

Appendix B

Hydrogeology Reports

B-1

Comprehensive Summary of Hydrogeologic Reports

Kennecott Eagle Minerals Company Eagle Project

Comprehensive Summary of Hydrogeologic Reports

**Prepared for
Kennecott Eagle Minerals Company
February 2006**

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1.0 Introduction

1.1 Project Description

Kennecott Eagle Minerals Company (KEMC) is evaluating environmental conditions and engineering plans for its Eagle Project (Project) in the Yellow Dog Plains (Plains), approximately 9.5 miles (mi) southwest of Big Bay in northern Marquette County, Michigan (Figure 1). The proposed mining plan includes underground mining of a massive and semi-massive sulfide ore body (primarily copper and nickel mineralization).

1.2 Purpose and Scope of This Report

Multiple hydrogeologic studies have been performed for the Project between November 2002 and December 2005. These studies have been performed through an iterative process of scientific evaluation of baseline conditions, engineering design work for the proposed mine facilities and predictive assessments of the effects of the proposed mining plans on surface water and groundwater resources in the vicinity of the proposed mine. This report provides a comprehensive summary of the findings of the baseline conditions and predictive assessment studies. The work summarized in this report has been performed in conjunction with, and in support of the development of the overall baseline environmental studies and mine engineering studies. The contents of the report are as follows:

Section 1 – Introduction to the purpose and scope of the report, description of the Project team and objectives of each study.

Section 2 – Description of the study area based on available regional information.

Section 3 – Baseline study findings presented on regional and Project scales. These findings include a description of the hydrogeology, emphasizing the interaction between groundwater and surface water flow, and baseline data on water quality.

Section 4 – Results of predictive assessments of the possible hydrologic effects of construction and operation of an underground mine. This is based primarily on numerical modeling of inflow from bedrock to underground mine workings and the discharge of treated mine inflow water to the alluvial aquifer, and the resulting predicted changes from baseline conditions in the alluvial groundwater and surface water systems.

1.3 Project Team

The Project team for these studies includes the following entities and primary responsibilities:

North Jackson Company (NJC) – Lead investigators for environmental baseline hydrologic studies (EBS) of surface water and groundwater resources and author of the following reports which are summarized in this document:

- Environmental Baseline Study Hydrology Report Volume I, II and III, 2005
- Supplemental Hydrogeologic Study for Groundwater Discharge, 2005
- Supplemental Wetland Baseline Hydrology Study, 2006

Fletcher Driscoll & Associates, LLC (FDA) – Lead investigators for evaluation of Quaternary aquifer hydraulic parameters and numerical modeling of Quaternary aquifer groundwater flow and surface water interaction. The final predictive assessment is described in Results of Predictive Assessment Modeling (FDA 2006).

Golder Associates Inc. (Golder) – Lead investigators of bedrock hydrogeology and numerical modeling of mine water inflows. This work has been performed in conjunction with bedrock geotechnical evaluation for mine workings and includes the following reports:

- Bedrock Hydrogeological Investigation, 2005
- Phase II Bedrock Hydrogeological Investigation, 2006
- Bedrock Hydrogeological Modeling, 2006

Foth and Van Dyke and Associates, Inc. Lead engineers for the development of environmental engineering plans for the mine operations, and the overall environmental impact assessment for the Project.

1.4 Hydrogeologic Investigations

In November 2002 NJC initiated the baseline monitoring with surface water quality and flow monitoring of two locations on the Salmon Trout River and Yellow Dog River within the Plains. In 2003 baseline monitoring was expanded and a watershed characterization approach was implemented. This expanded study area (Study Area) consists of the Salmon Trout River watershed and the portion of the Yellow Dog River watershed adjacent to the Salmon Trout River watershed divide and within the Plains (Figure 2). A headwater section of a third State-defined watershed, the Pine River watershed (containing the Cedar Creek subwatershed), was also added in 2003. The Cedar Creek subwatershed was determined to have hydrologic characteristics similar to the upper Salmon Trout River subwatersheds and is outside of the area with potential for direct or indirect hydrologic impacts from the Project. Therefore the Cedar Creek subwatershed may serve as a reference watershed for comparative data collection over the life of the Project. Surface water flow and water quality data were collected during

seasonally significant flow regimes (summer and winter baseflow, spring snowmelt runoff, summer and autumn rainfall precipitation periods).

In January 2004 the hydrologic study was further expanded to include the evaluation of the glacial deposit hydrogeology and aquifer characteristics. This work involved Quaternary aquifer water level measurement and water quality sampling, and preliminary groundwater basin divide mapping through the installation of 23 wetland piezometers and 6 monitoring well nests across the Study Area. This investigation program resulted in the development of a conceptual model of groundwater/surface water interaction. Simultaneously, other environmental baseline study programs were initiated, along with additional resource exploration at the Project and preliminary mining plans.

These initial results were used to develop a “second phase” of hydrologic study of baseline conditions that was performed from June 2004 through May 2005. These investigations included the installation and operation of continuous streamflow gaging stations with continuous (hourly) measurement of temperature and conductivity, expansion of the regional groundwater monitoring network to include 10 new well nests on the Plains and 4 new seep piezometers located near the base of the north terrace and hydraulic testing in the Quaternary aquifer formations near the ore body. A baseline conditions numerical flow model was also constructed to estimate the area and location of groundwater basins associated with specific subwatersheds of the Salmon Trout River and Yellow Dog River systems.

During this time period, initial hydraulic testing of bedrock formations was also performed in exploration coreholes within and adjacent to the ore body. These tests included downhole geophysical logging, packer isolation slug tests, and bedrock water quality sampling. The data were used to develop a conceptual model of bedrock hydrogeology and to make initial estimates of groundwater inflow to mine workings.

Following the completion of the baseline study period in May 2005, supplemental hydrologic studies were performed to further evaluate specific Project area baseline conditions, and to provide data for final engineering designs of mine water systems and predictive assessments of mining conditions. These studies included the following:

Supplemental Hydrogeologic Study for Groundwater Discharge

A supplemental hydrogeologic study was conducted in an area proposed for the discharge of treated mine inflow water to groundwater (proposed discharge area) from July through September 2005 (NJC 2006a). This work was performed in support of specific groundwater discharge permit requirements.

Supplemental Wetland Baseline Hydrology Study

A supplemental wetland baseline hydrology study was conducted from October through December 2005 (NJC 2006b). The objective of the study was to refine the understanding of hydrologic controls on the wetlands located above the Project ore body.

Bedrock Hydrogeologic Study

A supplemental bedrock hydrogeologic study was conducted during September and October 2005 (Golder 2006a). The objective of the study was to refine and support the conceptual bedrock hydrogeologic model and to create a numerical model of mine inflow. The study included multiple slug tests, a long-term bedrock formation pumping test, multiple level bedrock water quality sampling, and continuous piezometric data collection around and within the ore body.

Predictive Assessment Modeling

The predictive assessment modeling was conducted from September 2005 through January 2006 (FDA 2006 and Golder 2006b). The objectives of the

modeling studies were to predict bedrock and Quaternary aquifer hydrologic conditions during and following operation of the proposed underground mine and Quaternary groundwater conditions at the proposed discharge area. The bedrock modeling work was performed by Golder and the Quaternary aquifer flow modeling work was performed by FDA.

Hydrogeologic study methods are described in the following documents: Stage 2 Hydrological Assessment Work Plan (NJC 2004a); Supplemental Hydrogeologic Study Work Plan for Groundwater Discharge (NJC 2005b); Quality Assurance Project Plan for Stage 2 Hydrological Assessments (NJC 2004b); Hydrological Assessments Standard Operating Procedures Manual (NJC 2004c); and Work Plan for Bedrock Hydrogeological Investigations (Golder 2005).

2.0 Description of Study Area

The Project is located near the headwaters of the Salmon Trout River main branch (Main Branch) within the Plains (Figure 2). The Plains are a relatively flat-lying, sandy geomorphologic feature covering about 27 square miles (mi²). The Plains trend from the northwest to the southeast and are bounded to the south by shallow igneous and metamorphic bedrock that rises above the Plains and to the north by a steep, terraced escarpment (north terrace) of glacial moraine that slopes north to a northeast-trending valley below the Plains. The Yellow Dog Peridotite (Peridotite) containing the Project ore body is an igneous intrusion into the metasedimentary basin rock formation underlying the Plains. The Peridotite is exposed in two locations on the Plains, one forming a prominent rock outcrop, with a smaller exposure located near the Salmon Trout River Main Branch (Figure 2).

2.1 Geology

The geology of the Plains can be described generally as surficial deposits of unconsolidated, Quaternary period glacial outwash and till, and post-glacial sedimentation underlain by igneous and metamorphosed sedimentary (metasedimentary) rocks of Precambrian age. Within Marquette County this type of geologic setting is not unique, as large areas of outwash plains overlying Precambrian bedrock are well documented (Twenter 1981). The closest well-studied example is the Sands Plain, a 225 mi² feature located between the towns of Marquette and Gwinn in central Marquette County (Figure 1). Within the Sands Plain glacial deposits are the principal water-bearing strata. Precambrian bedrock formations in Marquette County are typically found to yield low quantities of water compared to glacial outwash aquifers (Grannemann 1984, Twenter 1981), and are not typically classified as aquifers.

2.1.1 Bedrock Geology

The bedrock beneath the Plains is mostly metasedimentary rocks of the Michigamme Formation, part of the Marquette Range Supergroup of Proterozoic age (Precambrian) rocks roughly 2 billion years old (Figure 3). In the Project area the Michigamme Formation is contained in an east-west trending structural trough known as the Baraga Basin (Klasner et al. 1979). The trough is flanked on the north, south and east by gneiss and greenstone Archean basement rocks, older than 2.5 billion years.

The Michigamme Formation consists mostly of fine-grained clastic rocks, largely black slate and argillite (fine-grained sedimentary rock hardened by incipient metamorphism) (Klasner et al. 1979). The terms siltstone (fine-grained, nonfissile rocks) and sandstone (described as fine-grained, turbiditic greywacke interbeds up to a few meters thick) has also been used to describe these units in Project mineral exploration logs and geologic cross sections (Kennecott Exploration Company (KEX) 2005). These units are commonly thought to have been deposited in marine waters and later deformed and metamorphosed regionally to the greenschist facies which is indicative of very widespread “low grade” metamorphism. The metamorphism has been dated at about 1.9 billion years before present, during the Penokean orogenic (mountain building) event (Dorr and Eschman 1970). In central Upper Michigan the mountain building was the apparent result of compressional forces acting from present day north-to-south, resulting in synclines (troughs) whose long axes trend east-west (Dorr and Eschman 1970). The closest outcrop of these metasedimentary rocks is west of the Project in the Huron River watershed.

Emplaced in the Michigamme Formation are east-to-west-trending diabase dikes which are iron-rich igneous rocks from magma intrusions into the older sedimentary rocks. These intrusives are Keweenawan age (about 1.1 billion years old) and are found in many areas around the Lake Superior Basin (Dorr

and Eschman 1970) and are associated with the Mid Continent Rift system in the Lake Superior Region. Two of these dike intrusions outcrop in the Plains near the Salmon Trout River Main Branch (Figure 4). The Peridotite outcrop in Section 12 is crystalline, coarse-grained and massive, very hard, and greenish black, with a thin weathered rind a few tenths of inches thick on the surface (Klasner et al. 1979). It is composed mainly of ferromagnesian minerals and derived from molten magma crystallized deep in the subsurface. These outcrops are part of a dike swarm that has been identified regionally with geophysical exploration techniques, primarily using magnetic and gravity field surveys (Klasner et al. 1979).

2.1.2 Quaternary Geology

The Quaternary deposits of the Plains are described as a large outwash-fan delta (Drexler 1981) that become finer and better sorted from the north toward the south (Segerstrom 1964) and are mapped regionally as glacial outwash sand and gravel and post-glacial alluvium (Twenter 1981). Along the north terrace the surficial deposits are mapped as coarse-textured glacial till of extremely heterogeneous particle size. This unit is referred to as the Negaunee Moraine (Segerstrom 1964). Regional Quaternary geology is shown in Figure 5 and a cross sectional representation of this model is shown in Figure 6.

The glacial depositional model proposed by Segerstrom indicates a late glacial history dominated by a stagnated ice margin along the valley that now separates the Plains from the Huron Mountains to the north. This glacier was part of a late-continental glacier readvance referred to as the “Marquette” phase that nearly refilled the Lake Superior basin about 10,000 years before present (Farrand and Drexler 1985). Locally, the ice was thickest through the valley along the southern edge of the Huron Mountains. Melt water then deposited kames and outwash plains as it flowed southward from this ice margin. The flow of melt water was obstructed by the high bedrock hills to the south, causing ponding within a glacial

lake basin that stood at an elevation well above other glacial lakes and outlets present in this area during this time period (Drexler 1981). Ponding of the melt water continued until the water surface elevation increased enough to flow southward through the Mulligan Plains to the valley containing the Dead River (Segerstrom 1964).

Subsequent erosion of the gap resulted in drainage of the glacial lake. Following deglaciation, drainage of the Plains soon became dominated by rapid headward cutting of tributary streams of the Salmon Trout River into the steep slope of the north terrace and the re-excavation of the Yellow Dog River along the southern Plains and then north toward Lake Superior.

2.2 Hydrogeology

The Project is situated near a hydrologic divide of surface watersheds mapped by the State of Michigan (State): those drained by the Salmon Trout River and those drained by the Yellow Dog River (Michigan Department of Natural Resources (MI DNR) 2000) (Figure 2). All Study Area streams flow to Lake Superior (average elevation 602 feet above mean sea level (ft MSL)).

The Salmon Trout River watershed encompasses an area of approximately 50 mi². The Salmon Trout River flows northward from its headwaters in the Plains and the north terrace, emptying into Lake Superior at Salmon Trout Bay northwest of the town of Big Bay. For the EBS, the upper portion of the State-defined watershed (MI DNR 2000) has been further divided into 3 topographically delineated subwatersheds referred to as the West Branch (3.3 mi²), Main Branch (8.8 mi²) and East Branch (13.0 mi²) (Figure 2). The headwaters of the Salmon Trout River Main Branch originate from a large wetland complex (wetland) on the Plains located south of the Project at elevations between 1,430 and 1,460 ft MSL. The Main Branch flows from this wetland northerly down the north terrace, joining the East Branch and West Branch downstream of the north terrace. The

tributaries of the West Branch and most of the tributaries of the East Branch emerge from north terrace groundwater seepage.

The Yellow Dog River watershed area is approximately 98 mi². The Yellow Dog River headwaters are in bedrock highlands at the outlet of Bulldog Lake in the Ottawa National Forest, Baraga County. The headwater lake elevation is at approximately 1,730 ft MSL, about 300 ft higher than the Plains. After flowing northward from these highlands, the Yellow Dog River flows west to east across the southern edge of the Plains (normal to the direction of flow of the Salmon Trout River Main Branch). The river then continues northward to Lake Independence in the town of Big Bay. The portion of the Yellow Dog River watershed within the Study Area is roughly 30 mi².

The Cedar Creek subwatershed area is approximately 7.4 mi² and is a part of the State-defined Pine River watershed (MI DNR 2000), a system made up of several small streams that flow north from the Plains and Huron Mountains into a series of inland lakes in northwest Marquette County. Cedar Creek is a major headwater stream of the Pine River watershed, originating in the Plains and flowing for roughly 5 mi before emptying into Mountain Lake (Figure 2).

2.3 Well Survey and Designated Wellhead Protection Areas

Water well surveys using State and county databases have been performed as part of the EBS and supplemental studies. Marquette County Health Department Records and Michigan Department of Environmental Quality (MDEQ) databases (MDEQ 1999 and 2006) were reviewed in 2004, 2005 and 2006. The search area encompasses approximately 75 mi² and includes the physical limits of the Quaternary alluvial aquifers of the Plains (Figure 7). Within this search area 7 water wells were identified (Table 1).

The Powell Township Wellhead Protection Program was also reviewed (UP Engineers & Architects, Inc. 2003). This wellhead protection zone is for an unconsolidated glacial deposit aquifer described as an unconfined, localized sand and gravel aquifer located about 1 mi south of the Village of Big Bay (Figure 7). Because the Quaternary aquifers present on the Plains do not extend to this area (as shown by the regional Quaternary geology map in Figure 5), the Powell Township Well Head Protection area is not in direct hydraulic connection to aquifers present on the Plains.

2.4 Precipitation

From April to September most precipitation in the region occurs as rain, while from November to mid-March it is usually in the form of snow. Precipitation stored in the form of snow throughout winter months is released to streams and groundwater in late winter and early spring (Grannemann 1984).

National Weather Service data (2005) from October 2004 through September 2005 indicate regional precipitation was 2.22 inches (in.) below the 1979-1998 average (35.39 in.). Notable changes to the average distribution of precipitation were dryer than average conditions in November 2004 (2.11 in. of rain compared to 3.32 in.) and August 2005 (1.95 in. of rain compared to 3.45 in.) and wetter than average conditions in December 2004 (5.05 in. compared to 2.38 in.). These data indicate that regional monthly precipitation patterns during EBS and predictive studies were close to recent climatologic averages.

3.0 Results of Baseline Studies

3.1 Geology

Detailed geologic data for the Project were obtained primarily through subsurface drilling and sample collection of rocks and soil formations during mineral resource exploration and environmental study programs. Figure 8 presents EBS drilling locations and groundwater monitoring locations and Figures 9 and 10 present Project views of environmental monitoring locations and mineral resource exploration locations, respectively.

3.1.1 Bedrock Geology of the Eagle Deposit

The mineralized ore body (Eagle intrusion) is located within the Peridotite, generally beneath the western outcrop at the east end of the Baraga Basin (Figure 4). The Eagle intrusion is dominantly peridotite with lesser feldspathic peridotite, gabbro, olivine gabbro and pyroxenite. This resource is described as bimodal with sharp transitions between massive and semi-massive zones with economic mineralization found in both zones and also in disseminated sulfide minerals within the Peridotite. The semi-massive zone ore is confined to the host peridotite intrusion while the massive sulfide intrudes internally and penetrates laterally into surrounding sedimentary rocks. Higher grade mineralization and deformation is found at depth. The mineralization either postdates or is syn-deformational. The proposed mining levels and a geologic cross section of the Eagle deposit are shown in Figure 11.

The mineralized portion of the Peridotite is intruded into the Fossum Creek member of the Michigamme Formation. The upper parts of the Fossum Creek are described as fine-grained, muddy turbidites with minor sandy turbidites. A lower sequence of siltstone is defined by a dominance of thin laminated slates/shales, syngenetic sulfide laminae, thin bedded siltstone and rare fine-

grained turbiditic sandstone. Near the contact of the intrusives these metasedimentary units are described as intensely hornfelsed (rock texture indicative of contact metamorphism) from the intrusion (KEX 2005).

The general structure of the intrusion hosting the Eagle deposit is elongate east-west with a maximum length of about 1,600 ft and a maximum width of about 330 ft, and generally narrowing with depth. Geotechnical logging of mineral exploration cores indicates that open and cemented joints are present within the Peridotite and although there is a broad range of orientations with no dominant joint set, most strike parallel to the east-west trend of the intrusion (KEX 2005).

The intrinsic permeability of the bedrock formations of this age and lithologies are low. In addition, although formation contacts, fractures, and faults are identified in core sampling of the bedrock, the structural and lithologic data for the bedrock do not readily correlate to zones of hydrologic significance, as demonstrated by hydraulic testing of the bedrock specifically focused on structural zones identified from core drilling (Section 3.2.3).

3.1.2 Project Area Quaternary Geology and Hydrostratigraphy

With the exception of the Peridotite outcrops in the Project area, the bedrock surface across the Plains is mantled by unconsolidated glacial deposits from the Quaternary period continental glaciation. The bedrock surface elevation contours are shown in Figure 12. This surface forms the base of the Quaternary deposits. Hydrologically, this surface is considered to create a boundary to the movement of groundwater within the unconsolidated materials.

The observed thickness of Quaternary deposits ranges from 0 ft (at the Peridotite outcrops) to greater than 200 ft (Figure 13). The deposit thickens in all directions away from the Peridotite outcrops, with the greatest thickness observed east and west of the Project area. The Quaternary deposits that define the Plains then thin toward the north and south, terminating at a boundary that is approximately

coincident to the boundaries of the Baraga Basin metasedimentary rocks adjacent to the Archean bedrock formations that outcrop north and south of the Plains.

Quaternary deposit data generated during the EBS are generally in good agreement with the glacial depositional model summarized in Section 2.1.2 above. Cross sectional views of Quaternary formation stratigraphy are shown in Figures 14 and 15. The hydrostratigraphic nomenclature is summarized below.

Surface Soil Layer

A surface soil layer (black color with organic material and tree litter) was identified at most drilling locations. This layer is generally less than 1 ft thick (and mapped regionally as 0-2 in. thick on the Plains) and is classified as a sandy organic soil). Thin surficial layers of peat have also been identified in the area directly overlying the Eagle deposit ore body.

Outwash and Beach Deposits (A Zone)

The outwash and beach deposits are comprised of well-sorted, stratified fine- to medium-grained sand, with some gravel and minor quantities of silt and clay (less than 10%, Table 2). The sand fraction of this material appears to be predominantly rounded quartz with trace to minor amounts of angular and sometimes platy mafic or fine-grained sedimentary rock grains. The unsaturated portion of this deposit is typically red to reddish brown and the saturated portion is brown. These surficial deposits are mapped regionally as having very rapid water infiltration rate characteristics (greater than 10 in./hr) (Twenter 1981).

An unconfined water table defined as the A zone hydrostratigraphic unit occurs in the saturated portion of this deposit. The depth to water table is represented by the unsaturated zone isopach shown in Figure 16. These data indicate that the unsaturated zone is very thin in the southern portion of the Plains, where the large wetland complex exists. The unsaturated portion of the A zone then

thickens significantly towards the northern edge of the Plains (up to 100 feet thick at well QAL009 A/D northeast of the Peridotite outcrop). Generally a fining downward sequence is found in the A zone.

Transitional Deposit (B Zone)

A gradational contact exists between the A zone outwash sand and a deeper transitional zone that contains a mix of fine sand, silt and clay, and typically continues to fine downward to predominantly silt and clay. While the A zone outwash and this transitional deposit may both be derived from melt water processes and could be lumped as outwash, the grain size characteristic change from predominantly sand to predominantly silt and clay. This transition is considered significant to primary conditions affecting groundwater flow as it indicates a decrease in permeability of the Quaternary formation from the coarse-grained material to the fine-grained material.

Directly above the Eagle deposit, the A zone coarse-grained materials are very thin (generally less than 5 ft in thickness) and the B zone fine-grained deposits form the bulk of the Quaternary deposits. As a result this area contains much more poorly drained surface soil and wetland.

Lacustrine Deposit (C Zone)

A laterally extensive, massive clay deposit was identified in samples from most borings, and is found to be thickest south of the Peridotite outcrops, and thinnest north of the outcrops. The clay deposit is easily recognized in soil sample cores as lean clay with medium to high plasticity. In some core samples it appears to be a massive deposit, while in other locations it contains thinly laminated and stratified layers of silt and clay. A sharp contact is typically observed at both the top and bottom of this deposit. On average the deposit contains 98% silt and clay (Table 2). This deposit is defined as the C zone hydrostratigraphic unit.

The clay deposit identified in soil borings ranged in thickness from 7-63 ft, thickest and most consistent in its elevation in the south/southeast part of the Plains (from locations QAL005A/D to QAL010A) and thinnest and less continuous towards the north and northeast, where this unit eventually pinches out near the edge of the north terrace. The pinch-out of the transitional and lacustrine deposits of the B zone near the north terrace is consistent with the glacial depositional model, as the transitional unit would be expected to pinch out at the edge of the moraine (Figure 5). This areal distribution pattern (Figure 17) indicates that the fine-grained deposits were formed in ponded water between the bedrock highlands south of the Plains and glacial ice to the north, also consistent with the depositional model proposed by Segerstrom (1964).

Outwash/Ablation Till (D Zone)

A deposit of coarser-grained material was encountered beneath the C zone lacustrine deposit at most drilling locations. Samples from this deposit are predominantly fine- to medium-grained sand and are similar to samples of A zone material. This material appears to be outwash deposited prior to the glacial lake period on the Plains. This deposit is defined as the D zone hydrostratigraphic unit.

Greater heterogeneity in grain size characteristics was observed within the D zone compared to the A zone (Table 2). At 2 locations (QAL004A/D and QAL005A/D) south and southwest of the Peridotite outcrop, the D zone contains a layer with significant amounts of gneiss and granitoid cobble and gravel-sized outwash material indicative of high flow velocity glacial drainage channel deposits. At other locations (QAL001A/D, QAL002A/D and the base of QAL004A/D), the D zone contains a relatively high percentage of fine sand and silt, and generally becomes increasingly finer-grained toward its base. The finer-grained portion is possibly derived from direct ice melt or sublimation (ablation till), since the base of this zone is most often identified in contact with a basal till deposit, described below. This outwash deposit is also discontinuous,

interrupted by shallow bedrock and pinched out between the fine-grained units above and below. This deposit was not encountered beneath the C zone at well nests QAL006A/B and QAL010A. This deposit appears to be confined or partially confined, except at location QAL009A/D where the overlying C zone clay is absent. As a result of the pinch-out of the B and C zones in close proximity to the northern edge of the Plains, the A and D zone aquifers at this location become a single unconfined system.

Basal Till (E Zone)

Poorly-sorted basal till consisting of boulder- to sandy-sized clasts in a fine-grained matrix is the lowermost Quaternary deposit material identified in samples from all but one boring (QAL004A/D). This unit is substantially thicker east (QAL009A/D), west (QAL007A/D) and southeast (QAL010A) of the Project. Bedrock is encountered at greater depths at these locations, indicating that earlier glacial moraine deposition occurred in the bedrock valleys. Boulders are commonly present along the north terrace, corresponding to the mapping of the Negaunee Moraine presented by Segerstrom (Figures 5 and 6).

Lower Outwash Units (F Zone)

At 2 locations (QAL007A/D and QAL010A), lower outwash deposits were found interlayered with E zone till. Representative samples of the lower outwash material are predominantly fine- to medium-grained sand. In QAL010A these units were found to be dry. The interlayered nature of the till and lower outwash units indicates fluctuations in glacial advances and retreats during earlier glacial depositional sequences. This lower outwash deposit is defined as the F zone hydrostratigraphic unit.

3.2 Hydrology

Water resources of the Plains include streams, wetlands, and aquifers within the unconsolidated glacial deposits. The water is primarily derived from precipitation.

Most precipitation that falls on Plains that is not evaporated back to the atmosphere enters the permeable surface soils and recharges the water table aquifer. This groundwater then discharges from the aquifer to seeps. The following sections of the report discuss the results of the data collection used to characterize these surface water and groundwater flow systems, and also present an assessment of the groundwater/surface water flow interaction in the Study Area.

3.2.1 Surface Water Flow Characteristics

Surface water monitoring locations are shown in Figure 18 and hydrographs presenting an annual cycle of mean daily flow at specific stream gaging stations are shown in Figure 19. The streamflow characteristic data derived from the hydrographs for the Salmon Trout Main Branch, Salmon Trout East Branch, and Yellow Dog River on the Plains are summarized in Table 3. The mean daily flow range of the Salmon Trout River Main Branch (STRM004) during September 2004 – September 2005 was 4.2 to 41 cubic feet per second (cfs) with an average flow of 6.7 cfs. The mean daily flow range of the Salmon Trout River East Branch (STRE002) was 12 to 119 cfs with an average flow of 21 cfs. Both tributaries have maximum flow to minimum flow ratios of 10.

By comparison the Salmon Trout River near the mouth (STRM005) exhibits somewhat higher peak response and longer duration to the significant runoff events. The mean daily flow range was 22 to 397 cfs with an average flow of 44 cfs. The maximum to minimum flow ratio of this location is 18, which indicates greater sensitivity downstream to surface runoff from the shallow bedrock terrain located north of the Plains. The Salmon Trout River East Branch and Main Branch subwatersheds account for about 46% and 15% of the total average flow (as measured at the downstream station STRM005), respectively.

The Yellow Dog River in the vicinity of the Project also shows a more pronounced response to surface runoff events in both peak flows and event

duration. The mean daily flow range was 6.5 to 242 cfs with an average flow of 28 cfs. The maximum to minimum flow ratio is 37, which indicates considerable “flashiness” due to high surface water inputs from headwaters portions of the watershed that are mostly shallow bedrock terrain.

3.2.2 Groundwater

Groundwater flow in the Plains has been assessed using hydraulic testing of geologic units and water level measurements in wells. Significant aquifers and aquicludes have been identified and mapping of groundwater flow within the portions of the geologic units considered to be aquifers has been performed.

Hydraulic Characteristics of Quaternary Formations

The values of hydraulic conductivity of geologic materials are of primary importance in understanding the relative ability of geologic formations to be classified as aquifers or aquitards. Hydraulic conductivity of geologic materials is known to vary over a wide range – over 13 orders of magnitude (Freeze and Cherry 1979). As a result the determination of this physical parameter provides a great deal of insight to the ability of formations to transmit water and is a fundamental parameter to be determined for quantitative assessments of groundwater flow.

Hydraulic characteristics of the Quaternary formations have been determined using multiple well aquifer pumping tests and single well pumping tests in both the A and D hydrostratigraphic zones, slug tests and single well pumping tests in the fine-grained B hydrostratigraphic zones, and grain size-based estimations. The testing locations are shown in Figure 20. Hydraulic characteristics have been similarly tested using slug tests and pumping tests in order to determine both small-scale and large scale hydraulic properties of the Eagle deposit bedrock formations. These locations are also shown in Figure 20.

The methodology considered to have the highest degree of absolute accuracy for measuring hydraulic parameters in transmissive materials is a multiple well pumping test. A multiple well pumping test was performed using nest QAL011 (Figure 20) for pumping water from separate tests in both the A and D zones. At this location the A and D zones are separated by a significant deposit of B and C zone fine-grained units. The A zone transmissivity calculated from these pumping test data indicated values ranging from about 7,700 to 12,400 gallons per day per foot (gpd/ft). Horizontal hydraulic conductivities in the A zone pumping test area range from 37 to 69 feet per day (ft/d). The average value determined from the test is 50 ft/d. The average specific yield of the A zone is 0.048. The average anisotropy ratio of A zone sediments is 0.036. The average vertical hydraulic conductivity of the A zone is 1.9 ft/d or approximately 26 times less than the average horizontal hydraulic conductivity value.

The pumping test data for the D zone indicated that the average D zone transmissivity was about 6,100 gpd/ft. The average horizontal hydraulic conductivity of the D zone is 40 ft/d. The average storage coefficient for the D zone is 1.7×10^{-04} .

During these tests no response was measured in the A zone to pumping in the D zone, or vice versa.

Single well pumping tests have also been performed throughout the Project area in order to correlate pumping test data over a broad area of investigation (Figure 20). Specific capacity tests in the A and D zones generally resulted in lower hydraulic conductivity estimates by one-half to one-third when compared to data for the same wells obtained in the longer term, multiple-well pumping tests summarized above. This testing scale relationship is typical of these test methodologies (Bradbury and Muldoon 1990) and was considered in interpreting specific capacity tests. In addition, estimates of hydraulic conductivity were made through empirical relationship of grain size data to hydraulic conductivity to

further develop a range of hydraulic conductivity values for the hydrostratigraphic units within the Quaternary deposits.

The estimated hydraulic conductivity for the A and D zone material ranges from about 7 ft/d to 130 ft/d (Figure 21). These test results are very similar to those presented in hydrogeologic studies of similar glacial hydrostratigraphic units in Marquette County, which employed the same methodologies over a broad area of the Sand Plain groundwater basin (Grannemann 1984).

Hydraulic conductivity testing of B zone transitional deposits was tested using slug tests, specific capacity tests and grain size-based estimations. These data indicated a range of values between 10^{-03} and about 1 ft/d (Figure 21). The C zone lacustrine clay unit was tested through laboratory testing and grain size-based estimation and the range of hydraulic conductivity for this unit is between 10^{-05} and about 10^{-02} ft/d.

Hydraulic Conductivity of Hydrostratigraphic Units Underlying the Project Area Wetland

The Project area wetland (Figure 9) is characterized by a thin layer of A zone outwash sand, fining downward to silty sand and silt and clay. The upper fine silty sand outwash unit appears to be 3 to 10 ft thick and has a geometric mean hydraulic conductivity (K) value measured with slug test methods of 0.9 ft/day. Underlying this unit is a silt and clay (identified as the B zone transitional deposit regionally) with a lower geometric mean K value of 0.03 ft/day. These values are consistent with those determined for the B zone at other locations. These results indicated very little A zone sand present over the ore body. This hydrogeologic condition is considered to be a primary mechanism for supporting wetlands in this area, as discussed further below.

Hydraulic Characteristics of Bedrock Formations

Within the bedrock formations, groundwater flow principally occurs in water conductive fractures. In the absence of these fractures, these rock formations (Precambrian igneous and fine-grained metasedimentary rocks) are generally considered to have insignificant primary porosity and typically can yield only low quantities of water to wells (Driscoll 1986). The upper portion of the bedrock (top of bedrock to about 300 ft (90 m) below this surface is characterized as a zone of low hydraulic conductivity material with a bulk hydraulic conductivity of about 5×10^{-03} ft/d. Below the upper zone (>300 ft below the bedrock surface), hydraulic testing results show relatively lower hydraulic conductivity attributed to a relatively sparse distribution of water conductive fractures in the rock mass. The bulk matrix hydraulic conductivity is estimated to be about 8×10^{-05} ft/d with relatively higher transmissivity than the bulk matrix of the lower bedrock unit (3.2×10^{-05} square feet per second (ft²/s)).

Summary of Hydraulic Characteristics of Geologic Materials

A summary of the hydraulic conductivity of the hydrostratigraphic units is presented in Figure 21. These data support the conclusion that the A and D outwash hydrostratigraphic zones of the Quaternary alluvium are the aquifers capable of yielding a significant amount of groundwater in the Study Area. The C zone lacustrine deposit and the bedrock formations are quite clearly aquitards capable of yielding only limited quantities of water. The B zone transitional deposit and the E zone till are generally intermediate formations with the greatest variability in hydraulic conductivity estimated for the till, which is poorly sorted and variable in terms of its grain size characteristics and corresponding hydraulic conductivity.

Infiltration Rate of Unsaturated Outwash Deposit

Infiltration rates measured at the proposed discharge area (Figure 9) ranged from 24 to 38 in./hr with a mean of 31 in./hr (Figure 22). This is consistent with regional mapping presented by Twenter (1981) that indicates surficial glacial outwash deposits on the Plains are characterized by high infiltration rates.

Infiltration rates were relatively stable from the beginning to end of each infiltration test and the inner and outer ring infiltration rates were very similar (relative percent difference <10%) at all locations except QAL042 (relative percent difference of 41%). Soil samples obtained from test pits document primarily fine- to medium-grained outwash sand with 5 to 20% rounded coarse sand and gravel (Table 2). Water flow in the test area was strongly vertical with negligible evidence of horizontal flow. The wetting front typically extended vertically greater than 8 ft.

These data indicate that in areas of the Plains that are covered by the coarse grained outwash deposits, infiltration of water is rapid and moves quickly downward through the deposit.

Regional Groundwater Flow Patterns in Quaternary Aquifers

Groundwater levels have been measured in monitoring wells and piezometers in the major hydrostratigraphic units, primarily in the A and D zone aquifers. The measurements have been made during discrete time events on seasonally significant basis across the monitoring network. These data are presented in Table 4.

Water flow in the primary productive hydrostratigraphic units (A and D zones) is strongly horizontal. The A zone hydrostratigraphic unit is unconfined. The B and C zones act together as a hydraulic barrier, restricting groundwater movement, or

leakage, between the A and D zones. The D zone hydrostratigraphic unit is confined in the presence of the B and C zones.

Groundwater in both the A and D zones can be generally described as flowing from the south/southwest to the north/northeast (Figures 23 and 24). This flow pattern was consistent during each measurement event, across all seasons. The data indicate that the Plains wetland is primarily a groundwater recharge location supported by precipitation and that the north terrace is a discharge area for groundwater of both the A and D zones. Stream gaging along a portion of the north terrace supports the groundwater elevation data suggesting a regional discharge area for groundwater characterized by numerous seeps and gaining streams (Figures 23-25). This flow pattern is consistent with the conceptual model of hydrology developed by Segerstrom (1964) based on regional drainage patterns and the glacial depositional model.

Regional Quaternary Aquifer Groundwater Level Fluctuations and Vertical Gradients

Continuous groundwater elevation data indicate relatively stable water levels in the vicinity of the proposed discharge area and more seasonal fluctuations in the upgradient portions of the aquifer. This observation is represented by data from well nests QAL008 and QAL004 respectively in Figure 26. This difference appears to be related to the change in spatial relationship from recharge to discharge areas with more fluctuation observed in closer proximity to the primary recharge area of the Quaternary aquifers.

The continuous groundwater elevation data show significant vertical gradients between the A and D zones where the B and C zone fine-grained units are present, indicating a high degree of hydraulic separation and the presence of the confining units. The direction of the vertical gradient between these zones varies, with an upward gradient consistently present in areas proximal and connected hydraulically to the primary regional recharge area (Plains wetland)

and a downward gradient at locations proximal and connected hydraulically to the primary regional discharge area (north terrace). By comparison, essentially no vertical gradient is observed in areas characterized by the absence of the fine-grained confining units (e.g., east of the proposed discharge area at well nest QAL009).

Project Area Flow Patterns

The Project view potentiometric surface map for the A zone aquifer show groundwater flow patterns in detail in the vicinity of the proposed mine facilities (Figure 27). The potentiometric data strongly indicate that groundwater flow is towards the east/northeast (consistent with the regional flow pattern for the Plains) from the proposed discharge area. Groundwater discharging from these areas is contained within the Salmon Trout River East Branch tributary system under baseline conditions. A Salmon Trout River East Branch and Main Branch flow divide is located west of the proposed discharge area, while the Eagle deposit is located west of the divide beneath the Salmon Trout River Main Branch on the Plains. The flow pattern and Quaternary aquifer hydrostratigraphy is also presented in cross sectional view in Figures 28 and 29.

A localized flow system above the Eagle deposit is also apparent on all potentiometric maps. This area is characterized by relatively shallow bedrock, a very thin (<5 ft) A zone of outwash sand and fine-grained B and C zone deposits. In combination with the drainage of the Salmon Trout River Main Branch on the Plains, this hydrostratigraphic assemblage creates a local groundwater mound and the Main Branch/East Branch groundwater basin flow divide. Shallow groundwater flow on the west side of the divide is generally from northeast to southwest, which is generally counter to the regional gradient and flow of groundwater (Figure 30).

Wetland Hydrology

Wetlands occur within the localized flow system discussed above. These wetlands are of particular interest due to their location directly above the Eagle deposit. Within this wetland area there are two distinct hydrologic zones that can be distinguished on the basis of vertical groundwater gradients (Table 5) and response to precipitation events (Figure 31). These are wetlands supported primarily by: 1) precipitation and created in small topographic depressions (natural and disturbed) by slow vertical drainage of precipitation recharge (due to the near surface, low hydraulic conductivity of near-surface, fine-grained deposits), and 2) groundwater discharge created by the topographic intersection with the regional water table along the Salmon Trout Main Branch valley. The precipitation dominated wetlands have downward vertical gradients and much more significant water level fluctuations (greater than 1 ft in seasonal and annual fluctuation) in response to precipitation events. In contrast, the groundwater supported wetlands are indicated by upward vertical gradients and relatively stable water levels (less than 0.4 ft in seasonal and annual range).

Although wetland delineation surveys appear to indicate some potentially isolated areas of precipitation supported wetlands, the boundary between these two Project wetland types appears to be contiguous (Figure 32).

A third wetland category is found along a narrow linear strip paralleling the Salmon Trout River Main Branch. The hydrodynamics of this category is wetland dominated by stream processes and therefore surface water supported. The Salmon Trout River Main Branch characteristic flow regime is fairly stable with a low degree of flashiness limiting the extent of these wetlands to a small distance beyond the main channel. The extent of these wetlands has been estimated by visual delineation from satellite imagery and topography. These wetlands are contiguous to the groundwater discharge supported wetlands described above (Figure 32).

There is no evidence of a strictly perched groundwater system within these Project wetlands as water saturated conditions appear to exist from the water table to the bedrock interface.

Bedrock Potentiometric Data and Vertical Gradients

Bedrock piezometric data is included in Table 6. These data were recorded primarily to evaluate the degree of vertical movement of water within the bedrock. The vertical hydraulic gradients are both small and in contradictory directions in close proximity to the Eagle deposit (Golder 2006a). This indicates that very little vertical movement of groundwater occurs within this system and provides evidence that suggests bedrock formations contribute very little to the flux of water in or out of the Quaternary aquifers. This is consistent with the large contrast in hydraulic conductivity between the outwash aquifers (A and D hydrostratigraphic zones) and the bedrock formation aquitards.

3.2.3 Groundwater Basins and Groundwater-Surface Water Interaction

Groundwater basin divides determined from EBS groundwater model simulations by backward particle tracking from model river cells established groundwater divides (and associated A and D zone groundwater basins) for the groundwater basins roughly correlating to the subwatersheds of the Salmon Trout River West Branch, Main Branch, East Branch and Yellow Dog River (Figure 33 and 34). A comparison of these modeled groundwater basins to the State-defined surface watershed delineations suggests that the Salmon Trout River basin captures groundwater from a significantly larger area of the Plains than is represented by the State-defined surface watershed. This is particularly true in the area of the Salmon Trout River East Branch basin, where the groundwater basin divide is offset approximately 1 mi south from the estimated surface watershed divide. The proposed surface facilities of the Project are entirely within the Salmon Trout River East Branch basin. The ore body lies beneath the Salmon Trout River Main Branch basin.

Average subwatershed flow data normalized to surface water drainage area also appears to support a conclusion that groundwater basins are likely significantly larger than the mapped surface watersheds for the Salmon Trout River tributaries originating from the north terrace. This is particularly noticeable in the calculated average flow per square mile of surface watershed area for the Salmon Trout River East Branch, which is approximately double that of the other subwatersheds.

The groundwater-surface water interaction model also indicates that the Salmon Trout River system is highly controlled by groundwater flow discharge to the tributary streams from the Plains north terrace escarpment. Up to 96% of the baseflow of the Salmon Trout East Branch system is attributed to groundwater discharge to the tributary streams (NJC 2005).

3.3 Water Quality

3.3.1 Surface Water Quality

Laboratory analyses of chemical constituents in surface water samples are presented in Table 7 (Salmon Trout River samples), Table 8 (Yellow Dog River samples) and Table 9 (Cedar Creek samples). These tables also include measurements of field index parameters (temperature, pH, specific conductance and dissolved oxygen).

The regional surface water quality can be generally described as soft (hardness <60 milligrams per liter (mg/L)) to moderately hard (60-120 mg/L), with neutral pH (ranging from weakly acidic to weakly alkaline) and with a low degree of mineralization and turbidity. Nutrient concentrations are generally low. Dissolved oxygen is generally high, although it does vary somewhat seasonally, typically decreasing during warm weather when biological and chemical demand is higher. This is most evident at Salmon Trout River monitoring location STRM001, which is situated within an area of fairly stagnant flow caused by

beaver ponds on the Plains and to a lesser extent at the Yellow Dog River monitoring locations.

Yellow Dog River samples have somewhat higher color (40-138 apparent color units (ACU)) compared to Salmon Trout River and Cedar Creek samples collected from monitoring locations at the base of the north terrace (STRE001, STRE002, STRM003, STRM004, STRW001, CDRA002 and CDRM004) (10-60 ACU) reflecting a higher total organic carbon content in the Yellow Dog River samples (5.7-13 mg/L versus 1.7-8.7 mg/L).

Major ion chemistry is presented as a Piper diagram in Figure 35. These data indicate that Study Area streams are dominated by calcium and bicarbonate ions. The stream major ion chemistry is quite stable seasonally, although the Yellow Dog River samples are characterized by a slightly lower proportion of bicarbonate ions, as are the headwater Salmon Trout River Main Branch samples (STRM001) during spring runoff events.

Surface water temperature monitoring data (Figure 36) also indicate some differences in the flow regimes of the Yellow Dog River and the streams originating from the north terrace. The temperature record from monitoring locations situated at the base of the north terrace (STRE001, STRE002, STRM004, STRM007, STRW001, CDRA002 and CDRM004) have slightly warmer winter temperatures (0-2 °C versus 0-0.4 °C) and cooler summer temperatures (9-16 °C versus 15-21 °C) compared to the Yellow Dog River (YDRM002) and Salmon Trout River monitoring locations on the Plains (STRM001 and STRM002) and the downstream Salmon Trout River monitoring location (STRM005). The continuous temperature data show a relatively uniform seasonal pattern of cooling throughout the fall with stable (near 0 °C) temperatures throughout the winter and warming temperatures in the spring.

Specific conductance data collected during water quality monitoring (Figure 37) are also somewhat higher (58-136 micromhos per centimeter at 25 degrees

Celsius ($\mu\text{mhos/cm}$ @ 25 °C) versus 17-99 $\mu\text{mhos/cm}$ @ 25 °C) for surface water monitoring locations at the base of the north terrace compared to those on the Plains. These data indicate that monitoring locations below the north terrace are characterized by a slightly higher degree of dissolved ionic constituents likely associated with higher groundwater baseflow inputs.

Hardness concentrations are somewhat greater (27-73 mg/L) for surface water monitoring locations at the base of the north terrace relative to concentrations measured at monitoring locations on the Plains (9-44 mg/L) and increase downstream in the Salmon Trout River (Figure 38). The seasonality of hardness is observed in Figure 39, with lowest hardness conditions present during spring snowmelt and the highest levels observed during summer baseflow conditions.

Mercury (total) was detected in all surface water samples at concentrations within the range of those typically found in US rivers and streams (1-7 nanogram per liter (ng/L), US Environmental Protection Agency 1997). Generally, the Yellow Dog River samples exhibit a slightly higher range of mercury concentration (1.7-6.8 ng/L) than is observed in the Salmon Trout River and Cedar Creek samples (<0.25-5.6 ng/L). All monitoring locations appear to exhibit increased mercury concentrations during periods of increased surface runoff (i.e., spring snowmelt runoff) and mercury concentrations tend to increase with distance downstream. Figure 40 illustrates this relationship for the Salmon Trout River monitoring locations.

Manganese (total unfiltered) was reported at low concentrations in most samples collected from monitoring locations other than the upstream Cedar Creek (CDRA002). Trace concentrations of barium (total) were reported in the results from samples collected from most Salmon Trout River monitoring locations and the downstream Cedar Creek monitoring location. Samples collected from monitoring locations near the base of the north terrace (STRM003, STRM004, STRW001, STRE001, STRE002 and CDRM004) often contained trace

concentrations of total arsenic (1.0-2.8 microgram per liter ($\mu\text{g/L}$)). Total iron concentrations for all monitoring locations was typical of area streams ($<10\text{-}5,860\ \mu\text{g/L}$). Yellow Dog River and Salmon Trout River monitoring locations on the Plains (STRM001 and STRM002) occasionally contained total trace concentrations of arsenic ($<1\text{-}1.3\ \mu\text{g/L}$) and copper ($<1\text{-}1.2\ \mu\text{g/L}$).

3.3.2 Surface Erosion

Surface erosion, primarily from road runoff, is a well known existing condition potentially effecting stream quality on the Plains and downstream of the Plains. In order to roughly quantify sediment inputs from roads, sediment traps were established in the EBS that represent the range of traffic use, parent road material and road gradients that exist within the Study Area (Figure 18, Table 10).

Traffic appears to be the strongest factor influencing erosion rates, which is consistent with other studies of road surface erosion associated with heavily logged watersheds (e.g., Reid and Dunne 1984). Two high-traffic monitoring locations (SED03 and SED08) on the Triple A Road yielded estimates of 256 and 515 tons per mile of road (tons/mi), respectively. Monitoring locations on the less frequently traveled Northwestern Road and secondary roads yielded estimates that were 1 to 2 orders of magnitude less (0.9-55 tons/mi) than the Triple A Road.

These estimates of surface erosion rates appear to be supported by a preliminary analysis of the initial series of road cross sections surveyed on the Triple A Road and Northwestern Road (Figure 18). A comparison of the current road profile to natural topography suggests that since construction, an average depth of roughly 1.7 ft of soil has been removed from the Triple A Road bed at these locations through a combination of initial road construction, repeated grading and a relatively high rate of surface erosion, whereas cross sections along the Northwestern Road indicate an estimated long-term soil depth loss of 0.7 ft. Assuming the Triple A Road is about 100 years old, this would correlate

with an annual sediment loss of roughly 2,500 ft³/mi or 140 tons/mi, and for the Northwestern Road, roughly 740 ft³/mi or 40 tons/mi (assuming the Northwestern Road is also about 100 years old).

On a subwatershed basis the annual estimate of sediment delivered to streams by surface erosion of roads was fairly similar, ranging from 33 tons/mi² for the West Branch to 50 tons/mi² for the East Branch and an overall estimate of 43 tons/mi².

This value was compared to an estimate of the natural sediment delivery rate expected for the upper Salmon Trout River watershed. In the absence of roads and other disturbances to the landscape associated with commercial forestry and recreational activities, the primary natural mechanism delivering sediment to streams is soil creep. Soil creep occurs on all hillsides and though it is slow (0.08-0.2 in./year over a soil depth of 1.6-3.3 ft); it is responsible for most of the downslope transport of debris to stream channels in heavily vegetated regions (Dunne and Leopold 1978). For the Study Area, an annual estimate of naturally-derived sediment delivery (through soil creep alone) to streams of roughly 8 tons/mi² was calculated.

This preliminary finding suggests that under baseline conditions, surface erosion associated with the current road network yields an annual sediment delivery to streams that is a factor of 6 above natural conditions. This is consistent with Cedarholm et al. (1981) who found that fine sediment in gravels increased by 2.6-4.3 times in watersheds with a road density greater than 4.1 mi/mi². An average road density of 7 mi/mi² was estimated for the upper Salmon Trout River watershed.

3.3.3 Quaternary Deposit Groundwater Quality

Quaternary deposit groundwater quality data is generally categorized as very fresh (TDS <100 mg/L) to fresh (TDS 100-1000 mg/L) and soft (hardness <60

mg/L) to moderately hard (60-120 mg/L). The A zone Quaternary deposit groundwater is largely very fresh (TDS <100 mg/L) and soft (hardness <60 mg/L) while the D zone Quaternary deposit groundwater trends toward fresh and moderately hard. In the Plains wetland, A zone samples tend to be weakly acidic, with low calcium concentrations and low specific conductance. Mineralization increases and pH increases to weakly alkaline with depth. Dissolved oxygen concentrations generally decrease with depth, with A zone samples having dissolved oxygen levels as high as 7 mg/L while D zone samples typically have concentrations less than 0.001 mg/L. This pattern suggests that shallow water is recharged by precipitation infiltration and becomes more mineralized and depleted in oxygen with depth and residence time in the aquifer. Water quality data of representative Quaternary aquifer samples are presented in Table 11.

Figure 41 presents a Piper diagram of water quality data for select Quaternary aquifer samples. Water quality of most Quaternary aquifer groundwater is dominated by calcium and bicarbonate ions. Exceptions are the samples collected from well QAL006A, with no dominant (greater than 50% milliequivalents per liter (meq/L)) anion chemistry, wells QAL005A, QAL006A and WLD006, with no to weakly calcium dominant cation chemistry. All of these samples are representative of groundwater strongly dominated by precipitation recharge from the Plains wetland.

Minor constituents detected include iron, fluoride and nitrate (mostly at concentrations <1 mg/L). Dissolved iron and manganese are redox-sensitive parameters and thus they tend to increase in concentration in response to oxygen depletion with depth, and in wetland soils. Other dissolved trace metals consistently detected in groundwater samples consist of aluminum (identified at QAL006A, WLD006 and WLD021), arsenic (QAL004D, QAL005D, QAL008D and QAL009D), barium (QAL002D, QAL005A, QAL005D and QAL007D),

molybdenum (QAL001D and QAL002D) and possibly zinc (QAL009A). Mercury was detected in most groundwater samples at concentrations less than 1 ng/L.

3.3.4 Proposed Discharge Area Water Quality

Quaternary deposit groundwater quality at and down gradient of the proposed discharge area can be generally categorized as very fresh, soft to moderately hard, weakly alkaline and dominated by calcium and bicarbonate ions. The groundwater was largely free (less than the laboratory reporting limits) of dissolved metals. Exceptions were the relatively frequent detection of arsenic (QAL008D) and zinc (QAL009A) at trace concentrations and the nearly ubiquitous detection of mercury at very low concentrations (less than 1.5 ng/L). Dissolved oxygen concentrations decreased with depth. Chloride and sulfate concentrations were reported at some monitoring locations although most reported concentrations were less than 10 mg/L. Nitrate concentrations ranged from <0.05 to 0.22 mg/L.

These data are consistent with the regional water quality data reported for the EBS. The piper diagram presented in Figure 40 indicates that QAL008D and QAL031D have quite similar major ion chemistries and that data from both monitoring points can be considered representative of baseline conditions at the proposed discharge area.

3.3.5 Wetland Water Quality

Wetland water quality (Table 12) within the area of the Eagle Deposit was studied to aid in categorizing the primary supporting hydrologic source of these wetlands. The surface layer of wetland waters in this area can be generally categorized as ombrotrophic (mineral poor) to slightly minerotrophic (trending towards mineral rich). The ombrotrophic water quality is associated with the wetland areas primarily supported by precipitation, and is mineral poor (alkalinity <2.0 mg/L, calcium <3.0 mg/L) and strongly to moderately acidic (pH 3.7-5.3 SU).

The slightly minerotrophic water quality is associated with the wetland areas primarily supported by groundwater or groundwater derived surface water. Water quality of these wetland areas trends toward mineral rich (alkalinity 34-49 mg/L, calcium 3.0 - 12 mg/L) and is weakly acidic to neutral (pH 6.0-7.0 SU).

The piper diagram presented in Figure 42 indicates that water quality samples collected from piezometers in the primarily precipitation supported wetland areas (QAL043, QAL044, WLD027 and WLD028) have relatively distinct major ion chemistries compared to water quality samples collected from piezometers in the primarily groundwater or groundwater derived surface water supported wetland areas (WLD001, WLD025 and WLD026). This grouping reflects the absence of measurable bicarbonate alkalinity concentrations and very low calcium concentrations of the water samples collected from the primarily precipitation supported wetland areas relative to the somewhat greater concentrations of these parameters in the water samples collected from the primarily groundwater supported wetland areas. The piper diagram also indicates that the water quality of the Salmon Trout River Main Branch (February 2005 sample results, NJC 2005a) upstream and downstream of these wetland areas is very similar to the quality of samples collected from the primarily groundwater or groundwater derived surface water supported wetland areas. The similarity of Salmon Trout River Main Branch water quality to groundwater derived surface water supported wetland water quality reflects that groundwater is the primary source of river water in this area.

3.3.6 Bedrock Groundwater Quality

Bedrock water quality results from 2005 water quality monitoring are presented in Table 13. Bedrock water quality samples were also collected during 2004 active exploration drilling; however, these data were compromised by a loss of drill fluid combined with inadequate well development and stabilization due to the pace of borehole advancement.

During the 2005 bedrock hydrogeologic investigation program water quality samples were collected from exploration boreholes 04EA084 and 05EA0107 during pumping test activities. Near the bedrock surface, bedrock water quality can be generally categorized as slightly alkaline, reducing, fresh and soft. The deeper bedrock zone water quality can be characterized as alkaline, reducing, moderately saline and very hard.

The Piper diagram presented in Figure 43 indicates bedrock groundwater is dominated by sodium-bicarbonate in the upper bedrock zone, and sodium-chloride in the lower bedrock hydrostratigraphic unit. Figure 43 also indicates the sharp contrast of the bedrock quality in both upper and lower zones to the groundwater quality in the Quaternary aquifers, which is strongly calcium-bicarbonate dominated. This fingerprint is indicative of increasing residence time of water within the bedrock formation compared to the overlying alluvium or significantly different source water chemistry within the bedrock and a rapidly decreasing influence of meteoric water mixing with depth below the bedrock surface.

Minor constituents detected included iron, fluoride and phosphorus in some samples. Trace metals consistently detected were boron, lithium, manganese, mercury, strontium and zinc. Arsenic, barium, silver and selenium were less consistently detected in the bedrock water quality samples.

The most notable trace metal detected consistently is boron, with concentrations greater than 1 mg/L in most samples. Studies of Precambrian rock formations within the Lake Superior basin have documented that boron concentrations as high as 30 mg/L exist in saline brines, which are found in association with metasedimentary rock formations originally deposited in marine environments (Tipping 1998; Allen et al. 1998), and are attributed to marine water incursions to these formations during the development of the mid continent rift.

Mercury concentrations (total dissolved) ranged from 0.21 to 0.44 ng/L in the uppermost interval samples to 0.66 to 4.95 ng/L in the deepest interval samples. An order of magnitude greater total (unfiltered) mercury concentration (89.1 ng/L) was reported for one of the bedrock water quality samples obtained in 2004.

Low level total tritium analyses were performed to provide another means of relative age dating and as a comparative environmental isotope to the groundwater present in the glacial deposits. Reported tritium concentrations for bedrock water quality samples were less than 1 tritium unit (TU). Concentrations near 1 or <1 TU are considered to indicate sub-modern (before 1953) groundwater. Quaternary aquifer water has much greater tritium concentrations indicating a source of water that was introduced to the aquifers after 1953.

4.0 Predictive Simulations

There are three primary concerns associated with the simulated drawdown associated with mining conditions, and discharge of water: changes to wetland hydrologic controls; changes to streamflow; and water quality of treated mine water. Water supply wells are not present in the localized area affected by mining conditions (Section 2.3). In this report estimated changes to the first two concerns are discussed. Water quality of treated mine water is addressed in specific engineering plans for the mine.

The Project mine plan does not require a large water supply to support the proposed mining operations. As a result, the primary causes of change to baseline hydrologic conditions will be the result of groundwater seepage into underground mine workings in bedrock formations and the removal and discharge of this groundwater (treated) to the Quaternary groundwater.

The results of the baseline studies of water resources indicates that there is a strong hydraulic connection between streams, particularly the Salmon Trout River system and the alluvial aquifers on the Plains (the A and D hydrostratigraphic zones composed of predominantly fine-sand glacial outwash). Portions of some wetlands are also well connected to this aquifer system and the streams. The bedrock is poorly connected to this system and the lower bedrock hydrostratigraphic zone (below the upper 300 ft), containing most of the ore deposit of mining interest, has been demonstrated to have essentially no direct hydraulic connection the Quaternary aquifers, streams, or wetlands under baseline conditions.

The fundamental change to baseline conditions will occur as a result of introducing mine workings to the bedrock. These changes are expected to cause some amount of groundwater seepage into the mine. The effects of this mine

seepage on water resources have been simulated using the following work process flow:

1. Estimation of mine inflow from bedrock using the FEFLOW numerical flow model of bedrock to simulate both fracture flow and porous media flow from bedrock formations;
2. Estimation of the change in Quaternary aquifer flow from seepage to the mine workings, and discharge of treated mine water to the Quaternary aquifer using the MODFLOW Quaternary aquifer model;
3. Estimation of the effects of Quaternary aquifer flow changes on streamflow at key watershed monitoring points; and
4. Estimation of the effects of Quaternary aquifer flow changes on wetland water levels in wetlands that are supported by regional groundwater flow systems.

The results of these predictive simulations are presented below.

4.1 Mine Inflow

The numerical model constructed for the predictive simulation of mine inflow was created based on the conceptual bedrock hydrogeologic model developed from geologic data and hydraulic testing of the bedrock formations at the Eagle deposit (described in section 3), and also based on the mine schedule presented in Table 14. The mine schedule presents a planned development for the mine that includes a 10-year plan of active development in 5 primary stages. The mine schedule describes the development of major underground mine workings development in terms of the elevation of the mining levels and declines and inclines for accessing the mining levels from ground surface. The following construction phases are planned:

- Year -2 (two years before ore body mining): Construction of a decline from ground surface at the Peridotite outcrop (approximate elevation 445 m above mean sea level to 263 m elevation (1,460-862 ft msl)). The 263 m elevation level is about 560 ft below ground surface at the location of the ore body and within the lower bedrock hydrostratigraphic unit.
- Year -1: Continued construction of the decline (263 m elevation to 143 m elevation (469 ft msl)).
- Years 1 to 3: Active ore mining begins in the lowest levels from 143 m elevation up to 263 m elevation.
- Years 4 to 6: Construction of an incline from 263 m elevation to 383 m (about 1,256 ft) elevation. This phase places the two uppermost levels of mining into the upper bedrock hydrostratigraphic unit.
- Years 4 to 8: Mining from 263 m to 383 m elevations.

The mining levels are projected onto a cross section of the Eagle deposit in Figure 11. The mining schedule on Table 14 indicates drift dimensions and total length of drifts and shaft development.

Conceptual Model of Bedrock Hydrostratigraphy and Key Assumptions for Numerical Inflow Modeling

The conceptual model for mine inflow, based on the findings of the 2004 and 2005 bedrock hydrogeologic investigations is described below.

- The bedrock consists of two hydrostratigraphic units whose primary hydraulic parameters are controlled by the intensity of open fractures which decreases with depth.
- The hydrostratigraphy of the bedrock is not controlled by lithology or geological structure, as many discrete lithological contacts and geological

structures do not produce measurable groundwater flow. This conceptual model is supported by hydraulic parameter testing and water quality data described in Section 3 and a correlation of bedrock geotechnical data to groundwater flow logging and hydraulic testing.

- The upper bedrock hydrostratigraphic unit extends to 90 m (295 ft) below the top of the bedrock with a hydraulic conductivity of 2×10^{-08} m/s (5.7×10^{-03} ft/d).
- The lower bedrock hydrostratigraphic unit is located below 90 m with a hydraulic conductivity of 5×10^{-10} m/s (1.4×10^{-04} ft/d). Sparsely spaced water conductive features are located within this unit with transmissivity of 3×10^{-06} m²/s (3.2×10^{-05} ft²/s). Various forms of hydraulic testing data indicate that these features are most likely small and disconnected with low storage characteristics.
- There exists poor hydraulic communication between the alluvium and bedrock groundwater systems which is primarily attributed to the relatively low hydraulic conductivity of the bedrock, in comparison to the overlying Quaternary alluvium.

Using this conceptual hydrogeologic model, a numerical flow model (FEFLOW) was constructed. In addition to the incorporation of the conceptual model elements and hydraulic parameters, the primary simplifying assumptions and boundary conditions for the FEFLOW model are summarized below:

1. The water conductive features are assumed to be vertical and terminate at the contact of the upper and lower bedrock hydrostratigraphic zones. Due to some uncertainty in the actual frequency of spacing, length and connectivity of fractures, and their dominant control on the estimated groundwater inflow to the mine workings, the modeled inflows were predicted for two scenarios:

Base Case: Water conductive features are represented as vertical, 145 m long and disconnected from each other.

Upper Bound: Water conductive features are represented as vertical, orthogonally oriented and connected features, extending 1 to 2 kilometers in length. Specific storage of both the lower bedrock hydrostratigraphic unit and conductive features within this unit have is also increased by a factor of 10 compared to the base case.

2. The boundary conditions for the model are all no-flow with the exception of the top of the model. The top is simulated as a head dependant boundary with conductance values assigned based on the hydraulic conductivity and thickness of the lower-most Quaternary alluvium unit and spatially consistent with the MODFLOW model used to simulate Quaternary aquifer and streamflow for the baseline studies. This condition allows for a coupling of the two numerical models so that Quaternary aquifer drawdowns and associated streamflow predictions can be simulated under mining conditions (described below).
3. Dilation is assumed to occur within the rock mass around underground mine workings with a 15 m zone. In this zone, the hydraulic conductivity of the bedrock and water conductive features is assumed to increase by a factor of 3.

Results of Mine Inflow Modeling

The predicted mine inflow rates are presented graphically in the time-series chart in Figure 44. In the base case simulation the inflow is predicted to be reach 75 gpm (0.17 cfs) at the end of mining, based on the projected mine schedule. In the upper bound simulation the predicted inflow at the end of mining increases is 220 gpm (0.48 cfs). The inflow rates have been used to help assess the treatment

system design capacity, and to estimate the total amount of treated water that will be infiltrated back to Quaternary aquifer groundwater at the surface.

The simulated potentiometric surface for the bedrock under mining conditions is presented in Figures 45 and 46 for the base case and upper bound simulations, respectively. The drawdown is somewhat elongated east-west, following the pattern of the decline from the Peridotite outcrop to the Eagle deposit ore body. The maximum drawdown is shown in the Project center of the mine workings, which is required in order to simulate dry conditions within the mine workings at each mining level. The contour simulating 1 m of drawdown extends away from the proposed mine to a distance of about 1,300 m (4,262 ft) in the base case simulation and about 1,500 m (4,920 ft) in the upper bound simulation. The relatively small difference in the extent of the drawdown cone is related to the boundary condition that is assigned to the model top in order to couple the bedrock inflow to the overburden. This boundary condition is considered to be a conservative assumption with respect to the amount of groundwater that is allowed to leak into the bedrock from the Quaternary alluvium. This is discussed further below.

4.2 Quaternary Aquifer Groundwater Flow

Base case and upper bound case predictive simulations of the anticipated changes to Quaternary aquifer groundwater conditions were performed using the calibrated regional Quaternary numerical model. The objectives of the predictive simulation were to:

- Determine the change in groundwater flow patterns associated with the mine inflow and treated groundwater discharge;
- Determine the amount of Quaternary aquifer drawdown associated with groundwater inflow to the proposed mine;

- Determine the amount of Quaternary aquifer mounding associated with discharge of treated water from mine dewatering water to the proposed groundwater discharge area and also to estimate the route taken by water released at the groundwater infiltration area once it reaches the water table and establish the distance traveled for ten years following the end of mine operations;
- Estimate the change in surface water flow caused by capture (mine inflow) of Quaternary aquifer groundwater, and by treated groundwater discharge activities;
- Estimate the change in wetland hydrology associated with mine inflow and groundwater discharge activities; and
- Delineate the sources that contribute to water entering the mine during operations.

The baseline groundwater flow model (Visual MODFLOW) provides the foundation for the predictive assessment model for Quaternary aquifers and streamflow. Changes (relative to the baseline flow model) are presented briefly below.

- Six “flux centers” are added to represent the accumulated mine inflow from the surrounding bedrock.
- The model is run as a transient model covering the ten-year mining period and the ten-year post-mining period. Other than inflow rate, the model inputs represent average conditions identified in the baseline hydrology studies and remain constant throughout the modeled period.
- Model layers 12 and 13 have been adjusted so bedrock heads and the drawdown pattern corresponded between the Visual MODFLOW and FEFLOW models.

- Upper model layers east of the ore body and hydraulic conductivity values from some alluvial units were adjusted based on boring logs data from new soil borings and additional aquifer testing at monitoring wells completed since the end of the baseline period (QAL024 to QAL044).
- Recharge in some areas north of the ore body (north terrace) are increased by 5 to 10 percent (for calibration) to balance the addition of two deep bedrock layers to the model and other layer and hydraulic conductivity adjustments made in the vicinity of the terrace escarpment.
- Supplemental recharge is assigned to six model cells in the uppermost model layer (layer 1) to coincide with the proposed discharge area.

Coupling and Calibration of the Quaternary System Predictive Model

The mine inflow simulation used two scenarios: the base case and upper bound simulations. These same two scenarios are also evaluated in the predictive assessment modeling. Flow rates from multiple stress periods used for FEFLOW bedrock modeling were combined to reduce the number of stress periods in the MODFLOW model.

Hydraulic parameters used in FEFLOW serve as the starting basis for average values assigned to bedrock in MODFLOW. However, because of the different simplifying assumptions used in the FEFLOW model and because MODFLOW does not represent discrete water-conductive features as accurately, hydraulic conductivity and storage parameters required adjustment in the MODFLOW simulations to produce a better fit with the FEFLOW results.

The model was iteratively calibrated for both the base case and upper bound simulations to assure that hydraulic parameters for the upper bedrock are consistent. The conductivity and storage parameters for lower bedrock are integrated values that represent the combined hydraulic effects of the bedrock matrix and water-conductive features.

4.2.1 Predicted Groundwater Flow – Base Case Scenario

The nature of the drawdown in the Quaternary aquifer under base case inflow conditions is represented in a time series plot (Figure 47). Because the center of the cone of depression of the bedrock potentiometric surface simulations are approximately centered above the mine level workings (Figures 45), the simulated time-series drawdown is presented for a monitoring location screened within the lowermost saturated alluvium at a location that is approximately above the center of the bedrock drawdown cone (monitoring location QAL043B, Figure 47). This plot illustrates that under the base case inflow scenario, the drawdown translated to the uppermost alluvium is negligible (0.12 ft).

The base case potentiometric surface indicates that all regional flow patterns are preserved and the predicted changes are thus highly localized (Figure 48). Results of particle tracking of the infiltrated, treated water are also shown in Figure 48. The total path length indicates the distance groundwater moves during a ten-year period. Time markers are spaced at one-year intervals to show groundwater movement year by year. The simulation indicates that all particles are captured by the Salmon Trout East Branch before ten years. Nearly all particles travel for over five years before capture.

The predicted height and extent of the groundwater mound, as well as the distance of particle travel over time predicted by this analysis, are based on the assumption that infiltrating water immediately reaches the groundwater system. The maximum rise in the water table (groundwater mound height) beneath the infiltration area is about 8 ft at the end of ten years. Because the depth to the water table in the area beneath and downgradient of the proposed discharge area is up to 80 ft, it is clear from this analysis that the mound will be well below the land surface. The mound height falls off downgradient of the proposed discharge area until it reaches 2 ft of water level rise less than 1,400 ft downgradient of the proposed discharge area.

This simulation provides a conservative estimate of the hydrological effects of the proposed discharge of treated water. Travel time through the unsaturated zone is not simulated and could be substantial because of the thickness of sediments (up to 80 ft) above the water table beneath the proposed discharge area. Infiltrating water may be distributed more broadly before reaching the water table, reducing the effective mound height and the horizontal distance that water will travel.

The base case simulation mass balance analysis indicates that all mine inflow comes from groundwater storage. This results from the low inflow rate, the large volume of bedrock influenced by mine inflow (large cone of depression) and drying of some bedrock model cells at the flux boundary as the simulation progresses. This reflects the extremely low hydraulic conductivity and storage characteristics established for the calibrated base case simulation and suggest that drying and mine inflow reduction over time may occur during actual mine development. The hydraulic component of flow (aquifer storage) is represented in Figure 49 for comparison to upper bound estimates discussed below.

4.2.2 Predicted Groundwater Flow – Upper Bound Scenario

The nature of the drawdown in the Quaternary aquifer under the upper bound inflow conditions simulation indicates a maximum drawdown of 0.95 ft, compared to 0.12 ft in the base case (Figure 50).

The upper bound simulation potentiometric surface suggests that all regional flow patterns are preserved and that the predicted changes to this surface are localized (Figure 51). Upper bound proposed discharge area particle tracking indicate that, within ten years of discharge, all particle tracks are captured by the Salmon Trout River East Branch (Figure 51).

The maximum rise in the water table (groundwater mound height) beneath the proposed discharge area is about 21 ft at the end of ten years. Because the depth to the water table in the area beneath and downgradient of the proposed

discharge area is up to 80 ft, the mound will be well below the land surface. The mound height falls off downgradient of the proposed discharge area until it reaches 2 ft of water level rise about 2,400 ft north-northeast (the predominant flow direction).

As with the base case scenario, the mounding and particle tracking simulation provides very conservative estimates of mounding and travel. Both simulations produce particle tracking results that suggests that: gradient reversals occur in close proximity to the mound; all discharge is contained within the Salmon Trout River East Branch subwatershed; and localized alteration to baseline groundwater basin flow patterns occur.

For the upper bound simulations, the sources of mine inflow and relative contribution from aquifer storage and diversion of groundwater that would replenish streamflow under baseline conditions is shown in Figure 52. For the upper bound case, the primary sources of water from hydraulic components of the model are:

- Groundwater from storage both in bedrock (including water-conductive features) and in overlying alluvium contributes about 15 percent (0.072 cfs) of the water seeping into the mine. Early in the simulation this component provides all mine inflow, with contribution gradually diminishing over time.
- Water diverted from streams to replenish groundwater storage provides about 67 percent (0.333 cfs). This percentage does not represent the reduction in streamflow, which is discussed in Section 4.2.4 below.
- Additional groundwater entering the system through constant head boundaries in the model, primarily representing contribution from groundwater storage outside the model domain, provides about 17 percent (0.082 cfs). Most, if not all, of the water contributing indirectly to

mine inflow through this component enters the model as diffuse flow from surrounding matrix storage.

- A minor share of the groundwater entering the mine is diverted from seeps discharging along the terrace escarpment. This component contributes 1 percent (0.001 cfs) of mine inflow (not 1 percent of the discharge at the seeps).

Surface runoff and storage from precipitation and meltwater may also be diverted to replenish groundwater storage by enhanced infiltration recharge through wetlands and likely would reduce the contribution from streams.

4.2.3 Predicted Hydrologic Changes to Wetlands

As shown in Figures 47 and 50, mine inflow simulations predict some drawdown in the lowermost portions of the alluvium at locations over the ore body. Located above this area are wetlands. As discussed in Section 3 these include wetlands supported primarily by precipitation inputs and those supported by groundwater discharge.

In order to estimate whether the simulated drawdown is likely to impact wetland hydrology, a focused Visual MODFLOW cross sectional slice model (slice model) was constructed along a vertical slice of the groundwater system at this location. This slice model reflects the localized flow conditions (Section 3.2.2). The slice model was focused on predicted head loss in the thin A zone aquifer in response to the 0.95 ft upper bound scenario lowering of head in the B zone deposit for the simulated mine inflow conditions. The base case scenario was not examined because the predicted base case head loss in the A zone is 0.0 ft.

The cross sectional representation of the slice model is shown in Figure 53. This cross section indicates the strong influence of precipitation recharge and the discharge of groundwater into the Salmon Trout River in this area. This calibrated cross sectional model also indicates that from the wetlands to the

Salmon Trout River Main Branch, there is a high degree of horizontal flow of upper A zone groundwater, while the gradient through the lower hydraulic conductivity B zone unit is more vertical.

The results of the upper bound simulation are shown in Table 15. Modeled drawdowns in the A zone ranged from 0.41 feet to 0.66 feet, compared to lower B zone drawdowns of 0.87 to 0.98 feet. These results indicate that as B-zone heads fall, A-zone heads respond in a subdued fashion.

Following the results of the slice model, the predictive model was also used to estimate the distribution of the A zone drawdown. Equipotentials produced by the transient simulation of the upper bound case are shown for the uppermost saturated layer (model layer 2) at the end (ten years) of mine operation (Figure 54). Consistent with the detailed slice model, drawdown approximately centered over the mine workings and ore body of between 0.4 and 0.75 ft is predicted.

4.2.4 Predicted Changes to Surface Water Flow

The maximum change to stream flow for the predicted base case and upper bound inflow scenarios are presented in Table 16. The changes are compared to baseline conditions modeled at key watershed monitoring locations for the Salmon Trout River tributaries and the Yellow Dog River near the proposed Project. The predicted changes to surface water flow are generally reflected in the predicted changes to groundwater basins presented in the proceeding section.

Base Case Scenario

In the base case scenario, the source of mine inflow is groundwater storage. As a result, no change to flow through indirect withdrawal of water from streams is predicted. The discharge of treated mine inflow occurs within the Salmon Trout East Branch basin. The resulting predicted maximum change to surface water flow is a 0.2 cfs increase at the STRE002 monitoring station. This corresponds

to a maximum increase of 1.1% compared to mean daily average baseline flow conditions at this monitoring location. The estimated stage change at this monitoring location is 0.01 feet. These changes are further reduced at downstream stations in the watershed (STRM005). The mounding heads created by the proposed discharge area are also expected to result in a slight increase to Yellow Dog River flow (0.026 cfs). All predicted flow increases or reductions are less than the accuracy of the hydrograph model and stage and flow instrumentation accuracy and therefore are unlikely to create a measurable difference to flow.

The upper bound scenario simulation derives some water from streamflow and predicts a small reduction in flow estimated in the Salmon Trout Main branch upstream of the AAA road (monitoring location STRM002). The discharge of treated water for maximum conditions creates gains relative to mean average daily flow conditions at most other watershed monitoring locations, as summarized below:

- 1.5% flow increase at Salmon Trout East Branch monitoring location STRE002 (0.316 cfs);
- 0.7% flow decrease at Salmon Trout Main Branch monitoring location STRM002 (-0.016 cfs); and
- 0.2% flow increase at Yellow Dog flow monitoring location YDRM002 (0.048 cfs).

Stage changes from these flow reductions are estimated to be 0.01 ft or less. All predicted flow increases or reductions are less than the accuracy of the hydrograph model and stage and flow instrumentation accuracy and therefore are unlikely to create a measurable difference to flow.

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TABLES

Table 1
Water Well Survey Results
Eagle Project

MDEQ Well Identification	Township	Range	Section	Source	Installation Date	Aquifer
52000004226	50N	28W	1	MDEQWL	Aug-00	QAL
52000004704	50N	28W	1	MDEQWL	Nov-00	QAL
990405	50N	29W	3	MCHD	Jan-00	QAL
ELLIOTT	50N	29W	8	MCHD	Jun-73	QAL
52000005636	51N	28W	29	MDEQWL	Aug-05	PCW
52000003906	51N	27W	32	MDEQWL	Jan-00	QAL
52000004423	51N	27W	33	MDEQWL	Apr-99	QAL

Notes:

NL	Not listed
MDEQWL	Marquette Department of Environmental Quality Wellogic
MCHD	Marquette County Health Department
QAL	Quaternary alluvium
PCW	Archean northern complex igneous/metamorphic

Table 2
Grain Size Distribution for Quaternary Deposits
Eagle Project

Location	Depth (ft)	Geologic Description	Zone Designation	USCS Classification	Percentage Retained by Weight (%)						
					Gravel	Coarse Sand	Medium Sand	Fine Sand	Silt	Clay	Fines (Silt + Clay)
QAL038	0	Unsaturated outwash sand	A+	SP	3.5	3.2	21	70			2.4
QAL038	2		A+	SP	3.2	2.3	22	72			0.3
QAL038	4		A+	SP	0.2	0.3	14	85			0.6
QAL031	5		A+	SP	0.7	1.1	13	84			0.9
QAL041	5		A+	SP	1.5	2.1	15	79			1.8
QAL037	6		A+	SP	1.7	1.5	17	79			0.8
QAL038	6		A+	SP	1.8	1.2	12	84			1.5
QAL036	7		A+	SP	1.0	1.2	17	81			0.5
QAL039	7		A+	SP	0.8	0.5	8.1	89			1.8
QAL040	7		A+	SP	0.3	1.1	12	85			1.3
QAL042	7		A+	SP	2.4	0.6	8.3	86			2.6
QAL038	8		A+	SP	1.0	0.6	8.0	89			1.2
QAL008	10		A+	SP	3.7	0.9	12	83			0.7
QAL004	15		A+	SP-SM	15	11	44	24			6.5
QAL041	18		A+	SP	1.7	3.0	21	72			2.7
QAL008	30		A+	SP/SP-SM	6.4	1.5	24	64			4.4
QAL009	37		A+	SP	0.1	0.7	11	85			3.5
QAL041	37		A+	SP-SM	0.1	0.5	6.4	83			10
QAL031	44		A+	SM/SP-SM	0.0	0.0	0.2	86			14
QAL036	60		A+	SP	0.0	0.0	2.9	96			1.1
Average			A+		2.3	1.6	14	79			3.0
QAL006	23	Saturated outwash sand (upper zone)	A	SP	0.0	0.3	19	79			1.4
QAL004	52		A/B	SM	0.1	0.9	3.1	80			16
QAL036	80		A	SM	0.0	0.0	0.3	51	46	2.8	49
QAL009	102		A	SP/SP-SM	0.0	0.0	1.4	94			4.3
Average			A		0.0	0.3	6.9	77			16
QAL041	55	Transitional fine sand, silt and clay	B	SM	0.0	0.0	0.2	78	20	1.8	22
QAL029	55		B	CH	0.0	0.0	0.3	3.1	69	28	97
QAL006	71		B	SP	0.0	0.0	0.2	96			3.8
QAL005	75		B	SM	0.0	0.0	0.0	74	25	0.5	26
QAL008	84		B	ML	0.0	0.0	0.1	16	77	7.0	84
QAL036	87		B	ML	0.0	0.0	0.3	21	73	5.5	79
QAL008	88		B	SP-SM	0.0	0.0	0.7	90			9.6
QAL031	61		B	ML/CL-ML	0.0	0.0	0.4	8.9	85	5.7	91
QAL031	79		B	SM	1.5	0.4	4.0	66	23	5.0	28
Average			B		0.2	0.1	0.8	49			50
QAL036	91	Lacustrine lean clay	C	CL-ML	0.0	0.1	0.3	4.3	68	27	95
QAL004	98-100		C	CL-ML	0.0	0.0	0.0	0.2	93	7.0	100
QAL008	107-109		C	CL	0.0	0.0	0.2	2.7	59	38	97
Average			C		0.0	0.0	0.2	2.4			97
QAL041	80	Lower outwash sand (lower zone)	D*	SP	17	6.3	25	50			2.4
QAL036	103		D	SP	16	3.5	18	59			2.5
QAL041	105		D	SP	0.0	0.0	1.3	94			4.4
QAL031	106		D	SP-SM	0.0	0.3	11	80	7.7	1.5	9.2
QAL031	111		D	SM	0.2	0.4	1.6	41	51	6.5	57
QAL008	117		D	SP	0.4	0.2	22	75			3.4
QAL005	121		D	SP	26	12	28	33			2.3
QAL004	142		D	SM	2.6	7.1	18	55			18
QAL009	145		D	SP/SP-SM	0.3	4.5	32	58			5.2
Average			D		6.9	3.8	17	60			12
QAL036	120	Clayey glacial till	E	SC	33	11	15	9.8	12	19	31
QAL031	123		E	SM-SC	42	11	14	7.6	11	15	26
QAL009	157		E	CH	1.2	0.1	1.0	5.3	14	78	92
QAL009	163		E	SM	0.0	0.2	17	58			26
QAL009	185		E	SM	0.0	0.0	0.2	71	22	6.2	28
QAL009	238		E	ML	0.0	0.0	0.6	11	83	6.4	89
QAL009	254		E	SC	29	8.5	12	27	15	9.2	24
Average			E		15	4.5	8.4	27			45

*Zone unsaturated at this location

Table 2: Grain Size Distribution

Table 3
Streamflow Characteristics Summary
Eagle Project

Monitoring Location	Area (mi ²)	Average Daily Flow (cfs)	Average Flow Per Unit Area (cfs/mi ²)	Flow (cfs)		Maximum / Minimum
				Maximum	Minimum	
Salmon Trout River						
STRM004	8.8	6.7	0.8	41	4.2	10
STRM005	41.7	44	1.1	397	22	18
STRE002	11.5	21	1.8	119	12	10
Yellow Dog River						
YDRM002	26.5	28	1.1	242	6.5	37

Note: Data are for September 2004 to September 2005.

Table 4
Regional Water Elevation Data
Eagle Project

Location	Water Elevation (ft MSL)					
	5/11/04	8/26/04	10/27/04	3/15/05	5/4/05	8/30/05
WLD001	1428.96	1428.87	1428.37	1428.80	1428.38	1428.26
WLD002	1430.73	1430.58	1430.77	1430.67	1430.79	1430.26
WLD003	1433.84	1433.61	1433.75	1433.62	1433.90	1432.45
WLD004	1446.50	1446.14	1446.40	1446.21	1447.48	1445.02
WLD005	1451.23	1450.98	1451.09	1450.94	1451.23	1449.66
WLD006	1455.51	1455.32	1455.38	1454.97	1455.50	1453.32
WLD007	1450.70	1450.51	1450.54	1450.20	1450.69	1448.76
WLD008	1453.59	1453.32	1453.55	1453.40	1453.64	1452.06
WLD009	1457.09	1457.01	1457.12	1456.82	1457.07	1455.19
WLD010	1447.49	1447.25	1447.48	1447.23	1447.50	1445.14
WLD011	1446.80	1445.91	1446.43	1445.97	1446.69	1444.29
WLD012	1446.22	1445.77	1445.99	1446.03	1446.18	1444.35
WLD013	1445.00	1444.02	1444.75	1444.83	1445.98	1442.46
WLD014	1441.64	1441.20	1441.45	1441.24	1441.58	1440.18
WLD015	1428.98	1428.90	1429.06	1428.91	1429.13	1428.14
WLD016	1428.44	1428.36	1428.41	1428.40	1428.56	1427.63
WLD017	1423.64	1422.98	1423.64	1423.29	1423.63	1421.76
WLD018	1423.13	1422.94	1423.10	1423.03	1423.16	1421.17
WLD019	1421.02	NM	1421.08	1420.47	1420.95	1418.37
WLD020	1420.17	1419.79	1420.18	1419.96	1420.24	1417.34
WLD021	1416.04	1415.36	1416.38	1415.19	1416.19	1414.25
WLD022	1422.61	1422.55	1422.63	1422.11	1422.58	1422.58
WLD023	1413.59	1413.59	NM	1413.60	1413.58	1413.16
QAL001A	1410.94	1412.79	1412.72	1412.00	1411.61	1411.97
QAL001D	1405.17	1407.90	1407.66*	1406.47	1406.38	1406.89
QAL002A	1433.86	1435.23	1434.76	1433.35	1433.54	1434.11
QAL002D	1391.91	1391.95	1395.92	1395.30	1395.21	1395.45
QAL003A	1428.08	1426.58	1425.99*	1425.15	1427.55	1425.37
QAL003B	1414.19	1413.12	1412.93*	1412.45	1413.93	1412.21
QAL004A	1426.44	1425.64	1425.21	1424.62	1426.16	1425.19
QAL004D	1434.41	1434.14	1434.02	1433.72	1434.36	1433.05
QAL005A	1455.70	1454.37	1454.18	1453.34	1455.54	1452.56
QAL005D	1453.96	1453.19	1452.94	1452.35	1453.68	1451.52
QAL006A	1416.49	1415.13	1414.60	1414.02	1415.96	1413.82
QAL006B	1401.47	1400.94	1400.23	1398.78	1400.11	1399.69
QAL007A	NM	NM	1430.17	1428.74	1428.99	1429.39
QAL007D	NM	NM	1438.35	1437.11	1438.15	1437.74
QAL008A	NM	NM	1390.43	1389.59	1389.26	1389.39
QAL008D	NM	NM	1354.07	1353.72	1353.82	1353.92

Table 4 : Water Elevations

Table 4
Regional Water Elevation Data
Eagle Project

Location	Water Elevation (ft MSL)					
	5/11/04	8/26/04	10/27/04	3/15/05	5/4/05	8/30/05
QAL009A	NM	NM	1354.99	1354.57	1354.02	1354.43
QAL009D	NM	NM	1354.84	1354.47	1354.32	1354.45
QAL010A	NM	NM	1424.54	1422.77	1424.89	1423.92
QAL015	NM	1292.56	1292.69	1292.90	1292.91	1292.49
QAL016	NM	1274.80	1274.20	1273.73	1273.69	1274.32
QAL017	NM	1251.00	1251.37	1251.40	1251.17	1250.39
QAL018	NM	1250.22	1250.24	1250.37	1250.41	1249.13
QAL019	NM	1285.55	1285.41	1285.35	1285.39	1285.18
QAL020	NM	1335.61	1335.65	1336.10	1335.71	1335.32
QAL021	NM	1389.30	1389.33	1389.22	1389.28	1389.21
QAL022	NM	1298.36	1298.44	1298.40	1298.42	1298.34
QAL023B	NM	1420.57	1418.52	NM	1418.16	1417.96
QAL024A	NM	NM	NM	NM	NM	1419.57
QAL025A	NM	NM	NM	NM	NM	1419.24
QAL026A	NM	NM	NM	NM	NM	1418.68
QAL027A	NM	NM	NM	NM	NM	1416.05
QAL028A	NM	NM	NM	NM	NM	1405.05
QAL029A	NM	NM	NM	NM	NM	1419.21
QAL029D	NM	NM	NM	NM	NM	1408.97
QAL031D	NM	NM	NM	NM	NM	1371.39
QAL041D	NM	NM	NM	NM	NM	1365.39
QAL043B	NM	NM	NM	NM	NM	1417.87
QAL044B	NM	NM	NM	NM	NM	1417.86
YDRM002	NM	1412.21	1412.65	1412.33	NM	1411.98
STRM002	NM	1400.91	NM	1403.19	1400.09	1400.36

NM Not measured
MSL Mean sea level
* Measured on 11/10/04

Table 5
Wetland Water Elevation Data
Eagle Project

Location	Water Elevation 12/20 & 12/22/05 (ft MSL)
QAL001A	1411.50
QAL001D	1406.31
QAL002A	1433.53
QAL002D	1395.32
QAL003A	1426.52
QAL003B	1413.31
QAL004A	1425.21
QAL004D	1434.13
QAL005A	1454.52
QAL005D	1453.09
QAL008A	1388.91
QAL023-1.0	1418.60
QAL023-4.5	1418.51 E
QAL023B	1418.10
QAL024A	1419.27
QAL025A	1418.65
QAL026A	1417.90
QAL027A	1413.75
QAL028A	1404.23
QAL029A	1418.49
QAL029D	1408.40
QAL031D	1371.79
QAL041D	1365.67
QAL043-1.0	1419.82
QAL043-4.5	1419.83
QAL043B	1417.84
QAL044-1.0	1424.60
QAL044-4.5	1424.60
QAL044B	1417.71

Table 5
Wetland Water Elevation Data
Eagle Project

Location	Water Elevation 12/20 & 12/22/05 (ft MSL)
WLD001-1.0	1429.15 F
WLD001-4.5	1429.05 F
WLD001-9.5	1429.53 F
WLD022-1.0	1422.16
WLD022-4.5	1422.37
WLD022-9.5	1422.81
WLD023-1.0	1413.81
WLD023-4.5	1413.56
WLD023-9.5	1414.99 F
WLD024-1.0	1423.18
WLD024-4.5	1423.36 F
WLD024-9.5	1423.75 F
WLD025-1.0	1415.56
WLD025-4.5	1415.61
WLD025-9.5	NM
WLD026-1.0	1415.84
WLD026-4.5	1416.48 F
WLD026-9.5	1416.44 F
WLD027-1.0	1422.97
WLD027-4.5	1422.72
WLD027-9.5	1422.70
WLD028-1.0	1427.85
WLD028-4.5	1427.61
WLD028-9.5	1427.39
WLD029-1.0	1429.11 F
WLD029-4.5	1429.08
WLD029-9.5	1429.22

NM Not measured

F Water thawed prior to measurement

E Estimated depth - top of ice

Table 6
Bedrock Piezometric Data
Eagle Project

Monitoring Zone Identity	Gauge Depth		Freshwater Head		Environmental Water Head	
	(m MSL)	(ft MSL)	(m MSL)	(ft MSL)	(m MSL)	(ft MSL)
QAL023	422.49	1386.11	431.55	1415.83	431.55	1415.83
QAL043	422.76	1386.99	431.7	1416.3	431.7	1416.3
QAL044	428.26	1405.04	431.63	1416.09	431.63	1416.09
04EA-077 Upper	388.6	1274.9	431.15	1414.52	431.15	1414.52
YD02-20 Upper	418.9	1374.3	431.96	1417.17	431.96	1417.17
04EA-074 Upper	412.5	1353.3	432.4	1418.6	432.4	1418.6
04EA-077 Lower	252.5	828.4	432.2	1418.0	432.09	1417.60
YD02-20 Lower	197.9	649.3	430.24	1411.53	429.93	1410.51
04EA-074 Lower	245.8	806.4	432.55	1419.11	432.4	1418.6

Table 7
Surface Water Quality Data
Salmon Trout River Monitoring Location STRM002
Eagle Project

Parameter	Units	Fall Rain Runoff	Winter Baseflow	Spring Snowmelt Runoff	Spring Rain Runoff	Summer Baseflow	Fall Rain Runoff	Winter Baseflow		Spring Snowmelt Runoff	Spring Rain Runoff	Summer Baseflow	Fall Rain Runoff			Winter Baseflow		Spring Snowmelt Runoff
		11/5/02	2/25/03	4/23/03	6/19/03	8/13/03	10/28/03	12/4/03	2/18/04	4/7/04	6/29/04	8/3/04	9/14/04	10/4/04	11/9/04	12/14/04	2/16/05	4/13/05
Field Parameters																		
Temperature	°C	1.7	0.2	5.1	14	18	3.3	0.3	0.4	3.7	16	16	16	7.0	2.4	0.4	0.4	6.6
Specific Conductance	µmhos/ cm @ 25°C	53	69	34	61	63	59	70	70	41	58	66	69	57	57	58	62	34
pH	SU	6.2	7.0	7.5	8.1	6.4	7.8	7.7	8.3	6.8	7.5	7.2	7.3	7.1	7.3	6.9	7.1	7.1
D.O.	ppm	11	6	7	4.5	5	5	NM	7	8	7	8	7	7	9	0.4	7	7
Organics (BTEX)																		
Benzene	µg/L	<1.0	<1.0	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	<1.0	<1.0
Ethylbenzene	µg/L	<1.0	<1.0	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	<1.0	<1.0
Toluene	µg/L	<1.0	<1.0	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	<1.0	<1.0
Xylene (Total)	µg/L	<3.0	<3.0	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	<3.0	<3.0
Metals/Inorganics																		
Aluminum, Total	µg/L	<200	<200	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	60	<50
Lithium, Total	µg/L	<20	<20	NM	NM	NM	NM	<20	NM	NM	NM	NM	NM	NM	NM	NM	<10	<10
Antimony, Total	µg/L	<2.0	<2.0	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	<2.0	<2.0
Arsenic, Total	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Barium, Total	µg/L	<10	<10	<10	12	11	<10	<10	<10	<10	<10	12	12	<10	<10	<10	<10	<10
Iron, Total	µg/L	180	160	200	650	580	210	220	180 a	290	440	580	400	330	320	310	210	290
Beryllium, Total	µg/L	<1.0	<1.0	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	<1.0	<1.0
Boron, Total	µg/L	<50	<50	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	<50	<50
Cadmium, Total	µg/L	<0.2	<0.2	NM	NM	NM	NM	<0.2	NM	NM	NM	NM	NM	NM	NM	NM	<0.2	<0.2
Chromium, Total	µg/L	<1.0	<1.0	NM	NM	NM	NM	<1.0	NM	NM	NM	NM	NM	NM	NM	NM	<1.0	<1.0
Cobalt, Total	µg/L	<10	<10	NM	NM	NM	NM	<10	NM	NM	NM	NM	NM	NM	NM	NM	<10	<10
Copper, Total	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0	1.2	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Lead, Total	µg/L	<1.0	<1.0	NM	NM	NM	NM	<1.0	NM	NM	NM	NM	NM	NM	NM	NM	<1.0	<1.0
Manganese, Total	µg/L	<10	<10	<10	54	21	<10	<10	10 a	11	32	23	18	13	12	13	11	14
Molybdenum, Total	µg/L	<10	<10	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	<10	<10
Nickel, Total	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<10	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Selenium, Total	µg/L	<2.0	<2.0	NM	NM	NM	NM	<2.0	NM	NM	NM	NM	NM	NM	NM	NM	<2.0	<2.0
Silver, Total	µg/L	<0.2	<0.2	NM	NM	NM	NM	<0.2	NM	NM	NM	NM	NM	NM	NM	NM	<0.2	<0.2
Zinc, Total	µg/L	<10	<10	NM	NM	NM	NM	145 a	NM	NM	NM	NM	NM	NM	NM	NM	<10 a	<10
Mercury, Total	ng/L	1.530	0.887	3.130	2.580	1.360	1.230	<200	0.887	3.150	2.030 a	2.210	1.270	1.990	1.660	1.590	1.300	3.880

Table 7: STRM002

Table 7
Surface Water Quality Data
Salmon Trout River Monitoring Location STRM002
Eagle Project

Parameter	Units	Fall Rain Runoff	Winter Baseflow	Spring Snowmelt Runoff	Spring Rain Runoff	Summer Baseflow	Fall Rain Runoff	Winter Baseflow		Spring Snowmelt Runoff	Spring Rain Runoff	Summer Baseflow	Fall Rain Runoff			Winter Baseflow		Spring Snowmelt Runoff
		11/5/02	2/25/03	4/23/03	6/19/03	8/13/03	10/28/03	12/4/03	2/18/04	4/7/04	6/29/04	8/3/04	9/14/04	10/4/04	11/9/04	12/14/04	2/16/05	4/13/05
Major Anions																		
Alkalinity, Bicarbonate	mg/L	30	33	14	32	33	29	30	33	16	24 a	38	34	24	36	29	30 a	26
Alkalinity, Carbonate	mg/L	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	NM	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Chloride	mg/L	<1.0	<1.0	<1.0	1.5	1.3	1.0	1.1	<1.0	<1.0	<1.0	1.1	1.0	<1.0	<1.0	<1.0	1.4	<1.0
Fluoride	mg/L	<0.10	<0.10	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	<0.10	<0.10
Nitrogen, Ammonia	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.05	<0.02
Nitrogen, Nitrate	mg/L	0.06	0.14	<0.05	<0.05	<0.05	<0.05	0.09	0.12	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.06	0.08	<0.05
Nitrogen, Nitrite	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Nitrogen, Total Kjeldahl	mg/L	NM	NM	NM	NM	NM	NM	NM	NM	NM	<0.50	NM	NM	NM	NM	NM	NM	NM
Sulfate	mg/L	<5.0	<5.0	5.7	5.2	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<1.0	<1.0
Sulfide	mg/L	<1.0	<1.0	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	<1.0	<1.0
Major Cations																		
Calcium, Dissolved	mg/L	7.4	9.0	4.5	8.3	8.9	7.9	9.3	8.7	5.6	8.7 a	10	10	8.1	7.9	7.9	8.2	4.7
Potassium, Dissolved	mg/L	<0.50	0.65	0.68	<0.50	<0.50	0.69	0.67	0.64	0.65	<0.50	<0.50	<0.50	0.67	0.64	0.56	0.6	<0.50
Magnesium, Dissolved	mg/L	1.5	1.8	0.97	1.7	1.9	1.7	2.0	1.8	1.2	1.8	2.0	2.2	1.8	1.7	1.6	1.8	1.1
Sodium, Dissolved	mg/L	<0.50	1.2	0.63	0.83	0.74	1.1	3.2 a	0.92	0.56	0.62	<0.50	1.0	0.65	<0.50	0.84	0.97	0.51
General Chemistry																		
Hardness (calculated) as CaCO3	mg/L	25	30	15	28	30	27	31	29	19	29 a	33	34	28	27	26	28	16
Residue, Dissolved @ 180°C	mg/L	64	66	110	60	60	50	NM	60	64	78	67	58	58	<20	42	<20	38
Residue, Suspended	mg/L	<5	<3	<3	<6	<3	<5	NM	<3	4	<3	<3	<3	<3	<3	<3	<3	3
Alkalinity, Total	mg/L	30	33	14	32	33	29	NM	33	16	24 a	38	34	24	36	29	30	26
Chemical Oxygen Demand	mg/L	14	7.4	23	22	22	16	12	8.6	23	20	22	15	24	19	11	11	25
Carbon, Dissolved Organic	mg/L	7.6	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	4.7	9.5
Carbon, Total Organic	mg/L	6.1	3.0	9.5	8.8	8.3	5.9	4.4	3.2	7.8	6.9	7.7	5.6	7.7	6.6	5.0	4.2	8.5
BOD, (5-Day)	mg/L	1.2	<1.0	4.4	1.6	<1.0	1.2	NM	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	1.1	1.0
Coliform, Total	col/100 mL	140 a	70 a,b	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	110 a	900 a
E. Coli	neg/pos	neg	pos	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
Color (Apparent)	A.C.U.	70	25	75	125	100	60	NM	35	120	100	90	50	70	70	45	45	90
SGT-HEM; Nonpolar Material (Total Petroleum Hydrocarbons)	mg/L	<10	<10	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	<10	<10
Turbidity	NTU	<1.0	<1.0	<1.0	1.6	1.5	<1.0	NM	<1.0	1.1	1.6	2.1	2.0	2.5	1.3	1.3	1.6	1.7
Gross-Alpha	pCi/L	u	u	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	u	u
Gross-Beta	pCi/L	u	u	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	u	u

- a Estimated value. Duplicate precision for this parameter exceeded quality control limit.
b Estimated value. Sample received after EPA-established hold time expired.
NM Not measured.
u Result is less than the sample detection limit.

Table 7: STRM002

Table 7
Surface Water Quality Data
Salmon Trout River Monitoring Location STRE002
Eagle Project

Parameter	Units	Spring Snowmelt Runoff	Summer Baseflow	Fall Rain Runoff	Fall Rain Runoff	Winter Baseflow		Spring Snowmelt Runoff
		6/30/04	8/5/04	9/15/04	10/6/04	12/14/04	2/21/05	4/19/05
Field Parameters								
Temperature	°C	13	10	13	7.6	0.1	0.2	11
Specific Conductance	µmhos/ cm @ 25°C	90	101	132	136	126	133	104
pH	SU	8.9	8.3	8.0	7.9	7.7	8.0	8.1
D.O.	ppm	7	8	7	7	8	10	8
Organics (BTEX)								
Benzene	µg/L	NM	NM	NM	NM	NM	<1.0	<1.0
Ethylbenzene	µg/L	NM	NM	NM	NM	NM	<1.0	<1.0
Toluene	µg/L	NM	NM	NM	NM	NM	<1.0	<1.0
Xylene (Total)	µg/L	NM	NM	NM	NM	NM	<3.0	<3.0
Metals/Inorganics								
Aluminum, Total	µg/L	NM	NM	NM	NM	NM	97	52
Lithium, Total	µg/L	NM	NM	NM	NM	NM	<10	<10
Antimony, Total	µg/L	NM	NM	NM	NM	NM	<2.0	<2.0
Arsenic, Total	µg/L	1.3	1.4	2.1	1.1	1.1	1.5	<1.0
Barium, Total	µg/L	11	12	13	11	11	11	11
Iron, Total	µg/L	76	91	130	79	130	150	130
Beryllium, Total	µg/L	NM	NM	NM	NM	NM	<1.0	<1.0
Boron, Total	µg/L	NM	NM	NM	NM	NM	<50	<50
Cadmium, Total	µg/L	NM	NM	NM	NM	NM	<0.2	0.3
Chromium, Total	µg/L	NM	NM	NM	NM	NM	<1.0	<1.0
Cobalt, Total	µg/L	NM	NM	NM	NM	NM	<10	<10
Copper, Total	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Lead, Total	µg/L	NM	NM	NM	NM	NM	<1.0	<1.0
Manganese, Total	µg/L	<10	<10	12	<10	11	14	11
Molybdenum, Total	µg/L	NM	NM	NM	NM	NM	<10	<10
Nickel, Total	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Selenium, Total	µg/L	NM	NM	NM	NM	NM	<2.0	<2.0
Silver, Total	µg/L	NM	NM	NM	NM	NM	<0.2	<0.2
Zinc, Total	µg/L	NM	NM	NM	NM	NM	<10 a	15
Mercury, Total	ng/L	0.885 a	0.921	1.440	0.779	1.520	1.540	1.940

Table 7
Surface Water Quality Data
Salmon Trout River Monitoring Location STRE002
Eagle Project

Parameter	Units	Spring Snowmelt Runoff	Summer Baseflow	Fall Rain Runoff	Fall Rain Runoff	Winter Baseflow		Spring Snowmelt Runoff
		6/30/04	8/5/04	9/15/04	10/6/04	12/14/04	2/21/05	4/19/05
Major Anions								
Alkalinity, Bicarbonate	mg/L	67 a	75	63	58	61	62 a	51
Alkalinity, Carbonate	mg/L	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Chloride	mg/L	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Fluoride	mg/L	NM	NM	NM	NM	NM	<0.10	<0.10
Nitrogen, Ammonia	mg/L	<0.05	<0.05	0.09	<0.05	0.07	<0.02	<0.02
Nitrogen, Nitrate	mg/L	<0.05	<0.05	<0.05	<0.05	0.08	0.10	0.05
Nitrogen, Nitrite	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Nitrogen, Total Kjeldahl	mg/L	<0.50	NM	NM	NM	NM	NM	NM
Sulfate	mg/L	<5.0	<5.0	<5.0	<5.0	<5.0	4.0	<1.0
Sulfide	mg/L	NM	NM	NM	NM	NM	<1.0	<1.0
Major Cations								
Calcium, Dissolved	mg/L	21 a	21	21	20	18	19	16
Potassium, Dissolved	mg/L	<0.50	0.62	0.77	0.58	0.55	0.63	0.62
Magnesium, Dissolved	mg/L	4.1	4.3	4.6	4.1	3.7	3.9	3.1
Sodium, Dissolved	mg/L	1.2	1.0	1.3	1.4	1.1	1.3	0.96
General Chemistry								
Hardness (calculated) as CaCO3	mg/L	69 a	70	71	67	60	63	53
Residue, Dissolved @ 180°C	mg/L	80	90	72	84	<20	46	63
Residue, Suspended	mg/L	<3	<3	3	<3	4	5	<3 e
Alkalinity, Total	mg/L	67 a	75	63	58	61	62	51
Chemical Oxygen Demand	mg/L	7.4	<5.0	10	9.3	7.8	7.8	15
Carbon, Dissolved Organic	mg/L	NM	NM	NM	NM	NM	2.2	6.7
Carbon, Total Organic	mg/L	2.2	2.2	3.2	2.2	3.4	2.0	5.4
BOD, (5-Day)	mg/L	<1.0	1.1	<1.0	<1.0	<1.0	<1.0	1.4
Coliform, Total	col/100 mL	NM	NM	NM	NM	NM	80 a	300 a
E. Coli	neg/pos	NM	NM	NM	NM	NM	NM	NM
Color (Apparent)	A.C.U.	15	15	20	15	20	10	40
SGT-HEM; Nonpolar Material (Total Petroleum Hydrocarbons)	mg/L	NM	NM	NM	NM	NM	<10	<10
Turbidity	NTU	1.1	1.4	2.6	1.3	2.1	2.8	2.1
Gross-Alpha	pCi/L	NM	NM	NM	NM	NM	u	u
Gross-Beta	pCi/L	NM	NM	NM	NM	NM	u	u

a Estimated value. Duplicate precision for this parameter exceeded quality control limit.

e Estimated value. The laboratory statement of data qualifications indicates that a quality control limit for this parameter was exceeded.

NM Not measured.

u Result is less than the sample detection limit.

Table 8
Surface Water Quality
Yellow Dog River Monitoring Location YDRM002
Eagle Project

Parameter	Units	Fall Rain Runoff	Winter Baseflow	Spring Snowmelt Runoff	Spring Rain Runoff	Summer Baseflow	Fall Rain Runoff	Winter Baseflow		Spring Snowmelt Runoff	Spring Rain Runoff	Summer Baseflow	Fall Rain Runoff			Winter Baseflow		Spring Snowmelt Runoff
		11/5/02	2/26/03	4/23/03	6/19/03	8/13/03	10/28/03	12/4/03	2/18/04	4/6/04	6/30/04	8/3/04	9/14/04	10/4/04	11/9/04	12/14/04	2/16/05	4/12/05
Field Parameters																		
Temperature	°C	1.7	0.0	5.4	17	16	3.8	0.2	0.3	3.1	18	17	17	7.7	1.7	0	0.3	4.7
Specific Conductance	µmhos/ cm @ 25°C	47	74	21	64	75	69	56	74	28	59	65	90	75	54	57	59	18
pH	SU	6.7	7.3	6.5	7.2	7.1	7.4	7.5	8.5	6.4	7.9	7.2	7.4	7.3	7.0	7.0	6.9	NM
D.O.	ppm	8	7	7	7	5.5	7	NM	8	9	7	7	7	7	9	9	NM	8
Organics (BTEX)																		
Benzene	µg/L	<1.0	<1.0	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	<1.0	<1.0
Ethylbenzene	µg/L	<1.0	<1.0	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	<1.0	<1.0
Toluene	µg/L	<1.0	<1.0	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	<1.0	<1.0
Xylene (Total)	µg/L	<3.0	<3.0	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	<3.0	<3.0
Metals/Inorganics																		
Aluminum, Total	µg/L	<200	<200	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	68	150
Lithium, Total	µg/L	<20	<20	NM	NM	NM	NM	<20	NM	NM	NM	NM	NM	NM	NM	NM	<10	<10
Antimony, Total	µg/L	<2.0	<2.0	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	<2.0	<2.0
Arsenic, Total	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	1.3	1.1	<1.0	<1.0	<1.0	<1.0	<1.0
Barium, Total	µg/L	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Iron, Total	µg/L	620	550	230	1,030	830	840	510	650 a	440	840	1,060	1,200	880	750 e	610	590	290
Beryllium, Total	µg/L	<1.0	<1.0	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	<1.0	<1.0
Boron, Total	µg/L	<50	<50	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	<50	<50
Cadmium, Total	µg/L	<0.2	<0.2	NM	NM	NM	NM	<0.2	NM	NM	NM	NM	NM	NM	NM	NM	<0.2	<0.2
Chromium, Total	µg/L	<1.0	<1.0	NM	NM	NM	NM	<1.0	NM	NM	NM	NM	NM	NM	NM	NM	<1.0	<1.0
Cobalt, Total	µg/L	<10	<10	NM	NM	NM	NM	<10	NM	NM	NM	NM	NM	NM	NM	NM	<10	<10
Copper, Total	µg/L	1.1	<1.0	1.2	<1.0	<1.0	1.2	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Lead, Total	µg/L	<1.0	<1.0	NM	NM	NM	NM	<1.0	NM	NM	NM	NM	NM	NM	NM	NM	<1.0	<1.0
Manganese, Total	µg/L	37	22	<10	40	19	32	28	33 a	19	29	31	21	23	34	34	31	<10
Molybdenum, Total	µg/L	<10	<10	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	<10	<10
Nickel, Total	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<10	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	3.2	<1.0
Selenium, Total	µg/L	<2.0	<2.0	NM	NM	NM	NM	<2.0	NM	NM	NM	NM	NM	NM	NM	NM	<2.0	<2.0
Silver, Total	µg/L	<0.2	<0.2	NM	NM	NM	NM	<0.2	NM	NM	NM	NM	NM	NM	NM	NM	<0.2	<0.2
Zinc, Total	µg/L	<10	<10	NM	NM	NM	NM	24 a	NM	NM	NM	NM	NM	NM	NM	NM	71 a	<10
Mercury, Total	ng/L	3.650	1.690	5.530	4.290	2.010	2.530	<200	1.820	6.280	3.290 a	2.850	1.860	4.460	3.050	2.610	2.320	6.780

Table 8
Surface Water Quality
Yellow Dog River Monitoring Location YDRM002
Eagle Project

Parameter	Units	Fall Rain Runoff	Winter Baseflow	Spring Snowmelt Runoff	Spring Rain Runoff	Summer Baseflow	Fall Rain Runoff	Winter Baseflow		Spring Snowmelt Runoff	Spring Rain Runoff	Summer Baseflow	Fall Rain Runoff			Winter Baseflow		Spring Snowmelt Runoff
		11/5/02	2/26/03	4/23/03	6/19/03	8/13/03	10/28/03	12/4/03	2/18/04	4/6/04	6/30/04	8/3/04	9/14/04	10/4/04	11/9/04	12/14/04	2/16/05	4/12/05
Major Anions																		
Alkalinity, Bicarbonate	mg/L	20	30	5.3	30	34	32	23	40	9.9	24 a	24	38	30	18	24	21 a	5.0
Alkalinity, Carbonate	mg/L	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	NM	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Chloride	mg/L	<1.0	133 a	<1.0	1.2	1.2	1.4	<1.0	1.5	1.2	1.4	1.1	1.3	<1.0	<1.0	<1.0	1.5	1.3
Fluoride	mg/L	<0.10	<0.10	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	<0.10	<0.10
Nitrogen, Ammonia	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.09	<0.05	<0.05	0.11	<0.02
Nitrogen, Nitrate	mg/L	0.05	0.11	0.10	<0.05	<0.05	<0.05	0.10	0.11	0.14	<0.05	<0.05	<0.05	<0.05	<0.05	0.09	0.10	0.08
Nitrogen, Nitrite	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Nitrogen, Total Kjeldahl	mg/L	NM	NM	NM	NM	NM	NM	NM	NM	NM	<0.50	NM	NM	NM	NM	NM	NM	NM
Sulfate	mg/L	15	5.1	6.0	8.3	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<1.0	<1.0
Sulfide	mg/L	<1.0	<1.0	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	<1.0	<1.0
Major Cations																		
Calcium, Dissolved	mg/L	6.6	9.6	2.8	8.8	9.9	9.5	7.2	9.7	3.9	8.8 a	10	13	10	7.5	7.6	7.9	2.7
Potassium, Dissolved	mg/L	<0.50	<0.50	<0.50	<0.50	<0.50	0.56	<0.50	<0.50	0.51	<0.50	<0.50	0.52	0.62	<0.50	<0.50	<0.50	<0.50
Magnesium, Dissolved	mg/L	1.4	2.0	0.64	1.9	2.2	2.1	1.6	2.1	0.89	1.8	2.0	2.9	2.3	1.6	1.6	1.9	0.64
Sodium, Dissolved	mg/L	<0.50	<0.50	<0.50	0.96	0.84	1.0	1.7 a	0.96	0.53	0.93	<0.50	0.91	0.90	0.86	0.78	0.83	<0.50
General Chemistry																		
Hardness, (calculated) as CaCO3	mg/L	21	32	10	28	34	33	24	31	13	29 a	33	44	34	25	26	28	9
Residue, Dissolved @ 180°C	mg/L	68	94	60	66	56	70	NM	84	31	60	75	75	70	25	64	<20	20
Residue, Suspended	mg/L	<5	<3	<3	<3	<3	<5	NM	<3	4	4	<3	<3	<3	<3	<3	<3	<3
Alkalinity, Total	mg/L	20	30	5.3	30	34	32	7.2	40	9.9	24 a	24	38	30	18	24	21	5.0
Chemical Oxygen Demand	mg/L	28	14	28	27	18	27	24	16	37	24	23	16	26	33	20	20	32
Carbon, Dissolved Organic	mg/L	13	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	8.5	12
Carbon, Total Organic	mg/L	12	6.1	11	9.3	7.1	11	NM	6.3	13	8.3	8.5	6.2	8.3	12	8.1	7.8	12
BOD, (5-Day)	mg/L	1.3	1.8	2.1	1.2	<1.0	1.0	NM	<1.0	1.8 s	<1.0	<1.0	<1.0	1.3	<1.0	<1.0	1.6	1.9
Coliform, Total	col/100 mL	240 a	170 a	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	30 a	280 a
E. Coli	neg/pos	pos	neg	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
Color (Apparent)	A.C.U.	125	40	75	112	75	100	NM	60	100	100	80	75	70	100	70	80	100
SGT-HEM; Nonpolar Material (Total Petroleum Hydrocarbons)	mg/L	<10	<10	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	<10	<10
Turbidity	NTU	3.8	1.8	1.3	4.8	2.6	1.6	NM	1.9	1.5	2.3	3.3	3.5	6.0	1.6	1.8	1.8	1.4
Gross-Alpha	pCi/L	u	u	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	u	u
Gross-Beta	pCi/L	u	u	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	u	u

a Estimated value. Duplicate precision for this parameter exceeded quality control limit.
e Estimated value. The laboratory statement of data qualifications indicates that a quality control limit for this parameter was exceeded.
NM Not measured.
s Potential false positive value. Compound present in field blank.
u Result is less than the sample detection limit.

Table 8: YDRM002

Table 9
Surface Water Quality Data
Cedar Creek Reference Stream Monitoring Location CDRM004
Eagle Project

Parameter	Units	Summer Baseflow	Fall Rain Runoff	Winter Baseflow	Spring Snowmelt Runoff	Spring Rain Runoff	Summer Baseflow	Fall Rain Runoff			Winter Baseflow		Spring Snowmelt Runoff
		8/14/03	10/29/03	2/24/04	4/8/04	6/29/04	8/3/04	9/14/04	10/4/04	11/9/04	12/14/04	2/15/05	4/19/05
Field Parameters													
Temperature	°C	14	5.5	2.1	3.4	16	14	14	6.9	2.6	0.9	1.5	10
Specific Conductance	µmhos/cm @ 25°C	150	120	116	84	122	116	149	141	134	129	132	112
pH	SU	7.3	7.0	8.2	7.3	8.1	8.0	8.0	7.8	7.8	7.7	7.8	8.0
D.O.	ppm	7	7	11	8	7	9	7	7	9	8	8	7
Organics (BTEX)													
Benzene	µg/L	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	<1.0	<1.0
Ethylbenzene	µg/L	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	<1.0	<1.0
Toluene	µg/L	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	<1.0	<1.0
Xylene (Total)	µg/L	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	<3.0	<3.0
Metals/Inorganics													
Aluminum, Total	µg/L	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	57	<50
Lithium, Total	µg/L	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	<10	<10
Antimony, Total	µg/L	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	<2.0	<2.0
Arsenic, Total	µg/L	1.9	1.3	1.3	<1.0	1.6	2.3	2.3	1.8	1.3	1.4	<1.0	1.4
Barium, Total	µg/L	14	11	11	<10	12	14	15	13	11	11	11	12
Iron, Total	µg/L	190	130	87 a	150	110	160	140	120	100	98	88 e	120
Beryllium, Total	µg/L	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	<1.0	<1.0
Boron, Total	µg/L	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	<50	<50
Cadmium, Total	µg/L	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	<0.2	<0.2
Chromium, Total	µg/L	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	<1.0	<1.0
Cobalt, Total	µg/L	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	<10	<10
Copper, Total	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Lead, Total	µg/L	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	<1.0	<1.0
Manganese, Total	µg/L	14	119	12 a	<10	13	16	11	15	13	<10	<10	13
Molybdenum, Total	µg/L	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	<10	<10
Nickel, Total	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Selenium, Total	µg/L	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	<2.0	<2.0
Silver, Total	µg/L	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	<0.2	<0.2
Zinc, Total	µg/L	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	<10 a	<10
Mercury, Total	ng/L	0.403	0.803	0.659	3.670	1.040 a	0.981	0.890	0.856	0.691	0.941	0.776	1.290

Table 9
Surface Water Quality Data
Cedar Creek Reference Stream Monitoring Location CDRM004
Eagle Project

Parameter	Units	Summer Baseflow	Fall Rain Runoff	Winter Baseflow	Spring Snowmelt Runoff	Spring Rain Runoff	Summer Baseflow	Fall Rain Runoff			Winter Baseflow		Spring Snowmelt Runoff
		8/14/03	10/29/03	2/24/04	4/8/04	6/29/04	8/3/04	9/14/04	10/4/04	11/9/04	12/14/04	2/15/05	4/19/05
Major Anions													
Alkalinity, Bicarbonate	mg/L	68	60	69	40	77 a	72	69	65	68	63	62 a	54
Alkalinity, Carbonate	mg/L	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Chloride	mg/L	<1.0	1.0	<1.0	<1.0	1.1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Fluoride	mg/L	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	<0.10	<0.10
Nitrogen, Ammonia	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.02	<0.02
Nitrogen, Nitrate	mg/L	<0.05	<0.05	0.10	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.08	0.10	0.06
Nitrogen, Nitrite	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Nitrogen, Total Kjeldahl	mg/L	NM	NM	NM	NM	<0.50	NM	NM	NM	NM	NM	NM	NM
Sulfate	mg/L	<5.0	<5.0	5.1	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<1.0	<1.0
Sulfide	mg/L	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	<1.0	<1.0
Major Cations													
Calcium, Dissolved	mg/L	22	19	19	13	22 a	25	24	22	21	19	20	18
Potassium, Dissolved	mg/L	<0.50	0.55	0.52	0.57	<0.50	<0.50	0.59	0.53	<0.50	<0.50	0.62	0.59
Magnesium, Dissolved	mg/L	3.7	3.3	3.3	2.3	3.6	4.0	4.0	3.7	3.6	3.2	3.4	2.7
Sodium, Dissolved	mg/L	1.0	1.3	1.2	0.78	0.73	1.3	1.2	1.1	1.0	1.2	1.2	0.98
General Chemistry													
Hardness, (calculated) as CaCO3	mg/L	70	61	61	42	70 a	79	76	70	67	61	64	56
Residue, Dissolved @ 180°C	mg/L	84	88	42	31	112	99	96	99	90	62	67	70
Residue, Suspended	mg/L	<3	<5	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3
Alkalinity, Total	mg/L	68	60	69	40	77 a	72	69	65	68	63	62	54
Chemical Oxygen Demand	mg/L	7.5	<5.0	5.8	21	10	8.7	19	13	9.5	10	5.7	13
Carbon, Dissolved Organic	mg/L	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	2.7	21
Carbon, Total Organic	mg/L	3.2	4.2	2.4	7.0	2.8	3.2	2.8	3.3	3.2	3.4	2.5	4.8
BOD, (5-Day)	mg/L	1.1 b	1.5	2.2	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	1.0	1.2
Coliform, Total	col/100mL	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	240 a,b	280 a
E. Coli	neg/pos	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
Color (Apparent)	A.C.U.	30 b	25	15	45	20	20	20	15	20	20	20	35
SGT-HEM; Nonpolar Material (Total Petroleum Hydrocarbons)	mg/L	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	<10	<10
Turbidity	NTU	<1.0 b	1.4	1.3	2.2	1.0	1.1	1.1	1.5	<1.0	<1.0	<1.0	1.3
Gross-Alpha	pCi/L	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	u	u
Gross-Beta	pCi/L	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	u	u

- a Estimated value. Duplicate precision for this parameter exceeded quality control limit.
- b Estimated value. Sample received after EPA-established hold time expired.
- e Estimated value. The laboratory statement of data qualifications indicates that a quality control limit for this parameter was exceeded.
- NM Not measured.
- u Result is less than the sample detection limit.

Table 10
Surface Erosion Monitoring Sediment Trap Summary
Eagle Project

Sediment Trap Number	Road	Relative Traffic Rating	Road Gradient	Parent Material (Quaternary Geology)	Sediment Volume Accumulated (ft ³)	Sediment Volume (tons/mi of road)
SED01	Secondary	Low	Low	Coarse Glacial Till	1.5	0.9
SED02	Secondary	Low	Moderate	Post Glacial Alluvium	NF	NF
SED03	Triple A Road	High	Moderate	Post Glacial Alluvium	152	256
SED04	Secondary	Low	Steep	Thin Till Over Bedrock	27	29
SED05	Northwestern Road	Medium	Moderate	Post Glacial Alluvium	27	35
SED06	Secondary	Low	Steep	Thin Till Over Bedrock	8.2	10
SED07	Northwestern Road	Medium	Steep	Coarse Glacial Till	30	13
SED08	Triple A Road	High	Steep	Coarse Glacial Till	204	515
SED09	Triple A Road	High	Moderate	Glacial Outwash	NF	NF
SED10	Secondary	Low	Steep	Coarse Glacial Till	67	55

Salmon Trout River Subwatershed	Total Road Length (mi)	Fraction of Active Roads Delivering Sediment to Streams	Delivery Length of Active Roads (mi)	Estimated Annual Sediment Delivery (tons)	Estimated Annual Sediment Delivery (tons/mi ² of watershed)
East Branch	57	0.8	46	588	50
Main Branch	51	0.5	26	379	39
West Branch	17	0.8	13	101	33
Upper Salmon Trout Watershed	125	0.7	92	1067	43

Notes:

All accumulated volume measurements are minimums as none of the sediment traps were functioning for 100% of the monitoring period. SE-2 and SE-9 did not function (NF) during significant portions of the monitoring period and therefore were eliminated from analysis.

Assumed 1.5 tons/yd³ to convert yd³ to tons.

Assumed a mean road density of 7 mi/mi².

Assumed that 30% of roads are abandoned and vegetated.

If delivery occurs at any time during the year (e.g., during spring rain and snowmelt runoff conditions), 100% delivery is assumed.

Data are for July 2004 to July 2005.

Table 10: Sediment Trap Summary

Table 11
Groundwater Quality Data
Quaternary Deposit Monitoring Location QAL004
Eagle Project

Parameter	Units	QAL004A								QAL004D							
		Spring Snowmelt Runoff	Summer Baseflow	Fall Rain Runoff		Winter Baseflow		Spring Snowmelt Runoff	Summer Baseflow	Spring Snowmelt Runoff	Summer Baseflow	Fall Rain Runoff		Winter Baseflow		Spring Snowmelt Runoff	Summer Baseflow
		4/14/04	8/17/04	9/21/04	10/19/04	12/15/04	2/24/05	4/27/05	8/17/05	4/14/04	8/17/04	9/21/04	10/19/04	12/15/04	2/25/05	4/27/05	8/17/05
Field Parameters																	
Temperature	°C	7.1	7.2	7.2	7.0	7.0	7.2	7.1	7.3	7.5	7.6	7.7	7.4	7.4	7.3	7.5	7.5
Specific Conductance	µmhos/ cm @ 25°C	90	94	92	90	91	84	85	78	155	156	155	156	154	151	151	157
pH	SU	8.9	9.1	9.1	9.0	9.1	9.1	9.6	8.5	8.6	7.9	8.4	8.2	8.5	8.5	8.9	8.4
D.O.	ppm	5	7	5	6	6	5	5	4	<0.001	<0.001	<0.001	<0.001	0.002	<0.001	<0.001	<0.05
Ferrous Iron	mg/L	0.15	<0.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.15	0.15	0.2	0.1	0.1	0.2	0.2	0.2
Metals/Inorganics																	
Aluminum, Dissolved	µg/L	<100	<100	<100	<100	<100	<50	<50	<50	<100	<100	<100	<100	<100	<50	<50	<50
Antimony, Dissolved	µg/L	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Arsenic, Dissolved	µg/L	4.8	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	8.4	8.5	8.7	8.7	7.6	9.8	9.4	8.6
Barium, Dissolved	µg/L	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20
Beryllium, Dissolved	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Boron, Dissolved	µg/L	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100
Cadmium, Dissolved	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.50	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.50
Chromium, Dissolved	µg/L	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Cobalt, Dissolved	µg/L	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Copper, Dissolved	µg/L	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Iron, Dissolved	µg/L	<20	<20	<20	<20	<20	<20	<20	<20	100	100	110	110	110	110	99	100
Lead, Dissolved	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Lithium, Dissolved	µg/L	<10	<10	<10	<10	<10	<10	<10	<8.0	<10	<10	<10	<10	<10	<10	<10	<8.0
Manganese, Dissolved	µg/L	<20	<20	<20	<20	<20	<20	<20	<20	52	53	55	56	54	54	58	54
Mercury, Dissolved	ng/L	0.267	0.100 U	0.209 B,s	0.344 a,s	0.194 B,s	0.191 B,s	0.100 U	0.100 U	0.322	0.100 U	0.293 s	0.179 a,B,s	0.190 B,s	0.181 B,s	0.100 U	0.170 B,s
Molybdenum, Dissolved	µg/L	40	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Nickel, Dissolved	µg/L	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25
Selenium, Dissolved	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Silver, Dissolved	µg/L	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<.20	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.20
Strontium, Dissolved	µg/L	NM	NM	NM	NM	NM	NM	NM	<50	NM	NM	NM	NM	NM	NM	NM	56
Zinc, Dissolved	µg/L	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10

Table 11: QAL004

Table 11
Groundwater Quality Data
Quaternary Deposit Monitoring Location QAL004
Eagle Project

Parameter	Units	QAL004A								QAL004D							
		Spring Snowmelt Runoff	Summer Baseflow	Fall Rain Runoff		Winter Baseflow		Spring Snowmelt Runoff	Summer Baseflow	Spring Snowmelt Runoff	Summer Baseflow	Fall Rain Runoff		Winter Baseflow		Spring Snowmelt Runoff	Summer Baseflow
		4/14/04	8/17/04	9/21/04	10/19/04	12/15/04	2/24/05	4/27/05	8/17/05	4/14/04	8/17/04	9/21/04	10/19/04	12/15/04	2/25/05	4/27/05	8/17/05
Major Anions																	
Alkalinity, Bicarbonate	mg/L	50	44	53	45 a	46	42	44	42	89	97	79	84 a	80	87	81	78
Alkalinity, Carbonate	mg/L	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Alkalinity, Total	mg/L	NM	NM	NM	NM	NM	NM	NM	42	NM	NM	NM	NM	NM	NM	NM	78
Chloride	mg/L	<1.0	<1.0	<1.0	<1.0	<1.0	1.1	<1.0	0.56	<1.0	<1.0	1.1	<1.0	<1.0	<1.0	<1.0	1.9
Fluoride	mg/L	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.20	<0.10
Nitrogen, Ammonia	mg/L	NM	NM	NM	NM	NM	NM	NM	<0.020	NM	NM	NM	NM	NM	NM	NM	0.095
Nitrogen, Nitrate	mg/L	0.08	0.21	0.16	0.13	0.12	0.18	0.19	0.20	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.050
Phosphorus, Total	mg/L	NM	NM	NM	NM	NM	NM	NM	0.0112	NM	NM	NM	NM	NM	NM	NM	0.0423
Sulfate	mg/L	<5.0	<5.0	9.3	<5.0	<5.0	<5.0	<5.0	3.5	<5.0	<0.05	<5.0	<5.0	<5.0	<5.0	<5.0	<2.0
Sulfide	mg/L	NM	NM	NM	NM	NM	NM	NM	<1.0	NM	NM	NM	NM	NM	NM	NM	<1.0
Major Cations																	
Calcium, Dissolved	mg/L	12	14	14	14	14	13	13	12	25	23	24	26	25	25	25	23
Magnesium, Dissolved	mg/L	2.1	2.3	2.4	2.5	2.3	2.1	2.3	2.2	3.2	3.0	3.1	3.3	3.1	3.2	3.3	3.1
Potassium, Dissolved	mg/L	0.73	<0.50	0.62	0.55	0.57	0.52	0.54	0.60	1.3	0.81	1.0	0.79	0.95	0.88	0.93	0.91
Sodium, Dissolved	mg/L	1.8	0.66	0.97	0.63	0.86	0.80	0.87	0.79	2.8	2.0	2.1	1.9	2.1	2.2	2.2	1.9
General Chemistry																	
Hardness, (calculated) as CaCO3	mg/L	39	44	45	45	44	41	42	39	76	70	73	79	75	76	76	70
Residue, Dissolved @ 180°C	mg/L	62	72	72	60	<50 a	<50	60	50	84	104	118	138	<50 a	81	104	104
Tritium	TU	NM	NM	NM	9.08	NM	NM	NM	NM	NM	NM	NM	<0.8	NM	NM	NM	NM

- aEstimated value. Duplicate precision for this parameter exceeded quality control limit.
- BEstimated value because sample result is above the method detection limit of 0.10 ng/L but below the reporting limit of 0.25 ng/L.
- NMNot measured.
- sPotential false positive value. Compound present in blank sample.
- UResult was below the reporting limit and reported at the method detection limit.

Table 11: QAL004

Table 11
Groundwater Quality Data
Quaternary Deposit Monitoring Location QAL005
Eagle Project

Parameter	Units	QAL005A								QAL005D							
		Spring Snowmelt Runoff	Summer Baseflow	Fall Rain Runoff		Winter Baseflow		Spring Snowmelt Runoff	Summer Baseflow	Spring Snowmelt Runoff	Summer Baseflow	Fall Rain Runoff		Winter Baseflow		Spring Snowmelt Runoff	Summer Baseflow
		4/15/04	8/17/04	10/6/04	10/20/04	12/15/04	2/24/05	4/26/05	8/17/05	4/15/04	8/17/04	9/16/04	10/20/04	12/15/04	2/23/05	4/26/05	8/17/05
Field Parameters																	
Temperature	°C	6.6	7.1	7.7	7.7	7.9	7.2	6.6	7.4	7.6	7.8	7.9	7.7	7.6	7.5	7.6	7.9
Specific Conductance	µmhos/ cm @ 25°C	22	18	18	18	17	17	16	17	169	163	163	168	166	165	85	101
pH	SU	7.1	5.6	5.4	5.5	5.5	5.5	5.6	5.5	8.0	7.8	8.2	8.0	8.0	8.0	8.3	7.7
D.O.	ppm	2	2	2	1.5	1.5	2	1.5	3	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.6	0.7
Ferrous Iron	mg/L	0.3	0.3	0.3	0.3	0.4	0.2	0.2	0.3	0.4	0.7	0.8	1.0	0.7	1.0	0.6	1.0
Metals/Inorganics																	
Aluminum, Dissolved	µg/L	<100	<100	<100	<100	<100	<50	<50	<50	<100	<100	<100	<100	<100	<50	<50	<50
Antimony, Dissolved	µg/L	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Arsenic, Dissolved	µg/L	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	3.1	3.7	3.4	3.6	3.8	3.7	3.3
Barium, Dissolved	µg/L	27	<20	<20	21	20	23	<20	<20	<20	28	30	33	31	32	30	28
Beryllium, Dissolved	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Boron, Dissolved	µg/L	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100
Cadmium, Dissolved	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.50	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.50
Chromium, Dissolved	µg/L	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Cobalt, Dissolved	µg/L	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Copper, Dissolved	µg/L	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Iron, Dissolved	µg/L	240	350	380	350	420	240	120	200	540	710	790	720	740	740	670	670
Lead, Dissolved	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Lithium, Dissolved	µg/L	<10	<10	<10	<10	<10	<10	<10	<8.0	<10	<10	<10	<10	<10	<10	<10	<8.0
Manganese, Dissolved	µg/L	140	24	<20	<20	<20	<20	<20	<20	180	200	210	190	200	210	200	190
Mercury, Dissolved	ng/L	0.274	0.100 U	0.277 s	0.103 a,B,s	0.253 s	0.182 B,s	0.187 B,s	0.190 B,s	0.340	0.100 U	0.252 s	0.126 a,B,s	0.114 B,s	0.208 B,s	0.100 U	0.100 U
Molybdenum, Dissolved	µg/L	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Nickel, Dissolved	µg/L	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25
Selenium, Dissolved	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Silver, Dissolved	µg/L	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.20	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.20
Strontium, Dissolved	µg/L	NM	NM	NM	NM	NM	NM	NM	<50	NM	NM	NM	NM	NM	NM	NM	<50
Zinc, Dissolved	µg/L	<10	13	<10	<10	<10	<10	<10	<10	<10	18	<10	<10	<10	<10	<10	<10

Table 11: QAL005

Table 11
Groundwater Quality Data
Quaternary Deposit Monitoring Location QAL005
Eagle Project

Parameter	Units	QAL005A								QAL005D							
		Spring Snowmelt Runoff	Summer Baseflow	Fall Rain Runoff		Winter Baseflow		Spring Snowmelt Runoff	Summer Baseflow	Spring Snowmelt Runoff	Summer Baseflow	Fall Rain Runoff		Winter Baseflow		Spring Snowmelt Runoff	Summer Baseflow
		4/15/04	8/17/04	10/6/04	10/20/04	12/15/04	2/24/05	4/26/05	8/17/05	4/15/04	8/17/04	9/16/04	10/20/04	12/15/04	2/23/05	4/26/05	8/17/05
Major Anions																	
Alkalinity, Bicarbonate	mg/L	6.5	4.7	6.1	6.9 a	<2.0	4.5	2.8	2.4	96	96	86	93 a	89	110	86	85
Alkalinity, Carbonate	mg/L	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Alkalinity, Total	mg/L	NM	NM	NM	NM	NM	NM	NM	2.4	NM	NM	NM	NM	NM	NM	NM	85
Chloride	mg/L	1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	1.1	1.4	<1.0	<1.0	<1.0	1.3	<1.0	<1.0
Fluoride	mg/L	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.16	<0.10
Nitrogen, Ammonia	mg/L	NM	NM	NM	NM	NM	NM	NM	<0.020	NM	NM	NM	NM	NM	NM	NM	0.068
Nitrogen, Nitrate	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05 b	<0.050	<0.05	<0.05	0.16	<0.05	<0.05	<0.05	<0.05 b	<0.050
Phosphorus, Total	mg/L	NM	NM	NM	NM	NM	NM	NM	<0.0100	NM	NM	NM	NM	NM	NM	NM	0.0354
Sulfate	mg/L	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	2.3	<5.0	<5.0	6.1	<5.0	<5.0	<5.0	<5.0	<5.0
Sulfide	mg/L	NM	NM	NM	NM	NM	NM	NM	<1.0	NM	NM	NM	NM	NM	NM	NM	<1.0
Major Cations																	
Calcium, Dissolved	mg/L	1.7	1.2	1.1	1.2	1.2	1.3	1.3	1.0	28	27	29	27	28	28	28	26
Magnesium, Dissolved	mg/L	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	3.3	2.9	3.2	2.8	2.9	2.9	2.9	2.8
Potassium, Dissolved	mg/L	0.73	0.69	0.71	0.66	0.81	0.68	0.60	0.62	1.0	0.53	0.65	0.66	0.61	0.57	0.58	0.67
Sodium, Dissolved	mg/L	0.89	<0.50	0.89	0.78	0.66	0.58	0.69	0.63	1.5	1.4	1.3	1.2	1.4	1.5	1.4	1.3
General Chemistry																	
Hardness, (calculated) as CaCO3	mg/L	5	4	4	4	4	4	4	4	84	79	86	79	82	82	82	76
Residue, Dissolved @ 180°C	mg/L	<50	<50	<50	<50	52 a	<50	<50	<20	104	114	122	124	96 a	92	94	110
Tritium	TU	NM	NM	NM	8.98	NM	NM	NM	NM	NM	NM	NM	7.07	NM	NM	NM	NM

- a Estimated value. Duplicate precision for this parameter exceeded quality control limit.
- b Estimated value. Sample received after EPA-established hold time expired.
- B Estimated value because sample result is above the method detection limit of 0.10 ng/L but below the reporting limit of 0.25 ng/L.
- NM Not measured.
- s Potential false positive value. Compound present in blank sample.
- U Result was below the reporting limit and reported at the method detection limit.

Table 11: QAL005

Table 11
Groundwater Quality Data
Quaternary Deposit Monitoring Location QAL008
Eagle Project

Parameter	Units	QAL008A					QAL008D				
		Fall Rain Runoff	Winter Baseflow		Spring Snowmelt Runoff	Summer Baseflow	Fall Rain Runoff	Winter Baseflow		Spring Snowmelt Runoff	Summer Baseflow
		11/3/04	12/28/04	2/25/05	4/27/05	8/24/05	11/3/04	12/28/04	2/25/05	4/27/05	8/24/05
Field Parameters											
Temperature	°C	7.4	5.8	6.4	7.3	7.8	6.8	7.3	6.2	6.7	8.5
Specific Conductance	µmhos/ cm @ 25°C	70	64	65	60	62	121	121	107	88	100
pH	SU	9.2	9.1	9.2	9.4	9.1	8.4	8.0	8.3	8.6	8.6
D.O.	ppm	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
Ferrous Iron	mg/L	NM	NM	NM	NM	<0.1	NM	NM	NM	NM	<0.01
Metals/Inorganics											
Aluminum, Dissolved	µg/L	<100	<100	<50	<50	<50	<100	<100	<50	<50	<50
Antimony, Dissolved	µg/L	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Arsenic, Dissolved	µg/L	<2.0	<2.0	<2.0	<2.0	<2.0	3.2	<2.0	3.9	3.0	3.7
Barium, Dissolved	µg/L	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20
Beryllium, Dissolved	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Boron, Dissolved	µg/L	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100
Cadmium, Dissolved	µg/L	<0.5	<0.5	<0.5	<0.5	<0.50	<0.5	<0.5	<0.5	<0.5	<0.50
Chromium, Dissolved	µg/L	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Cobalt, Dissolved	µg/L	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Copper, Dissolved	µg/L	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Iron, Dissolved	µg/L	29	<20	<20	<20	<20	<20	55	<20	56	<20
Lead, Dissolved	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Lithium, Dissolved	µg/L	<10	<10	<10	<10	<8.0	<10	<10	<10	<10	<8.0
Manganese, Dissolved	µg/L	<20	<20	<20	<20	<20	39	58	<20	<20	<20
Mercury, Dissolved	ng/L	0.808 a,s	0.346 s	0.394	0.451 s	0.110 B,s	1.340 a	0.643	0.704	0.620 s	0.240
Molybdenum, Dissolved	µg/L	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Nickel, Dissolved	µg/L	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25
Selenium, Dissolved	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Silver, Dissolved	µg/L	<0.2	<0.2	<0.2	<0.2	<0.20	<0.2	<0.2	<0.2	<0.2	<0.20
Strontium, Dissolved	µg/L	NM	NM	NM	NM	<50	NM	NM	NM	NM	<50
Zinc, Dissolved	µg/L	<10	<10	<10	52	<10	<10	<10	<10	12	<10

Table 11: QAL008

Table 11
Groundwater Quality Data
Quaternary Deposit Monitoring Location QAL008
Eagle Project

Parameter	Units	QAL008A					QAL008D				
		Fall Rain Runoff	Winter Baseflow		Spring Snowmelt Runoff	Summer Baseflow	Fall Rain Runoff	Winter Baseflow		Spring Snowmelt Runoff	Summer Baseflow
		11/3/04	12/28/04	2/25/05	4/27/05	8/24/05	11/3/04	12/28/04	2/25/05	4/27/05	8/24/05
Major Anions											
Alkalinity, Bicarbonate	mg/L	66 a	28	30	31	21	66 a	53	47	50	52
Alkalinity, Carbonate	mg/L	<2.0	<2.0	<2.0	<2.0	6.1	<2.0	<2.0	<2.0	<2.0	<2.0
Alkalinity, Total	mg/L	NM	NM	NM	NM	27	NM	NM	NM	NM	52
Chloride	mg/L	3.8	<1.0	1.0	<1.0	3.8	6.3	1.5	1.7	2.5	61
Fluoride	mg/L	<0.10	<0.10	<0.10	0.11	<0.10	<0.10	<0.10	<0.10	0.15	<0.10
Nitrogen, Ammonia	mg/L	NM	NM	NM	NM	<0.020	NM	NM	NM	NM	<0.020
Nitrogen, Nitrate	mg/L	0.12	0.12	0.11	0.10	0.079	<0.05	<0.05	0.05	0.06	0.053
Phosphorus, Total	mg/L	NM	NM	NM	NM	<0.0100	NM	NM	NM	NM	<0.0100
Sulfate	mg/L	5.3	<5.0	<5.0	<5.0	12	11	8.7	7.4	7.9	6.0
Sulfide	mg/L	NM	NM	NM	NM	<1.0	NM	NM	NM	NM	<1.0
Major Cations											
Calcium, Dissolved	mg/L	8.7	8.8	9.6	9.8	8.2	15	16	14	14	13
Magnesium, Dissolved	mg/L	1.4	1.4	1.5	1.5	1.3	2.9	3.0	2.8	2.9	2.8
Potassium, Dissolved	mg/L	0.82	0.64	<0.50	0.65	0.72	1.8	1.8	0.81	1.2	1.0
Sodium, Dissolved	mg/L	1.3	0.70	0.76	0.98	0.57	2.9	3.3	2.4	2.1	1.3 e
General Chemistry											
Hardness, (calculated) as CaCO ₃	mg/L	27	28	30	31	26	49	52	46	47	44
Residue, Dissolved @ 180°C	mg/L	54	50 a	<50	<50	<50	84	146 a	50	90	<50
Tritium	TU	9.08	NM	NM	NM	NM	12.6	NM	NM	NM	NM

- a Estimated value. Duplicate precision for this parameter exceeded quality control limit.
- B Estimated value because sample result is above the method detection limit of 0.10 ng/L but below the reporting limit of 0.25 ng/L.
- e Estimated value. The laboratory statement of data qualifications indicates that a quality control limit for this parameter was exceeded.
- NM Not measured.
- s Potential false positive value. Compound present in blank sample.

Table 11
Groundwater Quality Data
Quaternary Deposit Monitoring Location QAL018
Eagle Project

Parameter	Units	QAL018			
		Summer Baseflow	Fall Rain Runoff	Winter Baseflow	Spring Snowmelt Runoff
		8/19/04	10/20/04	3/2/05	5/3/05
Field Parameters					
Temperature	°C	7.4	7.5	5.5	5.9
Specific Conductance	µmhos/cm @ 25°C	136	141	168	115
pH	SU	7.5	7.2	NM	7.8
D.O.	ppm	3.5	NM	7	4.5
Ferrous Iron	mg/L	<0.1	NM	0.15	<0.1
Metals/Inorganics					
Aluminum, Dissolved	µg/L	<100	<100	<50	<50
Lithium, Dissolved	µg/L	<10	<10	<10	<10
Antimony, Dissolved	µg/L	<5.0	<5.0	<5.0	<5.0
Arsenic, Dissolved	µg/L	<2.0	<2.0	<2.0	<2.0
Barium, Dissolved	µg/L	<20	<20	<20	<20
Iron, Dissolved	µg/L	47	180	76	39
Beryllium, Dissolved	µg/L	<1.0	<1.0	<1.0	<1.0
Boron, Dissolved	µg/L	<100	<100	<100	<100
Cadmium, Dissolved	µg/L	<0.5	<0.5	<0.5	<0.5
Chromium, Dissolved	µg/L	<5.0	<5.0	<5.0	<5.0
Cobalt, Dissolved	µg/L	<10	<10	<10	<10
Copper, Dissolved	µg/L	<5.0	<5.0	<5.0	<5.0
Lead, Dissolved	µg/L	<1.0	<1.0	<1.0	<1.0
Manganese, Dissolved	µg/L	<20	<20	<20	<20
Molybdenum, Dissolved	µg/L	<10	<10	<10	<10
Nickel, Dissolved	µg/L	<25	<25	<25	<25
Selenium, Dissolved	µg/L	<1.0	<1.0	<1.0	<1.0
Silver, Dissolved	µg/L	<0.2	<0.2	<0.2	<0.2
Zinc, Dissolved	µg/L	<10	<10	<10	<10
Mercury, Dissolved	ng/L	0.707 s	1.740 a	0.562	1.120 s

Table 11: QAL018

Table 11
Groundwater Quality Data
Quaternary Deposit Monitoring Location QAL018
Eagle Project

Parameter	Units	QAL018			
		Summer Baseflow	Fall Rain Runoff	Winter Baseflow	Spring Snowmelt Runoff
		8/19/04	10/20/04	3/2/05	5/3/05
Major Anions					
Alkalinity, Bicarbonate	mg/L	37	72 a	63	56
Alkalinity, Carbonate	mg/L	<2.0	<2.0	<2.0	<2.0
Chloride	mg/L	<1.0	<1.0	<1.0	<1.0
Fluoride	mg/L	<0.10	<0.10	<0.10	0.12
Nitrogen, Nitrate	mg/L	0.17	0.20	0.20	0.12
Sulfate	mg/L	<5.0	5.1	5.4	<5.0
Major Cations					
Calcium, Dissolved	mg/L	20	21	20	17
Potassium, Dissolved	mg/L	<0.50	<0.50	0.52	<0.50
Magnesium, Dissolved	mg/L	3.8	4.1	4.0	3.5
Sodium, Dissolved	mg/L	1.1	0.80	0.89	1.1
General Chemistry					
Hardness, (calculated) as CaCO ₃	mg/L	66	69	66	57
Residue, Dissolved @ 180°C	mg/L	98	102	70	56
Tritium	TU	NM	10.3	NM	NM

- a Estimated value. Duplicate precision for this parameter exceeded quality control limit.
- NM Not measured.
- s Potential false positive value.
Compound present in blank sample.

Table 12
Wetland Water Quality Data
Monitoring Location WLD025
Eagle Project

Parameter	Unit	WLD025-1.0	WLD025-4.5	WLD025-9.5
Alkalinity, Bicarbonate	mg/L	37 a	110 a	72 a
Alkalinity, Carbonate	mg/L	<2.0	<2.0	<2.0
Calcium (Total)	mg/L	9.1	20	240
Chloride	mg/L	1.6	<1.0	1.1
Magnesium (Total)	mg/L	1.8	5.7	120
Potassium (Total)	mg/L	0.21	1.3	14
Residue, Dissolved @ 180° C	mg/L	84	102	76
Sodium (Total)	mg/L	<0.50	4.1	8.5
Sulfate	mg/L	<5.0	<5.0	<5.0
Hardness	mg/L	30	73	1,092
pH	SU	6.3	6.6	6.4
Specific Conductance	µmhos/cm @ 25°C	187	192	120

a Estimated value. Duplicate precision for this parameter exceeded quality control limit.

Table 12
Wetland Water Quality Data
Monitoring Location WLD028
Eagle Project

Parameter	Unit	WLD028-1.0	WLD028-4.5	WLD028-9.5
Alkalinity, Bicarbonate	mg/L	<2.0	7.5 a	86 a
Alkalinity, Carbonate	mg/L	<2.0	<2.0	<2.0
Calcium (Total)	mg/L	0.81	1.2	17
Chloride	mg/L	<1.0	<1.0	<1.0
Magnesium (Total)	mg/L	<0.50	<0.50	4.6
Potassium (Total)	mg/L	0.40	0.30	1.6
Residue, Dissolved @ 180° C	mg/L	32	21	64
Sodium (Total)	mg/L	<0.50	<0.50	1.1
Sulfate	mg/L	<5.0	<5.0	<5.0
Hardness	mg/L	3	4	61
pH	SU	5.1	5.3	6.6
Specific Conductance	µmhos/cm @ 25°C	158	23	76

a Estimated value. Duplicate precision for this parameter exceeded quality control limit.

Table 13
Groundwater Quality Data for Bedrock Samples
Eagle Project

Parameter	Units	05EA-107		04EA-084
		97.52-114.22 m	18.20-34.90 m	249.05-302.08 m
		9/18/05	9/20/05	9/23/05
Field Parameters				
pH	SU	7.52	7.57	8.25
Conductivity	µS/cm	599	359	4,980
Salinity	‰	0.3	0.2	2.6
Total Dissolved Solids	mg/L	287	168	2,540
Turbidity	NTU	56	18.5	5.92
Temperature	°C	12.3	9.4	9.4
Metals				
Aluminum	µg/L	<50	<50	<50
Antimony	µg/L	<5	<5	<5
Arsenic	µg/L	<2	<2	23
Barium	µg/L	<20	<20	24
Beryllium	µg/L	<1	<1	<1
Boron	µg/L	4,100	940	5,800
Cadmium	µg/L	<0.5	<0.5	<5
Calcium	mg/L	3.1	5.9	83
Chromium	µg/L	<5	<5	<5
Cobalt	µg/L	<10	<10	<10
Copper	µg/L	<5	<5	<5
Iron	µg/L	79	88	2,200
Lead	µg/L	<1	<1	<1
Lithium	µg/L	16	13	140
Magnesium	mg/L	0.98	2.4	67
Manganese	µg/L	<20	22	83
Molybdenum	µg/L	<10	<10	<10
Mercury	ng/L	3.51	0.81	0.44
Nickel	µg/L	<25	<25	<25
Selenium	µg/L	<1	<1	21
Silver	µg/L	<0.2	<0.2	<0.2
Sodium	mg/L	80	21	1,100
Strontium	µg/L	91	170	5,300
Zinc	µg/L	12	<10	18
Potassium	mg/L	1.7	2.9	9.2
Physical/Chemical Parameters				
Alkalinity, Bicarbonate	mg/L	70	39	36
Alkalinity, Carbonate	mg/L	28	<2	<1
Alkalinity, Total	mg/L	98	83	34
Chloride	mg/L	97	1.2	1,980
Fluoride	mg/L	0.85	0.53	0.95
Nitrogen, Ammonia	mg/L	0.093	0.076	0.29
Nitrogen, Nitrate	mg/L	<0.05	<0.05	<0.05
Phosphorus, Total	mg/L	0.033	<0.01	<0.01
Residue, Dissolved	mg/L	278	76	3,990
Sulfate	mg/L	<5	<5	<5
Sulfide	mg/L	<1	<1	<1
Tritium	TU	0.6	<0.8	<0.69

U Mercury sample results below the method detection limit (M
J Mercury result is an estimate. See notes in laboratory report
NA Not Analyzed
Sample interval depth (m along borehole) is provided below

Table 14
Mine Development Schedule
Eagle Project

Item	Drift Dimensions (m)	Total Length (m)	Year -2 (m)	Year -1 (m)	Year 1 (m)	Year 2 (m)	Year 3 (m)	Year 4 (m)	Year 5 (m)	Year 6 (m)	Year 7 (m)	Year 8 (m)	Totals (m)
<i>Lateral Development</i>													
Decline - Surface to 263 Level	5 x 5	1,383	759	624	0	0	0	0	0	0	0	0	1,383
Decline - 263 Level to 143 Level	5 x 5	1,080	0	1,080	0	0	0	0	0	0	0	0	1,080
Incline - 263 Level to 383 Level	5 x 5	1,080	0	0	0	0	0	500	250	330	0	0	1,080
143 Level Development	5 x 5	113	0	113	0	0	0	0	0	0	0	0	113
173 Level Development	5 x 5	374	0	374	0	0	0	0	0	0	0	0	374
203 Level Development	5 x 5	382	0	0	382	0	0	0	0	0	0	0	382
233 Level Development	5 x 5	464	0	0	464	0	0	0	0	0	0	0	464
263 Level Development	5 x 5	572	0	0	0	0	572	0	0	0	0	0	572
293 Level Development	4.5 x 4.5	178	0	0	0	0	0	178	0	0	0	0	178
323 Level Development	4.5 x 4.5	179	0	0	0	0	0	0	179	0	0	0	179
353 Level Development	4.5 x 4.5	234	0	0	0	0	0	0	234	0	0	0	234
383 Level Development	4.5 x 4.5	251	0	0	0	0	0	0	0	251	0	0	251
Sub-total		6,290	759	2,191	846	0	572	678	663	581	0	0	6,290
<i>Raise Development</i>													
Main Exhaust Raise	4*	277	0	277	0	0	30	30	30	30	0	0	397
Orepass - 383 Level to 263 Level	4*	120	0	0	0	0	0	0	0	0	0	0	0
Sub-total		397	0	277	0	0	30	30	30	30	0	0	397

Notes: * indicates diameter measurement.

Table 15
Wetland Slice Model Drawdown
Eagle Project

Well	Zone	Normal Head (ft msl)	Head in Upper Bound Drawdown Scenario (ft msl)	Change in Head (ft)
QAL023	B	1416.41	1415.43	0.98
QAL043	A	1419.76	1419.10	0.66
QAL043	B	1417.44	1416.51	0.93
QAL044	A	1424.80	1424.39	0.41
QAL044	B	1418.19	1417.32	0.87
WLD025	A	1415.49	1414.85	0.64

Table 16
Streamflow Predictive Assessment Summary
Eagle Project

Monitoring Location	Average Daily Flow (cfs)	Flow (cfs)		Base Case Maximum Change in Simulated Streamflow (cfs)	Base Case Percent Change			Upper Bound Maximum Change in Simulated Streamflow (cfs)	Upper Bound Percent Change		
		Max	Min		Relative to Max	Relative to Min	Relative to Ave		Relative to Max	Relative to Min	Relative to Ave
Salmon Trout River											
STRM002*	2.3	5.3	0.9	0	0	0	0	-0.016	-0.3	-1.8	-0.7
STRM004	6.7	41	4.2	0.003	0.01	0.1	0.04	0.004	0.01	0.1	0.1
STRE002	21	119	12	0.228	0.2	1.9	1.1	0.316	0.3	2.6	1.5
STRM005	44	397	22	0.230	0.1	1.0	0.5	0.319	0.1	1.5	0.7
Yellow Dog River											
YDRM002	28	242	6.5	0.026	0.01	0.4	0.1	0.048	0.02	0.7	0.2

Data are from hydrographs for September 2004 to September 2005.

* Flow characteristics for STRM002 based on discrete event measurement data.