WASHINGTON STATE
DEPARTMENT OF
ECOLOGY

FINAL CLEANUP ACTION PLAN

L-BAR SITE

STEVENS COUNTY, WA

Washington Department of Ecology

Eastern Regional Office

Toxics Cleanup Program

JUNE 2000

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1.0 INTRODUCTION

1.1 THE CLEANUP PROCESS AND THE FINAL CLEANUP ACTION PLAN

The Final Cleanup Action Plan (DCAP) is one of a series of documents used by Ecology to monitor the progress of site investigation and cleanup. Figure 1 identifies the documents required under the Model Toxics Control Act (MTCA) Cleanup Regulation, Chapter 173-340 WAC.

The Remedial Investigation (RI) Report presents results of investigations into the nature and extent of contamination. The Feasibility Study (FS) Report assesses the risk posed by the contamination, and evaluates cleanup actions that eliminate, reduce or control these risks. Evaluations of cleanup actions in the FS are done in accordance with MTCA requirements. The RI and FS are conducted in accordance with work plans approved by Ecology. These Reports are made available for public review and comment.

The selection of a cleanup action by Ecology is presented in the DCAP. Upon completion of a public comment period on the DCAP, and after review and consideration of the comments received, a Final Cleanup Action Plan (FCAP) is issued.

The FCAP is incorporated into a Consent Decree or Agreed Order that provides the legal agreement for implementing the cleanup action. The remaining documents implement the selected cleanup action.

1.2 PURPOSE AND OBJECTIVES

This decision document presents Ecology's selected cleanup action for the L-Bar Site (the Site). This Site is located about two miles south of Chewelah on the southern bank of the Colville River (as shown in Figure 2). The selected cleanup action is primarily based upon the following documents:

- L-Bar Phase I Remedial Investigation Final Report, CH2M HILL, August 1998;
- L-Bar Site Cleanup Standards Development (Draft), Ecology, October 1998,
- L-Bar Cleanup Levels Development and Feasibility Study Report, CH2M HILL, May 1999;
- L-Bar Baseline Human Health and Ecological Risk Assessment Report, CH2M HILL, January 1999;

- The Model Toxics Control Act Cleanup Regulation, Chapter 173-340 WAC.

Portions of the DCAP text and most of the figures are taken directly from these documents.

This FCAP includes the following:

- Brief description of the Site;
- The nature and extent of contamination at the Site;
- The cleanup standards for the Site;
- A description of the proposed remedial alternatives or actions presented and evaluated in the FS Report;
- Ecology's selected cleanup action and justification for the selection.

1.3 DECLARATION

Ecology's selected remedy is protective of human health and the environment. Furthermore, the selected remedy is consistent with the preference of the State of Washington as stated in RCW 70.105D.030(1)(b) for permanent solutions.

1.4 APPLICABILITY

This FCAP is applicable only to the L-Bar Site. Cleanup standards and cleanup actions have been developed as an overall remediation process being conducted under Ecology oversight using MTCA authority, and should not be considered as setting precedents for other sites.

1.5 ADMINISTRATIVE RECORD

The documents used to make the decisions discussed in this cleanup action plan are constituents of the administrative record for the site. These documents are listed in the Reference Section.

The entire administrative record for the Site is available for public review by appointment at Ecology's Eastern Regional Office, 4601 N. Monroe, Spokane, WA 99205-1295. Documents that were made available for public comment and review are also found at the Chewelah Public Library, 301 East Clay Avenue, Chewelah, WA 99109-8936.

2.0 SITE BACKGROUND

2.1 SITE SETTING

The Site occupies approximately 67 acres of industrial and agricultural land in the Colville River Valley (Figure 3). The industrial area covers approximately 50 acres; an adjoining 17-acre agricultural field (the North Field) lies between the industrial area and the Colville River.

A magnesite residue pile about 30 feet high and covering nearly 17 acres lies within the southwest quadrant of the Site. Two ditches --the Main Ditch and the West Ditch – provide drainage for the interior and western portion of the site, respectively. Two lined water storage ponds – the Evaporation Pond and the Holding Pond - are in the northern half of the Site.

The Site property plan is shown in Figure 3.

2.2 SITE HISTORY

The Site and the adjacent parcel to the South have been associated with magnesium processing since the 1930s. Large quantities of magnesite ore were processed and stockpiled until 1967. In the mid-1970s, the facility was converted to recover magnesium from a magnesium processing byproduct commonly referred to as flux bar (FB). FB was supplied primarily by Northwest Alloys (NWA) from their magnesium plant near Addy, Washington, and sold to the facility owners. The magnesium recovery facility was owned and operated by Phoenix Resources Recovery, Inc. from 1977 to 1986. L-Bar Products, Inc. operated the facility from 1986 to 1991 when it closed down due to insolvency.

The recovery process involved crushing the raw flux bars and screening the crushed materials to recover metallic magnesium granules by screening. The remaining material was called flux bar residue or FBR. Magnesium, magnesium oxide, magnesium chloride, potassium chloride, calcium chloride, and lesser amounts of magnesium nitride and magnesium flouride were the primary constituents of FBs and FBRs. These materials were very reactive with water; the reactions were exothermic and had caused several fires at the Site during the years of the plant's operation. The reaction of magnesium nitride with water released ammonia. The magnesium and potassium chloride salts were highly soluble in water and were easily leached from these materials into ground water. These materials also designated "state-only dangerous waste" due to fish toxicity.

FBRs were sold as a soil amendment/fertilizer and road de-icer. However, FBRs at the Site accumulated faster than it was sold, and stockpiles of material accumulated at the Site. In 1985, an unlined pile of about 50,000 tons of material was covered with plastic. Flux materials were also stockpiled on top of the magnesite residue pile and were left uncovered.

At the time of the plant's closure, more than 100,000 tons of materials (under the covered pile, on top of the magnesite pile, and in buildings) were left on Site. Some of the buildings used to store the materials collapsed during the winter of 1992-93 and exposed some of the materials inside these buildings to precipitation.

Past operating practices and inadequate storage of FB and FBR resulted in the leaching of soluble components of the materials into the soil, ground water and surface water. Ecology had issued several Enforcement Orders and penalties to L-Bar, for violations of air, water quality, and dangerous waste regulations while the plant was in operation. At the time of the plant's closure in 1991, L-Bar was doing some rehabilitation of the Site as part of a proposed settlement of a civil suit filed by Ecology. Part of the rehabilitation was to collect surface run-off and ground water for treatment before discharging to the Colville River. This system was not completed, but, as a result of the work, two collection ponds are in place. The two ponds contained primarily stormwater runoff and direct precipitation. Water levels in the stormwater Holding Pond were managed by pumping excess water to the Evaporation Pond.

In 1993, Ecology conducted emergency cleanup activities at the Site that included retrieving and storing acid drums that were in buildings damaged during the winter of 1992-93; limiting site access; repairing the HDPE cover over the FBR stockpile and broken curbs; and paving of the surface water run-off collection system. In 1994, NWA voluntarily initiated independent interim remedial actions, which included dismantling of structurally unsound buildings; repairing site buildings; relocating hazardous substances from unsecured to protected areas; and cleaning of areas to improve quality of storm water leaving the facility.

The formal cleanup process under the authority of MTCA was initiated in 1994 when Ecology named Potentially Liable Persons (PLPs) for this Site. NWA, L-Bar Products, Inc., and Reserve Industries Corporation were named PLPs. This was followed by an Enforcement Order to the PLPs, which only NWA complied with, and that required the following: (1) Apply for a NPDES permit to discharge all water coming from the Site to the Colville River within six months from the effective date of the Order, and (2) In the interim, releases of the water from the ditch must be controlled and monitored under specified Ecology conditions in order to prevent a potential catastrophic release of the water. The river flow and contaminant concentrations were required to be monitored every two weeks. The interim discharge was allowed for twelve months, after which discharges must stop if no NPDES permit had been obtained.

NWA entered into an Agreed Order in 1995 that included provisions for conducting interim actions, a Remedial Investigation (RI), and a Feasibility Study (FS). The interim actions provided additional interim protective actions, parts of which are in conjunction with the NPDES permit process. The RI/FS included further site investigations and sampling, and evaluating cleanup alternatives for the Site.

The Site was also selected in 1995 to serve as a MTCA demonstration pilot project under House Bill 1810, the purpose of which was to evaluate alternative methods for accomplishing faster, less expensive and equally protective cleanups at complex sites.

2.3 SITE INVESTIGATIONS

Past data collected for chloride during the facility's operating years had shown the leaching of these materials had impacted that ground water. Maximum values of about 60,000 mg/L chloride and 120,000 mg/L Total Dissolved Solids (TDS) were measured in the local shallow water table aquifer. Chloride concentrations along the Main Ditch ranged from 6,690 to 18,000 mg/L.

Site investigations under the Agreed Order were mostly conducted as part of the Remedial Investigation. An Electromagnetic (EM) Survey was conducted to locate high conductivity plumes that would help set up locations of monitoring wells and soil borings. Soil samples were collected from 29 soil borings throughout the Site. Thirty-three (33) piezometers/monitoring wells were installed and sampled; 19 of which were retained as monitoring wells. Surface water samples from the Main Ditch, West Ditch, the Holding Pond, the Evaporation Pond, and the Colville River were collected and analyzed. Sediments from the Main Ditch and West Ditch were also analyzed. The results are presented in the "L-Bar Phase I Remedial Investigation Final Report", August 1998. Based on these results, it was determined that a Phase II RI was not necessary.

As a result of the Enforcement Order issued in 1994, biweekly monitoring of surface water for chloride and ammonia was also conducted. Results of this biweekly monitoring are reported in the "L-Bar Surface Water and Groundwater Monitoring Report", submitted to Ecology annually.

Several supplemental studies were conducted from April through November 1997 to assess and quantify potential ecological risks as a result of this Site being selected as a pilot study site under HB 1810. Several reports are available in the Site files regarding these supplemental studies.

A risk assessment was conducted as part of the Agreed Order for the purpose of estimating the potential risk to human health and ecological receptors at the Site. The "L-Bar Baseline Human Health and Ecological Risk Assessment", January 1999, presents the results of the risk assessment.

The "L-Bar Cleanup Levels Development and Feasibility Study Report", May 1999, describes the applicable cleanup requirements and the cleanup standards, identifies and evaluates remedial action alternatives according to MTCA criteria, and recommends a remedial action for the Site.

2.4 INTERIM ACTIONS

The Agreed Order provided for interim actions that would: (1) Evaluate management and treatment options for surface water and ground water that discharge to the Colville River as a consequence of the Enforcement Order, and (2) Characterize and potentially remove or process on-site materials.

An Interim Action was conducted starting in 1995 that included:

- Conducting engineering evaluations and design for treatment of surface waters;
- Conducting a ground water extraction pilot study and barrier wall assessment;
- Characterizing or managing on-site FB and FBR materials.

This interim action did not result in the treatment of surface water discharge to the River. The Main Ditch discharge was stopped in late 1995 as a result of actions taken by NWA under the Enforcement Order. Hydraulic controls for the Main Ditch to eliminate direct discharge to the River were installed. Main Ditch water level was controlled by pumping excess water to the Evaporation Pond. A lined and bermed stormwater conveyance ditch from the Holding Pond to the river was also constructed so that clean surface stormwater runoff would not flow into the Main Ditch.

In 1996, NWA conducted a pilot study to determine the feasibility of land applying Main Ditch water stored in the Evaporation Pond to the North Field during the dry and growing season. A full-scale land application system was started in 1998 as a way to manage the water that is stored in the Evaporation Pond and is still ongoing.

An interim action involving the removal and off-site disposal of materials that were piled around and on top of the magnesite residue pile started in 1997. These materials were characterized as "special wastes" or solid wastes under WAC 173-303, Dangerous Waste Regulations. To date, all the materials on top of the pile totaling to 65,000 tons have been removed, transported by railcars, and disposed of at a permitted landfill in Oregon.

2.5 PHYSICAL SITE CHARACTERISTICS

2.5.1 Site Geology

The Site is in the center of the Colville River Valley. The Colville River Valley is underlain and flanked by bedrock units ranging from Tertiary to Precambrian in age. The valley has been filled to the present day land surface with Quaternary glacial deposits and lesser amounts of recent alluvium.

Post-glacial erosional and depositional processes have continued to the present. Local flooding is thought to have eroded shallow channels in the surface of the glaciolacustrine deposits.

Volcanic ash and backwater alluvial deposits (silt, clay, and organic-rich material) later accumulated in the erosional channels. Coarse-grained channel lag deposits were also deposited within small tributary drainages or within relic channels of the ancestral Colville River. These localized channel features have been noted in the North Field. Wind blown silt and recent flood deposits overlie these older glaciolacustrine, fluvial, and alluvial sediments and form the existing topsoil.

The soils underlying the Site represent a mixture of naturally deposited sediments and artificially placed fill. These soil units can be grouped into four lithological distinct deposits, listed below from youngest to oldest:

- Fill/magnesite residue
- Recent alluvium
- Volcanic ash
- Glaciolacustrine silt and clay.

Fill deposits are found in the southern portion of the Site, in the current L-Bar plant area, and in areas around the Holding Pond and Evaporation Pond, and along the eastern side of the Main Ditch. The magnesite pile residue is the dominant fill material, representing the accumulated waste materials from the previous Northwest Magnesite operation. The magnesite residue pile is up to 30 feet deep and covers about 16 acres. Other fill deposits include granular fill, gravel fill, and organic fill material known as Thermax (a fireproof fiber-board product consisting of shredded cottonwood impregnated with magnesite that was manufactured at the Site before L-Bar operations commenced).

Recent alluvial sediments up to several feet thick underlie the northern half of the Site (North Field). These sediments consist of an interbedded sequence of silty sand, silt, and some intermittent organic-rich layers.

A fairly distinct 1- to 2-foot-thick pinkish-gray to light-tan silt was frequently encountered in the northern half of the Site. This material is described as a volcanic ash deposit. The volcanic ash material is at depths ranging from 3 to 6 feet below grade and typically lies atop a glaciolacustrine silt and clay.

A very stiff to hard clayey silt up to 10 feet thick underlies the L-Bar Site and represents the upper member of a thick sequence of glaciolacustrine sediments. The hard clayey silt transitions vertically over several feet into a soft, silty clay. Borings drilled to a depth of 35 feet found that the silty clay became progressively softer and was fully saturated, having very little strength below about 20 feet.

2.5.2 Ground Water Hydrology

The L-Bar Site is within the U-shaped glacial valley of the Colville River. Four distinct hydrogeologic units have been differentiated within the unconsolidated sediments that underlie the L-Bar Site and the immediate vicinity. These units consist of the following:

- Shallow Water Bearing Unit (SWBU) – This is a thin, unconfined, locally discontinuous water-bearing zone, generally 1 to 3 feet thick and typically 2 to 5 feet below the uppermost native soil horizon
- Clay Aquiclude – A vertically extensive, low-permeability confining layer, this serves as the primary hydrostratigraphic unit separating the SWBU from the deeper aquifers below the Site.
- Intermediate Aquifer – This is a confined, locally developed water-bearing zone.
- Deep Aquifer – This is a deeper confined, regionally distributed sand and gravel aquifer.

The lowermost aquifer, or Deep Aquifer, is a confined unit typically encountered at a depth ranging from 190 to 360 feet bgs. Basal sand and gravel deposits form the primary water-bearing unit for the Deep Aquifer. An Intermediate Aquifer also is known to be locally developed in the immediate vicinity of the L-Bar Site and lies approximately 90 feet above the Deep Aquifer. The Intermediate Aquifer is thought to consist of sand and gravel material, although specific lithologic information is lacking. Shallow, unconfined to semi-confined water-bearing zones exist with the surficial deposits and maintain a water table at or near land surface under normal seasonal conditions. However, during periods of intermittent drought, these shallow water-bearing zones may be discontinuous or locally absent. A strong upward vertical gradient exists between the deeper confined aquifer units and the SWBU, and promotes flowing artesian conditions in water supply wells that tap into these deeper ground water production zones.

Ground water from either the Intermediate or Deep Aquifer is the primary source of potable drinking water for rural residents and commercial operations in the vicinity of the L-Bar Site. No known water supply wells are completed within the SWBU in the immediate vicinity of the Site.

Ground water in the SWBU flows in a general northwesterly direction toward the Colville River under an average sitewide hydraulic gradient of 0.003 to 0.005 ft/ft. Water in the onsite drainage ditches locally influences the direction of ground water flow. Ground water levels in the SWBU fluctuated as much as 5.3 feet during the period of monitoring. The ambient seasonal ground water level changes generally range from 3 to 4 feet up to a maximum of about 4.8 feet. Ground water levels during the period of measurement were highest during the month of February. Generally, water levels in the North Field area and the area immediately east of the covered pile showed the greatest water level changes. SWBU water levels in the North Field are very near or at the ground's surface during the wet season.

3.0 NATURE AND EXTENT OF CONTAMINATION

3.1 GROUND WATER

3.1.1 Shallow Water Bearing Unit (SWBU)

FB and FBR materials directly contribute to localized ground water impacts that include elevated concentrations of chloride, ammonia, TDS, and barium. The covered pile is a primary source of the contamination. Materials that used to be stockpiled on top of the magnesite pile and along the southern site boundary were also a significant source of shallow ground water contamination.

Chloride is measured at a maximum concentration of 45,400 mg/L in the vicinity of the covered pile. The background chloride concentrations range up to 50.8 mg/L. Figure 4 shows an isocontour map of chloride concentrations detected in ground water and at selected surface water sampling locations.

Total Dissolved Solids (TDS), a measure of the dissolved mineral content of water that includes carbonates, chlorides, sulfates, nitrates, sodium, potassium, calcium, and magnesium, is measured at a maximum concentration of 68,000 mg/L, also adjacent to the covered pile. The distribution of TDS in ground water is very similar to the distribution of chloride.

Ammonia (as nitrogen or N) is detected at concentrations ranging from 0.4 to 1,030 mg/L. Figure 5 shows isocontour maps of ammonia concentrations detected in ground water and at selected surface water sampling locations.

Nitrate (as N) isocontours, which are similar in shape to the ammonia plume, are shown in Figure 6. Concentrations range from 0.165 to 40 mg/L. Nitrification of ammonia is the primary source of nitrate.

Sulfate concentrations range up to 1790 mg/L compared to the highest background concentration of 500 mg/L. Sulfate concentrations are much lower than the chloride concentrations; therefore the TDS is mostly in the form of chloride salts. The magnesite residue pile is the main source of the sulfate at the Site.

Barium, iron, and manganese are the metals detected in ground water that are believed to be related to L-Bar materials. Arsenic concentrations in the SWBU are elevated in the North Field near the Colville River and at a background monitoring well on the north side of the

3.4.2 West Ditch

Chloride and ammonia concentrations increase significantly below the confluence of the South Ditch, which is tributary to the West Ditch at the southwest corner of the magnesite residue pile. The source of these elevated concentrations appears to be flux bar materials at the south end of the magnesite residue pile. These materials were removed in 1997 as part of an interim action.

3.4.3 Colville River

A slight increase from upstream to downstream concentrations is observed routinely for chloride and ammonia; however, none of the concentrations exceed the surface water criteria.

3.5 CONTAMINANT TRANSPORT

The principal mechanism of contaminant transport at the Site is the leaching of soluble constituents from the materials to shallow ground water and transport of these contaminants via the ground water to soils, and surface water. Currently, most of the leaching is taking place from the covered pile, the bottom of which is in contact with ground water. The shallow ground water flows towards the North Field and then discharges to the Colville River. Ground water chloride flux estimates to the Colville River range from 0.1 to 125 Kg/day and the ammonia flux estimates are from 0.0000008 to 0.2 Kg/day. Some shallow ground water also discharges to the West Ditch and Main Ditch; West Ditch surface water, in turn discharges to the Colville River.

Ammonia found at the Site is a product of the reaction of magnesium nitride with water. Ammonia normally exists as a colorless gas but is also soluble in water. Nitrification reactions convert ammonia to nitrite and then nitrate. Ammonia is also released to air from site surface waters and from the L-Bar materials.

The chloride, TDS, and other source-related constituents in L-Bar Site media result from the dissolution of the salts that are present in the source materials. Chloride is not normally adsorbed to soil particles; it can be transported with water with little adsorption to soil, and may thus be viewed as a conservative tracer of the extent of contamination within the SWBU. Chloride concentrations in ground water or surface water are reduced mostly by dilution or dispersion and may be slightly reduced by biotic uptake. Evaporative processes can concentrate chloride in surface water.

3.6 RISKS TO HUMAN HEALTH AND THE ENVIRONMENT

Ecology has made a determination that the SWBU is a not a source of drinking water because of insufficient yield. The SWBU discharges to the Colville River which is a Class A surface river. The higher concentrations coincide with floodplain areas known to contain volcanic ash and silty sand. The arsenic levels in this area are believed to be naturally occurring.

3.1.2 Intermediate Aquifer

Results show that there are no impacts to the intermediate aquifer as a result of downward migration of chemicals from the SWBU. This is consistent with the vertical upward hydraulic gradient that is known to exist between the Intermediate Aquifer and the SWBU.

3.2 MAGNESITE RESIDUE

A distinct leaching front is evident at approximately 7 to 15 feet below the interface between the magnesite residue and the FB material based on field screening results for chloride and ammonia. Over an approximately 5-foot span, chloride concentrations decrease 2 to 3 orders of magnitude and ammonia concentrations decrease 1 to 2 orders of magnitude. Trace metal and semi-metal concentrations in the magnesite residue materials below the leaching front are similar to those above the front, indicating that metals are not being leached or remobilized.

3.3 VADOSE ZONE SOILS

Elevated concentrations of chloride and ammonia are in several vadose zone soil samples collected from the North Field and main plant areas. The elevated concentrations in the main plant area are found in areas where source material stockpiling occurred prior to 1991 (i.e., at historical stockpile areas other than those atop or adjacent to the magnesite pile). In the North Field vadose zone soils, elevated levels of chloride and ammonia likely result from seasonal saturation of the soils by high ground water generated near the covered pile and/or seepage of the Main Ditch surface water into the SWBU.

Barium appears to be the only FB-related metal detected in the vadose zone exceeding the background concentration.

The depth of penetration of chloride and ammonia from the SWBU into the Clay Aquiclude is approximately 8 feet where TDS levels are highest.

3.4 SURFACE WATER

3.4.1 Main Ditch

Chloride concentrations range from 4,200 mg/L to 13,700 mg/L as shown in Figure 4. TDS concentrations generally follow the pattern exhibited by chloride. Ammonia (see Figure 5) is detected in all sampling locations with concentrations ranging from 285 mg/L to 1,110 mg/L. Nitrate concentrations are shown in Figure 6 with higher concentrations at the head of the Main Ditch and near the covered pile.

3.0 CLEANUP STANDARDS

One of the requirements of the Model Toxics Control Act (MTCA) cleanup regulation (WAC 173-340) is to establish cleanup standards for individual sites. The two primary components of cleanup standards are (1) cleanup levels and (2) points of compliance. Both must be established for each site. Cleanup levels determine at what concentration a particular hazardous substance does not threaten human health or the environment. The goal is to address all substances above those concentrations with some remedy that prevents exposure to those materials. Points of compliance designate the locations on the site where the cleanup levels must be met. This document develops the cleanup standards for the L-Bar Site located near Chewelah, WA following the requirements of MTCA.

4.1 CLEANUP LEVELS

Developing cleanup levels involves several steps: determining which method to use; determining the reasonable maximum exposure scenario; developing cleanup levels for individual substances in individual media, taking into account potential cross-media contamination; determining what substances contribute to overall risks at the site (indicator hazardous substances); evaluating levels for single substances in single media for indicators; and, adjusting individual levels downward to meet site risk and hazard limits specified in MTCA.

There are three methods used to determine cleanup levels under MTCA: Methods A, B, and C. Method A is used for routine sites or sites that involve relatively few hazardous substances which have available numerical levels. Method B is the standard method for determining cleanup levels and is applicable to all sites. Method C is a conditional method used when a cleanup level under Method A or B is technically impossible to achieve or may cause greater environmental harm. Method C may also be applied to qualifying industrial properties. Cleanup level methods are established for ground water, surface water, soil, and air.

WAC 173-340-708 states that "when defining cleanup requirements at a site that is contaminated with a large number of hazardous substances, the department may eliminate from consideration those hazardous substances that contribute a small percentage of the overall threat to human health and the environment. The remaining hazardous substances shall serve as indicator hazardous substances for purposes of defining site cleanup requirements."

The factors to be considered in determining whether or not a substance should be retained for an analysis of overall site risk or hazard are:

body of water of the State under WAC 173-201A. No exceedances of surface water criteria have been detected in the River. The SWBU underlies an agricultural field referred to as the North Field. Shallow ground water from the SWBU is exposed at the surface in low-lying areas during high ground water conditions. Several low-lying areas in the western half of this field are bare of vegetation showing some impacts from the high salinity of the ground water and soils, as well as from seasonal saturation of the plant root zone. Agricultural workers may be exposed to incidental ingestion and dermal contact of the ground water.

The L-Bar Baseline Human Health and Ecological Risk Assessment Report (CH2M HILL, 1999) estimated potential risks to human health and ecological receptors from uncontrolled releases from the L-Bar materials. Some primary site indicators such as chloride and TDS do not have available toxicity factors and represent unquantifiable risk to human health and the environment. Risks from these constituents are qualitatively described by comparing the concentrations with other state and federal standards.

The risk assessment shows that quantifiable risks for human exposure pathways are below the acceptable risks specified under MTCA. The ecological risk assessment shows that no significant risks were identified for aquatic and benthic biota in the Colville River, or for terrestrial wildlife frequenting the Site.

1. The frequency of detection of the substance. It may be appropriate to eliminate compounds, which are detected with a frequency of 5 % or less.

2. The concentration of the substance. Substances with concentrations marginally above their cleanup standards may not be important in considerations of overall hazard and risk.

3. The toxicity of the substance. It may be suitable to delete substances of low toxicity.

4. Environmental fate. Substances, which readily degrade in the environment, may not be of importance to overall hazard or risk. Conversely, those with highly toxic degradation products should be included in an analysis of overall hazard and risk.

5. The natural background levels of the substance. MTCA regulates risks due to substances found at contaminated waste sites. The risks caused by substances at background concentrations are not addressed by MTCA.

6. The mobility and potential for exposure to the substance. Substances may be eliminated if the values for these factors are low.

Limitations of analytical chemistry are also considered. The practical quantitation limit (PQL) for detection of a substance may be greater than its risk-based cleanup level. The risk-based cleanup level is used in the analysis of the over-all site hazard and risk in such cases, but the regulatory limit for that substance will be the PQL. Improvements in analytical technology will result in readjustment of the regulatory limit to match the new, lower PQL during any subsequent evaluation of the Site.

Once a list of substances to be assessed for cumulative risks and hazards has been developed, total site risk is calculated based upon the established cleanup levels. The total site risk for a site must not exceed 1×10^{-5} and the hazard index, calculated for chemicals with similar non-carcinogenic toxicity endpoints, must not exceed 1. MTCA does not define how to apportion risk and hazard index among substances, as long as individual standards for each standard are not violated.

4.2 SITE CLEANUP LEVELS

Results of the Remedial Investigation show that major cations and anions, other conventionals (e.g., conductivity, pH, TDS, TSS), and trace metals are found in ground water, soils, surface water and sediments. Based on these results, site cleanup levels are developed for each media as illustrated in Tables 1 through 11. Ground water cleanup levels are developed first, as soil cleanup levels must be calculated at levels that will not violate the ground water standard. Similarly, surface water cleanup levels will be developed before determining the sediment cleanup levels. Contamination in the ground water has been shown only to occur in the SWBU, which is the uppermost ground water zone at the Site. It has been shown that the intermediate and deep aquifers are not impacted by contamination from the SWBU.

4.2.1 Ground Water Cleanup Levels

Cleanup levels for the SWBU will be based on protection of surface water, protection of the North Field, and protection of industrial and/or agricultural workers. Characteristic uses for Class A water bodies include domestic, industrial, agricultural water supply; stock watering; fish and shellfish; wildlife habitat; recreation, and commerce and navigation. Method B is the appropriate method for developing cleanup levels for ground water because there are multiple hazardous substances and multiple pathways of exposure.

Method B ground water cleanup levels for the Site are developed from:

1. Drinking water levels that include

    - Applicable or Relevant and Appropriate Requirements (ARARs) including Maximum Contaminant Levels (MCLs) and Secondary Maximum Contaminant Levels (SMCLs). An ARAR value can be used as a cleanup level if it is sufficiently protective of human health and environment (i.e., the cancer risk is less than 1×10^{-5} or if the hazard quotient is less than 1).

    - formula values based on human health under WAC 173-340-720(3)(ii) for those substances for which sufficiently protective, health-based criteria have not been established under ARARs.

2. Method A values.

3. Surface water levels that include:

    - all water quality criteria published under Chapter 173-201A WAC, Water Quality Standards for Surface Water of the State of Washington;

    - the EPA Ambient Water Quality Criteria (AWQC or the Gold Book);

    - formula values under WAC 173-340-730(3)(iii) for hazardous substances for which sufficiently protective, health-based criteria or standards have not been established under ARARs.

4. Critical levels for plant growth and irrigation.

5. Levels based on background concentrations.

6. Practical Quantitation Limits (PQLs). The PQL for a substance may be greater than the health-based number. In such cases, the cleanup level becomes the PQL. If the PQL is lowered during cleanup of the site or during periodic review, the regulatory limit will be adjusted downward. However, total site risk will be calculated using actual health based levels.

Table 1 shows the applicable cleanup criteria for chemicals detected in site ground water (excluding the PQLs). The Total Dissolved Solids (TDS) include carbonates, chlorides, nitrates, sodium, potassium, calcium, and magnesium. Conductivity is a measure of the TDS in the ground water. The AWQC or Gold Book criterion for TDS is 250 mg/L for chlorides and sulfates in domestic water supplies (welfare). The AWQC TDS hazards for Irrigation Water (mg/L) are as follows.

Water from which no detrimental effects will usually be noticed ---------500
Water which can have detrimental effects on sensitive crops ------------- 500 - 1,000
Water that may have adverse effects on many crops and requires
careful management practices --1,000-2,000
Water that can be used for tolerant plants on permeable soils with
careful management practices --- 2,000-5,000.

The surface water criteria for ammonia are dependent on pH and temperature. The acute and chronic criteria listed in Table 1 are based on pH 8.88 and 23.1 degrees C temperature. These are the maximum pH and temperature measured in the River that give the most conservative criteria. The area background values are obtained from MTCAStat calculations using data from background wells. MTCAStat is Ecology's software package developed to meet the need for a fast, simple, integrated method of performing routine statistical analyses described in the *Statistical Guidance for Ecology Site Managers.*

The higher of two concentrations - the most stringent concentration (among the drinking water, surface water, and irrigation water criteria) and the background concentration - is the final Method B cleanup level for the constituent. A Method B cleanup level can not be set for a constituent that has no Method B formula value and/or applicable ARARs.

Table 2 shows the results of the screening evaluation to determine ground water indicators. Maximum concentrations, frequencies of detection along with cleanup levels are used to screen indicators. Constituents with maximum concentrations that exceed the Method B cleanup level at a frequency of greater than 5% are considered indicators except for special circumstances as shown in the table.

Table 3 shows the proposed individual ground water cleanup levels for the indicators and, the individual cancer risk and hazard quotients associated with the indicators. Risks and hazard indices for cleanup levels based on background concentrations are not calculated. All the cleanup levels are above the PQLs. There is no cancer risk associated with the indicators in ground water and the total hazard quotient for each toxic end effect does not exceed 1.0.

4.2.2 Soil Cleanup Levels

Table 4 shows applicable soil cleanup criteria for the Site. The L-Bar Site includes the L-Bar facility, which is used for and will continue to be used for industrial purposes, and the agricultural North Field area. It is bordered by agricultural properties to the west, north, and east. To the south, the property is used for industrial/commercial purposes. The Site does not qualify for industrial soil cleanup levels under MTCA because the site is not zoned by a city or county under the Growth Management Act, nor is it adjacent to properties currently used or designated for industrial purposes. Method C-Commercial cleanup levels are chosen for direct contact for this Site. This choice is consistent with WAC 173-340-740(1)(d)(ii)(B) that requires soil cleanup levels for other nonresidential land uses to be at least as stringent as Method C cleanup levels. Soil cleanup levels that are protective of ground water, which is 100 times the adjusted ground water cleanup level, shown in Table 3, are included for substances that have been identified as ground water indicators for the site. The cleanup level is the most stringent level listed in this table.

The results of screening to determine indicator substances in the soils are shown in Table 5. The indicators are substances that exceed the cleanup levels at a frequency of more than 5%. In general, soil cleanup levels for substances that are in ground water are driven by protection of ground water. Indicators for the soils are constituents that are ground water indicators and the cleanup levels are based on protection of ground water. The soil cleanup levels are also protective of the North Field.

Table 6 shows the cancer risk and the hazard quotient in soils. There is no cancer risk associated with the substances in soils and the hazard quotient for each end effect does not exceed 1. The proposed soil cleanup levels in Table 6 do not have to be adjusted downwards.

4.2.3 Surface Water Cleanup Levels

Surface water on Site includes two ditches, the West Ditch and the Main Ditch. The West Ditch discharges seasonally to the Colville River. The discharge of Main Ditch surface water was eliminated through NWA's construction of a water retention dam in late 1995. The Main Ditch water level is currently being maintained by pumping excess water to a lined storage pond referred to as the Evaporation Pond. Stored water is land applied to the North Field during the summer months meeting substantive requirements of a State Waste Discharge Permit, and/or is used for heat and dust control during interim action source removal.

West Ditch

The West Ditch flows along the western boundary of the Site. This ditch is fed by runoff from areas south of the site and from two other ditches at the southern end of the site. Ground water contribution into the West Ditch (as it flows along the boundary of the site towards the river) includes ground water from the L-Bar facility and the agricultural field west of the site. Sampling station WD4, located upstream of the South Ditch confluence serves as a background water quality location for the West Ditch.

The Method B criteria identified in Table 1 are appropriate for the West Ditch because this water discharges to the Colville River which is a Class A surface body of water of the State. The results of screening for West Ditch indicators are shown in Table 7.

Main Ditch

The Main Ditch does not discharge to the Colville River nor is it supporting a fish or shellfish population. It is not a drinking water source and exposure in the Main Ditch is to agricultural or industrial workers and to wildlife. Therefore ground water Method C cleanup criteria are appropriate for the Main Ditch for direct contact. Some Main Ditch water is pumped to the Evaporation Pond as needed to control Main Ditch water levels during the wet winter months; the water is land applied to the North Field during the summer. Irrigation water criteria are also considered. As shown in Table 8, ammonia and TDS are the indicators for the Main Ditch.

4.2.4 Sediment Cleanup Levels

Sediment samples were taken from the West Ditch and the Main Ditch. Table 9 shows the indicator substance screening for West Ditch sediments. Method C commercial soils criteria and soil concentrations to protect west ditch water concentrations derived in Table 7 are applicable to the West Ditch. There are no regulatory cleanup levels established for freshwater sediments. However, maximum concentrations are compared to the Freshwater Sediment Quality Values (FSQV) found in Ecology's Publication No. 97-323a, "Creation and Analysis of Freshwater Sediment Quality Values in Washington State", July 1997. These are not enforceable concentrations but can serve as guidelines for freshwater sediments. The maximum concentrations of most of the trace metals (except for zinc) in the West Ditch are all less than the FSQV. Since the maximum concentration of zinc is only slightly above the FSQV and since the West Ditch does not support any aquatic life, zinc is not considered an indicator for the West Ditch.

Method C commercial levels for soils, and soil levels that are protective of Main Ditch water indicators (identified in Table 8) are the appropriate cleanup criteria for the Main Ditch sediments. FSQV's are also included in Table 10. No indicators are found in the Main Ditch sediments as shown in Table 10.

4.2.5 Final Site Cleanup Levels

The site cleanup levels are shown in Table 11. Total site cancer risk is 0 and the hazard quotient for each toxic end effect is 1.00 or less. These levels meet the requirement under MTCA that total site cancer risk be $\leq 1 \times 10^{-5}$ and that the hazard quotient for each end effect not exceed 1.0.

4.3 POINTS OF COMPLIANCE

4.3.1 Ground Water

For ground water, the point of compliance is the point or points where ground water cleanup levels must be attained. The point of compliance shall be throughout the site from the uppermost level of the saturated zone extending vertically to the lowest most depth, which could potentially be affected by the Site. At this Site, where the affected ground water flows into nearby surface water, the cleanup level may be based on protection of surface water. A conditional point of compliance that is located within the surface water as close as technically possible to the point or points where ground water flows into the surface water may be approved if the following conditions are met:

(i) Use of a dilution zone under WAC 173-201-035 to demonstrate compliance with surface water cleanup level shall not be allowed;

(ii) Ground water discharges shall be provided with all known available and reasonable methods of treatment prior to release into surface waters;

(iii) Ground water discharges shall not result in violations of sediment quality values published in chapter 173-204 WAC, Sediment Management Standards;

(iv) Ground water monitoring shall be performed to estimate contaminant flux rates and to address potential bioaccumulation problems resulting from surface water concentrations below method detection limits.

4.3.2 Soil

Soil cleanup levels for this Site are based on the protection of ground water. The point of compliance shall be established in soils throughout the Site.

4.3.3 West Ditch Surface Water

The West Ditch discharges to the Colville River. The Colville River is a surface water of the state. The point of compliance shall be the point or points at which hazardous substances are

5.0 PROPOSED CLEANUP ACTIONS

5.1 REMEDIAL ACTION GOALS

The remedial action goals are intended to protect human health and the environment by eliminating, reducing, or otherwise controlling risks posed through each exposure pathway and migration route. They are developed considering the characteristics of the contaminated medium, the characteristics of the hazardous substances present, migration and exposure pathways, and potential receptor points.

Exceedances of MTCA cleanup levels occurred in soil, shallow ground water, the West Ditch, the Main Ditch, and ditch sediments as represented by the indicators for each of these media. The chemicals that threaten human health and the environment in these media are primarily chloride, TDS, and ammonia. Contaminants in shallow ground water and the West Ditch are released to the Colville River, a Class A surface water of the State. Ammonia that is released to the River is toxic to aquatic life. The contamination in the SWBU in the North Field locally impacts pasture grass growth and yield. Exposure to agricultural and industrial workers to SWBU, ditch water, and soils are also possible.

Based upon these anticipated pathways, the following remedial action goals are reasonable for the site:

- Protect beneficial uses of the Colville River;
- Reduce concentrations of contaminants in soil, SWBU, and ditches to identified cleanup levels at the designated points of compliance;
- Prevent or minimize leaching of contaminants from the materials to the environment.

5.2 SUMMARY OF FEASIBILITY STUDY CLEANUP ALTERNATIVES

Alternatives for reaching remedial action goals in soils, ground water, and surface water were evaluated in the "L-Bar Cleanup Levels Development and Feasibility Study (FS) Report", CH2M Hill, May 1999.

The technologies analyzed for soil were:

- No Action
- Institutional Controls
- Containment

released to surface waters of the state unless the department has authorized a dilution zone in accordance with WAC 173-201-035.

4.3.4 Main Ditch Surface Water

The Main Ditch is not discharging to the River. The ammonia cleanup level arrived at for the Main Ditch is for the protection of industrial and/or agricultural workers. The TDS cleanup level is based on irrigation water criteria. The point of compliance for these cleanup levels is everywhere throughout the ditch.

4.3.5 West Ditch Sediments

The point of compliance for the West Ditch sediments is everywhere in the West Ditch adjacent to the Site.

- Removal and Disposal

The ground water and surface water technologies were:

- No Action
- Institutional Controls and Monitoring
- Containment
- Collection and Removal
- Treatment
    - -Reverse osmosis
    - -Sequencing batch reactor
    - -Land application
- Disposal

Source removal technologies applicable to the materials on site analyzed included:

- No Action
- Institutional Controls
- Containment
- Removal and Disposal
- Reuse and Recycling

Following this individual analysis and initial screening of technologies, five (5) alternatives, combining different technologies were presented. Of the five alternatives presented, one is the "no action" alternative, used as a baseline for comparison.

5.3 CLEANUP ACTION ALTERNATIVES

5.3.1 Alternative 1: No Action (Figure 7)

This alternative is carried forward as the baseline alternative for comparison purposes. The Site would be managed under current conditions, including (1) routine inspection, maintenance, and upkeep of facility buildings, engineering controls, and water management features; (2) routine monitoring of surface water and ground water; and (3) applicable institutional controls such as fencing, security lighting, and signage. Deed restrictions would be required.

5.3.2 Alternative 2: Source Removal with Natural Attenuation and Monitoring (Figure 8)

Source materials (i.e., FB and FBR) would be removed and appropriately disposed of off-site which would require hazardous waste characterization. Concentrations of the contaminants in ground water, surface water, soils, and sediments will be reduced over time due to source removal and natural attenuation. Post-removal water monitoring data will be used to demonstrate the effectiveness of natural attenuation. West Ditch water would continue to discharge to the Colville River meeting substantive requirements of a NPDES permit. Stored water in the Evaporation Pond would continue to be managed through land application. Following source removal, management options (including closure) for the Main Ditch will be evaluated and possibly implemented.

5.3.3 Alternative 3: Source Removal with Groundwater Interception and Land Application (Figure 9)

This is Alternative 2 with collection of contaminated ground water within the SWBU and water treatment via land application. Ground water would be collected in French drains constructed along the north and northwest sides of the Site, as well as a small segment along the west side near the South Ditch. This water collection system typically would operate for 6 months during the dry season (May to October) to minimize collection of large volumes of diluted low-TDS surface water and precipitation infiltration. A new lined storage pond also would be constructed to handle the water to be captured by the French drain and the current North Field land application system would need to be expanded to include additional acreage to allow for long-term treatment of up to 4 million gallons of water. The pumped stored water would be land applied during the summer months.

5.3.4 Alternative 4: Source Removal with Ground Water Interception and Surface Water Collection (Figure 10)

This is Alternative 3 plus provisions for collecting West Ditch water for 6 months during the dry season.

5.3.5 Alternative 5: Source Removal, Soil Excavation, and Removal or Treatment of Excavation Water (Figure 11)

This is Alternative 2 with excavation to remove residual soil contamination in areas adjacent to the covered pile, as well as from the North Field areas. Soil removal below the water table would require engineering controls to dewater the excavation pit. Some or all of the shallow ground water that is pumped from the soils excavation pit would be used for dust and temperature control during covered pile source removal or shipped as a concentrated brine to an offsite treatment and disposal facility.

6.0 CLEANUP ACTION CRITERIA

The MTCA Cleanup Regulation describes the requirements for selecting a cleanup action (WAC 173-340-360). It specifies the criteria for approving cleanup actions, the order of preference for cleanup technologies, policies for permanent solutions, the application of these criteria to particular situations, and the process for making these decisions.

6.1 THRESHOLD REQUIREMENTS [WAC 173-340-360(2)]

All cleanup actions shall:

1. Protect human health and the environment.
2. Comply with cleanup standards.
3. Comply with applicable state and federal laws.
4. Provide for compliance monitoring.

6.2 OTHER REQUIREMENTS [WAC 173-340-360(3)]

The selected cleanup action must also:

1. Use permanent solutions to the maximum extent practicable.
2. Provide for a reasonable restoration time frame.
3. Consider public concerns raised during public comment on the draft cleanup action plan.

6.3 CLEANUP TECHNOLOGY HIERARCHY [WAC 173-340-360(4)]

Cleanup of hazardous waste sites shall utilize technologies that minimize the amount of untreated hazardous substances remaining at a site. The following technologies shall be considered in order of descending preference:

1. Reuse or recycling;
2. Destruction or detoxification;
3. Separation or volume reduction followed by reuse, recycling, destruction, or detoxification of the residual hazardous substances;
4. Immobilization of hazardous substances;

5. On-site or off-site disposal at an engineering facility designed to minimize the future release of hazardous substances and in accordance with applicable state and federal laws;
6. Isolation or containment with attendant engineering controls;
7. Institutional controls and monitoring.

6.4 CRITERIA FOR PERMANENT SOLUTIONS [WAC 173-340-360(5)]

When selecting a cleanup action, preference shall be given to permanent solutions to the maximum extent practicable. A permanent solution is one in which cleanup standards can be met without further action being required at the site. Ecology recognizes that permanent solutions may not be practicable for all sites. A determination that a cleanup action satisfies the requirement to use permanent solutions to the maximum extent practicable is based upon the following criteria:

- Overall protection of human health and the environment.
- Long term effectiveness.
- Short-term effectiveness.
- Permanent reduction of toxicity, mobility and volume of hazardous substances.
- Ability to be implemented.
- Cleanup costs.
- The degree to which community concerns is addressed.

7.0 EVALUATION OF PROPOSED REMEDIAL ALTERNATIVES

Applicable State and Federal Laws and Regulations to the five proposed alternatives have been identified in the FS Report. Table 12 shows a summary of the evaluations done for the five alternatives in relation to the threshold criteria and other requirements.

7.1 THRESHOLD CRITERIA

Of the five alternatives proposed, only Alternative 1 does not meet the threshold criteria. The source materials will continue to leach contaminants into the shallow ground water that in turn discharges to site ditches and the Colville River. Cleanup standards will not be met at the specified points of compliance for a prolonged period of time. Continued management of the Main Ditch (via pumping and seasonal land application) would be required to avoid uncontrolled release of chloride and ammonia to the Colville River. ARARs will not be complied with for a prolonged period of time.

Alternatives 2,3,4, and 5 all meet the threshold requirements. In these alternatives, the source of the contaminants that are released to the environment will be removed. Indicator constituents will undergo natural attenuation in the soils, ground water, and surface water after source removal by (1) plant utilization of ammonia and other bio-available nitrogen compounds, (2) seasonal flushing and dilution of chloride and other conservative constituents in soil and ground water by seasonal rainfall, snowmelt, and wet-season flooding, and (3) natural advective/dispersion processes. It is anticipated that cleanup levels and ARARs will be complied with several years after source removal. Compliance monitoring will be provided.

Alternatives 3 and 4, which include ground water interception and land application will reduce the loading to the Colville River during the dry season when the water levels are low. Contaminant loading to the river will be further reduced under Alternative 4 due to additional West Ditch surface water interception.

Alternative 5 is Alternative 2 with soil excavation, and removal and treatment of excavation water. Soil cleanup level would be met after excavation. Ground water cleanup levels and ARARs will be complied with over a shorter amount of time.

7.2 OTHER REQUIREMENTS

7.2.1 Use of Permanent Solutions to the Maximum Extent Practicable

When selecting a cleanup action, preference is given to permanent solutions to the maximum extent practicable. The criteria for evaluating whether a solution is permanent to the maximum extent practicable are discussed individually below and a comparison of the alternatives with the criteria using a scoring scale of 1 to 5 (1 being the lowest and 5 being the highest) is shown in Table 13.

7.2.1.1 Overall Protection of Human Health and the Environment

This includes the degree to which existing risks are reduced, time required to reduce the risk at the facility and attain cleanup standards, on-site and off-site risks resulting from implementing the alternative, the degree the cleanup action may perform to a higher level than specified cleanup standards, and improvement of the overall environmental quality.

Alternative 1 ranks the lowest since the source materials will not be removed and will continue to leach contaminants to ground water, soils, and surface water. Alternatives 2, 3, 4, and 5 all involve removing the source materials from the site. Alternative 2 does not actively address soil, ground water, and surface water contamination but anticipates that ammonia, chloride, and other conservative contaminants will be addressed through natural attenuation. Alternative 3 includes ground water collection and treatment that will reduce contaminant loading to the river during the dry season. Contaminant loading to the Colville River will be further reduced under Alternative 4 with additional surface water collection from the West Ditch during the dry season. Alternative 5 includes source materials removal, soils excavation and removal or treatment of excavation water. Compliance with soil cleanup levels and ground water, and surface water will be accelerated under this alternative.

7.2.1.2 Long Term Effectiveness

This is a measure of the degree of certainty that the alternative will be successful, long-term reliability, magnitude of residual risk, and effectiveness of controls required to manage treatment residues and wastes.

Alternative 1 is ranked very low since the success of this alternative in terms of meeting cleanup levels will not be achieved over a very prolonged period of time. Existing control measures at the Site must be maintained to minimize and control releases to the environment. Alternatives 2, 3, 4, and 5 all will be successful with Alternative 5 achieving success over the shortest period of time. Long-term reliability and magnitude of residual risks are the same for these alternatives.

7.2.1.3 Short Term Effectiveness

This includes protection of human health and the environment during construction and implementation of the alternative, and the degree of risk to human health and the environment prior to attainment of cleanup standards.

Current risks to human health and the environment remain the same under the No Action or Alternative 1. Risks to workers during material's removal and off-site disposal could occur under Alternatives 2, 3, 4, and 5. Additional risks to workers during trench construction in Alternatives 3 and 4, and during soil excavation in Alternative 5 are also potentially present. As a consequence of materials removal action in Alternatives 2, 3, 4, and 5, concentrations in all the Site media could increase temporarily due to disturbances.

7.2.1.4 Permanent Reduction in Toxicity, Mobility, and Volume of Hazardous Substances

This considers the adequacy of the alternative in destroying the hazardous substances, reduction or elimination of hazardous substances releases and sources of releases, degree of irreversibility of waste treatment process, and the characteristics and quantity of treatment residuals generated.

Alternative 1 would not reduce the toxicity or volume of hazardous substances at the Site. Alternatives 2, 3, 4, and 5 would effectively reduce the volume of source materials on site and would eliminate leaching of the contaminants to ground water and other site media. Additional volume of contaminated soils would be removed in Alternative 5. The collection of ground water (Alternative 3) and of ground water and West Ditch water (Alternative 4) will reduce the contaminant loading to the river during the dry season when water levels are low. The land application of these waters will remove most of the ammonia and some of the chloride.

7.2.1.5 Implementability

This includes consideration of whether the alternative is technically possible, availability of necessary off-site facilities, services and materials, administrative and regulatory requirements, scheduling, size, complexity, monitoring requirements, access for construction, operations and monitoring, and integration with existing facility operations and other current or potential remedial actions.

Alternative 1 is the easiest to implement. Source material removal and off-site disposal in Alternatives 2, 3, 4, and 5 can be implemented as demonstrated by a previous interim action that removed 65,000 tons of materials piled around and on top of the magnesite residue pile. Adequate materials characterization must be performed to determine regulatorily acceptable disposal sites. Continued discharge of the West Ditch into the Colville River must meet NPDES requirements. The collection of ground water and West Ditch surface water are also easily implementable although additional storage ponds must be constructed. Soils excavation under Alternative 5 will add to volume of contaminated material to be disposed.

7.2.1.6 Cleanup Costs

A cleanup action shall not be considered practicable if the incremental cost of the cleanup action is substantial and disproportionate to the incremental degree of protection it would achieve over a lower preference cleanup action. When selecting from among two or more cleanup action alternatives, which have an equivalent level of preference, preference may be given to the least cost alternative.

The estimated cleanup costs for each of the alternatives are as follows:

REMEDIAL ALTERNATIVE	CAPITAL COST	OPERATION AND MAINTENANCE	TOTAL COST
Alternative 1	$ 120,000	$1,181,000	$ 1,301,000
Alternative 2	$ 6,893,000	$ 911,000	$ 7,804,000
Alternative 3	$ 7,822,000	$2,097,000	$ 9,919,000
Alternative 4	$ 8,148,000	$2,638,000	$10,786,000
Alternative 5	$14,740,000	$1,197,000	$15,937,000

These costs are extracted from the Feasibility Study Report. The projected costs are in October 1998 dollars and do not include escalation.

The costs for these alternatives are based on 30 years of Operation and Maintenance. For Alternative 1, cleanup levels are not anticipated to be met after 30 years; total cost will be much higher to continue monitoring and maintain controls for an indeterminate amount of time.

7.2.2 Provide for a Reasonable Restoration Time Frame

Criteria for establishing a reasonable restoration time frame are outlined in WAC 173-340-360(6). Restoration time frame is the longest for Alternative 1 and shortest for Alternative 5 (see Table 12). Restoration time frame for Alternatives 2, 3, and 4 are all expected to be between 20 to 30 years.

7.2.3 Consider Public Concerns Raised During Public Comment on the Draft Cleanup Action Plan

Ecology will provide the public with an opportunity to review and comment on the draft cleanup action during a 30-day public comment period.

7.3 CLEANUP TECHNOLOGY PREFERENCE

Alternatives 2, 3, 4, and 5 all utilize source removal and off-site disposal at an engineered facility, if necessary, to minimize future release of hazardous substances. Alternatives 3 and 4 would employ the additional collection and treatment of ground water (Alternative 3) or of ground water and West Ditch Water (Alternative 4) to minimize discharge of contaminants to the River during the dry season. Alternative 5 will remove the contaminated soils on Site. Alternative 5 has the highest preference because in addition to source removal, it would remove the contamination in the soils. Alternatives 2, 3, and 4 are almost of the same preference, although Alternative 4 is slightly higher than Alternative 3, and Alternative 3 slightly higher than Alternative 2.

8.0 SITE CLEANUP ACTION

Of the alternatives presented, Alternatives 2, 3, 4, and 5 meet the remedial action goals discussed in Section 5.1. The primary differences are the rate at which cleanup of the site would be achieved and the relative costs of the alternatives. The relative difference in environmental protection and in the level of remediation achieved by these four alternatives is small. Alternative 5 provides the shortest restoration time frame but costs the most. The restoration time frame for Alternatives 2, 3, and 4 are almost the same and the cost differentials between these alternatives are not as drastic, but still significant. Alternatives 2, 3, and 4 therefore provide equivalent environmental protection and reduction of risk at a significantly lower cost compared to Alternative 5.

The major cleanup component of Alternatives 2, 3, and 4 is the off-site disposal of source materials at a permitted waste facility, which is not a permanent solution. The interception and land application of ground water/surface water in Alternatives 3 and 4, which will treat most of the ammonia (but not the chloride) and reduce the loading of the contaminants to the Colville River during the dry season, is partially permanent. Implementability of Alternatives 3 and 4 will be much more difficult than Alternative 2 since additional water storage and land application area will be required. The costs for Alternatives 3 and 4 are higher than Alternative 2.

MTCA recognizes that permanent solutions may not be practicable for all sites but requires that the cleanup action must satisfy the criteria outlined in WAC 173-340-360(5)(d) used to determine whether the cleanup is "permanent to the maximum extent practicable". Table 13 shows that the average environmental benefit is the same for Alternatives 2, 3, and 4 with Alternative 2 showing the highest overall average for permanence when cost and implementation are considered. Alternative 2 is the most cost effective and is "permanent to the maximum extent practicable". Therefore, Ecology's selected cleanup action for the L-Bar Site is Alternative 2 (see Figure 8).

Having met the permanence criteria, Alternative 2 is also determined to have met "All Known Available and Reasonable Methods of Treatment" (AKART) requirements in relation to the ground water discharge and West Ditch water discharge to the Colville River.

8.1 SOURCE MATERIALS REMOVAL

Most L-Bar source materials that continue to leach contaminants to ground water are located within the covered pile. These source materials will be removed and disposed of off-site. These materials will be characterized accordingly to determine appropriate disposal sites. All federal and state regulations regarding waste transport and disposal will be complied with.

Concentrations of indicator substances in shallow ground water and soil in the immediate vicinity of the covered pile may increase temporarily due to excavation-related disturbances. It is expected that these disturbances will not promote adverse changes to the nature and extent of contamination in areas hydraulically downgradient of the covered pile area. The general low permeability of the native soils, slow ground water flow rates within the SWBU, and hydraulic impedance provided by the HDPE barrier wall system are all expected to temper any short-term concentration changes downgradient of the covered pile area. Excavation work near the water table will be performed in a manner that minimizes, to the extent possible, the potential for increased leaching and release of indicator substances into the SWBU and nearby soils. Dewatering around the covered pile will be performed, if necessary, to facilitate the excavation work, and/or to minimize soil and ground water impacts.

8.2 GROUND WATER AND SOILS/SEDIMENTS

Contaminants in ground water and in the soils/sediments are expected to decrease over time due to natural attenuation. Ammonia will be reduced due to natural processes of ammonia conversion via plant uptake, nitrification, and biodegradation. Concentrations of chloride and other constituents which move conservatively in ground water will be reduced mostly by seasonal flushing and dilution.

Ground water that is pumped from the SWBU as a result of source removal activities at the covered pile will be used for dust amd temperature control of materials during removal to the extent possible. Excess water will be stored in the Evaporation Pond and managed as appropriate. This may include land application, use of the ground water for dust and temperature control of materials removed, or the shipment as a concentrated brine to an off-site facility for treatment or disposal.

8.3 SURFACE WATER

Concentrations of contaminants in the Main Ditch and the West Ditch surface waters are expected to decrease after source removal via natural attenuation.

The surface water level in the Main Ditch, which does not discharge to the Colville River, will continue to be maintained by pumping excess water to the Evaporation Pond. The stored water in the Evaporation Pond will also continue to be seasonally land applied to the North Field meeting the substantive requirements of a State Waste Discharge permit that have been previously identified for this Site, or applied to source materials for dust and temperature control. Following completion of source removal, other Main Ditch management options (such as closure) will be considered and may be implemented.

Water in the West Ditch will continue to discharge to the Colville River. This discharge will have to meet all substantive requirements of a NPDES permit, which are identified in Appendix A.

8. 4 MONITORING

A compliance monitoring plan, shall be prepared in accordance with the requirements of WAC 173-340-410 to address the following objectives:

1. Protection monitoring. Monitoring will be conducted during implementation of the cleanup action to confirm that human health and the environment are being protected. Air quality (i.e., ammonia levels) will be monitored at appropriate site areas to ensure the protection of site workers and nearby residents. Site-wide ground water quality will continue to be monitored during the period of active source removal. Post-removal confirmational samples will be collected to document concentrations of indicator substances in the native soils underlying the covered pile.

2. Performance monitoring. Monitoring will be conducted to confirm that the cleanup action has attained cleanup standards and other performance standards. Compliance with cleanup levels and other performance standards will be done in accordance with the statistical requirements of MTCA. Performance monitoring will continue until cleanup levels are met in all media. NWA may request and get approval from Ecology to stop monitoring if compliance with cleanup levels is shown to be not attainable, upon which Ecology will review if additional remedial actions are needed. Ground water, soils, and surface water shall be monitored to evaluate the performance of cleanup technologies and demonstrate compliance with substantive requirements of applicable state and federal laws. Surface water monitoring of the West Ditch will also be performed in accordance with the substantive requirements of a NPDES permit.

3. Confirmational monitoring. The long-term effectiveness of the cleanup action once cleanup standards and other performance standards have been attained will be confirmed through continued monitoring.

8.5 INSTITUTIONAL CONTROLS

For this Site, institutional controls will be required because (1) Method C Commercial exposure assumptions are used for soils (WAC 173-340-706(1)(a); and, (2) A conditional point of compliance for ground water is established.

8.6 PERMIT REQUIREMENTS

RCW 70.105D.090 exempts remedial actions at a facility conducted under a consent decree, order, or agreed order from the procedural requirements of chapters 70.94, 70.95, 70.105, 75.20, 90.48 and 90.58 RCW and of any laws requiring or authorizing local government permits or approvals. However, the Department shall ensure compliance with the substantive provisions of such permits or approvals.

The West Ditch discharges to the Colville River, which is a Class A Surface Body of Water of the State of Washington. Discharge from the ditch to the River does not require a NPDES permit; however, all substantive requirements of the permit must be complied with. Substantive Requirements have been identified as shown in Appendix A.

Substantive Requirements for a State Waste Discharge Permit had been identified under a previous interim action for land applying Evaporation Pond water to the North Field.

For removal and off-site disposal of the source materials, substantive requirements for permits under 70.105 RCW must be met, if applicable. The proposed material's removal action will also result in the release of ammonia to air. If necessary, substantive requirements for applicable air permits must also be satisfied.

Substantive requirements of applicable local permits must also be complied with.

9.0 EVALUATION OF THE CLEANUP ACTION WITH RESPECT TO MTCA CRITERIA

9.1 EVALUATION WITH RESPECT TO THRESHOLD CRITERIA

9.1.1 Protection of Human Health and the Environment

The selected remedy is protective of human health and the environment. The removal of materials will stop the leaching of contaminants to the ground water, which flows to an agricultural field and which then discharges to the river and also to the ditches.

9.1.2 Compliance with Cleanup Standards

Contaminants in ground water, surface water, soils, and sediments will meet cleanup standards several years after source removal is completed. While cleanup levels have not been attained, monitoring and other engineering/institutional controls at the Site will be implemented to make sure that human health and the environment is still being protected.

9.1.3 Compliance with Applicable State and Federal Laws

The selected remedy will comply with applicable state and federal laws, identified in Table 14. Local laws, which may be more stringent than specified state and federal law, will govern where applicable.

9.1.4 Provide for Compliance Monitoring

The selected remedy will provide for compliance monitoring. A compliance monitoring plan will be prepared in accordance with the requirements in WAC 173-340-410.

9.2 EVALUATION WITH RESPECT TO OTHER REQUIREMENTS

9.2.1 Use of Permanent Solutions to the Maximum Extent Practicable

Source removal followed by off-site removal at an engineered facility is not considered permanent. Natural attenuation of ammonia and flushing and dilution of chloride and other conservative contaminants may be considered permanent. Ecology recognizes that permanent solutions may not be practicable for all sites. A cleanup action involving off-site transport and disposal of hazardous substances without treatment shall not be used if a treatment technology or method exists which will attain cleanup standards and is practicable. Treatment of the source materials at the Site is impractical, given its large volume and its low levels of hazardous substances. Reuse/Recycling of the materials is not economically feasible. Therefore, this selected cleanup action is "permanent to the maximum extent practicable" based on the criteria under WAC 173-340-360(5)(e) [see Table 13].

Ecology has also determined that meeting the criterion "permanent to the maximum extent practicable" also satisfies the "All Known Available and Reasonable Method of Treatment (AKART)" requirement in relation to ground water and West Ditch water discharging to the Colville River.

9.2.1.1 Long-term Effectiveness

Long-term effectiveness will be achieved by removing the source of contamination.

9.2.1.2 Short-term Effectiveness

Risks associated with the cleanup action include potential exposure of workers to the source materials, soil, ground water, and surface water during removal activities, and exposure to ammonia vapor during materials removal and transport. Mitigation measures will be part of the remedial design, and on-site monitoring will be conducted.

9.2.1.3 Permanent Reduction of Toxicity, Mobility, and Volume

The removal of source materials will permanently reduce the volume of hazardous substances on site. Natural attenuation, over time, will reduce the toxicity and mobility of residual source-related constituents that are present in the Site media.

9.2.1.4 Implementability

This selected remedy is readily implemented.

9.2.1.5 Cost

The cost for this selected remedy is significantly less than the cost for Alternatives 3, 4, and 5 which provides almost the same level of protection and risk reduction.

9.2.2 Provide for a Reasonable Restoration Time Frame

Restoration time frame for this alternative is estimated to be from 20 to 30 years. Ecology believes that this is a reasonable restoration time frame based on the criteria under WAC 173-340-360(6).

9.2.3 Consider Public Concerns

Ecology will provide opportunity for the public to review and comment this Draft Cleanup Action Plan. Public comments and concerns will be evaluated in developing the final Cleanup Action Plan.

10.0 IMPLEMENTATION SCHEDULE

Submittal of the following documents for Ecology's review and approval will be required within ninety (90) days of the date of signing the Agreed Order or other instrument implementing this cleanup action plan:

Material Removal and Disposal Management Plan
Institutional Control Plan
Compliance Monitoring Plan (including medium specific Sampling and Analysis Plan, and Quality Assurance Procedures Plan)
Health and Safety Plan
Data Management Plan

Public notice and opportunity to comment will be provided on these plans.

A cleanup action report will be submitted no later than 3 months after completion of the removal of materials.

The Material Removal and Disposal Management Plan shall constitute the Engineering Design and Construction and Specifications Report requirements of MTCA.

11.0 REFERENCES CITED

CH2M HILL. L-Bar Baseline Human Health and Ecological Risk Assessment Report. January 1999.

CH2M HILL. L-Bar Phase I Remedial Investigation Report, August 1998.

CH2M HILL. L-Bar Cleanup Levels Development and Feasibility Study Report, May 1999.

Ecology. L-Bar Site Cleanup Standards Development (draft). October 22, 1998.

TABLE 1. APPLICABLE CRITERIA FOR SHALLOW GROUNDWATER

		DRINKING WATER CRITERIA						SURFACE FRESH WATER CRITERIA						
		ARAR												
ANALYTE	UNITS	MCL	SMCL	Cancer Risk	Hazard Quotient	MTCA Method B (formula)	Basis	MTCA Method B (formula)	Acute	Chronic	Human Health	Source and Comments	IRRIGATION WATER CRITERIA	AREA BACK-GROUND
Major Anions														
Alkalinity, Bicarbonate	mg/L													724.72
Alkalinity, Carbonate	mg/L									**20000 ***		AWQC		654
Chloride	mg/L		250						860	**230 ***	As TDS	WAC 173-201A		74.85
Fluoride	mg/L	4	2		4.17	**0.96 ***	NCAR							0.75
Sulfate	mg/L	500	250								As TDS			416
Major Cations														
Calcium	mg/L										As TDS			173.5
Magnesium	mg/L										As TDS			225.6
Potassium	mg/L										As TDS			9.82
Sodium	mg/L										As TDS			175.4
Conventionals														
Ammonia as N	mg/L					272	NCAR		0.80(b)	**0.13 (b) ***		WAC 173-201A		0
Chemical Oxygen Demand	mg/L													0
Conductivity	umhos/cm													4040
Nitrate as N	mg/L	**10 ***			0.391	25.6	NCAR				**10 ***	AWQC		0.85
Nitrite as N	mg/L	**1 ***			0.625	1.6	NCAR							0
Orthophosphate as P	mg/L													0.65
pH	units		**6.5 - 8.5 ***						**6.5 - 8.5 ***			WAC 173-201A		8.19
Total Dissolved Solids (TDS)[1]	mg/L		500								250 (a)	AWQC	500 (c)	**1092.4 ***
Total Kiejdahl Nitrogen (TKN)	mg/L													0
Total Phosphorus - P	mg/L					3.20E-04	NCAR							**0.22 ***
Total Suspended Solids	mg/L													0
Turbidity	NTU	5							<5 NTU over BG			WAC 173-201A		**20.4 ***

[1] TDS includes carbonates chlorides, sulfates, nitrates, sodium, potassium, calcium, and magnesium.

*** Final Method B cleanup level**
(a) 250 mg/L for chlorides and sulfates.
(b) at pH 8.88 and 23.1 C
(c) AWQC

CAR - carcinogen
NCAR - noncarcinogen

TABLE 1. APPLICABLE CRITERIA FOR SHALLOW GROUNDWATER

		DRINKING WATER CRITERIA						SURFACE FRESH WATER CRITERIA						
		ARAR												
ANALYTE	UNITS	MCL	SMCL	Cancer Risk	Hazard Quotient	MTCA Method B (formula)	Basis	MTCA Method B (formula)	Acute	Chronic	Human Health	Source and Comments	IRRIGATION WATER CRITERIA	AREA BACK-GROUND
Trace Metals														
Aluminum	ug/L		50 - 200						750	87		EPA-440/5-86-008		**510 ***
Antimony	ug/L	**6 ***							9000	1600	14	NTR-HH		0
Arsenic	ug/L	50		8.57E-04	10.4	0.0583	CAR	0.0982	360	190	0.018	WAC 173-201A, NTR-RR		**5.4 ***
Barium	ug/L	2000			1.79	1120	NCAR				**1000 ***	AWQC		447.8
Beryllium	ug/L	4		1.97E-04	0.005	**0.0203 ***	CAR	0.0793	130	5.3		AWQC		0
Boron	ug/L					1440	NCAR						**750 * (c)**	
Cadmium[2]	ug/L	5			0.625	8	NCAR	20.3	7.84	**1.72 ***		WAC 173-201A		0
Chromium (Hex)	ug/L					80	NCAR	810	16	**11 ***		WAC 173-201A		0
Cobalt	ug/L													0
Copper[2]	ug/L	1300	1000			592	NCAR	2660	32.7	**20.52 ***		WAC 173-201A		0
Iron	ug/L		300							1000		AWQC		**540.4 ***
Lead[2]	ug/L								136.14	**5.31 ***		WAC 173-201A		0
Manganese	ug/L		50			2240	NCAR				50	AWQC		**440.2 ***
Mercury	ug/L	2			0.417	4.8	NCAR		2.1	**0.012 ***	0.14	WAC 173-201A, NTR-HH		0
Nickel[2]	ug/L	**100 ***			0.312	320	NCAR	1100	2544.21	282.55	610	WAC 173-201A, NTR		**0**
Selenium	ug/L	50				80	NCAR		20	5		WAC 173-201A		**8.2 ***
Silver[2]	ug/L	50	100		0.625	80	NCAR	25900	**11.37 ***			WAC 1730201A		0
Thallium	ug/L	2			1.79	**1.12 ***	NCAR	1.56	1400	40	1.7	Gold Book, NTR-HH		0
Vanadium	ug/L					**112 ***	NCAR							4.8
Zinc[2]	ug/L		500			4800	NCAR	16500	205.91	**188.02 ***		WAC 173-201A		30.4
[2] At 200 mg/L hardness														

CAR - carcinogen
NCAR - noncarcinogen

*** Final Method B cleanup level**
(a) 250 mg/L for chlorides and sulfates.
(b) at pH 8.88 and 23.1 C
(c) AWQC

TABLE 2. INDICATOR SUBSTANCE SCREENING - GROUND WATER

ANALYTE	UNITS	Frequency of Detection	Maximum Concentration	Method B Cleanup Level (Table 2)	Basis	Screening Comments
Major Anions						
Alkalinity, Bicarbonate	mg/L	0.87	634	na		No cleanup level
Alkalinity, Carbonate	mg/L	0.33	66	20000	AWQC	< cleanup level
Chloride	mg/L	1	45,400	230	WAC 173-201A	INDICATOR
Fluoride	mg/L	1	0.71	0.96	BNCAR	< cleanup level
Sulfate	mg/L	1	1790	As TDS		As TDS
Major Cations						
Calcium	mg/L	1	2530	As TDS		As TDS
Magnesium	mg/L	1	3580	As TDS		
Potassium	mg/L	1	12200	As TDS		
Sodium	mg/L	1	10600	As TDS		
Conventionals						
Ammonia as N	mg/L	0.8	1030	0.13	WAC 173-201A	INDICATOR
Chemical Oxygen Demand	mg/L	0.4	2690	na		No cleanup level
Conductivity	umhos/cm	1	31500	na		No cleanup level
Nitrate as N	mg/L	0.47	40	10	MCL, AWQC	INDICATOR
Nitrite as N	mg/L	0.27	4.64	1	MCL	INDICATOR
Orthophosphate as P	mg/L	0.6	0.84	na		No cleanup level
pH	units	1	9.75	8.5	SMCL, WAC 173-201A	INDICATOR
Total Dissolved Solids (TDS)	mg/L	1	68800	1092.4	Background	INDICATOR
Total Kiejdahl Nitrogen (TKN)	mg/L	0.93	991	na		No cleanup level
Total Phosphorus - P	mg/L	0.33	0.29	0.22	Background	All exceedances very close to background
Turbidity	NTU	0.93	57	20.4	Background	Comment 1
Trace Metals						
Aluminum	ug/L	0.73	4220	510	Background	Comment 1
Antimony	ug/L	0		6	MCL	0 frequency of detection
Arsenic	ug/L	0.67	20	5.4	Background	Comment 1
Barium	ug/L	1	3760	1000	AWQC	INDICATOR
Beryllium	ug/L	0		0.0203	BCAR	0 frequency of detection

na - not available

* 250 mg/L for chlorides and sulfates; 500 mg/L TDS

TABLE 2. INDICATOR SUBSTANCE SCREENING - GROUND WATER

ANALYTE	UNITS	Frequency of Detection	Maximum Concentration	Method B Cleanup Level (Table 2)	Basis	Screening Comments
Boron	ug/L	0.4	13500	750	AWQC- Irrigation	Comment 2
Cadmium	ug/L	0.07	2	1.72	WAC 173-201A	~ cleanup level
Chromium	ug/L	0		11	WAC 173-201A	0 frequency of detection
Cobalt	ug/L	0.13	4.8	na		No cleanup level
Copper	ug/L	0.27	14.5	20.52	AWQC	< cleanup level
Iron	ug/L	0.8	9790	540.4	Background	Comment 1
Lead	ug/L	0.27	6	5.31	AWQC	~ cleanup level
Manganese	ug/L	0.93	18300	440.2	Background	INDICATOR
Mercury	ug/L	0		0.012	WAC 173-201A, AWQC	0 frequency of detection
Nickel	ug/L	0		100	MCL	0 frequency of detection
Selenium	ug/L	1	54	8.2	Background	INDICATOR
Silver	ug/L	0		11.37	AWQC	0 frequency of detection
Thallium	ug/L	0.73	52	1.12	BNCAR	INDICATOR
Vanadium	ug/L	0.4	18.2	112	BNCAR	< cleanup level
Zinc	ug/L	0.27	114	188.02	WAC 173-201A	< cleanup level

COMMENTS ON TABLE 2:

1. The monitoring wells in the North Field are screened within volcanic ash or native silty sands deposited in the river floodplain. One other well, P-14, is also screened within silty material. This material is different in grain size and mineralogy than in other areas of the Site. Turbidity and trace metal exceedances are related to lithologic conditions. The following are not indicators because the exceedances of cleanup levels (only in North Field wells and sometimes in P-14) are considered to be naturally occurring : turbidity, aluminum, arsenic, and iron.

2. The concentration of boron exceeds the agriculture criterion in P-14 which is outside of the North Field. Also, one background well has a concentration higher than this maximum concentration measured.

na - not available

* 250 mg/L for chlorides and sulfates; 500 mg/L TDS

TABLE 3 - GROUND WATER CLEANUP LEVELS AND RISK CALCULATIONS

INDICATOR SUBSTANCE	UNITS	METHOD B CLEANUP LEVEL	BASIS	CANCER RISK	HAZARD QUOTIENT				
					taste threshold	hemotoxicity	cardiovascular toxicity	clinical selenosis	other
Major Anions									
chloride	mg/L	230	AWQC	Not calculated					
Conventionals									
Ammonia as N	mg/L	0.13	WAC 173-201A		0.0005				
Nitrate as N	mg/L	10	MCL, AWQC			0.3906			
Nitrite as N	mg/L	1	MCL			0.625			
pH	units	8.5	SMCL, AWQC	Not calculated					
TDS	mg/L	1092.4	Background	Not calculated					
Trace Metals									
Barium	ug/L	1000	AWQC				0.8929		
Manganese	ug/L	440.2	Background	Not calculated					
Selenium	ug/L	8.2	Background	Not calculated					
Thallium	ug/L	1.12	BNCAR						1
Total cancer risk =				0					
Total Hazard Index =					0.0005	1.0156	0.8929	0	1

* 250 mg/L for chlorides and sulfates; 500 mg/L TDS

TABLE 4. APPLICABLE CLEANUP CRITERIA FOR SOILS

ANALYTE	UNITS	METHOD C COMMERCIAL CLEANUP LEVEL	BASIS	AGRICUL-TURE CRITERIA	BACKGROUND		PROTECTION OF GROUND WATER	METHOD C CLEANUP LEVEL	BASIS
					NATURAL	AREA			
Major Anions and Cations									
Chloride	mg/Kg					33.6	23000	23,000	GW
Calcium	mg/Kg				5493	7100		Comment 1	
Magnesium	mg/Kg				3415	1590		Comment 1	
Potassium	mg/Kg					204		Comment 1	
Sodium	mg/Kg				298	147		Comment 1	
Conventionals									
Ammonia as N	mg/Kg	10900000	NCAR				13	13	GW
Cation Exchange Capacity(CE	meq/100g					19.1		Comment 1	
Nitrate as N	mg/Kg					141	1000	1000	GW
pH				5.5 - 8.5		7.76		8.5	Agriculture
Total Organic Carbon, TOC	mg/Kg					36600		Comment 1	
Trace Metals									
Aluminum	mg/Kg				21376	18500		Comment 1	
Antimony	mg/Kg				5	0		Comment 1	
Arsenic	mg/Kg	66.7	CAR		9.34	12.4		66.7	NCAR
Barium	mg/Kg	22400	NCAR		255	266	100	100	GW
Beryllium	mg/Kg	9.3	CAR		0.8	0.72		9.3	NCAR
Cadmium	mg/Kg	320	NCAR		0.7	7.8		320	NCAR
Chromium	mg/Kg	1600	NCAR		17.8	24.9		1600	NCAR
Cobalt	mg/Kg				11	10.1		Comment 1	
Copper	mg/Kg	11800	NCAR		21.6	79.2		11800	NCAR
Iron	mg/Kg				25026	23700		Comment 1	
Lead	mg/Kg	250	A		14.9	303		303	Background
Manganese	mg/Kg	44800	NCAR		664	665	44	44	GW
Mercury	mg/Kg	96	NCAR		0.02	0.26		96	NCAR
Nickel	mg/Kg	6400	NCAR		16.2	23.1		6400	NCAR

NCAR - Noncarcinogenic
CAR - Carcinogenic
A - Method A
GW -Pprotection of ground water

TABLE 4. APPLICABLE CLEANUP CRITERIA FOR SOILS

ANALYTE	UNITS	METHOD C COMMERCIAL CLEANUP LEVEL	BASIS	AGRICUL-TURE CRITERIA	BACKGROUND		PROTECTION OF GROUND WATER	METHOD C CLEANUP LEVEL	BASIS
					NATURAL	AREA			
Selenium	mg/Kg	1600	NCAR		0.78	0.68	0.82	0.82	GW
Silver	mg/Kg	1600	NCAR		0.61	0		1600	NCAR
Thallium	mg/Kg	22.4	NCAR			0.37	0.112	0.112	GW
Vanadium	mg/Kg	2240	NCAR		45	37.2		2240	NCAR
Zinc	mg/Kg	96000	NCAR		66.4	337		96,000	NCAR

Comments on Table 4:

1. Constituent does not have toxicity numbers available (or Method C formula value), applicable ARAR concentrations, or protection of ground water criterion. No Method C level is set.

NCAR - Noncarcinogenic
CAR - Carcinogenic
A - Method A
GW -Pprotection of ground water

TABLE 5. INDICATOR SUBSTANCE SCREENING - SOILS

ANALYTE	UNITS	DETECTION FREQUENCY	MAXIMUM CONCENTRATION	METHOD C CLEANUP LEVEL	BASIS	SCREENING COMMENTS
Major Anions and Cations						
Chloride	mg/Kg	1	70,500	23000	GW	INDICATOR
Calcium	mg/Kg	0.6	31400	na		No cleanup level
Magnesium	mg/Kg	1	45000	na		No cleanup level
Potassium	mg/Kg	1	25600	na		No cleanup level
Sodium	mg/Kg	1	2960	na		No cleanup level
Conventionals						
Ammonia as N	mg/Kg	0.67	1960	13	GW	INDICATOR
Cation Exchange Capacity(CEC)	meq/100g	1	41.5	na		No cleanup level
Nitrate as N	mg/Kg	0.88	231	1000	GW	< cleanup level
pH		1	9.69	8.5	Agriculture	INDICATOR
Total Organic Carbon, TOC	mg/Kg	1	80,300	na		No cleanup level
Trace Metals						
Aluminum	mg/Kg	1	31800	na		No cleanup level
Antimony	mg/Kg	0.59	32.8	na		No cleanup level
Arsenic	mg/Kg	1	87.5	na	CNCAR	Comment 1
Barium	mg/Kg	1	538	100	GW	INDICATOR
Beryllium	mg/Kg	0.5	1.2	9.3	CNCAR	< cleanup level
Cadmium	mg/Kg	0.38	6.8	320	CNCAR	< cleanup level
Chromium	mg/Kg	1	39.5	1600	CNCAR	< cleanup level
Cobalt	mg/Kg	1	23.7	na		No cleanup level
Copper	mg/Kg	1	587	11800	CNCAR	< cleanup level
Iron	mg/Kg	1	47000	na		No cleanup level
Lead	mg/Kg	1	172	303	Background	< cleanup level
Manganese	mg/Kg	1	1120	44	GW	INDICATOR
Mercury	mg/Kg	0.61	1.2	96	CNCAR	< cleanup level
Nickel	mg/Kg	0.88	70.5	6400	CNCAR	< cleanup level
Selenium	mg/Kg	0.5	11.5	0.82	GW	INDICATOR
Silver	mg/Kg	0.58	3.7	1600	CNCAR	< cleanup level
Thallium	mg/Kg	0.08	0.39	0.112	GW	INDICATOR
Vanadium	mg/Kg	1	91.8	2240	CNCAR	< cleanup level
Zinc	mg/Kg	1	1590	96000	CNCAR	< cleanup level

Comments on Table 5:

1. The two exceedances in arsenic concentrations are from magnesite residue pile borings. Magnesite residue material has been shown to have elevated arsenic content. The arsenic found in these two borings is therefore arsenic in the magnesite residue. Arsenic is not considered an indicator.

na - not available

GW - protection of ground water
CNCAR - Method C, noncarcinogen

TABLE 6. SOILS METHOD C CLEANUP LEVELS AND RISK CALCULATIONS

					Hazard Index				
INDICATOR SUBSTANCE	UNITS	METHOD C CLEANUP LEVEL	BASIS	CANCER RISK	Taste Threshold	Cardiovascular Toxicity	Neurotoxicity	Clinical Selenosis	Other
Major Anions and Cations									
chloride	mg/Kg	23000	GW	Not calculated					
Conventionals									
ammonia	mg/Kg	13	GW		1.19266E-06				
Trace Metals									
Barium	mg/Kg	100	GW			0.00446			
Manganese	mg/Kg	44	GW				0.00098		
Selenium	mg/Kg	0.82	GW					0.00205	
Thallium	mg/Kg	0.112	GW						0.005
			Total cancer risk =	0					
			Hazard Quotient =		1.19266E-06	0.00446	0.00098	0.00205	0.005

GW - Protection of ground water

TABLE 7. INDICATOR SUBSTANCE SCREENING - WEST DITCH

ANALYTE	UNITS	Most Stringent Criteria (Table 1*)	WD4 Concentrations (Background)	Method B Cleanup Level	Maximum Concentration	No. of Samples Exceeding Cleanup Level **	Screening Comments
Major Anions							
Chloride	mg/L	230	105	230	309	3	INDICATOR
Sulfate	mg/L	As TDS	36.5		729	3	As TDS
Major Cations							
Calcium	mg/L	As TDS	33.9		40.3		As TDS
Magnesium	mg/L	As TDS	66.6		143		
Potassium	mg/L	As TDS	35		417		
Sodium	mg/L	As TDS	20.7		61		
Conventionals							
Alkalinity, Total as CaCO3	mg/L	20000	272	20000	272	0	< cleanup level, = Background
Ammonia as N	mg/L	0.13	0	0.13	2.8	2	INDICATOR
Biological Oxygen Demand (BOD), 5-Day	mg/L	na	0	na	13		No cleanup level
Chemical Oxygen Demand	mg/L	na	0	na	0	0	0 detection
Conductivity	umhos/cm	na	900	na	2930		No cleanup level
Nitrate as N	mg/L	10	0.088	10	6.77	0	< cleanup level
Nitrite as N	mg/L	1	0	1	0	0	0 detection
Orthophosphate as P	mg/L	na	0	na	0		No cleanup level, 0 detection
pH	units	8.5	7.81	8.5	7.93	0	< cleanup level
Total Dissolved Solids (TDS)	mg/L	(a)	436	(a)	1870	3	INDICATOR
Total Kiejdahl Nitrogen (TKN)	mg/L	na	0.5	na	3.2		No cleanup level
Total Organic Carbon (TOC)	mg/L	na	7.6	na	7.6		No cleanup level, = Background
Total Phosphorus - P	mg/L	na	0	na	0		0 detection
Total Suspended Solids	mg/L	na	0	na	16		No cleanup level
Turbidity	NTU	5	9.4	9.4	17.3	2	Comment 1
Trace Metals							
Aluminum	ug/L	87	273	273	647	3	Comment 1
Antimony	ug/L	6	0	6	0		0 detection
Arsenic	ug/L	0.018	0	0.018	4.4	3	Comment 1
Barium	ug/L	1000	125	1000	118	0	< cleanup level
Beryllium	ug/L	0.0203	0	0.0203	0		0 detection
Boron	ug/L	750	0	750	0		0 detection
Cadmium	ug/L	1.72	0	1.72	0		0 detection
Chromium	ug/L	11	0	11	0		0 detection
Cobalt	ug/L	na	0	na	0		No cleanup level

* Excluding area background

** Out of 3 samples

(a) 250 mg/L for chlorides and sulfates
500 mg/L for TDS (SMCL and irrigation)

TABLE 7. INDICATOR SUBSTANCE SCREENING - WEST DITCH

ANALYTE	UNITS	Most Stringent Criteria (Table 1*)	WD4 Concentrations (Background)	Method B Cleanup Level	Maximum Concentration	No. of Samples Exceeding Cleanup Level **	Screening Comments
Copper	ug/L	20.52	0	20.52	0		0 detection
Iron	ug/L	300	414	414	584	3	Comment 1
Lead	ug/L	5.31	1	5.31	0	0	0 detection
Manganese	ug/L	50	187	187	207	1	Comment 2
Mercury	ug/L	0.012	0	0.012	0		0 detection
Nickel	ug/L	100	0	100	0		0 detection
Selenium	ug/L	5	0	5	7	1	Comment 2
Silver	ug/L	11.37	0	11.37	0		0 detection
Thallium	ug/L	1.12	0	1.12	0		0 detection
Vanadium	ug/L	112	2.1	112	7.1	0	< cleanup level
Zinc, at 200 mg/L hardness	ug/L	188.02	5.1	188.02	7.4	0	< cleanup level

COMMENTS ON TABLE 7:

1. At least one concentration of the constituent exceed the background or WD4 concentration. These changes in concentrations in the water as it flows along the west boundary of the site is attributed to ground water discharging into the ditch from the West Field and from the L-Bar Facility. Turbidity, aluminum, arsenic, and iron are not considered ground water indicators since their presence in ground water have been determined to be due to lithologic conditions. Therefore turbidity, aluminum, arsenic, and iron are also not considered indicators for the West Ditch.

2. Only one concentration exceeds the cleanup level. Since this concentration is much lower than the ground water background concentration (440.2 ug/L manganese and 8.2 ug/L selenium), the exceedance may be attributed to ground water flowing into the ditch. Manganese and selenium are therefore not considered indicators for the West Ditch.

* Excluding area background

** Out of 3 samples

(a) 250 mg/L for chlorides and sulfates
500 mg/L for TDS (SMCL and irrigation)

TABLE 8 - INDICATOR SUBSTANCE SCREENING - MAIN DITCH

ANALYTE	UNITS	METHOD C		IRRIGATION CRITERIA	BACKGROUND*	MAXIMUM CONCENTRATION	SCREENING COMMENTS
		CARCI-NOGEN	NONCARCI-NOGEN				
Major Anions							
Chloride	mg/L				74.85	13700	No cleanup level
Sulfate	mg/L				416	1480	No cleanup level
Major Cations							
Calcium	mg/L				173.5	285	No cleanup level
Magnesium	mg/L				225.6	2290	No cleanup level
Potassium	mg/L				9.82	7410	No cleanup level
Sodium	mg/L				175.4	865	No cleanup level
Conventionals							
Alkalinity, Total as CaCO3	mg/L				654	2030	No cleanup level
Ammonia as N	mg/L		595		0	1110	INDICATOR
Biological Oxygen Demand (BOD), 5-Day	mg/L				na	13	No cleanup level
Chemical Oxygen Demand	mg/L				0	278	No cleanup level
Conductivity	umhos/cm				4040	43900	No cleanup level, Comment 1
Nitrate as N	mg/L		56		0.85	14.1	< cleanup level
Nitrite as N	mg/L	1.6	3.5		0	0	0 detection
Orthophosphate as P	mg/L				0.65	0	No cleanup level, 0 detection
pH	units				8.19	9.61	No cleanup level
Total Dissolved Solids (TDS)	mg/L			5000**	1092.4	27900	INDICATOR
Total Kiejdahl Nitrogen (TKN)	mg/L				0	982	No cleanup level
Total Organic Carbon (TOC)	mg/L				na	11.8	No cleanup level
Total Phosphorus - P	mg/L				0.22	0	No cleanup level, 0 detection
Total Suspended Solids	mg/L				0	30	No cleanup level
Turbidity	NTU				20.4	20	No cleanup level
Trace Metals							
Aluminum	ug/L				510	647	No cleanup level
Antimony	ug/L				0	0	No cleanup level, 0 detection
Arsenic	ug/L	0.583	10.5		5.4	0	0 detection
Barium	ug/L		2450		447.8	471	< cleanup level

* Ground water background concentrations since water in the Main Ditch is mostly ground water discharge.

na - not available

** Maximum TDS concentration for tolerant plants

TABLE 8 - INDICATOR SUBSTANCE SCREENING - MAIN DITCH

ANALYTE	UNITS	METHOD C		IRRIGATION CRITERIA	BACKGROUND*	MAXIMUM CONCENTRATION	SCREENING COMMENTS
		CARCI-NOGEN	NONCARCI-NOGEN				
Beryllium	ug/L	0.203	175		0	0	0 detection
Boron	ug/L		3150	750	na	13.4	< cleanup level
Cadmium	ug/L		17.5		0	0	0 detection
Chromium	ug/L		175		0	0	0 detection
Cobalt	ug/L				0	0	No cleanup level, 0 detection
Copper	ug/L		1300		0	911	< cleanup level
Iron	ug/L				540.4	376	No cleanup level
Lead	ug/L				0	8.5	No cleanup level
Manganese	ug/L		4900		440.2	414	< cleanup level
Mercury	ug/L		10.5		0	0	0 detection
Nickel	ug/L		700		0	0	0 detection
Selenium	ug/L		175		8.2	83.3	< cleanup level
Silver	ug/L		175		0	0	0 detection
Thallium	ug/L		2.45		0	0	0 detection
Vanadium	ug/L		245		4.8	0	0 detection
Zinc	ug/L		1050		188.02	0	0 detection
Comments on Table 8:							
1. Conductivity is a measure of the TDS concentration.							

* Ground water background concentrations since water in the Main Ditch is mostly ground water discharge.

na - not available

** Maximum
TDS concentration for tolerant plants

TABLE 9. INDICATOR SUBSTANCE SCREENING - WEST DITCH SEDIMENTS

ANALYTE	UNITS	METHOD C COMMERCIAL		PROTECTION OF DITCH WATER*	BACKGROUND	FSQV*	MAXIMUM CONCENTRATION	SCREENING COMMENTS
		Carcinogen	Noncarcinogen					
Major Anions and Cations								
Chloride	mg/Kg			23000	33.6		593	< cleanup level
Calcium	mg/Kg				7100		6190	No cleanup level
Magnesium	mg/Kg				1590		4660	No cleanup level
Potassium	mg/Kg				204		2080	No cleanup level
Sodium	mg/Kg				147		401	No cleanup level
Conventionals								
Ammonia as N	mg/Kg		1.09E+07	1.30E+01			180	INDICATOR
Cation Exchange Capacity(CEC)	meq/100g				19.1		24.9	No cleanup level
Nitrate as N	mg/Kg		5.12E+05		141		3.12	< cleanup level
pH					7.76		8.4	No cleanup level
Total Organic Carbon, TOC	mg/Kg				36600		33700	No cleanup level
Trace Metals								
Aluminum	mg/Kg				18500		20300	No cleanup level
Antimony	mg/Kg							
Arsenic	mg/Kg	66.7	240		12.4	57	20.1	< cleanup level
Barium	mg/Kg		2.24E+04		266		493	< cleanup level
Beryllium	mg/Kg	9.3	1600		0.72		0.7	< cleanup level
Boron	mg/Kg		2.88E+04					
Cadmium	mg/Kg		320		7.8	5.1	2.7	< cleanup level
Chromium	mg/Kg				24.9	260	24.5	
Cobalt	mg/Kg				10.1		9.3	
Copper	mg/Kg		1.18E+04		79.2	390	152	< cleanup level
Iron	mg/Kg				23700	450	22900	
Lead					303		51.2	
Manganese	mg/Kg		4.48E+04		665		1050	< cleanup level
Mercury	mg/Kg		96		0.26	0.41	0.38	< cleanup level
Nickel	mg/Kg		6400		23.1		17.4	< cleanup level
Selenium	mg/Kg		1600		0.68		4.9	< cleanup level
Silver	mg/Kg		1600			6.1		< cleanup level
Thallium	mg/Kg		22.4		0.37		0.92	< cleanup level
Vanadium	mg/Kg		2240		37.2		43.1	< cleanup level
Zinc	mg/Kg		9.60E+04		337	410	489	< cleanup level, comment 1
COMMENTS ON TABLE 9:								

1. The maximum concentration of zinc is less than the cleanup level but slightly over the FSQV which is not an enforceable concentration but serves only as a guidance. Since the West Ditch does not support aquatic life, zinc is not considered an indicator.

* 100 X GW Concentration from Table 7

* FSQV - Freshwater Sediment Quality Values

TABLE 10. INDICATOR SUBSTANCE SCREENING - MAIN DITCH SEDIMENTS

ANALYTE	UNITS	METHOD C COMMERCIAL Carcinogen	METHOD C COMMERCIAL Noncarcinogen	PROTECTION OF DITCH WATER*	BACKGROUND	FSQV**	MAXIMUM CONCENTRATION	SCREENING COMMENTS
Major Anions and Cations								
Chloride	mg/Kg				33.6		66130	No cleanup level
Calcium	mg/Kg				7100		9080	No cleanup level
Magnesium	mg/Kg				1590		17800	No cleanup level
Potassium	mg/Kg				204		13100	No cleanup level
Sodium	mg/Kg				147		11500	No cleanup level
Conventionals								
Ammonia as N	mg/Kg		1.09E+07	59500			1860	< cleanup level
Cation Exchange Capacity(CEC)	meq/100g				19.1		18.6	No cleanup level
Nitrate as N	mg/Kg		5.12E+05		141		1.84	< cleanup level
pH					7.76		9.17	No cleanup level
Total Organic Carbon, TOC	mg/Kg				36600		33800	No cleanup level
Trace Metals								
Aluminum	mg/Kg				18500		15600	No cleanup level
Antimony	mg/Kg						0	No cleanup level, 0 detection
Arsenic	mg/Kg	66.7	240		12.4	57	9.4	< cleanup level
Barium	mg/Kg		2.24E+04		266		2320	< cleanup level
Beryllium	mg/Kg	9.3	1600		0.72		0	0 detection
Cadmium	mg/Kg		320		7.8	5.1	1.6	< cleanup level
Chromium	mg/Kg		1600		24.9	260	13.8	< cleanup level
Cobalt	mg/Kg				10.1		5.6	No cleanup level
Copper	mg/Kg		1.18E+04		79.2	390	72	< cleanup level
Iron	mg/Kg				23700		12800	No cleanup level
Lead	mg/Kg				303	450	42.8	No cleanup level, Comment 1
Manganese	mg/Kg		4.48E+04		665		2700	< cleanup level
Mercury	mg/Kg		96		0.26		0.41	< cleanup level
Nickel	mg/Kg		6400		23.1	0.41	11.9	< cleanup level
Selenium	mg/Kg		1600		0.68		4.5	< cleanup level
Silver	mg/Kg		1600			6.1	0	0 detection
Thallium	mg/Kg		22.4		0.37		0.77	< cleanup level
Vanadium	mg/Kg		2240		37.2		28.3	< cleanup level
Zinc	mg/Kg		9.60E+04		337	410	363	< cleanup level
Comments on Table 10:								
1. The maximum concentration of lead is less then the Method A cleanup level of 250 mg/Kg.								

* 100 x GW concentration from Table 8

** FSQV - Freshwater Sediment Quality Values

TABLE 11. SITE CLEANUP LEVELS AND CANCER RISK/HAZARD QUOTIENT CALCULATIONS

Constituent	Ground Water, mg/L	Soils, mg/Kg	West Ditch Water, mg/L*	West Ditch Sediments, mg/Kg	Main Ditch Water, mg/L	Main Ditch Sediments, mg/Kg	
Major Anions							
chloride	230	23000	230				
Conventionals							
Ammonia as N (a)	0.13	13	0.13	13	595		
Nitrate as N (b)	10						
Nitrite as N (b)	1						
pH	8.5						
TDS	1092.4		250 for Cl and SO4, 500 for TDS		5000		
Trace Metals							
Barium (c)	1	100					
Manganese (d)	0.44**	44					
Selenium (e)	0.0082**	0.82					
Thallium (f)	0.00112	0.112					
** Background							
RISK AND HAZARD QUOTIENT CALCULATIONS							
Cancer Risk	0	0	0	0	0		**SITE TOTAL**
Hazard Index							0
(a) taste threshold	0.000477941	1.19266E-06	0.00047794	1.1927E-06	1		
(b) hemotoxicity	1.015625						1.000958268
(c) cardiovascular toxicity	0.892857143	0.004464286					1.015625
(d) neurotoxicity	nc	0.0275					0.897321429
(e) clinical selenosis	nc	0.0005125					0.0275
(f) other	1	0.005					0.0005125
							1.005

* may change depending on discharge requirements of NPDES permit

nc - not calculated

TABLE 12 . COMPARISON OF PROPOSED ALTERNATIVES WITH MTCA REQUIREMENTS

	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
	No Action	Source Removal With Natural Attenuation and Monitoring	Source Removal with Ground Water Interception and Land Application	Source Removal with Ground Water Interception and Surface Water Collection	Source Removal With Soils Excavation
THRESHOLD CRITERIA					
• Protect Human Health and the Environment	NO	YES	YES	YES	YES
• Comply with Cleanup Standards	NO	YES	YES	YES	YES
• Comply with Applicable State and Federal Laws	NO	YES	YES	YES	YES
• Provide for Compliance Monitoring	NO	YES	YES	YES	YES
OTHER REQUIREMENTS					
• Permanent Solution	NO	YES	YES	YES	YES
- *Overall Protection*	*Low*	*Medium-High*	*Medium-High*	*Medium-High*	*High*
- *Long Term Effectiveness*	*Low*	*High*	*High*	*High*	*High*
- *Short Term Effeciveness*	*Medium-high*	*Medium*	*Medium-low*	*Medium-low*	*low*
- *Reduction in Toxicity, Mobility and Volume*	*Low*	*Medium*	*Medium-High*	*Medium-High*	*High*
- *Implementability*	*High*	*Medium-High*	*Medium-Low*	*Medium-Low*	*Low*
- *Cost*	*High*	*Medium-low*	*Medium*	*Medium-High*	*High*
• Restoration Time Frame	>30 YEARS	20-30 YEARS	20-30 YEARS	20-30 YEARS	15-25 YEARS
• Consider Public Concerns	YES	YES	YES	YES	YES

TABLE 13. COMPARISON OF CLEANUP ALTERNATIVES WITH PERMANENT SOLUTION CRITERIA [WAC 173-340-360(5)]

	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
	No Action	Source Removal with Natural Attenuation and Monitoring	Source Removal with Ground Water Interception and Land Application	Source Removal with Ground water Interception and Surface Water Collection	Source Removal with Soils Excavation
(a) Overall Protection of Human Health and the Environment	1	4	4	4	5
(b) Long Term Effectiveness	1	5	5	5	5
(c) Short Term Effectiveness	4	3	2	2	1
(d) Reduction in Toxicity, Mobility, and Volume	1	3	4	4	5
Average (Environmental Benefit)	*1.75*	*3.75*	*3.75*	*3.75*	*4.0*
(e) Implementability	5	4	2	2	1
(f) Cost	1	5	4.5	4	2
Overall Average Score	2.17	3.83	3.5	3.5	3.0

Scoring Scale: 1 – lowest; 5 - highest

Average (Environmental Benefit) = [(a) + (b) + (c) + (d)]/4

Overall Average Score = [(a) + (b) + (c) + (d) + (e) + (f)]/6

TABLE 14. FEDERAL AND STATE LAWS AND REGULATIONS APPLICABLE OR RELEVANT AND APPROPRIATE TO THE SELECTED CLEANUP ACTION

ACTION	CITATION	COMMENT
Materials Removal and Disposal	29 CFR 1910	Occupational Safety and Health Act
	Chapter 43.21 RCW	State Environmental Policy Act
	WAC 173-303	Washington Dangerous Waste Regulations
	WAC 173-304	Minimum Functional Standards for Solid Waste Handling
	WAC 173-340	Model Toxics Control Act
	WAC 173-400	Washington State General Regulations for Air Pollution Sources
	WAC 446.50	Transportation of Hazardous Materials
Ground Water/Surface Water Discharges	WAC 173-216	State Waste Discharge Permit Program
	WAC 173-220	National Pollutant Discharge Elimination System Permit Program
Cleanup Standards	Chapter 173-340	Model Toxics Control Act
	42 USC 300; 40 CFR 141 and 143	Safe Drinking Water Act
	33 USC 1251	Clean Water Act
	Chapter 246-290 WAC	Safe Drinking Water Act for Public Water Supplies
	Chapter 173-201A	Water Quality Standards for Surface Waters of the State of Washington

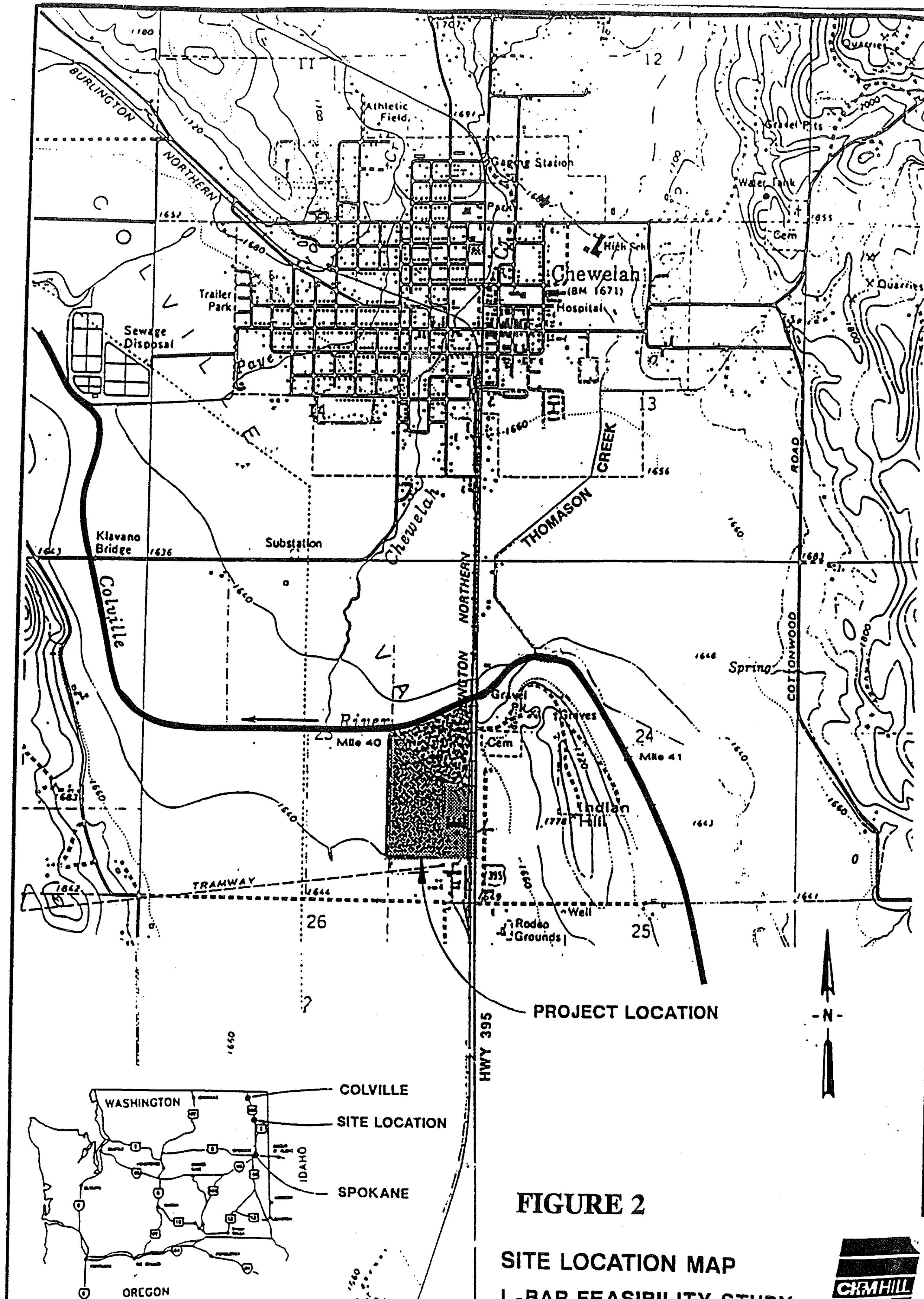
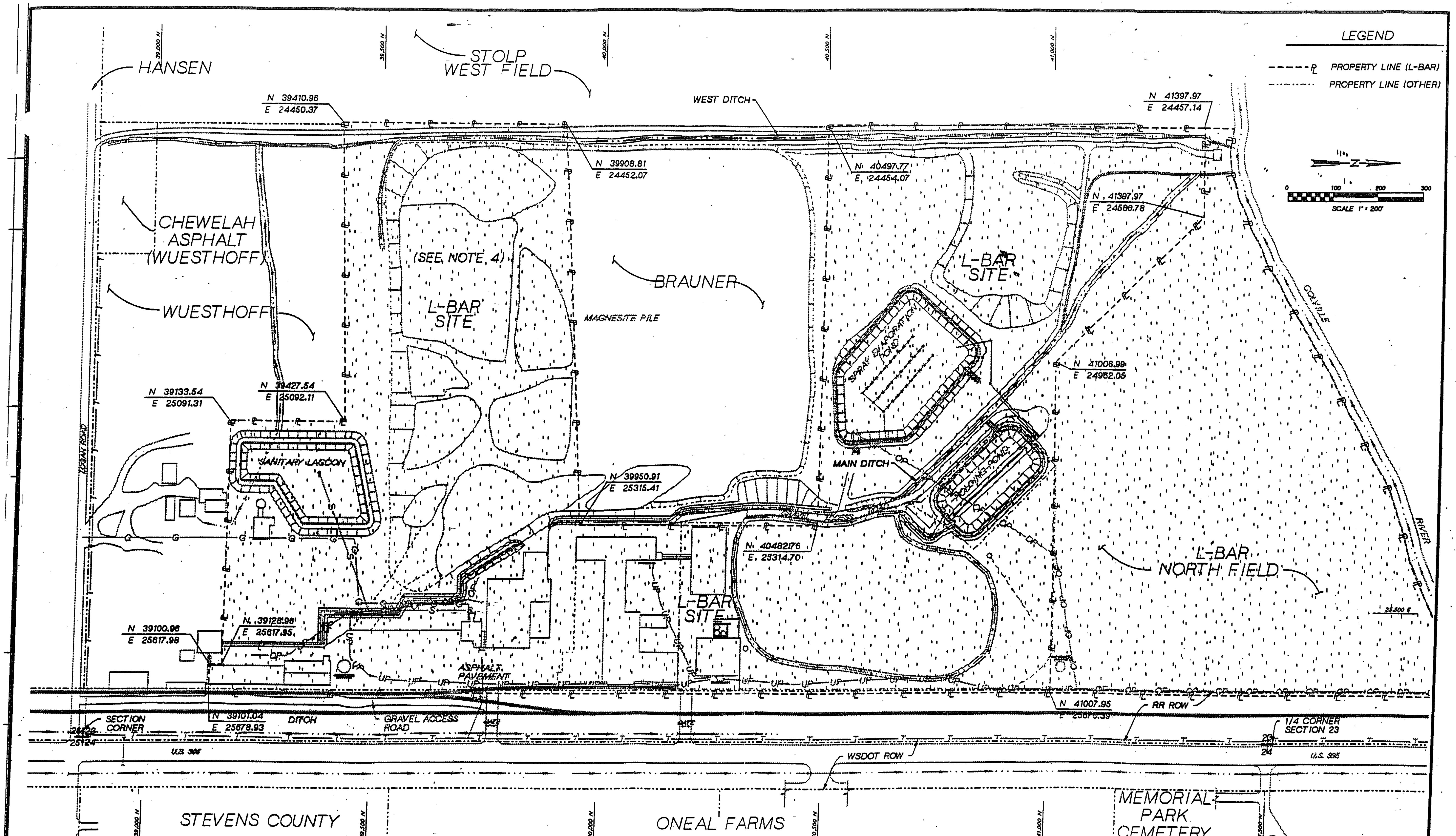


FIGURE 2

SITE LOCATION MAP
L-BAR FEASIBILITY STUDY

CH2M HILL



NOTES:

1. SITE COORDINATES BASED ON A LOCALLY ESTABLISHED GRID SYSTEM.
2. PROPERTY INFORMATION OBTAINED FROM STEVENS COUNTY TITLE COMPANY, AND STEVENS COUNTY TAX ASSESSOR.
3. STIPPLED AREAS LABELLED AS "L-BAR SITE" REPRESENT SEVERAL PARCELS INDIVIDUALLY OWNED BY NW ALLOYS AND/OR L-BAR PRODUCTS TRUSTEE.
4. THE SOUTHERN HALF OF THE MAGNESITE RESIDUE PILE IS NOT OWNED BY NW ALLOYS OR L-BAR PRODUCTS - ONLY THE LAND BENEATH IT.

FIGURE 3

SITE PROPERTY PLAN

L-BAR FEASIBILITY STUDY

CH2M HILL

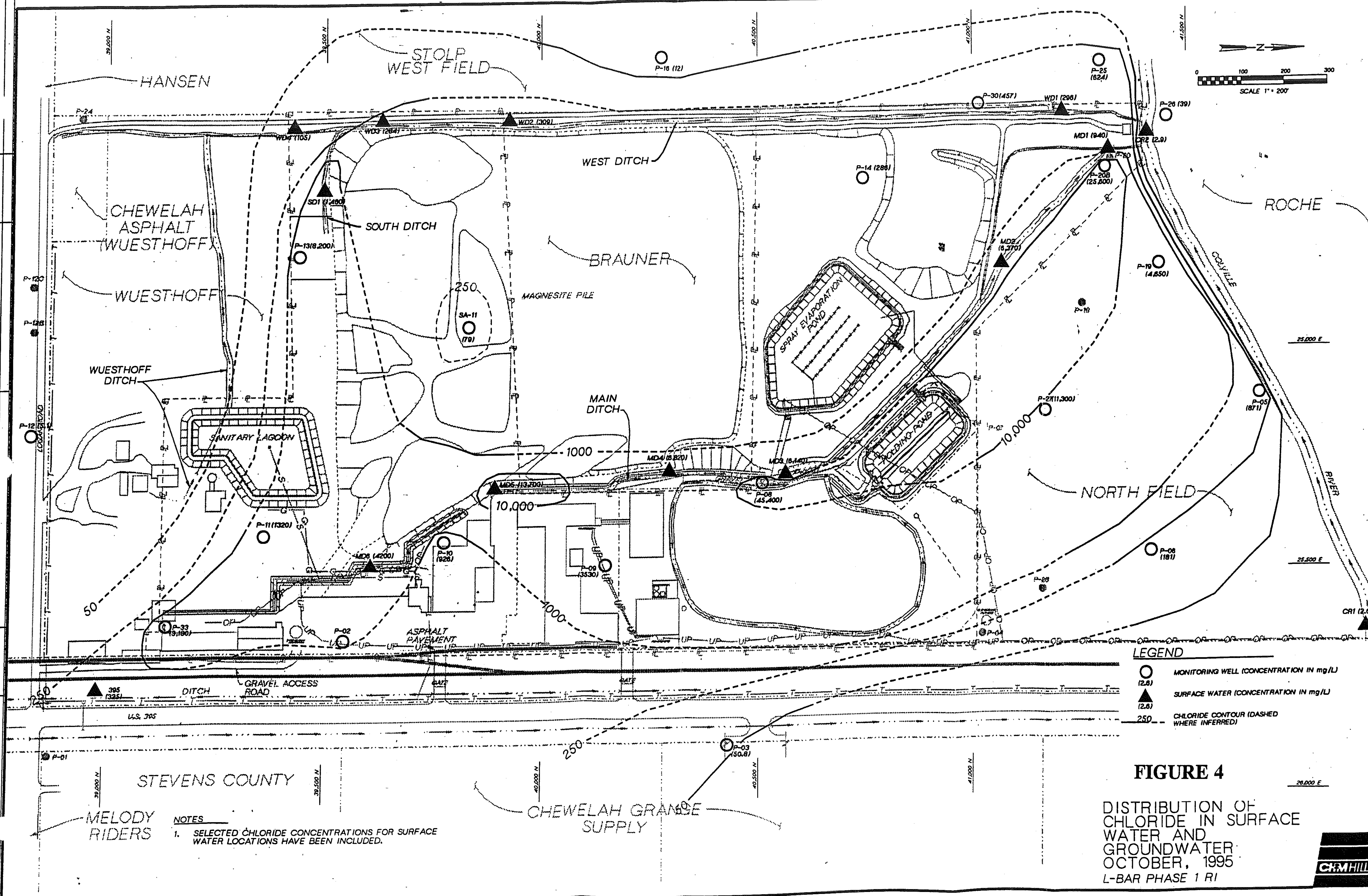
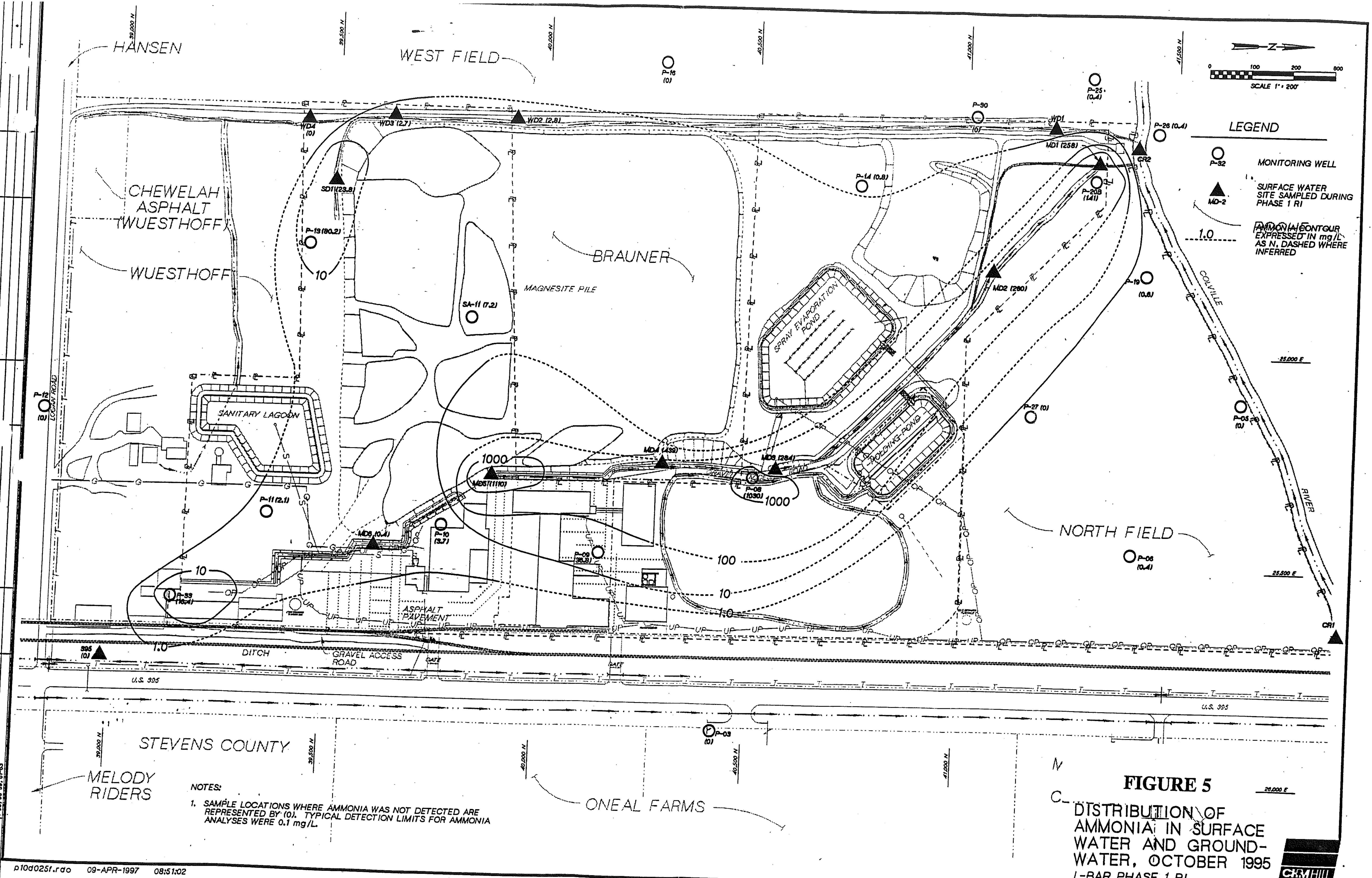


FIGURE 4

DISTRIBUTION OF CHLORIDE IN SURFACE WATER AND GROUNDWATER OCTOBER, 1995

L-BAR PHASE 1 RI



NOTES:

1. SAMPLE LOCATIONS WHERE AMMONIA WAS NOT DETECTED ARE REPRESENTED BY (0). TYPICAL DETECTION LIMITS FOR AMMONIA ANALYSES WERE 0.1 mg/L.

FIGURE 5

DISTRIBUTION OF AMMONIA IN SURFACE WATER AND GROUND-WATER, OCTOBER 1995

L-BAR PHASE 1 RI

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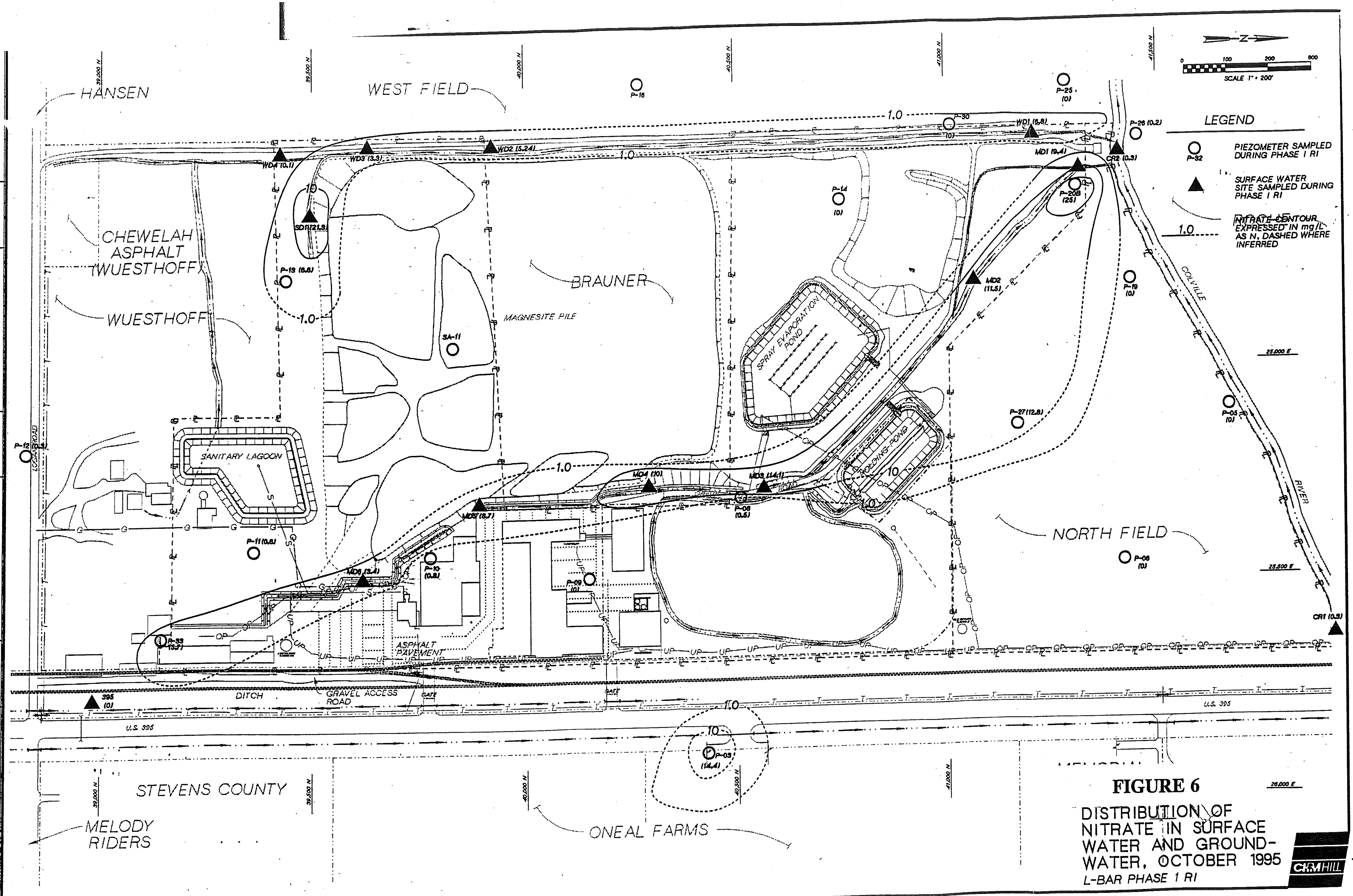
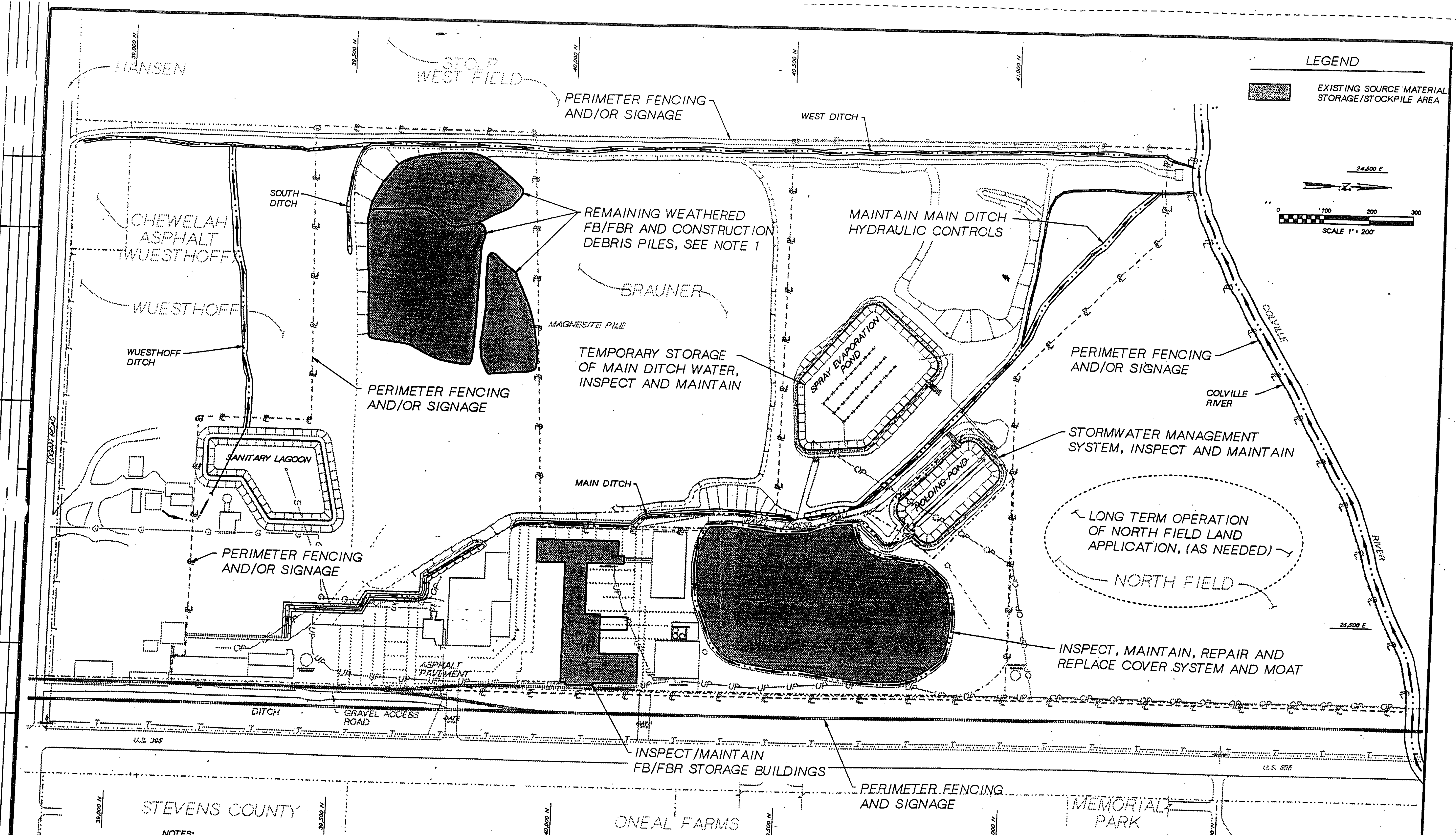


FIGURE 6

DISTRIBUTION OF NITRATE IN SURFACE WATER AND GROUND-WATER, OCTOBER 1995

L-BAR PHASE 1 RI



NOTES:

1. AS OF 01-01-1999 PILES A, B, F AND G HAVE BEEN REMOVED; ALTERNATIVE 1 ASSUMES NO ADDITIONAL SOURCE REMOVAL WOULD OCCUR.

2. ALTERNATIVE 1 ALSO WOULD INCLUDE ACCESS RESTRICTIONS, DEED RESTRICTIONS, SECURITY LIGHTING AND ROUTINE MONITORING OF SURFACE WATER AND GROUNDWATER.

ALTERNATIVE 1 - NO ACTION

FIGURE 7

PROPOSED COMPONENTS OF REMEDIAL ALTERNATIVE 1

L-BAR FEASIBILITY STUDY

CH2M HILL

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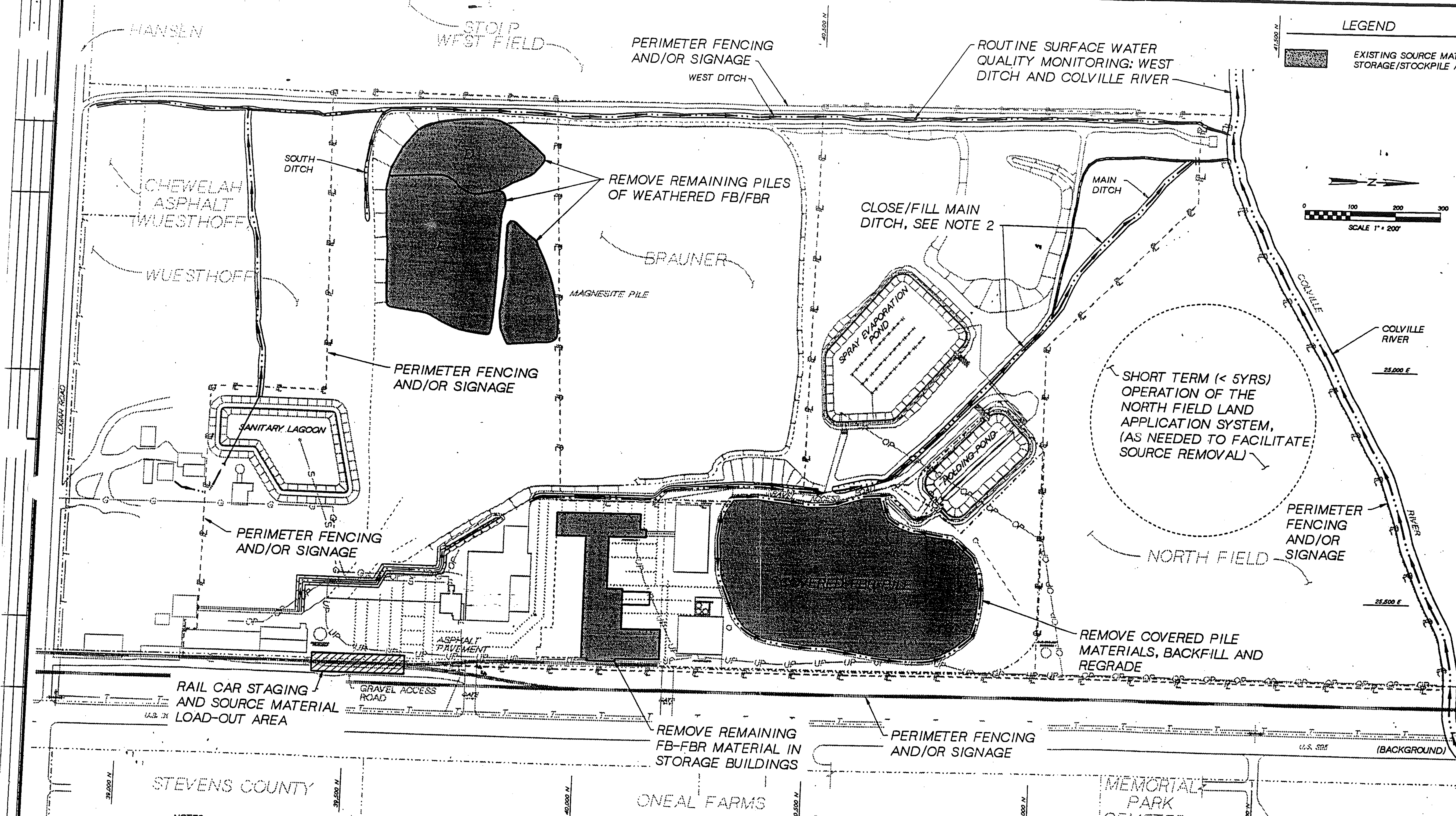

NOTES:

1. ALTERNATIVE 2 ALSO WOULD INCLUDE ACCESS AND DEED RESTRICTIONS, SECURITY LIGHTING AND ROUTINE FACILITY INSPECTION AND MAINTENANCE. ALTERNATIVE 2 WOULD INCLUDE PROVISIONS FOR GROUND WATER AND SURFACE WATER MONITORING THAT WOULD MEET "MTCA" REQUIREMENTS FOR COMPLIANCE MONITORING (WAC173-340-410).
2. ALTERNATIVE 2 INCLUDES PROVISIONS FOR MAIN DITCH CLOSURE FOLLOWING FINAL REMOVAL OF THE COVERED FBR PILE.

ALTERNATIVE 2 - SOURCE REMOVAL WITH NATURAL ATTENUATION AND MONITORING

FIGURE 8

PROPOSED COMPONENTS OF REMEDIAL ALTERNATIVE 2

L-BAR FEASIBILITY STUDY

CH2M HILL

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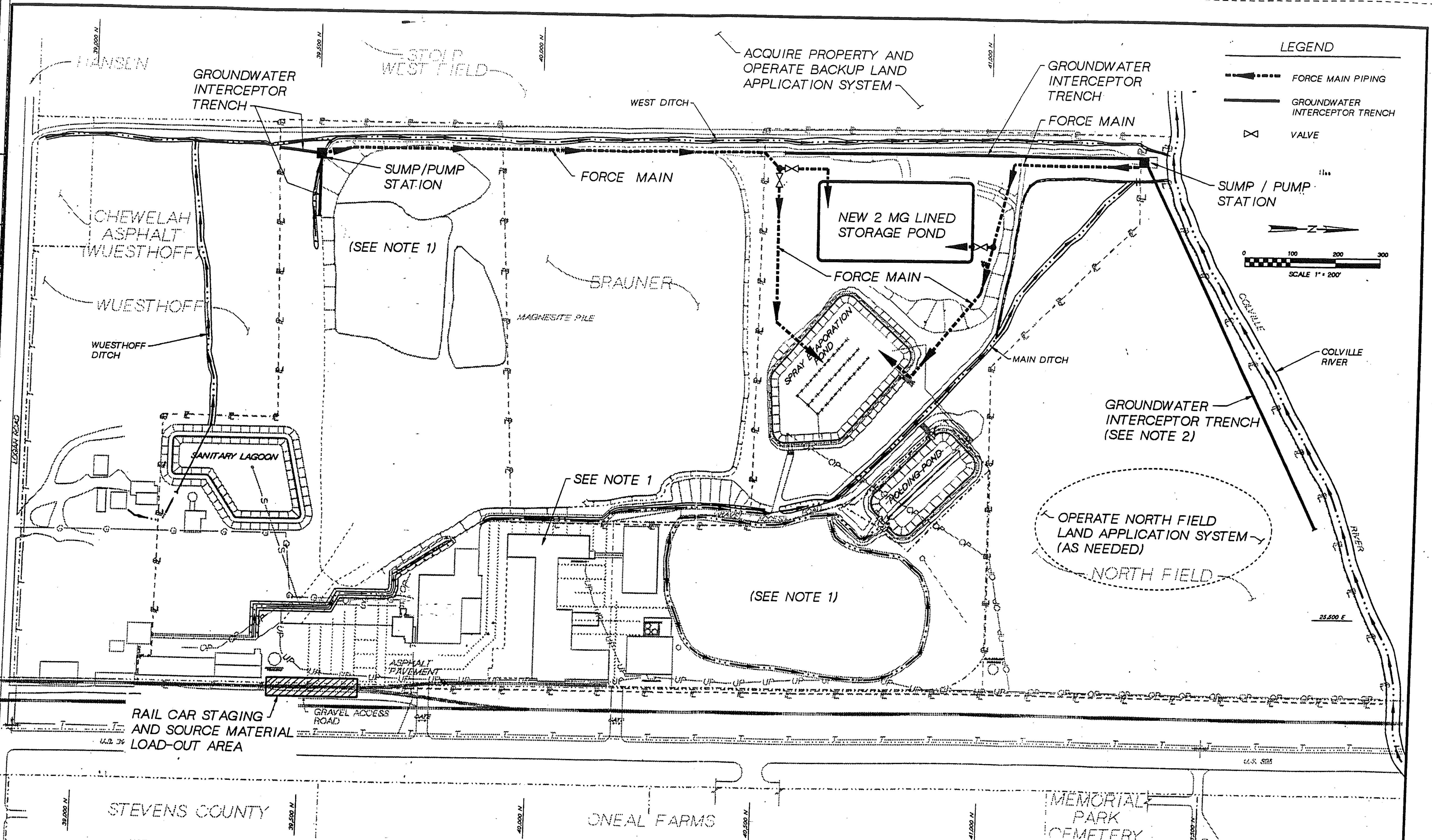

NOTES:

1. ALTERNATIVE 3 ALSO INCLUDES ALL REMEDIAL COMPONENTS OF ALTERNATIVE 2, (SEE FIGURE 5-2) RELATED TO SOURCE REMOVAL, NATURAL ATTENUATION, MONITORING, INSTITUTIONAL CONTROLS, AND MAIN DITCH CLOSURE.
2. FIGURES 2-3 AND 2-5 DEPICT THE APPROXIMATE EXTENT OF SHALLOW GROUNDWATER CONTAMINATION.

ALTERNATIVE 3 - SOURCE REMOVAL WITH NATURAL ATTENUATION, GROUNDWATER INTERCEPTION, LAND APPLICATION AND MONITORING

FIGURE 9
PROPOSED COMPONENTS OF REMEDIAL ALTERNATIVE 3
L-BAR FEASIBILITY STUDY

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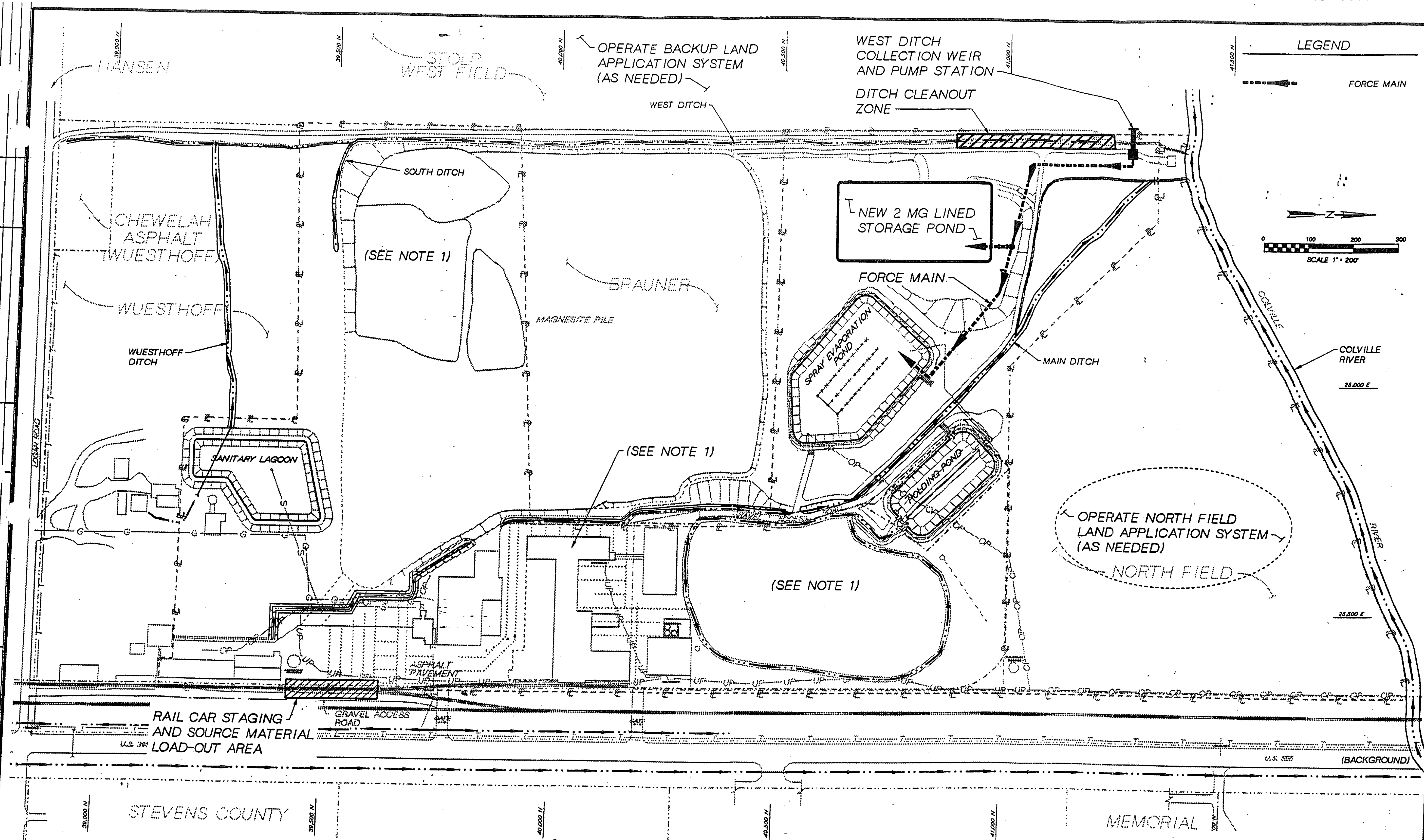

NOTES:

1. ALTERNATIVE 4 ALSO INCLUDES ALL REMEDIAL COMPONENTS OF ALTERNATIVES 2 AND 3, (SEE FIGURES 5-2 AND 5-3) RELATED TO GROUNDWATER INTERCEPTION, SOURCE REMOVAL, NATURAL ATTENTUATION, MONITORING AND INSTITUTIONAL CONTROLS.

ALTERNATIVE 4 - SOURCE REMOVAL, NATURAL ATTENUATION, SURFACE WATER COLLECTION, GROUNDWATER INTERCEPTION, LAND APPLICATION AND MONITORING

FIGURE 10

PROPOSED COMPONENTS OF REMEDIAL ALTERNATIVE 4

L-BAR FEASIBILITY STUDY

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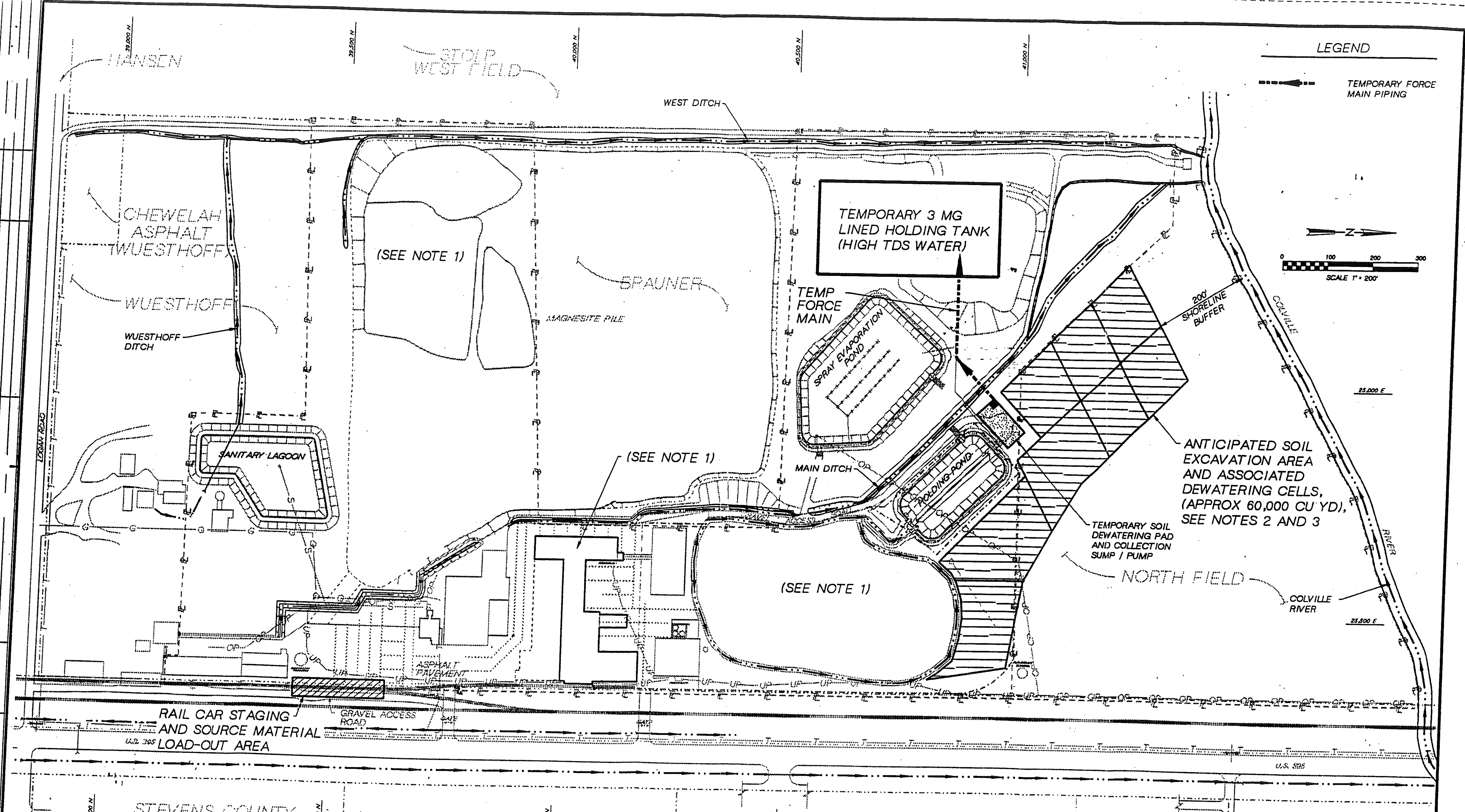

NOTES:

1. ALTERNATIVE 5 ALSO INCLUDES ALL REMEDIAL COMPONENTS OF ALTERNATIVE 2 (SEE FIGURE 5-2) RELATED TO SOURCE REMOVAL, NATURAL ATTENUATION, COMPLIANCE MONITORING, INSTITUTIONAL CONTROLS AND MAIN DITCH CLOSURE.
2. SOIL EXCAVATION AREA IS ESTIMATED BASED ON SOIL AND GROUNDWATER DATA FROM RI AND MTCA PILOT PROGRAM SAMPLING EVENTS IN 1995 AND 1996, AND EM TERRAIN CONDUCTIVITY DATA. EXCAVATION WILL BE BACKFILLED WITH IMPORTED FILL TO RE-ESTABLISH GRADE.
3. SOIL EXCAVATION ASSUMED TO A DEPTH OF 8 FEET IN THE NORTH FIELD AREA.

ALTERNATIVE 5 - SOURCE REMOVAL, NATURAL ATTENTUATION, SOIL EXCAVATION AND MONITORING

FIGURE 11

PROPOSED COMPONENTS OF REMEDIAL ALTERNATIVE 5

L-BAR FEASIBILITY STUDY

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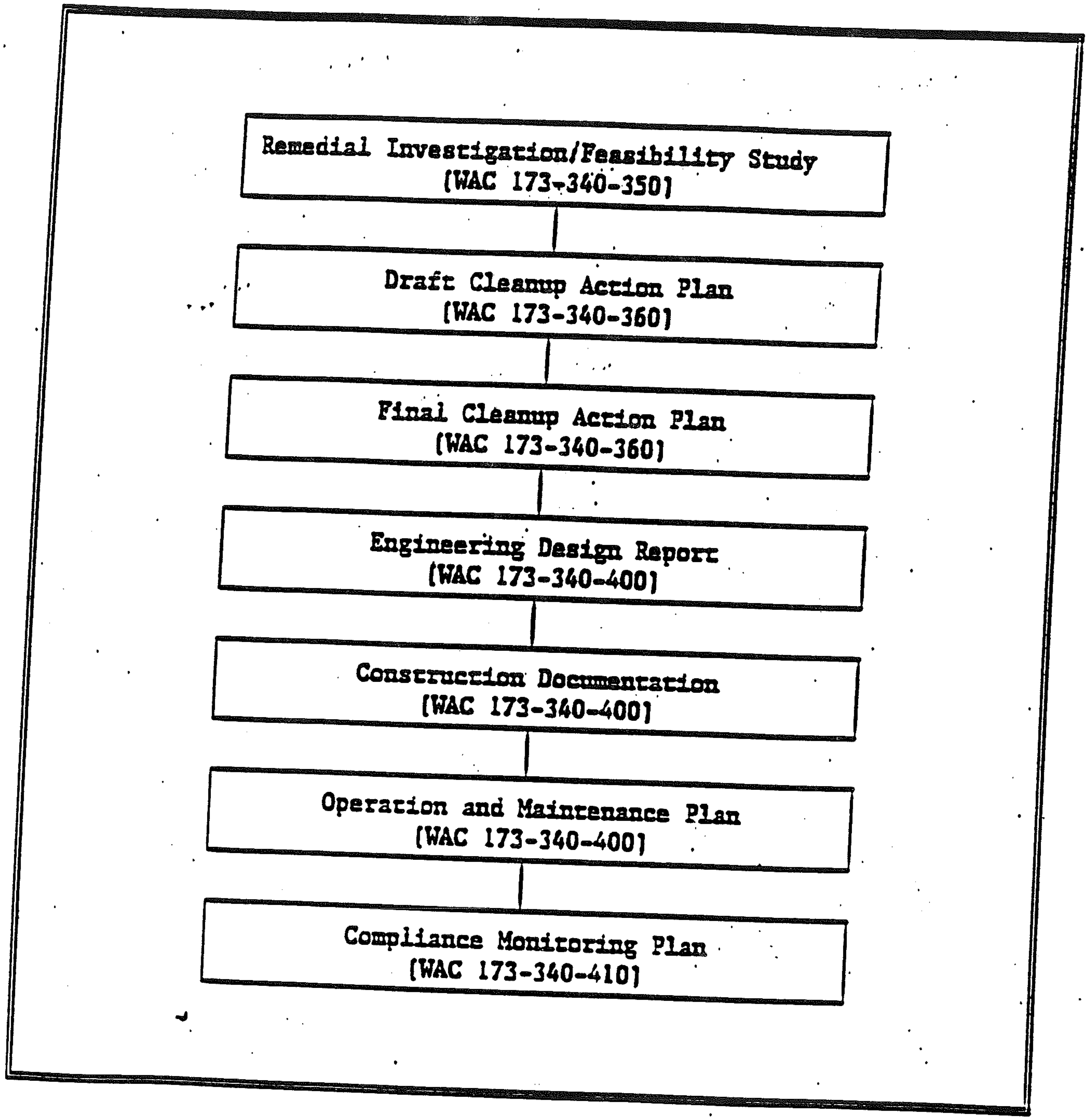


FIGURE 1

Documents required under Model Toxics Control Act (Chapter 173-304 WAC).

SUBSTANTIVE REQUIREMENTS
NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM

State of Washington
DEPARTMENT OF ECOLOGY
Toxics Cleanup Program
Eastern Regional Office
Spokane, WA
April 2000

Facility Location:	L-Bar Site, Chewelah, Washington
Discharge Type:	Surface (Ditch) Water
Discharge Location:	Township – 32 North Range – 40 East Section – 23, E ½ of the SE ¼ Latitude: 48° 15' 33" Longitude: 117° 43' 12"
Receiving Water:	Colville River
Water Body I.D. No.:	DH01RX

STATEMENT OF PURPOSE

Northwest Alloys, Inc. (NWA) and the Washington State Department of Ecology (Ecology) are entering into an Agreed Order under the authority of Chapter 70.105D RCW, the Model Toxics Control Act (MTCA), to implement the Cleanup Action Plan (CAP) at the L-Bar Site (the Site). The CAP is also developed in accordance with MTCA.

The contaminants at the Site are primarily ammonia (NH_3), chloride, and total dissolved solids (TDS). The remedial action involves the removal of source materials at the Site and to allow natural attenuation to remediate the soils, ground water, and surface water at the Site. This remedial action meets all the requirements of MTCA and has been determined to constitute all known, available, and reasonable methods of prevention, control, and treatment (AKART). Therefore point discharges from the Site to the Colville River are authorized to utilize a mixing zone in accordance with the requirements of WAC 173-201A-100.

Pursuant to RCW 70.105D.090, a National Pollutant Discharge Elimination System (NPDES) permit is not required for remedial actions conducted under a MTCA Agreed Order. However, all substantive requirements for a NPDES permit must be met.

In compliance with the provisions of the Federal Water Pollution Control Act and State of Washington Water Pollution Control Law, Chapter 90.48 RCW, the National Pollutant Discharge Elimination Permit Program, Chapter 173-220 WAC, and the Water Quality Standards for Surface Waters of the State of Washington, Chapter 173-201A WAC, this document establishes discharge requirements of surface water from the West Ditch to the Colville River.

FACT SHEET

This fact sheet explains the Substantive Requirements of a National Pollutant Discharge Elimination System (NPDES) permit for the L-Bar Site. It explains the nature of the proposed discharge, the limits placed on contaminants in a ditch discharging to the river, and the regulatory and technical basis for those limits.

GENERAL INFORMATION

Facility Name and Address	L-Bar Facility Chewelah, Stevens County, Washington
Discharge Type	Ditch Water
Discharge Location	Colville River

Background Information

The L-Bar Site lies on the south bank of the Colville River, which is approximately two miles south of Chewelah, WA. The Site occupies approximately 67 acres of industrial and agricultural land in the Colville River Valley. The 17-acre agricultural field lies between the 50-acre industrial area and the Colville River.

The L-Bar facility operated from 1978 to 1991 as a magnesium recovery and by-product or flux bar (FB) reprocessing plant. L-Bar processed FBs by crushing these materials and screening the crushed materials to recover metallic granules. The remaining non-metallic material was called flux bar residue (FBR). FBs and FBRs had been designated as state-only dangerous wastes due to fish toxicity. Throughout the plant's operation, FBs and FBRs continued to accumulate on site as the market for processed FBRs as fertilizers or deicers could not cope up with the production. L-Bar ceased operations in 1991 because of insolvency. More than 100,000 tons of materials remained on Site after the closure. About 65,000 tons of materials piled on top of the magnesite pile had been removed and disposed of under an interim action that started in 1996. Approximately more than 60,000 tons are still on Site under a plastic-covered pile but sits in ground water for most of the year. Past operating practices and inadequate storage of FB and FBR resulted in the leaching of constituents from these materials into soils, ground water, and surface water.

Site cleanup conducted under the authority of MTCA started in 1993 when NWA, a named potentially liable person for this Site, entered into an Agreed Order with Ecology to conduct interim actions and a remedial investigation/feasibility study (RI/FS) for the

Site. Interim actions conducted under the Agreed Order included water management and materials removal. The RI was conducted to determine the extent of contamination and the FS evaluated remedial options for the Site. High concentrations, primarily of ammonia, chloride, and TDS were found in soils, ground water, and surface water in two ditches at the Site.

The two ditches running through the Site historically discharged to the Colville River. An Emergency Order issued by Ecology in 1993 resulted in the stoppage of discharge from the Main Ditch that had high concentrations of ammonia, chloride, and TDS. The other ditch, referred to as the West Ditch, continues to discharge to the Colville River with slightly elevated concentrations of ammonia, chloride, and TDS. The metals detected in the West Ditch during the RI were below surface water criteria. The RI also showed that impacted shallow ground water from the Site discharges directly to the Colville River.

Concentrations of site contaminants have never exceeded surface water criteria in the Colville River. Supplemental studies conducted to evaluate potential impacts to the Colville River benthic organisms in the areas immediately upstream, adjacent to, and downstream of the L-Bar Site show little or no quantifiable impacts to the benthic community.

Description of the Cleanup Action

The FS evaluated cleanup remedies that are applicable to the Site according to the MTCA criteria. Based on information in the RI and the FS, Ecology selected a site remedy in the Draft Cleanup Action Plan (DCAP). Upon completion of a public comment period, and after review and consideration of the comments received, Ecology will issue a final Cleanup Action Plan (CAP) for this Site.

The cleanup action selected for the Site includes source removal (primarily the covered pile) and natural attenuation to address the contaminants in soil, ground water, and surface water. Compliance monitoring conducted after source removal will have to demonstrate that natural attenuation is remediating the Site at a reasonable rate; otherwise treatment options for ground water and surface water will have to be reevaluated.

The selected cleanup action meets all of MTCA's criteria (WAC 173-340-360). One of the MTCA requirements is that the cleanup action conducted shall use ***permanent solutions to the maximum extent practicable*** which is based upon consideration of a number of factors: overall protectiveness of human health and the environment, long- and short-term effectiveness, permanent reduction of toxicity, mobility and volume of hazardous substances, implementability, cost, and addressing community concerns. The selection of a cleanup action at this Site that is permanent to the maximum extent practicable is considered to have met AKART.

Under the selected cleanup action, the West Ditch will continue to discharge to the Colville River meeting the substantive requirements of a NPDES permit. The outfall for the West Ditch is a surface discharge from free flow in a canal.

Description of Receiving Water

The receiving water is the Colville River, a Class A surface water body of the state. The applicable receiving water quality standards are those adopted by the Washington State Department of Ecology and approved by the Environmental Protection Agency (EPA) Regional Administrator pursuant to Section 303 of the Clean Water Act. Applicable standards are contained in Chapter 173-201A WAC.

Three seasonal critical flows have been determined for the Colville River in an ecology report "Colville River Water Quality: Pollutant Loading Capacity and Recommendations for Total Maximum Daily Loads", January 1997, by Gregory Pelletier. The following three seasons were recommended:

- June – October
- November – February
- March - May

Critical river flows for the three permit periods were estimated as the 7-day average low flows with a recurrence interval of once every 29 years (7Q29). Seasonal critical conditions for ammonia for mixing zones (using available data at the time) for the L-Bar discharge in the Colville River and effluent limits for NPDES permits to meet dissolved oxygen standards in the Colville River were summarized in Tables 18 and 20, respectively of the report.

Monitoring of the Colville River upstream of the Site started in 1994 as part of an Enforcment Order requirement. Seasonal river water data upstream of the L-Bar Site are shown in Tables A1 to A3.

Description of West Ditch Water

The West Ditch flows along the west side of the magnesite residue pile and into the Colville River. This ditch is fed by runoff from areas south of the Site and two ditches at the southern end of the Site. Surface flow from the ditch does not always reach the river. The mouth of the ditch dries up usually between the months of mid-July to November. Some ground water from the L-Bar Site discharges to the West Ditch; the quantity of which varies seasonally.

The indicator substances or the substances present in the West Ditch that need to be addressed in the cleanup (determined using data obtained from the RI) are ammonia, chloride, and TDS. The metals detected in the West Ditch during the RI were all below MTCA surface water standards and were lower than the recommended critical conditions for evaluation of metals for NPDES permits for L-Bar as presented in Table 23 of Pelletier's report (1).

Potassium 40(K-40), a naturally occurring isotope, was earlier detected in the ditch. EPA and state standards apply only to artificial or man made isotopes. No radionuclides of concern have been identified.

Monitoring of the West Ditch water discharging to the river also started in 1994. Seasonal West Ditch data are also shown in Tables A1 to A3.

WEST DITCH LIMITATIONS DETERMINATION

The Site is a non-operating facility. Remedy selection under MTCA has identified source removal as the most practicable way to cleanup the Site. This cleanup action has also been determined to meet AKART.

Federal and State regulations require that discharge limitations set forth in a NPDES permit must be the more stringent of either technology-based or water quality-based limits. Technology-based limitations are based upon the treatment methods available for specific pollutants and are set by regulation or developed on a case-by-case basis. Water quality-based limitations are based upon compliance with the Surface Water Quality Standards or Chapter 173-201A WAC.

Water-quality-based limits for this site contaminants are presumed to be potentially more stringent than technology-based limitations. The water-quality based limits are also more stringent than human-based limitations. Therefore discharge limits for the West Ditch are water quality-based. Surface water quality-based effluent limitations may be based on an individual waste load allocation (WLA) or on a WLA developed during a basin wide total maximum daily loading study (TMDL).

The State of Washington's Antidegradation Policy requires that discharges into a receiving water shall not further degrade the existing water quality of the water body. The discharges authorized by this proposed permit should not cause a loss of beneficial uses of a Class A surface water.

The limitations are for pollutants in the West Ditch identified in these studies. If significant changes occur in any constituent, NWA is required to notify the Department of Ecology.

Mixing Zones

Individual water quality-based discharge limits for the West Ditch are determined using mixing zone calculations as discussed in Appendix A1. Data collected from 1994 to 1999 as a result of the Enforcement Order are used in this determination. Ammonia limits are then compared with Pelletier's results of 1997 (1).

TMDLs

Currently, there are no existing ammonia and chloride TMDL values for the Colville River. However, ammonia waste load allocations for point sources along the Colville River that includes the L-Bar facility or TMDLs are recommended by Pelletier (1). The study shows that potential effluent limits for ammonia from the L-Bar Site may affect effluent limits for the Chewelah POTW. The approved facility plan for the Chewelah POTW requires that no ammonia load is discharged from the L-Bar facility except for the existing nonpoint ground water loading assumed to be the maximum rate of 0.2 Kg/day.

Whole Effluent Toxicity

Toxicity caused by unidentified pollutants is not expected in the West Ditch. Therefore, no whole effluent toxicity testing is required. The Department may require effluent toxicity testing in the future if it receives information that toxicity may be present in this effluent.

REFERENCES

(1) Pelletier, (Ecology Publication No. 96-349), "Colville River Water Quality: Pollutant Loading Capacity and Recommendations for Total Maximum Daily Loads", January 1997

(2) EPA. "Technical Support Document for Water Quality-based Toxics Control", March 1991

(3) CH2M HILL, "L-Bar Phase I Remedial Investigation Final Report", August 1998.

(4) CH2M HILL, "L-Bar Baseline Human Health and Ecological Risk Assessment Report", January, 1999.

(5) CH2M Hill, "L-Bar Cleanup Levels Development and Feasibility Study Report", May 1999.

(6) CH2M Hill, "L-Bar Surface Water and Groundwater Monitoring Report", 1998.

SUBSTANTIVE REQUIREMENTS

S1. FINAL WEST DITCH DISCHARGE LIMITATIONS

The discharge limitations for the West Ditch are developed in Appendix A1 and are summarized as follows:

SEASON	UNITS	Ammonia as N		Chloride	
		Maximum Daily Limit (MDL)	Average Monthly Limit (AML), $n^1=2$	Maximum Daily Limit (MDL)	Average Monthly Limit (AML), $n^1=2$
June to October	lbs/day	A^2	0.577A	771	445
November to February	lbs/day	3.6	2.1	2775	1602
March to May	lbs/day	4.1	2.4	NR[3]	NR[3]

[1] n = number of samples taken per month for compliance

[2] $A = 0.44$ lbs/day – L_{GW}

where L_{GW} (in lbs/day) is the ground water ammonia loading to the river as calculated in Appendix A1.

[3] NR – not required (no potential to exceed criteria)

The average monthly limitation is defined as the highest allowable average of daily discharges over a calendar month, calculated as the sum of all daily discharges measured during that month. The daily maximum is defined as the highest allowable daily discharge.

S2. INTERIM WEST DITCH DISCHARGE LIMITATIONS

WAC 173-201A-160(4), allows the inclusion of a schedule for achieving compliance with water quality criteria for existing discharges. The schedules shall be developed to ensure final compliance with all water qualilty-based effluent limits in the shortest practicable time. Schedules of compliance may be issued to allow for conditions specified under this section that includes the implementation of best management practices that will prevent violation of water quality criteria. For the period of time during which compliance with water quality criteria is deferred, interim effluent limitations shall be formally established, based on best professional judgment. Schedules of compliance may in no case exceed ten years.

Source removal at this Site constitutes best management practice because it will stop the leaching of the contaminants to ground water that discharges to the ditch and the Colville River. Implementation of the remedy involving source removal from this site is expected to last 3 to 4 years. The West Ditch discharge to the Colville River will not comply with the limits specified in S1 during and immediately after materials removal. Monitoring of the West Ditch and ground water discharging to the River will continue during and after materials removal to determine if chloride and ammonia are decreasing.

Excavation work near the ground water table will be performed in a manner that minimizes, to the extent possible, the potential for increased leaching to the ground water and nearby soils. Dewatering around the covered pile will be performed, if necessary, to facilitate the excavation work, and/or to minimize soil and ground water impacts.

Surface water monitoring during the last four years shows that surface water criteria were never exceeded in the Colville River. Monitoring of the West Ditch and of the Colville River have shown that the ammonia and loadings from the L-Bar Site have not caused exceedances of surface water criteria in the Colville River. Concentrations in the river have never exceeded 13% of the chronic criteria for ammonia or 5 % of the chloride criteria.

Interim discharge limits are based on current performance of the ditch and not allowing additional site cleanup activities to further degrade the ditch water. Interim discharge limits will be expressed in mass/day as the flow rate of the ditch varies even during a single season. Calculated ammonia and chloride loadings from the West Ditch since 1996 are used to estimate the maximum expected loadings as shown in Table A5.

The following interim limits are therefore proposed :

SEASON	UNITS	AMMONIA AS N		CHLORIDE	
		MDL	AML(n=2)	MDL	AML(n=2)
June to October	lbs/day	12.5	7.2	968	560
November to February	lbs/day	40.2	23.24	3172	1834
March to May	lbs/day	76.8	44.4	NR	NR

NR – not required

Monitoring of the river must be conducted as long as the West Ditch discharge have not met the final limits specified in S1 to ensure that water quality criteria in the river are not being exceeded.

S3. COMPLIANCE SCHEDULE

The West Ditch Discharge must be in compliance with both ammonia and chloride final limits within ten (10) years starting on the effective date of the Agreed Order. The Compliance Schedule shall be as follows:

- Monitoring according to S4 shall begin on the effective date of the Agreed Order.
- Data shall be collected according to S4.A to determine compliance with the discharge limits and to ensure that water quality criteria in the river are not being exceeded in the river during the interim.
- For the first five (5) years NWA will collect additional data specified under S4.B for the following purposes: to evaluate and revise, if necessary, the existing model (1) that predicts the Chewelah POTW ammonia limits based on L-Bar discharges or to develop flow-based limits. NWA may also work with the POTW on other alternatives to revise the final ammonia limits.
- Model revisions or other limits shall be developed during the sixth year after which the final limits will be modified, if necessary.
- If the data will indicate that the final discharge limits, as modified, are not going to be met in ten years, NWA shall evaluate and implement other alternatives that will make the discharge in compliance within the required time. The table below summarizes the activities and dates of compliance:

ACTIVITY	DATES*
Start of Monitoring	Effective date of the Agreed Order – March 2000
Monitoring to determine compliance with discharge limits	In accordance with S4.A.starting March 2000.
Additional five-year monitoring for ammonia final limits evaluation	In accordance with S4.B until February 2005
Modeling and final limits evaluation	March 2005 to February 2006
Final evaluation – limits and additional remedial measures	March 2006 to February 2007
Implementation of additional remedial measures, if necessary	Not later March 2009
Date for compliance with final limits	March 2010

* Dates will be readjusted based on the actual date of effectivity of the Order.

S4. MONITORING REQUIREMENTS

The following shall be monitored:

A. For Compliance with Discharge Limits

Location	Parameter	Units	Sample Type	Minimum Frequency
West Ditch Discharge	Flow	gpm or cfs		twice a month
	Ammonia as N	mg/L	grab	twice a month
	Chloride	mg/L	grab	twice a month
	pH	standard units	grab	twice a month
	Alkalinity	mg/L as CaCO3	grab	once a month
Colville River (a) Upstream (b) 300 feet downstream from West Ditch Discharge	Flow	gpm or cfs		twice a month until modified
	Temperature	°C or °F	grab	twice a month until modified
	pH	standard units	grab	twice a month until modified
	Dissolved Oxygen (field measurement)	mg/L	grab	twice a month until modified
	Ammonia as N	mg/L	grab	twice a month until modified
	Chloride	mg/L	grab	twice a month until modified
	Alkalinity	mg/L as CaCO3		once a month until modified
Ground Water P-05, P-19, P-20B	Ammonia as N	mg/L		twice per season
	Chloride	mg/L		twice per season

B. For Final Ammonia Discharge Limits Modeling/Evaluation

The annual minimum frequency to be conducted for five years are as follows:

Location[1]	Parameter	Units	Sample Type	Minimum Frequency[3]
(1) Colville River upstream from L-Bar (RM 40.3 at Rt. 395) (2) West Ditch Discharge (3) Colville River 300 feet downstream of West Ditch Discharge (4) Chewelah Creek (5) Colville River RM 38.8 (6) Colville River RM 37.8 (downstream of POTW) (7) Colville River RM 32.1(below Blue Creek)	Flow	gpm or cfs		Once per month
	pH[2]	standard units		
	Temperature[2]	°C or °F		
	Dissolved Oxygen[2]	mg/L	grab	
	Alkalinity	mg/L as CaCO3	grab	Once in February Once per month from May to November
	Ammonia Nitrogen	mg/L	grab	
	Nitrate + nitrite nitrogen	mg/L	grab	
	Total persulfate nitrogen	mg/L	grab	
	Orthophosphate	mg/L	grab	
	Total Phosphorus	mg/L	grab	
	Total Organic Carbon	mg/L	grab	
	5-day BOD	mg/L	grab	
	Ultimate Carbonaceous BOD	mg/L	grab	
	Chlorophyll a	mg/L	grab	

1 Locations are based on those given in reference (1).
2 DO, pH, and temperature shall be measured twice per sampling day: early morning within 1 hour of sunrise, and afternoon.
3 Sampling minimum frequency to be reviewed periodically and modified if necessary.

C. Sampling and Analytical Procedures

Samples and measurements taken shall be representative of the volume and nature of the monitored parameters.

D. Flow Measurement

Appropriate flow measurement devices and methods consistent with accepted scientific practices shall be selected and used to ensure the accuracy and reliability of measurements of the quantity monitored flow. The devices shall be installed, calibrated, and maintained to ensure the accuracy of the measurements.

E. Laboratory Accreditation

All laboratory data required by the Department shall be prepared by a laboratory registered or accredited under the provisions of, *Accreditation of Environmental Laboratories,* Chapter 173-50 WAC. Flow, temperature, conductivity and pH are exempt from this requirement.

S4. REPORTING AND RECORDKEEPING REQUIREMENTS

A. Reporting

Monitoring data obtained during each monitoring period shall be summarized, reported and submitted in a report and in an elctronic spreadsheet compatible with excel TM. Monitoring results shall be submitted monthly as will be specified in the Compliance Monitoring Plan. Three copies, one of which will be forwarded to the Water Quality Program, of the reports and the electronic data shall be sent to:

Teresita Bala
Department of Ecology
Toxics Cleanup Program
Eastern Regional Office
4601 N. Monroe Street, Suite 100
Spokane, WA 99205-1295.

B. Recording of Results

For each measurement of sample taken, the following information shall be recorded: (1) the date, exact place, method, and time of sampling; (2) the individual who performed the sampling and measurement; (3) the dates the analyses were performed; (4) who performed the analyses; (5) the analytical techniques or methods used; and (6) the results of all analyses.

C. Additional Monitoring

If monitoring of any pollutant is conducted more frequently that required by this substantive requirement, then the results of this monitoring shall be included in the calculation and reporting of the data to be submitted to Ecology.

D. Noncompliance Notification

In the event, these substantive requirements are not met, the discharger shall:

1. Immediately take action to stop the violation and correct the problem;
2. Immediately notify Ecology of the failure to comply;
3. Submit a written report to the Department within thirty days describing the nature of the violation and actions taken to correct the violation.

S5. OPERATION AND MAINTENANCE

Northwest Alloys shall at all time be responsible for the proper operation and maintenance of any facilities or systems of control installed to achieve compliance with the terms and conditions of these substantive requirements.

APPENDIX A1

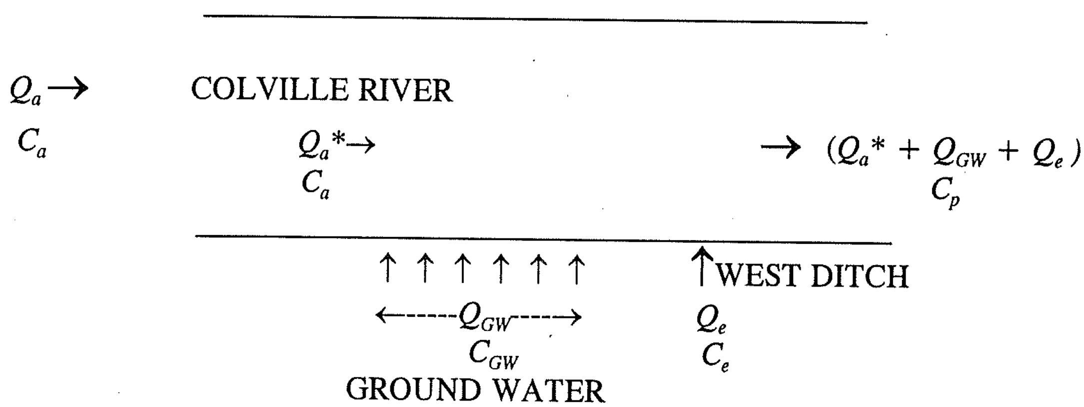
WEST DITCH DISCHARGE LIMITS (WATER QUALITY BASED) CALCULATIONS

I. MIXING ZONE CALCULATIONS

A steady-state model is used for conducting mixing zone analysis. The discharges from this Site to the Colville River are from two sources:

- West Ditch (point source)
- Ground water (nonpoint source)

Discharge limits are calculated for the West Ditch, a point source discharge to the river, taking into consideration the ground water discharge to the river. To be most conservative, it is assumed that pollutant loading from ground water all ends up inside the mixing zone.



The basic steady state mixing zone mass balance equation is given as:

$$Q_a{*}\,C_a + Q_eC_e + Q_{GW}C_{GW} = (Q_a{*} + Q_e + Q_{GW})C_p$$

where,

Q_a *is* the critical volumetric flow of receiving water

$Q_a{}^*$ is the volumetric flow of receiving (ambient) water entrained in the plume from an outfall at some sampling point in the plume;

$Q_a{}^*$ = 2.5% of receiving water flow, Q_a, for an **acute** mixing zone,
25% of receiving water flow, Q_a, for a **chronic** mixing zone

C_a is the ambient concentration of receiving water;

Q_e is the volumetric flux of effluent in the plume;

C_e is the pollutant concentration in the effluent;

Q_{GW} is the volume flow of ground water to the river;

C_{GW} is the pollutant concentration in ground water; and,

C_p is the resulting pollutant concentration at the edge of the mixing zone.

Assuming that the ground water flux is negligible compared to the river flow, the mixing zone equation may be written as:

$$Q_a{}^* C_a + Q_e C_e + L_{GW} = (Q_a{}^* + Q_e) C_p$$

where L_{GW} = pollutant loading from ground water = $Q_{GW} C_{GW}$

Receiving Water Flow, Q_a

Q_a is the critical receiving water flow. For the Colville River, three seasonal 7-day average low flows with a recurrence interval of once every 29 years (7Q29) have been proposed by Ecology (1) and are given as follows:

SEASON	7Q29(cfs)
June to October	5.5
November to February	13.7
March to May	25.6

Receiving Water Concentration, C_a

This critical background receiving river concentration is the 90th percentile obtained from data shown in Tables A1 to A3.

Ground Water Loading, L_{GW}

L_{GW} is the pollutant loading from the ground water to the river. Results of the Remedial Investigation show the following seasonal ammonia and chloride loading:

SEASON	Ground Water Loading to the Colville River from L-Bar			
	Ammonia as N		Chloride	
	Kg/day	lb/day	Kg/day	lb/day
June to October	0.2	0.44	123	272
November to February	0.001	0.003	44	97
March to May	0.02	0.05	46	101

As discussed in the RI Report (3), L_{GW} (in lbs/day) = $0.0042*C_{ave}$, where C_{ave} is the average ammonia or chloride concentration in mg/L measured in monitoring wells P-05, P-19, and P-20B.

A. DETERMINING REASONABLE POTENTIAL

To determine whether the West Ditch discharge causes, has the reasonable potential to cause, or contributes to the excursion of water quality criteria, the following effluent characteristics are used in conjunction with critical receiving water flow and concentrations.

Effluent Discharge Flow, Q_e: The seasonal effluent discharge flow rate is the maximum value observed from 1994 to 1998 as shown in Tables A1 to A3.

Effluent Concentration, C_e: The seasonal maximum effluent concentration from the data shown in Tables A1 to A3 is used as the critical effluent concentration.

The concentration of a pollutant at the edge of the mixing zone is calculated using the following equation:

$$C_p = \frac{Q_a * C_a + Q_e C_e + L_{GW}}{Q_a * + Q_e}$$

If this pollutant concentration at the edge of the mixing zone exceeds the water quality criterion, there is reasonable potential and permit limits will have to be set.

Reasonable potential to exceed was analyzed for both chronic and acute conditions. Table A4 (under Mixing Zone) shows that there are reasonable potentials for ammonia to exceed the criteria in the mixing zone for all seasons. Ammonia discharge limits are necessary for all seasons. There are reasonable potentials for chloride to exceed water quality criteria in the mixing zone for two seasons, but not for the March to May season. Chloride discharge limits will not be set for the March to May season.

B. CALCULATING DISCHARGE LIMITS

The discharge limit for a pollutant is the effluent loading or concentration that will result in achieving the water quality criterion at the edge of the mixing zone. The equation used to determine a pollutant discharge limit is as follows:

$$WLA_m = Q_eC_e = (Q_a * + Q_e)C_{pc} - Q_a * C_a - L_{GW}$$

$$WLA_c = C_e = \frac{(Q_a * + Q_e)C_{pc} - Q_a * C_a - L_{GW}}{Q_e}$$

where

WLA_m is the waste load allocation expressed in mass per unit time;
WLA_c is the waste load allocation in concentration units; and,
C_{pc} is the water quality criterion for the pollutant.

Waste load allocations were determined using the critical river flows and ambient concentrations for each of the proposed seasons. Table A4 shows the acute and chronic waste load allocations for chloride and ammonia.

Long Term Averages

The long-term averages, LTA_a (acute) and LTA_c (chronic), that will comply with the corresponding wasteload allocations WLAs are given as follows:

$$LTA_a = WLA_a \times e^{(0.5\sigma^2 - z\sigma)}$$

where:

$\sigma^2 = \ln[CV^2+1]$
$z = 2.326$

$$LTA_c = WLA_c \times e^{(0.5\sigma^2 - z\sigma)}$$

where:

$\sigma^2 = \ln[(CV^2/4)+1]$
$z = 2.326$

Maximum Daily Limit (MDL)

The smallest of the LTA_a or LTA_c is used to calculate the MDL.

$$MDL = LTA \times e^{(z\sigma - 0.5\sigma^2)}$$

where:

$\sigma^2 = \ln[CV^2 + 1]$
$z = 2.326$

Average Monthly Limit (AML)

The smallest of the LTA is used to calculate the AML.

$$AML = LTA \times e^{(z\sigma_n - 0.5\sigma_n^2)}$$

where:

$\sigma^2_n = \ln[(CV^2/n) + 1]$
n = number of samples per month
$z = 1.645$

A value of 0.6 is used for the coefficient of variation CV as recommended (1,2).

Individual waste load allocations for ammonia are calculated using a mixing zone and shown in Table A4.

II. TOTAL MAXIMUM DAILY LOAD

Pelletier (1) recommended that ammonia waste load allocations for the Colville River be based on protecting the water quality criteria for dissolved oxygen (DO). Potential ammonia effluent limits from the L-Bar Site have been shown to affect effluent limits for the Chewelah POTW. Table A6 shows a summary of the Chewelah Treatment Plant limits to meet DO in the River for 2 scenarios (i) without surface water discharge from L-Bar and (ii) with surface water discharge from L-Bar as presented in (1). An analysis of the effects of the L-Bar discharge on the POTW ammonia discharge limits shown on this table illustrates that the effect of ammonia effluent limits from the L-Bar Site is significant during the June to October season; a surface discharge of 1.8 lbs/day of ammonia from the L-Bar Site results in a 73% lowering of the POTW ammonia limit. The effects during the November to February and the March to May seasons are not as drastic.

The approved facility plan for the Chewelah POTW requires that no ammonia is discharged from surface water at the L-Bar facility except for the existing nonpoint ground water loads (assumed to be 0.2 Kg/day, the maximum loading calculated for the Site). Even with this assumption, it is still possible that the DO standards will still not be consistently met and the City may still be required to do further treatment. To minimize the effect of the L-Bar Site ammonia discharge to the Colville River on the Chewelah POTW, the following ammonia seasonal point source allocations for the L-Bar Site are being proposed:

> <u>June to October</u>: The total ammonia loading from the West Ditch and the ground water will be 0.2 Kg/day. This is equivalent to setting zero surface water discharge and 0.2 Kg/day from ground water. Both concentrations of ammonia in ground water and in the West Ditch are expected to decrease after the source materials are removed.
>
> <u>November to February</u>: The individual waste load allocation for ammonia from the L-Bar Site is 7.1 lbs/day. This loading rate from the L-Bar Site causes a lowering of the Chewelah limits for no surface water from L-Bar by 7 to 14 %. A loading rate of 50% of the individual waste load allocation or 3.5 lbs/day should not cause the ammonia limits at the treatment plant to change by much.
>
> <u>March to May</u>: The individual waste load allocation of 8.1 lbs/day from the L-Bar Site will cause permit limits at the treatment plant to be reduced by 1 to 8 %. A loading rate of 50% of the individual waste load allocation or 4 lbs/day should not affect the Chewelah treatment plant limits significantly.

II. DISCHARGE LIMITS

Ammonia

The ammonia discharge limit selected is the most stringent MDL or AML from the following

SEASON	UNITS	AMMONIA AS N					
		MDL		AML(n=2)		Proposed MDL to meet dissolved O2(1)	AML (n=2) (corresponding to MDL to meet dissolved O2)
		Calculated	(1)	Calculated	(1)		
June to October	lbs/day	1.7	1.9	1.0	0.75	0.44	0.3
	Kg/day	0.8		0.4		0.2	0.1
November to February	lbs/day	10.1	7.1	5.9	2.8	3.6	2.1
	Kg/day	4.6		2.7		1.6	0.9
March to May	lbs/day	10.2	8.1	5.9	3.2	4.1	2.4
	Kg/day	4.6		2.7		1.86	1.1

(1) refers Reference (1).

Chloride

Currently, there are no recommended or existing TMDLs for chloride in the Colville River. Chloride limits are calculated as individual waste load allocations using mixing zones as presented in Table A4, which are summarized in the table below.

SEASON	UNITS	CHLORIDE	
		MDL	AML(n=2)
June to October	lbs/day	771	445
	Kg/day	350	202
November to February	lbs/day	2775	1602
	Kg/day	1260	727
March to May	lbs/day	Not required	Not required
	Kg/day		

Table A1. West Ditch and Upstream River Seasonal Data - March to May

March - May										
	NH3-N	NO3 + NO2	CHLORIDE	TDS	pH	TEMP.	FLOW		MASS LOADING	
	mg/L	mg/L	mg/L	mg/L		DEG. C	GPM	CFS	NH3, lbs/day	Cl, lbs/day
WEST DITCH DATA										
1994	7.07		1435		7.71	8.9				
	7		1410		7.72	12.8				
	1.1		715		7.82	10.9				
	0.21		424.5		7.96	21.6				
	0.59		580.5		7.69	17.5				
1995	0.13		10.75		8.58	6.7				
	0.06		4.15		7.26	6.7				
	6.56		635		7.91	6.6				
	2.39		590		7.44	9.3				
	3.86		580		7.39	13.1				
	2.87		475		7.45	9.5				
1996	12.1	7.36	757.5	2046	8.31	4.8	106	0.2332	15.2090708	952.13811
	21.86	7.1	1326.5	3588	8.15	2.1	29	0.0638	7.51726052	456.159473
	18.37	7.01	1345	3430	7.95	12.6	29	0.0638	6.31711234	462.52129
	12.85	7.54	1125	2952	7.84	9.3	(a)			
	15.58	8.3	1530	3506	8.06	7.5	(a)			
	17.42	8.96	1030	3344	7.71	13.7	(a)			
1997	8.63	4.48	457.5	1176	8.55	2.9	225	0.495	23.0252715	1220.63288
1998	19.05	7.77	950	2232	8.49	7.2	162	0.3564	36.5949738	1824.9462
1999	13.72	2.34	524.7	1134	7.4	7.9	5	0.011	0.8134588	31.109463
UPSTREAM RIVER DATA										
1994	0.02		1.8		7.94	6.4	35685.96	79.5		
	0.04		1.85		8.04	11.7	66030.248	147.1		
	0.02		1.2		8.26	9.8	64818.272	144.4		
	0.03		1.5		8.85	20.9	33935.328	75.6		
	0.04		1.6		8.42	17.3	30793.168	68.6		
1995	0.04		3.4		8.88	7	243158.296	541.7		
	0.01		2.65		7.43	6.2	215327.736	479.7		
	0.01		1.95		7.43	6.6	94668.792	210.9		
	0.03		1.95		7.34	9.6	67287.112	149.9		
	0.02		2.05		7.22	11	60598.8	135		
	0.01		1.85		7.13	12	43496.472	96.9		

(a) River over weir

Table A1. West Ditch and Upstream River Seasonal Data - March to May

March - May										
	NH3-N	NO3 + NO2	CHLORIDE	TDS	pH	TEMP.	FLOW		MASS LOADING	
	mg/L	mg/L	mg/L	mg/L		DEG. C	GPM	CFS	NH3, lbs/day	Cl, lbs/day
1996	0.07	1.22	4.8	241.3	7.93	6	112220	250		
	0.04	0.36	3.3	186.7	8	4.2	108853.4	242.5		
	0.01	0.16	3.05	136	7.85	10.2	91526.632	203.9		
	0.1	0.41	3.35	178.7	7.83	9.3	133721.352	297.9		
	0.01	0.37	3.35	188	7.4	8.2	123172.672	274.4		
	0.01	0.29	2.65	185.3	8.23	13.6	95162.56	212		
1997	0.05	1.54	5.1	222.7	7.22	2.6	181257.744	403.8		
	0.06	1.5	5.35	222.7	7.26	2.5	duplicate sample			
1998	0.03	0.78	4.4	228	7.89	5.8	128379.68	286		
1999	0.01	0.29	2.15	157.3	8.01	10.5	220265.416	490.7		
								239.525		

(a) River over weir

TABLE A2. West Ditch and Upstream River Seasonal Data - June to October

JUN - OCT										
	NH3-N	NO3 + NO2	CHLORIDE	TDS	pH	TEMP	FLOW		MASS LOADING	
	mg/L	mg/L	mg/L	mg/L		Deg. C	GPM	CFS	NH3, lbs/day	Cl, lbs/day
WEST DITCH DATA										
1994	0.22		321.5		7.52	13.3				
	0.16		350.5		7.76	18				
	0.38		335		8.24	21.5				
1995	3.65	4.05	355	1568	7.5	11.2				
	5.47	8.76	580	2156	7.44	12.3				
	5.9	6.8	585	2054	7.56	14.5				
	7	1.98	555	2290	7.66	16.2				
	3.39	0.31	690	3094	8.49	25.2				
	3.34	4.7	490	2320	7.7	20.4				
	6.23	7	440	2014	7.93	5.5				
	5.93	10.68	440	1984						
	4.97	11.13	655	2500	7.73	9.1				
	7.17	13.23	750	2658	7.73	6.3				
1996	8.76	10.38	1625	3590	7.62	16.1	14.5	0.0319	1.50620316	279.404125
	16.42	8.26	1605	3518	7.54	15.2	13.9	0.03058	2.7064462	264.546051
	20.14	10.76	1770	4010	7.43	18.1	29.5	0.0649	7.04519354	619.16547
	14	9.14	1800	4027	7.29	22	8.1	0.01782	1.3446972	172.88964
	10.01	1.47	1890	4475	7.51	19	0.7	0.00154	0.08308901	15.688134
	9.46	1.44	1856	4557.5	7.5	18.9	duplicate sample			
	2.36	1.68	1415	4005	7.4	13.2	0	0	0	0
	0.47	2.79	855	4097.5	7.39	15.2	0	0	0	0
	0.81	9.27	695	2300	7.39	9.1	8.2	0.01804	0.07876084	67.578742
	0.17	7.72	555	1817.5	7.52	10.4	9.7	0.02134	0.01955384	63.837543
	5.62	12.65	1110	2867.5	7.53	3.3	20.7	0.04554	1.37948857	272.461266
1997	27.91	2.88	1662.5	4072	7.94	17.7	nm			
	24.02	8.57	1805	4428	7.75	19	nm			
1998	17.62	9.98	1367.5	5700	7.93	21.3	39.8	0.08756	8.31573081	645.389437
	11.59	7.13	740	2274	8.02	17.3	10.8	0.02376	1.48428958	94.769136
1999	45.17	10	1670	4818	8.31	17.7	5	0.011	2.6781293	99.0143
	24.81	20.28	1282.5	4886	7.72	9.3	0	0	0	0
UPSTREAM RIVER DATA										
1994	0.02		1.05		7.8	14.8	26124.816	58.2		

nm - not measured, weir silted

TABLE A2. West Ditch and Upstream River Seasonal Data - June to October

JUN - OCT	NH3-N	NO3 + NO2	CHLORIDE	TDS	pH	TEMP	FLOW		MASS LOADING	
	mg/L	mg/L	mg/L	mg/L		Deg. C	GPM	CFS	NH3, lbs/day	Cl, lbs/day
	0.02		0.9		8.86	17	14184.608	31.6		
	0.01		1.15		8.89	20.3	7720.736	17.2		
	0.01		1.8		8.08	22.2	4354.136	9.7		
	0.25		2.4		8.31	21.1	2962.608	6.6		
	0.01		2		8.25	22.3	3995.032	8.9		
	0.14		1.6		8.02	15.6	6688.312	14.9		
	0.23		2		7.82	9.9	9067.376	20.2		
	0.01		1.85		7.42	11.7	8214.504	18.3		
	0.01		2.2		7.99	9.9	9112.264	20.3		
	0.03		2.15		8.1	5.6	10099.8	22.5		
1995	0.05	0.45	1.9	225.3	7.75	12.3	45606.208	101.6		
	0.02	0.32	2.1	205.3	7.58	12.7	42329.384	94.3		
	0.08	0.28	1.95	169.3	8.01	16.8	21501.352	47.9		
	0.04	0.1	1.15	221.3	7.51	19	12344.2	27.5		
	0.04	0.08	2.2	221.3	8.29	19.7	8887.824	19.8		
	0.06	0.18	2.3	210.7	7.81	13.3	13197.072	29.4		
	0.08	0.24	2.7	250.7	8.19	15.2	12837.968	28.6		
	0.18	0.28	2.75	266.7			duplicate sample			
	0.05	0.27	2.75	221.3	7.94	15.5	18224.528	40.6		
	0.04	0.33	2.6	221.3	7.91	9.1	15665.912	34.9		
	0.06	0.45	2.55	222.7	7.73	9.5	16743.224	37.3		
	0.03	0.44	2.65	224	8.3	7.4	19975.16	44.5		
1996	0.01	0.29	2	192	8.05	16.4	79002.88	176		
	0.01	0.27	1.9	180	8.24	15.8	38603.68	86		
	0.01	0.29	2.2	188	7.95	16.7	44169.792	98.4		
	0.04	0.26	2.05	186.7	8.2	23	22040.008	49.1		
	0.04	0.32	2.6	218.7	8.08	20.5	15935.24	35.5		
	0.01	0.24	3	258.7	8.16	20.1	17371.656	38.7		
	0.01	0.18	2.65	212	8.13	17.3	16967.664	37.8		
	0.02	0.23	2.5	200	8.27	16.7	16159.68	36		
	0.02	0.34	2.7	229.3	8.08	10.8	26079.928	58.1		
	0.01	0.33	2.4	196	7.88	10.8	23970.192	53.4		
	0.01	0.41	3.55	186.7	8.01	4.7	26887.912	59.9		
1997	0.02	0.39	2.15	218.7	8.01	15.2	61361.896	136.7		

nm - not measured, weir silted

TABLE A2. West Ditch and Upstream River Seasonal Data - June to October

JUN - OCT										
	NH3-N	NO3 + NO2	CHLORIDE	TDS	pH	TEMP	FLOW		MASS LOADING	
	mg/L	mg/L	mg/L	mg/L		Deg. C	GPM	CFS	NH3, lbs/day	Cl, lbs/day
	0.04	0.36	2.75	228	8.16	14.5	43990.24	98		
1998	0.01	0.25	2.3	124	8.15	18.4	47087.512	104.9		
1999	0.01	0.36	1.6	173.3	8.19	15.1	57277.088	127.6		
	0.01	0.3	2.15	197.3	8.43	13.8	30838.056	68.7		

nm - not measured, weir silted

TABLE A3. West Ditch and Upstream River Seasonal Data - November to February

NOV - FEB										
	NH3-N	NO3 + NO2	CHLORIDE	TDS	pH	TEMP	FLOW		MASS LOADING	
	mg/L	mg/L	mg/L	mg/L		Deg. C	GPM	CFS	NH3, lbs/day	CL, lbs/day
WEST DITCH DATA										
1994-1995	8.13		1675		7.73	0.8				
	8.8		2500		8.27	1.1				
	2.94		1470		8.26	1.7				
	10.03		1550		8.36	0.9				
	8.81		985		8.73	1.6				
	5.95		895		8.33	3				
	11.2		1180		8.32	0.8				
	9.36		905		8.34	2.6				
1995-1996	3.82	7.59	475	1982	7.7	0.5	16.2	0.03564	0.73382047	91.24731
	10.02	13.84	1107.5	3524	7.76	2.7	29.2	0.06424	3.46946107	383.475862
	16.09	11.78	1032.5	3236	8.03	2.3	69.3	0.15246	13.2221087	848.466581
	14.78	12.06	1020	3380	8.64	2.2	102	0.2244	17.8766465	1233.70632
	8.96	8.91	1077.5	2834	8.09	1.5	108	0.2376	11.4747494	1379.91546
	6.43	6.66	672.5	2106	8.64	2.4	161	0.3542	12.2757573	1283.89531
	10.92	12.77	1307.5	3598	7.8	0	42.2	0.09284	5.46445099	654.282937
	16.14	8.73	1120	3014	8.56	1.3	65.5	0.1441	12.5359219	869.90288
	20.15	6.78	1305	3556	8.55	0.4	49.7	0.10934	11.8752534	769.092093
	17.51	6.78	1270	2962	8.51	0	duplicate sample			
1996-1997	19.39	18.72	1885	4227.5	7.46	5.8	29.5	0.0649	6.78283529	659.393735
	10	15.24	1295	2862.5	7.6	4.6	98.8	0.21736	11.715704	1517.18367
	9.94	15.5	1270	2895	7.65	4.6	duplicate sample			
	14.34	16.27	1435	3162.5	8.29	1.1	101.9	0.22418	17.3274551	1733.95384
	14.31	13.05	1275	2947.5	8.3	0.6	93.8	0.20636	15.9167325	1418.15751
	17.4	8.98	1080	2555	8.25	0	123	0.2706	25.3784916	1575.21672
	18.63	10.71	1505	3825	8.37	0.1	41.4	0.09108	9.14586196	738.836406
	22.7	8.52	1505	3302.5	8.7	0	36.1	0.07942	9.71727526	644.251069
	12.63	7.23	790	1842.5	8.62	2.2	95.4	0.20988	14.2877279	893.690028
1997-1998	29.06	17.17	2455	5200	7.85	2.7	28.7	0.06314	9.88983288	835.496893
	19.31	21	1525	3374	8.25	5.6	125.3	0.27566	28.6909409	2265.85629
UPSTREAM RIVER DATA										
1994-1995	0.05		2.1		8.47	4.1	12972.632	28.9		
	0.04		2.55		8.48	0.9	11985.096	26.7		

TABLE A3. West Ditch and Upstream River Seasonal Data - November to February

NOV - FEB										
	NH3-N	NO3 + NO2	CHLORIDE	TDS	pH	TEMP	FLOW		MASS LOADING	
	mg/L	mg/L	mg/L	mg/L		Deg. C	GPM	CFS	NH3, lbs/day	CL, lbs/day
	0.04		3.1		8.25	0.4	9695.808	21.6		
	0.06		2.85		8.18	2.5	28548.768	63.6		
	0.1		5.75		7.87	0.5	10728.232	23.9		
	0.14		3.65		7.9	3.4	67780.88	151		
	0.26		3.55		7.91	4.3	43182.256	96.2		
	0.05		3.25		7.76	0.8	41296.96	92		
	0.03		2.95		7.93	2.1	117471.896	261.7		
1995-1996	0.06	0.47	2.65	214.7	8.02	2.7	21007.584	46.8		
	0.03	0.5	2.65	237.3	8.01	3.7	22578.664	50.3		
	0.1	0.53	3.4	222.7	7.89	2.2	33845.552	75.4		
	0.11	1.44	3.45	238.7	7.9	2	53551.384	119.3		
	0.11	1.39	3.6	233.3			duplicate sample			
	0.06	0.55	2.7	224	7.93	2.3	33306.896	74.2		
	0.1	0.89	3.7	214.7	8.02	2	74424.304	165.8		
	0.04	0.62	2.7	260	7.33	0.7	19301.84	43		
	0.05	1.23	4.8	229.3	7.44	0.4	101222.44	225.5		
	0.05	0.88	4.6	260	7.55	1.8	116978.128	260.6		
1996-1997	0.03	0.45	2.95	202.7	7.69	5	30478.952	67.9		
	0.03	0.53	4.3	212	7.54	4.1	43316.92	96.5		
	0.1	0.85	4.2	232	7.42	1	37571.256	83.7		
	0.07	0.85	4.45	241.3	7.24	0.6	45830.648	102.1		
	0.06	1.22	5.25	268	7.11	0	95925.656	213.7		
	0.05	0.91	3.95	244	7.28	0	41835.616	93.2		
	0.03	0.72	3.2	218.7	7.55	0.3	66793.344	148.8		
	0.06	1.14	5.15	210.7	7.02	3.3	96733.64	215.5		
1997-1998	0.04	0.5	2.7	228	7.96	4	44124.904	98.3		
	0.04	0.71	3.45	193.3	8.01	4.6	128245.016	285.7		

Table A4. West Ditch Discharge Mixing Zone Limits Calculations				
VARIABLE	UNITS	JUNE - OCTOBER	NOVEMBER - FEBRUARY	MARCH - MAY
UPSTREAM RIVER				
Flow	cfs	5.5	13.7	25.6
	gpm	2468.73	6149.382	11490.816
	gals/day	3554971.2	8855110.08	16546775.04
ammonia concentration	mg/L, NH3-N	0.08	0.13	0.07
chloride concentration	mg/L	2.95	4.83	4.72
temperature	degrees C	23.86	4.26	16.75
pH		8.46	8.3	8.55
acute ammonia criteria	mg/L, NH3-N	1.6	3.1	1.7
chronic ammonia criteria	mg/L, NH3-N	0.26	0.72	0.35
acute chloride criteria	mg/L	860	860	860
chronic chloride criteria	mg/L	230	230	230
River flows are 7Q29 flows.				
Ammonia, chloride, T, and pH are 90th percentiles of data used				
WEST DITCH DISCHARGE				
Flow *	gals/day	57,312	180,432	324,000
	gpm	39.8	125.3	225
	cfs	0.088669073	0.279151629	0.501269884
ammonia concentration *	mg/L, NH3-N	27.91	29.06	21.86
chloride concentration *	mg/L, NH3-N	1890	2500	1530
ammonia loading	lbs/day	13.34882211	43.75691728	59.10615559
	Kg/day	6.060365238	19.86564045	26.83419464
chloride loading	lbs/day	903.9510493	3764.359711	4136.890122
	Kg/day	410.3937764	1709.019309	1878.148115
* Maximum value measured				
MIXING ZONE				
acute ammonia concentration	mg/L	11.35214619	13.12162585	9.647792227
chronic ammonia concentration	mg/L	1.821794575	2.310327961	1.653889053
acute chloride concentration	mg/L	968.6747498	1154.213125	691.1304339
chronic chloride concentration	mg/L	152.17572	197.7259619	118.2323781
comparison with ammonia criteria				
acute		TRUE	TRUE	TRUE
chronic		TRUE	TRUE	TRUE
comparison with chloride criteria				
acute		TRUE	TRUE	FALSE
chronic		FALSE	FALSE	FALSE

Table A4 (continuation)				
EFFLUENT LIMITS				
Waste Load Allocation (WLA)				
Ammonia WLA				
acute	Kg/day	0.65839298	4.604705802	4.635931899
	lbs/day	1.450204801	10.14252379	10.21130374
acute concentration	mg/L, NH3-N	3.035105163	6.74252307	3.780299019
chronic	Kg/day	0.461901209	5.434410555	4.793287047
	lbs/day	1.017403544	11.9700673	10.55790098
chronic concentration	mg/L, NH3-N	2.129303906	7.957433138	3.908611842
Chloride WLA				
acute	Kg/day	349.858612	1259.883795	2347.7973
	lbs/day	770.6136829	2775.074439	5171.359691
acute concentration	mg/L	1612.802251	1844.807447	1914.475023
chronic	Kg/day	688.6645262	1999.807813	3763.354091
	lbs/day	1516.882216	4404.863025	8289.326193
chronic concentration	mg/L	3174.653016	2928.254463	3068.768931
Long Term Averages (LTA)				
Ammonia				
Acute	Kg/day	0.211398793	1.478492753	1.488518922
	lbs/day	0.465636108	3.256591967	3.278676039
	mg/L, NH3-N	0.974520671	2.164909535	1.21378975
chronic	Kg/day	0.243622402	2.866292897	2.52814256
	lbs/day	0.536613221	6.313420477	5.568595948
	mg/L, NH3-N	1.123067277	4.19702079	2.061534779
Chloride				
acute	Kg/day	112.3336527	404.5272686	753.8378004
	lbs/day	247.4309531	891.0292261	1660.435684
	mg/L	517.8433851	592.3363096	614.7053838
chronic	Kg/day	363.2250857	1054.766634	1984.920902
	lbs/day	800.0552549	2323.274525	4372.072471
	mg/L	1674.419939	1544.460965	1618.573073
Maximum Daily Limit (MDL)				
Ammonia	Kg/day	0.758751496	4.604702104	4.635928176
	lbs/day	1.671258801	10.14251565	10.21129554
	mg/L, NH3-N	3.497744741	6.742517656	3.780295983
Chloride	Kg/day	349.8583311	1259.882784	2347.795414
	lbs/day	770.613064	2775.07221	5171.355538
	mg/L	1612.800956	1844.805966	1914.473486

Table A4 (continuation)				
Effluent Limits (Continuation)				
Average Monthly Limit (AML)				
n = 4				
ammonia	Kg/day	0.37820502	2.295246155	2.31081101
	lbs/day	0.833050706	5.055608271	5.089892093
	mg/L	1.743475471	3.360855355	1.884315125
chloride	Kg/day	174.3893462	627.997436	1170.27514
	lbs/day	384.1175026	1383.254264	2577.698545
	mg/L	803.9119814	919.5565107	954.282776
n=2				
ammonia	Kg/day	0.437950491	2.657828761	2.675852414
	lbs/day	0.964648659	5.854248372	5.893948047
	mg/L	2.018894243	3.89177344	2.181982496
chloride	Kg/day	201.9378265	727.2028943	1355.144814
	lbs/day	444.7969747	1601.76849	2984.900471
	mg/L	930.9068575	1064.819883	1105.031895

Table A5. Interim Limits Calculations

SEASON	Maximum Loading, lbs/day		Coefficient of Variation	Number of Data Points	Multiplier*	Maximum Expected Loading, lbs/day		Proposed Interim Limits, lbs/day			
	NH3	Chloride				NH3	Chloride	NH3		Chloride	
June to October	8.32	645.39	0.6	14	1.5	12.48	968.085	12.48	(a)	968.085	(d)
November to February	28.69	2265.85	0.6	19	1.4	40.166	3172.19	40.165	(b)	3172.19	(e)
March to May	36.59	1824.94	0.6	6	2.1	76.839	3832.374	76.839	(c)	NR	(f)

* Source: Technical Support Document For Water Quality-Base Toxics Control, EPA

(a) Water quality-based limit is 1.67 lbs/day. June to October loadings measured since 1996 show that only 4 out of 14 values exceeded this

(b) Water quality-based limit is 10.14 lbs/day. November to February loading values since 1995 show that out of 14 values 4 exceeded 15

(c) Water quality-based limit is 10.25 lbs/day. March to May measured loadings since 1996 show 3 out of 6 exceedances to this limit. (See

(d) Water quality-based limit is 770.6 lbs/day. No exceedances were observed since 1996 to present. Maximum loading observed is 645.4

(e) Water quality-based limit is 2775.07 lbs/day. No exceedances have been observed in the River since 1996.

(f) NR - not required. Maximum loading observed does not exceed the water quality-based limit.

Table A6. Effect of L-Bar Ammonia Surface Water Loading to Chewelah POTW

Season	Chewelah Treatment Plant Effluent Limits for NPDES permits to meet dissolved Oxygen								L-Bar West Ditch Water Quality-based
	Daily Maximum BOD5		Without Surface		With Surface Discharge from L-			% change with L-Bar Surface Discharge =[(2)-(1)]/(1)	
			Daily Maximum Ammonia		L-Bar Discharge Rate/ lbs/day	Daily Maximum Ammonia			
	mg/L	lbs/day	mg/L as N	lbs/day (1)		mg/L as N	lbs/day(2)		
June - October	10	59	1.7	15	1.8	0.5	4	-73%	1.7
	15	89	0	0		0	0	0	
November - February	15	150	5.7	102	7.1	5.3	95	-7%	7.1
	30	300	4.6	82		4.3	77	-6%	
	45	451	3.7	66		3.2	57	-14%	
March - May	15	150	10	179	8.1	9.9	177	-1%	8.1
	30	300	9.6	171		8.7	155	-9%	
	45	451	8.6	154		7.9	141	-8%	

* NH_3 loading from the L-Bar Site is assumed to be from ground water only which is estimated to be 0.2 Kg/day or 0.44 lbs/day.