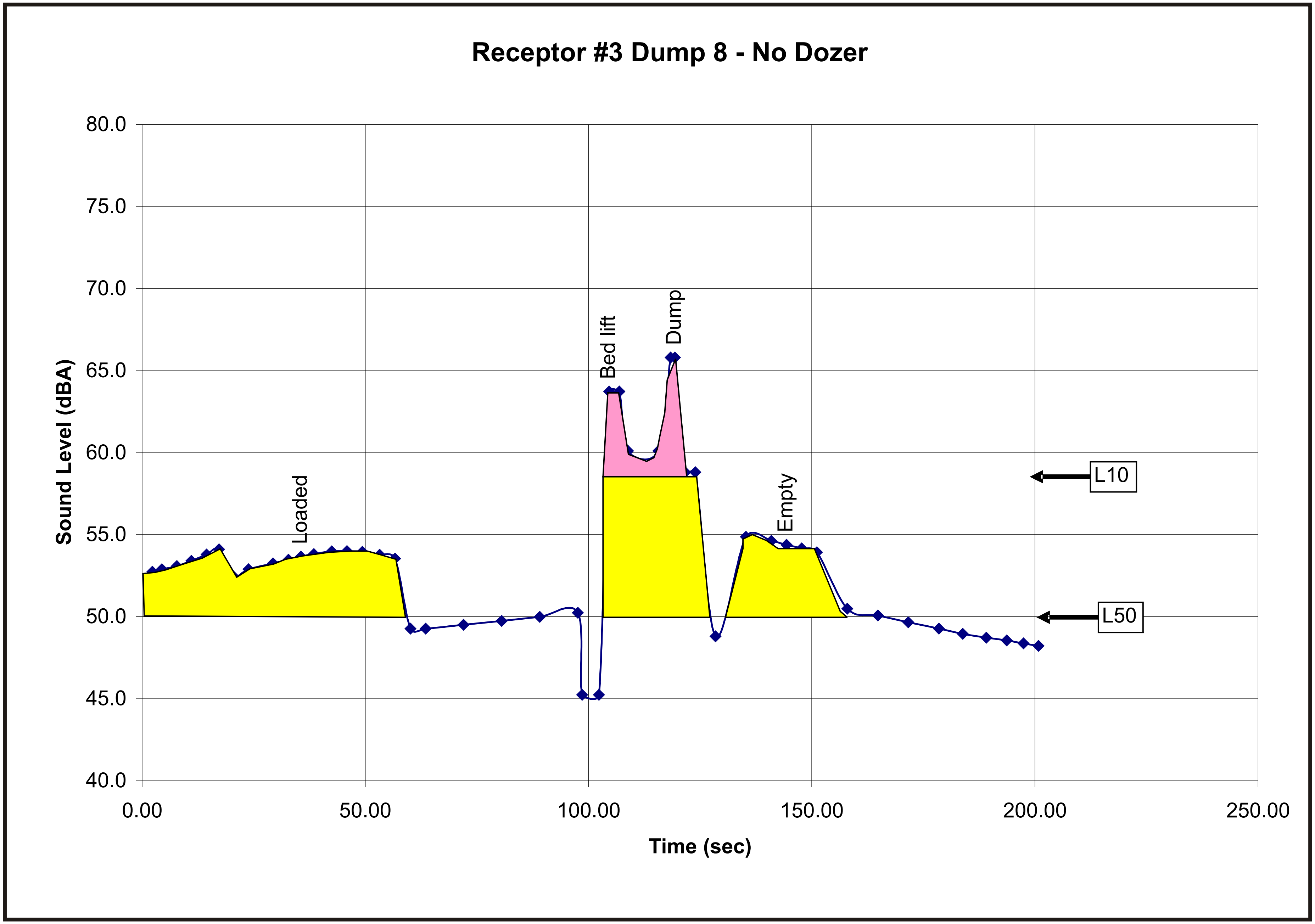

FIGURE 5.1

Contributing Sources with Dozer Activity

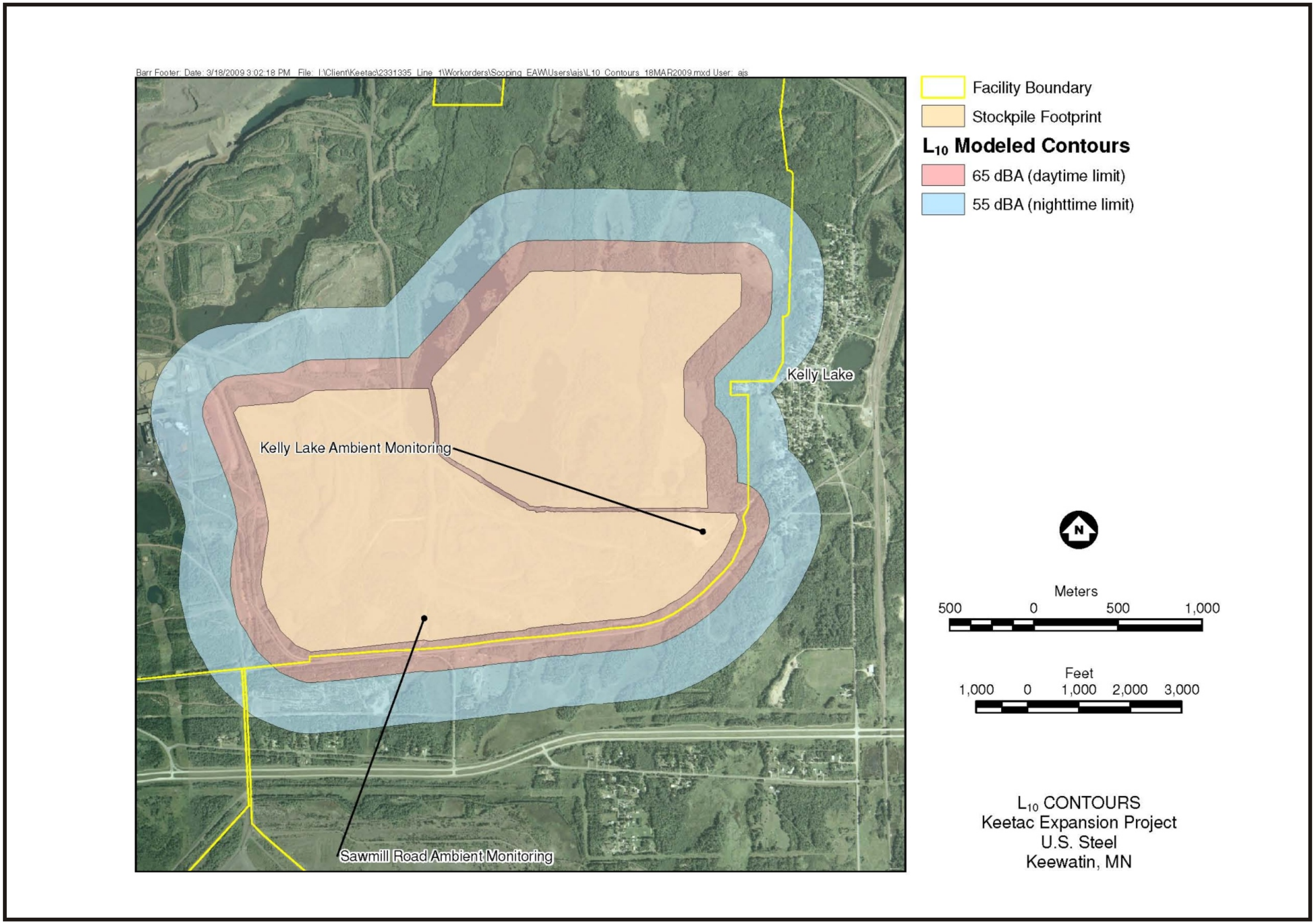

FIGURE 6.1

L10 Contours with Quiet Dozer

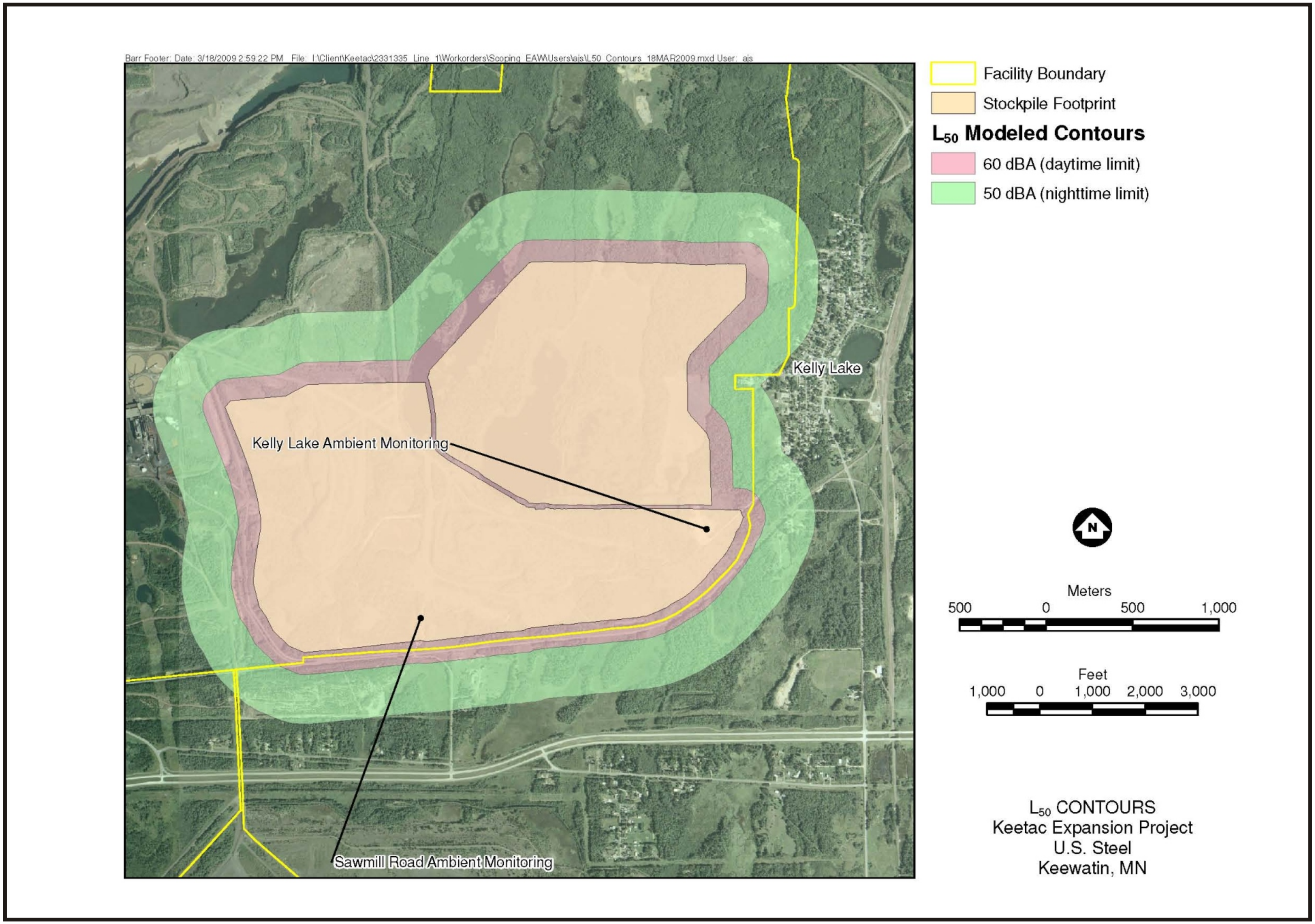

FIGURE 6.2

L50 Contours with Quiet Dozer

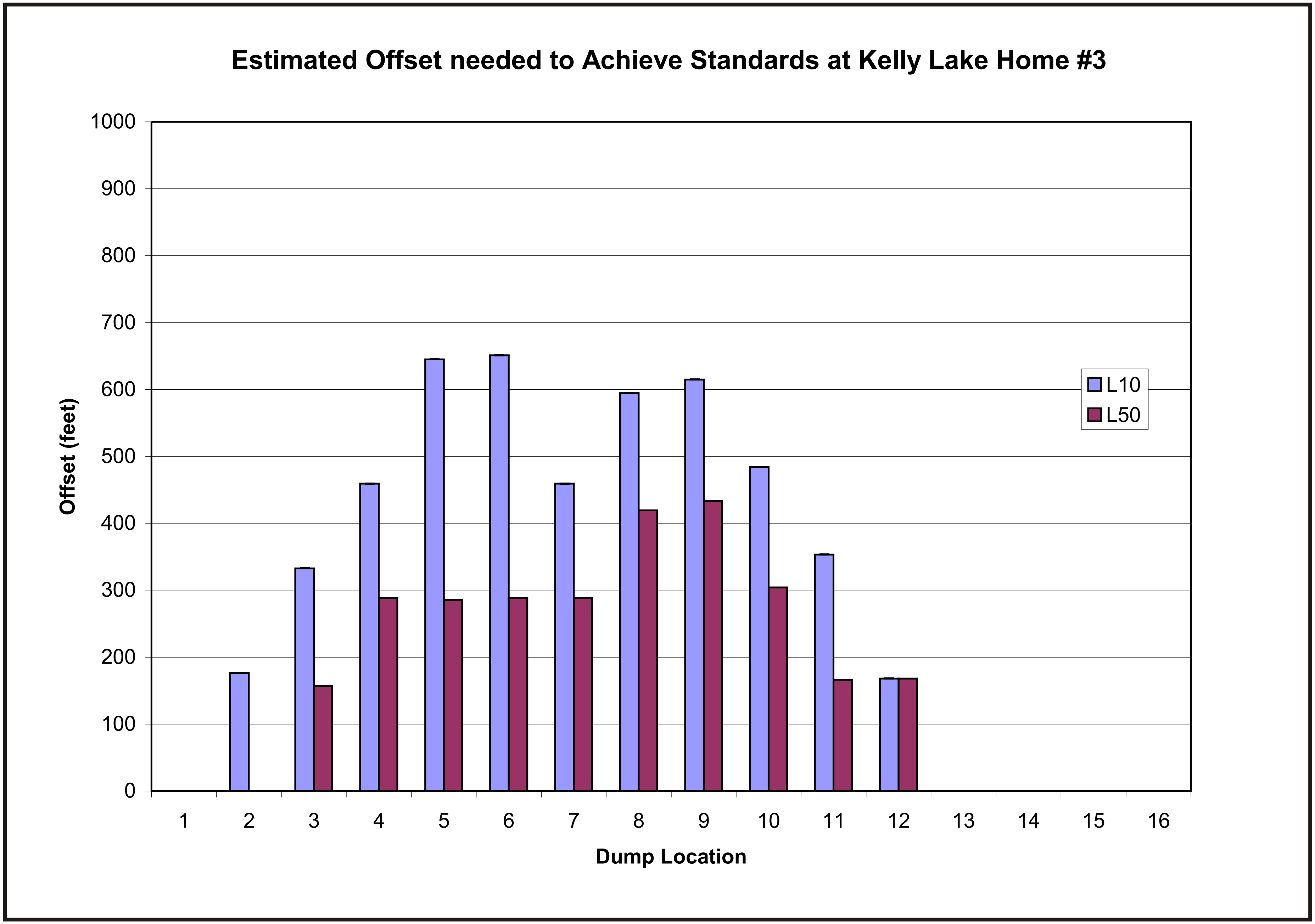

FIGURE 7.1

Offsets at Kelly Lake Needed to Comply with Nighttime Standards

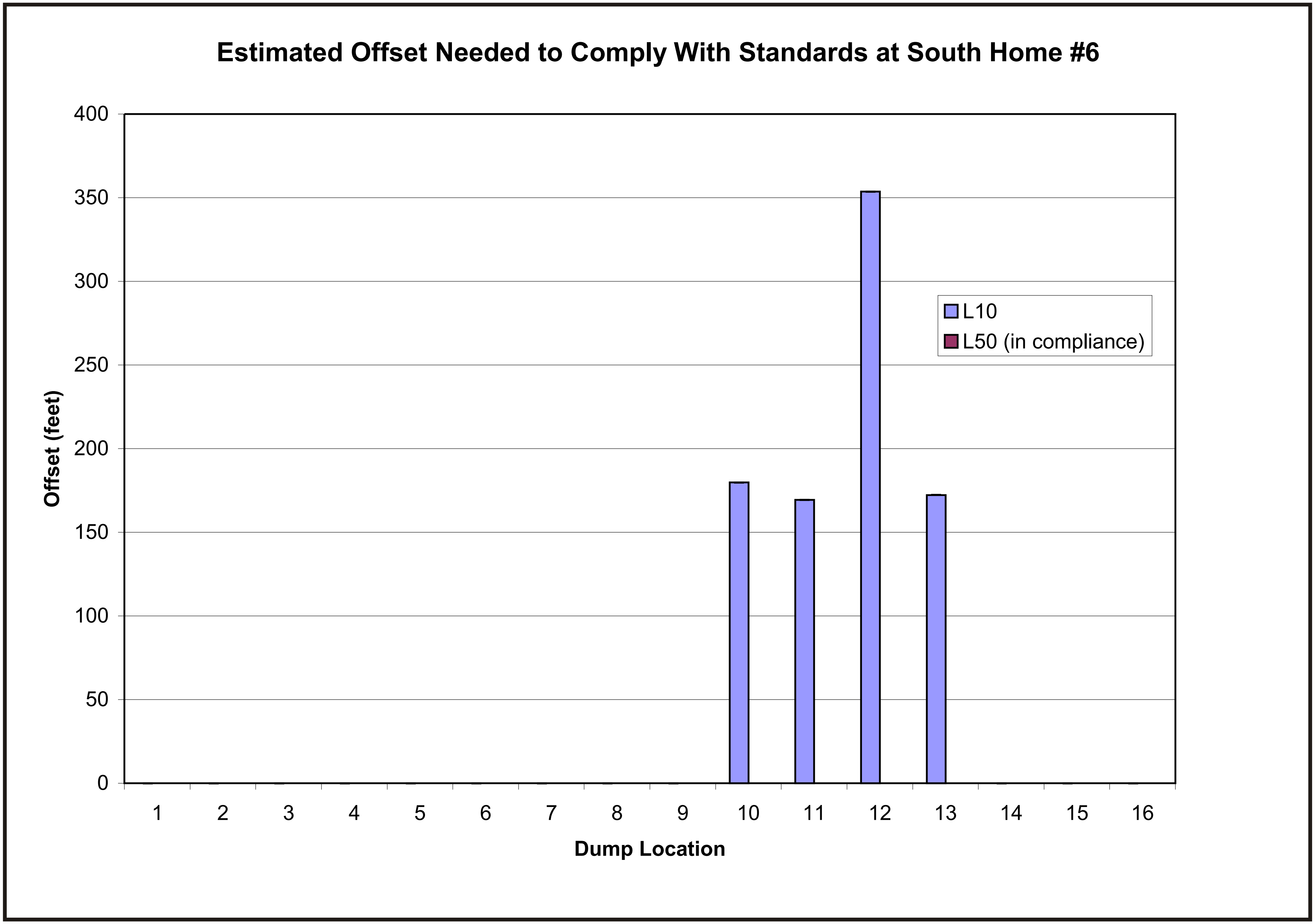

FIGURE 7.2

Offsets at South Residences Needed to Comply with Nighttime Standards

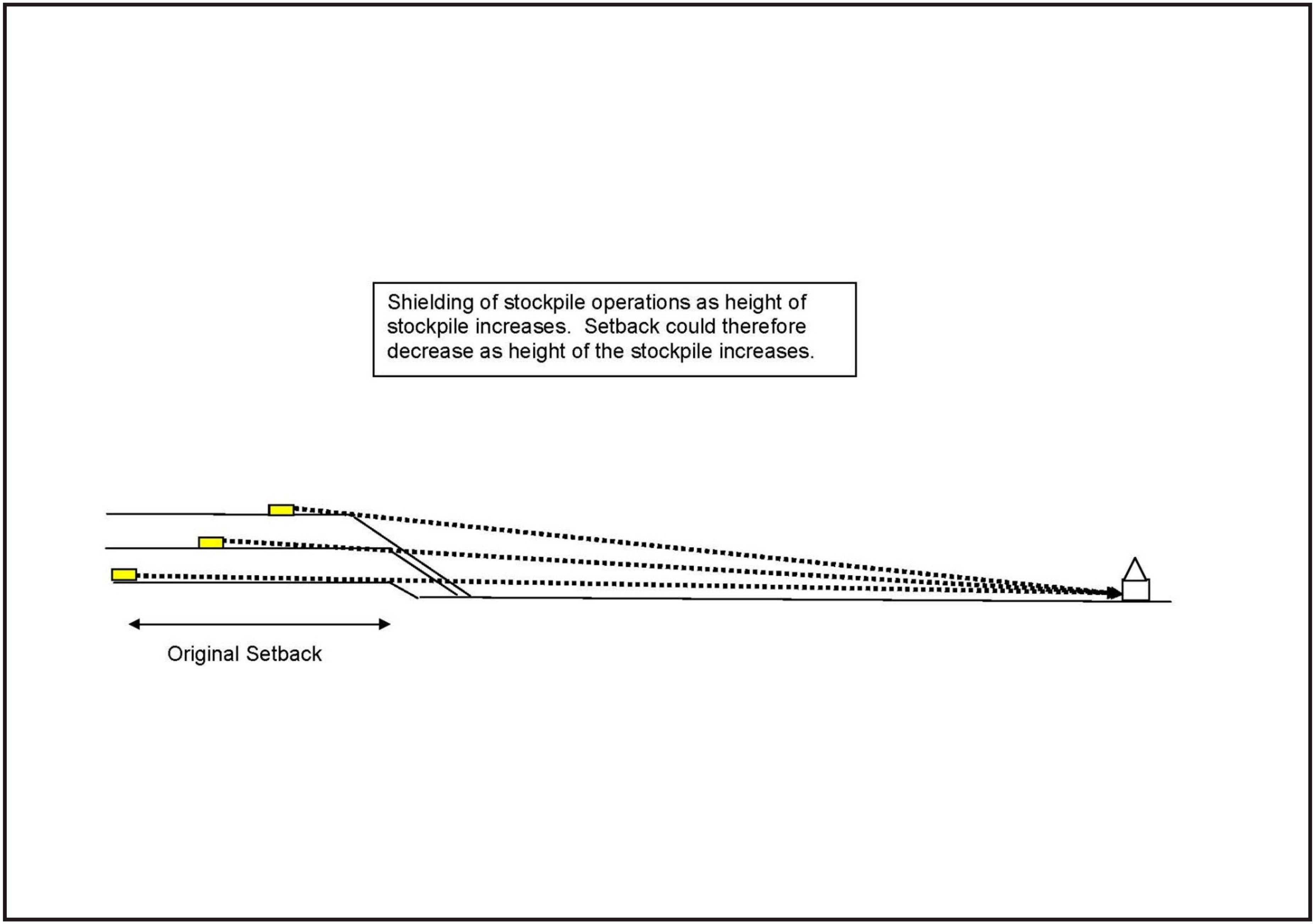

FIGURE 7.3

Reduced Offsets with Increasing Stockpile Height