FIVE-YEAR REVIEW REPORT
REPUBLIC STEEL QUARRY SITE
ELYRIA, OHIO

Remedial Planning Activities At Selected Uncontrolled Disposal Sites

U.S. EPA Contract No. 68-W8-0089

Roy F. Weston Inc.

FIVE-YEAR REVIEW REPORT
REPUBLIC STEEL QUARRY SITE
ELYRIA, OHIO

May 1998

Prepared for:

U.S. Environmental Protection Agency
Superfund Division-Region V
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Work Assignment No. 86-5WE

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION V

DATE: June 19, 1998

SUBJECT: Five-Year Review of the Republic Steel Quarry Site, Elyria, Ohio

FROM: Sheila A. Sullivan S.A.Sullivan
RPM, Risk Assessor

TO: William E. Muno, Director
Superfund Division

Attached for your concurrence, is the Five-Year Review Report for the Republic Steel Quarry NPL Site in the City of Elyria, Lorraine County, Ohio. In order to implement the Record of Decision signed September 30, 1988, a Removial Action was completed by U.S. EPA at the Site in 1990, which consisted of removing soils (about 150 yd^3) exceeding an action level of 300 ppb for carcinogenic PAHs and fencing the quarry and some of the surrounding land. Contaminated quarry sediments were left in place; it was believed that disturbance of sediments would create a greater potential health threat. Groundwater sampling showed one contaminant (a common laboratory solvent), but this finding could not be duplicated. Since groundwater was not used as a potable water supply, the ROD did not call for groundwater treatment. Fish tissue samples were not collected during the RI, but contamination was modeled. The ROD called for conducting a fish tissue study and resampling groundwater to ensure that risks remain acceptable.

A supplemental study was conducted in 1989 to follow up on the health risks identified during the earlier RI. The study evaluated soil, groundwater and fish tissue samples and recalculated risks based on the additional data. The resulting Supplemental Report of September 1990 stated that no unacceptable risks were posed under current-use trespasser scenarios, however groundwater posed unacceptable risks under a future-use residential scenario. The Report also identified the need for additional data on cadmium and copper levels in fish tissue, and beryllium and bis-2(ethylhexyl)phthalate levels in groundwater. The latter two contaminants had recently been reclassified as having greater carcinogenic potential than originally thought. These data needs were reflected in the Preliminary Closeout Report of December 1992. Accordingly, this statutory review consisted of a detailed Level II analysis involving site inspection, sampling of all site media, sample analyses, data analyses and risk recalculation. The work was completed under my direction utilizing the ARCS contractor, Roy F. Weston, Inc., and conducted with the cooperation of the present Site owner, the City of Elyria.

The risk assessment considered current trespasser, future residential, and future recreational park patron scenarios in developing probable exposure pathways. The results of the on-site investigation indicated that the Site has no formal use[1], however trespassing is well-established. There is currently no unacceptable on-site or off-site risk to casual trespassers, however regular use of the quarry via swimming or fish consumption presents unacceptable risk. The fence would normally limit such exposure, however it is currently breached in many places rendering it ineffective. Under future residential use, groundwater consumption and soil ingestion are two pathways that each pose unacceptable risk. Future park patrons (children) would be at risk from soil ingestion; presumably, no groundwater will be made available as this would present a risk to any and all users.

The recommendations made in the Five-Year Review to limit or prevent these exposures include having the owner, the City of Elyria, restore the fence to functional condition, repost warning signs, and conduct regular, monthly inspections of the fence, with increased vigilance in warm weather, to detect and repair vandalism. The Review also recommends that groundwater monitoring be performed during future five-year reviews until the Site can be delisted. In anticipation of delisting, we are also recommending that the City formalize and codify land use restrictions so that no residential development can occur, and use of groundwater as a potable source of water is prohibited for current and future commercial/industrial or public use. This codification is necessary since soil data from this Level II investigation indicated that carcinogenic PAHs exceed the original Action Level of 300 ppb in several areas of the Site. These areas are currently enclosed by the fence.

The Ohio EPA Northeast District Office has been involved with this Five-Year Review assessment, and has reviewed and concurred with the recommendations summarized above. If you concur, please sign the page indicated by the red tab.

Attachment

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[1] The City of Elyria purchased the property (quarry and seven acres) in 1977 from Republic Steel Corporation with federal funds for the purpose of turning it into a municipal park. Recent discussions with City officials indicate that they have since abandoned this plan and have no intentions for future residential or commercial development of the property. They may allow industrial development in the future.

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REGION V

U.S. EPA CONTRACT NO. 68-W8-0089

Work Assignment No. 86-5WE
Document Control No. 4500-86-APOA

May 1998

Prepared and Approved By:	Robert H. Gilbertsen, P.E. Site Manager	Date: 5/15/98
Approved By:	for James M. Burton, P.E. Technical Operation Manager	Date: 5/15/98
Approved By:	Dean F. Geers Program Manager	Date: 5/15/98

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SECTION 1
INTRODUCTION

1.1 AUTHORITY STATEMENT

The United States Environmental Protection Agency (U.S. EPA) Region V conducted this Five-Year Review pursuant to the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) Section 121(c); the National Contingency Plan (NCP) Section 300.400(f)(4)(ii); Office of Solid Waste and Emergency Response (OSWER) Directive 9355.7-02, 23 May 1991 (hereinafter U.S. EPA 1991); OSWER Directive 9355.7-02A, 26 July 1994 (hereinafter U.S. EPA, 1994); and to the Record of Decision (ROD) for the Republic Steel Quarry (RSQ) site, September 1988 (hereinafter the ROD or U.S. EPA, 1988).

This Five-Year Review is a statutory review, originally scheduled for Fiscal Year 1995 (U.S. EPA, 1994a., Attachment II, explicitly defining RSQ's status and schedule). This date was later definitionally revised to fiscal year 1997 to occur 5 years from the preliminary closeout report of 1992. The statutory-review criteria are defined in CERCLA:

> If the President selects a remedial action that results in any hazardous substances, pollutants, or contaminants remaining at the site, the President shall review such remedial action not less often than each five years after the initiation of such remedial action to assure that human health and the environment are being protected by the remedial action being implemented (CERCLA Section 121(c)).

CERCLA's statutory-review requirement is implemented into regulation by the NCP:

> If a remedial action is selected that results in hazardous substances, pollutants, or contaminants remaining at the site above levels that allow for unlimited use and unrestricted exposure, the lead agency shall review such action no less often than every five years after initiation of the selected remedial action. (NCP Section 300.430(f)(4)(ii)).

The ROD's declaration section provided for the present review:

> Because low levels of hazardous substances will remain on site, the five-year facility review will apply to this action (U.S. EPA, 1988).

1.2 PURPOSE

The purpose of any Five-Year Review is to ensure that a response action remain protective of public health and the environment and is functioning as designed (U.S. EPA, 1994, III.A). This document will become a part of the site files (see U.S. EPA 1994a., Attachment I). This review is conducted as a Level II, the intermediate level of scrutiny for a Five-Year Review (see U.S. EPA, 1996, defining Levels I, II, and III). U.S. EPA Region V selected Level II because of the continuing presence of hazardous substances; requisite groundwater monitoring identified as necessary; and more stringent toxicity factors assigned to chemicals remaining at the site.

Specifically at this site, this Five-Year Review will evaluate the effectiveness of the Removal Action (RA) at the RSQ site (U.S. EPA, 1996). In quantifying the risk to public health and the environment, the evaluation must also determine whether changes in risk are attributable to substantive changes (e.g., changes in site contaminant levels) or to procedural changes (e.g., indices of toxicity).

The specific goals of the field investigations in accordance with the U.S. EPA-approved Work Plan are as follows:

- Groundwater: Determine the current concentrations and location of contaminants in groundwater at the existing eight wells.

- Surface water: Determine the current vertical and horizontal extent of contamination in surface water.

- Fish tissue: Determine the current concentrations of select metals (as identified by previous studies) in fish.

- Soil: Determine the current vertical and horizontal extent of soil contamination, focusing on areas where previous RA work was performed.

- Sediment: Determine the current concentrations and locations of contaminants in quarry sediment.

- Collect data needed to support the revised risk assessment to determine the threat to human health and the environment posed by the fish tissue, soil, sediment, and surface water on and near the site.

- Collect sufficient data on all soil at the ditch and boat ramp areas to determine the effectiveness of the RA.

The specific objectives of the risk assessment recalculation are as follows:

- Contaminant Identification: Identify the contaminants of concern using the new field data and current guidance.

- Exposure Assessment: Identify actual and potential exposure pathways.

- Toxicity Assessment: Assess the health effects of the chemicals using current toxicity values.

- Risk Assessment: Calculate risks to human health.

- Ecological Risk Assessment: Calculate risks to animal receptors.

1.3 SITE DESCRIPTION AND BACKGROUND

1.3.1 Site Setting

The RSQ site is located in Elyria, Ohio. The site consists of a 4-acre quarry and 7 acres of fenced land surrounding the quarry. The site is located east of West River Road and west of the west branch of the Black River, directly across the river from the Franklin School.

The City of Elyria is located southwest of Cleveland in Lorain County in northeastern Ohio and can be found on the Grafton USGS quadrangle map in Township 6 North, Range 17 West (CH2M Hill, 1989). A site location map is provided as Figure 1-1.

The site consists of a water-filled quarry surrounded by a densely vegetated fenced area, as illustrated in Figure 1-2. Water in the quarry has been measured at depth of up to 62 feet, as illustrated in Figure 1-3. The sides of the quarry are nearly vertical and rise approximately 20 to 30 feet above the water's surface level. The quarry walls are composed of the in-place Berea Sandstone Formation at and below the present water level. Above the Berea Sandstone, the walls are composed of large, vertically stacked sandstone blocks. These blocks were placed during quarry operations as retaining walls to support the soil zone (CH2M Hill, 1989).

Although the site is fenced, it is still accessible through holes in the fence and areas where the bottom of the fence is 1 to 3 feet above the ground surface. Trespassers are known to enter the site for recreational use, because debris associated with drinking, fishing, and swimming is evident. Well-worn foot paths lead inward to the quarry pond from gaps in the fence.

Water from the quarry discharges directly into the west branch of the Black River at the outlet depicted in Figure 1-2. Water in the quarry is in direct contact with the Berea Sandstone Formation which is a water supply aquifer in the area. Vegetation around the quarry perimeter is mostly grass and small brush; however, several larger trees can be found around the site and along the river. Vegetation is fairly dense over most of the site (CH2M Hill, 1989).

There are two hydraulic systems in the quarry. The first system is concrete outlet-works equipped with a gate valve located along the east quarry wall where the elevation dips to about 704 feet above mean sea level (MSL), as shown in Figure 1-2. Water is usually draining from the outlet works into the river (CH2M Hill, 1989), but the gate valve can no longer be adjusted.

The second system is a 4-inch diameter steel pipe located at the southeasternmost corner of the quarry extending down into the water. The approximate location is shown on Figure 1-2. This pipe is believed to have been used for withdrawing water from the quarry to the Republic Steel plant, rather than being used for discharging the pickle liquor wastes. The pipe system is not operational (CH2M Hill, 1989).

1.3.2 Site History

The RSQ site was operated as a sandstone quarry during an unknown time period before 1950. From 1950 to 1975, the Republic Steel Corporation discharged about 200,000 gallons per day of waste pickle liquor and rinse water from pickling operations to the quarry. Waste pickle liquor, consisting largely of sulfuric acid and metal oxides, was pumped through an aboveground pipe to a ditch which flows to the quarry. The location of the ditch is shown on Figure 1-2. Republic Steel Corporation was later acquired by LTV Steel Corporation, who is presently operating the steel plant south of the quarry. In 1969, LTV reportedly stopped disposing of pickle liquor in the quarry and began hauling the liquor off-site. Between 1969 and 1975 however, rinse water from steel pickling was still discharged into the quarry. In 1976, the discharge ditch leading to the quarry was dammed. The quarry and the seven surrounding acres of land were sold by Republic Steel to the City of Elyria in 1977. In late 1983, Ecology and Environment, Inc. (E&E) performed a site investigation for U.S. EPA as its Field Investigation Team (FIT) contractor and installed three monitoring wells. The site was then proposed for the National Priorities List (NPL) due to the findings of heavy metals in the groundwater. Both the City and the LTV Corporation challenged the site's eventual placement on the NPL which was finalized in 1986. A remedial investigation

(RI) was conducted in late 1987 by ICF Technology to confirm or refute the presence of site-related environmental and public health hazards.

The Phase I RI activities included the following activities:

- Profiling of quarry water quality and depth.
- Performance of a magnetometer survey to identify metal objects on the quarry bottom.
- Reconnaissance of quarry surface geology.
- Chemical characterization of surface water from the quarry and the Black River.
- Chemical characterization of sediment from the quarry and Black River.
- Chemical characterization of surface soils adjacent to the quarry.
- Installation of eight monitoring wells and sampling of groundwater.
- Two rounds of groundwater sampling (August 1987 and March 1988).
- Property boundary search (CH2M Hill, 1990).

In August 1989, the Technical Assistance Team (TAT) delineated the extent of soil contamination. In February 1990, 150 cubic yards of soil were removed from the boat launch area and pickle liquor discharge ditch (Figure 1-2). Confirmatory samples indicated that the boat launch area was remedied to the cleanup objective (sum concentration of less than 300 parts per billion [ppb] for four PAHs, namely benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, and benzo(a)anthracene), but that the ditch was still contaminated. An additional 40 cubic yards of soil were removed from the pickle liquor ditch in June 1990, achieving the cleanup criterion.

In 1990, U.S. EPA conducted a Supplemental Investigation at the RSQ site. The objectives were as follows:

- Provide a summary of additional activities performed at the site following completion of the RI.
- Provide additional data on the presence or absence of chemical contamination in surface soils, groundwater, and fish tissue at the site.
- Revise the exposure and risk assessment for current use and future use conditions at the site to incorporate data collected during Supplemental Investigation activities into the exposure and risk evaluation (CH2M Hill, 1990).

1.3.3 Types and Volumes of Waste Present

At the outset of the Five-Year Review, the following was known with respect to contamination of each environmental medium.

Groundwater

At the RSQ site, groundwater was estimated to be free of volatile organic contamination. Downgradient from the quarry, the groundwater showed elevated levels of acid-extractable, base-neutral (ABN) organic compounds and inorganic chemicals (CH2M Hill, 1990, p. ES-8).

Surface Water

No organic compounds in the quarry water were identified as being potentially site-related. Several inorganic compounds were identified as possibly site-related. When compared to upgradient groundwater, all of the inorganic compounds were detected at elevated concentrations with the greatest concentrations observed near the quarry bottom. A comparison of downgradient and upgradient Black River surface water samples indicated that the site was not adversely affecting the Black River water quality (CH2M Hills, 1990).

Fish Tissue

Elevated concentrations of mercury and manganese were observed in fish tissue samples from the quarry and downstream in Black River compared to upstream samples. Although elevated, mercury and manganese were not as concentrated as was expected based on modeling of fish. Cadmium and copper were suspected in fish, but had not been measured directly, so the occurrence of cadmium and copper was speculative (CH2M Hill, 1990).

Surface Soil

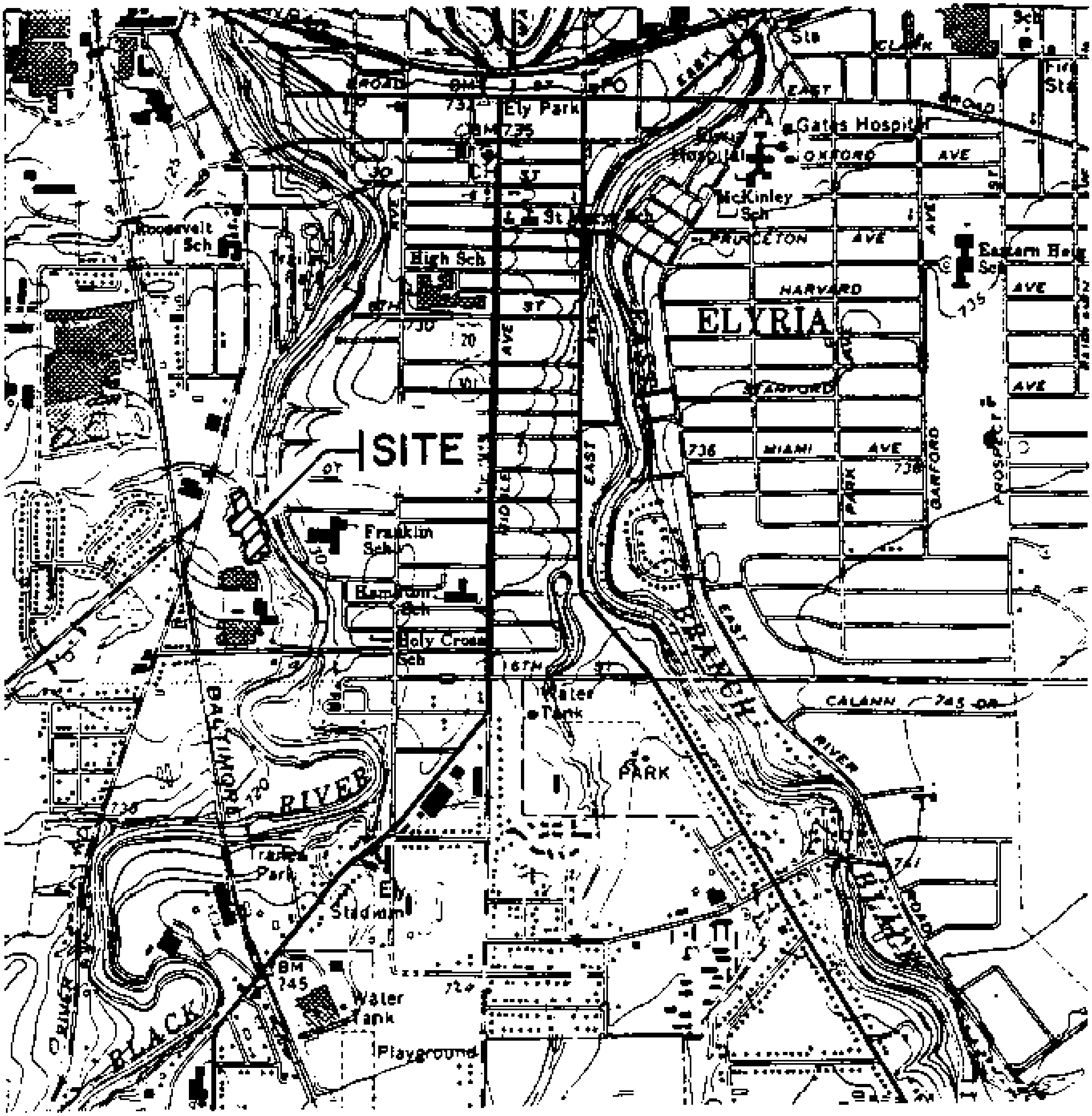
Before the RA was conducted, results of surface soil samples obtained from areas of the site that were periodically inundated by quarry water or that were exposed to waste discharges in the past, indicated that volatile and semivolatile organic compounds (VOCs and SVOCs) and inorganic compounds were detected above background concentrations. Past disposal activities appeared to have affected the quality of the surface soils at the site. SVOCs and inorganic compounds were also detected in a sample of the steel yard soils that were sliding into the quarry. After the RA, concentrations of SVOCs and inorganic compounds were thought to be above background, but reduced below the cleanup criterion (CH2M Hill, 1990).

Sediment

Results of sediment samples collected from the quarry indicated that quarry sediments contained elevated levels of VOCs and SVOCs and inorganic compounds. Volatile organic compounds were detected only in the deep quarry sediment samples (greater than 35 feet), while semivolatile and inorganic compounds were detected in both deep and shallow samples. Concentrations of the semivolatiles and inorganic compounds in deep sediment samples were greater than those in shallow samples. The results indicated that past activities have affected quarry sediment quality (CH2M Hill, 1990).

A comparison of downstream and upstream Black River sediment samples indicated that the site was not affecting sediments in the Black River (CH2M Hill, 1990).

For additional quantitative information about historic levels of contamination, see Section 4 of this report.



SOURCE U.S.G.S. 7.5' TOPOGRAPHIC MAP GRAFTON QUADRANGLE OHIO, SCALE 1" = 2000'.

SITE LOCATION

0 1540 3080

SCALE IN FEET

SOURCE: CH2MHILL, 1988.

FIGURE 1-1

ALTERNATIVE REMEDIAL CONTRACTING STRATEGY U.S. EPA CONTRACT No. 68-W8-0089 WORK ASSIGNMENT No. 86-5WE DOCUMENT CONTROL No. 4500-86-ANWY	SITE LOCATION MAP RSQ SITE Elyria, Ohio

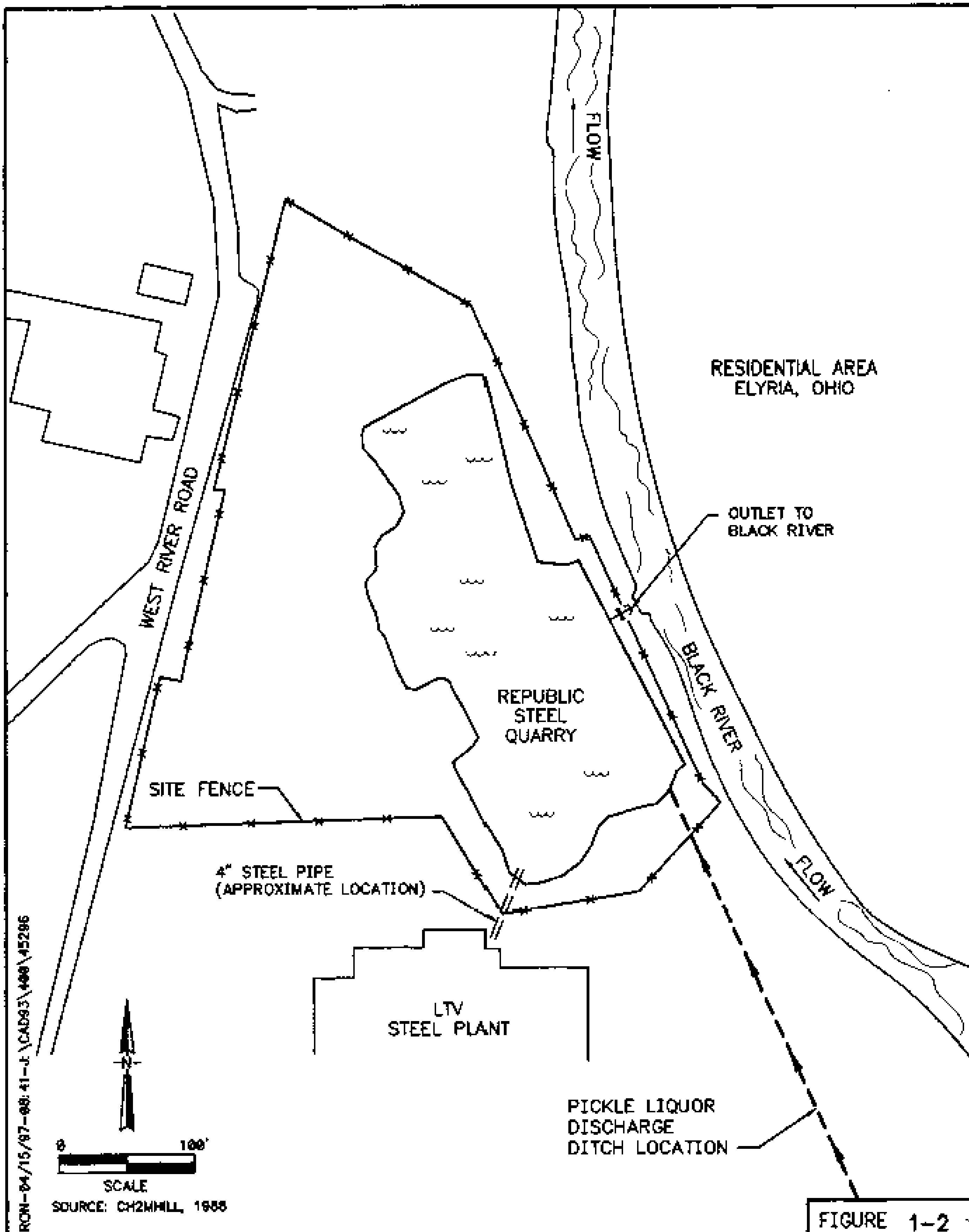
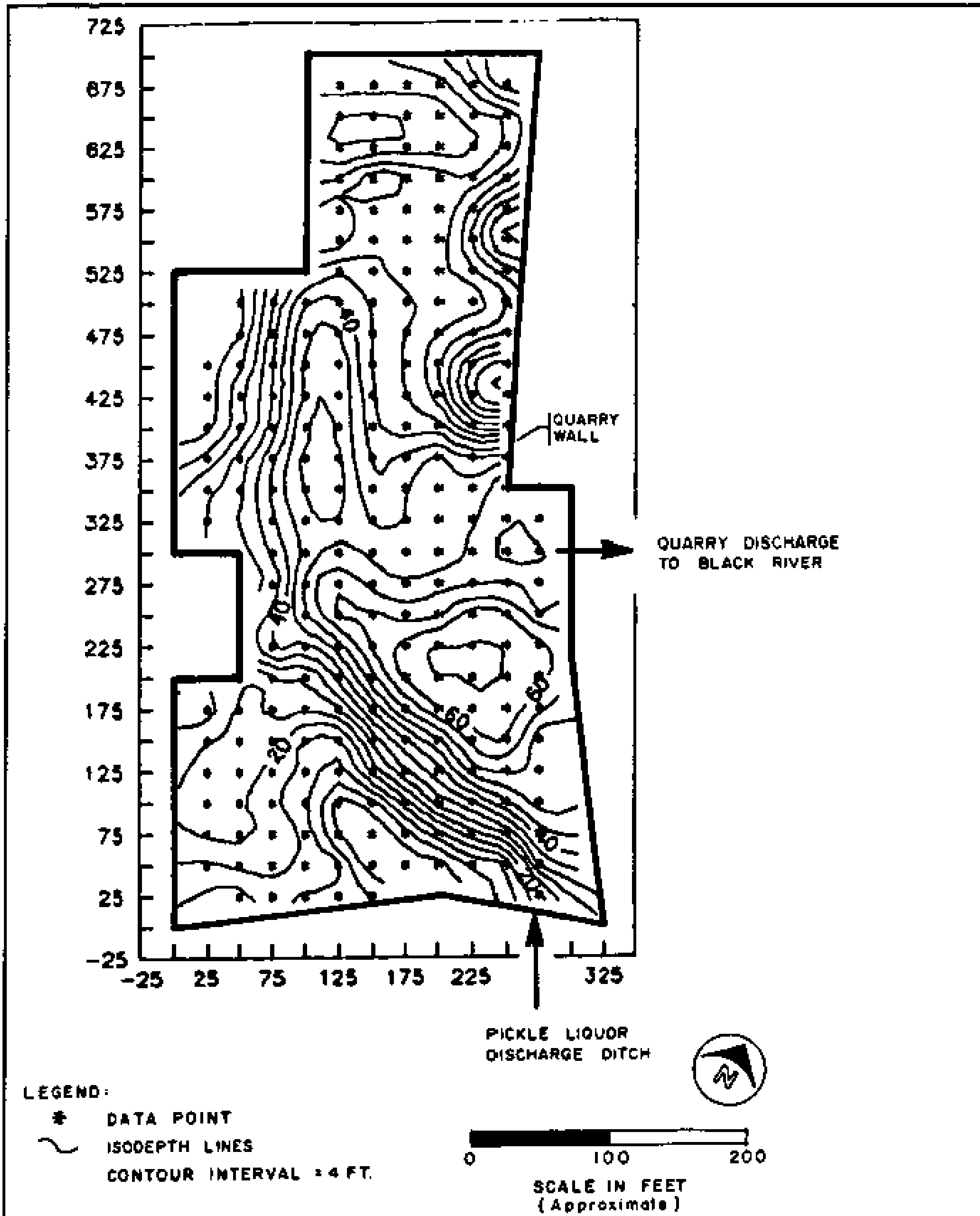


FIGURE 1-2

ALTERNATIVE REMEDIAL CONTRACTING STRATEGY U.S. EPA CONTRACT No. 68-W8-0089 WORK ASSIGNMENT No. 86-5WE DOCUMENT CONTROL No. 4500-86-ANWY	SITE MAP RSQ SITE Elyria, Ohio



SOURCE: CH2MHILL, 1988.

FIGURE 1-3

ALTERNATIVE REMEDIAL CONTRACTING STRATEGY U.S. EPA CONTRACT No. 68-W8-0089 WORK ASSIGNMENT No. 86-5WE DOCUMENT CONTROL No. 4500-86-ANWY	QUARRY DEPTH MAP RSQ SITE Elyria, Ohio

SECTION 2
REMEDIAL OBJECTIVES

The ROD, signed September 1988, determined that a cleanup focused primarily on soil was needed, even though other media were known to be contaminated. The selected remedy was excavation and disposal of contaminated soil located in the pickle liquor ditch and boat ramp areas (illustrated in Figure 1-2). The ROD estimated the volume of excavation as approximately 100 yards and called for disposal of the waste in accordance with the Resource Conservation and Recovery Act (RCRA) Subtitle C, which includes land disposal restrictions (LDRs). The waste was assigned the RCRA listed-waste code of K062, based on the historical understanding of the waste as spent pickle liquor.

The ROD considered removal of contaminated sediments, but rejected that option because the sediments were naturally immobilized at the quarry's bottom. According to the ROD, the removal process would have disturbed the sediments and mixed them into the quarry water, which would have counterproductively increased the danger to human health.

In addition to the focused soil cleanup, the ROD also called for additional studies of fish tissue and groundwater. These studies were implemented in 1990 during the Supplemental Investigation for the RSQ Site (CH2M Hill, 1990).

The ROD declared that the selected remedy would be protective of human health and the environment, attain federal and state requirements as applicable or relevant and appropriate, and be cost-effective.

The selected remedy was implemented in spring 1990. The removal criterion was established, namely, to remove all soils where the sum of four carcinogenic PAHs (benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, and benzo(a)anthracene) exceeded

300 parts per billion (ug/kg). The excavated volume increased slightly over expectations, to 150 cubic yards. Three factors were responsible for the increase: first, the topsoil was slightly thicker than expected; second, the weather was wet during removal; and third, some contamination had been tracked onto access roads. Tests showed that the waste was not characteristically hazardous by Extraction Procedure (EP) Toxicity, but the K062 listing remained in effect. The soil was disposed of at Envirosafe Services of Oregon, Ohio (CH2M Hill, 1990).

Confirmatory sampling provided documentation that the cleanup successfully met the cleanup goal.

SECTION 3
ARARS REVIEW

This section reviews the applicable or relevant and appropriate requirements (ARARs) for the RSQ site. It contains the role of ARARs in a Five-Year Review, an identification of each type (chemical-, location-, and action-specific) identified in the ROD, the identification of new ARARs that may be appropriate today, and a concluding summary of the apparent controlling ARARs for the RSQ site.

This discussion of ARARs is conducted within the framework of the Superfund Amendments and Reauthorization Act of 1986 (SARA) and the 1990 NCP (55 FR 8741, 8 March 1990). SARA called for a major revision of the 1985 NCP, and the 1990 NCP enacted that revision. Meanwhile, the Record of Decision (ROD) for the RSQ site was signed in September 1988. Therefore, the ROD for the RSQ site was written after SARA was passed, but before the 1990 NCP was fully implemented.

Subsection 3.1, describes the role of ARARs in a Five-Year Review. Subsection 3.2 identifies each ARAR and each type (chemical-, location-, and action-specific) identified in the ROD. Subsection 3.3 identifies new ARARs that may be appropriate today. Subsection 3.4 presents a concluding summary of the apparent controlling ARARs for the RSQ Site.

3.1 THE ROLE OF ARARS IN A FIVE-YEAR REVIEW

The basis for ARARs is defined in Section 121(d) of CERCLA, as amended SARA, which requires that remedial actions comply with all applicable or relevant and appropriate federal environmental or promulgated state environmental or facility siting laws.

The "applicable requirements," as defined in 40 Code of Federal Regulations (CFR) 300.5, are "those clean-up standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility siting laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance found a CERCLA site. Only those state standards that are identified by a state in a timely manner and that are more stringent than federal requirements may be applicable." "Relevant and appropriate requirements," also defined in 40 CFR 300.5, are "those clean-up standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility siting laws, that, while not "applicable" to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site. Only those state standards that are identified in a timely manner and are more stringent than federal requirements may be relevant and appropriate."

In general, ARARs fall into three categories:

- Chemical-specific requirements: Chemical-specific ARARs specify maximum concentrations of particular chemicals in particular environmental media.

- Location-specific requirements: Location-specific ARARs specify restrictions that have been placed on the concentration of hazardous substances or on the conduct of an activity solely because it occurs in a special location.

- Performance, design, or other action-specific requirements: Action-specific ARARs and remediation goals are identified for specific remedial actions.

The ARARs identified at the time that the ROD is signed exerts an enduring influence on the remedy. However, the ARARs are reconsidered to a limited extent during the five-year review.

> It is important to note that a policy of freezing ARARs at the time of the ROD signing will not sacrifice protection of human health and the environment, because the remedy will be reviewed for protectiveness every five years, considering new or modified requirements at that point, or more frequently, if there is reason to believe that the remedy is no longer protective of health and the environment.
>
> In response to the specific comments received, EPA notes that under this policy, EPA does not intend that a remedy must be modified solely to attain a newly promulgated or modified requirement. Rather, a remedy must be modified if necessary to protect human health and the environment, newly promulgated or modified requirements contribute to that evaluation of protectiveness (55 FR at 8758).

The reasoning expressed in the Federal Register is carried forward explicitly into regulation.

> Requirements that are promulgated or modified after ROD signature must be attained (or waived) only when determined to be applicable or relevant and appropriate and necessary to ensure that the remedy is protective of human health and the environment (40 CFR 300.430(f)(1)(ii)(B)).

Accordingly, this review primarily evaluates compliance with the ARARs in the ROD, and to a limited extent with those new ARARs which would potentially influence its protectiveness.

3.2 ARARS IN THE ROD

3.2.1 Chemical-Specific ARARs

Groundwater. The ROD identified federal Maximum Contaminant Levels (MCLS) and some federal Ambient Water Quality Criteria (AWQCs) as an ARAR for groundwater. (See Table 3-1 reproduced from Table 10 of the ROD for the chemicals for which AWQCs were provided.) Since certain exceedences were present (namely, for beryllium and nickel), the ROD called for continued groundwater monitoring (see the ROD at p. 19). The ROD then acknowledged and allowed the exceedences, noting that "[g]roundwater is not currently used as drinking water downgradient at the site (see the ROD at p. 23)."

Surface Water. The ROD cited the federal AWQCs for the consumption of fish as the ARARs for surface water. (See Table 3-2 reproduced from Table 8 of the ROD.) Even though only metals (barium, calcium, iron, magnesium, manganese, nickel, vanadium, and zinc) were identified as site-related in the ROD, it also identified ARARs for many chemicals including organics. According to the ROD, manganese and mercury exceeded their respective AWQCs, and nickel approached its AWQC.

The ROD cited the federal AWQCs for the protection of aquatic life as an ARAR for surface water. (See Table 3-3 reproduced from Table 9 of the ROD.) As with the list of AWQCs for the consumption of fish, the list of AWQCs for the protection of aquatic life includes chemicals which were not identified as site-related in the ROD. The ROD concluded that no exceedences of AWQCs for aquatic life occurred.

Fish Tissue. The ROD identified no chemical-specific ARARs for fish tissue. However, the AWQCs for the consumption of fish (previously specified in the ARARs for surface water) were ultimately intended to ensure that fish tissue would not contain a harmful amount of contaminants.

Soil. The ROD identified no chemical-specific ARARs for soil. "[N]o ARARs are available for surface soils. . . . . (See the ROD at p. 23)."

Sediment. The ROD identified no chemical-specific ARARs for sediment. "[N]o ARARs are available for . . . . quarry sediments . . . . (See the ROD at p. 23)."

3.2.2 Location-Specifc ARARs

The ROD identified no location-specific ARARs for any media.

3.2.3 Action-Specifc ARARs

The ROD identified RCRA Land Disposal Restrictions (LDRs) as ARARs for the soil removal action.

> The [LDRs] under 40 CFR 268 were determined to be an applicable requirement to the selected remedy because the primary source of contamination of the ditch sediments was from waste pickle liquor. Waste pickle liquor is identified as RCRA waste K062. Under the first third rule promulgated on August 8, 1988, pickle liquor waste must meet specific Best Demonstrated Available Technology (BDAT) treatment levels for chromium and lead prior to land disposal. The BDAT levels promulgated in the first third rule (non-waste waters) are 0.094 mg/L [and] 0.37 mg/L (TCLP extract) for chromium and lead respectively. Due to the low levels of chromium and lead contamination in the soils at the Republic Steel Quarry site, it is believed that treatment will not be required to meet these BDAT levels. However, prior to off-site disposal, TCLP tests will be performed on the soils to determine their compliance. In the event that testing reveals that the soils do not meet the TCLP BDAT levels for chromium or lead, EPA will select an appropriate treatment technology to ensure compliance with the Land Disposal Restrictions (ROD for the RSQ Site, September 1988, p. 19).

The RCRA LDRs are strictly action-specific and only apply to active management of the contaminated soil, and not to contaminated soil lying in place (57 FR 2676, 18 August 1992).

3.3 POTENTIAL NEW ARARS

The Ohio EPA provided a standard packet of potential ARARs for consideration. Of the standard list of potential ARARs, a number of items appeared to merit closer attention.

Those items are listed below. Along with the potential Ohio ARARs are listed their corresponding federal analogues.

3.3.1 Chemical-Specific ARARs

No new classes of potential chemical-specific ARARs were noted. The controlling ARAR categories remain MCLs under the Safe Drinking Water Act (SDWA) and AWQCs under the Clean Water Act (CWA). However, the lists of regulated chemical have grown and have been refined in the years since the signing of the ROD, so the individual values for particular chemicals have changed in some cases.

Groundwater

Table 3-4 reports the evolution of the ARARs for groundwater, contrasting the ARARs as identified in 1988 with the current regulations for the same chemicals. It shows that additional MCLs have been promulgated since 1988, and in some cases, that MCL values have been adjusted. The table also has four additional metals for consideration: antimony, iron, manganese, and thallium. As discussed later in this report, these metals are now of interest with respect to ARARs.

Surface Water

Table 3-5 reports the evolution of ARARs for surface water, based on the AWQC for the consumption of fish. Generally speaking, the requirements have relaxed somewhat.

Table 3-6 reports the evolution of ARARs for surface water, based on the AWQC for the protection of aquatic life. In addition to updating the old ARARs, new ARARs have been developed for total chromium, total lead, total silver, and total zinc. One difference between past and present AWQCs is the attributable hardness dependency. The current AWQCs have been adjusted to reflect hardness.

3.3.2 Location-specific ARARs

No new classes of potential location-specific ARARs for groundwater were noted.

3.3.3 Action-Specific ARARs

Action-specific ARARs were specified in the ROD for remedial actions previously performed. Because the five-year review does not include any remedial actions, existing action-specific ARARs do not apply and no new ones are identified.

3.4 SUMMARY OF CONTROLLING ARARS

3.4.1 Chemical-Specific ARARs

Groundwater. MCLs continue to define acceptable groundwater concentrations, although MCLs for new compounds and revised MCLs for old compounds may now be applicable. As previously discussed, an ARAR exceedence does not necessarily trigger remedial action, as long as protectiveness is maintained.

Surface Water. As with MCLs for groundwater, AWQCs continue to define acceptable surface water concentrations, although AWQCs for new compounds and revised AWQCs for old compounds may now be applicable. As previously discussed, an ARAR exceedence does not necessarily trigger remedial action, as long as protectiveness is maintained.

Other Media. For other media (soil, sediment, and fish), controlling ARARs still do not exist. Protective levels for contaminants in these media must be estimated using risk assessment.

3.4.2 Location-Specific ARARs

No controlling location-specific ARARs have been identified.

3.4.3 Action-Specific ARARs

LDRs under RCRA had been identified in the ROD as action-specific ARARs for removal. During this Five-Year Review, no further removal is anticipated. As a result, LDRs cease to be ARARs.

Table 3-1

RI's Comparison of Groundwater Concentration with ARARs Republic Steel Quarry Elyria, Ohio

Chemical	Concentration in Groundwater (ug/L)			
	Average	Maximum	Ohio	Federal
Barium	64	114	---	1,000 MCL[c]
Beryllium	1	2.1	---	0(3.9 ng/1)[d]
Manganese	1,490	11,600	---	---
Chromium	8.4	20	---	50 MCL[c]
Copper	11	28	---	---
Lead	NR	19	---	50 MCL[c]
Nickel	117	131	---	15.4 WQC[a]
Zinc	51	106	---	5,000 WQC[b] (organoleptic)
Pentachlorophenol	NR	5	---	---
Phenol	NR	10	---	3,500 WQC[a]
Aluminum	2,600	11,600	---	---
Calcium	190,000	348,000	---	---
Cobalt	NR	18	---	---
Silver	NR	4.1	---	50 WQC[a]
Vanadium	29	57	---	--
Methylene Chloride	7	140	---	--
Acetone	8	55	---	--

NR - Not relevant. Chemical was detected at only one location.

[a] These adjusted criteria, for drinking water investigation only, were derived from published EPA ambient water quality criteria (45 FR 79318-79379, November 28, 1980) for combined fish and drinking water ingestion and for fish ingestion alone. The adjusted values are not official EPA ambient water quality criteria, but may be appropriate for Superfund sites with contaminated groundwater.

[b] Criteria designated as organoleptic are based on taste and odor effects, not human health effects. Health-based water quality criteria is not available for this chemical.

[c] MCL - Maximum Contaminant Level for drinking water standards.

[d] Water Quality Criteria (WQC); concentrations in parentheses correspond to midpoint of risk range for potential carcinogens.

Source: RSQ ROD, 1988.

Table 3-2

RI's Comparison of Quarry Surface Water Concentrations with AWQC Toxicity Values for Consumption of Fish Republic Steel Quarry Elyria, Ohio

Chemical	Concentration in Surface Water (ug/L)		Federal Water Quality Criteria (ug/L) for Consumption of Fish
	Average	Maximum	
Nickel	NA	86	100
Vanadium	4.4	60	---
Barium	46	113	---
Manganese	9,210	75,700	100
ncPNA[a]	0.00014	0.00060	--
cPNA[a]	0.000050	0.00058	0.031
Pentachlorophenol[a]	0.0028	0.0059	---
Acetone[a]	3.4	42	---
Tetrachloroethane[a]	0.0026	0.011	---
Ethylbenzene[a]	0.00029	0.00024	3,280
2-Butanone[a]	1.0	8.0	---
bis(2-ethylhexyl)phthalate[a]	0.0042	0.061	---
Copper[a]	18	96	---
Mercury[a]	0.44	0.81	0.146
Methylene Chloride[a]	NR	0.28	---
Butylbenzylphthalate[a]	0.014	0.405	---
Di-n-butylphthalate[a]	0.0012	0.017	---
Toluene[a]	0.009	0.11	424,000

NR - Not relevant. Chemical was detected at only one location.
NA - Not applicable. The mean value was below detection.

[a] Calculated concentration.

Source: RSQ ROD, 1988.

Table 3-3

RI's Comparison of Surface Water Concentrations with AWQC Toxicity Values for Protection of Aquatic Life Republic Steel Quarry Elyria, Ohio

	Concentrations in Water (ug/L)		State Water Quality Criteria Aquatic Life (ug/L)		Federal Water Quality Criteria	
Chemical	Average	Maximum	Average	Maximum	Chronic	Acute
Tetrachloroethene	0.0013	0.011	---	---	---	---
Ethylbenzene	0.00029	0.0025	---	---	---	32,000 (LOEL)
2-Butanone	1.0	8.0	---	---	---	---
ncPNA	0.00014	0.00060	---	---	620[a]	2,300[a]
cPNA	0.000050	0.00058	---	---	---	---
Copper	18	96	14[b]	---	12	18
Mercury	0.44	0.81	0.2	2.2	0.012	2.4
Pentachlorophenol	0.015	0.043	1	---	13	20
Acetone	3.4	42	---	---	---	---
Methylene Chloride	NC	0.28	---	---	---	---
bis(2-ethylhexyl)phthalate	0.0042	0.061	---	---	3[c]	940[c]
Diethylphthalate	40	87	---	---	3[c]	940[c]
Magnesium	23,600	67,500	---	---	---	---
Nickel	NA	86	341	---	160	1,400
Vanadium	4.4	60	---	---	---	---
Calcium	56,700	315,000	---	---	---	---
Methylene Chloride	NA	0.28	---	---	---	---
Tin	---	---	---	---	---	---
Barium	46	113	---	---	---	---
Manganese	940	25,700	---	---	---	---
Butylbenzylphthalate	0.014	0.405	---	---	3[c]	940[c]
Di-n-butylphthalate	0.0012	0.017	---	---	3[c]	940[c]
Di-n-octylphthalate	0.0053	0.0047	---	---	3[c]	940[c]
Toluene	0.009	0.11	---	---	---	17,500[b]

NC - Not calculated.
NA -The mean value was below detection.

[a] For naphthalene.

[b] Hardness dependent parameter.

[c] As phthalate esters. Insufficient data to develop criteria. Value present at the lowest observed effect level.

Source: RSQ ROD, 1988.

Table 3-4

Updated Chemical-Specific ARARs for Groundwater
Republic Steel Quarry
Elyria, Ohio

Chemical	ROD's Limit (ug/L, except as noted) in 1988	ROD's Citation	Current Limit (ug/L, except as noted) in 1997	Current Citation
Antimony	None specified	None	6	Ohio and Federal MCL
Barium	1,000	MCL	2,000	Ohio and Federal MCL
Beryllium	0 ng/L	WQC	4	Ohio and Federal MCL
Chromium	50	MCL	100	Ohio and Federal MCL
Iron	None specified	None	300	Ohio and Federal SMCL
Lead	50	MCL	15	Ohio and Federal action level
Manganese	None specified	None	50	Ohio and Federal SMCL
Nickel	15.4	WQC	100	Ohio and Federal MCL
Silver	50 ug	WQC	100	Ohio and Federal SMCL
Thallium	None specified	None	2	Ohio and Federal MCL
Zinc	5,000	WQC	5,000	Ohio and Federal SMCL
Phenol	3,500	WQC	1	WQC

Note: While Secondary Maximum Contaminant Levels (SMCLs) are primarily for aesthetic quality of potable water, Ohio does use them for monitoring groundwater from hazardous wastes sites (see, e.g., Ohio Admin. Code 3745-30-08).

Table 3-5

Updated Ambient Water Quality Criteria for Consumption of Fish
Republic Steel Quarry
Elyria, Ohio

Chemical	ROD's Limit (ug/L, except as noted) in 1988	ROD's Citation	Current Limit (ug/L, except as noted) in 1997	Current Citation
Nickel	100	Federal WQC	4,600	WQC
Manganese	100	Federal WQC	Not published	
PNA	0.031	Federal WQC	0.31	WQC
Ethylbenzene	3,280	Federal WQC	Not published	
Mercury	0.146	Federal WQC	0.012	WQC
Toluene	424,000	Federal WQC	300,000	WQC

Table 3-6

Updated Ambient Water Quality Criteria for Protection of Aquatic Life
Republic Steel Quarry
Elyria, Ohio

Chemical	ROD's Limit (ug/L, except as noted) in 1988		ROD's Citation	Current Limit (ug/L, except as noted) in 1997		Current Citation[a]
	Chronic	Acute		Chronic	Acute	
Inorganics						
Chromium	---	---	None	2,475	4,949	Calculated hardness-dependent WQC
Copper	12	18	Federal WQC	26.1	52.3	Calculated hardness-dependent WQC
Lead (total)	---	---	None	216	432	Calculated hardness-dependent WQC
Mercury (total)	0.012	2.4	Federal WQC	---	2.4	Federal WQC
NIckel	160	1,400	Federal WQC	160	1,400	
Silver (total)	---	---	None	---	3.11	Calculated hardness-dependent WQC
Zinc (total)	---	---	None	27.9	30.8	Calculated hardness-dependent WQC
Organics						
Bis(2-ethylhexyl)phthalate	3	940	Federal WQC	3	27	Tier II
Butylbenzylphthalate	3	940	Federal WQC	---	19	Tier II
Diethylphthalate	3	940	Federal WQC	210	1,800	Tier II
Di-n-butylphthalate	3	940	Federal WQC	35	190	Tier II
Di-n-octylphthalate	3	940	Federal WQC	---	---	Not published
Ethylphthalate	3	32,000	Federal WQC	7.3	130	Tier II
Pentachlorophenol	13	20	Federal WQC	---	---	Not published
Diethylphthalate	3	940	Federal WQC	210	1,800	Tier II
PNA	620	2,300	Federal WQC	---	---	Not published
Toluene		17,500	Federal WQC	9.8	120	Tier II

[a] See Section 6 for description of these criteria.

SECTION 4
SUMMARY OF FIVE-YEAR REVIEW SITE INVESTIGATION

A Five-Year review field investigation was conducted in November 1996 as required by the ROD for the RSQ site based on the results of previous investigations (i.e., 1988 RI and 1990 Supplemental Investigation) which indicated the continued presence of hazardous constituents at the site. More specifically, the ROD recommended that various media, including groundwater and fish tissue, be resampled at specific time intervals as they were identified as current and potential future exposure pathways. The five-year review investigation also looked at additional media (surface water, sediment, and soil) to assess any additional contribution to overall risk.

Section 4 summarizes the results of the five-year review investigation. Initial subsections contain brief descriptions of the methods and procedures used, as well as the number and type of media samples collected. This is followed by a discussion of historical trends and current results for each media analyzed.

4.1 SUMMARY OF INVESTIGATION METHODS AND PROCEDURES

The following subsections summarize the methods and procedures that were followed during the five-year review investigation at the RSQ site. The media type and number of samples collected are also contained in this subsection. Field work and laboratory analytical procedures were carried out in accordance with the approved Field Sampling Plan (FSP) and Quality Assurance Project Plan (QAPP). Quality assurance/quality control (QA/QC) samples were also collected for each media type sampled in accordance with the QAPP.

4.1.1 Water Level Measurement

Before re-development of monitoring wells, water level measurements were collected at each of the existing wells shown in Figure 4-1, with the exception of monitoring well B-4. Monitoring well B-4 was not developed or sampled because of an obstruction at its opening. An unidentified yellow substance was present inside the well (shown in Figure 4-2, see Appendix D for additional information). The yellow substance is tentatively identified as biological. Monitoring well B-4 is located upgradient of the site and therefore believed not to be site-related. The water level data from the other six wells were used to determine the approximate direction of groundwater flow and compute lateral and vertical hydraulic gradients. The following protocols were used during water level measurements:

- Depth to water was measured with an electrical sounding device (accuracy ±0.01 feet). The reference point for this measurement was the top of the well riser pipe.

- The depth to water and the time was recorded in the field logbook.

4.1.2 Well Development

Each monitoring well was re-developed prior to groundwater sample collection, with the exception of monitoring well B-4 which was not developed or sampled as discussed in the preceding subsection. Well re-development was necessary to remove the loose particulate material present in the wells which may have collected during the long time period since the last groundwater samples were collected (during the RI). The following procedures were followed during well re-development:

- The initial static water level was measured with an electrical sounding device, and recorded in the field logbook. A measurement was also taken of the total well depth, and the volume of the water column was calculated.

- The wells were developed using a pump to alternately surge and purge the well contents. The surge and purge cycle consisted of several minutes of surging followed by several minutes of purging to remove the material collecting in the bottom of the well.

- A minimum of three well volumes were removed from each well. After removing the second well volume, readings for pH, temperature, and specific conductance were recorded. Well development continued until the readings stabilized for two consecutive volumes (0.25 units for pH, ±10 percent for specific conductance, and 1.0° C for temperature). A minimum of three well volumes were purged during development.

- If a well was purged dry during well development (as occurred at B-2), the well was developed by slowly purging it dry, a manner which limits agitation.

- All development water was returned to the quarry pond.

Monitoring well re-development data is summarized on Table 4-1 and well locations are shown on Figure 4-1.

4.1.3 Media Sampling and Analysis Procedures

4.1.3.1 Groundwater

Ten groundwater samples were collected during the five-year review investigation. Seven samples were investigative samples while the remaining three were quality control (QC) samples consisting of one bottle blank, one equipment blank, and a field duplicate sample. Monitoring well sampling locations are shown on Figure 4-1. No groundwater sample was collected from monitoring well B-4 as previously discussed.

Groundwater samples were analyzed for SVOCs, metals, and cyanide. Analysis did not include VOCs, pesticides, or PCBs because these fractions were previously studied and dismissed (CH2M Hill, 1990). Groundwater samples were analyzed through the U.S. EPA Contract Laboratory Program (CLP). SVOC samples were analyzed by American Technical and Analytical Services in Maryland Heights, Missouri. The metals and cyanide fractions were analyzed by American Analytical and Technical Services in Broken Arrow, Oklahoma.

Purging and groundwater sampling occurred within 24 hours after well re-development. Each sample was collected using the following methods:

- Upon removal of the protective cap to the monitoring well riser, the well's head space was monitored with a flame ionization detector (FID) or photo-ionization detector (PID). The purpose of this analysis was strictly for health and safety monitoring, not characterization. The measured values were recorded in the field logbook.

- The depth to the water level in the well was measured with an electrical sounding device (accuracy ±0.01 feet). The depth to water and the time of measurement was recorded in the field logbook. The reference point for these depths was the top of the well riser pipe.

- The volume of standing water in the well was calculated. Volume of water in a 2-inch-diameter well (gallons) = length (feet) x 0.16 (gallons/foot).

- A Grundfos pump was used for purging and sampling, and was decontaminated before use at each well. Tubing was thick and of minimal length to exclude atmospheric gases.

- Well purging was done at moderate flow rates (1.0 to 4.0 L/min) with the pump intake just above or within the screened interval. Field measurements of pH, temperature, conductivity, and dissolved oxygen (DO) were made over time. Stabilization of these well purging parameters (±0.25 units for pH, ±1°C for temperature, ±10 percent for conductivity, and ±0.1 mg/L DO) indicated equilibrated conditions. A visual qualitative assessment of turbidity was made as well. A minimum of three well volumes were purged to determine that parameters had stabilized or until five volumes had been removed. Remarks on purge water quality will be entered into the logbook.

- In the event that a monitoring well pumped dry before three volumes had been removed, the well was allowed to recharge for 15 minutes and then pumped dry again before sampling. All purge water was returned to the quarry pond.

- Samples were collected at low flow rates (0.2 to 2 L/min) directly from the pump after the well purging was completed. The groundwater samples were collected in decreasing order of sensitivity of volatility of organic contaminants: TCL semivolatile organic compounds (SVOCs), followed by TAL unfiltered metals and cyanide.

Two blank samples were collected and analyzed for QA purposes. One high-performance liquid chromatography (HPLC) water bottle blank and one HPLC equipment blank were collected during the monitoring well sampling. One duplicate groundwater sample was obtained from monitoring well B-6. The duplicate sample was collected in the same manner as the other groundwater samples.

4.1.3.2 Surface Water

A total of four surface water grab samples were collected from two sampling locations within the quarry. At each location, two water samples were collected: one at the surface (0 to 1 foot below the surface water level, and one at mid-depth or deep (approximately 17 feet or 60 feet, respectively, below the surface water level). Two surface water grab samples were also collected from the Black River, one upstream of the site (SW-209, 210) and one downstream from the site (SW-213, 214). An additional surface water sample was also collected from the quarry outfall area (SW-211, 212). Surface water sampling locations are illustrated in Figure 4-3.

Three QC samples consisting of one bottle blank, one equipment blank, and a field duplicate sample were also collected. The surface water samples were analyzed for SVOCs, metals, cyanide, and the following water quality parameters: total suspended solids (TSS), total dissolved solids (TDS), acidity, total alkalinity, chloride, sulfate, and oil and grease. The surface water samples were not analyzed for VOCs, pesticides, or PCBs, because these fractions were not deemed to be fractions of concern according to the RI Report (CH2M Hill, 1988) and Supplemental Report (CH2M Hill, 1990).

Surface water metals samples were collected as paired filtered and unfiltered samples. The surface water metal fraction quality control samples (bottle blank, equipment blank, and field duplicate) were only analyzed as unfiltered samples. Eight surface water samples were analyzed for the seven water quality parameters listed above. The only quality control associated with the water quality parameters was a field duplicate sample.

The surface water SVOCs, metals, and cyanide were analyzed through the U.S. EPA CLP. SVOC samples were analyzed by Datachem Labs, Inc., in Salt Lake City, Utah. The metals and cyanide samples were analyzed by Recra Labnet-Houston in Houston, Texas. The water quality parameters were analyzed following procedures described in SAS requests prepared by WESTON. All of the water quality analyses were performed by the Region V Central Regional Laboratory in Chicago, Illinois.

In situ water quality field measurements for water quality profiles were collected at 5-foot intervals from the surface to the bottom at each sample location. Parameter measurements were recorded in the field logbook. In situ water quality measurements included pH, specific conductance, temperature, and dissolved oxygen.

Surface water samples obtained from the quarry were collected using a decontaminated stainless steel Kemmer bottle. The Kemmer bottle was lowered to the desired depth, where a volume of water was collected. Then the bottle was brought to the surface and transferred into sample containers. Sample portions for routine analytical service (RAS) parameters were filled first. RAS samples were collected in decreasing order of sensitivity of volatilizing organic contaminants (i.e., first volatile organic aromatics [VOAs], then SVOCs, then TAL-unfiltered parameters, then TAL-filtered parameters). The TAL-filtered metals were filtered using a vacuum pump connected to a disposable, sterile filtration unit containing a 0.45-micron filter. The special analytical service (SAS) parameters were collected last.

Two blank samples were collected during surface water sampling and analyzed for QA purposes: one HPLC water bottle blank (SW-215) and one HPLC equipment blank (SW-216). One duplicate surface water sample (SW-217) was obtained from surface water sampling location SW-205. The duplicate sample was collected in the same manner as the other surface water samples.

4.1.3.3 Fish Tissue

Eighteen fish tissue samples were collected during the five-year review. Two fish samples were designated as fish blanks. These samples were collected from a fish farm in Pennsylvania. Due to the time of year, it was difficult to obtain species similar to those caught in the quarry (i.e., bass, bluegill, etc.). The fish tissue samples were analyzed for copper, cadmium, mercury, manganese, and percent lipids. The fish tissue parameters were analyzed utilizing a SAS request prepared by WESTON. The Southwest Research Institute in San Antonio, Texas, conducted the fish tissue analyses.

The following summary provides the approach and method used to collect fish from the RSQ quarry site and the adjacent Black River. The fish collection techniques were designed to provide fish sample data which is representative of environmental contamination at the location from which they were collected; and representative of fish species reflecting human consumption patterns. The results of these fish analyses were used in the recalculation of risk (Section 6). Predetermined target species were sought from the quarry and two locations (up- and downgradient) in the Black River. The results of previous fish sampling programs for this project were used to support the selection of target fish species, fish collection locations, and fish sampling methods. Fish sampling locations are shown on Figure 4-4.

Quarry Fish Collection

Fish samples were collected from the quarry using gill nets, trot lines, and electroshocking methods. A total of eight gill nets were deployed in the quarry. Four 100-foot by 4-foot six-panel experimental nets (1/2", 1", 1 1/2", 2"), and four 100-foot by 4-foot six-panel experimental nets (1", 2", 3", 4") were initially deployed on 13 November 1996. The nets were allowed to set overnight prior to being pulled up and emptied. Each morning, any fish caught were carefully removed and kept "live" in decontaminated containers until processing. Trot lines were also set in the quarry as an additional attempt to collect bottom feeders.

Fish samples were also collected from the quarry using a Coffelt-brand Mark 10 CPS electrofisher. Electroshocking was conducted prior to emptying gill nets each morning and consisted of one complete lap around the shoreline of the quarry and all shallow areas (areas less than 10 feet deep).

Black River Fish Collection

Fish samples were collected at two locations in the Black River. Previous investigations indicated that habitats above and below the quarry outfall (or, equivalently, above and below the Mussey Avenue Dam, upstream of the RSQ site) exhibited identical fish community structure. The dam (approximately 6 feet high) is the only nearby structure that would impede the movement of fish upstream. Because there are no structures to keep fish from moving above and below the outfall, for the purpose of the study, "downstream" will be referred to as the area of river fished below the quarry outfall and upstream as far as the Mussey Avenue dam.

Upstream of Mussey Avenue dam, the field team attempted to collect fish from the same location as in the previous study (Supplemental Investigation, 1990); however, no fish were encountered after significant effort. Therefore, the station was then moved farther upstream to just below the next dam where fishery habitat conditions were very similar to the downstream locations and fish were more numerous.

At both Black River locations, a Coffelt-brand Mark 10 CPS electrofisher was used. Fish were collected in dip nets, placed in decontaminated stainless steel buckets, then processed in the field. Field processing included identification, enumeration, length and weight measurement. Preferred target species were identified and stored on wet ice until sample preparation. The remaining fish were then released back into the Black River.

Fish Selection and Tissue Preparation

Target species were identified for collection at each sampling location prior to sampling. If the preferred target species were not captured in sufficient numbers or weight, other species were used.

Fish collected and used for analytical samples were filleted (with the skin remaining) and the scales removed. The fish were rinsed in de-ionized water to remove any debris. Total length, whole body weight, and fillet weight were measured for each fish designated for analysis. Right and left fillets were combined for each fish to obtain the desired mass per sample. The filleted fish were wrapped in aluminum foil (dull side toward the fish), placed in a cooler, and frozen with dry ice prior to shipment to the laboratory. The laboratory homogenized fish tissue samples in accordance with the SAS request.

4.1.3.4 Soil

Fifteen soil samples were collected during the five-year review investigation. Fourteen of the 15 samples were investigative samples while the remaining sample was designated as a QC field duplicate. Eight investigative surface soil samples were collected at the quarry's south end representing an affected area. Six background surface soil samples were collected in the wooded area west of the quarry. Figure 4-5 shows investigative soil sampling locations and Figure 4-6 shows background soil sampling locations. Five of the shallow surface soil samples and all of the background surface soil samples were collected from a depth of 0 to 8 inches below ground surface (bgs). The remaining on-site surface soil samples were collected at 12 inches bgs.

Soil samples were analyzed for SVOCs, metals, and cyanide. The samples were not analyzed for VOCs, pesticides, and PCBs because these fractions were not deemed to be fractions of concern according to the Supplemental Report (CH2M Hill, 1990). Soil samples were analyzed through the U.S. EPA CLP. SVOC samples were analyzed by American Technical and Analytical Services in Maryland Heights, Missouri. The metals and cyanide samples were analyzed by American Analytical and Technical Services in Broken Arrow, Oklahoma.

Soil samples were collected using a decontaminated hand held bucket auger or a decontaminated shovel. The sample material was removed from the bucket auger or shovel with a decontaminated stainless steel spatula and scoop. The sampling material was placed into a decontaminated stainless steel bowl and homogenized. The homogenizing procedure was designed to increase the probability that a relatively small sample aliquot would be representative of a relatively large soil or sediment volume removed from a sample location, thereby enhancing the representativeness and reproducibility of the sample. Sample material was placed in a decontaminated stainless steel bowl or tray, and a decontaminated stainless steel spoon or spatula was used to break it up into pieces approximately 1/2-inch or less in diameter. It was then stirred with decontaminated spoons or spatulas so that all of the material at the bottom of the bowl was displaced to the top and vice versa. This action was repeated at least three times. The homogenizing process was considered complete when the texture and color of the sample appeared to be uniform throughout. After homogenization, the sample material was placed in the appropriate sample jars for analysis.

4.1.3.5 Sediment

Eight sediment samples were collected during the five-year review, consisting of seven investigative samples and one QC duplicate. Sediment samples were collected from six locations in the quarry and one location in the quarry outfall area. Figure 4-7 shows the locations of the sediment samples.

The sediment samples were analyzed for VOCs, SVOCs, pesticides, PCBs, metals, cyanide, TOC, and oil and grease. VOCs, SVOCs, pesticides/PCBs, metals, and cyanide were analyzed through the U.S. EPA CLP. Organic fractions were analyzed by Southwest Labs of Oklahoma in Broken Arrow, Oklahoma. The metals and cyanide samples were analyzed by Inchcape Testing Services Aquatec Laboratory in Colchester, Vermont. The TOC and oil and grease parameters were analyzed following procedures described in SAS requests prepared by WESTON. TOC and oil and grease analyses were performed by the Region V CRL in Chicago, Illinois.

Sediment samples were collected using a decontaminated, stainless steel petite Ponar sediment sampler. The estimated depth of penetration into the sediment was noted in the logbook. One duplicate sediment sample (SD-108) was obtained from sediment sampling location (SD-105). The specific procedures were followed to obtain the sediment samples.

- The Ponar sampler was dropped overboard and lowered to the bottom gently to avoid blowout.
- The Ponar release mechanism was then activated and the sample was retrieved at the surface.
- The sediment sample was placed into a decontaminated stainless steel bowl.
- A decontaminated stainless steel spoon was used to remove the sediment from the sampler.

- The VOC aliquots were collected first as a grab sample in order to minimize the loss of VOCs. Each VOC aliquot was filled completely, with the sediment packed in the container as tightly as possible.

- Following the collection of the VOC sample, the remaining sample was homogenized in accordance with the QAPP. The remaining sample containers were filled as follows: TCL SVOCs and pesticides/PCBs; SAS TOC; SAS oil and grease; and TAL total metals and cyanide.

4.1.4 Aquatic Ecology Investigation

During the collection of fish samples, the field personnel qualitatively assessed the aquatic habitat of the Black River adjacent to the RSQ site. Information regarding the fish habitat structures was recorded during the collection of fish samples for tissue analysis. All fish collected were identified by species and tallied. The total length of the largest and smallest individuals of each species was measured to the nearest millimeter. The mass of all individuals of each species was determined to the nearest 0.1 gram. Each fish was examined for deformities, eroded fins, lesions, and external tumors. Representative samples of each species were preserved in 10% buffered formalin (i.e., 37 percent formaldehyde solution) and retained as voucher specimens. All fish not retained as vouchers or tissue samples were returned unharmed to the creek at the location of capture. The numbers and types of fish collected were used to calculate an Index of Biotic Integrity (IBI).

The IBI was developed by the Ohio Environmental Protection Agency (OEPA) as a method of evaluating the overall quality of the fish community. The IBI incorporates 12 community metrics. The location-specific values of each metric are compared with values expected at a reference site located in a similar geographic region where human influence has been minimal. Ratings of 5, 3, or 1 are assigned to each metric based on comparisons to expected values: a "5" is given for a metric that approximates reference site values; a "3" is assigned to a metric that deviates somewhat from reference values; and "1" is given to a metric that strongly deviates from the value expected at a reference location.

A Qualitative Habitat Evaluation Index (QHEI) was completed for each sample location of the Black River. The QHEI is a general evaluation of the habitat of flowing water with respect to the suitability for fish community development. The QHEI method was developed by the OEPA to evaluate the quantity of the fish habitats in permanent Ohio streams and rivers, and has been adopted by the U.S. EPA for the evaluation of fish community development with respect to habitat. The QHEI is generally used in conjunction with the IBI. The habitat evaluation by the QHEI method was made by the field team leader for each location in the Black River where fish were collected.

4.1.5 Terrestrial Ecology Investigation

The field team identified terrestrial habitats, terrestrial receptors (e.g., birds, mammals, and amphibians), and sensitive areas (e.g., wetlands) and recorded their observations in the logbook.

4.1.6 Human Population Investigation

The field team observed on-site indications of land use at the site and adjacent areas. Observations were recorded in the logbook.

4.2 INVESTIGATION RESULTS AND DISCUSSION

4.2.1 Groundwater

4.2.1.1 Evaluation Criteria

To evaluate current groundwater analytical results, monitoring wells B-2 and B-3 were used for establishing the quality of groundwater upgradient of the RSQ site. Monitoring wells B-1, B-5, B-6, B-7, and B-8 are considered to be downgradient monitoring wells.

The following criteria were used to determine whether a particular compound detected in the groundwater during the current sampling event was potentially site-related:

- A chemical compound was considered to be potentially site-related if it was detected in the groundwater at concentrations greater than five times the concentrations in the water blank, where:

    1) A compound was detected in the downgradient monitoring well sample at concentrations greater than two times the maximum concentration in the upgradient monitoring well sample, and

    2) A compound was detected at concentrations greater than two times the upgradient concentration in more than one downgradient monitoring well, or

    3) A chemical compound was detected in only one monitoring well at concentrations greater than two times the maximum upgradient concentration and was considered to be site-related during the RI.

Once the site-related compounds were identified, they were further evaluated to characterize current conditions and to disclose historic trends.

To characterize the current nature and extent of contamination for groundwater, the analytical results of downgradient groundwater samples were compared to upgradient monitoring wells; and to MCLs, SMCLs, and OEPA public water standards to determine if exceedences had occurred. To establish potential trends, the maximum concentrations of current site-related contaminants were compared with the RI's maximum concentrations for the same site-related compounds to determine whether concentrations had increased or decreased. This comparison is shown graphically for each site-related compound in Figure 4-8 (multiple pages).

4.2.1.2 Groundwater Analytical Results

The analytical results for current groundwater sampling are summarized in Tables 4-2 and 4-3.

Semivolatile Organic Compounds

The compound bis(2-ethylhexyl)phthalate was detected at similar concentrations in both upgradient and downgradient monitoring wells. This phthalate compound is considered a common laboratory artifact at low concentrations and is not considered a site-related compound. No other SVOCs were detected above the sample detection limits in the upgradient or downgradient monitoring wells and therefore, there are no site-related SVOCs detected in the current groundwater samples.

Inorganics

Downgradient samples contained significantly higher concentrations of aluminum, antimony, arsenic, beryllium, cadmium, calcium, chromium, cobalt, copper iron, manganese, nickel, potassium, selenium, sodium, thallium, and zinc, when compared to upgradient samples. Antimony, arsenic, selenium, and sodium, are not considered to be site-related compounds because they were detected at higher concentrations in only one downgradient monitoring well. Additionally, these metals were not determined to be site-related compounds during the RI.

The MCLs for antimony and cadmium in downgradient monitoring well B-1, and thallium in downgradient monitoring wells B-1, B-6, B-7, and B-8 were exceeded. The MCLs for thallium were also exceeded in upgradient monitoring wells B-2 and B-3. The SMCLs for aluminum were exceeded in downgradient monitoring wells B-1, B-6, B-7, and B-8. The

SMCLs for iron and manganese were exceeded in all downgradient monitoring wells. The SMCLs for manganese were also exceeded in upgradient monitoring wells B-2 and B-3. The Ohio MCLs for public supply water for antimony and cadmium in downgradient monitoring well B-1 and thallium in downgradient monitoring wells B-1, B-6, B-7, and B-8 were exceeded. The Ohio MCLs for thallium were also exceeded in upgradient monitoring wells B-2 and B-3.

4.2.1.3 Groundwater Trends

Bis(2-ethylhexyl)phthalate was detected in the groundwater in both the current sampling effort and during the RI, and at both times was not considered a site-related compound. Pentachlorophenol, phenol, and benzoic acid detected during the RI in the downgradient monitoring wells were not detected in the downgradient monitoring wells in the current samples. Therefore, the levels of SVOCs in the groundwater appear to have declined.

The concentrations of aluminum, beryllium, calcium, iron, lead, manganese, nickel, potassium, vanadium, and zinc have all shown a declining trend. The concentration trend of the site-related inorganic compounds during the current sampling effort and the RI is graphically depicted in Figure 4-8. The concentration of barium in all downgradient monitoring wells, except monitoring well B-5 has decreased, while barium in monitoring well B-5 during the current sampling event has slightly increased compared to the RI. The concentration of chromium and copper in all monitoring wells except monitoring well B-7 have decreased while the concentration of chromium and copper in monitoring well B-7 during the current sampling has increased. The concentration of cobalt in all monitoring wells, except monitoring wells B-5 and B-7, has decreased, but increased in monitoring wells B-5 and B-7 during the current sampling event. The concentration of cadmium in monitoring wells B-5 and B-8 has decreased, while indicating an increase in monitoring wells

B-1 and B-7. A trend for thallium and selenium cannot be determined because the groundwater samples during the RI were not analyzed for thallium and selenium.

4.2.2 Quarry Surface Water

4.2.2.1 Evaluation Criteria

Analytical results for surface water samples were evaluated to determine the extent of contamination in this media. To establish potential trends, the maximum concentrations of site-related contaminants were compared to the RI's maximum concentrations for the same site-related compounds. This comparison was made to determine whether the concentrations have increased or decreased. The discussion of the results begins with the quarry surface water, then proceeds to the Black River.

The evaluation of surface water contamination began with the identification of potentially site-related contaminants by using a structured, multi-step process. For the quarry, a chemical was considered to be potentially site-related if it was:

- Detected at greater than five times the concentrations in the water blank, and
- Detected at greater than two times the concentrations in the upgradient (background) groundwater concentration, and
- Encountered at more than one sample location, or
- Detected only at one sample location, but was found to be site-related during the RI.

Once the site-related compounds were identified, they were further evaluated to determine their nature and extent by characterizing current conditions and disclosing historic trends. The analytical results for the surface water samples from the quarry were also compared to the latest AWQCs for surface water.

4.2.2.2 Quarry Surface Water Analytical Results

The current analytical results for surface water sampling are summarized in Tables 4-4 through 4-7.

Semivolatile Organic Compounds

No SVOCs were detected in the surface water samples collected form the quarry, therefore, no exceedences of water quality standards occurred.

Inorganics

Only calcium, iron, manganese, and vanadium were detected and validated in quarry samples at significantly higher concentrations compared to upgradient monitoring well samples. Accordingly, these metals are considered to be site-related. The site-related impact appears to increase with depth. The maximum concentration of these metals was detected in the surface water sample collected at a depth of 60 feet.

Concentrations of barium in the quarry exceeded the water quality standard, which is the chronic criterion for the protection of aquatic organisms.

4.2.2.3 Quarry Surface Water Trends

A comparison of RI to current analytical results indicates SVOCs appear to be declining. Some compounds were detected during the RI, but were not detected during the current sampling.

Calcium, iron, manganese, and vanadium were identified as current site-related contaminants. During the RI, magnesium, nickel, and zinc were also considered to be site-related compounds. These additional compounds no longer satisfy the criteria for being site-related based on current sampling. Magnesium was detected in the quarry surface sample at a lower concentration compared to the upgradient groundwater sample. Nickel and zinc were not detected above detection limits in the quarry surface water sample.

The concentrations of site-related contaminants in the quarry surface water have demonstrated a decreasing trend. The concentrations of barium, iron, magnesium, calcium, manganese, vanadium, nickel, and zinc in the quarry surface water samples are uniformly lower compared to RI results. The concentration trends for these inorganic compounds for the current sampling and the RI are depicted in Figure 4-9.

Like metals, standard water quality parameters are also apparently improving at the site. The maximum concentrations of water quality parameters measured during this investigation (TSS, TSD, total alkalinity, and sulfate), indicate a declining trend compared to maximum concentrations detected during the RI. However, the chloride concentrations in the current quarry surface water samples have increased compared to the maximum concentrations detected in the RI. The concentration trend for these special parameters for the current investigation and the RI is graphically depicted in Figure 4-9.

4.2.3 <u>Black River Surface Water</u>

4.2.3.1 Evaluation Criteria

As with the quarry surface water analysis, the Black River surface water analysis began with identification of site-related contaminants. The downstream surface water sample collected from the river was compared to the upstream surface water sample, and checked against the quarry outfall sample in a structured evaluation. Specifically, the following evaluation criteria were used to identify the site-related contaminants impacting the Black River:

- A chemical was considered to be potentially site-related if it was detected at greater than five times the concentrations in the water blank, and

- Its concentration present in the downstream surface sample from Black River was greater than two times the upstream surface water sample, and

- Identified as a site-related compound in the quarry surface water, or

- Its concentration in the quarry outfall sample was two or more times the concentration in the upstream Black River sample, and

- The contaminant loading from the outfall was algebraically reconcilable by mass balance to the observed concentration downstream in the Black River.

The current analytical results for the surface water samples from the Black River were compared to the latest Ohio Water Quality Standards for surface water. Once site-related contaminants were identified, current contamination was evaluated and comparisons to historical trends were made.

4.2.3.2 Black River Surface Water Analytical Results

Analytical results for surface water sampling are summarized in Tables 4-4 through 4-6.

Semivolatile Organic Compounds

No site-related SVOCs were found in the Black River or the quarry outfall. One compound, diethylphthalate, was detected at a concentration of 0.9 ug/L in the surface water sample collected from the upgradient portion of the Black River. Diethylphthalate at such a low concentration is potentially a laboratory artifact. Furthermore, no SVOCs were detected above the detection limit in the downgradient surface water sample.

No exceedences of Ohio Water Quality Standards were noted in the Black River, or in the outfall.

Metals

Several metals were detected, but at similar concentrations in the upstream and downstream Black River samples. Based on the upstream-to-downstream evaluation criterion described above, no metals were identified as site-related contaminants in the Black River.

Using the quarry outfall-to-upstream criterion described above, two metals in the quarry outfall satisfied at least part of the criteria as site-related. Compared to the upstream surface water sample in the Black River, the quarry outfall sample showed more than double the upstream's level of manganese and sodium. Accordingly, sodium and manganese were subjected to mass balance analysis. For performing this analysis, the flow rates of 15 gpm (0.033 cfs) from the quarry and 1,170 gpm (2.6 cfs) for the west branch of the Black River were used. (These are the flow rates estimated during the RI.) The flow rates estimate that the river has 78 times the flow of the quarry outfall. Even if the discharge from the quarry to the Black River was to increase significantly, there will be little to no impact to the Black River due to significant flow difference as demonstrated above.

The results of the mass balance for manganese and sodium are provided below:

Metal	Upstream Concentration (ug/L)	Quarry Outfall Concentration (ug/L)	Predicted Downstream Concentration (ug/L)	Actual Downstream Concentration (ug/L)
Manganese	35.3	152	35.3	37.3
Sodium	9,300	47,600	9,301	10,100

These results indicate that the discharge from the quarry has a negligible effect on the water quality of Black River. The outfall's high concentration could exist near the bank of the river at the outfall, but diminishes rapidly through the mixing zone and virtually disappears downstream due to dilution.

No exceedences of Ohio Water Quality Standards were noted for metals in the Black River.

4.2.3.3 Black River Surface Water Trends

The analytical results indicate SVOC concentrations are apparently declining in the Black River since they were detected during the RI, but were not detected during the current sampling event.

Nickel and zinc, once considered site-related surface water contaminants in the river, are declining. Nickel and zinc detected in the downgradient surface water sample from the Black River were determined to be site-related contaminants during the RI. However, neither nickel or zinc were found to be site-related contaminants for the present-day sampling. Both nickel and zinc were not detected above the detection limit in the samples collected from the Black River or quarry discharge.

Manganese and sodium were determined to be potentially site-related contaminants with respect to the quarry outfall during the present day. However, mass balance of manganese and sodium have demonstrated that the quarry discharge is not affecting the downstream portion of the Black River. Hence, the trend for manganese and sodium is not of concern as far as measurable influence on the Black River is concerned.

4.2.4 Fish Tissue

4.2.4.1 Evaluation Criterion

Fish tissue sample results were first evaluated by examining the average concentration of a compound in a fish tissue sample from a particular species from the upstream, downstream, and quarry locations. Since only one species, the white sucker, was caught at both the upstream and downstream locations in the Black River, a second analysis was performed to evaluate average concentrations of compounds in all fish tissue from the quarry, downstream Black River, and upstream Black River. In the second analysis, the sample results from all fish species were combined by location to calculate the average concentration of each compound in fish at that location. The second analysis is limited because different fish species will have different percent lipids and therefore, a different adsorption capacity for cadmium, copper, manganese, and mercury.

4.2.4.2 Fish Tissue Analytical Results

The current fish tissue samples were analyzed for percent lipids, cadmium, copper, manganese, and mercury. The analytical results are summarized in Table 4-8.

The white sucker was the only fish species caught from the upstream and downstream locations. The white suckers from the downstream location had higher levels of percent lipids and manganese. Cadmium was not detected in the upstream or downstream sample location. However, levels of copper and mercury were higher in the upstream sample location. No white suckers were caught from the quarry. The summary of fish tissue results for white suckers is provided in Table 4-9.

The evaluation by location has suggested that the average level of manganese is higher in the downstream fish tissue samples compared to upstream fish tissue samples. The levels of cadmium, copper, and mercury are higher in the upstream samples compared to the downstream samples. The levels of cadmium and mercury in fish from the quarry are higher when compared to the upstream samples. The levels of percent lipids, copper, and manganese are higher in upstream fish compared to fish in the quarry. The summary of average concentration by location is provided in Table 4-10.

4.2.4.3 Fish Tissue Trends

All comparisons must be tempered with the understanding that the five-year review fish samples were obtained under unfavorably cool weather conditions in November 1996, during which time the fish were lethargic, and the catch was poor. The Supplemental Report's fish were obtained under warm weather conditions during which the fish were actively feeding, and the catch was considerably better. Differences in concentrations may be attributable to these differing weather conditions and feeding patterns.

Compared to the RI, the current concentration of manganese in the white sucker species has increased and the concentration of mercury has decreased from the upstream Black River location. The current concentrations of manganese in the fish samples from the downstream Black River location have increased and the concentration of mercury has decreased. The current concentration of manganese and mercury in the fish sample from the quarry has decreased. A graph depicting the trend for manganese and mercury in upstream, downstream Black River and quarry samples is presented in Figure 4-10.

4.2.5 Soil

4.2.5.1 Evaluation Criteria

The evaluation of soil contamination begins with the identification of potentially site-related contamination. The identification of site-related contamination is a multi-step process as described below:

- A chemical compound (an SVOC, metal, or cyanide) was considered to be potentially site-related when the validated maximum concentration of the chemical compound detected in the soil sample was greater than two times the maximum concentration detected in the background soil samples, or

- An SVOC was considered to be site-related when an investigative sample revealed a validated detection of a chemical compound previously included as a target compound in the removal action.

Once the site-related compounds were identified, they were further evaluated to establish potential trends. In order to determine trends, the present-day maximum concentrations of the site-related SVOC compounds were compared to previously measured concentrations and to the removal action's soil excavation cleanup criterion. The removal action's soil excavation cleanup criterion prescribed that the total concentration of four target compounds remaining in the soil after excavation must not exceed 300 ppb. The four target compounds consisted of the carcinogenic PAHs (CPAHs) benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, and benzo(a)anthracene. Trends could not be evaluated for inorganics because earlier analytical work on soil from the ditch and the boat ramp did not address inorganics.

4.2.5.2 Boat Ramp Soil Analytical Results

The current analytical result for soil sampling are presented in Tables 4-11 and 4-12.

Semivolatile Organic Compounds

No SVOCs were detected at concentrations exceeding background soil concentrations in the soil samples collected from the boat ramp area. Therefore, there are no site-related SVOCs in the boat ramp area.

Inorganics

Copper was the only metal detected in the boat ramp area at significantly elevated concentrations, compared to background soil sample concentrations. Therefore, copper is considered to be a potentially site-related compound. No other inorganics satisfied the criteria outlined above for site-related chemicals in the soil samples collected from the boat ramp area.

4.2.5.3 Boat Ramp Soil Trends

Focusing on the four target compounds of the removal action, an attempt was made to compare the maximum detected concentrations in the current samples to the maximum concentration of the respective compounds in the post-excavation samples for the establishment of potential trends. However, the target compounds were not detected above the laboratory detection limits in the current soil samples; therefore, a comparison was not possible.

Historically, the ditch and boat ramp had not been analyzed for metals and cyanide; therefore, no comparison could be performed for metals and cyanide.

4.2.5.4 Ditch Soil Analytical Results

The current analytical result for soil sampling is presented in Tables 4-11 and 4-12.

Semivolatile Organic Compounds

Benzo(a)anthracene, chrysene, anthracene, pentachlorophenol, indeno(1,2,3-cd)pyrene, and benzo(g,h,i)perylene were detected in soil samples at significantly higher concentrations compared to the background soil samples. Anthracene, pentachlorophenol, and benzo(g,h,i)perylene are not considered to be contaminants of concern because they are not CPAHs and, therefore, were not included as a part of cleanup criteria during the removal action. However, benzo(a)anthracene and chrysene are considered to be site-related contaminants of concern to be addressed in the risk assessment (Section 6).

Inorganics

Iron, mercury, potassium, selenium, and thallium were detected at significantly higher concentrations compared with the background soil sample. The soil samples from the ditch during post excavation were not analyzed for metals and therefore iron, mercury, potassium, selenium, and thallium are potentially site-related compounds. No other metals or cyanide exceeded the criteria listed above.

4.2.5.5 Ditch Soil Trends

Focusing on the four target compounds of the removal action, the maximum concentrations of compounds detected in the current samples were compared against the maximum concentrations of the respective compounds detected in the post-excavation sample for the establishment of potential trends.

Benzo(b)fluoranthene and benzo(k)fluoranthene were not detected above respective sample detection limit in the present-day soil samples or in the post-excavation samples. Therefore, there is no recognizable concentration trend for these compounds above the detection limits.

The concentrations of benzo(a)anthracene and chrysene in the present-day soil samples are higher than the concentrations detected in the soil samples collected after the removal action. The increase in concentration in the current soil samples could be due to the fact that grab soil samples were collected for the current sampling and composite samples were collected for post-excavation sampling. Because of compositing, the soil samples from eight locations during post-excavation showed a reduction in concentration of these compounds due to possible dilution effects. On the other hand, the increase could be genuine and could disclose spots that were missed during the removal. The sum of the concentrations of cPAHs exceeds the soil cleanup criteria used in the 1990 Supplemental Report of 300 ppb for cPAHs at three sampling locations. These samples were collected from one location (SS-102) inside the fence at depths of 0 to 8 inches and at two locations used as background samples located northwest of the quarry (SS-110, SS-111) and inside the fence at depths of 2 to 8 inches. These results are further discussed in Section 6.

The concentration trends for benzo(a)anthracene and chrysene are presented graphically in Figure 4-11.

4.2.6 <u>Sediment</u>

4.2.6.1 Evaluation Criteria

The following criteria were used to determine whether an SVOC or an inorganic compound detected in the sediment samples during the current sampling effort was potentially site-related:

- A compound was detected and validated in the sediment sample at concentrations greater than two times the maximum concentration in the background soil sample, and

- Detected and validated in more than one sediment sample location, or

- Detected at only one sediment sample location at a concentration greater than two times the background soil concentration and considered to be site-related during the RI.

The above criteria were not used to determine whether a VOC, pesticide, or PCB detected in the sediment sample was a site-related compound because the current background soil samples were not analyzed for VOCs, pesticides, or PCBs. To determine whether a VOC, pesticide, or PCB detected in the sediment samples during current sampling was potentially site-related; the following criteria were used

- A compound was detected and validated in the sediment sample and was previously identified as site-related in the RI, or

- The compound was identified as site-related in any environmental medium during the RI, or

- The compound was detected and validated in more than one sediment sample.

Once the site-related compounds were identified, they were further evaluated to determine potential trends. For SVOCs, metals, and cyanide, the analytical results were compared to background soil samples. For VOCs, pesticides, and PCBs, the analytical results were compared to the RI data, site-related compounds in the soil, and upgradient groundwater. This approach for analysis of VOCs, pesticides, and PCBs was used because the current soil samples were not analyzed for these parameters making it necessary to evaluate results against other criteria (i.e., RI data, site-related compounds and upgradient groundwater).

To evaluate historical trends, the maximum concentrations of present-day site-related contaminants were compared with the RI's maximum concentrations for the same site-related compounds to determine whether concentrations had increased or decreased. The present-day analytical results of the sediment samples from the quarry were compared to the RI analytical results of the sediment samples.

4.2.6.2 Sediment Analytical Results

The analytical results for sediment sampling are summarized in Tables 4-13 through 4-17.

Volatile Organic Compounds

Methylene chloride, acetone, carbon disulfide, benzene, 2-butanone, tetrachloroethene, toluene, ethylbenzene, and total xylene, were detected at relatively higher concentrations in the sediment samples as compared to other media sampled. Benzene is not suspected to be a site-related compound because it is believed that this compound was not used historically at the site.

Although carbon disulfide was detected at two sediment sample locations, it is not considered to be a site-related compound because it was detected at similar concentrations in both background soil sample collected during the RI, and current sediment samples.

Xylene is not suspected to be a site-related compound because it was detected at only one sediment sampling location in the current sampling, and was not detected in any other media during the RI.

Therefore, methylene chloride, acetone, 2-butanone, tetrachloroethene, toluene, and ethylbenzene detected in the sediment samples are considered to be the only site-related VOCs.

Semivolatile Organic Compounds

Anthracene, fluorene, phenanthrene, di-n-butylphthalate, fluoranthene, pyrene, benzo(a)-anthracene, chrysene, bis(2-ethylhexyl)phthalate, di-n-octylphthalate, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, indeno(1,2,3-cd)pyrene, and benzo(g,h,i)perylene are considered to be site-related compounds because they were detected at significantly higher levels compared to maximum concentration in the background samples.

The analytical data for the current sampling for butylbenzylphthalate were not usable for all samples, except the sample collected from the outfall area (as discussed in Subsection 4.2.7). Butylbenzylphthalate was considered to be a site-related compound during the RI.

Pesticides and PCBs

No PCBs were detected in the quarry sediment samples. The pesticides detected in the sediment samples were detected at generally low and estimated concentrations and are not considered to be site-related compounds.

Special Parameter Analysis

Oil and grease were detected at significantly higher concentrations in the sediment samples and are considered to be site-related compounds as they were also considered to be site-related compounds in sediments during the RI.

Inorganics

Calcium, chromium, copper iron, magnesium, mercury, nickel, potassium, selenium, sodium, thallium, and zinc were detected at significantly higher concentrations compared to background soil samples, and therefore are defined as site-related compounds.

4.2.6.3 Sediment Trends

Methylene chloride, acetone, 2-butanone, tetrachloroethene, toluene, and ethylbenzene were considered to be site-related compounds during the present day and the RI. The concentration of toluene and ethylbenzene are declining and the concentration of methylene chloride, acetone, 2-butanone, and TCE are increasing. The trend of the site-related VOCs is graphically depicted in Figure 4-12.

Anthracene, phenanthrene, di-n-butylphthalate, fluoranthene, pyrene, benzo(a)anthracene, chrysene, bis(2-ethylhexyl)phthalate, di-n-octylphthalate, benzo(b)fluoranthene, benzo(k)-fluoranthene, benzo(a)pyrene, indeno(1,2,3-cd)pyrene, benzo(g,h,i)perylene were considered to be site-related compounds in the current sampling and during the RI. Fluorene was considered to be a site-related compound in the current sampling event, but not during the RI. Diethylphthalate, pentachlorophenol, and butylbenzylphthalate were considered to be site-related during the RI but not in the current samples. The concentrations of all SVOCs except indeno(1,2,3-cd)pyrene, benzo(g,h,i)perylene, and fluorene have decreased. The concentrations of indeno(1,2,3-cd)pyrene, benzo(g,h,i)perylene, and fluorene have increased. The trend for the SVOCs is graphically depicted in Figure 4-12.

Oil and grease were considered to be site-related compounds during the current sampling effort. Aldrin and alpha-chlordane were not considered to be site-related compounds based on the RI.

Calcium, chromium, copper iron, magnesium, mercury, nickel, potassium, and zinc were considered to be site-related compounds in both the current samples, and samples collected during the RI.

Selenium and sodium were considered to be site-related compounds in the current samples, but were not considered to be site-related during the RI. The samples collected during the RI were not analyzed for selenium. Arsenic, lead, and tin were considered to be site-related compounds during the RI, but were not considered to be site-related compounds in the current samples. The current samples were not analyzed for tin. Concentrations of all metals except arsenic, potassium, sodium, and zinc have decreased. Concentrations of arsenic, potassium, sodium, and zinc have increased. The trend for the inorganics is graphically depicted in Figure 4-12.

4.2.7 Quality Control Samples

For the groundwater SVOC fraction, no compounds were detected in the bottle blank or in the equipment blank. The SVOC field duplicate sample showed good correlation with the investigative sample. For the metals and cyanide fractions, calcium, iron, sodium, and zinc were detected in both the bottle blanks and the equipment blank. All calcium, iron, and sodium investigative results exceeded the blank contamination criterion of five times the blank contamination and are acceptable. All but the zinc investigative result did not exceed the blank contamination criterion, so all zinc data were qualified as estimated. The inorganic field duplicate sample showed good correlation with the investigative sample.

For the surface water, all thallium data were unusable due to an extremely low matrix spike recovery. No compounds were detected in the SVOC bottle blank. Bis(2-ethylhexyl) phthalate was detected in the SVOC equipment blank. All SVOC detections of bis(2-ethylhexyl) phthalate were below the blank criterion of ten times the blank contamination;

therefore, all bis(2-ethylhexyl) phthalate results were identified as nondetectable. The SVOC field duplicate sample showed good correlation with the investigative sample. Several metals were identified in the bottle blank and in the equipment blank. The investigative samples were qualified based on the established blank contamination criteria. The inorganic field duplicate sample showed good correlation with the investigative sample. For the water quality parameters, the field duplicate sample showed good correlation with the investigative sample.

For fish tissue, no cadmium was detected in the fish blanks; however, the remaining compounds of interest were detected in the fish blanks. Two fish samples were designated as field duplicates. The fish duplicates were different portions of fish tissue taken from the same fish. Overall, the fish duplicates showed poor correlation; however, due to the heterogeneous nature of fish tissue, applying the same criteria for duplicate comparison as for water or soil may be overly stringent. As a result, no qualifications were applied to the results based on fish duplicates.

For soil, one of the grab samples collected from the boat ramp area was not analyzed because the bottle was broken by the laboratory. The soil field duplicate samples for SVOCs, metals, and cyanide showed good correlation with the corresponding investigative samples.

For sediment, the VOC fraction included several unusable results. Specifically, 4-methyl-2-pentanone; 2-hexanone; 1,1,2,2-tetrachloroethane; chlorobenzene; and styrene results were qualified as unusable for several samples due to an out-of-control internal standard during the samples' analyses. For the SVOC fraction, numerous sample results were qualified as unusable due to problems associated with internal standards. For the pesticide fraction, all nondetected compounds in one sample were designated as unusable due to an out-of-control surrogate recovery incurred during the sample's analysis. For the cyanide fraction, all sample results were qualified a unusable due to an out-of-control matrix spike recovery. All other sediment sample results were usable. Overall, the VOC, SVOC, pesticide/PCB, metals, and cyanide field duplicates showed good correlation with the corresponding investigative sediment samples.

4.2.8 Aquatic Ecology Investigation Results

An investigation of aquatic ecological conditions allowed calculation of the IBI, presented in Table 4-18, and QHEI, presented in Table 4-19. A total of 315 fish representing 15 species were collected from the two reaches in the Black River and the RSQ site. A list of fish species collected along with length and weight ranges measured during this investigation is presented in Table 4-20.

Quarry

Only four fish, all from the centrachidae (sunfish) family, were collected in the quarry during the present sampling effort. Two smallmouth bass were caught using gill nets, and were found in relatively shallow waters at the southwest corner of the quarry, close to the pond's island. Two bluegills were caught by electroshock methods in shallow waters along the sides of the southwest quadrant of the quarry. The bluegills' lengths ranged from 70 to 120 mm in length. The largest fish caught in the quarry had a standard length of 255 mm (see Table 4-20 for specific lengths and weight information).

During the Supplemental Investigation (CH2M Hill, 1990) at the quarry, fish sampling was conducted during the summer months. Dissolved oxygen profiles at that time indicated that only the top few feet of water had enough oxygen to support fish activity; thereby limiting fish populations to this shallow zone. Additionally, fish prefer to congregate around structures such as the shear rock walls, boat launch, and small island area for feeding and protection. Because of these contributing factors, the fish were constrained to less than 10 percent of the total area of the quarry during the RI.

During the present investigation, dissolved oxygen was nearly at the saturation level throughout the entire water column, thereby allowing the full range of the quarry habitat for fish refuge. This obviously aided in the dispersal of the existing fish population. The surface water temperature continued to drop through the month of November, which typically results in fish populations sounding to the deepest areas. During the winter months, fish also tend to lower their activity and metabolism to a near-dormant state in order to conserve resources during severe conditions. These are just a few of the possible explanations for the low numbers of fish collected from the quarry waters.

Experimental gill nets were set at selected locations in an attempt to collect fish from surface waters and deep zones in the quarry. Given the dissolved oxygen and vertical temperature profile of the quarry, it was then decided to set most of the experimental nets in the deeper areas of the quarry where fish were expected to be. The shallow areas were worked extensively with the electroshocking equipment. If fish were present in the limited shallow areas, this technique would have captured them.

After the nets were checked each morning, they were moved to new locations in order to cover as much area of the quarry as possible. The fish living in the quarry at the time of the sampling did not appear to be very active. No fish were captured in any of the deeper nets, possibly because they were not moving enough to become entangled. The nets were then moved following each unsuccessful return and even dragged in a herding manner to get some movement and perhaps entangle a few fish. This procedure was continued unsuccessfully (5 days) until the decision was made to stop.

Black River

A total of 170 fish representing six species were collected in the upstream location and 141 fish representing eight species downstream. The sand shiner was the most common fish (79 upstream and 86 downstream) collected in either station in the Black River. The second most common fish was the bluntnose minnow (54). Game species present at the upstream station included the grass pickerel, white crappie, and largemouth bass. The only catfish collected during the investigation were found upstream. Both largemouth and smallmouth bass were collected downstream.

The QHE (Table 4-19) evaluates the quality of the river's habitat. The upstream station can be described as a low- to mid-gradient run with boulder/slab, boulder substrate with some undercut banks, root wads, logs, and trees or woody debris for cover. The riparian zone is narrow to very narrow with forest and shrub on both sides of the river. Bank erosion was little to moderate in this area with fairly slow-moving water at an average depth of approximately 2 feet at the time of sampling.

The downstream station can be described as a mid-gradient reach with 50 percent run, 25 percent riffle, and 25 percent pool. The substrate is primarily large boulder, slab, and bedrock. Little or no cobble gravel or silt exist in the area. Undercut banks, root wads, and some wood debris provide some cover. A few deep pools exist as well for deeper habitat. The riparian zone is very narrow with trees and shrubs on both banks. There is little evidence of bank erosion within the reach and it appears moderately stable.

The IBI calculated for the upstream reach of the Black River was 30, which is slightly lower than the downstream reach, calculated at 32. Table 4-18 presents the metric values and calculated IBI for the upstream and downstream stations. Although the upstream location is characterized by a higher number of species, it is outweighed by the higher number of omnivores and lithophilic species present in the downstream reaches.

4.2.9 Terrestrial Ecology Investigation Results

Terrestrial habitats, terrestrial receptors (e.g., birds, mammals, reptiles, and amphibians), and sensitive areas (e.g., wetlands) were noted if observed on the site. Because of the time of year during this investigation, it is likely that a number of herbaceous species were not identified since the germination of annual species and the initiation of aboveground growth for perennial species had not yet occurred.

Vegetation around the quarry perimeter is mostly grass and small brush; however, several larger trees can be found around the site. Vegetation is fairly dense over most of the site.

A mixed deciduous woodland forest is located within the site and west of the quarry. The southernmost third of the area west of the quarry appears to be a transitional woodland with very little understory and a canopy dominated by red maple and pin oak. Toward the north, the middle third of the wooded portion of the site is an area of thick brush and wetlands areas. The common tree species includes red oak, pin oak, red maple, silver maple, sycamore, and northern crabapple. Common scrub/shrub species includes cottonwood, silky dogwood, hawthorn, wild grape, multiflora rose, blueberry, and honeysuckle. An emergent wetland area is located to the west of the quarry, just east of and adjacent to the West River Road. These areas contain standing water with cattails, silky dogwood, and phragmites. The northernmost third of the wooded area is a fairly mature oak forest with a mixture of red and pin oaks. A small stream cuts across the northern edge of the site and drops into a tunnel before it discharges into the Black River just downstream of the quarry outfall.

Evidence of wildlife observed during the field investigations of the site included sightings, sounds, footprints, dens, and scat. The following species were either known to be present or suspected based on the evidence encountered:

Mammals	**Birds**
gray squirrel	cardinal
eastern cottontail rabbit	junco
groundhog	woodcock
raccoon	nuthatch
	Black capped chickadee
	Buteo sp.
	mallard duck

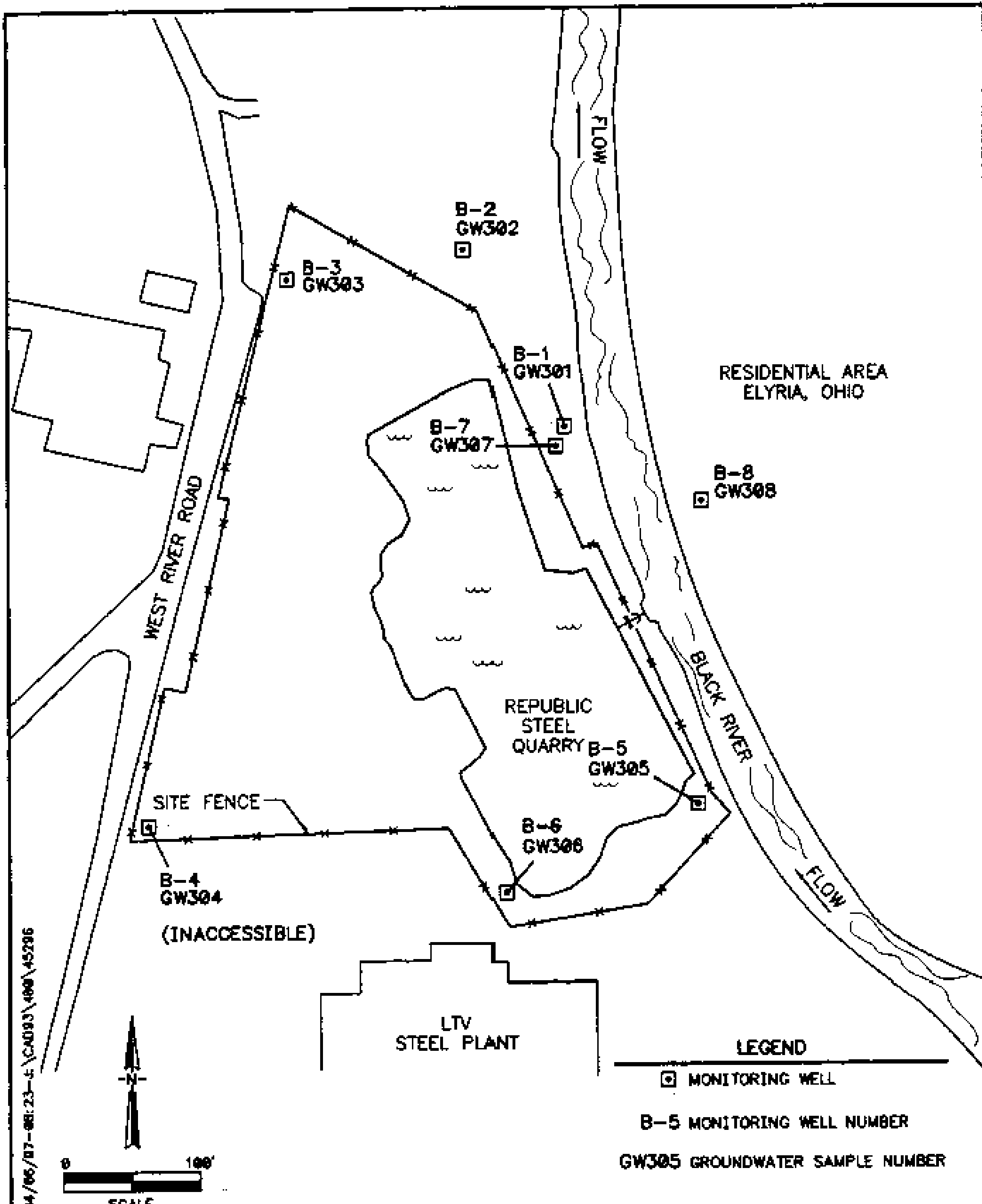


FIGURE 4-1

ALTERNATIVE REMEDIAL CONTRACTING STRATEGY
U.S. EPA CONTRACT No. 68-W8-0089
WORK ASSIGNMENT No. 86-5WE
DOCUMENT CONTROL No. 4500-86-ANWY

GROUNDWATER RESAMPLING LOCATIONS

RSQ SITE
Elyria, Ohio

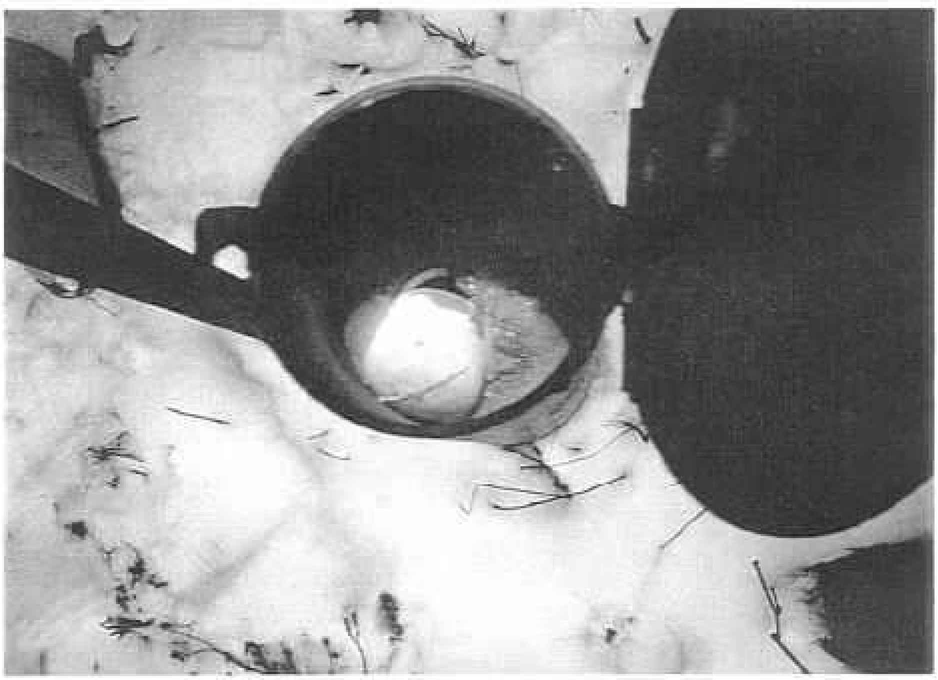


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FIGURE 4-2

ALTERNATIVE REMEDIAL CONTRACTING STRATEGY U.S. EPA CONTRACT No. 68-W8-0089 WORK ASSIGNMENT No. 86-5WE DOCUMENT CONTROL No. 4500-86-ANWY	WELL OBSTRUCTION AT B-4 RSQ SITE Elyria, Ohio

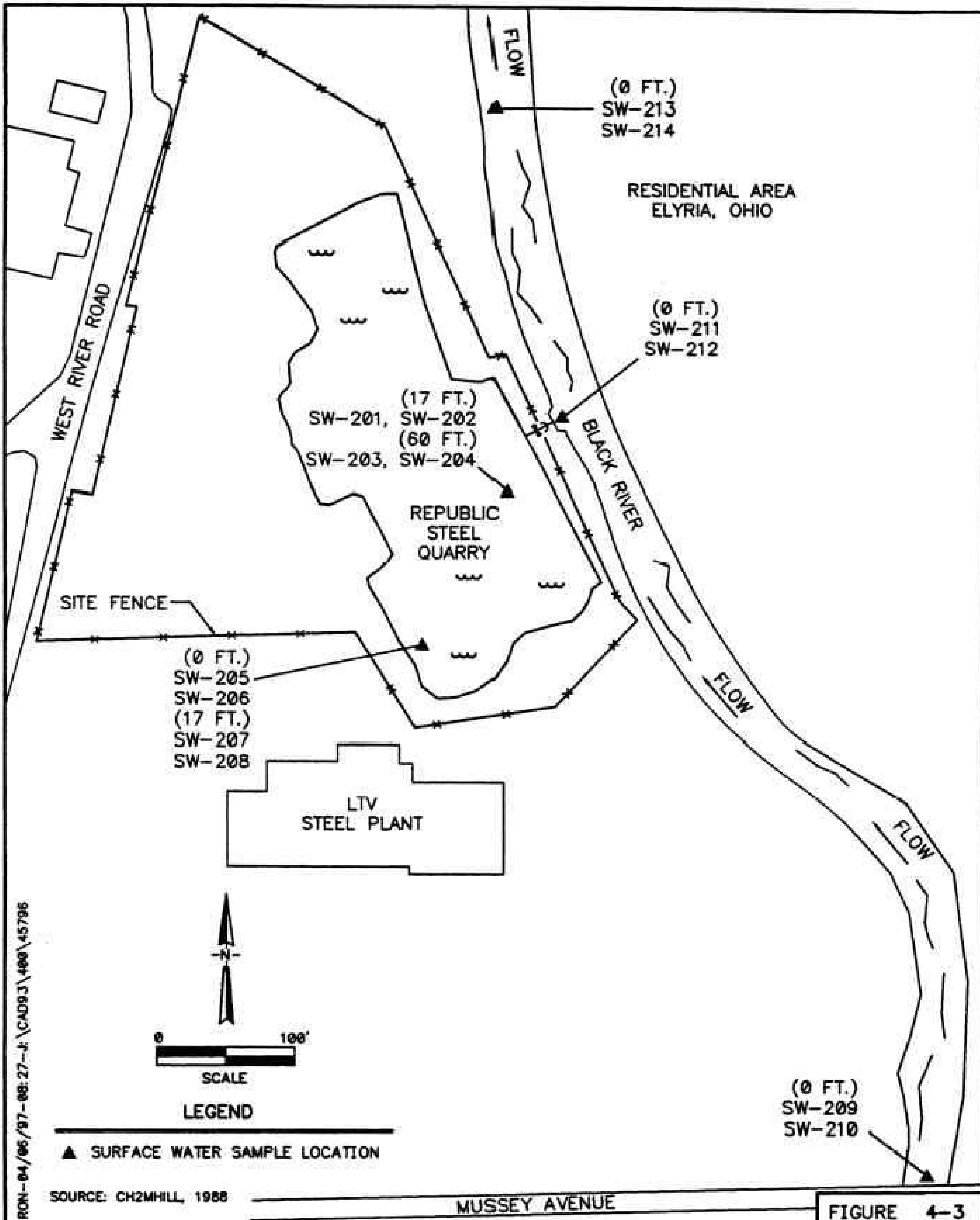


FIGURE 4-3

ALTERNATIVE REMEDIAL CONTRACTING STRATEGY
U.S. EPA CONTRACT No. 68-W8-0089
WORK ASSIGNMENT No. 86-5WE
DOCUMENT CONTROL No. 4500-86-ANWY

SURFACE WATER SAMPLING LOCATIONS

RSQ SITE
Elyria, Ohio

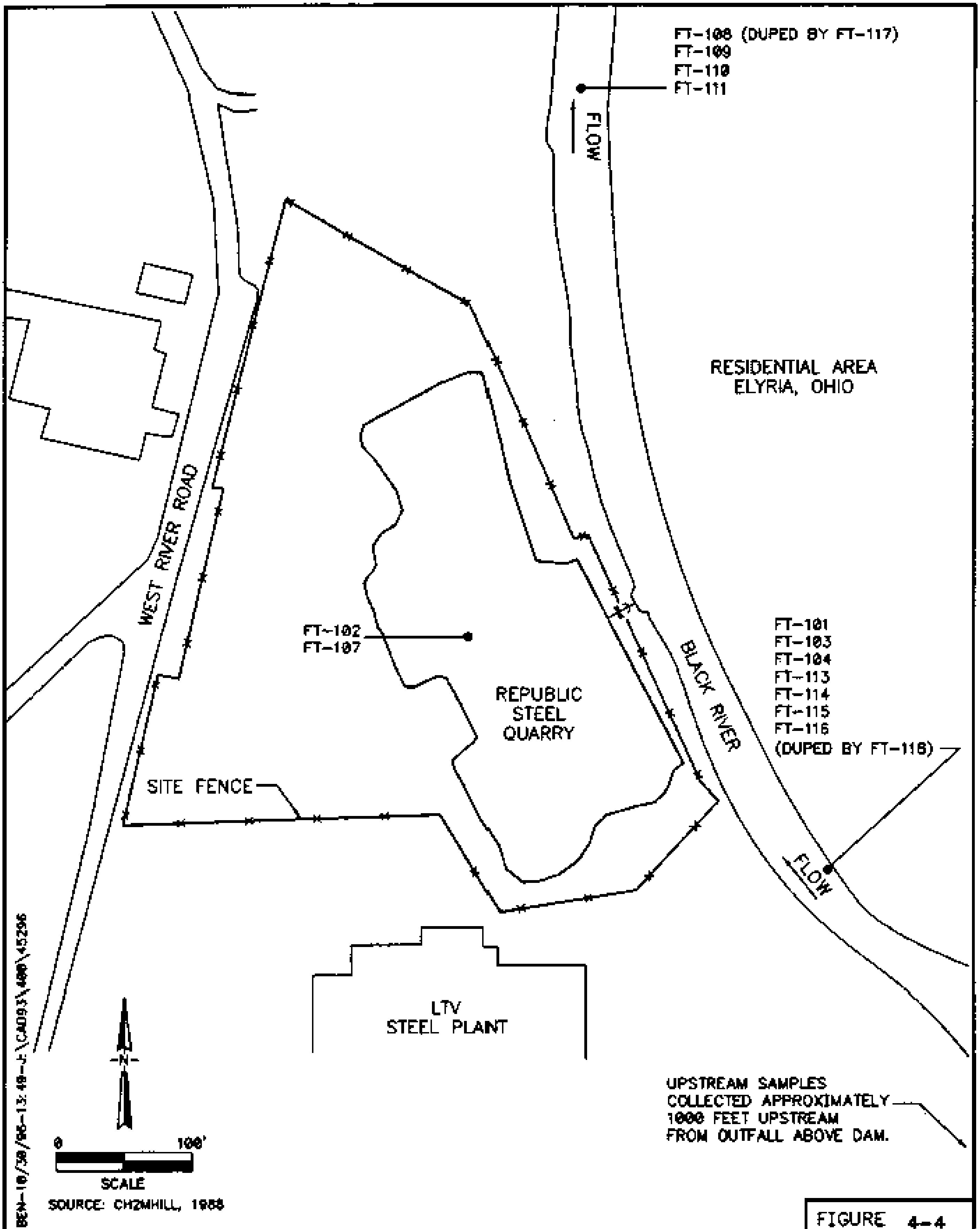


FIGURE 4-4

ALTERNATIVE REMEDIAL CONTRACTING STRATEGY U.S. EPA CONTRACT No. 68-W8-0089 WORK ASSIGNMENT No. 86-5WE DOCUMENT CONTROL No. 4500-86-ANWY	FISH SAMPLING LOCATIONS RSQ SITE Elyria, Ohio

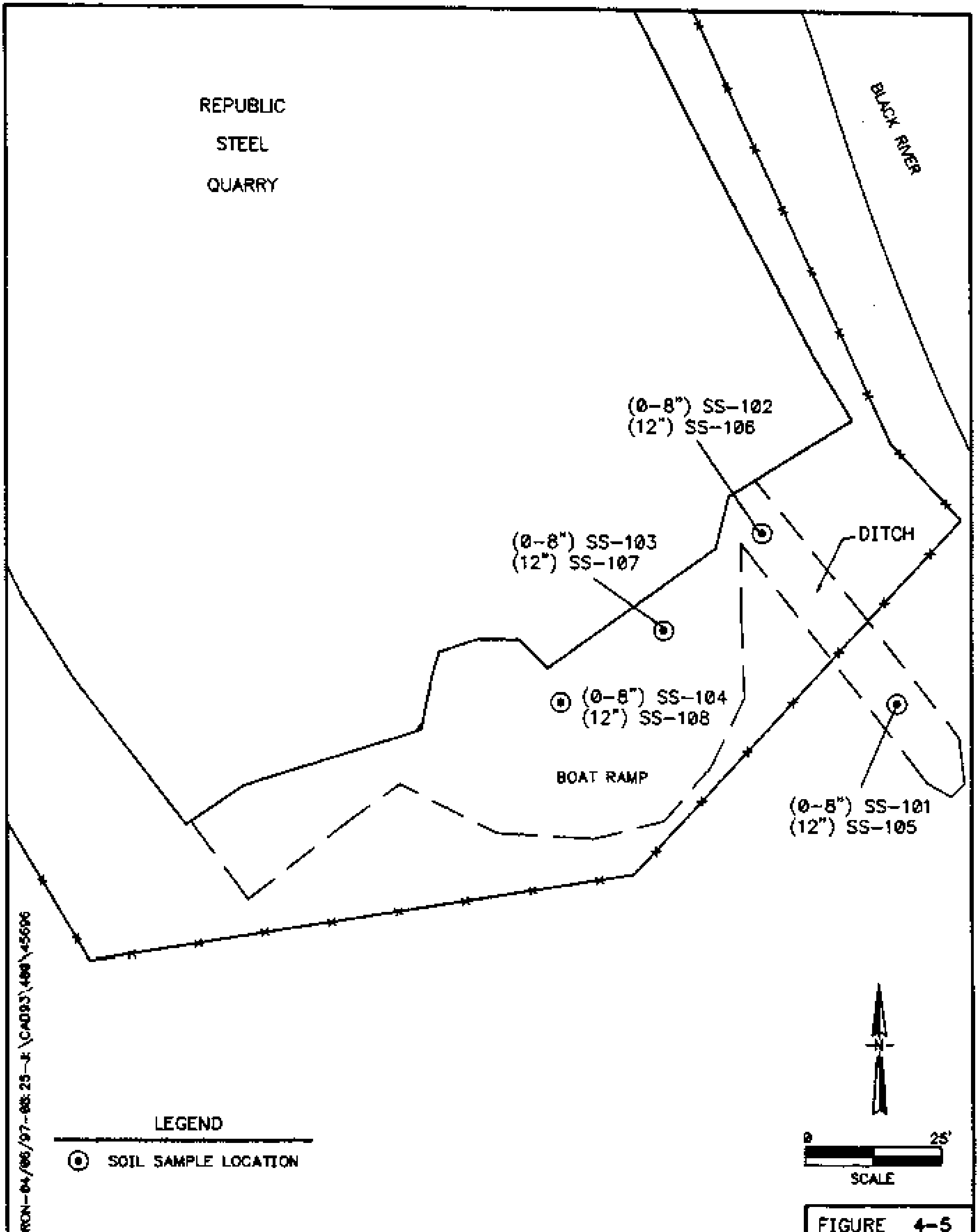


FIGURE 4-5

ALTERNATIVE REMEDIAL CONTRACTING STRATEGY
U.S. EPA CONTRACT No. 68-W8-0089
WORK ASSIGNMENT No. 86-5WE
DOCUMENT CONTROL No. 4500-86-ANWY

SOURCE CHARACTERIZATION
SOIL SAMPLING LOCATIONS
RSQ SITE
Elyria, Ohio

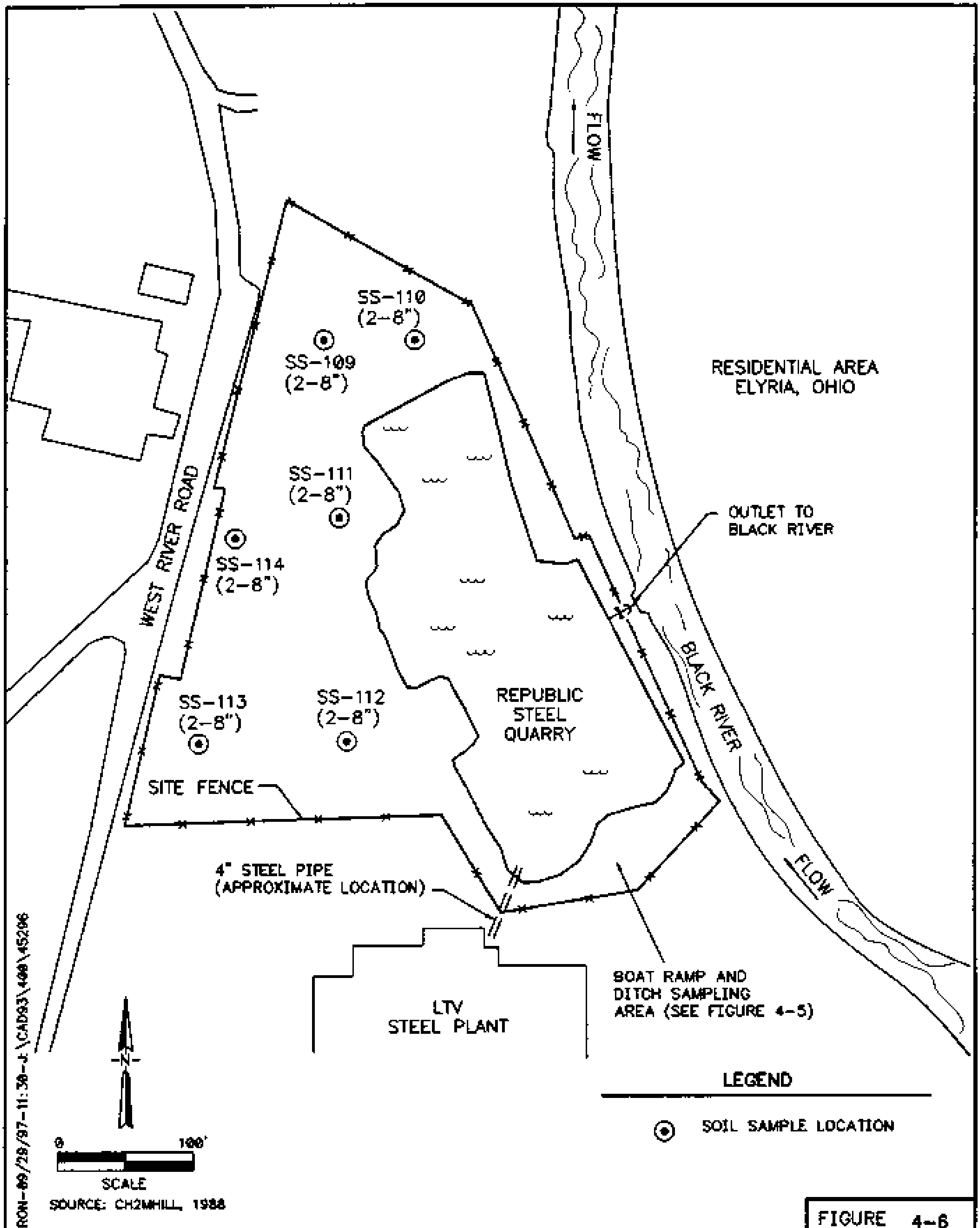


FIGURE 4-6

ALTERNATIVE REMEDIAL CONTRACTING STRATEGY U.S. EPA CONTRACT No. 68-W8-0089 WORK ASSIGNMENT No. 86-5WE DOCUMENT CONTROL No. 4500-86-ANWY	BACKGROUND SOIL SAMPLING LOCATIONS RSQ SITE Elyria, Ohio

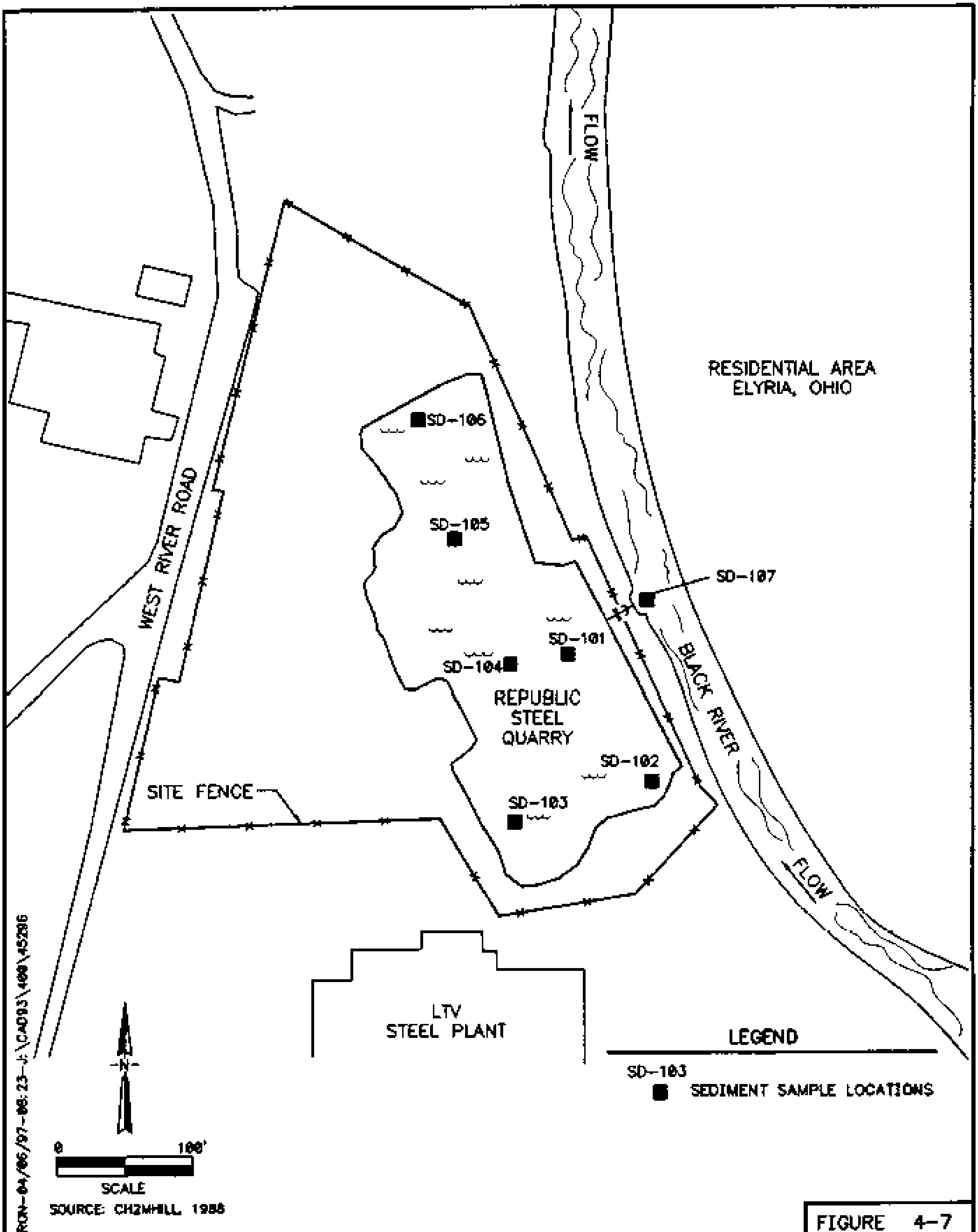
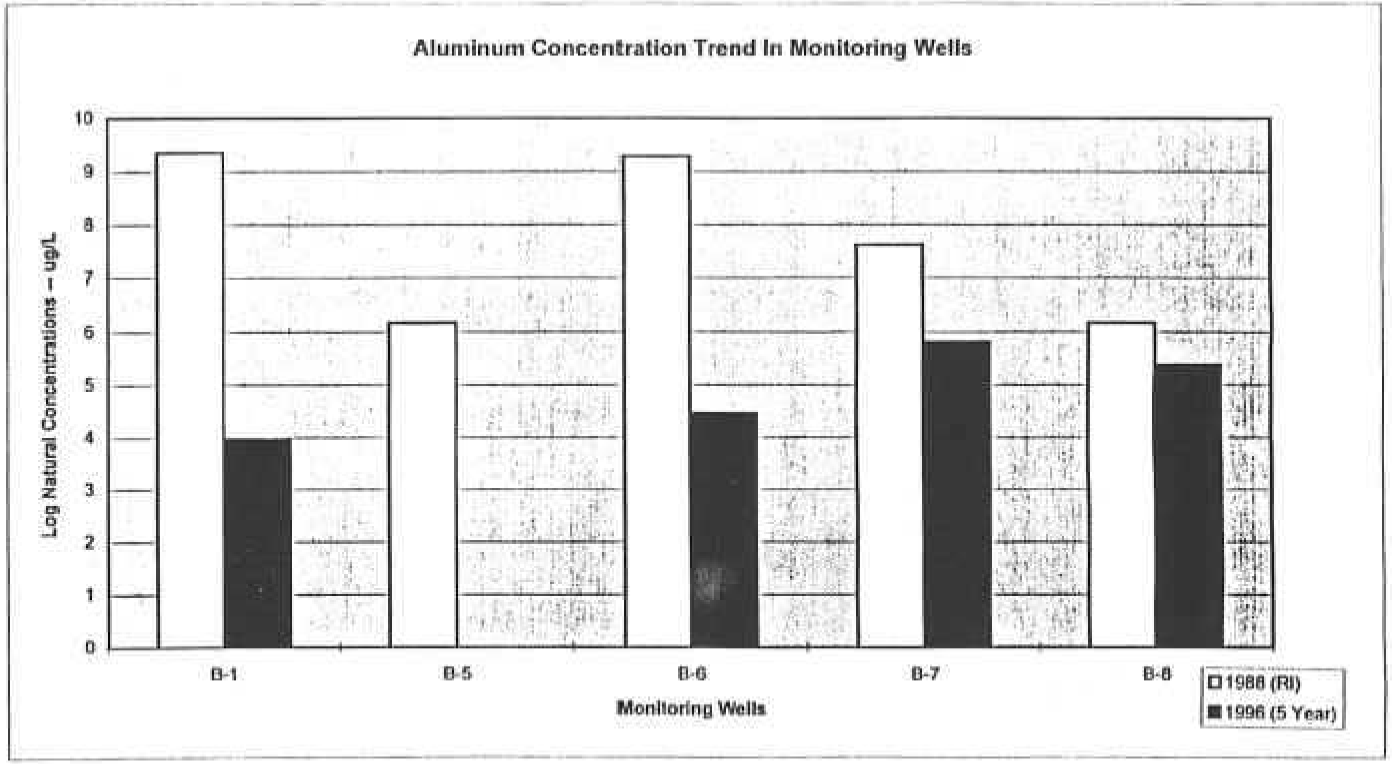


FIGURE 4-7

ALTERNATIVE REMEDIAL CONTRACTING STRATEGY U.S. EPA CONTRACT No. 68-W8-0089 WORK ASSIGNMENT No. 86-5WE DOCUMENT CONTROL No. 4500-86-ANWY	SEDIMENT SAMPLING LOCATIONS RSQ SITE Elyria, Ohio



Aluminum Concentration -- ug/L		
Well	1988 (RI)	1996 (5 Year)
B-1	11600	52.1
B-5	482	0
B-6	10800	85.7
B-7	2030	334
B-8	482	217

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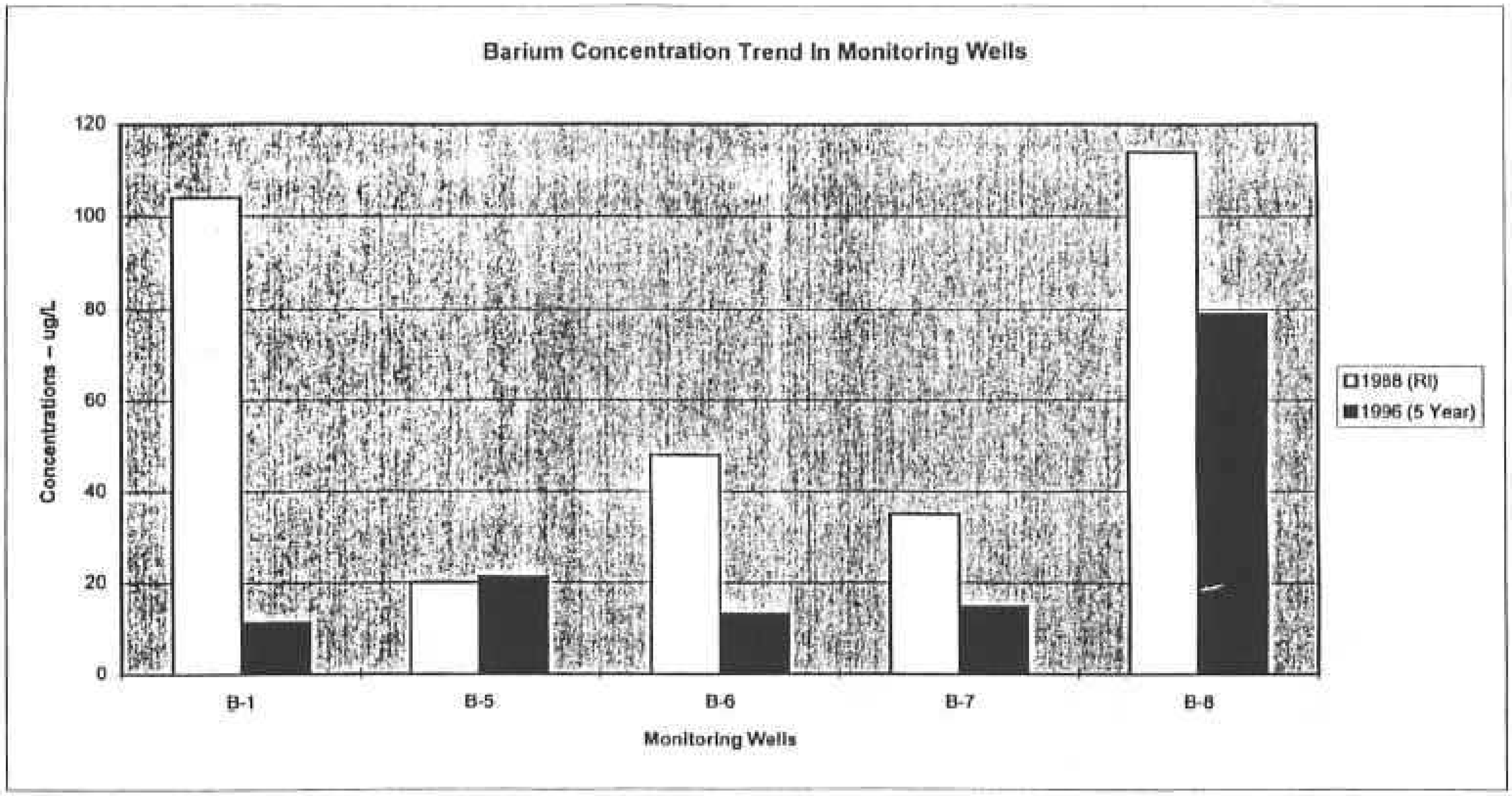
FIGURE 4-8

ALTERNATIVE REMEDIAL CONTRACTING STRATEGY
U.S. EPA CONTRACT No. 68-W8-0089
WORK ASSIGNMENT No. 86-5WE
DOCUMENT CONTROL No. 4500-86-ANWY

TREND FOR GROUNDWATER

RSQ SITE
Elyria, Ohio



Barium Concentration -- ug/L		
Well	1988 (RI)	1996 (5 Year)
B-1	104	11.3
B-5	20	21.1
B-6	48	13.1
B-7	35	14.8
B-8	114	78.9

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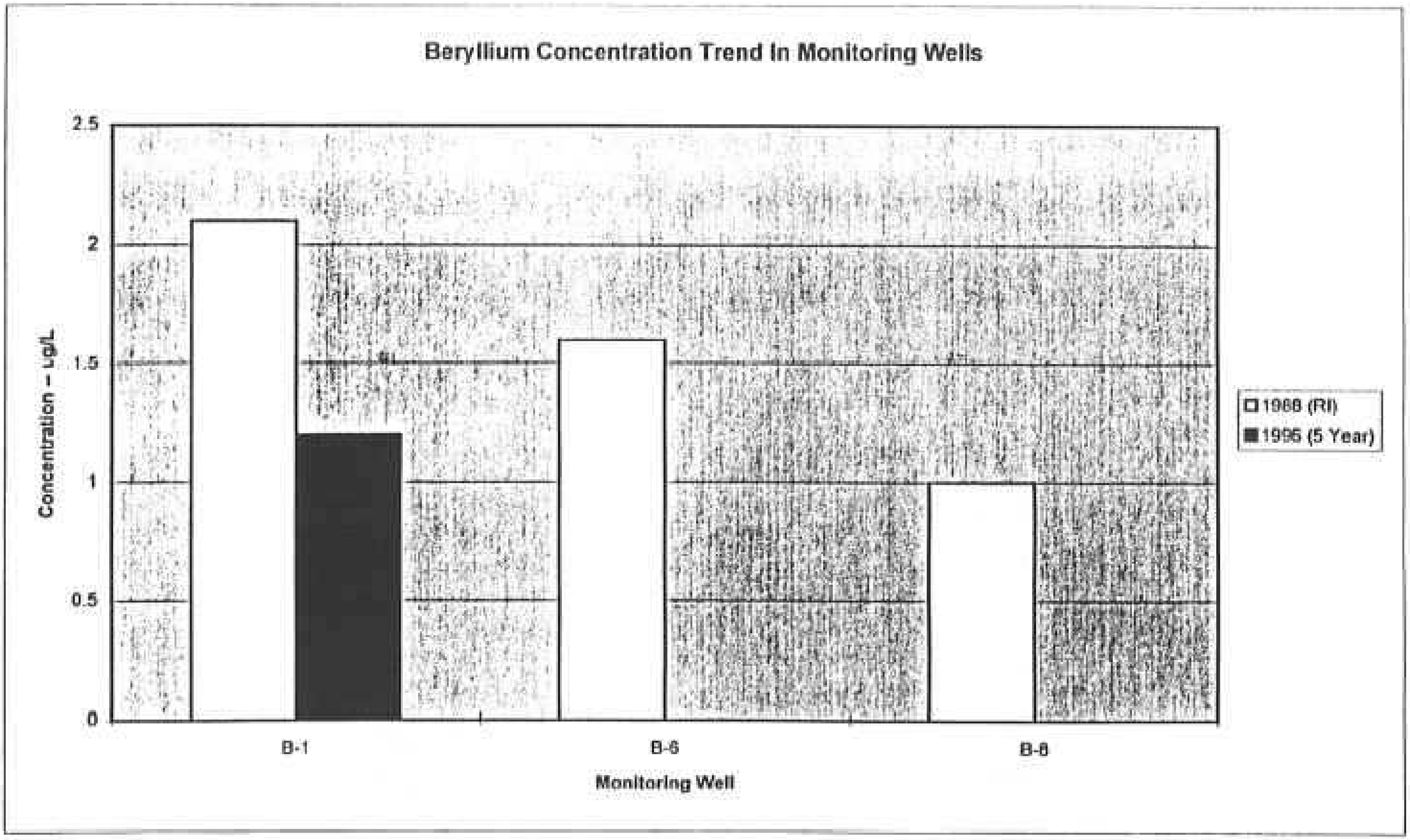
FIGURE 4-8

ALTERNATIVE REMEDIAL CONTRACTING STRATEGY
U.S. EPA CONTRACT No. 68-W8-0089
WORK ASSIGNMENT No. 86-5WE
DOCUMENT CONTROL No. 4500-86-ANWY

TREND FOR GROUNDWATER

RSQ SITE
Elyria, Ohio



Beryllium Concentration -- ug/L		
Well	1988 (RI)	1996 (5 Year)
B-1	2.1	1.2
B-6	1.6	0
B-8	1	0

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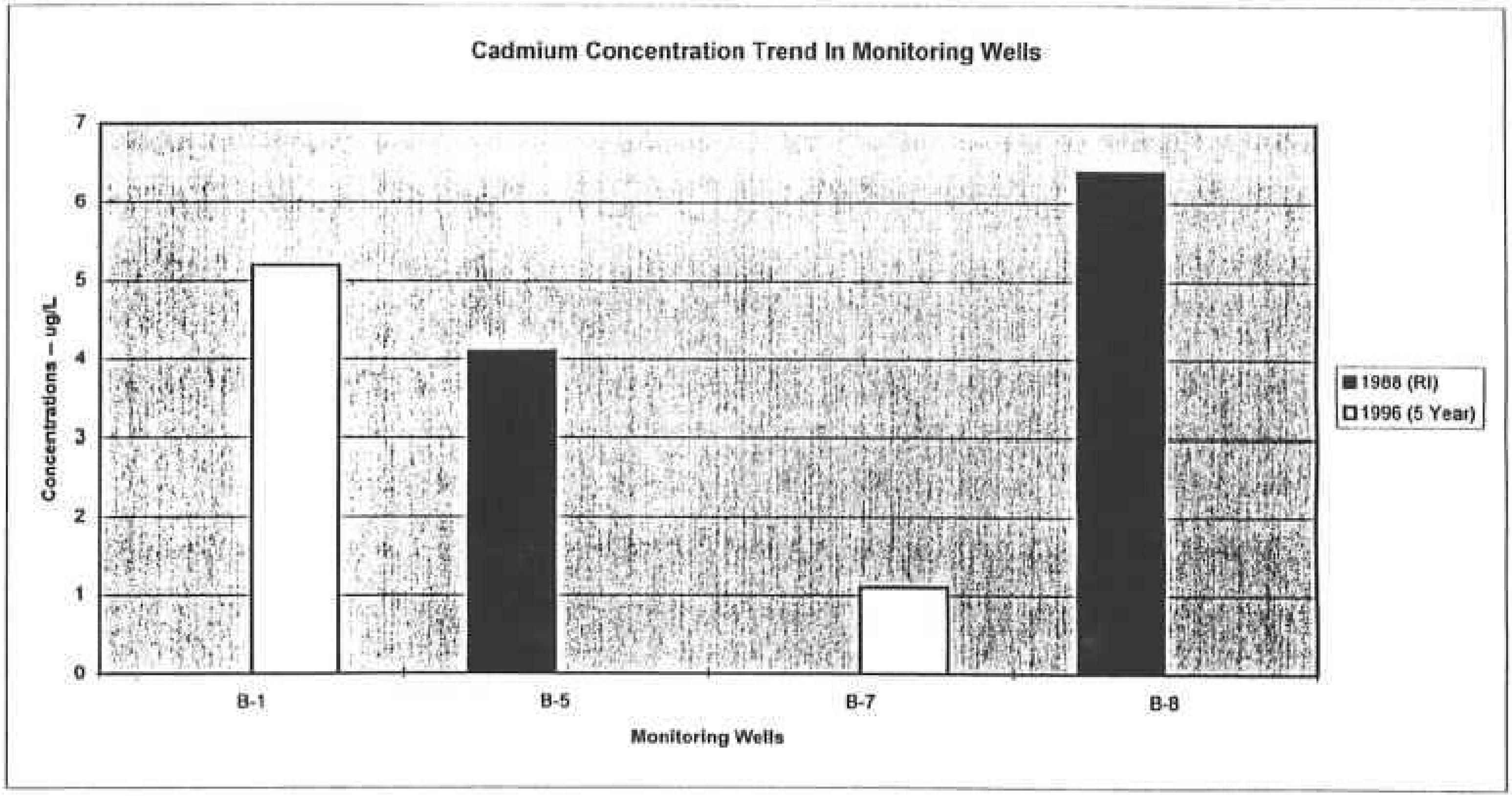
FIGURE 4-8

ALTERNATIVE REMEDIAL CONTRACTING STRATEGY
U.S. EPA CONTRACT No. 68-W8-0089
WORK ASSIGNMENT No. 86-5WE
DOCUMENT CONTROL No. 4500-86-ANWY

TREND FOR GROUNDWATER

RSQ SITE
Elyria, Ohio



Cadmium Concentration -- ug/L		
Well	1988 (RI)	1996 (5 Year)
B-1	0	5.2
B-5	4.1	0
B-7	0	1.1
B-8	6.4	0

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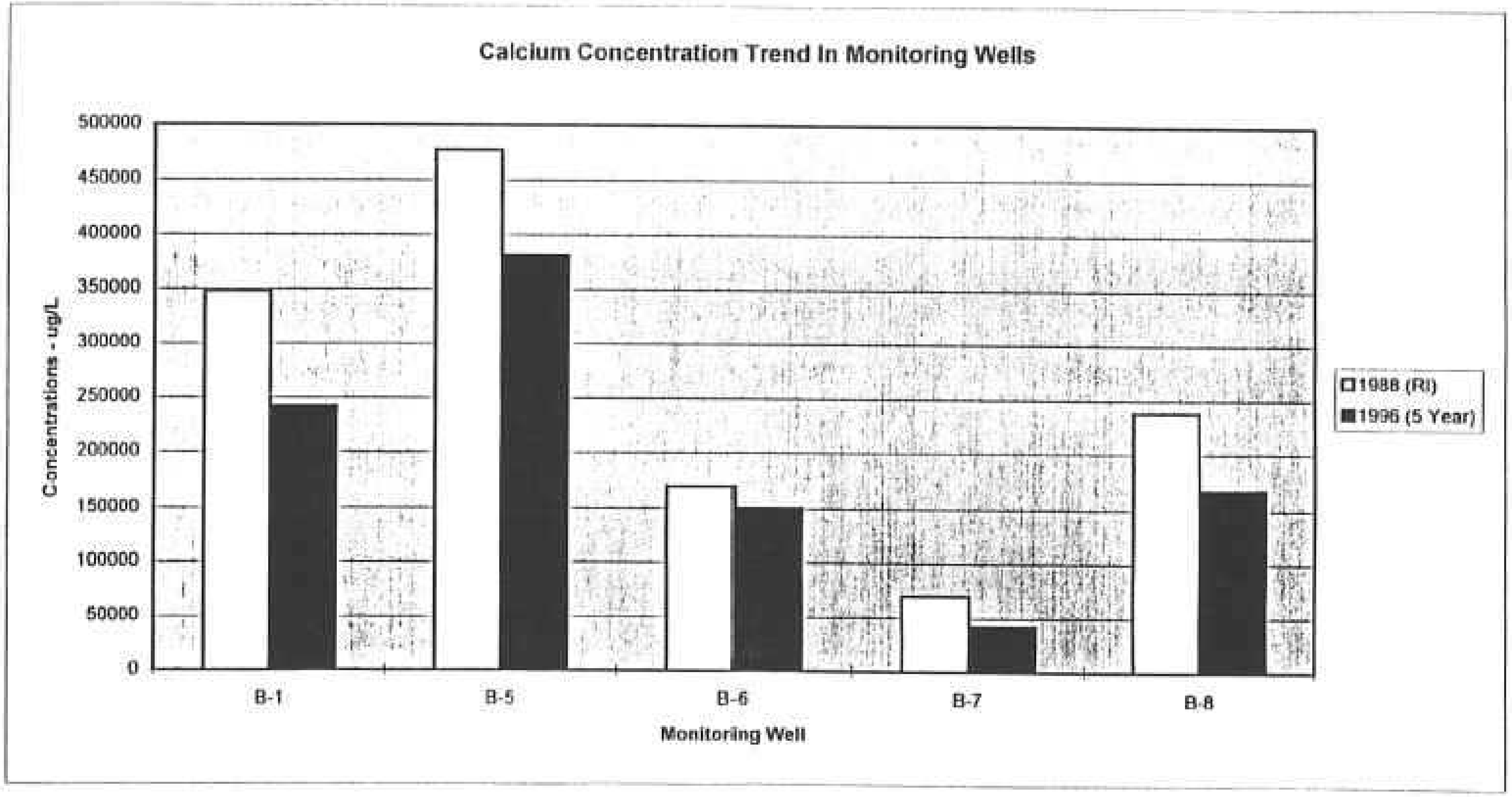
FIGURE 4-8

ALTERNATIVE REMEDIAL CONTRACTING STRATEGY
U.S. EPA CONTRACT No. 68-W8-0089
WORK ASSIGNMENT No. 86-5WE
DOCUMENT CONTROL No. 4500-86-ANWY

TREND FOR GROUNDWATER

RSQ SITE
Elyria, Ohio



Calcium Concentration -- ug/L		
Well	1988 (RI)	1996 (5 Year)
B-1	348000	242000
B-5	477000	381000
B-6	170000	150000
B-7	69700	42200
B-8	238000	168000

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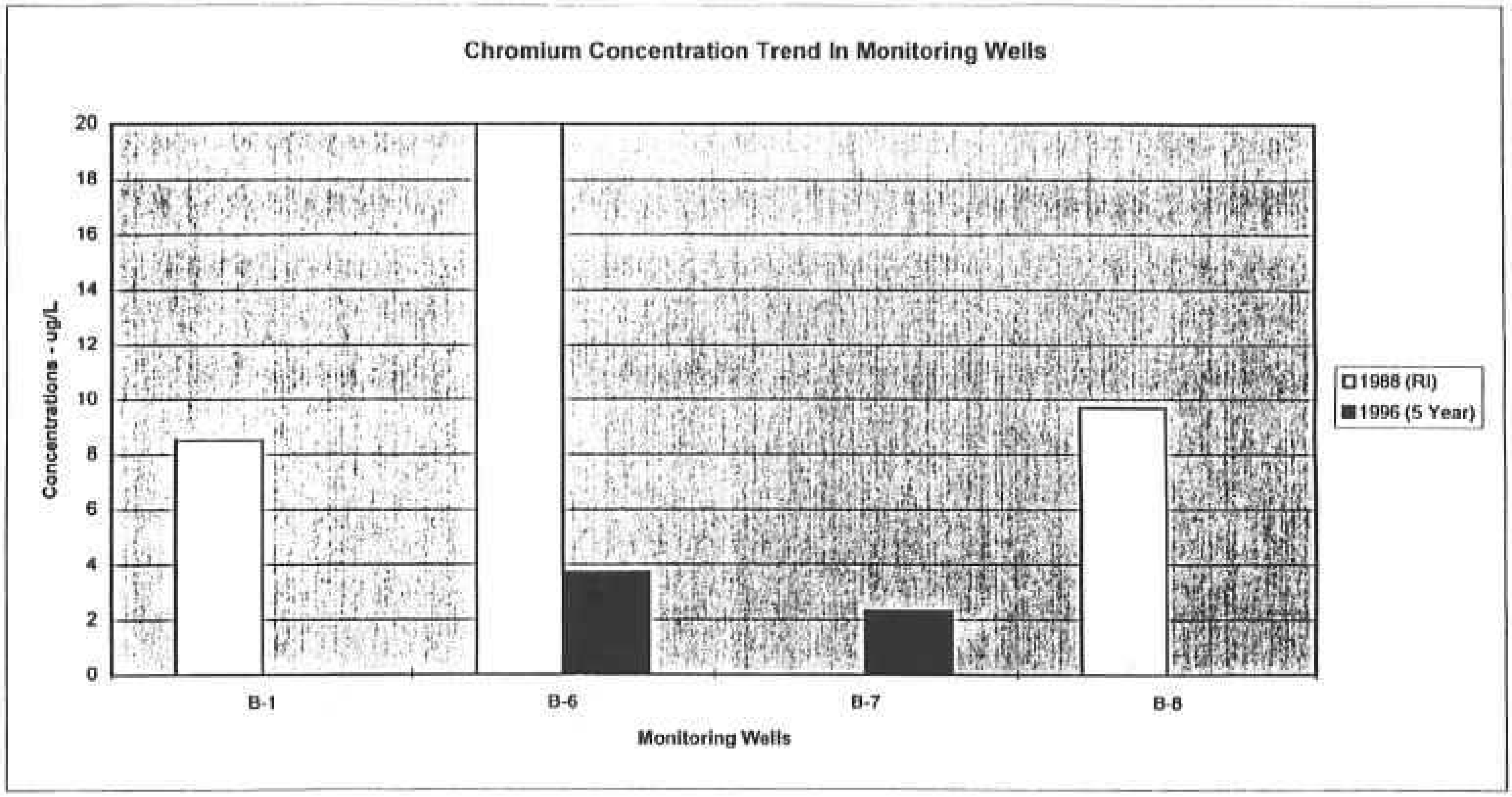
FIGURE 4-8

ALTERNATIVE REMEDIAL CONTRACTING STRATEGY
U.S. EPA CONTRACT No. 68-W8-0089
WORK ASSIGNMENT No. 86-5WE
DOCUMENT CONTROL No. 4500-86-ANWY

TREND FOR GROUNDWATER

RSQ SITE
Elyria, Ohio



Chromium Concentration -- ug/L		
Well	1988 (RI)	1996 (5 Year)
B-1	8.5	0
B-6	20	3.7
B-7	0	2.3
B-8	9.7	0

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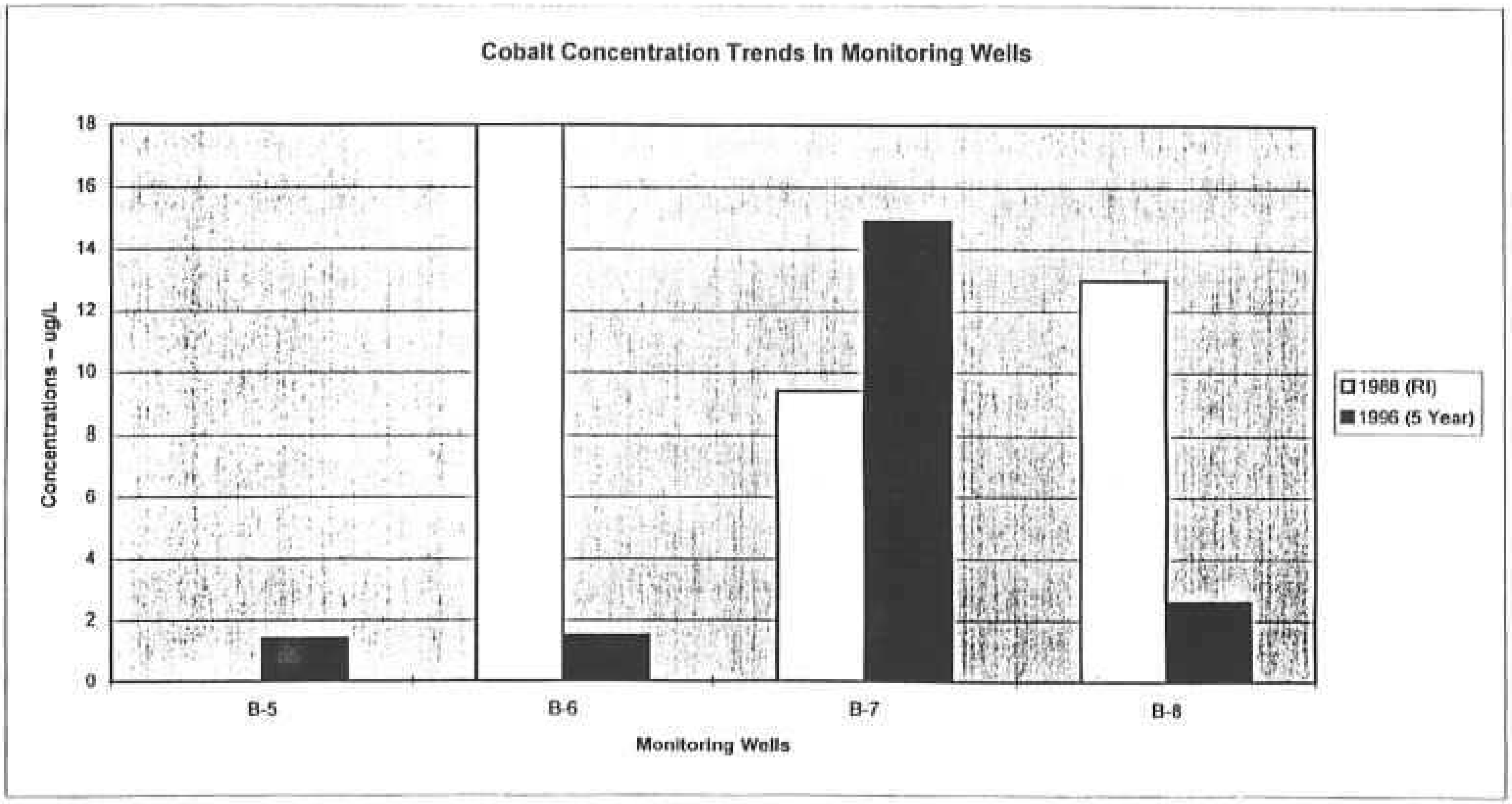
FIGURE 4-8

ALTERNATIVE REMEDIAL CONTRACTING STRATEGY
U.S. EPA CONTRACT No. 68-W8-0089
WORK ASSIGNMENT No. 86-5WE
DOCUMENT CONTROL No. 4500-86-ANWY

TREND FOR GROUNDWATER

RSQ SITE
Elyria, Ohio



Cobalt Concentration -- ug/L		
Well	1988 (RI)	1996 (5 Year)
B-5	0	1.4
B-6	18	1.5
B-7	9.4	14.9
B-8	13	2.6

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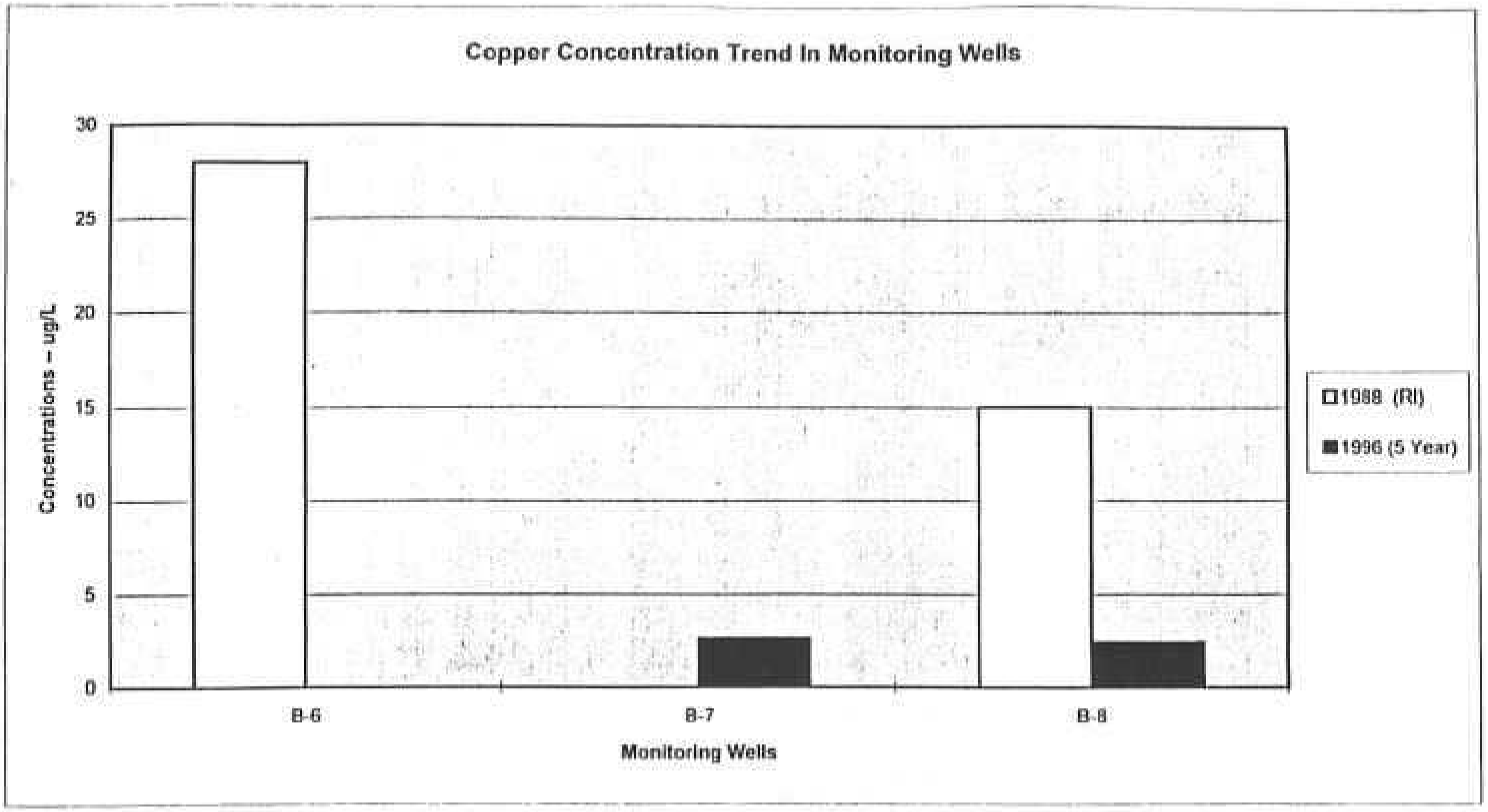
FIGURE 4-8

ALTERNATIVE REMEDIAL CONTRACTING STRATEGY
U.S. EPA CONTRACT No. 68-W8-0089
WORK ASSIGNMENT No. 86-5WE
DOCUMENT CONTROL No. 4500-86-ANWY

TREND FOR GROUNDWATER

RSQ SITE
Elyria, Ohio



Copper Concentration -- ug/L		
Well	1988 (RI)	1996 (5 Year)
B-6	28	0
B-7	0	2.6
B-8	15	2.4

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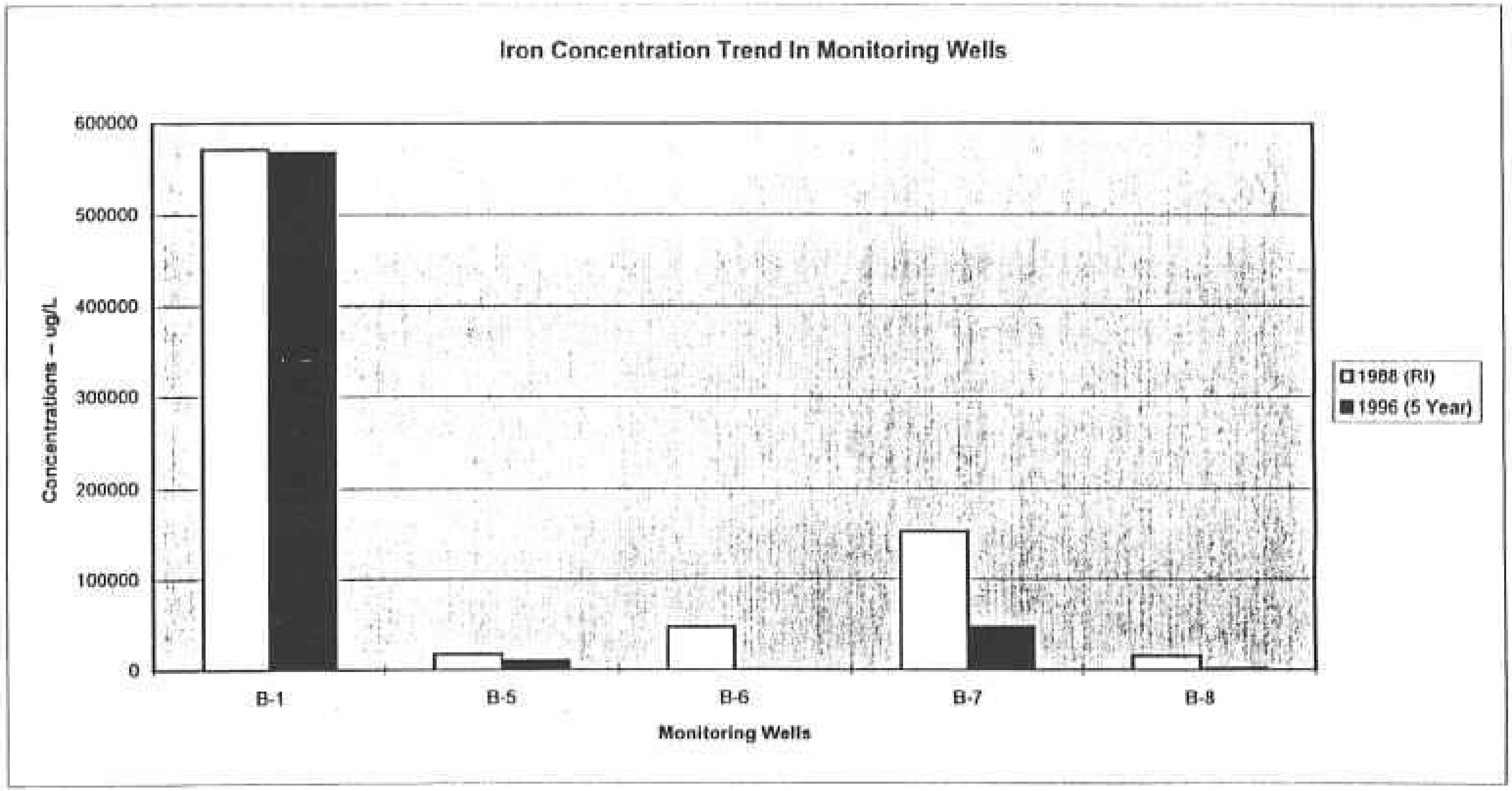
FIGURE 4-8

ALTERNATIVE REMEDIAL CONTRACTING STRATEGY
U.S. EPA CONTRACT No. 68-W8-0089
WORK ASSIGNMENT No. 86-5WE
DOCUMENT CONTROL No. 4500-86-ANWY

TREND FOR GROUNDWATER

RSQ SITE
Elyria, Ohio



Iron Concentration -- ug/L		
Well	1988 (RI)	1996 (5 Year)
B-1	571000	568000
B-5	17400	10000
B-6	46900	434
B-7	153000	47000
B-8	15500	2170

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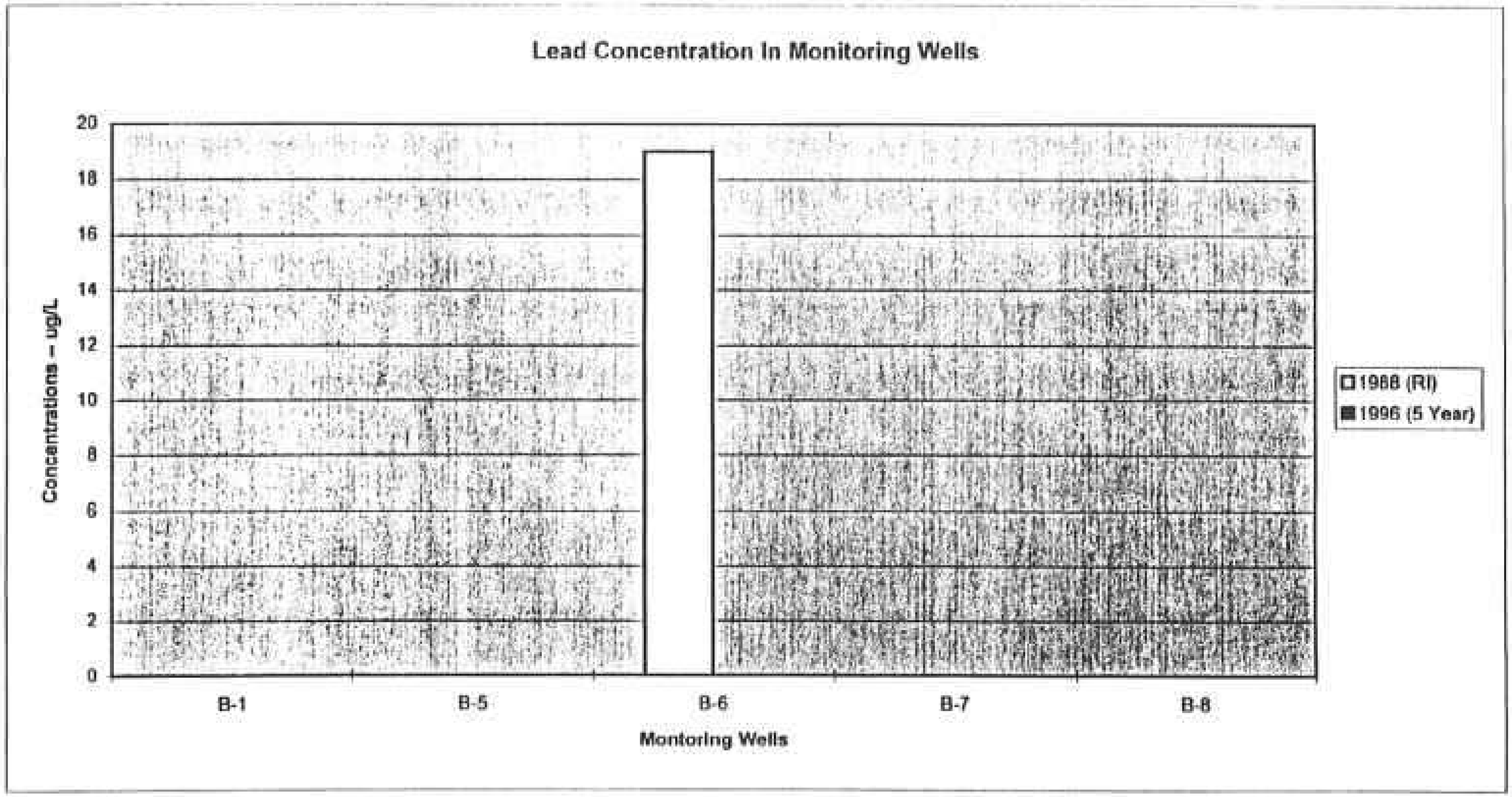
FIGURE 4-8

ALTERNATIVE REMEDIAL CONTRACTING STRATEGY
U.S. EPA CONTRACT No. 68-W8-0089
WORK ASSIGNMENT No. 86-5WE
DOCUMENT CONTROL No. 4500-86-ANWY

TREND FOR GROUNDWATER

RSQ SITE
Elyria, Ohio



Lead Concentration -- ug/L		
Well	1988 (RI)	1996 (5 Year)
B-1	0	0
B-5	0	0
B-6	19	0
B-7	0	0
B-8	0	0

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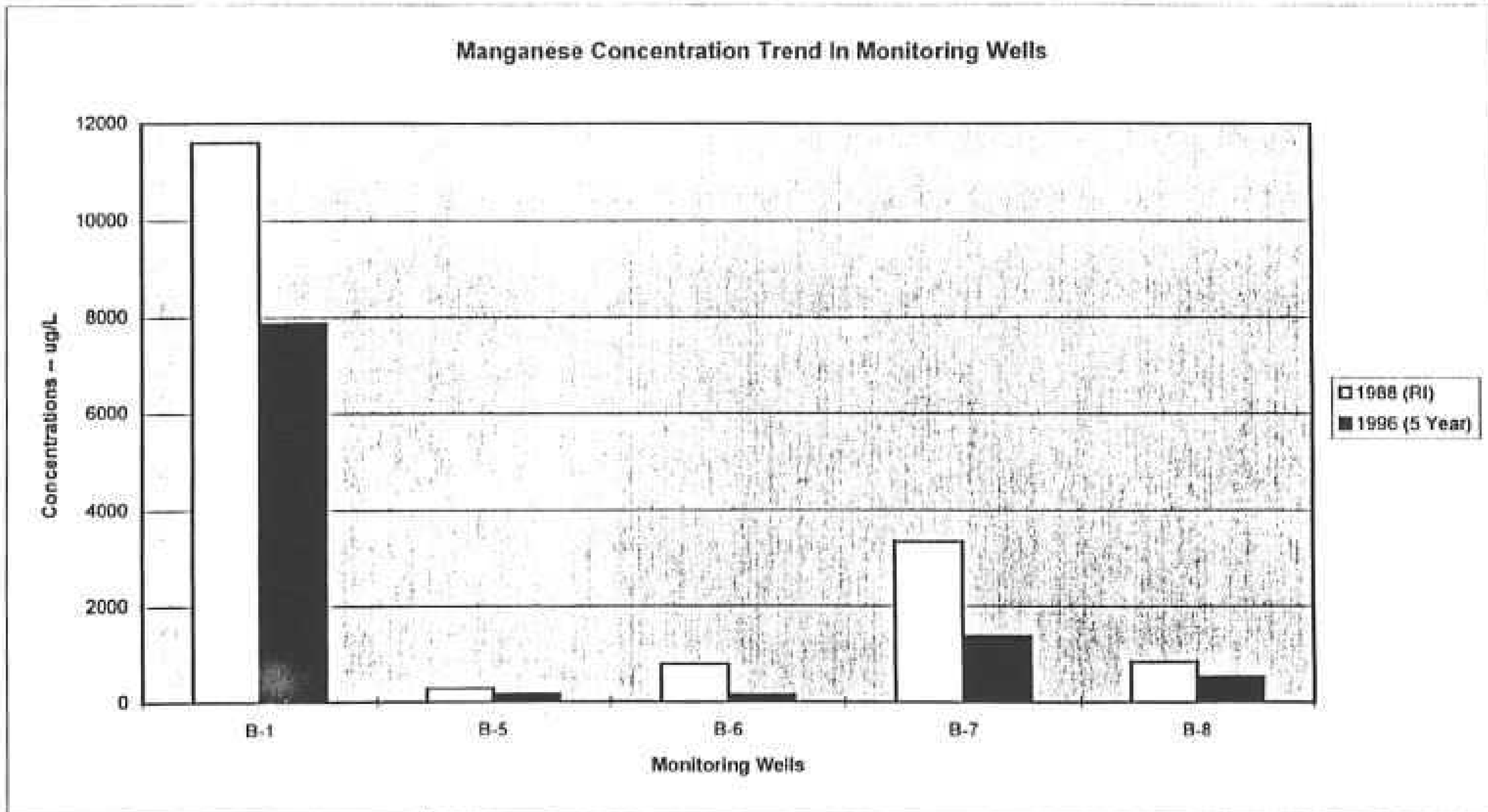
FIGURE 4-8

ALTERNATIVE REMEDIAL CONTRACTING STRATEGY
U.S. EPA CONTRACT No. 68-W8-0089
WORK ASSIGNMENT No. 86-5WE
DOCUMENT CONTROL No. 4500-86-ANWY

TREND FOR GROUNDWATER

RSQ SITE
Elyria, Ohio



Manganese Concentration -- ug/L		
Well	1988 (RI)	1996 (5 Year)
B-1	11600	7870
B-5	286	157
B-6	799	137
B-7	3340	1380
B-8	842	524

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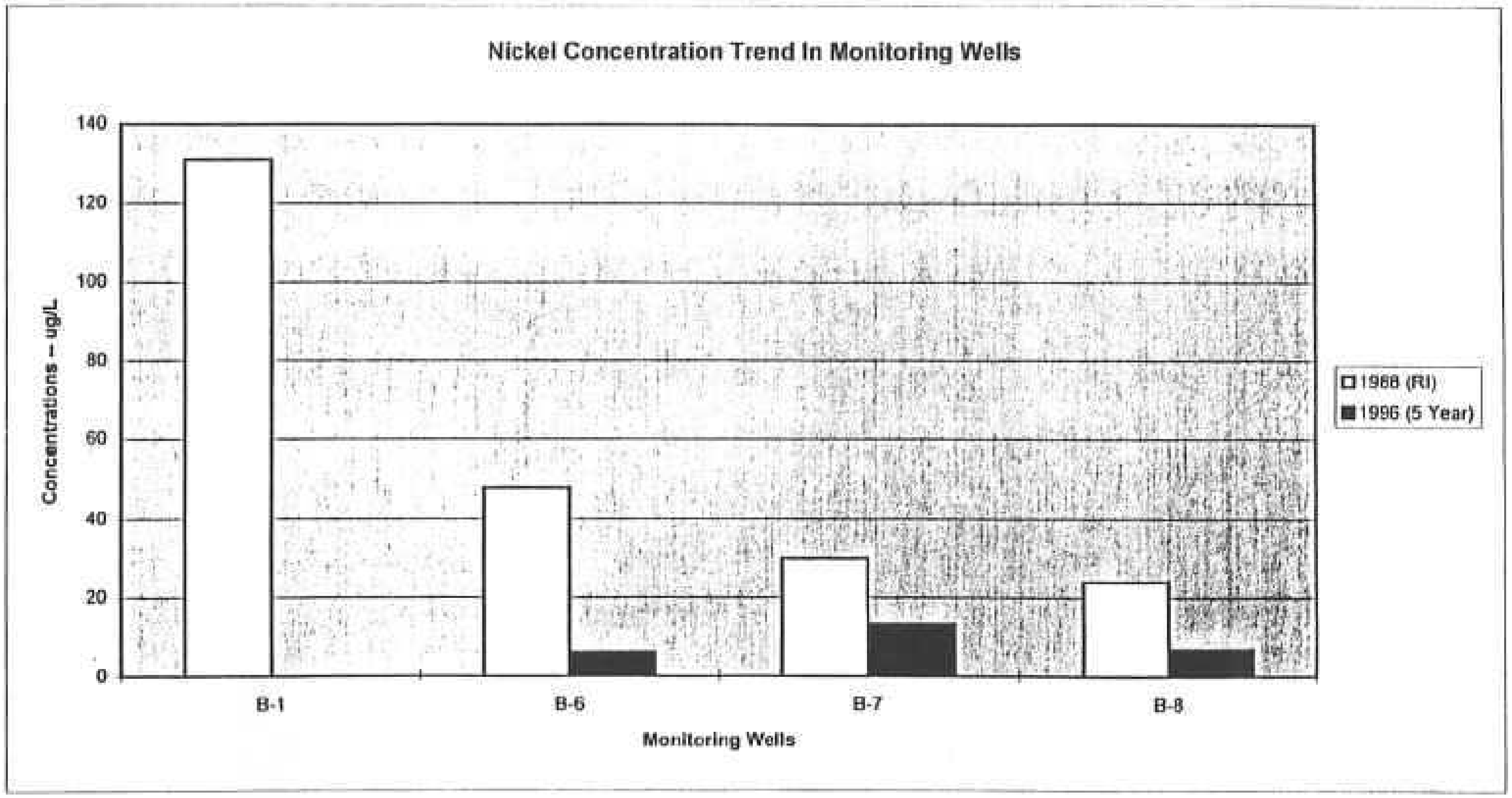
FIGURE 4-8

ALTERNATIVE REMEDIAL CONTRACTING STRATEGY
U.S. EPA CONTRACT No. 68-W8-0089
WORK ASSIGNMENT No. 86-5WE
DOCUMENT CONTROL No. 4500-86-ANWY

TREND FOR GROUNDWATER

RSQ SITE
Elyria, Ohio



Nickel Concentration -- ug/L		
Well	1988 (RI)	1996 (5 Year)
B-1	131	0
B-6	48	6.2
B-7	30	13.4
B-8	24	7

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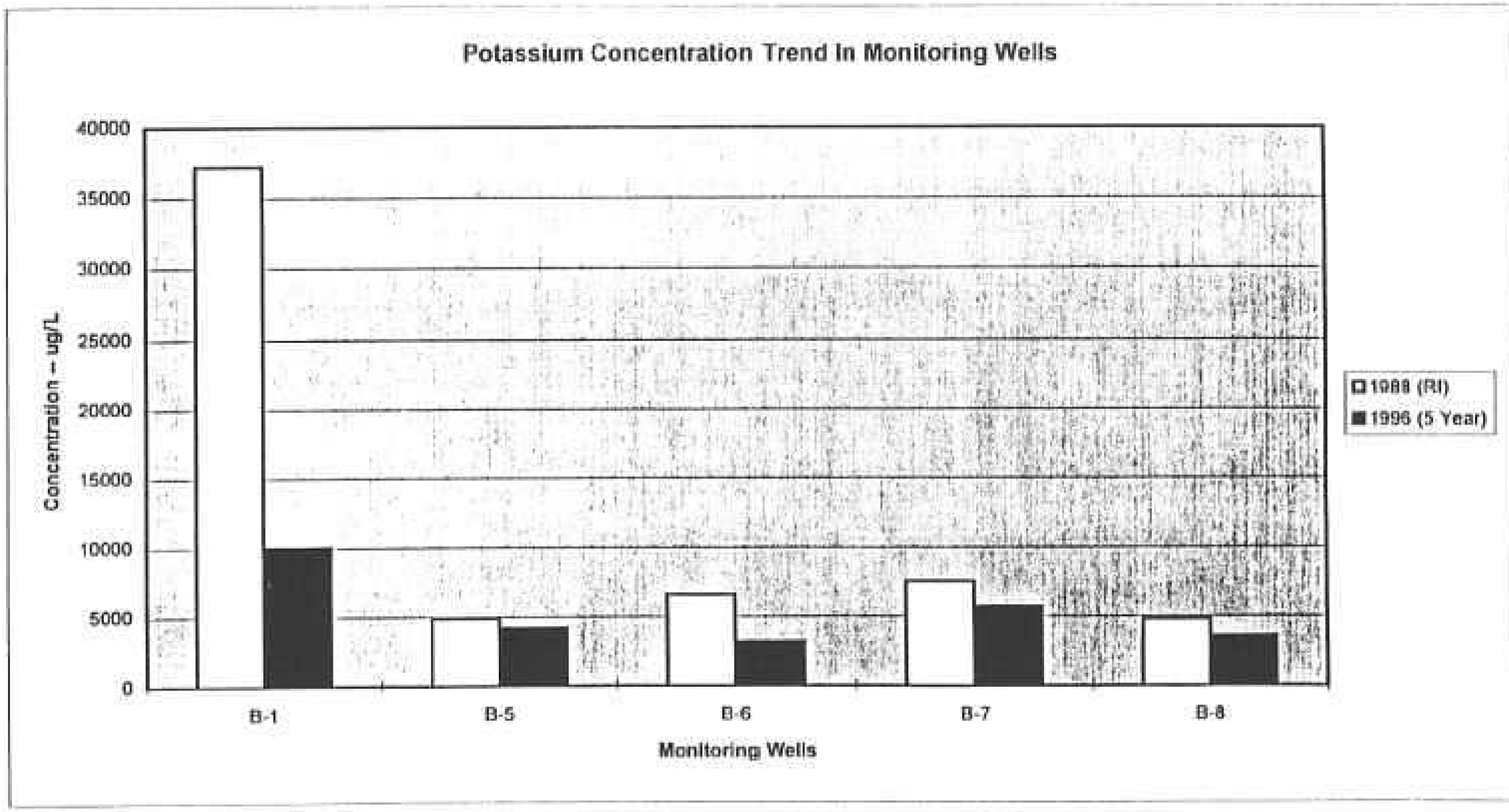
FIGURE 4-8

ALTERNATIVE REMEDIAL CONTRACTING STRATEGY
U.S. EPA CONTRACT No. 68-W8-0089
WORK ASSIGNMENT No. 86-5WE
DOCUMENT CONTROL No. 4500-86-ANWY

TREND FOR GROUNDWATER

RSQ SITE
Elyria, Ohio



Pottassium Concentration -- ug/L		
Well	1988 (RI)	1996 (5 Year)
B-1	37200	10000
B-5	4850	4130
B-6	6580	3190
B-7	7480	5650
B-8	4790	3530

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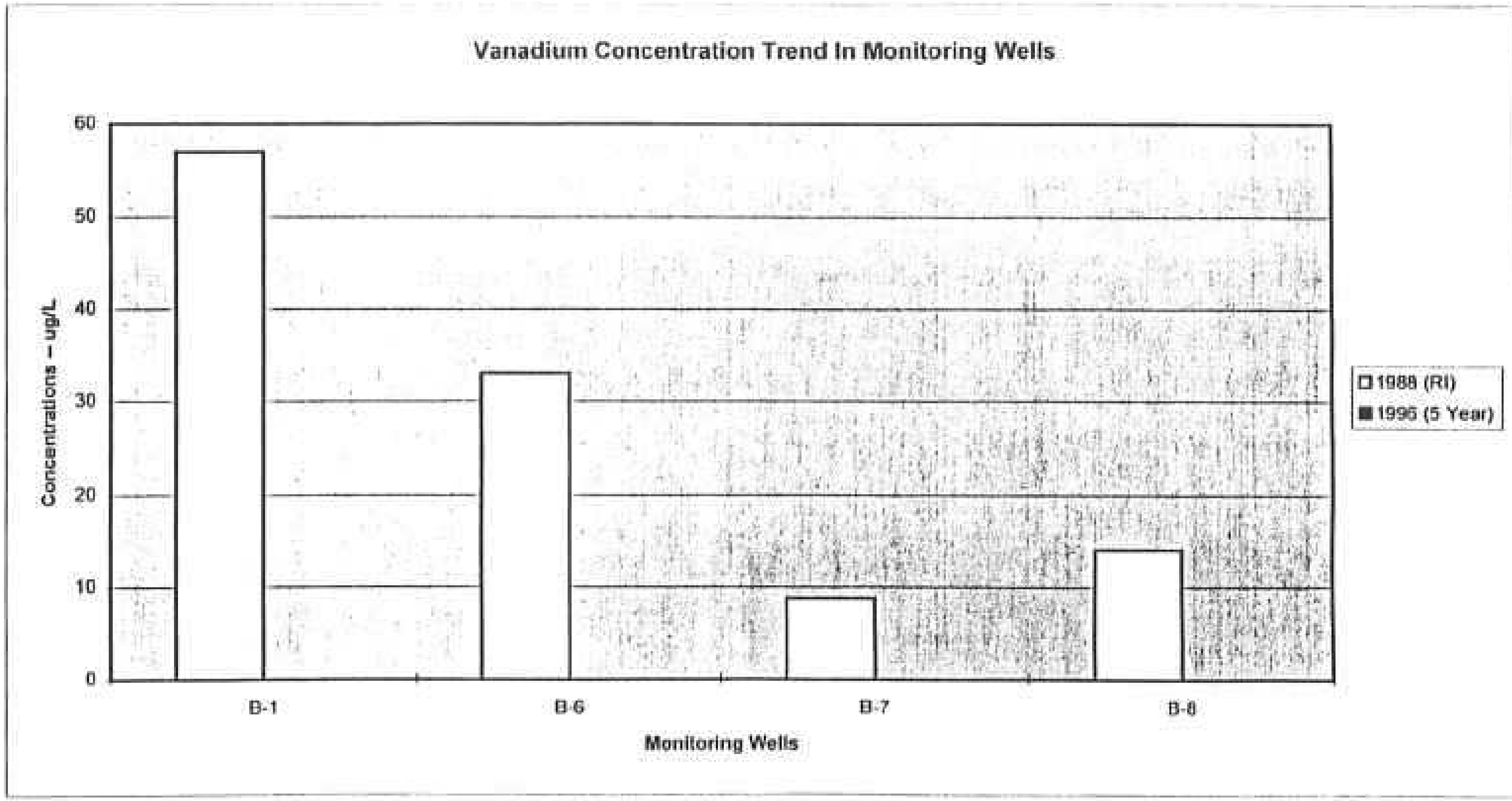
FIGURE 4-8

ALTERNATIVE REMEDIAL CONTRACTING STRATEGY
U.S. EPA CONTRACT No. 68-W8-0089
WORK ASSIGNMENT No. 86-5WE
DOCUMENT CONTROL No. 4500-86-ANWY

TREND FOR GROUNDWATER

RSQ SITE
Elyria, Ohio



Vanadium Concentration -- ug/L		
Well	1988 (RI)	1996 (5 Year)
B-1	57	0
B-6	33	0
B-7	8.7	0
B-8	14	0

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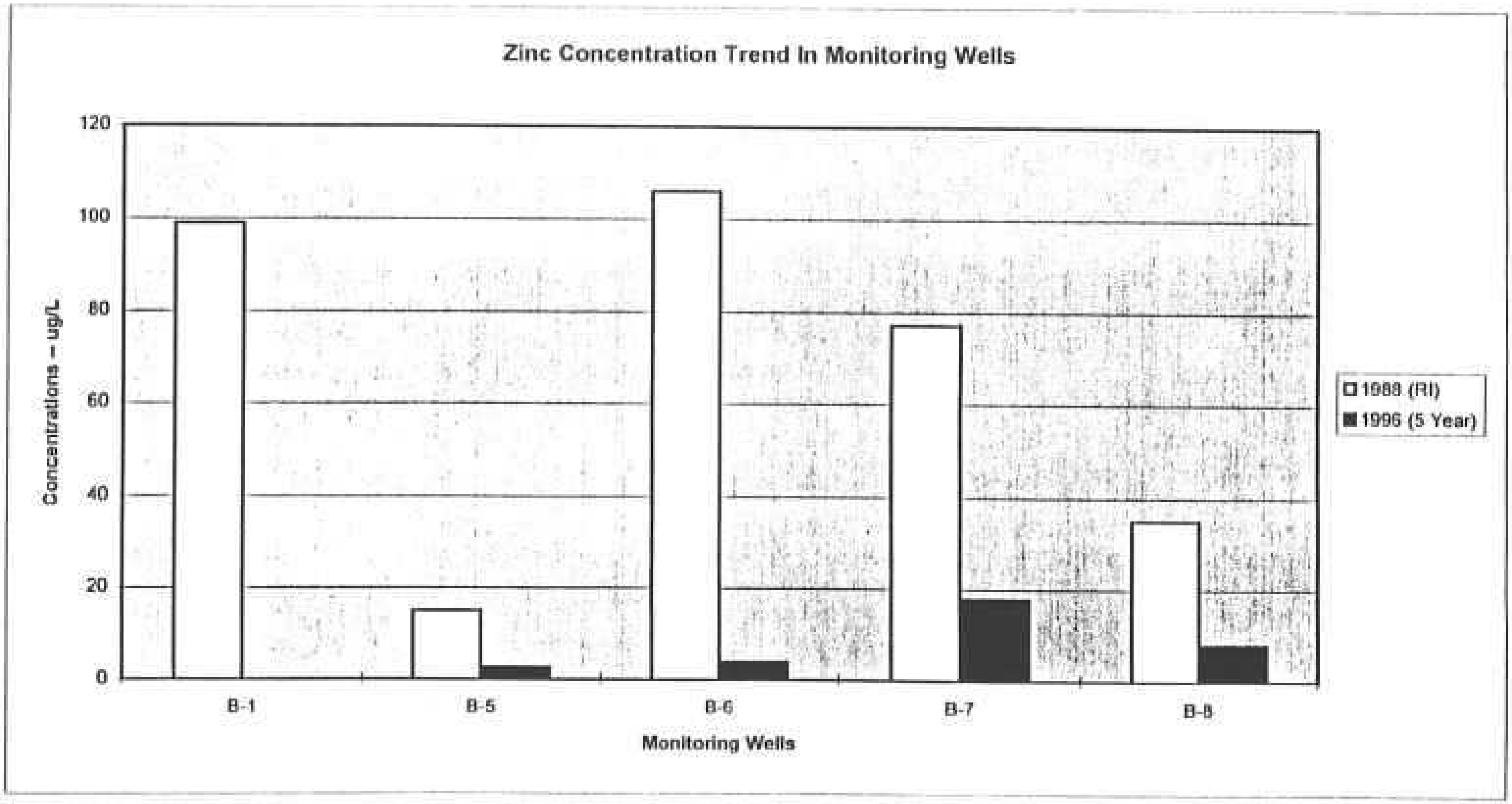
FIGURE 4-8

ALTERNATIVE REMEDIAL CONTRACTING STRATEGY
U.S. EPA CONTRACT No. 68-W8-0089
WORK ASSIGNMENT No. 86-5WE
DOCUMENT CONTROL No. 4500-86-ANWY

TREND FOR GROUNDWATER

RSQ SITE
Elyria, Ohio



Zinc Concentration -- ug/L		
Well	1988 (RI)	1996 (5 Year)
B-1	99	0
B-5	15	2.5
B-6	106	3.9
B-7	77	17.7
B-8	35	7.9

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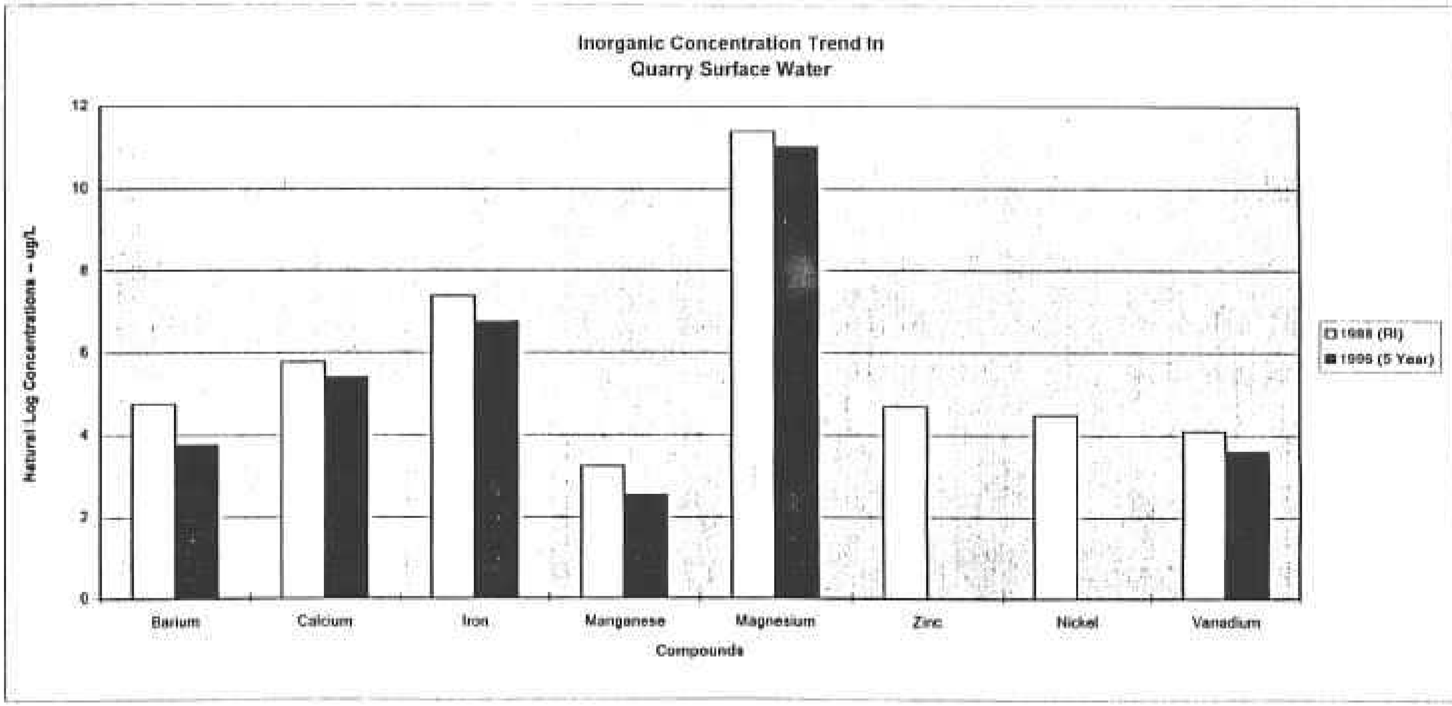
FIGURE 4-8

ALTERNATIVE REMEDIAL CONTRACTING STRATEGY
U.S. EPA CONTRACT No. 68-W8-0089
WORK ASSIGNMENT No. 86-5WE
DOCUMENT CONTROL No. 4500-86-ANWY

TREND FOR GROUNDWATER

RSQ SITE
Elyria, Ohio



Parameter ug/L	1988 (RI)	1996 (5 Year)
Barium	113	43.4
Calcium	315	220
Iron	1600	847
Manganese	25.7	12.8
Magnesium	88900	61700
Zinc	106	0
Nickel	86	0
Vanadium	60	37.5

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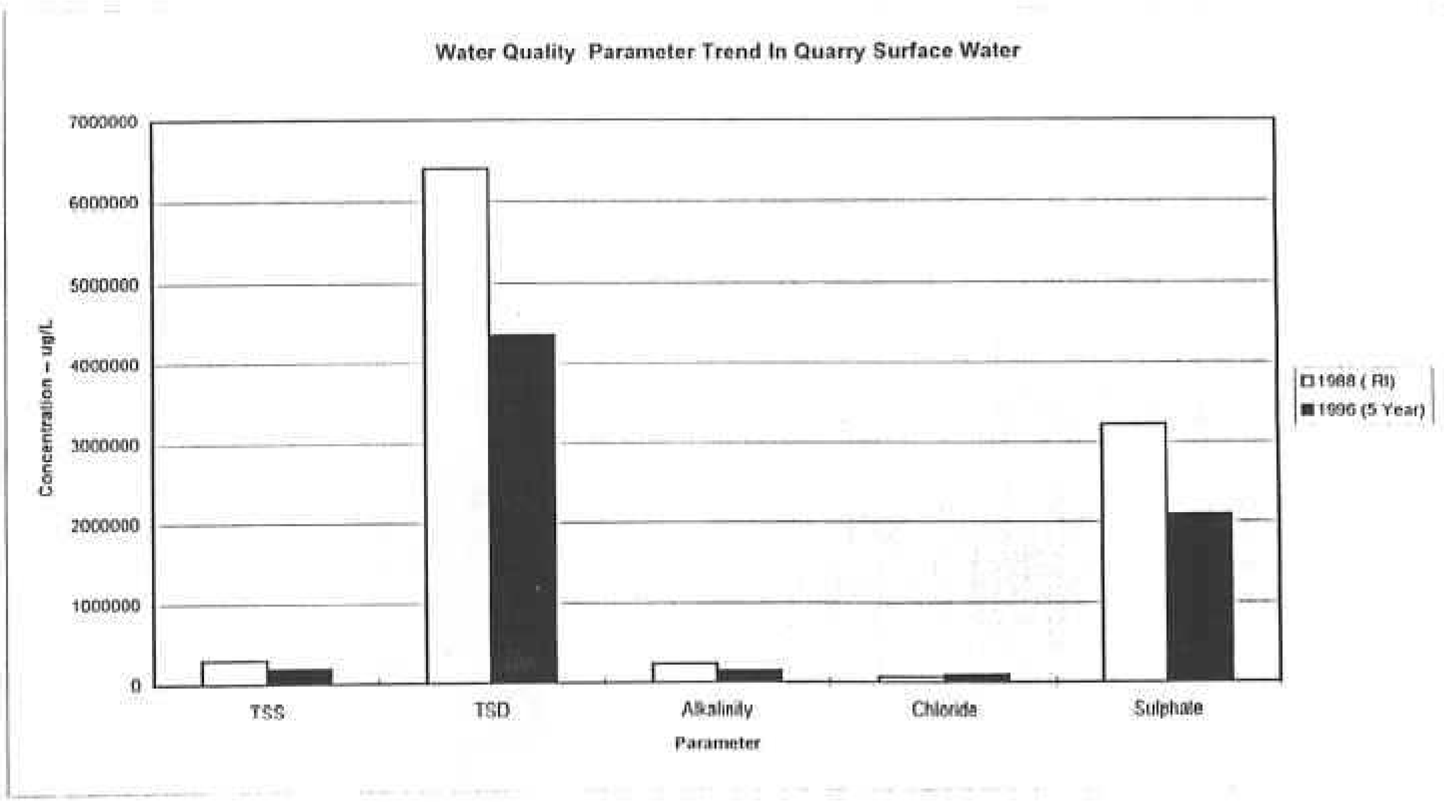
FIGURE 4-9

ALTERNATIVE REMEDIAL CONTRACTING STRATEGY
U.S. EPA CONTRACT No. 68-W8-0089
WORK ASSIGNMENT No. 86-5WE
DOCUMENT CONTROL No. 4500-86-ANWY

TREND FOR
SURFACEWATER IN THE QUARRY
RSQ SITE
Elyria, Ohio



Parameter ug/L	1988 (RI)	1996 (5 Year)
TSS	296000	192000
TSD	6400000	4350000
Alkalinity	235000	147000
Chloride	64000	85000
Sulphate	3220000	2090000

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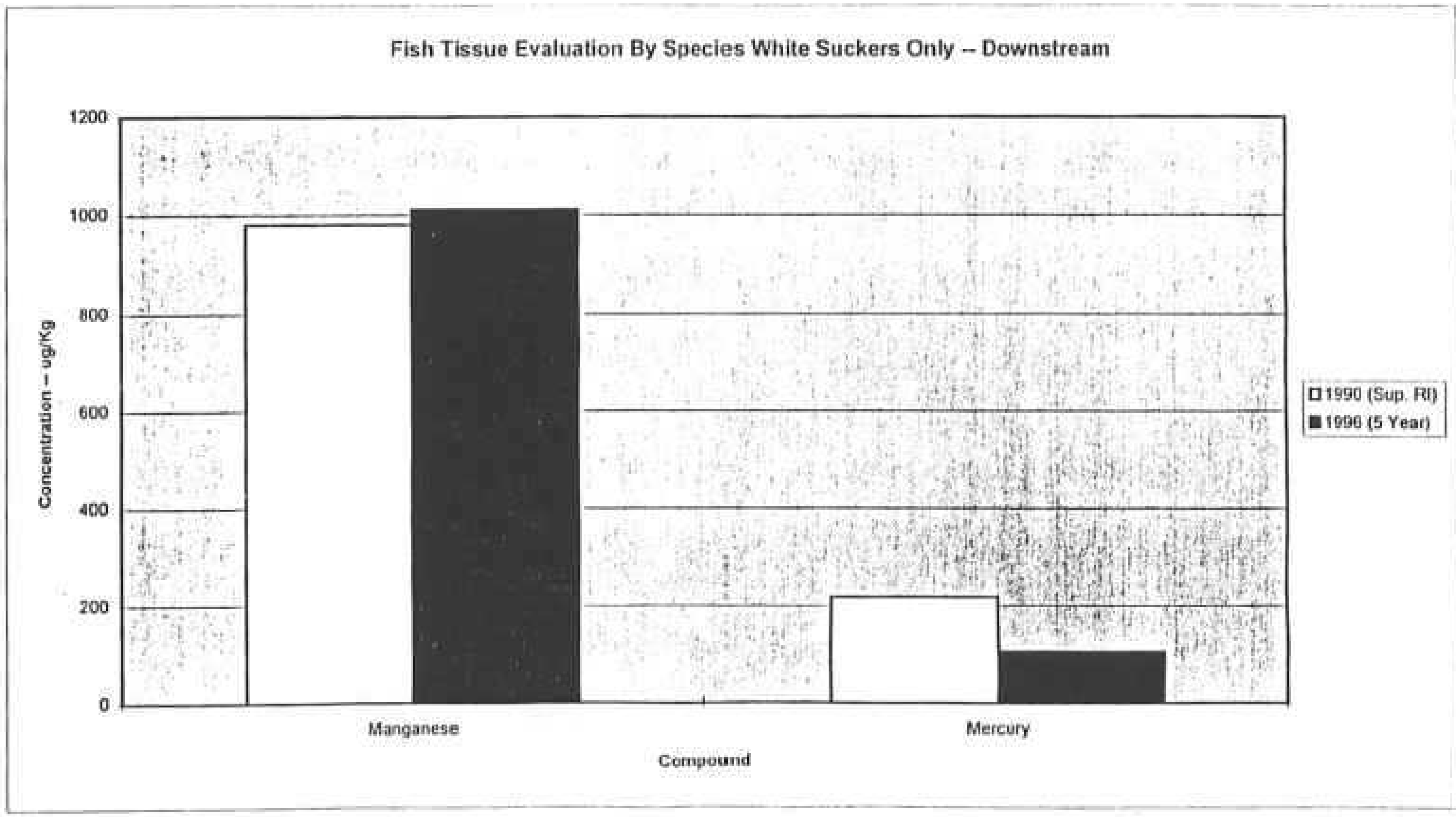
FIGURE 4-9

ALTERNATIVE REMEDIAL CONTRACTING STRATEGY
U.S. EPA CONTRACT No. 68-W8-0089
WORK ASSIGNMENT No. 86-5WE
DOCUMENT CONTROL No. 4500-86-ANWY

TREND FOR
SURFACEWATER IN THE QUARRY
RSQ SITE
Elyria, Ohio



Compound ug/Kg	1990 (Sup. RI)	1996 (5 Year)
Manganese	980	1011
Mercury	217	105.25

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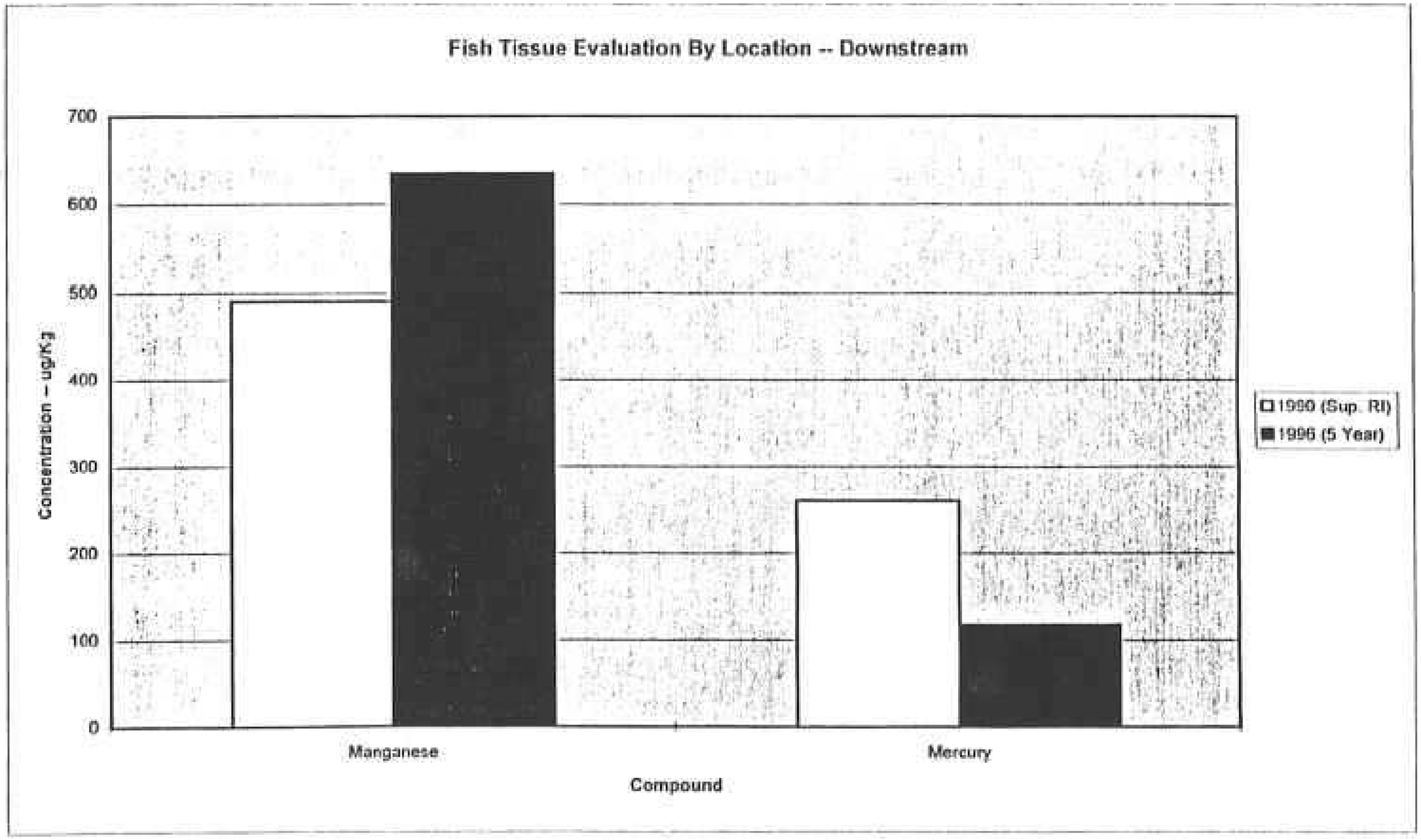
FIGURE 4-10

ALTERNATIVE REMEDIAL CONTRACTING STRATEGY
U.S. EPA CONTRACT No. 68-W8-0089
WORK ASSIGNMENT No. 86-5WE
DOCUMENT CONTROL No. 4500-86-ANWY

TREND FOR
FISH TISSUE
RSQ SITE
Elyria, Ohio



Compound ug/Kg	1990 (Sup. RI)	1996 (5 Year)
Manganese	490	634.6
Mercury	260	117.7

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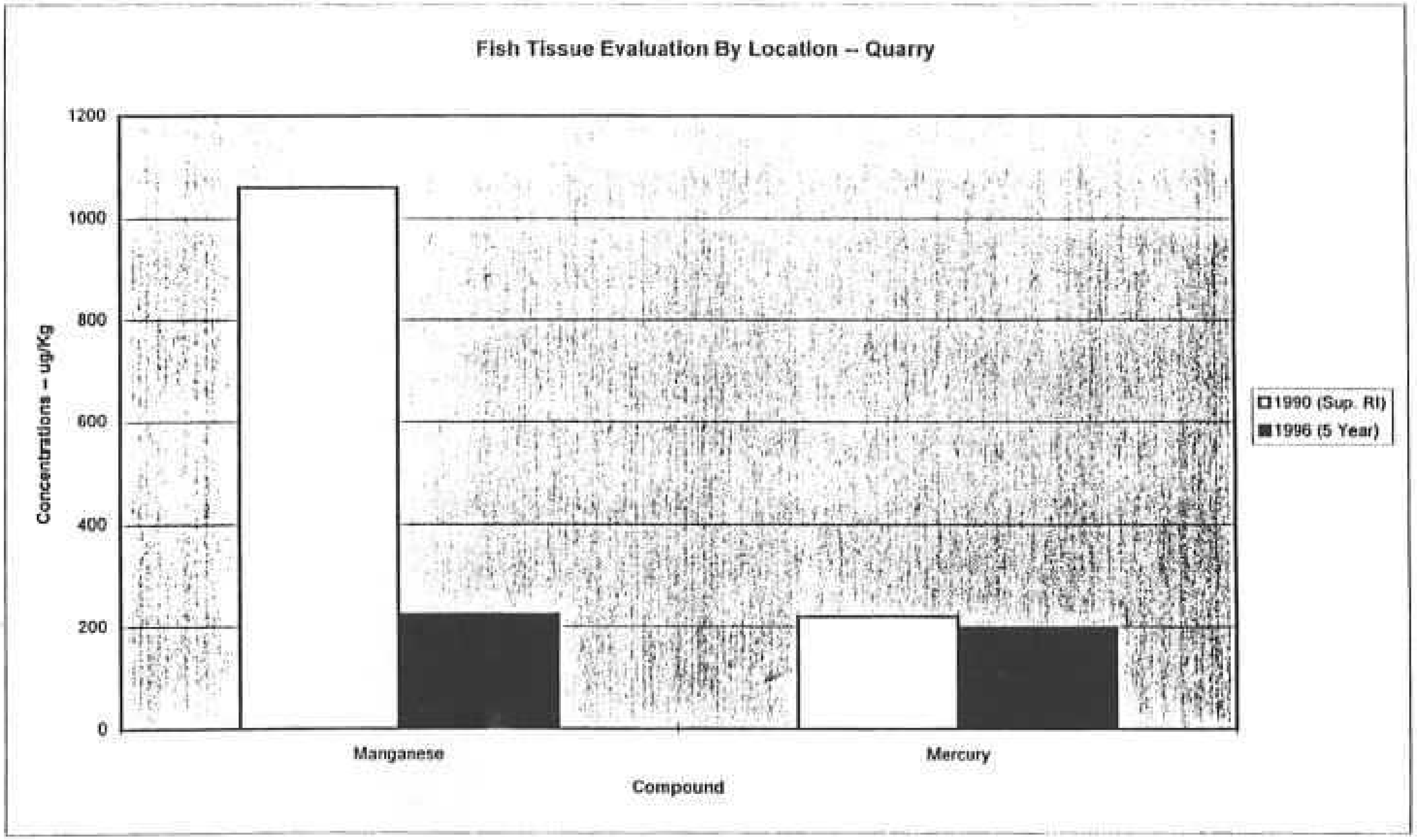
FIGURE 4-10

ALTERNATIVE REMEDIAL CONTRACTING STRATEGY
U.S. EPA CONTRACT No. 68-W8-0089
WORK ASSIGNMENT No. 86-5WE
DOCUMENT CONTROL No. 4500-86-ANWY

TREND FOR
FISH TISSUE
RSQ SITE
Elyria, Ohio



Compound ug/Kg	1990 (Sup. RI)	1996 (5 Year)
Manganese	1060	224
Mercury	220	199

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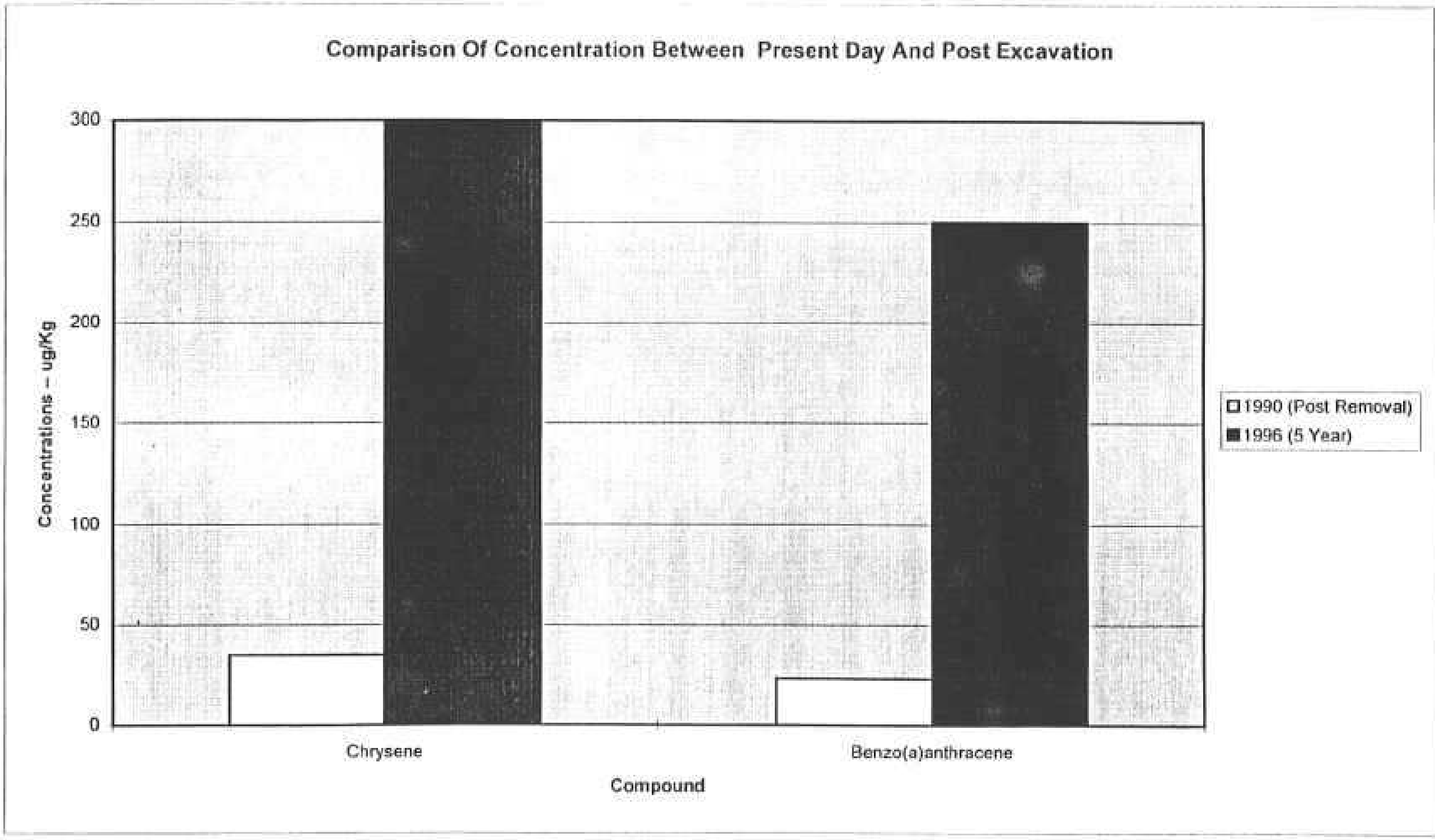
FIGURE 4-10

ALTERNATIVE REMEDIAL CONTRACTING STRATEGY
U.S. EPA CONTRACT No. 68-W8-0089
WORK ASSIGNMENT No. 86-5WE
DOCUMENT CONTROL No. 4500-86-ANWY

TREND FOR
FISH TISSUE
RSQ SITE
Elyria, Ohio



Compound - ug/Kg	1990 (Post Removal)	1996 (5 Year)	% Increase
Chrysene	35	300	757%
Benzo(a)anthracene	23	250	987%

FIGURE 4-11

ALTERNATIVE REMEDIAL CONTRACTING STRATEGY
U.S. EPA CONTRACT No. 68-W8-0089
WORK ASSIGNMENT No. 86-5WE
DOCUMENT CONTROL No. 4500-86-ANWY

TREND FOR SOIL
RSQ SITE
Elyria, Ohio

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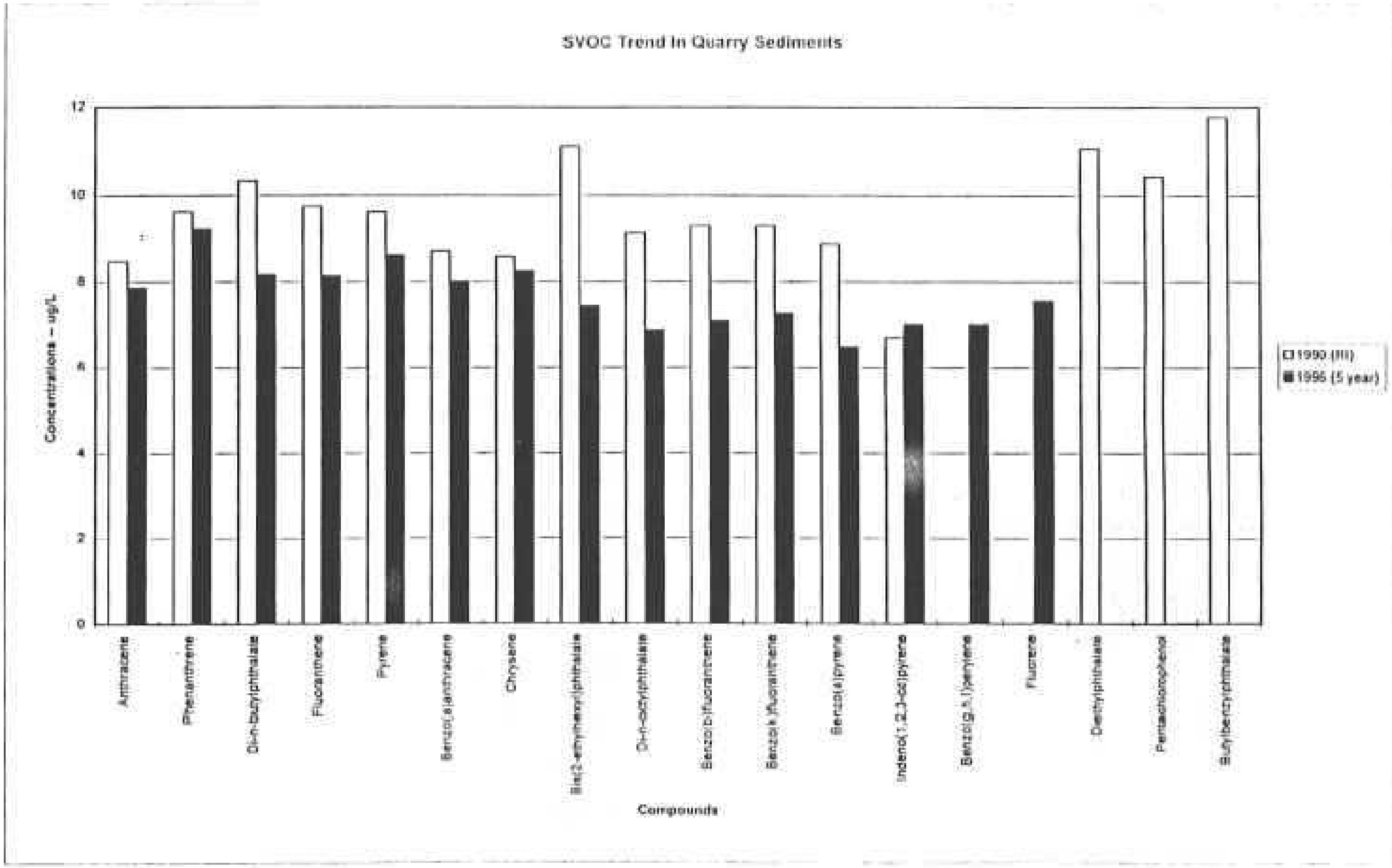

Semi-volatile Organic Componds		
Compound -ug/Kg	1990 (RI)	1996 (5 year)
Anthracene	4800	2600
Phenanthrene	15000	10000
Di-n-butylphthalate	31000	3500
Fluoranthene	17000	3400
Pyrene	15000	5500
Benzo(a)anthracene	6000	3000

Semi-volatile Organic Componds		
Compound -ug/Kg	1990 (RI)	1996 (5 year)
Chrysene	5300	3800
Bis(2-ethylhexyl)phthalate	68000	1700
Di-n-octylphthalate	9200	960
Benzo(b)fluoranthene	11000	1200
Benzo(k)fluoranthene	11000	1400
Benzo(a)pyrene	7200	650

Semi-volatile Organic Componds		
Compound -ug/Kg	1990 (RI)	1996 (5 year)
Indeno(1,2,3-cd)pyrene	600	1100
Benzo(g,h,i)perylene	0	1100
Fluorene	0	1900
Diethylphthalate	65000	0
Pentachlorophenol	34000	0
Butylbenzylphthalate	130000	42

FIGURE 4-12

ALTERNATIVE REMEDIAL CONTRACTING STRATEGY
U.S. EPA CONTRACT No. 68-W8-0089
WORK ASSIGNMENT No. 86-5WE
DOCUMENT CONTROL No. 4500-86-ANWY

TREND FOR SEDIMENT

RSQ SITE
Elyria, Ohio

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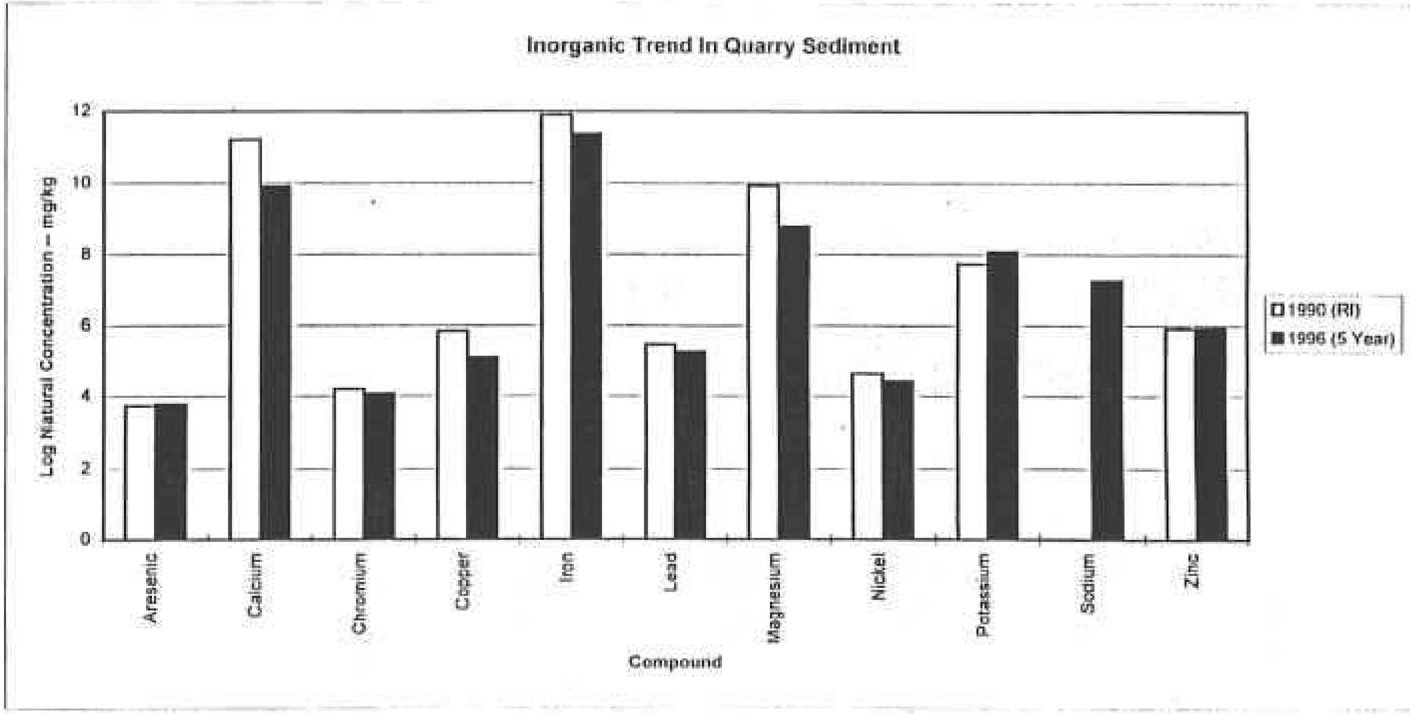

Inorganic Compounds mg/Kg	1990 (RI)	1996 (5 Year)
Aresenic	42	43.9
Calcium	73700	19900
Chromium	66	58.2
Copper	343	164
Iron	145000	87500
Lead	232	192
Magnesium	20300	6480

Inorganic Compounds mg/Kg	1990 (RI)	1996 (5 Year)
Nickel	103	84.1
Potassium	2290	3210
Sodium	0	1420
Zinc	369	371

FIGURE 4-12

ALTERNATIVE REMEDIAL CONTRACTING STRATEGY
U.S. EPA CONTRACT No. 68-W8-0089
WORK ASSIGNMENT No. 86-5WE
DOCUMENT CONTROL No. 4500-86-ANWY

TREND FOR SEDIMENT
RSQ SITE
Elyria, Ohio

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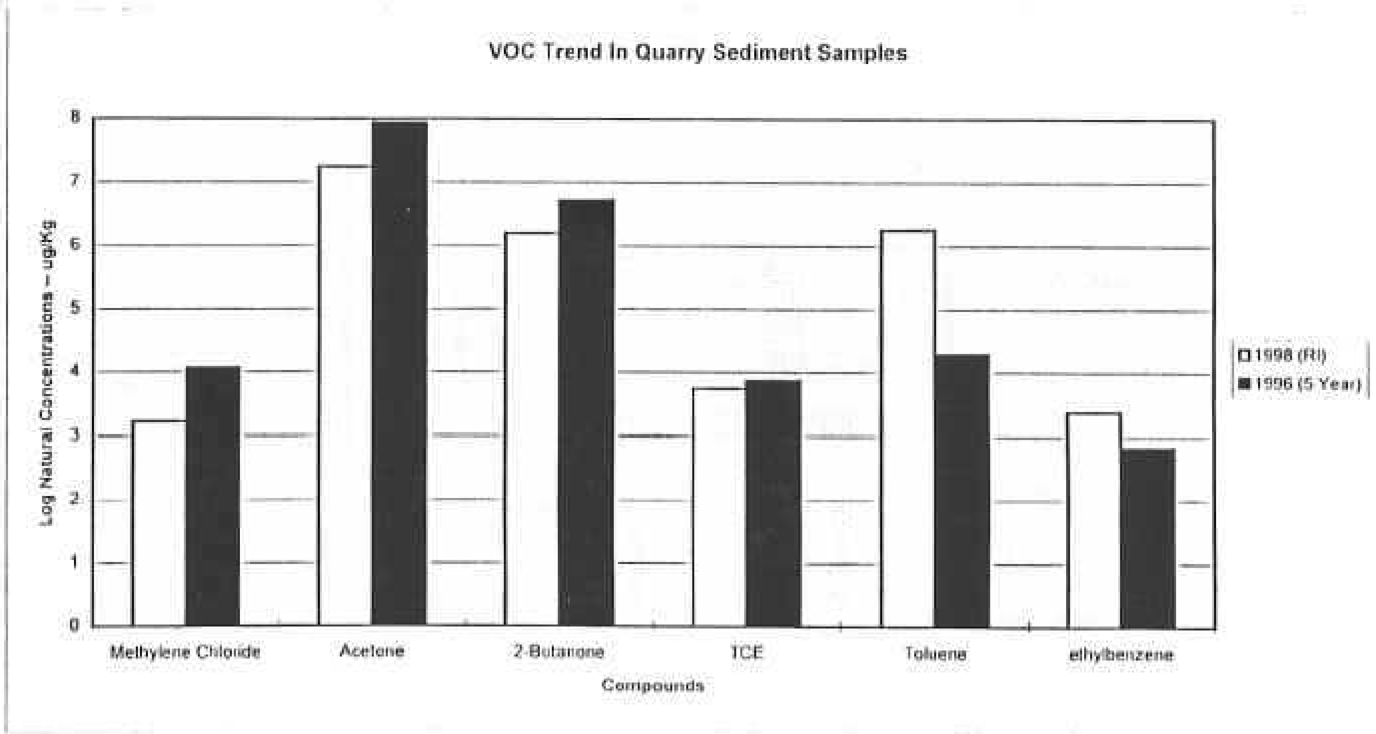

Volatile Organic Componds		
Compound - ug/Kg	1988 (RI)	1996 (5 Year)
Methylene Chloride	25	58
Acetone	1400	2800
2-Butanone	490	830
TCE	42	48
Toluene	520	73
ethylbenzene	29	17

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FIGURE 4-12

ALTERNATIVE REMEDIAL CONTRACTING STRATEGY
U.S. EPA CONTRACT No. 68-W8-0089
WORK ASSIGNMENT No. 86-5WE
DOCUMENT CONTROL No. 4500-86-ANWY

TREND FOR SEDIMENT

RSQ SITE
Elyria, Ohio

Table 4-1

Monitoring Well Redevelopment
Republic Steel Quarry
Elyria, Ohio

	Monitoring Well						
	B-1	B-2	B-3	B-5	B-6	B-7	B-8
1st Well Volume							
pH	6.09	8.07	7.44	6.81	7.21	6.47	6.79
Conductivity (umhos)	1500	11000	650	1200	700	450	2350
Disolved Oxygen (mg/	3.6	3.65	9.5	9.4	9.1	3.9	1.95
Temperature (*C)	10	11.5	10.2	10.5	10	10	12
2nd Well Volume							
pH	6.03	7.32	7.18	6.86	7.17	6.48	6.75
Conductivity	1600	700	650	1250	700	460	2400
Disolved Oxygen	2.1	2.4	5.9	9.2	8	3.2	1.9
Temperature	10.5	11	10.5	11	11	11	12.5
3rd Well Volume							
pH	6.03	7.22	7.18	6.89	7.11	6.5	6.75
Conductivity	1650	600	650	1250	700	465	2450
Disolved Oxygen	1.3	2.5	4.2	9.4	8	3	1.9
Temperature	10.5	11.5	11	11	12	11	12.5
4th Well Volume							
pH	6.03	7.23	NA	NA	7.14	NA	NA
Conductivity	1650	600	NA	NA	700	NA	NA
Disolved Oxygen	1.3	2.4	NA	NA	8	NA	NA
Temperature	10.5	11	NA	NA	12	NA	NA
5th Well Volume							
pH	6.03	NA	NA	NA	NA	NA	NA
Conductivity	1650	NA	NA	NA	NA	NA	NA
Disolved Oxygen	1.4	NA	NA	NA	NA	NA	NA
Temperature	10.5	NA	NA	NA	NA	NA	NA

Table 4-2
Groundwater Results -- Semivolatile Organic Compounds
Republic Steel Quarry
Elyria, Ohio

Location:	MWB-1	MWB-2	MWB-3	MWB-5	MWB-6	MWB-7	MWB-8	---	---	MWB-6-DUP
Type:	Investigative	Investigative	Investigative	Investigative	Investigative	Investigative	Investigative	Bottle Blank	Equipment Blank	Field Duplicate
EPA Sample No.:	EXX63	EXX64	EXX65	EXX67	EXX68	EXX69	EXX70	EXX71	EXX72	EXX73
Sample I.D.:	GW-301MSD	GW-302	GW-303	GW-305	GW-306	GW-307	GW-308	GW-309	GW-310	GW-311
Matrix:	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater
Sample Date:	11/15/96	11/15/96	11/15/96	11/14/96	11/14/96	11/15/96	11/15/96	11/14/96	11/15/96	11/14/96
Units:	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
PARAMETER										
Phenol	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
bis(2-Chloroethyl)ether	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2-Chlorophenol	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
1,4-Dichlorobenzene	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
1,3-Dichlorobenzene	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
1,2-Dichlorobenzene	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2-Methylphenol	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2,2'-oxybis(1-Chloropropane)	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ
4-Methylphenol	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
N-Nitroso-di-n-propylamine	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Hexachloroethane	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Nitrobenzene	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Isophorone	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2-Nitrophenol	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2,4-Dimethylphenol	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
bis(2-Chloroethoxy)methane	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2,4-Dichlorophenol	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
1,2,4-Trichlorobenzene	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Naphthalene	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
4-Chloroaniline	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Hexachlorobutadiene	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
4-Chloro-3-methylphenol	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2-Methylnaphthalene	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Hexachlorocyclopentadiene	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2,4,6-Trichlorophenol	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2,4,5-Trichlorophenol	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U
2-Chloronaphthalene	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2-Nitroaniline	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U
Dimethylphthalate	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Acenaphthylene	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U

Table 4-2
Groundwater Results -- Semivolatile Organic Compounds
Republic Steel Quarry
Elyria, Ohio
(Continued)

Location:	MWB-1	MWB-2	MWB-3	MWB-5	MWB-6	MWB-7	MWB-8	---	---	MWB-6-DUP
Type:	Investigative	Investigative	Investigative	Investigative	Investigative	Investigative	Investigative	Bottle Blank	Equipment Blank	Field Duplicate
EPA Sample No.:	EXX63	EXX64	EXX65	EXX67	EXX68	EXX69	EXX70	EXX71	EXX72	EXX73
Sample I.D.:	GW-301MSD	GW-302	GW-303	GW-305	GW-306	GW-307	GW-308	GW-309	GW-310	GW-311
Matrix:	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater
Sample Date:	11/15/96	11/15/96	11/15/96	11/14/96	11/14/96	11/15/96	11/15/96	11/14/96	11/15/96	11/14/96
Units:	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
PARAMETER										
2,6-Dinitrotoluene	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
3-Nitroaniline	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U
Acenaphthene	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2,4-Dinitrophenol	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U
4-Nitrophenol	25 UJ	25 UJ	25 UJ	25 UJ	25 UJ	25 UJ	25 UJ	25 UJ	25 UJ	25 UJ
Dibenzofuran	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2,4-Dinitrotoluene	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Diethylphthalate	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
4-Chlorophenyl-phenylether	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Fluorene	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
4-Nitroaniline	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U
4,6-Dinitro-2-methylphenol	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U
N-Nitrosodiphenylamine	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
4-Bromophenyl-phenylether	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Hexachlorobenzene	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Pentachlorophenol	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U
Phenanthrene	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Anthracene	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Carbazole	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Di-n-butylphthalate	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Fluoranthene	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Pyrene	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Butylbenzylphthalate	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
3,3'-Dichlorobenzidine	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Benzo(a)anthracene	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Chrysene	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
bis(2-Ethylhexyl)phthalate	0.7 J	1 J	10 U	10 U	0.8 J	10 U	1 J	10 U	10 U	0.9 J
Di-n-octylphthalate	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Benzo(b)fluoranthene	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Benzo(k)fluoranthene	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U

Table 4-2
Groundwater Results -- Semivolatile Organic Compounds
Republic Steel Quarry
Elyria, Ohio
(Continued)

Location:	MWB-1	MWB-2	MWB-3	MWB-5	MWB-6	MWB-7	MWB-8	---	---	MWB-6-DUP
Type:	Investigative	Investigative	Investigative	Investigative	Investigative	Investigative	Investigative	Bottle Blank	Equipment Blank	Field Duplicate
EPA Sample No.:	EXX63	EXX64	EXX65	EXX67	EXX68	EXX69	EXX70	EXX71	EXX72	EXX73
Sample I.D.:	GW-301MSD	GW-302	GW-303	GW-305	GW-306	GW-307	GW-308	GW-309	GW-310	GW-311
Matrix:	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater
Sample Date:	11/15/96	11/15/96	11/15/96	11/14/96	11/14/96	11/15/96	11/15/96	11/14/96	11/15/96	11/14/96
Units:	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
PARAMETER										
Benzo(a)pyrene	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Indeno(1,2,3-cd)pyrene	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Dibenz(a,h)anthracene	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Benzo(g,h,i)perylene	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U

- Indicates detection.
GW-304 not collected due to yellow, gelatinous obstruction.
U - Compound was not detected.
J - Estimated quantity.

Table 4-3
Groundwater Results -- Inorganic Compounds
Republic Steel Quarry
Elyria, Ohio

Location:	MWB-1	MWB-2	MWB-3	MWB-5	MWB-6	MWB-7	MWB-8	---	---	MWB-6-DUP
Type:	Investigative	Investigative	Investigative	Investigative	Investigative	Investigative	Investigative	Bottle Blank	Equipment Blank	Field Duplicate
EPA Sample No.:	MEXJ01	MEXJ02	MEXJ03	MEXJ05	MEXJ06	MEXJ07	MEXJ08	MEXJ09	MEXJ10	MEXJ11
Sample I.D.:	GW-301MSD	GW-302	GW-303	GW-305	GW-306	GW-307	GW-308	GW-309	GW-310	GW-311
Matrix:	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater
Sample Date:	11/15/96	11/15/96	11/15/96	11/14/96	11/14/96	11/15/96	11/15/96	11/14/96	11/15/96	11/14/96
Units:	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
PARAMETER										
Aluminum	52.1	21.4	17.0 U	17.0 U	85.7	334	217	17.0 U	17.0 U	92.9 J
Antimony	8.9	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U
Arsenic	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	28.8	3.0 U	3.0 U	3.0 U	3.0 U
Barium	11.3	46.8	33.9	21.1	13.1	14.8	78.9	1.0 U	1.0 U	3.6
Beryllium	1.2	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Cadmium	5.2	1.0 U	1.0 U	1.0 U	1.0 U	1.1	1.0 U	1.0 U	1.0 U	1.0 U
Calcium	242,000	167,000	125,000	381,000	150,000	42,200	168,000	35.1	62.4	36,500
Chromium	1.0 U	1.3	1.0 U	1.0 U	3.7	2.3	1.0 U	1.0 U	1.0 U	1.8
Cobalt	1.0 U	1.0 U	1.0 U	1.4	1.5	14.9	2.6	1.0 U	1.0 U	1.0 U
Copper	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	2.6	2.4	1.0 U	1.0 U	1.0 U
Iron	568,000 J	27.1 J	215 J	10,000 J	434 J	47,000 J	2,170 J	10.0 J	32.7 J	286 J
Lead	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Magnesium	52,600	64,400	63,000	20,200	41,900	14,200	37,100	22.0 U	22.0 U	10,200
Manganese	7,870	135	312	157	137	1,380	524	1.0 U	1.0 U	36.3
Mercury	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
Nickel	1.0 U	1.1	1.0 U	1.0 U	6.2	13.4	7.0	1.0 U	1.0 U	2.4
Potassium	10,000	3,740	3,220	4,130	3,190	5,650	3,530	41.0 U	41.0 U	840
Selenium	13.7	4.0 U	4.0 U	4.0 U	4.0 U	4.0 U	4.0 U	4.0 U	4.0 U	4.0 U
Silver	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Sodium	43,800 J	50,500 J	52,600 J	44,700 J	52,600 J	40,600 J	398,000 J	183 J	241 J	16,500 J
Thallium	43.6	2.3	2.7	2.0 U	2.9	8.9	2.4	2.0 U	2.0 U	2.0 U
Vanadium	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Zinc	2.0 U	3.2 J	3.5 J	2.5 J	3.9 J	17.7 J	7.9 J	2.9 J	3.3 J	5.4 J
Cyanide	3.3	2.1	2.6	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U

- Indicates detection.
GW-304 not collected due to yellow, gelatinous obstruction.
U - Compound was not detected.
J - Estimated quantity.

Table 4-4
Surface Water Results -- Semivolatile Organic Compounds
Republic Steel Quarry
Elyria, Ohio

Location:	Quarry at 17 ft.	Quarry at 60 ft.	Quarry at 0 ft.	Quarry at 17 Ft.	River Upstream	Quarry Outfall	River Downstream	---	---	SW-205-DUP
Type:	Investigative	Investigative	Investigative	Investigative	Investigative	Investigative	Investigative	Bottle Blank	Equipment Blank	Field Duplicate
EPA Sample No.:	EXX75	EXX76	EXX77	EXX78	EXX79	EXX80	EXX81	EXX82	EXX83	EXX84
Sample I.D.:	SW-201MSD	SW-203	SW-205	SW-207	SW-209	SW-211	SW-213	SW-215	SW-216	SW-217
Matrix:	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water
Sample Date:	11/12/96	11/12/96	11/12/96	11/12/96	11/12/96	11/12/96	11/12/96	11/12/96	11/12/96	11/12/96
Units:	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
PARAMETER										
Phenol	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
bis(2-Chloroethyl)ether	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2-Chlorophenol	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
1,3-Dichlorobenzene	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
1,4-Dichlorobenzene	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
1,2-Dichlorobenzene	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2-Methylphenol	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2,2'-oxybis(1-Chloropropane)	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
4-Methylphenol	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
N-Niboso-di-n-propylamine	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Hexachloroethane	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Nitrobenzene	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Isophorone	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2-Nitrophenol	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2,4-Dimethylphenol	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
bis(2-Chloroethoxy)methane	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2,4-Dichlorophenol	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
1,2,4-Trichlorobenzene	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Naphthalene	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
4-Chloroaniline	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Hexachlorobutadiene	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
4-Chloro-3-methylphenol	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2-Methylnaphthalene	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Hexachlororyclopentadiene	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2,4,6-Trichlorophenol	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2,4,5-Trichlorophenol	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U
2-Chloronaphthalene	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2-Nitroaniline	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U
Dimethylphthalate	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Acenaphthylene	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2,6-Dinitrotoluene	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
3-Nitroaniline	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U
Acenaphthene	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2,4-Dinitrophenol	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U

Table 4-4
Surface Water Results -- Semivolatile Organic Compounds
Republic Steel Quarry
Elyria, Ohio
(Continued)

Location:	Quarry at 17 ft.	Quarry at 60 ft.	Quarry at 0 ft.	Quarry at 17 Ft.	River Upstream	Quarry Outfall	River Downstream	---	---	SW-205-DUP
Type:	Investigative	Investigative	Investigative	Investigative	Investigative	Investigative	Investigative	Bottle Blank	Equipment Blank	Field Duplicate
EPA Sample No.:	EXX75	EXX76	EXX77	EXX78	EXX79	EXX80	EXX81	EXX82	EXX83	EXX84
Sample I.D.:	SW-201MSD	SW-203	SW-205	SW-207	SW-209	SW-211	SW-213	SW-215	SW-216	SW-217
Matrix:	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water
Sample Date:	11/12/96	11/12/96	11/12/96	11/12/96	11/12/96	11/12/96	11/12/96	11/12/96	11/12/96	11/12/96
Units:	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
PARAMETER										
4-Nitrophenol	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U
Dibenzofuran	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2,4-Dinitrotoluene	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Diethylphthalate	10 U	10 U	10 U	10 U	0.9 J	10 U	10 U	10 U	10 U	10 U
4-Chlorophenyl-phenylether	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Fluorene	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
4-Nitroaniline	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U
4,6-Dinitro-2-methylphenol	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U
N-Nitrosodiphenylamine	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
4-Bromophenyl-phenylether	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Hexachlorobenzene	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Pentachlorophenol	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U
Phenanthrene	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Anthracene	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Carbazole	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Di-n-butylphthalate	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Fluoranthene	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Pyrene	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Butylbenzylphthalate	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
3,3'-Dichlorobenzidine	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Benzo(a)anthracene	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Chrysene	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
bis(2-Ethylhexyl)phthalate	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	3 J	10 U
Di-n-octylphthalate	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Benzo(b)fluoranthene	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Benzo(k)fluoranthene	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Benzo(a)pyrene	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Indeno(1,2,3-cd)pyrene	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Dibenz(a,h)anthracene	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Benzo(g,h,i)perylene	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U

- Indicates detection.
GW-304 not collected due to yellow, gelatinous obstruction.
U - Compound was not detected.
J - Estimated quantity.

Table 4-5
Surface Water Results -- Inorganic Compounds
Republic Steel Quarry
Elyria, Ohio

Location:	Quarry at 17 ft.	Quarry at 17 ft.	Quarry at 60 ft.	Quarry at 60 ft.	Quarry at 0 ft.	Quarry at 0 ft.	Quarry at 17 ft.	Quarry at 17 ft.
Type:	**Investigative**	**Investigative**	**Investigative**	**Investigative**	**Investigative**	**Investigative**	**Investigative**	**Investigative**
Field Preparation:	**Unfiltered**	**Filtered**	**Unfiltered**	**Filtered**	**Unfiltered**	**Filtered**	**Unfiltered**	**Filtered**
EPA Sample No.:	**MEXJ13**	**MEXJ14**	**MEXJ15**	**MEXJ16**	**MEXJ17**	**MEXJ18**	**MEXJ19**	**MEXJ20**
Sample I.D.:	**SW-201MSD**	**SW-202**	**SW-203**	**SW-204**	**SW-205**	**SW-206**	**SW-207**	**SW-208**
Matrix:	**Surface Water**	**Surface Water**	**Surface Water**	**Surface Water**	**Surface Water**	**Surface Water**	**Surface Water**	**Surface Water**
Sample Date:	**11/12/96**	**11/12/96**	**11/12/96**	**11/12/96**	**11/12/96**	**11/12/96**	**11/12/96**	**11/12/96**
Units:	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**
PARAMETER								
Aluminum	32.0 U	32.0 U	32.0 U	32.0 U	32.0 U	32.0 U	32.0 U	32.0 U
Antimony	19.6 U	19.6 U	19.6 U	19.6 U	19.6 U	19.6 U	19.6 U	19.6 U
Arsenic	3.4 U	3.4 U	18.3 U	18.2 U	3.4 UJ	3.4 UJ	3.4 UJ	3.4 U
Barium	29.5	29.3	41.5	43.4	28.8	29.9	28.6	27.9
Beryllium	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U
Cadmium	2.7 U	2.7 U	2.7 U	2.7 U	2.7 U	2.7 U	2.7 U	2.7 U
Calcium	55,300	56,400	210,000	220,000	54,900	56,600	54,500	53,100
Chromium	3.4 U	3.4 U	3.4 U	3.4 J	3.4 U	3.4 U	3.4 U	3.4 U
Cobalt	3.1 U	3.1 U	47.2	50.7	3.1 U	3.1 U	3.1 U	3.1 U
Copper	3.0 U	3.0 U	299	292	3.0 U	3.0 U	3.0 U	3.0 U
Iron	136 U	24.9 U	800,000	847,000	166 U	40.5 U	130 U	26.7 U
Lead	0.80 UJ	2.4 J	0.80 UJ	0.80 UJ	0.80 UJ	0.8 UJ	0.80 UJ	0.80 UJ
Magnesium	14,800	15,100	59,000	61,700	14,700	15,000	14,600	14,100
Manganese	179	147	12,300	12,800	182	151	176	138
Mercury	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U
Nickel	13.5 U	13.5 U	13.5 U	13.5 U	13.5 U	13.5 U	13.5 U	13.5 U
Potassium	3,030	3,480	5,040	5,350	3,450	3,200	3,490	3,460
Selenium	3.6 UJ	3.6 UJ	3.6 UJ	3.6 UJ	3.6 UJ	3.6 UJ	3.6 UJ	3.6 UJ
Silver	3.4 U	3.4 U	280	272	3.4 U	3.4 U	3.4 U	3.4 U
Sodium	47,600 J	48,300 J	40,500 J	42,100 J	47,000 J	48,200 J	46,500 J	45,000 J
Thallium	2.0 R	2.0 R	2.0 R	2.0 R	2.0 R	2.0 R	2.0 R	2.0 R
Vanadium	6.0 U	6.0 U	34.1	37.5	6.0 U	6.0 U	6.0 U	6.0 U
Zinc	12.6 U	18.4 U	1.2 U	1.2 U	13.2 U	16.5 U	20.8 U	10.6 U
Cyanide	1.7 UJ	NA	1.5 J	NA	1.7 UJ	NA	1.7 UJ	NA

- Indicates detection.
R - Results
U Compound was not detected.
J Estimated quantity.

Table 4-5
Surface Water Results -- Inorganic Compounds
Republic Steel Quarry
Elyria, Ohio
(Continued)

Location:	River Upstream	River Upstream	Quarry Outfall	Quarry Outfall	River Downstream	River Downstream	---	---	SW-205-DUP
Type:	Investigative	Investigative	Investigative	Investigative	Investigative	Investigative	Bottle Blank	Equipment Blank	Field Duplicate
Field Preparation:	Unfiltered	Filtered	Unfiltered	Filtered	Unfiltered	Filtered	Unfiltered	Unfiltered	Unfiltered
EPA Sample No.:	MEXJ21	MEXJ22	MEXJ23	MEXJ24	MEXJ25	MEXJ26	MEXJ27	MEXJ28	MEXJ29
Sample I.D.:	SW-209	SW-210	SW-211	SW-212	SW-213	SW-214	SW-215	SW-216	SW-217
Matrix:	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water
Sample Date:	11/12/96	11/12/96	11/12/96	11/12/96	11/12/96	11/12/96	11/12/96	11/12/96	11/12/96
Units:	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
PARAMETER									
Aluminum	1,030	70.8	32.0 U	32.0 U	1,180	62.2	32.0 U	32.0 U	32.0 U
Antimony	19.6 U	19.6 U	19.6 U	19.6 U	19.6 U	19.6 U	19.6 U	19.6 U	19.6 U
Arsenic	3.4 U	3.4 U	3.4 UJ	3.4 UJ	3.4 U	3.4 U	3.4 U	8.6	3.4 UJ
Barium	27.7	22.9	31.9	28.4	30.6	22.8	1.8 J	4.0 J	27.6
Beryllium	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U
Cadmium	2.7 U	2.7 U	2.7 U	2.7 U	2.7 U	2.7 U	2.7 U	2.7 U	2.7 U
Calcium	39,200	41,100	56,200	55,400	41,900	40,400	106 J	431	53,600
Chromium	3.4 U	3.4 U	3.4 U	3.4 U	3.4 U	3.4 U	3.4 U	3.4 U	3.4 U
Cobalt	3.1 U	3.1 U	3.1 U	3.1 U	3.1 U	3.1 U	3.1 U	3.1 U	3.1 U
Copper	5.4	3.5	3.0 U	3.0 U	5.0	3.0 U	3.0 U	3.0 U	3.0 U
Iron	1,470	187 U	136 U	25.3 U	1,590	219 U	70.4	28.0	109 U
Lead	1.2 J	0.80 UJ	0.80 UJ	0.80 UJ	1.3 J	0.80 UJ	0.80 UJ	0.80 UJ	0.80 UJ
Magnesium	10,700	11,000	14,900	14,800	11,600	11,000	23.1 U	27.6 J	14,300
Manganese	35.3	21.2	152	123	37.3	22.9	0.70 U	1.4	177
Mercury	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U
Nickel	13.5 U	13.5 U	13.5 U	13.5 U	13.5 U	13.5 U	13.5 U	13.5 U	13.5 U
Potassium	3,690	4,010	3,160	3,080	3,860	3,500	682 U	682 U	3,140
Selenium	3.6 UJ	3.6 UJ	3.6 UJ	3.6 UJ	3.6 UJ	3.6 UJ	3.6 UJ	4.3 J	3.6 UJ
Silver	3.4 U	3.4 U	3.4 U	3.4 U	3.4 U	3.4 U	3.4 U	3.4 U	3.4 U
Sodium	9,310 J	9,800 J	47,600 J	47,500 J	10,100 J	9,860 J	134 J	132 J	46,000 J
Thallium	2.0 R	2.0 R	2.0 R	2.0 R	2.0 R	2.0 R	2.0 R	2.0 R	2.0 R
Vanadium	6.0 U	6.0 U	6.0 U	6.0 U	6.0 U	6.0 U	6.0 U	6.0 U	6.0 U
Zinc	16.9 U	12.3 U	16.8 U	13.2 U	25.0 U	17.4 U	12.8 U	13.7	20.8 U
Cyanide	2.1 J	NA	1.7 UJ	NA	1.2 J	NA	1.7 UJ	1.7 UJ	1.7 UJ

- Indicates detection.
R - Results are unusable.
U Compound was not detected.
J Estimated quantity.

Table 4-6
Surface Water Results -- Water Quality Parameters
Republic Steel Quarry
Elyria, Ohio

Location:	**Quarry at 17 ft.**	**Quarry at 60 ft.**	**Quarry at 0 ft.**	**SW-205-DUP**	**Quarry at 17 ft.**	**River Upstream**	**Quarry Outfall**	**River Downstream**
Type:	**Investigative**	**Investigative**	**Investigative**	**Field Duplicate**	**Investigative**	**Investigative**	**Investigative**	**Investigative**
EPA Sample No.:	**97ZG02S14**	**97ZG02S15**	**97ZG02S16**	**97ZG02D16**	**97ZG02S17**	**97ZG02S18**	**97ZG02S19**	**97ZG02S20**
Sample I.D.:	**SW-201**	**SW-203**	**SW-205**	**SW-217**	**SW-207**	**SW-209**	**SW-211**	**SW-213**
Matrix:	**Surface Water**	**Surface Water**	**Surface Water**	**Surface Water**	**Surface Water**	**Surface Water**	**Surface Water**	**Surface Water**
Sample Date:	**11/12/96**	**11/12/96**	**11/12/96**	**11/12/96**	**11/12/96**	**11/12/96**	**11/12/96**	**11/12/96**
PARAMETER								
Total Suspended Solids in Water (mg TSS/L)	5 U	192	5 U	5 U	5 U	25.5	5 U	10.3
Total Dissolved Solids in Water (mg TDS/L)	1,100	4,350	402	390	408	264	400	258
Acidity in Water (mg $CaCO_3$/L)	-118	-1,370	-110	-110	-110	-98	-108	-96
Total Alkalinity in Water (mg $ClCO_3$/L)	114	147	118	109	118	95	95	104
Chloride in Water (mg Cl/L)	85	38	83	84	85	20	85	20
Sulfate in Water (mg SO_4/L)	103	2,090	106	104	104	52	104	49
Oil & Grease (mg/L)	3.6	5.8	9.0	6.7	4.9	7.9	5.1	4.2

U - Compound was not detected.

Table 4-7

Surface Water Results -- Water Profile
Republic Steel Quarry
Elyria, Ohio

Location	Depth	Temperature Celsius	Conductivity umhos	Dissolved Oxygen mg/l	pH
Quarry	0	10	480	9.2	7.48
	5	10	480	9.4	7.5
	10	10	480	10.2	7.5
	15	10	485	10.4	7.6
	20	10	485	10.4	7.65
	25	10	485	10.4	7.55
	30	10	485	10.7	7.5
	35	8	485	10.4	7.55
	40	8	485	11	7.6
	45	8.2	480	10.8	7.62
	50	8.5	480	11.4	7.6
	55	9	480	11.4	7.65
	60	9	480	11.6	7.65
Upstream	0	3	230	10.1	7.65
Downstream	0	3	230	10.3	7.68
Quarry Outfall	0	9.2	480	10	7.4

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Table 4-8
Fish Tissue Results
Republic Steel Quarry
Elyria, Ohio

Location:	Upstream	Quarry	Upstream	Quarry	---	---	Quarry	Downstream	Downstream
Type:	Investigative	Investigative	Investigative	Investigative	Blank	Blank	Investigative	Investigative	Investigative
Species:	White Sucker	Bluegill	Crappie	Small Mouth Bass	Fish Farm	Fish Farm	Small Mouth Bass	Large Mouth Bass	Bluegill
EPA Sample No.:	97ZG02S13	97ZG02S01	97ZG02S14	97ZG02S02	97ZG02R01	97ZG02R02	97ZG02S03	97ZG02S04	97ZG02S05
Sample I.D.:	FT-101	FT-102	FT-103	FT-104	FT-105 BLNK	FT-106 BLNK	FT-107	FT-108	FT-109
Matrix:	Fish Tissue	Fish Tissue	Fish Tissue	Fish Tissue	Fish Tissue	Fish Tissue	Fish Tissue	Fish Tissue	Fish Tissue
Sample Date:	11/16/96	11/15/96	11/16/96	11/15/96	11/21/96	11/21/96	11/16/96	11/15/96	11/15/96
Units:	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg
PARAMETER									
Cadmium	4.9 U	75.2	4.9 U	9.3	4.9 U	5.0 U	4.9 U	5.0 U	4.9 U
Copper	656 J	409 J	312 J	329 J	469 J	487 J	283 J	328 J	360 J
Manganese	584	402	181	146	519	859	124	111	649
Mercury	228	191	74.1	357	46.5	53.1	49.1	25.1	63.3
% Lipids	0.77	1.06	0.60	0.74	1.44	2.02	0.42	0.27	0.67

- Indicates detection.
U - Compound was not detected.
J - Estimated quantity.

Table 4-8
Fish Tissue Results
Republic Steel Quarry
Elyria, Ohio
(Continued)

Location:	Downstream	Downstream	Downstream	Upstream	Upstream	Upstream	Upstream	FT-108-DUP	FT-116-DUP
Type:	Investigative	Investigative	Investigative	Investigative	Investigative	Investigative	Investigative	Field Duplicate	Field Duplicate
Species:	White Sucker	Small Mouth Bass	White Sucker	White Sucker	Brown Bullhead	Crappie	Carp	Large Mouth Bass	Carp
EPA Sample No.:	97ZG02S06	97ZG02S07	97ZG02S08	97ZG02S09	97ZG02S10	97ZG02S11	97ZG02S12	91ZG02D04	97ZG02D12
Sample I.D.:	FT-110	FT-111	FT-112	FT-113	FT-114	FT-115	FT-116	FT-117 DUP	FT-118 DUP
Matrix:	Fish Tissue	Fish Tissue	Fish Tissue	Fish Tissue	Fish Tissue	Fish Tissue	Fish Tissue	Fish Tissue	Fish Tissue
Sample Date:	11/15/96	11/16/96	11/15/96	11/16/96	11/16/96	11/16/96	11/16/96	11/15/96	11/16/96
Units:	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg
PARAMETER									
Cadmium	4.7 U	4.9	5.0 U	5.0 U	5.0 U	7.8	5.0 U	4.8 U	5.0 U
Copper	362 J	459 J	524 J	407 J	571 J	306 J	736 J	818 J	1,020
Manganese	1,170	391	852	403	367	172	358	178	678
Mercury	55.5	63.7	155	156	142	109	235	240	212
% Lipids	0.82	0.97	0.61	0.56	1.37	0.60	0.88	0.44	1.02

- Indicates detection.
U - Compound was not detected.
J - Estimated quantity.

Table 4-9

Fish Tissue Evaluation by Species: White Sucker
Republic Steel Quarry
Elyria, Ohio

Location	% Lipids	Cadmium	Copper	Manganese	Mercury
Downstream (average)	0.72	---	443	1,011	105.25
Upstream (average)	0.67	---	531.5	493.5	192

Note: Unfavorable fishing conditions and poor catch make data less reliable.

Table 4-10

Fish Tissue Evaluation by Location: All Species Combined
Republic Steel Quarry
Elyria, Ohio

Location	% Lipids	Cadmium	Copper	Manganese	Mercury
Quarry	0.70	42.3	340.3	224	199
Downgradient	0.67	4.9[1]	406.6	634.6	117.7
Upgradient	0.80	7.8[1]	498	344.2	157.4

Note: Unfavorable fishing conditions and poor catch make data less reliable.

[1] Cadmium was detected in only one species sample; therefore, the concentration provided is not an arthmetic mean.

Table 4-11
Soil Results -- Semivolatile Organic Compounds
Republic Steel Quarry
Elyria, Ohio

Location:	Discharge Ditch (Outside Fence 0-8")	Discharge Ditch (Inside Fence 0-8")	Boat Ramp 0-8"	Boat Ramp 0-8"	Discharge Ditch (Outside Fence 12")	Discharge Ditch (Inside Fence 12")	Boat Ramp 12"	Boat Ramp 12"
Type:	**Investigative**	**Investigative**	**Investigative**	**Investigative**	**Investigative**	**Investigative**	**Investigative**	**Investigative**
EPA Sample No.:	**EXX27**	**EXX28**	**EXX29**	**EXX30**	**EXX31**	**EXX32**	**EXX54**	**EXX55**
Sample I.D.:	**SS-101MSD**	**SS-102**	**SS-103**	**SS-104**	**SS-105**	**SS-106**	**SS-107**	**SS-108**
Matrix:	**Soil**	**Soil**	**Soil**	**Soil**	**Soil**	**Soil**	**Soil**	**Soil**
Sample Date:	**11/16/96**	**11/16/96**	**11/16/96**	**11/16/96**	**11/16/96**	**11/16/96**	**11/16/96**	**11/16/96**
Units:	**µg/kg**	**µg/kg**	**µg/kg**	**µg/kg**	**µg/kg**	**µg/kg**	**µg/kg**	**µg/kg**
PARAMETER								
Phenol	400 U	380 U	390 U	380 U	420 U	400 U	400 U	390 U
bis(2-Chloroethyl)ether	400 U	380 U	390 U	380 U	420 U	400 U	400 U	390 U
2-Chlorophenol	400 U	380 U	390 U	380 U	420 U	400 U	400 U	390 U
1,4-Dichlorobenzene	400 U	380 U	390 U	380 U	420 U	400 U	400 U	390 U
1,3-Dichlorobenzene	400 U	380 U	390 U	380 U	420 U	400 U	400 U	390 U
1,2-Dichlorobenzene	400 U	380 UJ	390 U	380 U	420 U	400 U	400 U	390 U
2-Methylphenol	400 U	380 UJ	390 U	380 U	420 U	400 U	400 U	390 U
2,2'-oxybis(1-Chloropropane)	400 U	380 U	390 U	380 U	420 U	400 U	400 U	390 U
4-Methylphenol	400 U	380 U	390 U	380 U	420 U	400 U	400 U	390 U
N-Nitroso-di-n-propylamine	400 UJ	380 U	390 UJ	380 UJ	420 UJ	400 U	400 U	390 U
Hexachloroethane	400 U	380 U	390 U	380 U	420 U	400 U	400 U	390 U
Nitrobenzene	400 U	380 U	390 U	380 U	420 U	400 U	400 U	390 U
Isophorone	400 UJ	380 U	390 UJ	380 UJ	420 UJ	400 U	400 U	390 U
2-Nitrophenol	400 U	380 U	390 U	380 U	420 U	400 U	400 U	390 U
2,4-Dimethylphenol	400 U	380 U	390 U	380 U	420 U	400 U	400 U	390 U
bis(2-Chloroethoxy)methane	400 U	380 U	390 U	380 U	420 U	400 U	400 U	390 U
2,4-Dichlorophenol	400 U	380 U	390 U	380 U	420 U	400 U	400 U	390 U
1,2,4-Trichlorobenzene	400 U	380 U	390 U	380 U	420 U	400 U	400 U	390 U
Naphthalene	24 J	26 J	390 U	380 U	36 J	44 J	400 U	390 U
4-Chloroaniline	400 U	380 U	390 U	380 U	420 U	400 U	400 U	390 U
Hexachlorobutadiene	400 U	380 U	390 U	380 U	420 U	400 U	400 U	390 U
4-Chloro-3-methylphenol	400 U	380 U	390 U	380 U	420 U	400 U	400 U	390 U
2-Methylnaphthalene	63 J	45 J	390 U	380 U	71 J	76 J	400 U	26 J
Hexachlorocyclopentadiene	400 UJ	380 U	390 UJ	380 UJ	420 UJ	400 U	400 U	390 U
2,4,6-Trichlorophenol	400 U	380 U	390 U	380 U	420 U	400 U	400 U	390 U
2,4,5-Trichlorophenol	960 U	930 U	950 U	930 U	1,000 U	960 U	980 U	940 U
2-Chloronaphthalene	400 U	380 U	390 U	380 U	420 U	400 U	400 U	390 U
2-Nitroaniline	960 UJ	930 U	950 UJ	930 UJ	1,000 UJ	960 U	980 U	940 U
Dimethylphthalate	400 U	380 U	390 U	380 U	420 U	400 U	400 U	390 U

Table 4-11
Soil Results -- Semivolatile Organic Compounds
Republic Steel Quarry
Elyria, Ohio

Location:	Discharge Ditch (Outside Fence 0-8")	Discharge Ditch (Inside Fence 0-8")	Boat Ramp 0-8"	Boat Ramp 0-8"	Discharge Ditch (Outside Fence 12")	Discharge Ditch (Inside Fence 12")	Boat Ramp 12"	Boat Ramp 12"
Type:	Investigative	Investigative	Investigative	Investigative	Investigative	Investigative	Investigative	Investigative
EPA Sample No.:	EXX27	EXX28	EXX29	EXX30	EXX31	EXX32	EXX54	EXX55
Sample I.D.:	SS-101MSD	SS-102	SS-103	SS-104	SS-105	SS-106	SS-107	SS-108
Matrix:	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
Sample Date:	11/16/96	11/16/96	11/16/96	11/16/96	11/16/96	11/16/96	11/16/96	11/16/96
Units:	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg
PARAMETER								
Acenaphthylene	400 U	380 U	390 U	380 U	420 U	400 U	400 U	390 U
2,6-Dinitrotoluene	400 U	380 U	390 U	380 U	420 U	400 U	400 U	390 U
3-Nitroaniline	960 U	930 U	950 U	930 U	1,000 U	960 U	980 U	940 U
Acenaphthene	400 U	380 U	390 U	380 U	420 U	400 U	400 U	390 U
2,4-Dinitrophenol	960 U	930 U	950 U	930 U	1,000 U	960 U	980 U	940 U
4-Nitrophenol	960 UJ	930 U	950 UJ	930 UJ	1,000 UJ	960 U	980 U	940 U
Dibenzofuran	400 U	20 J	390 U	380 U	22 J	28 J	400 U	390 U
2,4-Dinitrotoluene	400 U	380 U	390 U	380 U	420 U	400 U	400 U	390 U
Diethylphthalate	400 U	380 U	390 U	380 U	420 U	400 U	400 U	390 U
4-Chlorophenyl-phenylether	400 U	380 U	390 U	380 U	420 U	400 U	400 U	390 U
Fluorene	400 U	380 U	390 U	380 U	420 U	400 U	400 U	390 U
4-Nitroaniline	960 U	930 U	950 U	930 U	1,000 U	960 U	980 U	940 U
4,6-Dinitro-2-methylphenol	960 U	930 UJ	950 U	930 U	1,000 U	960 U	980 U	940 U
N-Nitrosodiphenylamine	400 U	380 UJ	390 U	380 U	420 U	400 U	400 U	390 U
4-Bromophenyl-phenylether	400 U	380 UJ	390 U	380 U	420 U	400 U	400 U	390 U
Hexachlorobenzene	400 U	380 UJ	390 U	380 U	420 U	400 U	400 U	390 U
Pentachlorophenol	230 J	350 J	950 UJ	930 UJ	120 J	250 J	980 U	940 U
Phenanthrene	31 J	84 J	390 U	380 U	42 J	120 J	400 U	390 U
Anthracene	400 U	380 UJ	390 U	380 U	420 U	120 J	400 U	390 U
Carbazole	400 U	380 UJ	390 U	380 U	420 U	400 U	400 U	390 U
Di-n-butylphthalate	400 U	380 UJ	390 U	380 U	420 U	400 U	400 U	390 U
Fluoranthene	34 J	78 J	390 U	380 U	50 J	400 U	400 U	390 U
Pyrene	400 U	120 J	390 U	380 U	67 J	400 R	400 UJ	390 UJ
Butylbenzylphthalate	400 U	380 UJ	390 U	380 U	420 U	400 R	400 UJ	390 UJ
3,3'-Dichlorobenzidine	400 U	380 UJ	390 U	380 U	420 U	400 R	400 UJ	390 UJ
Benzo(a)anthracene	48 J	250 J	390 U	380 U	52 J	400 R	400 UJ	390 UJ
Chrysene	63 J	300 J	390 U	380 U	77 J	400 R	400 UJ	390 UJ
bis(2-Ethylhexyl)phthalate	400 U	380 UJ	390 U	380 U	420 U	400 R	400 UJ	390 UJ
Di-n-octylphthalate	400 U	380 UJ	390 U	380 U	420 U	400 UJ	400 UJ	390 UJ

Table 4-11
Soil Results -- Semivolatile Organic Compounds
Republic Steel Quarry
Elyria, Ohio

Location:	Discharge Ditch (Outside Fence 0-8")	Discharge Ditch (Inside Fence 0-8")	Boat Ramp 0-8"	Boat Ramp 0-8"	Discharge Ditch (Outside Fence 12")	Discharge Ditch (Inside Fence 12")	Boat Ramp 12"	Boat Ramp 12"
Type:	Investigative	Investigative	Investigative	Investigative	Investigative	Investigative	Investigative	Investigative
EPA Sample No.:	EXX27	EXX28	EXX29	EXX30	EXX31	EXX32	EXX54	EXX55
Sample I.D.:	SS-101MSD	SS-102	SS-103	SS-104	SS-105	SS-106	SS-107	SS-108
Matrix:	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
Sample Date:	11/16/96	11/16/96	11/16/96	11/16/96	11/16/96	11/16/96	11/16/96	11/16/96
Units:	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg
PARAMETER								
Benzo(b)fluoranthene	400 U	380 UJ	390 U	380 U	420 U	400 UJ	400 UJ	390 UJ
Benzo(k)fluoranthene	400 U	380 UJ	390 U	380 U	420 U	400 UJ	400 UJ	390 UJ
Benzo(a)pyrene	400 U	380 UJ	390 U	380 U	420 U	400 UJ	400 UJ	390 UJ
Indeno(1,2,3-cd)pyrene	34 J	180 J	390 U	380 U	58 J	280 J	400 UJ	390 UJ
Dibenz(a,h)anthracene	400 U	380 UJ	390 U	380 U	420 U	400 UJ	400 UJ	390 UJ
Benzo(g,h,i)perylene	30 J	180 J	390 U	380 U	49 J	260 J	400 UJ	390 UJ

- Indicates detection.
U - Compound was not detected.
J - Estimated quantity.

Table 4-11
Soil Results -- Semivolatile Organic Compounds
Republic Steel Quarry
Elyria, Ohio

Location:	Background	Background	Background	Background	Background	Background	SS-103-DUP
Type:	Investigative	Investigative	Investigative	Investigative	Investigative	Investigative	Field Duplicate
EPA Sample No.:	EXX56	EXX57	EXX58	EXX59	EXX60	EXX61	EXX62
Sample I.D.:	SS-109	SS-110	SS-111	SS-112	SS-113	SS-114	SS-115
Matrix:	Soil	Soil	Soil	Soil	Soil	Soil	Soil
Sample Date:	11/16/96	11/16/96	11/16/96	11/16/96	11/16/96	11/16/96	11/16/96
Units:	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg
PARAMETER							
Phenol	390 U	430 U	430 U	440 U	440 U	430 U	390 U
bis(2-Chloroethyl)ether	390 U	430 U	430 U	440 U	440 U	430 U	390 U
2-Chlorophenol	390 U	430 U	430 U	440 U	440 U	430 U	390 U
1,4-Dichlorobenzene	390 U	430 U	430 U	440 U	440 U	430 U	390 U
1,3-Dichlorobenzene	390 U	430 U	430 U	440 U	440 U	430 U	390 U
1,2-Dichlorobenzene	390 UJ	430 U	430 UJ	440 U	440 U	430 U	390 UJ
2-Methylphenol	390 UJ	430 U	430 UJ	440 U	440 U	430 U	390 UJ
2,2'-oxybis(1-Chloropropane)	390 U	430 U	430 U	440 U	440 U	430 U	390 U
4-Methylphenol	390 U	430 U	430 U	440 U	440 U	430 U	390 U
N-Nitroso-di-n-propylamine	390 U	430 U	430 U	440 U	440 U	430 U	390 U
Hexachloroethane	390 U	430 U	430 U	440 U	440 U	430 U	390 U
Nitrobenzene	390 U	430 U	430 U	440 U	440 U	430 U	390 U
Isophorone	390 U	430 U	430 U	440 U	440 U	430 U	390 U
2-Nitrophenol	390 U	430 U	430 U	440 U	440 U	430 U	390 U
2,4-Dimethylphenol	390 U	430 U	430 U	440 U	440 U	430 U	390 U
bis(2-Chloroethoxy)methane	390 U	430 U	430 U	440 U	440 U	430 U	390 U
2,4-Dichlorophenol	390 U	430 U	430 U	440 U	440 U	430 U	390 U
1,2,4-Trichlorobenzene	390 U	430 U	430 U	440 U	440 U	430 U	390 U
Naphthalene	210 J	39 J	180 J	54 J	32 J	26 J	390 U
4-Chloroaniline	390 U	430 U	430 U	440 U	440 U	430 U	390 U
Hexachlorobutadiene	390 U	430 U	430 U	440 U	440 U	430 U	390 U
4-Chloro-3-methylphenol	390 U	430 U	430 U	440 U	440 U	430 U	390 U
2-Methylnaphthalene	280 J	56 J	290 J	81 J	49 J	36 J	390 U
Hexachlorocyclopentadiene	390 U	430 U	430 U	440 U	440 U	430 U	390 U
2,4,6-Trichlorophenol	390 U	430 U	430 U	440 U	440 U	430 U	390 U
2,4,5-Trichlorophenol	940 U	1,000 U	1,000 U	1,100 U	1,100 U	1,000 U	950 U
2-Chloronaphthalene	390 U	430 U	430 U	440 U	440 U	430 U	390 U
2-Nitroaniline	940 U	1,000 U	1,000 U	1,100 U	1,100 U	1,000 U	950 U
Dimethylphthalate	390 U	430 U	430 U	440 U	440 U	430 U	390 U

Table 4-11
Soil Results -- Semivolatile Organic Compounds
Republic Steel Quarry
Elyria, Ohio

Location:	Background	Background	Background	Background	Background	Background	SS-103-DUP
Type:	Investigative	Investigative	Investigative	Investigative	Investigative	Investigative	Field Duplicate
EPA Sample No.:	EXX56	EXX57	EXX58	EXX59	EXX60	EXX61	EXX62
Sample I.D.:	SS-109	SS-110	SS-111	SS-112	SS-113	SS-114	SS-115
Matrix:	Soil	Soil	Soil	Soil	Soil	Soil	Soil
Sample Date:	11/16/96	11/16/96	11/16/96	11/16/96	11/16/96	11/16/96	11/16/96
Units:	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg
PARAMETER							
Acenaphthylene	390 U	430 U	430 U	440 U	440 U	430 U	390 U
2,6-Dinitrotoluene	390 U	430 U	430 U	440 U	440 U	430 U	390 U
3-Nitroaniline	940 U	1,000 U	1,000 U	1,100 U	1,100 U	1,000 U	950 U
Acenaphthene	390 U	430 U	430 U	440 U	440 U	430 U	390 U
2,4-Dinitrophenol	940 U	1,000 U	1,000 U	1,100 U	1,100 U	1,000 U	950 U
4-Nitrophenol	940 U	1,000 U	1,000 U	1,100 U	1,100 U	1,000 U	950 U
Dibenzofuran	44 J	430 U	65 J	440 U	440 U	430 U	390 U
2,4-Dinitrotoluene	390 U	430 U	430 U	440 U	440 U	430 U	390 U
Diethylphthalate	390 U	430 U	430 U	440 U	440 U	430 U	390 U
4-Chlorophenyl-phenylether	390 U	430 U	430 U	440 U	440 U	430 U	390 U
Fluorene	390 U	430 U	430 U	440 U	440 U	430 U	390 U
4-Nitroaniline	940 U	1,000 U	1,000 U	1,100 U	1,100 U	1,000 U	950 U
4,6-Dinitro-2-methylphenol	940 U	1,000 U	1,000 U	1,100 U	1,100 U	1,000 U	950 U
N-Nitrosodiphenylamine	390 U	430 U	430 U	440 U	440 U	430 U	390 U
4-Bromophenyl-phenylether	390 U	430 U	430 U	440 U	440 U	430 U	390 U
Hexachlorobenzene	390 U	430 U	430 U	440 U	440 U	430 U	390 U
Pentachlorophenol	940 U	1,000 U	1,000 U	1,100 U	1,100 U	1,000 U	950 U
Phenanthrene	98 J	100 J	180 J	64 J	36 J	31 J	390 U
Anthracene	390 U	24 J	430 U	440 U	440 U	430 U	390 U
Carbazole	390 U	430 U	430 U	440 U	440 U	430 U	390 U
Di-n-butylphthalate	32 J	430 U	430 U	440 U	440 U	430 U	390 U
Fluoranthene	59 J	190 J	150 J	72 J	34 J	40 J	390 U
Pyrene	67 J	210 J	180 J	68 J	28 J	35 J	390 UJ
Butylbenzylphthalate	390 U	430 U	430 U	440 U	440 U	430 U	390 UJ
3,3'-Dichlorobenzidine	390 U	430 U	430 U	440 U	440 U	430 U	390 UJ
Benzo(a)anthracene	35 J	100 J	83 J	38 J	440 U	430 U	390 UJ
Chrysene	53 J	130 J	130 J	54 J	28 J	34 J	390 UJ
bis(2-Ethylhexyl)phthalate	390 U	62 J	100 J	39 J	54 J	33 J	390 UJ
Di-n-octylphthalate	390 U	430 U	430 U	440 U	440 U	430 U	390 UJ

Table 4-11
Soil Results -- Semivolatile Organic Compounds
Republic Steel Quarry
Elyria, Ohio

Location:	Background	Background	Background	Background	Background	Background	SS-103-DUP
Type:	Investigative	Investigative	Investigative	Investigative	Investigative	Investigative	Field Duplicate
EPA Sample No.:	EXX56	EXX57	EXX58	EXX59	EXX60	EXX61	EXX62
Sample I.D.:	SS-109	SS-110	SS-111	SS-112	SS-113	SS-114	SS-115
Matrix:	Soil	Soil	Soil	Soil	Soil	Soil	Soil
Sample Date:	11/16/96	11/16/96	11/16/96	11/16/96	11/16/96	11/16/96	11/16/96
Units:	μg/kg	μg/kg	μg/kg	μg/kg	μg/kg	μg/kg	μg/kg
PARAMETER							
Benzo(b)fluoranthene	390 U	99 J	120 J	57 J	440 U	430 U	390 UJ
Benzo(k)fluoranthene	390 U	120 J	140 J	43 J	440 U	430 U	390 UJ
Benzo(a)pyrene	390 U	430 U	430 U	440 U	440 U	430 U	390 UJ
Indeno(1,2,3-cd)pyrene	390 U	61 J	70 J	440 U	440 U	430 U	390 UJ
Dibenz(a,h)anthracene	390 U	430 U	430 U	440 U	440 U	430 U	390 UJ
Benzo(g,h,i)perylene	390 U	430 U	48 J	440 U	440 U	430 U	390 UJ

- Indicates detection.
U - Compound was not detected.
J - Estimated quantity.

Table 4-12
Soil Results -- Inorganic Compounds
Republic Steel Quarry
Elyria, Ohio

Location:	Discharge Ditch (Inside Fence 0-8")	Boat Ramp 0-8"	Boat Ramp 0-8"	Discharge Ditch (Outside Fence 12")	Discharge Ditch (Inside Fence 12")	Boat Ramp 12"	Boat Ramp 12"
Type:	Investigative	Investigative	Investigative	Investigative	Investigative	Investigative	Investigative
EPA Sample No.:	MEXG81	MEXG82	MEXG83	MEXG84	MEXG85	MEXG86	MEXG87
Sample I.D.:	SS-102	SS-103	SS-104	SS-105	SS-106	SS-107	SS-108
Matrix:	Soil	Soil	Soil	Soil	Soil	Soil	Soil
Sample Date:	11/16/96	11/16/96	11/16/96	11/16/96	11/16/96	11/16/96	11/16/96
Units:	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
PARAMETER							
Aluminum	741	1,530	1,170	658	1,360	1,660	1,220
Antimony	2.8	1.2 U	1.1 U	2.2	3.0	1.7	1.2 U
Arsenic	11.6 J	16.2 J	6.8 J	8.8 J	13.8 J	15.2 J	7.8 J
Barium	45.0	6.5	4.4	32.2	53.3	6.5	5.0
Beryllium	0.23 U	0.23 U	0.23 U	0.25 U	0.24 U	0.24 U	0.23 U
Cadmium	1.3	0.45	0.23 U	1.2	1.4	0.55	0.31
Calcium	467	633	578	1,130	446	601	744
Chromium	11.4	12.7	5.7	8.9	15.6	18.4	9.7
Cobalt	2.0	3.4	4.1	2.0	3.9	3.2	3.3
Copper	19.1	30.2	16.8	34.7	24.4	45.8	31.2
Iron	91,800	28,300	7,730	82,900	107,000	29,600	10,900
Lead	33.5	18.7	8.2	22.7	38.6	22.3	15.2
Magnesium	154	480	518	255	241	491	551
Manganese	209	69.3	87.6	145	376	72.7	83.2
Mercury	0.12 U	0.12 U	0.11 U	0.24	0.12	0.12 U	0.12 U
Nickel	2.1	8.2	9.7	1.7	5.2	8.4	9.0
Potassium	2,160	373	338	1,690	2,000	407	327
Selenium	3.5	1.2 U	1.1 U	3.2	4.1	1.2 U	1.2 U
Silver	0.94 U	0.94 U	0.90 U	0.99 U	0.94 U	0.94 U	0.93 U
Sodium	390	188	182	400	360	171	173
Thallium	1.2 U	1.2 U	1.1 U	1.2 U	1.9	1.2 U	1.2 U
Vanadium	10.0	5.8	4.6	9.9	12.8	6.3	4.8
Zinc	14.7	25.4	24.6	20.6	18.1	27.4	30.6
Cyanide	0.30 J	0.28 J	0.12 J	0.44 J	0.36 J	0.19 J	0.12 UJ

- Indicates detection.
No sample results for SS-102 because the sample container was broken by the laboratory. Therefore, the sample was not able to be analyzed.
U - Compound was not detected.
J - Estimated quantity.

Table 4-12
Soil Results -- Inorganic Compounds
Republic Steel Quarry
Elyria, Ohio

Location:	Background	Background	Background	Background	Background	Background	SS-103-DUP
Type:	Investigative	Investigative	Investigative	Investigative	Investigative	Investigative	Field Duplicate
EPA Sample No.:	MEXG88	MEXG89	MEXG90	MEXG91	MEXG92	MEXG93	MEXG94
Sample I.D.:	SS-109	SS-110	SS-111	SS-112	SS-113	SS-114	SS-115
Matrix:	Soil	Soil	Soil	Soil	Soil	Soil	Soil
Sample Date:	11/16/96	11/16/96	11/16/96	11/16/96	11/16/96	11/16/96	11/16/96
Units:	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
PARAMETER							
Aluminum	3,980	12,600	2,420	10,700	8,270	9,640	1,460
Antimony	1.3	1.3 U	2.6	1.4	1.3 U	1.3 U	1.4
Arsenic	29.1 J	10.2 J	14.0 J	10.6 J	8.5 J	10.0 J	14.6 J
Barium	33.6	105	18.6	79.7	53.3	74.8	6.3
Beryllium	0.24	0.89	0.33	0.70	0.48	0.64	0.23 U
Cadmium	0.62	0.92	0.94	0.89	0.62	0.86	0.43
Calcium	1,860	1,960	1,240	2,790	1,080	3,220	754
Chromium	7.7	17.1	6.0	14.2	10.6	12.9	13.2
Cobalt	3.7	15.5	5.6	10.6	5.3	12.1	2.9
Copper	21.7	14.8	18.4	17.6	10.8	14.0	27.6
Iron	23,000	26,300	13,100	19,900	16,600	19,700	25,000
Lead	30.3	118	59.0	31.1	22.3	38.5	16.2
Magnesium	1,110	2,290	618	2,430	1,440	2,010	470
Manganese	110	532	228	724	355	964	61.5
Mercury	0.12 U	0.13 U	0.13 U	0.14 U	0.13 U	0.13 U	0.14
Nickel	11.6	17.9	9.9	17.1	10.0	12.3	8.0
Potassium	769	869	365	978	479	834	374
Selenium	1.7	1.7	1.5	1.4	1.3 U	1.7	1.2 J
Silver	0.93 U	1.0 U	1.0 U	1.1 U	1.1 U	1.1 U	0.94 U
Sodium	235	217	218	264	250	224	204
Thallium	1.2 U	1.3 U	1.3 U	1.4 U	1.3 U	1.3 U	1.2 U
Vanadium	15.3	25.8	8.7	21.1	19.9	21.3	5.7
Zinc	85.5	178	49.6	74.8	50.2	75.8	22.1
Cyanide	0.20 J	0.41 J	0.37 J	0.25 J	0.14 J	0.23 J	0.15 J

- Indicates detection.
No sample results for SS-102 because the sample container was broken by the laboratory. Therefore, the sample was not able to be analyzed.
U - Compound was not detected.
J - Estimated quantity.

Table 4-13
Sediment Results -- Volatile Organic Compounds
Republic Steel Quarry
Elyria, Ohio

Location:	Quarry	Quarry	Quarry	Quarry	Quarry	Quarry	Quarry Outfall	SD-105-DUP
Type:	Investigative	Investigative	Investigative	Investigative	Investigative	Investigative	Investigative	Field Duplicate
EPA Sample No.:	EXX18	EXX19	EXX20	EXX21	EXX22	EXX23	EXX24	EXX25
Sample I.D.:	SS-101MSD	SS-102	SS-103	SS-104	SS-105	SS-106	SS-107	SS-108
Matrix:	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment
Sample Date:	11/13/96	11/13/96	11/13/96	11/13/96	11/13/96	11/13/96	11/13/96	11/13/96
Units:	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg
PARAMETER								
Chloromethane	45 U	77 U	40 U	140 U	150 U	59 UJ	18 U	83 UJ
Bromomethane	45 U	77 U	40 U	140 U	150 U	59 UJ	18 U	83 UJ
Vinyl Chloride	45 U	77 U	40 U	140 U	150 U	59 UJ	18 U	83 UJ
Chloroethane	45 U	77 U	40 U	140 U	150 U	59 UJ	18 U	83 UJ
Methylene Chloride	13 J	41 J	5 J	28 J	58 J	37 J	6 J	48 J
Acetone	230 J	920 J	300 J	2,800 J	1,300 J	910 J	38 J	1,400 J
Carbon Disulfide	45 U	77 U	40 U	16 J	150 J	22 J	18 U	26 J
1,1-Dichloroethene	45 U	77 U	40 U	140 U	150 U	59 UJ	18 U	83 UJ
1,1-Dichloroethane	45 U	77 U	40 U	140 U	150 U	59 UJ	18 U	83 UJ
1,2-Dichloroethene (total)	45 U	77 U	40 U	140 U	150 U	59 UJ	18 U	83 UJ
Chloroform	45 U	77 U	40 U	140 U	150 U	59 UJ	18 U	83 UJ
1,2-Dichloroethane	45 UJ	77 UJ	40 UJ	140 UJ	150 UJ	59 UJ	18 UJ	83 UJ
2-Butanone	62	280	91	830	440	300 J	7 J	530 J
1,1,1-Trichloroethane	45 UJ	77 U	40 U	140 U	150 U	59 UJ	18 U	83 UJ
Carbon Tetrachloride	45 UJ	77 U	40 U	140 U	150 U	59 UJ	18 U	83 UJ
Bromodichloromethane	45 UJ	77 U	40 U	140 U	150 U	59 UJ	18 U	83 UJ
1,2-Dichloropropene	45 UJ	77 U	40 U	140 U	150 U	59 UJ	18 U	83 UJ
cis-1,3-Dichloropropene	45 UJ	77 U	40 U	140 U	150 U	59 UJ	18 U	83 UJ
Trichloroethene	45 UJ	77 U	40 U	140 U	150 U	59 UJ	18 U	83 UJ
Dibromochloromethane	45 UJ	77 U	40 U	140 U	150 U	59 UJ	18 U	83 UJ
1,1,2-Trichloroethane	45 UJ	77 U	40 U	140 U	150 U	59 UJ	18 U	83 UJ
Benzene	45 UJ	77 U	40 U	140 U	150 U	8 J	18 U	16 J
trans-1,3-Dichloropropene	45 UJ	77 U	40 U	140 U	150 U	59 UJ	18 U	83 UJ
Bromoform	45 UJ	77 U	40 U	140 U	150 U	59 UJ	18 U	83 UJ
4-Methyl-2-Pentanone	45 UJ	77 UJ	40 UJ	140 UJ	150 UJ	59 R	18 UJ	83 R
2-Hexanone	45 UJ	77 UJ	40 UJ	140 U	150 UJ	59 R	18 U	83 R
Tetrachloroethene	45 UJ	77 UJ	40 UJ	140 U	150 UJ	48 J	18 U	34 J
1,1,2,2-Tetrachloroethane	45 UJ	77 UJ	40 UJ	140 U	150 UJ	59 R	18 U	83 R
Toluene	45 UJ	9 J	40 UJ	140 U	150 UJ	73 J	18 U	10 J
Chlorobenzene	45 UJ	77 UJ	40 UJ	140 U	150 UJ	59 R	18 U	83 R

Table 4-13
Sediment Results -- Volatile Organic Compounds
Republic Steel Quarry
Elyria, Ohio

Location:	**Quarry**	**Quarry**	**Quarry**	**Quarry**	**Quarry**	**Quarry**	**Quarry Outfall**	**SD-105-DUP**
Type:	**Investigative**	**Investigative**	**Investigative**	**Investigative**	**Investigative**	**Investigative**	**Investigative**	**Field Duplicate**
EPA Sample No.:	**EXX18**	**EXX19**	**EXX20**	**EXX21**	**EXX22**	**EXX23**	**EXX24**	**EXX25**
Sample I.D.:	**SS-101MSD**	**SS-102**	**SS-103**	**SS-104**	**SS-105**	**SS-106**	**SS-107**	**SS-108**
Matrix:	**Sediment**	**Sediment**	**Sediment**	**Sediment**	**Sediment**	**Sediment**	**Sediment**	**Sediment**
Sample Date:	**11/13/96**	**11/13/96**	**11/13/96**	**11/13/96**	**11/13/96**	**11/13/96**	**11/13/96**	**11/13/96**
Units:	**µg/kg**	**µg/kg**	**µg/kg**	**µg/kg**	**µg/kg**	**µg/kg**	**µg/kg**	**µg/kg**
PARAMETER								
Ethylbenzene	45 UJ	77 UJ	40 UJ	140 U	150 UJ	17 J	18 U	83 R
Styrene	45 UJ	77 UJ	40 UJ	140 U	150 UJ	59 R	18 U	83 R
Xylene (total)	45 UJ	77 UJ	40 UJ	140 U	150 UJ	70 J	18 U	83 R

- Indicates detection.
U - Compound was not detected.
J - Estimated quantity.
R - Result is unusable.

Table 4-14
Sediment Results -- Semivolatile Organic Compounds
Republic Steel Quarry
Elyria, Ohio

Location:	Quarry	Quarry	Quarry	Quarry	Quarry	Quarry	Quarry Outfall	SD-105-DUP
Type:	Investigative	Investigative	Investigative	Investigative	Investigative	Investigative	Investigative	Field Duplicate
EPA Sample No.:	EXX18	EXX19	EXX20	EXX21	EXX22	EXX23	EXX24	EXX25
Sample I.D.:	SS-101MSD	SS-102	SS-103	SS-104	SS-105	SS-106	SS-107	SS-108
Matrix:	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment
Sample Date:	11/13/96	11/13/96	11/13/96	11/13/96	11/13/96	11/13/96	11/13/96	11/13/96
Units:	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg
PARAMETER								
Phenol	1,500 U	2,500 U	1,300 U	4,700 U	2,500 U	1,900 U	610 U	2,800 U
bis(2-Chloroethyl)ether	1,500 U	2,500 U	1,300 U	4,700 U	2,500 U	1,900 U	610 U	2,800 U
2-Chlorophenol	1,500 U	2,500 U	1,300 U	4,700 U	2,500 U	1,900 U	610 U	2,800 U
1,3-Dichlorobenzene	1,500 U	2,500 U	1,300 U	4,700 U	160 J	1,900 U	610 U	2,800 U
1,4-Dichlorobenzene	1,500 U	200 J	1,300 U	4,700 U	2,500 U	1,900 U	610 U	2,800 U
1,2-Dichlorobenzene	1,500 U	2,500 U	1,300 U	4,700 U	2,500 U	1,900 U	610 U	2,800 U
2-Methylphenol	1,500 U	2,500 U	1,300 U	4,700 U	2,500 U	1,900 U	610 U	2,800 U
2,2'-oxybis(1-Chloropropane)	1,500 U	2,500 U	1,300 U	4,700 U	2,500 U	1,900 U	610 U	2,800 U
4-Methylphenol	1,500 U	2,500 U	1,300 U	4,700 U	2,500 U	390 J	610 U	2,800 U
N-Nitroso-di-n-propylamine	1,500 UJ	2,500 UJ	1,300 UJ	4,700 UJ	2,500 UJ	1,900 UJ	610 UJ	2,800 UJ
Hexachloroethane	1,500 U	2,500 U	1,300 U	4,700 U	2,500 U	1,900 U	610 U	2,800 U
Nitrobenzene	1,500 U	2,500 U	1,300 U	4,700 U	2,500 UJ	1,900 UJ	610 U	2,800 U
Isophorone	1,500 U	2,500 U	1,300 U	4,700 U	2,500 UJ	1,900 UJ	610 U	2,800 U
2-Nitrophenol	1,500 U	2,500 U	1,300 U	4,700 U	2,500 UJ	1,900 UJ	610 U	2,800 U
2,4-Dimethylphenol	1,500 U	2,500 U	1,300 U	4,700 U	2,500 UJ	1,900 UJ	610 U	2,800 U
bis(2-Chloroethoxy)methane	1,500 U	2,500 U	1,300 U	4,700 U	2,500 UJ	1,900 UJ	610 U	2,800 U
2,4-Dichlorophenol	1,500 U	2,500 U	1,300 U	4,700 U	2,500 UJ	1,900 UJ	610 U	2,800 U
1,2,4-Trichlorobenzene	1,500 U	170 J	1,300 U	4,700 U	2,500 UJ	1,900 UJ	610 U	2,800 U
Naphthalene	1,500 U	2,500 U	94 J	4,700 U	2,500 UJ	240 J	610 U	2,800 U
4-Chloroaniline	1,500 U	2,500 U	1,300 U	4,700 U	2,500 UJ	1,900 UJ	610 U	2,800 U
Hexachlorobutadiene	1,500 U	2,500 U	1,300 U	4,700 U	2,500 UJ	1,900 UJ	610 U	2,800 U
4-Chloro-3-methylphenol	1,500 U	280 J	1,300 U	4,700 U	2,500 UJ	1,900 UJ	610 U	2,800 U
2-Methylnaphthalene	1,500 U	2,500 U	130 J	4,700 U	2,500 UJ	600 J	610 U	2,800 U
Hexachlorocyclopentadiene	1,500 UJ	2,500 UJ	1,300 UJ	4,700 UJ	2,500 UJ	1,900 UJ	610 UJ	2,800 UJ
2,4,6-Trichlorophenol	1,500 UJ	2,500 U	1,300 UJ	4,700 UJ	2,500 UJ	1,900 UJ	610 U	2,800 UJ
2,4,5-Trichlorophenol	3,600 UJ	6,200 U	3,200 UJ	11,000 UJ	6,200 UJ	4,700 UJ	1,500 U	6,700 UJ
2-Chloronaphthalene	1,500 UJ	2,500 U	1,300 UJ	4,700 UJ	2,500 UJ	1,900 UJ	610 U	2,800 UJ
2-Nitroaniline	3,600 UJ	6,200 U	3,200 UJ	11,000 UJ	6,200 UJ	4,700 UJ	1,500 U	6,700 UJ
Dimethylphthalate	1,500 UJ	2,500 U	1,300 UJ	4,700 UJ	2,500 UJ	1,900 UJ	610 U	2,800 UJ
Acenaphthylene	1,500 UJ	2,500 U	1,300 UJ	4,700 UJ	2,500 UJ	1,900 UJ	610 U	2,800 UJ

Table 4-14
Sediment Results -- Semivolatile Organic Compounds
Republic Steel Quarry
Elyria, Ohio

Location:	Quarry	Quarry	Quarry	Quarry	Quarry	Quarry	Quarry Outfall	SD-105-DUP
Type:	Investigative	Investigative	Investigative	Investigative	Investigative	Investigative	Investigative	Field Duplicate
EPA Sample No.:	EXX18	EXX19	EXX20	EXX21	EXX22	EXX23	EXX24	EXX25
Sample I.D.:	SD-101MSD	SS-102	SS-103	SS-104	SS-105	SS-106	SS-107	SS-108
Matrix:	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment
Sample Date:	11/13/96	11/13/96	11/13/96	11/13/96	11/13/96	11/13/96	11/13/96	11/13/96
Units:	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg
PARAMETER								
2,6-Dinitrotoluene	1,500 UJ	2,500 U	1,300 UJ	4,700 UJ	2,500 UJ	1,900 UJ	610 U	2,800 UJ
3-Nitroaniline	3,600 UJ	6,200 U	3,200 UJ	11,000 UJ	6,200 UJ	4,700 UJ	1,500 U	6,700 UJ
Acenaphthene	1,500 UJ	230 J	1,300 UJ	4,700 UJ	2,500 UJ	1,900 UJ	610 U	2,800 UJ
2,4-Dinitrophenol	3,600 UJ	6,200 UJ	3,200 UJ	11,000 UJ	6,200 UJ	4,700 UJ	1,500 UJ	6,700 UJ
4-Nitrophenol	3,600 UJ	6,200 U	3,200 UJ	11,000 UJ	6,200 UJ	4,700 UJ	1,500 U	6,700 UJ
Dibenzofuran	1,500 UJ	2,500 U	1,300 UJ	4,700 UJ	2,500 UJ	1,900 UJ	610 U	2,800 UJ
2,4-Dinitrotoluene	1,500 UJ	2,500 U	1,300 UJ	4,700 UJ	2,500 UJ	1,900 UJ	610 U	2,800 UJ
Diethylphthalate	1,500 UJ	2,500 U	1,300 UJ	4,700 UJ	2,500 UJ	1,900 UJ	610 U	2,800 UJ
4-Chlorophenyl-phenylether	1,500 UJ	2,500 U	1,300 UJ	4,700 UJ	2,500 UJ	1,900 UJ	610 U	2,800 UJ
Fluorene	570 J	150 J	1,300 UJ	730 J	1,500 J	1,900 J	610 U	1,000 J
4-Nitroaniline	3,600 UJ	6,200 UJ	3,200 UJ	11,000 UJ	6,200 UJ	4,700 UJ	1,500 UJ	6,700 UJ
4,6-Dinitro-2-methylphenol	3,600 R	6,200 U	3,200 UJ	11,000 UJ	6,200 R	4,700 UJ	1,500 U	6,700 UJ
N-Nitrosodiphenylamine	1,500 R	2,500 U	1,300 UJ	4,700 UJ	2,500 R	1,900 UJ	610 U	2,800 UJ
4-Bromophenyl-phenylether	1,500 R	2,500 U	1,300 UJ	4,700 UJ	2,500 R	1,900 UJ	610 U	2,800 UJ
Hexachlorobenzene	1,500 R	2,500 U	1,300 UJ	4,700 UJ	2,500 R	1,900 UJ	610 U	2,800 UJ
Pentachlorophenol	3,600 R	6,200 U	3,200 UJ	11,000 UJ	6,200 R	4,700 UJ	1,500 U	6,700 UJ
Phenanthrene	1,500 R	300 J	360 J	1,200 J	1,800 J	10,000 J	44 J	1,300 J
Anthracene	1,500 R	170 J	160 J	1,800 J	2,600 J	1,900 UJ	610 U	1,500 J
Carbazole	1,500 R	2,500 UJ	1,300 UJ	4,700 UJ	2,500 R	1,900 UJ	610 UJ	2,800 UJ
Di-n-butylphthalate	1,500 R	2,500 U	1,300 UJ	4,700 UJ	2,500 R	3,500 J	610 U	2,800 UJ
Fluoranthene	1,800 J	460 J	510 J	1,800 J	3,400 J	3,200 J	70 J	1,700 J
Pyrene	2,400 J	1,300 J	1,300 J	3,800 J	4,600 J	5,500 J	1,000 J	4,200 J
Butylbenzylphthalate	1,500 R	2,500 R	1,300 R	4,700 R	2,500 R	1,900 R	42 J	2,800 R
3,3'-Dichlorobenzidine	1,500 R	2,500 R	1,300 R	4,700 R	2,500 R	1,900 R	610 UJ	2,800 R
Benzo(a)anthracene	1,300 J	330 J	400 J	4,700 R	2,500 J	3,000 J	33 J	2,800 R
Chrysene	2,100 J	510 J	700 J	2,200 J	3,200 J	3,800 J	61 J	1,900 J
bis(2-Ethylhexyl)phthalate	1,700 J	2,500 R	1,600 R	4,700 R	2,700 R	1,900 R	610 U	2,800 R
Di-n-octylphthalate	1,500 R	2,500 R	960 J	4,700 R	2,500 R	1,900 R	610 UJ	2,800 R
Benzo(b)fluoranthene	1,500 R	2,500 R	1,300 R	1,200 J	2,500 R	1,900 R	110 J	2,800 R
Benzo(k)fluoranthene	1,500 R	2,500 R	1,300 R	1,400 J	2,500 R	1,900 R	610 UJ	2,800 R

Table 4-14
Sediment Results -- Semivolatile Organic Compounds
Republic Steel Quarry
Elyria, Ohio

Location:	Quarry	Quarry	Quarry	Quarry	Quarry	Quarry	Quarry Outfall	SD-105-DUP
Type:	Investigative	Investigative	Investigative	Investigative	Investigative	Investigative	Investigative	Field Duplicate
EPA Sample No.:	EXX18	EXX19	EXX20	EXX21	EXX22	EXX23	EXX24	EXX25
Sample I.D.:	SD-101MSD	SS-102	SS-103	SS-104	SS-105	SS-106	SS-107	SS-108
Matrix:	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment
Sample Date:	11/13/96	11/13/96	11/13/96	11/13/96	11/13/96	11/13/96	11/13/96	11/13/96
Units:	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg
PARAMETER								
Benzo(a)phrene	1,500 R	380 J	650 J	4,700 R	2,500 R	1,900 R	56 J	2,800 R
Indeno(1,2,3-cd)pyrene	710 J	2,500 R	800 J	1,100 J	710 J	760 J	610 UJ	1,400 J
Dibenz(a,h)anthracene	410 J	2,500 R	1,300 R	4,700 R	2500 R	1900 R	610 UJ	2800 R
Benzo(g,h,i)perylene	860 J	470 J	770 J	1,100 J	1,100 J	800 J	610 UJ	1,400 J

- Indicates detection.
U - Compound was not detected.
J - Estimated quantity.
R - Result are unusable.

Table 4-15
Sediment Results -- Pesticides
Republic Steel Quarry
Elyria, Ohio

Location:	Quarry	Quarry	Quarry	Quarry	Quarry	Quarry	Quarry Outfall	SD-105-DUP
Type:	Investigative	Investigative	Investigative	Investigative	Investigative	Investigative	Investigative	Field Duplicate
EPA Sample No.:	EXX18	EXX19	EXX20	EXX21	EXX22	EXX23	EXX24	EXX25
Sample I.D.:	SD-101MSD	SS-102	SS-103	SS-104	SS-105	SS-106	SS-107	SS-108
Matrix:	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment
Sample Date:	11/13/96	11/13/96	11/13/96	11/13/96	11/13/96	11/13/96	11/13/96	11/13/96
Units:	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg
PARAMETER								
alpha-BHC	7.7 U	13 U	6.8 U	24 U	13 U	10 R	3.2 U	14 U
beta-BHC	7.7 U	13 U	6.8 U	24 U	13 U	10 R	3.2 U	14 U
delta-BHC	7.7 U	13 U	6.8 U	24 U	13 U	10 R	3.2 U	14 U
gamma-BHC (Lindane)	7.7 UJ	13 U	6.8 U	24 U	13 U	10 R	3.2 U	14 U
Heptachlor	7.7 UJ	13 U	6.8 U	24 U	29 J	10 R	3.2 U	19 J
Aldrin	7.7 UJ	21	6.8 U	24 U	13 U	69 J	3.2 U	14 U
Heptachlor epoxide	7.7 U	13 U	6.8 U	24 U	13 U	10 R	3.2 U	14 U
Endosulfan I	7.7 U	13 U	6.8 U	24 U	13 U	10 R	3.2 U	14 U
Dieldrin	15 U	25 U	13 U	47 U	25 U	19 R	6.1 U	28 U
4,4'-DDE	15 U	25 U	13 U	47 U	25 U	19 R	6.1 U	28 U
Endrin	15 U	25 U	13 U	47 U	25 U	19 R	6.1 U	28 U
Endosulfan II	15 U	25 U	13 U	47 U	25 U	19 R	6.1 U	28 U
4,4'-DDD	15 U	25 U	13 U	47 U	25 U	19 R	6.1 U	28 U
Endosulfan sulfate	15 U	25 U	13 U	47 U	25 U	19 R	6.1 U	28 U
4,4'-DDT	15 U	25 U	14 J	47 U	25 U	19 R	6.1 U	28 U
Methoxychlor	77 U	130 U	68 U	240 U	130 U	100 R	31 U	140 U
Endrin ketone	15 U	25 U	13 U	47 U	25 U	19 R	6.1 U	28 U
Endrin aldehyde	15 U	25 U	13 U	47 U	25 U	19 R	6.1 U	28 U
alpha-Chlordane	7.7 U	13 U	7.6 J	24 U	19 J	75 J	3.2 U	14 U
gamma-Chlordane	7.7 U	13 U	6.8 U	24 U	34 J	10 R	3.2 U	14 U
Toxaphene	770 U	1,300 U	680 U	2,400 U	1,300 U	1,000 R	310 U	1,400 U
Aroclor-1016	150 U	250 U	130 U	470 U	250 U	190 R	61 U	280 U
Aroclor-1221	300 U	520 U	270 U	960 U	520 U	390 R	120 U	560 U
Aroclor-1232	150 U	250 U	130 U	470 U	250 U	190 R	61 U	280 U
Aroclor-1242	150 U	250 U	130 U	470 U	250 U	190 R	61 U	280 U
Aroclor-1248	150 U	250 U	130 U	470 U	250 U	190 R	61 U	280 U
Aroclor-1254	150 U	250 U	130 U	470 U	250 U	190 R	61 U	280 U
Aroclor-1260	150 U	250 U	130 U	470 U	250 U	190 R	61 U	280 U

- Indicates detection.
U - Compound was not detected.
J - Estimated quantity.
R - Result is unusable.

Table 4-16
Sediment Results -- Inorganic Compounds
Republic Steel Quarry
Elyria, Ohio

Location:	Quarry	Quarry	Quarry	Quarry	Quarry	Quarry	Quarry Outfall	SD-105-DUP
Type:	Investigative	Investigative	Investigative	Investigative	Investigative	Investigative	Investigative	Field Duplicate
EPA Sample No.:	MEXG71	MEXG72	MEXG73	MEXG74	MEXG75	MEXG76	MEXG77	MEXG78
Sample I.D.:	SD-101MSD	SS-102	SS-103	SS-104	SS-105	SS-106	SS-107	SS-108
Matrix:	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment
Sample Date:	11/13/96	11/13/96	11/13/96	11/13/96	11/13/96	11/13/96	11/13/96	11/13/96
Units:	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
PARAMETER								
Aluminum	14,700 EJ	30,300 J	11,100 J	21,600 J	9,160 J	12,200 J	6,400 J	12,700 J
Antimony	4.1 UJ	6.8 JU	2.2 JU	6.5 JU	6.0 JU	4.1 JU	1.4 JU	6.0 JU
Arsenic	24.0	43.9	12.4	26.9	4.6 U	16.7	7.2	4.7 U
Barium	125 B	109 B	62.5 B	73.8 B	56.8 B	129 B	54.5 B	84.3 B
Beryllium	0.35 U	0.56 U	0.18 U	0.88 B	0.50 U	0.34 U	0.11 U	0.50 U
Cadmium	1.5 B	1.6 B	1.4 B	1.3 B	0.66 U	0.64 B	0.58 B	0.94 B
Calcium	4,320 B	10,900	19,900	9,240	4,110 B	4,280 B	6,610	6,260 B
Chromium	45.9	117	28.2	58.2	26.7	27.5	12.9	39.8
Cobalt	12.4 B	18.6 B	11.3 B	13.6 B	8.5 B	2.6 U	8.2 B	23.3 B
Copper	126	161	83.2	164	58.4	333	24.5	75.5
Iron	58,700 J	214,000 J	56,100 J	87,500 J	58,700 J	35,500 J	27,200 J	116,000 J
Lead	52.4	192	75.7	73.3	33.4	96.8	24.5	46.0
Magnesium	3,380 B	4,920 B	7,420	6,480 B	2,430 B	1,860 B	3,480	3,430 B
Manganese	417 J	3,470 J	1,840 J	588 J	784 J	170 J	808 J	1,480 J
Mercury	0.34 B	0.42 U	0.72	0.49 U	0.61 B	0.44 B	0.10 U	0.62 B
Nichel	56.8	84.1	22.6 B	75.9	47.2 B	8.9 B	19.4	80.2
Potassium	2,730 B	2,090 B	2,040 B	3,210 B	1,480 B	3,960 B	1,150 B	2,210 B
Selenium	4.8 BJ	6.0 BJ	1.9 JU	5.6 JU	5.1 JU	3.6 JU	1.2 JU	5.2 JU
Silver	1.4 U	2.3 U	0.73 U	2.2 U	2.0 U	1.4 U	0.46 U	2.0 U
Sodium	610 B	969 B	449 B	1,420 B	511 U	940 B	177 BJ	953 B
Thallium	4.1 U	10.5 BJ	4.0 BJ	6.5 U	6.0 U	4.1 U	1.4 U	6.0 U
Vanadium	29.6 B	50.5 B	27.4 B	41.9 B	18.4 B	33.3 B	15.0 B	26.6 B
Zinc	163 J	371 J	216 J	234 J	123 J	41.1 J	139 J	170 J
Cyanide	3.6 RU	5.6 RU	2.4 RU	5.9 RU	5.0 RU	4.6 RU	1.3 RU	5.4 RU

- Indicates detection.
U - Compound was not detected.
J - Estimated quantity.
B - Compound was detected below the contract required detection limit but above the instrument detection limit.

Table 4-17
Sediment Results -- Geotechnical
Republic Steel Quarry
Elyria, Ohio

Location:	Quarry	Quarry	Quarry	Quarry	Quarry	Quarry	Quarry Outfall	SD-105-DUP
Type:	Investigative	Investigative	Investigative	Investigative	Investigative	Investigative	Investigative	Field Duplicate
EPA Sample No.:	97ZG02S21	97ZG02S22	97ZG02S23	97ZG02S24	97ZG02S25	97ZG02S26	97ZG02S27	97ZG02D25
Sample I.D.:	SD-101MSD	SD-102	SD-103	SD-104	SD-105	SD-106	SD-107	SD-108
Matrix:	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment
Sample Date:	11/13/96	11/13/96	11/13/96	11/13/96	11/13/96	11/13/96	11/13/96	11/13/96
Units:	%	%	%	%	%	%	%	%
PARAMETER								
Percent Solids (60°C)	11.8	11.8	27.7	8.62	12.9	17.8	54.5	12.9
Percent Solids (105°C)	11.3	11.4	27.2	8.21	12.1	16.7	54.3	12.2
Percent Solids (550°C)	19.4	19.7	13.9	19.9	22.2	29.5	4.40	20.1
Total Organic Carbon (TOC)	0.50 J	0.46 J	1.22 J	0.38 J	0.61 J	1.27 J	0.55 J	0.51 J
Oil & Grease (mg/L)	44,485	11,024	35,484	25,100	30,692	1,533	35,590	130,287

J - Estimated quantity.

Table 4-18

Index of Biological Activity (IBI)
Republic Steel Quarry
Elyria, Ohio

Metric	Upstream		Downstream	
	V	R	V	R
Total Number of Species	12	3	8	1
Number of Darter Species	0	1	0	1
Number of Sunfish Species	2	3	2	3
Number of Sucker Species	3	3	3	3
Number of Sensitive Species	1	1	2	1
Percent Tolerant Species	50%	1	38%	1
Percent Omnivores	25%	3	13%	5
Percent Insectivorous Species	33%	3	505	3
Percent Top Carnivore Species	8%	5	25%	5
Number of Individuals[a]	< 100	1	< 100	1
Number of Simple Lithophilic Species	8%	1	25%	3
Percent DELT Anomalies[b]	0	5	0	5
FINAL INDEX SCORE		30		32

Note: V - value; R - rating.

[a] Excludes species designated as tolerant, hybrids, and exotics.

[b] Includes deformities, eroded fins, lesions, and external tumors (DELT).

Table 4-19

Qualitative Habitat Evaluation Index
Republic Steel Quarry

Procedure No. WDPA-SWS-3 Date Issued 9-30-89
Revision No. 5 Date Effective 9-30-89

Figure V-4-5. Front side of the Ohio EPA Site Description Sheet for evaluating the geographical and physical characteristics of fish sampling locations. This is used to record information for the calculation of the Qualitative Habitat Evaluation Index (QHEI).

Ohio EPA Site Description Sheet - Fish QHEI SCORE: 63

Stream: BLACK RIVER RM ____ Date: 5-Nov-96
Location: DOWNSTREAM OF [illegible] AVE. BRIDGE Crew: JOHN CASOLI / STEVE BROWN

1) SUBSTRATE (Check ONLY Two Substrate TYPE BOXES; Check all types present) SUBSTRATE SCORE: 21

TYPE POOL RIFFLE POOL RIFFLE SUBSTRATE QUALITY
BLDER/SLABS [10] — GRAVEL [7] — Substrate Origin (Check all)
BOULDER [9] — SAND [6] — LIMESTONE [1] RIPRAP [0] SILT HEAVY [-2] SILT MODERATE [-1]
COBBLE [8] — BEDROCK [5] — TILLS [1] HARDPAN [0] SILT NORMAL [0] SILT FREE [1]
HARDPAN [4] — DETRITUS [3] — SANDSTONE [0] Extent of Embeddedness (Check One)
MUCK [2] — ARTIFIC [0] — SHALE [-1] EXTENSIVE [-2] MODERATE [-1]
TOTAL NUMBER OF SUBSTRATE TYPES: > 4 [2] <= 4 [0] COAL FINES [-2] LOW [0] NONE [1]
NOTE: (Ignore sludge that originates from point sources; score is based on natural substrates)
COMMENTS ____

2) INSTREAM COVER COVER SCORE: 10

TYPE (Check All That Apply) AMOUNT (Check ONLY One or check 2 and AVERAGE)
UNDERCUT BANKS [1] DEEP POOLS [2] OXBOWS [1] EXTENSIVE > 75% [11]
OVERHANGING VEGETATION [1] ROOTWADS [1] AQUATIC MACROPHYTES [1] MODERATE 25-75% [7]
SHALLOWS (IN SLOW WATER) [1] BOULDERS [1] LOGS OR WOODY DEBRIS [1] SPARSE 5-25% [3]
NEARLY ABSENT < 5% [1]
COMMENTS: ____

3) CHANNEL MORPHOLOGY: (Check ONLY One PER Category OR check 2 and AVERAGE) CHANNEL: 11

SINUOSITY / DEVELOPMENT / CHANNELIZATION / STABILITY / MODIFICATIONS/OTHER
HIGH [4] / EXCELLENT [7] / NONE [6] / HIGH [3] / SNAGGING / IMPOUND.
MODERATE [3] / GOOD [5] / RECOVERED [4] / MODERATE [2] / RELOCATION / ISLANDS
LOW [2] / FAIR [3] / RECOVERING [3] / LOW [1] / CANOPY REMOVAL / LEVEED
NONE [1] / POOR [1] / RECENT OR NO RECOVERY [1] / DREDGING / BANK SHAPING
ONE SIDE CHANNEL MODIFICATIONS
COMMENTS: ____

4) RIPARIAN ZONE AND BANK EROSION - (check ONE box per bank or check 2 and AVERAGE per bank) RIPARIAN: 7.5
River Right Looking Downstream

RIPARIAN WIDTH / EROSION/RUNOFF - FLOOD PLAIN QUALITY / BANK EROSION
L R (Per Bank) / L R (Most Predominant Per Bank) L R (Per Bank)
WIDE > 50m [4] / FOREST, SWAMP [3] / URBAN OR INDUSTRIAL [0] / NONE OR LITTLE [3]
MODERATE 10-50m [3] / OPEN PASTURE/ROWCROP [0] / SHRUB OR OLD FIELD [2] / MODERATE [2]
NARROW 5-10m [2] / RESID., PARK, NEW FIELD [1] / CONSERV. TILLAGE [1] / HEAVY OR SEVERE [1]
VERY NARROW 1-5m [1] / FENCED PASTURE [1] / MINING/CONSTRUCTION [0]
NONE [0]
COMMENTS: ____

5) POOL/GLIDE AND RIFFLE/RUN QUALITY POOL: 3

MAX. DEPTH (Check 1) / MORPHOLOGY (Check 1) / POOL/RUN/GLIDE CURRENT VELOCITY (Check All That Apply)
> 1m [6] / POOL WIDTH > RIFFLE WIDTH [2] / TORRENTIAL [-1] / EDDIES [1]
0.7-1m [4] / POOL WIDTH = RIFFLE WIDTH [1] / FAST [1] / INTERSTITIAL [-1] / NO POOL [0]
0.4-0.7m [2] / POOL WIDTH < RIFFLE W. [0] / MODERATE [1] / INTERMITTENT [-2]
< 0.4m [1] / SLOW [1]
< 0.2m (Pool = 0)
COMMENTS: ____

RIFFLE: 6

RIFFLE/RUN DEPTH / RIFFLE/RUN SUBSTRATE / RIFFLE/RUN EMBEDDEDNESS
GENERALLY > 10 cm, MAX > 50 [4] / STABLE (e.g., Cobble, Boulder) [2] / EXTENSIVE [-1] / MODERATE [0]
GENERALLY > 10 cm, MAX < 50 [3] / MOD. STABLE (e.g., Pea Gravel) [1] / LOW [1] / NONE [2]
GENERALLY 5-10 cm [1] / UNSTABLE (Gravel, Sand) [0] / NO RIFFLE [0]
GENERALLY < 5 cm (Riffle = 0)
COMMENTS ____ GRADIENT: 8

6) Gradient (feet/mile): 14.54/mile %POOL: 25 %RIFFLE: 25 %RUN: 50

EPA 4520

Table 4-19

Qualitative Habitat Evaluation Index
Republic Steel Quarry
(Continued)

QA Manual (5th Update) – Fish – September 30, 1989

Procedure No.	WDPA-SWS-3	Date Issued	[illegible]
Revision No.	[illegible]	Date Effective	[illegible]

Figure V-4-5. Front side of the Ohio EPA Site Description Sheet for evaluating the geographical and physical characteristics of fish sampling locations. This is used to record information for the calculation of the Qualitative Habitat Evaluation Index (QHEI).

Ohio EPA Site Description Sheet - Fish QHEI SCORE: 75

Stream: BLACK RIVER

1) SUBSTRATE SUBSTRATE SCORE: 20

COMMENTS:

2) INSTREAM COVER COVER SCORE: 12

COMMENTS:

3) CHANNEL MORPHOLOGY CHANNEL: 16

COMMENTS:

4) RIPARIAN ZONE AND BANK EROSION RIPARIAN: 7.5

COMMENTS:

5) POOL/GLIDE AND RIFFLE/RUN QUALITY POOL: 9

COMMENTS:

RIFFLE: 0

COMMENTS: GRADIENT: 6

6) Gradient (feet/mile): 11.2 ft/mile %POOL: ____ %RIFFLE: ____ %RUN: 100

EPA 4520

Table 4-20

Aquatic Species Field Measurements
Republic Steel Quarry
Elyria, Ohio

Location	Species	Total Length (mm)	Whole Body (grams)	Right Fillet (grams)	Left Fillet (grams)	Total Weight (grams)	Laboratory ID Number
Quarry	Smallmouth bass	275	278	61	44.7	105	FT-104
	Smallmouth bass	300	334.5	66.2	60.2	126.4	FT-107
	Bluegill	95-130	47.1	7	8.3	15.3	FT-102
Upstream	White sucker	310-360	754.3	134.1	146.8	280.9	FT-113
	Carp	490-500	3,000	423.73	494	917.73	FT-116,118
	Crappie	190-240	502	91.3	94.1	185.4	FT-115
	Brown bullhead	185-205	212.6	45.8	38	83.8	FT-114
Downstream	Largemouth bass	300	376	75.5	72.9	148.4	FT-108,117
	Smallmouth bass	100-170	151.4	29.2	27.8	57	FT-111
	White sucker	280	224.9	47.6	62.6	100.2	FT-110
	White sucker	290	248.2	50.1	50.1	100.2	FT-112
	Bluegill	140-145	155.8	27.3	29.5	56.8	FT-109

Notes:

FT-117 duplicates FT-108.
FT-118 duplicates FT-116.
FT-105 and FT-106 were contaminant-free blank samples.

SECTION 5
AREAS OF NONCOMPLIANCE

The RSQ site's perimeter fence shows widespread evidence of deterioration. The chain-link fence contains rips in its fabric and gaps at its base. The deterioration makes the RSQ site easily accessible, as evidenced by footpaths that pass through many of the openings; and widespread evidence of trespass for recreational purposes. In addition to potential exposure to contamination, these conditions can result in numerous physical hazards associated with the site which are described in Sections 6 and 7. These issues were discussed with city officials at the time of the site visit (3 October 1996) and repairs were recommended.

The RSQ site contains groundwater and surface water with chemical concentrations that exceed ARARs. However, this condition was anticipated in the ROD, and access controls were declared to be adequately protective.

The RSQ site contains at least some soil containing polynuclear aromatic hydrocarbons (PNAs) in excess of the soil cleanup's removal criterion. The protectiveness of this situation is discussed in detail in the following section, the recalculation of risk.

SECTION 6
RECALCULATION OF RISK

6.1 INTRODUCTION

A revised risk assessment was prepared for the RSQ site to assess the potential human health and environmental risks posed by the site under its current status, i.e., five-year review of a completed remedial action. In accordance with the NCP, the revised human health and ecological risk assessments evaluate the potential human health and environmental impacts associated with the RSQ site under the no-further-action alternative (i.e., in the absence of additional remedial [corrective] action). This risk assessment follows up on concerns previously raised by earlier risk assessment work presented in the Supplemental Report to the RI (CH2M Hill, 1990). Information and data collected during the five-year review investigation serve as the basis for the risk assessment presented in this report.

6.1.1 Objectives

The objectives of the revised human health and ecological risk assessments for the RSQ site are:

- Determine whether the contaminants remaining at the site, given the newly revised toxicity factors, pose risk to human health and the environment.
- Identify specific media and areas associated with unacceptable risk, if applicable.
- Provide an analysis of risks and help determine the need for remedial actions at the site, if applicable.

6.1.2 Approach

The revised risk assessment is improved in technical quality and efficiency by using advances in risk assessment science. Although written in 1990, the Supplemental Report used 1986 methodologies, regulation and guidance (Supplemental Report, ES-10, CH2M Hill, 1990). Since 1986, advances in science and regulation have improved risk assessments. In addition, toxicity criteria were updated. Guidance used in the preparation of the revised risk assessment include:

- *Risk Assessment Guidance for Superfund, Human Health Evaluation Manual, Part A* (U.S. EPA, 1989b).
- *Risk Assessment Guidance for Superfund, Human Health Evaluation Manual, Part B* (U.S. EPA, 1991b).
- *Supplemental Guidance to RAGS: Calculating the Concentration Term* (U.S. EPA, 1992b).
- *Exposure Factors Handbook* (U.S. EPA, 1989a); Revised Exposure Factors Handbook (U.S. EPA, 1996g).
- *Dermal Exposure Assessment: Principles and Applications* (U.S. EPA, 1992a).
- *Soil Screening Guidance: Technical Background Document* (U.S. EPA, 1996a).
- *Region III Risk-Based Concentration Tables* (U.S. EPA, 1996b).
- *Region 9 Preliminary Remediation Goals* (U.S. EPA, 1996c).
- *Proposed Guidelines for Ecological Risk Assessment* (U.S. EPA, 1996f).
- *Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments* (U.S. EPA, 1996e).

6.1.3 Summary of Previous Risk Assessments

Previous risk assessments prepared for the site include:

- *A Preliminary Health Assessment for RSQ site* (ATSDR, 18 November 1988).
- *A Preliminary Health Assessment for RSQ site* (ATSDR, 13 January 1989).
- *Revised Endangerment Assessment* (REM IV Team, c. 1988).
- *Republic Steel/South Boat Launch Cleanup Goals* (Clement Associates, Incorporated, 30 January 1989).
- *Cleanup Goals for RSQ site* (Clement Associates, Incorporated, 2 February 1989).
- *Revised Endangerment Assessment* (RSQ site Supplemental Report, CH2M Hill, 26 September 1990).

The *Revised Endangerment Assessment* (CH2M Hill, 1990) is the most recent risk assessment for the RSQ site. It was prepared after the Remedial Action and confirmatory sampling tasks were completed at RSQ. The basis for its preparation was to determine whether modeled uptake of contaminants by fish tissues was accurate in the 1988 RI Report. The potential risks documented in this report are summarized in Table 6-1. No unacceptable health risks were identified at that time under current use exposure scenarios. Fish tissue data showed that conservative uptake modeling in the RI report resulted in overestimation of risks. Risks associated with direct contact with soil were also reduced to acceptable levels under the future-use scenarios since impacted soil was removed from the site. However, unacceptable risks, associated with bis(2-ethylhexyl)phthalate and beryllium, were identified under future residential use of groundwater.

The supplemental report documented that the objectives of the 29 September 1988 ROD were accomplished (i.e., the soil removal and additional sampling showed that the site posed acceptable risks except under the future-use ingestion of groundwater scenario). The report also concluded that the next step in the process was to determine if the groundwater problems at the RSQ site warrant further remedial action.

6.1.4 Report Organization

The Revised Risk Assessment Report is organized into the following components:

- Hazard Identification.
- Exposure Assessment.
- Toxicity Assessment.
- Risk Characterization.
- Ecological Risk Assessment.

6.2 HAZARD IDENTIFICATION

In this subsection, the available information on the hazardous substances remaining at the site is evaluated, the chemicals detected in the environmental media (i.e., soil, groundwater, surface water, and sediment) sampled at the RSQ site are summarized, and the constituents of potential concern are verified, using the results of the five-year review sampling (November 1996) and each constituent's status in the previous risk assessment (CH2M Hill, 1990).

6.2.1 Contaminant Characterization

Media investigated during the five-year review included soil, groundwater, fish, surface water, and sediment. An effort was made to collect all samples from similar locations and using similar sampling techniques as used during the RI. A total of eight soil samples were collected from the boat ramp and drainage ditch area, at up to a 1-foot depth. Six additional soil samples were collected from background locations. Soil samples were analyzed for TAL metals and TCL SVOCs. Seven of the eight existing monitoring wells were resampled (MW-B-4, a background well, was not resampled) and analyzed for TAL metals and TCL SVOCs. A total of seven surface water samples were collected from the quarry, the Black River (upstream and downstream of the quarry), and the quarry outfall. All surface water samples were analyzed for TAL metals (filtered and unfiltered), TCL SVOCs, and water quality parameters. Seven sediment samples were collected from the quarry bottom and the quarry outfall; all samples were analyzed for TCL VOCs, SVOCs, pesticides/PCBs, TAL metals, TOC, and oil and grease. Fish were collected from the quarry and the Black River (upstream and downstream). Fish tissue was analyzed for manganese, mercury, copper, cadmium, and percent lipids.

6.2.2 Data Evaluation

All chemical analyses were performed by a Contract Laboratory Program (CLP) laboratory according to the U.S. EPA-approved Quality Assurance Project Plan (QAPP) developed for the RSQ site (WESTON, 1996). Data validation and data package review were performed by U.S. EPA. The reader is referred to Section 4 for detailed information on site sampling activities and data quality.

The chemicals found in each environmental medium are summarized by frequency of detection (i.e., the ratio of the number of samples in which the chemical was detected to the number of samples available) and the minimum and maximum detected concentrations in Table 6-2 for groundwater, Table 6-3 for surface water in the quarry, Table 6-4 for surface water in the river, Table 6-5 for soil, Table 6-6 for sediment, and Table 6-7 for fish tissue.

Since the quarry ranges in depth from 8 to 60 feet with most areas at 40 feet, human exposure to sediments was not considered in the RI human health risk assessment (Supplemental Report, CH2M Hill, 1990) nor were they considered in this risk assessment. Sediments are evaluated in the ecological risk assessment.

6.2.3 Identification of Constituents of Potential Concern (COPCs)

The quantitative assessment of exposure, and consequently, risk, for a site is based on those chemicals considered to be COPCs for the site. The COPCs are a subset of all chemicals positively identified at a site. The risks associated with the COPCs are expected to be more significant than the risks associated with the other less toxic and less prevalent chemicals at the site that are not evaluated quantitatively. The list of COPCs evaluated in the human health risk assessment may not be the same as the COPCs evaluated in the ecological risk assessment. The COPCs may also differ from the list of site-related chemicals identified in Section 4. The selection of COPCs for the ecological risk assessment is discussed in Subsection 6.6.

The list of COPCs evaluated in the human health risk assessment includes those that are:

- Positively detected in at least one CLP sample in a given medium, including: (a) chemicals with no qualifiers attached (excluding samples with unusually high detection limits), and (b) chemicals with qualifiers attached that indicate known identities but unknown or estimated concentrations (e.g., J-qualified data).
- Detected at levels more that five times greater than the same chemicals detected in associated blank samples. For common laboratory contaminants, when they are detected at levels more than ten times greater than the same chemicals detected in associated blank samples.
- Detected at levels above human-health risk-based screening levels.

- Detected at levels greater than two times above naturally occurring levels of the same chemicals. Only naturally occurring inorganic substances were considered for comparison with background. Background groundwater data was compared to surface water data in the quarry since the quarry is below the groundwater level and is fed by groundwater.

- Considered to be toxic to humans. Calcium, magnesium, potassium, and sodium are considered to be essential nutrients and are toxic only at very high doses.

Risk-based screening is a major step used in the determination of COPCs for the human-health risk assessment. The risk-based screening followed U.S. EPA (1993a) guidance, and included the following steps:

- Determine maximum concentration of each substance detected in each medium.

- If the maximum concentration exceeds the risk-based concentration for that medium, the contaminant is retained for risk assessment, for all routes of exposure involving that medium. Otherwise the contaminant is excluded for that medium.

- If a specific contaminant does not exceed its risk-based concentration for any medium, the contaminant is excluded from the risk assessment.

- If no contaminant in a specific medium exceeds its risk-based concentration, the medium is excluded from the risk assessment.

- All contaminants and exposure routes that are excluded are kept on a sub-list and considered for re-inclusion, based on special properties which are discussed in the following subsection.

Residential soil screening levels (U.S. EPA, 1996a) and residential soil and groundwater risk-based screening concentrations (U.S. EPA, 1996b and 1996c) were used in the risk-based screening. These screening levels are derived using a cancer risk of 1E-6 (one-in-one million) and a systemic hazard quotient (HQ) of 1. In order to provide a more conservative screening and to account for similar toxic endpoints among noncarcinogenic compounds, a HQ of 0.1 was used in screening noncarcinogenic chemicals, based on U.S. EPA, (1993a) guidance. Where risk-based concentrations are available for both cancer and noncancer endpoints, the lower of the two values was used for the screening comparison. Groundwater screening levels were used to screen surface water used for recreational purposes. U.S. EPA and Ohio MCLs were also used to screen COPCs in groundwater and surface water. Screening levels for fish ingestion have been developed by U.S. EPA Region III (U.S. EPA, 1996b). Maximum chemical concentrations detected in each medium are compared to the screening levels in Tables 6-8 and 6-9 for soil, Table 6-10 for groundwater, Table 6-11 for surface water in the quarry, Table 6-12 for surface water in the Black River, and Table 6-13 for fish. Appendix A presents this screening for each sample location for each medium.

Based on this evaluation, the chemicals that are considered to be COPCs in the human-health risk assessment are:

Groundwater	Surface Water - Quarry	Surface Water - River
Antimony	Copper	Iron
Arsenic	Iron	Manganese
Beryllium	Manganese	
Cadmium	Vanadium	
Iron		
Manganese		
Thallium		

Soil	Fish - Quarry	Fish-River
Arsenic	Cadmium	Manganese
Iron	Mercury	Mercury
Thallium		

Further Exclusion or Re-inclusion of COPCs

While iron and manganese screening criteria were exceeded in surface water from the Black River, this medium was excluded from further evaluation in the risk assessment. Iron and manganese are noncarcinogenic. A HQ of 0.1 was used as the basis for screening noncarcinogens to ensure that cumulative noncarcinogenic effects do not exceed a HQ of one. Iron and manganese do not have the same endpoint of toxicity. Manganese affects the central nervous system (U.S. EPA, 1996a) and iron accumulates in the tissues (U.S. EPA, 1984). In addition, concentrations do not exceed screening levels based on a HQ of 1 and iron and manganese were found to be only slightly higher in downstream samples.

All constituents measured in fish tissue (i.e., cadmium, copper, manganese, and mercury) were re-included as COPCs since actual fish tissue rather than modeled tissue data was available for this revised risk assessment. The risk assessment conservatively included all analyzed metals, though no adverse health effects are expected for the constituents re-included as COPCs.

For the human health risk assessment, arsenic and beryllium were re-included as COPCs in groundwater, and arsenic was re-included as a COPC in soil because these constituents were primary constituents of concern in the original risk assessment.

6.3 EXPOSURE ASSESSMENT

The purpose of the exposure assessment is to estimate the magnitude of human exposure to the chemicals found in environmental media at the RSQ site. The results of the exposure assessment are then combined with the chemical-specific toxicity information to quantitatively estimate the human health risks associated with chemical exposure at this site.

The identification of actual or potential pathways through which human receptors could be exposed to chemicals in soil, groundwater, surface water, and sediment at the RSQ site includes identification and characterization of the site and the potentially exposed populations. After exposure pathways have been identified, daily intakes of the COPCs can be quantified using standard exposure algorithms.

6.3.1 Identification of Exposure Pathways

An exposure pathway generally consists of four elements: (1) a source and mechanism of contaminant release, (2) a retention or transport medium, (3) a point of potential human contact with the contaminated medium (referred to as the exposure point), and (4) an exposure route (i.e., ingestion, dermal contact, or inhalation) at the exposure point (U.S. EPA, 1989b). An exposure pathway is considered complete if contamination is expected to reach a receptor, i.e., all four elements are present. Figure 6-1 integrates and summarizes the information concerning residual source areas, chemical migration pathways, receptor populations, and exposure routes into a combination of potential human exposure pathways for the residual contamination at the RSQ site.

The following subsections describes the process used to identify and select exposure pathways for quantitative analysis. The first two elements are discussed briefly since they have been previously described in the Supplemental Report (CH2M Hill, 1990).

6.3.1.1 Source Areas and Chemical Migration Pathways

After a chemical is released into the environment, it may be transported (e.g., convected downstream in water), physically transformed (e.g., volatilized), chemically transformed (e.g., oxidation/reduction), biologically transformed (e.g., biodegradation), or bioaccumulated in one or more media (U.S. EPA, 1989b). A goal of fate analysis is to identify other (non-source) environmental media and off-site areas potentially affected by chemical migration. This subsection qualitatively addresses the fate of chemicals measured in soil, surface water, sediment, and groundwater at the RSQ site, their potential to be transported to other environmental media, and their potential to migrate off-site.

Residual inorganic constituents have been measured in soil at the boat launch and former pickle liquor ditch. Inorganics have also been measured in on-site groundwater and in quarry surface water and sediment. The chemicals detected at the site could migrate toward downgradient receptor areas or into other environmental media. Chemicals in the soil could be transported into the groundwater in leachate or into the air as suspended particulates. Chemicals in the groundwater could be transported to off-site downgradient areas. Chemicals in surface water may discharge into the Black River through the outfall. Chemicals in surface water and sediment may be accumulated by aquatic organisms.

6.3.1.2 Exposure Points and Exposure Routes

The three receptor groups evaluated in the Supplemental Report Revised Endangerment Assessment (CH2M Hill, 1990) are also evaluated in this risk assessment. The receptor groups that are assumed to be potentially exposed to constituents in environmental media at the site are:

- Current trespasser.
- Future park patron.
- Future on-site resident.

The current trespasser is assumed to be a 7- through 16-year-old who may come in contact with site soil and swim in the quarry. Older children within this age group have been observed on the property and swimming in the quarry. Adult trespassers have also been observed fishing in both the quarry and the Black River. If the quarry is developed as a park, future park patrons, both adults and young children (1- through 6-years-old) may also contact site soil, swim in the quarry, and fish in the river and in the quarry. If residences are built adjacent to the quarry, residents (adults and young children) may contact site soil, or may use groundwater as their potable water supply. Future residents may also swim in the quarry and fish in the river and in the quarry.

These receptor groups may be potentially exposed to contaminants in soil, surface water, and groundwater at the RSQ site. There are three primary exposure routes for chemicals in soil: incidental ingestion, dermal absorption, and inhalation of dust. While most of the site is heavily vegetated, there is potential for receptors to come in direct contact with site soils or to inhale particulate-phase contaminants that are entrained in the atmosphere.

There are three primary exposure routes for chemicals in surface water: incidental ingestion, dermal absorption, and fish ingestion. Receptors may inadvertently ingest surface water and dermally absorb chemicals from surface water while swimming in the quarry. As noted in the Supplemental Report Revised Endangerment Assessment (CH2M Hill, 1990), contact with sediments is considered an unlikely exposure pathway because the depth of the quarry ranges from 8 to 60 feet with predominant depths of 40 feet. In addition, in the rare instances where contact with sediment does occur, swimming activities would quickly rinse sediments from the skin surface.

For groundwater, the exposure routes are ingestion and dermal absorption. If groundwater is used as the primary household water supply, residential users may directly ingest contaminants in groundwater used as drinking water and absorb contaminants from groundwater while bathing. Inhalation of volatile compounds from soil, surface water, or groundwater is not considered because there are no volatile COPCs.

6.3.1.3 Exposure Pathways

The following exposure pathways are evaluated in this risk assessment:

- Current Use—trespasser [for adolescent (7 through 16 years old), and adult]:

  - Incidental ingestion of soil (7 through 16 years old).
  - Dermal contact with soil (7 through 16 years old).
  - Inhalation of dust (7 through 16 years old).
  - Incidental ingestion of water while swimming in the quarry (7 through 16 years old).
  - Dermal absorption from water while swimming in the quarry (7 through 16 years old).
  - Consumption of fish from the quarry (adult).
  - Consumption of fish from the Black River (adult).

- Future Use—park patron [adult and young child (0 through 6 years old), for adolescent, see trespasser under Current Use]:

  - Incidental ingestion of soil.
  - Dermal contact with soil.
  - Inhalation of dust.
  - Incidental ingestion of water while swimming in the quarry (adult and child).
  - Dermal absorption from water while swimming (adult and child).
  - Consumption of fish from the quarry (adult and child).
  - Consumption of fish from the Black River (adult and child).

- Future Use—resident [adult and young child (0 through 6 years old), for adolescent, see trespasser under Current Use]:

  - Incidental ingestion of soil.
  - Dermal contact with soil.
  - Inhalation of dust.
  - Direct contact with soil.

- Incidental ingestion of water while swimming in the quarry (adult and child).
- Dermal absorption from water while swimming (adult and child).
- Consumption of fish from the quarry (adult and child).
- Consumption of fish from the Black River (adult and child).
- Ingestion of groundwater.
- Dermal contact with groundwater.

6.3.2 Quantification of Exposure

The degree of receptor exposure that occurs through each exposure pathway is determined by behavioral, chemical, and physiological factors. Behavioral factors affecting exposure would include the amount of time spent on site, the activities engaged in while on site, and the amount and type of clothing worn. Chemical factors affecting the degree of exposure would include the extent to which a chemical is absorbed through the skin and gastrointestinal tract (i.e., the absorption efficiency). Physiological factors affecting exposure would include the ability of the body to metabolize and eliminate the chemical(s). To quantify exposures in the risk assessment process, it is necessary to make assumptions concerning these factors in the absence of specific, detailed information. These assumptions are represented by a series of exposure parameters that quantify the magnitude, frequency, and duration of the exposure. In addition, the quantification of exposure requires estimates of the chemical concentrations to which the receptor is exposed

6.3.2.1 Exposure Point Concentrations

The exposure point concentration is the concentration of a chemical to which a receptor is expected to be exposed. The exposure point concentration for each chemical in each medium is intended to represent a reasonable maximum estimate of the concentration a receptor is likely to be exposed to over time. Exposure point concentrations were calculated as the upper 95 percent confidence limit (95% UCL) on the arithmetic mean of log-transformed data. In most cases, it is reasonable to assume that environmental chemical data is lognormally distributed (U.S. EPA, 1992b). If the calculated exposure point concentration is greater than the maximum positively detected concentration, the maximum detected concentration is used as the exposure point concentration (U.S. EPA, 1989b). For all media, the calculated exposure point concentration was greater than the maximum detected concentration; therefore, the exposure point concentration for soil, surface water, and groundwater is the maximum detected concentration. The maximum detected concentration in fish, regardless of species, was used since calculating an average concentration using different fish species is not appropriate.

6.3.2.2 Reasonable Maximum and Representative Average Exposure

To evaluate exposures over the range of possible conditions that may exist at the RSQ site, two hypothetical degrees of exposure were considered in this study following U.S. EPA (1992d) guidance. These degrees are a reasonable maximum exposure (RME) and a representative average exposure (RAE). The RME is the highest exposure that is reasonably expected to occur at a site; the RAE is intended to represent more typical (i.e., central tendency) exposure conditions. In evaluating RME and RAE scenarios, the exposure point concentration remains the same, while the exposure parameters are adjusted to reasonable maximum and central tendency values.

6.3.2.3 Exposure Algorithms

U.S. EPA has developed exposure algorithms for use in calculating chemical intakes through the exposure pathways and routes that are relevant for this site. These algorithms combine chemical exposure point concentrations with pathway- and route-specific parameters to produce daily chemical intakes in terms of the milligrams of chemical taken into the body per kilogram of body weight per day (mg/kg-day).

The following subsections discuss the exposure pathways and routes through which receptors may be exposed to site contaminants, and present the exposure algorithms and exposure parameters that were used in this risk assessment.

Soil Pathway

For trespasser, recreational, and residential scenarios, surface soil data will be used to model exposures via this pathway. Soil exposure routes include incidental ingestion, dermal absorption, and inhalation of dust. All receptors will be assumed to be exposed to the same soil concentrations.

Daily COPC intake via soil ingestion, dermal absorption, and dust inhalation were calculated using the equations shown in Table 6-14. The exposure parameter values for these exposure routes are also shown in this table. The estimated daily intakes that result from soil ingestion, dermal absorption, and dust inhalation are presented in Appendix B, Tb1. B1-B6.

Contaminated soil may be inadvertently ingested while eating or, in the case of small children, by directly ingesting soil or by placing soiled objects in the mouth. The combined soil and dust ingestion rate for children aged 1 through 6 (i.e., six years of exposure) is 200 mg per day and 100 mg per day for all others (U.S. EPA, 1991c). These upper-bound values account for both ingestion of outdoor soil and indoor dust.

The extent of chemical absorption through the skin is dependent on many factors, including the type(s) of protective clothing worn, the part(s) of the body exposed, the presence of open sores or abrasions on the skin, the degree of soil adherence to the skin, the duration of the event (i.e., the contact time with contaminated soil), the constituent concentration in soil, and the ability of the chemical to enter the body through the skin (i.e., the dermal absorption efficiency).

The skin surface area available for contact is based on the mean body surface area not covered by clothing. In cases of soil contact, clothing is expected to limit the extent of exposed surface area (U.S. EPA, 1992a). Twenty-five percent of the total body surface area is recommended as the default value for dermal absorption, which assumes that the head, neck, arms, hands, and legs are exposed. For the child resident, an RAE value of 2,900 cm^2 and an RME value of 3,400 cm^2 were used, which are 25 percent of the 50^{th} percentile and 95^{th} percentile total body surface area (U.S. EPA, 1996a). For the adult, an RAE value of 5,700 cm^2 and an RME value of 6,600 cm^2 are recommended by U.S. EPA (1992a). For the 7- through 16-year-old trespasser, the RAE surface area was estimated at 4,300 cm^2 and the RME surface area is 5,000 cm^2.

The adherence factor accounts for the amount of soil that adheres to the skin after contact. This parameter is dependent on the physical characteristics of the soil encountered. Site-specific adherence factors are not known, but a range of values from 0.5 to 1.5 has been reported for non-site soils (U.S. EPA, 1992a). This range is for hand measurements only and may overestimate the average adherence factor for the entire exposed skin surface. A value of 0.03 mg/cm^2 is recommended by Kissel et al. (1996) for adult exposure and a range of 0.2 mg/cm^2 to 0.8 mg/cm^2 (reasonable maximum) is recommended for a child. The adult adherance factor was applied for the adolescent trespasser.

The absorption factor which accounts for the fraction of chemicals in soil that is transferred through the skin, is a chemical-specific property. Limited toxicological studies area available that specifically address the dermal absorption efficiency of inorganics. Chemical-specific absorption values have been developed for arsenic, cadmium, pentachlorophenol, PCBs, and dioxins (U.S. EPA, 1996c). An absorption factor of 1 percent has been recommended as the default value for inorganics (U.S. EPA, 1996c).

The daily intake via inhalation of airborne dusts is based on the duration of exposure, the inhalation rate during exposure, and the concentrations of constituents in air. An inhalation rate of 20 m^3 per day is the recommended reasonable maximum value for a resident (U.S. EPA, 1991c). This value was also used for the average exposure scenario. For the young child and trespasser, this value was adjusted by mass-scaling to an inhalation rate of 12 m^3/day for the child and 17 m^3/day for the trespasser (U.S. EPA, 1996b).

A particulate emission factor (PEF) is used to relate COPC concentration in soil to the concentration of respirable particles in air due to fugitive dust emission from surface contaminated areas. A PEF of 1.2×10^9 kg/m^3, derived using guidance from U.S. EPA (1996a) and the relationship developed by Cowherd (1985), was applied. This relationship is a rapid assessment procedure for sites where surface contamination provides a relatively continuous and constant potential for emission over an extended period of time. The PEF algorithm recommended by U.S. EPA (1996a) is conservative, representing a surface with unlimited erosion potential, characterized by bare surfaces of finely divided material, such as sandy agricultural soil, with a large number of erodible particles. Such surfaces erode at low wind speeds, and particulate emission rates are relatively time-independent at low wind speeds (U.S. EPA, 1991b).

An exposure frequency (EF) of 350 days per year is the default reasonable maximum value for residents. This EF is based on the common assumption that workers take two weeks of vacation per year to support a value of 15 days per year spent away from home (U.S. EPA, 1991b). For recreational exposure, an EF of 60 days per year has been recommended (U.S. EPA, 1992e) as the reasonable maximum value. This value is used for the current trespasser and future park patron. An EF of 30 days per year is estimated as the average exposure frequency for the current trespasser and future park patron. The national upperbound time at one residence (i.e., the exposure duration) is 30 years (U.S. EPA, 1991c) and the average time at one residence is 9 years (U.S. EPA, 1989a). These values are applied as the exposure duration (ED) for the adult resident and park patron. The ED for a 7- through 16-year-old is 10 years and the ED for a 1- through 6-year-old is 6 years.

The value for body weight is the average body weight over the exposure period. An average body weight is used because, when combined with other variable values, it is believed to result in the reasonable maximum exposure. Incorporating a higher body weight with the same intake rate would result in lower exposure than the reasonable maximum. In addition, using an average body weight rather than a reasonable maximum is recommended because the available toxicity data are based on average body weight. The recommended average body weight for an 18- to 75-year-old adult is 70 kg (U.S. EPA, 1991c). The recommended average body weight for a 1- through 6-year-old is 15 kg (U.S. EPA, 1991c). The average body weight of a 7- through 16-year-old is 43 kg (U.S. EPA, 1992e). The averaging time is the period over which exposure is averaged. For noncarcinogenic effects, AT is equal to ED.

Surface Water Pathway

The current trespasser, future park patron (adult and child), and future resident (adult and child) exposure to contaminants in surface water through incidental ingestion and dermal absorption while swimming in the quarry is considered in this risk assessment. Daily intakes via incidental ingestion of surface water while swimming and dermal absorption from surface water while swimming were calculated using the equations shown in Table 6-15. The exposure parameters values for these exposure routes are also shown in this table. The estimated daily intakes that result from surface water ingestion and dermal contact are presented in Appendix B.

A swimmer may accidentally swallow water while swimming. A swimmer incidentally ingests about 0.05 L of water per hour, which is equivalent to about a mouthful (U.S. EPA, 1989b). The U.S. EPA (1992a) recommends an exposure time of 0.5 hour per event, one event per day for 5 days per year as the average time spent swimming. For the reasonable maximum case, an exposure time of 1 hour per event, 1 event per day for 90 days per year (i.e., during the summer months) is assumed.

For bathing and swimming scenarios, 75 to 100% of the skin surface is exposed. The total body surface area for a 7- through 16-year-old is estimated at 14,750 cm^2 for the RME value and 12,250 cm^2 for the RAE value, which is the average of adult and child surface areas. The total adult body surface area can vary from 17,000 to 23,000 cm^2 for an adult. A mean value of 18,000 cm^2 and a reasonable maximum value of 22,000 cm^2 are recommended as default values by U.S. EPA (1996g). The total body surface area for a 1- to 6-year-old child is 7,500 cm^2 for the 95th percentile and 6,500 cm^2 for the 50th percentile (U.S. EPA, 1996g). For dermal absorption of chemicals from aqueous solutions, permeability coefficients define the rate of movement of the chemical across the skin. For inorganics, a permeability coefficient of 1 x 10^{-3} cm/hour is the recommended default value (U.S. EPA, 1992a).

The values and justification for the remaining exposure parameters (i.e., EF, ED, BW, and AT) are the same as those discussed for trespasser soil exposure.

Fish Pathway

Fishing is known to occur in the quarry and the Black River. Exposure through ingestion of fish from the quarry and the Black River was considered for the current adult trespasser, future park patron (adult and child) and future resident (adult and child). Daily intakes via fish ingestion were calculated using the equations shown in Table 6-16. The exposure parameter values used for this exposure route are also shown in this table. The estimated daily intakes that result from fish ingestion are presented in Appendix B.

For recreational fishing, the reasonable maximum consumption rate is 54 g/day and the average consumption rate is 6.5 g/day (U.S. EPA, 1992e). The values and justification for the remaining exposure parameters (i.e., EF, ED, BW, and AT) are the same as those discussed for adult park patron soil exposure.

Groundwater Pathway

Future resident exposure to groundwater through drinking water ingestion and dermal absorption while bathing were also considered for both an adult and child receptor. Daily intakes via ingestion of drinking water and dermal absorption while bathing were calculated using the equations shown in Table 6-17. The exposure parameter values used for these exposure routes are also shown in this table. The estimated daily intakes that result from groundwater ingestion and dermal absorption are presented in Appendix B.

Exposures via drinking water may occur by a variety of mechanisms, including ingestion of drinking water and ingestion of foods prepared with or in water. The reasonable maximum ingestion rate for potable water is established at 2 L/day for an adult and 1 L/day for a child (U.S. EPA, 1989b). The average drinking water ingestion rate is 1.4 L/day for an adult and 0.7 L/day for a child (U.S. EPA, 1989a). These amounts include water consumed in the form of other beverages and the ingestion of foods prepared in or with water. Certain nonpotable uses of water may result in skin contact and dermal absorption of waterborne contaminants. For bathing and swimming scenarios, 75 to 100% of the skin surface is exposed. The total adult body surface area can vary from 17,000 to 23,000 cm^2 for an adult. A mean value of 18,000 cm^2 and a reasonable maximum value of 22,000 cm^2 are recommended as default values by U.S. EPA (1996g). The total body surface area for a 1- to 6-year-old child is 7,500 cm^2 for the 95^{th} percentile and 6,500 cm^2 for the 50^{th} percentile (U.S. EPA, 1996g). Shower times have been found to range from 7 to 12 minutes. Adding a few minutes for water residue to dry, a default range of 10 to 15 minutes is recommended by U.S. EPA (1992a). The recommended permeability coefficient for inorganics is 1E-03 cm/hr (U.S. EPA, 1992a).

The values and justification for the remaining exposure parameters (i.e., EF, ED, BW, and AT) are the same as those discussed for residential soil exposure.

6.4 TOXICITY ASSESSMENT

A toxicity assessment presents appropriate toxicity values and the weight of evidence for the toxicity of each of the COPCs. Applicable human toxicity values are identified for each COPC for the relevant exposure routes. These toxicity values include reference doses (RfDs) for evaluating potential noncarcinogenic health effects, and cancer slope factors (CSFs) for evaluating carcinogenic risks.

Toxicity criteria were obtained from the U.S. EPA's Integrated Risk Information System (IRIS) database and from the U.S. EPA's (1994b) Health Effects Assessment Summary Tables (HEAST). If toxicity criteria were not available from these two sources, toxicity criteria presented in the Region III Risk-Based Concentration Tables (U.S. EPA, 1996b) and the Region IX Preliminary Remediation Goals Tables (U.S. EPA, 1996c) were used. The toxicity criteria used in this risk assessment are presented in Table 6-18 for noncarcinogens and in Table 6-19 for carcinogens. Chemicals lacking toxicity criteria will be discussed in the Uncertainty Analysis (Subsection 6.5.2).

6.5 RISK CHARACTERIZATION

In a risk characterization, the results of the exposure assessment and the toxicity assessment are integrated to characterize the current or potential risks to human health. Carcinogenic and noncarcinogenic risks are evaluated for each COPC through each exposure route of concern and for all COPCs through all exposure routes combined. The risk characterization also identifies uncertainties associated with contaminant, toxicity, or exposure assumptions. In addition, the results of the risk assessment are compared to the risk assessment results presented in the Supplemental Report (CH2M Hill, 1990).

6.5.1 Quantitative Evaluation

In quantifying risk, both carcinogenic and noncarcinogenic effects are considered.

Carcinogenic risks were calculated for each carcinogen through each exposure pathway for each receptor. In risk assessment calculations, cancer risks are estimated as the incremental, or excess, probability of an individual developing cancer over a lifetime as a result of exposure to a carcinogen. This risk is in addition to the lifetime cancer risk experienced by the general, non-exposed population. Cancer risk were calculated for each chemical COPC using the following formula:

$$\text{Risk} = \text{EDI} \times \text{CSF}$$

where:

Risk	=	Excess cancer risk (unitless probability)
EDI	=	Estimated daily intake (mg/kg-d)
CSF	=	Cancer slope factor $(\text{mg/kg-d})^{-1}$

The total risk posed by each chemical COPC will be calculated by adding risks posed by the COPC through all exposure routes.

Noncarcinogenic effects are evaluated by comparing estimated daily intakes of chemical COPCs to RfDs. This is accomplished by calculating hazard quotients (HQs) and hazard indices (HIs). A HQ for a particular COPC through a given exposure route is the ratio between the estimated daily intake and the applicable RfD, as shown in the following equation:

$$\text{HQ} = \text{EDI} / \text{RfD}$$

where:

HQ = Hazard quotient (unitless)
EDI = Estimated daily intake (mg/kg-day)
RfD = Reference dose (mg/kg-day)

Screening level HIs were calculated by summing across all exposure pathways, for all COPCs to calculate the total HI. Separate HIs were calculated for child and adult residential receptors.

If the screening level HI exceeds 1, chemical COPCs are segregated by target organ and a separate HI value for each effect/target organ calculated (U.S. EPA, 1989b). If the HI value for any effect exceeds 1, noncarcinogenic health effects are considered possible.

6.5.1.1 Current Trespasser Scenario

Under this exposure scenario, it was assumed that older children (7 through 16 years old) trespass on the site and swim in the quarry. It was also assumed that adult trespassers fish in the quarry and river. Trespassers were assumed to be exposed to constituents in on-site soil through incidental ingestion, dermal absorption, and inhalation of dusts. They were also assumed to be exposed to constituents in quarry surface water through incidental ingestion and dermal absorption. Consumption of impacted fish from the quarry and the river was also evaluated for this receptor. Details of all risk calculations for this receptor group are presented in Appendix B.

The estimates of the potential for adverse noncarcinogenic health effects associated with current trespasser exposure are presented in Table 6-20, and the estimates of potential cancer risk are presented in Table 6-21. For the soil exposure pathway, the HIs ranged from 0.04 to 0.2 for the RAE and RME scenarios, respectively. This range lies well below unity (1.0), indicating that there is little potential for adverse noncarcinogenic health effects as a result of soil exposure. The cancer risk estimates ranged from 2E-06 to 4E-07 for the RME and RAE scenarios, respectively. These estimates fall within the range of 1E-06 to 1E-04; thus cancer risks may be acceptable for this exposure scenario. The potential risk is associated with arsenic ingestion. However, arsenic was detected in investigative samples at concentrations below background (Appendix A). For the surface water exposure pathway, the HIs ranged from 0.03 to 1 for the RAE and RME scenarios, respectively. The primary contributors, iron and manganese, do not have the same endpoint of toxicity. Manganese affects the central nervous system (U.S. EPA, 1996a) and iron accumulates in the tissues (U.S. EPA, 1984). It should be noted that elevated levels of inorganics were only measured in the surface water samples collected from a 60-foot depth. A swimmer would not typically swim at this depth, however, since there was only this one measurement available, U.S. EPA used it in the risk recalculation. For the quarry fish ingestion scenario, the HIs ranged from 0.6 to 1 for the RME and RAE scenarios, respectively. For the Black River fish ingestion scenario, the HIs ranged from 0.4 to 0.7 for the RME and RAE scenarios, respectively. These ranges do not exceed unity, indicating that there is little potential for adverse noncarcinogenic health effects as a result of fish ingestion.

Similar results of no potential for adverse health effects from these exposure routes for this receptor group were presented in the Supplemental Report (CH2M Hill, 1990).

6.5.1.2 Future Recreational (Park Patron) Scenario

Under this exposure scenario, it was assumed that the property is converted to a park in the future. Park visitors (adults and young children) were assumed to be exposed to constituents in on-site soil through incidental ingestion, dermal absorption, and inhalation of dusts. They were also assumed to be exposed to constituents in quarry surface water through incidental ingestion and dermal absorption. Consumption of impacted fish from the quarry and the river was also evaluated for this receptor. Details of all risk calculations for this receptor group are presented in Appendix B.

The estimates of the potential for adverse noncarcinogenic health effects associated with future recreational exposure are presented in Table 6-20, and the estimates of potential cancer risks are presented in Table 6-21. For the adult, the HIs ranged from 0.02 to 0.08, for soil exposure, from 0.02 to 0.8 for surface water exposure, from 0.6 to 1 for fish ingestion from the quarry, and from 0.04 to 0.7 for fish ingestion from the river. For the young child, the HIs ranged from 0.3 to 1 for soil exposure, from 0.08 to 3 for surface water exposure, from 0.1 to 0.6 for fish ingestion from the quarry, and from 0.08 to 0.4 for fish ingestion from the river. For the adult, these ranges lie below one, indicating that there is little potential for adverse noncarcinogenic health effects from soil, surface water, exposure and fish ingestion. For the child, all HIs fell below 1 except for surface water ingestion. This potential effect is associated primarily with iron ingestion. Iron was detected only in samples collected at a 60-foot depth in water. Exposure at this depth is not anticipated. Similar results for this receptor group were presented in the Supplemental Report (CH2M Hill, 1990).

The cancer risk estimates for soil exposure ranged from 1E-05 to 2E-06 for the adult and from 4E-07 to 5E-06 for the child. These estimates fall within the range of 1E-06 to 1E-04; thus cancer risk may be acceptable for these exposure scenarios. The potential risk is associated with arsenic ingestion. However, arsenic was detected in investigative samples at concentrations below background (Appendix A).

6.5.1.3 Future Residential Scenario

Under this future exposure scenario, it was assumed that residences are developed on the property in the future. Residents (adults and young children) were assumed to be exposed to constituents in on-site soil through incidental ingestion, dermal absorption, and inhalation of dusts. They were also assumed to be exposed to constituents in quarry surface water through incidental ingestion and dermal absorption. Consumption of impacted fish from the quarry and the river was also evaluated for this receptor. Future residents were also assumed to use on-site groundwater as a potable water supply, being exposed to constituents in groundwater through incidental ingestion and dermal absorption. Details of all risk calculations for this receptor group are presented in Appendix B.

The estimates of the potential for adverse noncarcinogenic health effects associated with future residential exposure are presented in Table 6-20, and the estimates of potential cancer risks are presented in Table 6-21. For the adult soil exposure pathway, the HIs ranged from 0.3 to 0.6, for the RAE and RME scenarios, respectively. This range lies below one, indicating that there is little potential for adverse noncarcinogenic health effects to adults exposed to site soil. For the young child exposure pathway, the HIs ranged from 2 to 5 for the RAE and RME scenarios, respectively. This range exceeds one, indicating that there is a potential for adverse noncarcinogenic health effects from soil exposure. An HQ of one was exceeded for iron through incidental ingestion. Elevated levels of iron (in comparison to risk-based screening levels presented in Appendix A tables) were noted at sample locations SS-102, SS-105, and SS-106. These locations are within the former pickle liquor ditch. The cancer risk estimates for soil exposure ranged from 2E-06 to 1E-05 for the adult and from 2E-06 to 2E-05 for the child. These estimates fall within the range of 1E-06 to 1E-04; thus cancer risk may be acceptable for these exposure scenarios. The potential risk is associated with arsenic ingestion. However, arsenic was detected in investigative samples at concentrations below background (Appendix A). The Supplemental Report (CH2M Hill, 1990) showed no potential for adverse noncarcinogenic health effects, but did show potential carcinogenic risk associated with exposure to CPAHs. The Supplemental Report did not evaluate iron because it is an essential human nutrient and it is not especially toxic. In addition, no toxicity criteria were available for iron at this earlier date. The toxicity criteria for cPAHs has been revised since the Supplemental Report of 1990. In the Supplemental Report, the 300 ppb soil cleanup goal for the boat launch and other unvegetated areas was based on a 1E-06 cancer risk from incidental ingestion and dermal absorption pathways. The current revised toxicity criteria for cPAHs are lower than the values previously used, thus resulting in an acceptable cancer risk associated with cPAH exposure. Although total PAHs were seen in areas exceeding 300 ppb during the Five-Year Review investigation, the lower toxicity values indicate that these concentrations still pose no threat.

For surface water exposure scenarios, the HIs ranged from 0.02 to 0.8 for the adult and from 0.08 to 3 for the child. For the quarry fish ingestion scenarios, the HIs ranged from 0.06 to 1 for the adult, and from 0.1 to 0.6 for the child. For the river fish ingestion scenarios, the HIs ranged from 0.04 to 0.7 for the adult and from 0.08 to 0.4 for the child. For the adult, the ranges lie below 1, indicating that there is little potential for adverse noncarcinogenic health effects from surface water exposure and fish ingestion. For the child, all HIs fell below 1 except for iron exposure via incidental surface water ingestion. However, iron was detected only in samples collected from a 60-foot depth, at which such exposure is not anticipated.

For the adult groundwater exposure pathway, the HIs ranged from 50 to 80 for the RAE and RME scenarios, respectively. For the child groundwater exposure pathway, the HIs ranged from 100 to 200 for the RME and RAE scenarios, respectively. These ranges exceed one, indicating that there is a potential for adverse noncarcinogenic health effects from groundwater exposure. For the adult, the HQs for iron, manganese, and thallium exceed one. For the child, the HQs for antimony, iron, manganese, and thallium exceed one. Antimony, iron, manganese, and thallium exceeded their MCL or risk-based concentrations in monitoring well GW-301 (Appendix A). Thallium and iron also exceeded their respective MCLs or risk-based concentrations at GW-307, however, iron is not a concern in and of itself, since it is an essential human nutrient and not especially toxic at these concentrations. These wells are both located on the northeast side of the quarry.

The cancer risk estimates for groundwater exposure ranged from 1E-04 to 6E-04 for the adult and from 2E-03 to 3E-04 for the child. For the adult, these risk estimates fall within the range of 1E-06 to 1E-04; thus cancer risk may be acceptable for this exposure scenario. For the child, the risk estimate exceeded the acceptable range due to ingestion of arsenic and beryllium. Although arsenic and beryllium concentrations did not exceed their individual MCLs (Appendix A), the cumulative risk presented by arsenic and beryllium would be unacceptable. However, there are no current users of this groundwater and it is expected that any future users would be required to connect to the Elyria municipal water supply.

The Supplemental Report (CH2M Hill, 1990) showed a potential for adverse noncarcinogenic health effects associated with manganese exposure. The 1990 Supplemental Report also showed a potential for carcinogenic effects associated with exposure to beryllium and bis(2-ethylhexyl)phthalate. Antimony and thallium were not considered as COPCs during the RI. The Supplemental Report did not evaluate iron because no toxicity criteria were available for iron at that time, and it is an essential human nutrient. Bis(2-ethylhexyl)phthalate was screened out as COPC in this new risk assessment because it was not detected above the MCL. Both the new risk assessment and the Supplemental Report show potential risks associated with future use of groundwater. However, the Supplemental Report noted that the residents in the vicinity of the site do not have private groundwater wells, but are on a public water supply system. Furthermore, USEPA will work with the city of Elyria to ensure adequate institutional controls are in place to prevent private use of this groundwater. The city currently does not anticipate residential development at the site and expects that any development on or around the site would be required to connect to the Elyria municipal water supply. The City does not currently anticipate any commercial or residential development at the site, and expects that any development on or around the site would be required to connect to the City of Elyria for all potable use. Thus, it is unlikely that groundwater would be developed as a source of drinking water in the future. Thus, it is unlikely that groundwater would be developed as a source of drinking water in the future.

6.5.2 <u>Uncertainty Analysis</u>

The goal of an uncertainty analysis in a risk assessment is to provide to the appropriate decision makers (i.e., risk managers) a wide range of information about the key assumptions, their inherent uncertainty and variability, and the impact of this uncertainty and variability on the estimates of risk. The uncertainty analysis should show that risks are relative in nature and do not represent an absolute quantification. This is an important point that is vital to the proper interpretation and understanding of the risks presented in this report. This subsection attempts to explain the key assumptions used in this risk assessment and present a range of risks covering the variability inherent in these assumptions.

There are three areas in this report with significant levels of uncertainty:

- Environmental data used in risk assessment.
- Toxicological assumptions.
- Exposure assumptions.

Table 6-22 presents a qualitative evaluation of the effects of each of these three key areas on the estimation of risk for the RSQ site. The risks presented in this report need to be viewed in light of the inherent uncertainty, which is summarized in this table. Column 1 lists the uncertainty elements identified as key contributors to this risk assessment. Column 2 shows the assumptions that represent a likely moderate to high overestimation of risk, while potential underestimations of risk are noted in Column 3. Column 4 identified several areas where the potential exists for low to moderate over- or underestimation of risk.

In summary, the level of uncertainty in this risk assessment is moderate. Most of the uncertainty results in overestimating risk, while some may result in either an over- or an underestimation of the risk, and some may result in an underestimation of risk. However, it is likely that the overall risk is overestimated by one order of magnitude.

6.6 ECOLOGICAL RISK ASSESSMENT

Ecological risk assessment is "the process that evaluates the likelihood that adverse ecological effects may occur or are occurring as a result of exposure to one or more stressors" (U.S. EPA, 1992c). An ecological risk assessment is an integrated or tiered evaluation of impact on the biotic environment derived through estimates and/or measurements of exposure. Initial tiers are based on conservative assumptions, such as maximum exposure and ecological sensitivity. When an early tier cannot sufficiently define risk to support a management decision, a higher assessment tier that may require additional data collection or more refined analysis techniques may be needed. Higher tiers provide more ecologically realistic assessments while making less conservative assumptions about exposure and effect (U.S. EPA, 1996f).

A screening ecological risk assessment was conducted for the RSQ site to evaluate the potential impacts of residual chemicals on ecological receptors inhabiting the site and adjacent areas. A screening ecological risk assessment has been defined by U.S. EPA (1996e) as "a preliminary risk assessment that can be conducted with limited site-specific data by defining assumptions for parameters that lack site-specific data." To ensure that sites which may pose an ecological risk are properly identified, the U.S. EPA (1996e) suggests that values should be consistently biased in the direction of overestimating risk. Without this bias, a screening evaluation could not provide a defensible conclusion for an absence of ecological risk.

Technical risk assessment guidance for the performance of this screening ecological risk assessment comes primarily from:

- *Proposed Guidelines for Ecological Risk Assessment* (U.S. EPA, 1996f).

Conducting Ecological Risk Assessments (U.S. EPA, 1996e).

An ecological risk assessment consists of three phases: problem formulation, analysis, and risk characterization. Each phase of the ecological risk assessment is presented in the following subsections.

6.6.1 Problem Formulation

The problem formulation phase is "the formal process of generating and evaluating preliminary hypotheses about why ecological effects have occurred or may occur from human activities" (U.S. EPA, 1996f). It is a planning step that identifies the major factors (e.g., site ecology, extent of contamination, potential ecological receptors) to be considered in the assessment. The problem formulation addresses the following issues, which are described below:

- Environmental setting and contamination.
- Contaminant fate and transport.
- Potential receptors.
- Complete exposure pathways.
- General assessment endpoints.
- Conceptual model.

The first two issues have been discussed in other sections of this document and will not be discussed here. The environmental setting and the extent of contamination are described in Section 4. Contaminant fate and transport has been addressed in Subsection 6.3 and in the Supplemental Report (CH2M Hill, 1990).

6.6.1.1 Potential Receptors

Potential receptors include terrestrial plant and animal species inhabiting the land surrounding the quarry. Aquatic organisms, including fish, aquatic plants, and macrobenthos inhabiting the quarry and the Black River are potential aquatic receptors. Species common to northcentral Ohio are expected to inhabit the area. Species observed on the site during three days on site in November 1996 are presented in Section 4. This list is not all inclusive of species that may inhabit the area.

6.6.1.2 Complete Exposure Pathways

For an exposure pathway to be complete, a contaminant must be able to travel from the source to ecological receptors and to be taken up by the receptors via one or more exposure routes (U.S. EPA, 1996f). For terrestrial animals, there are three basic exposure routes: ingestion, inhalation, and dermal absorption. For terrestrial plants, root absorption of contaminants in soil or leaf absorption of contaminants evaporating form the soil are potential exposure routes. For aquatic organisms, direct contact of water or sediment with the gills or dermis, and ingestion of food and sediments are the primary exposure routes. For aquatic plants, direct contact with water, and sometimes with air or sediments, can be primary exposure routes.

Ingestion is the primary exposure route for terrestrial animals at the RSQ site. Terrestrial mammals may be exposed to contaminants in site soils through the consumption of prey that have bioaccumulated contaminants or incidental ingestion of soil while feeding and burrowing. Direct contact with soil is the primary exposure route for terrestrial plants and soil-dwelling organisms that inhabit the site. Direct contact with surface water is the primary exposure route for fish inhabiting the quarry and the Black River. Direct contact with sediments is the primary exposure route for benthic organisms inhabiting the quarry. Birds that consume fish from the quarry or Black River may be exposed to contaminants in their diet. Little information is available for quantifying the inhalation or dermal absorption exposure pathways for terrestrial animals. Although these exposure pathways may be complete, their risk is considered minimal when compared to ingestion.

6.6.1.3 General Assessment Endpoints

Assessment endpoints are "explicit expressions of the environmental value that is to be protected" (U.S EPA, 1996f). The ecological resources selected to represent management goals for environment protection are reflected in the assessment endpoint. Assessment endpoints link the risk assessment to management concerns and they are central to conceptual model development (U.S. EPA, 1996f). Three principal criteria are used when selecting assessment endpoints (U.S. EPA, 1996f):

- Ecological relevance.
- Susceptibility to known or potential stressors.
- Representation of management goals.

The assessment endpoints for the RSQ site are presented in Table 6-23.

6.6.1.4 Conceptual Model

A conceptual model establishes the complete exposure pathways that will be evaluated in an ecological risk assessment and the relationship of the measurement endpoints to the assessment endpoints (U.S. EPA, 1996e). The conceptual model for the RSQ site is presented in Figure 6-2.

Based on the assessment endpoints and the conceptual site model, the following measures of effect, which are based on the presence of adequate habitat for the selected receptor species, were included in the environmental evaluation of the site:

Terrestrial Habitat

- A secondary consumer (carnivore/insectivore) hazard quotient evaluation for a mammalian species, where cumulative exposure (i.e., consumption of insect/earthworm, incidental ingestion of soil) is compared with published or derived toxicity reference values, which are based primarily on survival and reproductive-related effects. Soil-earthworm chemical transfer (i.e., bioaccumulation) is also evaluated to support dose calculations.

- A phytotoxicity hazard quotient evaluation where measured soil concentrations are compared to plant toxicity data obtained from Oak Ridge National Laboratory (ORNL) (Will and Suter, 1995a). Direct observations of phytotoxic signs (e.g., necrosis and chlorosis) are also considered.

- A soil invertebrate and microorganism hazard quotient evaluation where measured soil concentrations are compared to soil benchmarks obtained from ORNL (Will and Suter, 1995b).

Aquatic Habitat

- Aquatic organisms may be directly exposed to chemicals in their surface water environment. A hazard quotient evaluation of surface water concentrations to state and federal water quality criteria was performed to evaluate changes in the aquatic community. In addition, the Index of Biological Activity and the Qualitative Habitat Evaluation Index are calculated for the river to evaluate fish community structure.

- Benthic organisms may be directly exposed to chemicals in their sediment environment. A hazard quotient evaluation of sediment concentrations to sediment benchmarks obtained from U.S. EPA, National Oceanic and Atmospheric Administration (NOAA), Ontario Ministry of Environment

(OMOE), and ORNL (Jones et al., 1996) is performed to evaluate potential impact to the benthic community in the quarry.

- Piscivorous birds may be directly exposed to chemicals in their prey. A hazard quotient evaluation where dietary intake of fish is compared to published or derived reference toxicity values, which are based primarily on survival and reproductive-related effects, is performed to evaluate this potential hazard.

6.6.2 Analysis Phase

The second phase of an ecological risk assessment is to characterize both ecological exposure and ecological effects.

6.6.2.1 Characterization of Exposure

The exposure characterization identifies the potential magnitude and frequency by which target species are exposed to COPCs that have migrated through various pathways to terrestrial and aquatic habitats. In addition, the exposure characterization identifies all routes of exposure (e.g., soil ingestion, water ingestion) by which species inhabiting these areas may be exposed, and serves as an input to risk characterization. The specific objectives of the exposure characterization are to:

- Select target or indicator species and/or communities that directly relate to assessment endpoints.
- Identify significant pathways/routes of exposure.
- Predict exposure doses for selected target or indicator species.

Selection of Target Receptors/Pathways of Exposure

Target receptors were selected to represent all exposed receptors with comparable habitat requirements, feeding preferences, and life histories, as well as any critical or "key" receptors identified by the following characteristics:

- Receptors that are vital to the structure and function of the food web such as principal prey or primary food sources of the principal prey.
- Receptors that exhibit increased sensitivities to the COPCs.
- Receptors that have unique life histories or feeding behaviors whose loss may result in the elimination of a unique ecological niche or unpredictable results on the overall ecosystem.

Bird, mammals, fish, benthic organisms, plants, and soil-dwelling organisms representing several trophic levels were selected as the target receptors for the RSQ site. Exposure of terrestrial wildlife to COPCs occurs primarily when animals feed in areas impacted by site contamination. Exposure of aquatic wildlife to COPCs occurs when the organism's environment becomes contaminated. Aquatic waterfowl are exposed when they feed on contaminated prey. The species selected as receptors of concern represent a range of feeding relationships within the principal habitats present at the site. The receptors of concern, their habitats, and exposure routes are presented in Table 6-24.

Terrestrial Receptors

The short-tailed shrew (*Blarina brevicauda*) was evaluated as a target mammalian species for numerous reasons, including its almost exclusive insectivorous feeding habits, its limited home range (0.5 to 1 acre), its high rate of food intake relative to its small body size (if food is available, this shrew is known to consume more than its body weight daily) (Hoffmeister, 1989), its burrowing habits (i.e., makes tunnels into ground and snow), and its location in the food chain. The shrew is native to the area, although it has not been observed on the site during the ecological site survey. The shrew can be found in a variety of habitats, including forests, grasslands, marshes, and brushy areas (Merrit, 1987), although it is usually most abundant in damp woods that support a thick leaf mold (Hamilton and Whitaker, 1979). Predators include hawks, owls, snakes, opossums, raccoons, foxes, and weasels. The shrew is representative of an extensive and potentially diverse small mammal community that may inhabit the land surrounding the quarry. The shrew was evaluated for exposure to chemicals detected in soil through the ingestion of earthworms that may accumulate chemicals from their environment, as well as through the incidental ingestion of impacted soil while feeding and burrowing. Intake of contaminants via surface water was not considered because the shrew can obtain water from various sources, including its food supply. In addition, elevated levels of inorganic contaminants in surface water were only detected at a 60-foot depth in the quarry.

Plants are the major biotic component of the terrestrial environment and serve as the major source of food and shelter for other living forms within the terrestrial ecosystem. Because abundance and composition of plants in a terrestrial ecosystem are integral to the overall health of the system, it is essential that the assessment of ecological risks to terrestrial communities includes an evaluation of the effects that environmental stressors may have on the growth and survival of vascular plants within the ecosystem (Fletcher et al., 1990).

Earthworms are an important component of the diets of many higher animals. Earthworms may constitute up to 80% of the total biomass of soil fauna, and because of their relatively large biomass, provide a significant food source for many species of several predators, e.g., birds, small mammals (Kabata-Pendias and Pendias, 1992). Their feeding and burrowing activities break down organic matter and releases nutrients, and improve aeration, drainage, and aggregation of soil (Will and Suter, 1995b). Earthworms can take up many inorganic and organic contaminants from soil, and be potentially hazardous to predatory animals. In addition, highly contaminated soils may be toxic, resulting in decreased populations, inhibited metabolism, and possible loss of earthworms from the area.

Soil microorganisms are primary consumers of soil organic matter, converting nutrients to plant available forms. They also serve as a food source for higher trophic levels (Will and Suter, 1995b). Although microorganisms are sensitive to both deficiencies and excesses of trace elements, they can adapt to higher concentrations of these elements in their environment (Kabata-Pendias and Pendias, 1992).

Aquatic Receptors

The belted kingfisher (*Ceryl alcyon*) was chosen as a target avian species because of its piscivorous feeding habits. The kingfisher is native to this area, though it has not been observed during the ecological site survey. The kingfisher is typically found along river and streams and lake and pond edges (U.S. EPA, 1993b). Kingfishers feed predominantly on fish, though sometimes they consume large numbers of crayfish (U.S. EPA, 1993b). The kingfisher generally feeds on fish that swim on the surface or in shallow water that they catch by diving. The kingfisher breeds throughout most of North America and winters in most regions of the continental United States (U.S. EPA, 1993b). For this assessment, the potential dietary exposure from COPCs in the quarry and the Black River was evaluated based on the consumption of fish. Ingestion of surface water was not considered because elevated levels of metals were only measured at a 60 foot depth in the quarry.

Aquatic invertebrates are evaluated as receptors because of their close association with benthic (i.e., sediment) environments. Exposure of invertebrates to COPCs in sediment is expected through dietary incidental ingestion and dermal contact with sediment. Aquatic biota are evaluated as receptors because of their surface water environment. Exposure of aquatic biota is through the gills, dermis, and food ingestion.

6.6.2.2 Estimation of Exposure Doses

To ensure that sites which may pose an ecological risk are property identified, the U.S. EPA suggests that exposure values should be consistently biased in the direction of overestimating risk. "Without this bias, a screening evaluation could not provide a defensible conclusion for an absence of ecological risk" (U.S. EPA, 1996e). Conservative assumptions were used to estimate exposure levels in this screening-level assessment, including:

- Maximum contaminant concentrations at exposure point.
- 100% bioavailability of contaminants.
- 100% of diet consisting of most contaminated food item.
- Minimum body weights and maximum ingestion rates.
- Most sensitive life stage.
- Home range lies entirely within site.

Chemicals were detected above background levels in soil and in fish. To estimate chemical exposure by ecological receptors, exposure doses were estimated for selected indicator species using the following general equation:

$$Dose = C_{medium} \times IR \times FI / BW$$

where:

Dose = Daily dose through exposure route i.e. soil or food (mg/kg-day).

IR = Ingestion rate of the medium (kg/day).

C_{medium} = Chemical concentration in soil or food (mg/kg).

FI = Fraction ingested from contaminated source (unitless).

BW = Body weight (kg).

The equation and exposure parameters and the resultant estimated daily dose to each receptor group are presented in Table 6-25 for the short-tailed shrew and Table 6-26 for the belted kingfisher.

6.6.2.3 Characterization of Ecological Effects

In the ecological effects characterization, information on the toxicity of the COPCs to ecological receptors is presented. Toxicity information from published literature was used to develop toxicity reference values (TRVs) for selected indicator species or communities. TRVs are expressed as an acceptable daily dose or as a media concentration, depending on the receptor(s).

TRVs presented in the form of an acceptable daily dose are based on field and laboratory tests for birds, mammals, or other organisms, and indicate the absence of or presence of adverse ecological impact. For example, daily doses for mammal species such as mice, rats, or dogs are readily available in the literature for many chemicals at levels often indicative of adverse effects. For chemical exposures, dose is expressed in mg-constituent/kg-body weight (bw)/day as a administered dose (mg/kg-bw/day). There are no U.S. EPA-established acceptable daily doses for ecological receptors; therefore, this type of TRV was developed from the available scientific literature.

For each COPC with a complete exposure pathway, a TRV (in the form of an acceptable dose) was obtained directly from published studies or developed for potential receptor species. The TRVs in the form of an acceptable dose are presented in Table 6-25 for the short-tailed shrew and Table 6-26 for the belted kingfisher. To reduce uncertainty and to ensure that TRVs are adequately conservative, the following guidelines were followed:

- Ideally, the selected TRVs were based on toxicity data specific to the receptors of concern.

- Chronic toxicity values were preferentially selected over acute toxicity values.

- A no-observable-adverse-effect level (NOAEL) were preferentially used over a lowest-observable-adverse-effect level (LOAEL).

- Ecologically significant endpoints (e.g., reproductive effects, mortality, serious histopathological effects, serious alterations in behavior) were preferentially used when determining appropriate literature-based NOAEL or LOAEL.

- If only acute toxicity data are available, an uncertainty factor of 5 is used to extrapolate from an acute LD_{50} to an acute toxicity threshold (U.S. EPA, 1986).
  No extrapolation from an acute to a chronic threshold was performed due to high degree of uncertainty.

- A body weight scaling factor is used for interspecies extrapolation (Sample, et al., 1996).

In contrast, TRVs based on media concentrations are not specific to individual species but instead are applicable to groups of organisms or communities occupying the same medium (i.e., plants in soil, invertebrates in sediment, aquatic biota in surface water. For example, ambient water quality criteria for chemicals in surface water are designed to be protective of all aquatic biota occupying the same aquatic community or body of water. TRVs based on media concentrations are expressed as a concentration (e.g., mg-chemical/kg-soil). TRVs based on media concentrations are available for surface water, sediment, plants, earthworms, and soil microorganisms.

As a means of characterizing aquatic toxicity, ambient water quality criteria (AWQC) have been developed for the protection of 95 percent of all aquatic life where sufficient data are available (U.S. EPA, 1992f). Not only fish, but also aquatic invertebrates and plants are protected (U.S. EPA, 1986). The Ohio EPA has also established water quality criteria to protect aquatic life habitat. For metals, most water quality criteria are hardness-dependent. Surface water data was used to calculated hardness values and hardness-dependent criteria for each water body (Appendix C).

Various agencies have developed sediment quality criteria and benchmarks for the assessment of toxicological effects on sediment-associated biota (Jones et al., 1996). Note that these benchmarks are not remediation goals; remediation goals must consider the adverse effects on habitat and remobilization of contaminants caused by removal or remediation of sediments (Jones et al., 1996). The sediment benchmarks should not be considered as the sole measure of sediment toxicity; rather, field studies and toxicity tests are primary indicators of sediment toxicity (Jones et al., 1996). The sediment benchmarks provide a means to determine which chemicals are most likely causing toxicity. Use of multiple benchmarks provides an indication of the likelihood and nature of effects. For example, exceeding one benchmark may provide weak evidence of real effects while exceeding numerous benchmarks may provide strong evidence of real effects (Jones et al., 1996).

The OMOE (1993) has developed a set of numerical guidelines for freshwater systems in Ontario which include No Effect, Low Effect, and Severe Effect levels. At the No Effect Level, no impact on water quality uses or benthic organisms is expected. The Low Effect

Level is the level of sediment contamination that can be tolerated by the majority of benthic organisms. The Severe Effect Level is the level of sediment contamination at which pronounced disturbance of the sediment-dwelling community is expected. The NOAA (1990) has developed sediment effect ranges to determine concentrations of chemicals which are likely to result in effects based upon available sediment data collected primarily in marine and estuarine environments throughout the United States. The Effects Range-Low (ER-L) values represent the lower tenth percentile of the range of concentrations in which effects were observed or predicted. The Effects Range-Median (ER-M) values represent median concentrations. The U.S. EPA (1996g) has published Ecotox Thresholds (ETs) for screening contaminants at CERCLA sites. Values are available for 8 metals and 41 organics in sediment. ORNL (Efroymson et al., 1996) has developed preliminary remediation goals (PRGs) for sediment which are the lowest value of numerous sediment benchmarks.

Screening benchmarks for phytotoxicity and for toxic effects on earthworms and soil microbial processes have also been developed by ORNL (Will and Suter, 1995a; 1995b). These screening values present a means for determining what chemicals require further study at a site. Soil, plant, earthworm, and microorganism characteristics play a large part in toxicity and should be considered in the evaluation of potential hazards (Will and Suter, 1995a; 1995b).

6.6.3 Risk Characterization

The risk characterization integrates information from the problem formulation and analysis sections to estimate the nature and extent of ecological risk or threat, as well as the environmental impact of previous site activities. The ecological risk characterization is based on a preponderance of evidence approach where measurement endpoints are compared with various environmental criteria (i.e., TRVs).

6.6.3.1 Hazard Quotient Approach

The hazard quotient approach was used as the basis for evaluating risk. The hazard quotient approach is routinely used by U.S. EPA as the simplest quantitative method for estimating risk to ecological receptors. The hazard quotient compares exposure values to TRVs, and can be expressed as the ratio of a potential exposure level to the TRV:

HQ = Exposure / TRV

where:

HQ = Hazard quotient (unitless).

Exposure = Exposure concentration at the exposure point (e.g., mg contaminant/L surface water) or estimated contaminant dose at the exposure point (mg/kg-bw/day).

TRV = Toxicity reference value, expressed as an acceptable daily dose or a media concentration (in units that match the exposure point concentration or the estimated daily dose).

Exposure to the same chemical through multiple exposure routes (e.g., soil ingestion, surface water ingestion) is assumed to be cumulative. Consequently, a hazard index (HI) for a specific chemical examines the potential risk posed by the chemical through more than one exposure route, where applicable. A calculated HQ or HI exceeding one indicates that the species of concern (or species for which the toxicity data was based on) may be at risk for an adverse effect from the particular chemical, exposure route, or media on which the HQ was calculated. Further evaluation may be needed in terms of site-specific toxicity data for a given target receptor.

Terrestrial Receptors

Short-tailed shrew

The shrew was assumed to be exposed to soil COPCs through ingestion of earthworms and soil. The estimated daily dose and the potential risk to the shrew are presented in Table 6-27. There is a potential for adverse effects to a shrew residing at the RSQ site. Antimony, iron, and selenium were found to be of potential concern. For antimony and selenium, hazard quotients greater than one are due to earthworm ingestion only. For iron, a hazard quotient greater than one is due to soil and earthworm ingestion. However, these risks may be overestimated, as discussed further in the Uncertainty Analysis (Subsection 6.6.3.2).

Plants

Soil concentrations are directly compared to concentrations that are known to be phytotoxic in Tables 6-28 and 6-29. The hazard quotients for selenium and thallium exceeded one, indicating a potential for adverse effects on vegetation. Elevated levels of these metals (in comparison to background) were only measured in the former pickle liquor ditch. Phytotoxicity data was not available for iron and the PAHs. No evidence of phytotoxic effects (e.g., chiorosis, necrosis, barren areas) were noted during field investigations. Vegetation is fairly dense over most of the site.

Earthworms

Soil concentrations are directly compared to concentrations that are known to be toxic to earthworms in Tables 6-28 and 6-29. The hazard quotient for mercury exceeded one, indicating a potential for adverse effects. Elevated levels of these metals (in comparison to background) were only measured in the former pickle liquor ditch. Earthworm toxicity data was not available for antimony, iron, thallium, and the PAHs.

Soil Microorganisms

Soil concentrations are directly compared to concentrations that are known to be toxic to soil microorganisms in Tables 6-28 and 6-29. The hazard quotient for iron exceeded one, suggesting that there is a potential for adverse effects on soil microorganisms. Soil microorganism toxicity data was not available for antimony, thallium, and the PAHs.

Aquatic Receptors

Belted Kingfisher

The kingfisher was assumed to be exposed to site-related COPCs through ingestion of fish from the quarry and the Black River. The estimated daily dose and the potential risk to the kingfisher are presented in Table 6-30. There were no hazard quotients greater than one for this receptor, suggesting that there is no potential for site-related adverse effects to this piscivorous bird.

Aquatic Organisms

A comparison of surface water chemical concentrations with federal and state water quality criteria for the protection of freshwater organisms was used to assess the likelihood of adverse effects to aquatic organisms in the quarry and the Black River. The maximum detected unfiltered and filtered surface water concentrations were compared to the lowest acute and chronic criteria.

In the quarry, hazard quotients were greater than one for calcium, cobalt, copper, iron, manganese, silver, and vanadium for both total (unfiltered) and dissolved (filtered) phases (Table 6-31). These constituents were detected in only one sample (SW-204) above detection limits or background levels. This sample was collected at the bottom of the quarry (i.e., at a depth of 60 feet). During the Supplemental Investigation (CH2M Hill, 1990) conducted in the summer months, dissolved oxygen profiles indicated that only the top few feet of water in the quarry had enough oxygen to support fish. During the present investigation conducted during November, dissolved oxygen was nearly at the saturation level throughout the entire water column, thereby allowing full range of quarry habitat for fish refuge. However, no fish were captured in any of the deeper nets set in the quarry during the present investigation. Thus, while there is potential for adverse effects on aquatic organisms inhabiting the bottom of the quarry, exposure may be limited especially during the summer months.

Surface water concentrations in the quarry outfall did not exceed background levels and surface water concentrations of aluminum, barium, and iron in the Black River were only slightly higher downstream than upstream (i.e., less than two times background) (Appendix C). No adverse effects are expected for aquatic organisms inhabiting the Black River or the outfall.

Benthic Organisms

To assess the potential for adverse effects on benthic organisms from exposure to potentially toxic sediment, sediment concentrations were compared to sediment benchmarks. Since benthic organisms are relatively immobile, each sampling location is evaluated separately. In addition, multiple benchmarks were evaluated to provide an indication of the likelihood and nature of effects. For example, exceeding one benchmark may provide weak evidence of real effects while exceeding numerous benchmarks may provide strong evidence of real effects (Jones et al., 1996).

Of the VOCs detected in sediments, acetone, carbon disulfide, 2-butanone, toluene, and xylene exceeded sediment benchmarks (Table 6-32). Acetone, 2-butanone, toluene are considered to be common laboratory contaminants though only acetone was detected in the method blanks. Toluene and xylene were measured at elevated levels in one sample (SD-106; Appendix C), though this location did not exceed all sediment benchmarks. Acetone and 2-butanone were detected at all sample locations (Appendix C). However, acetone and 2-butanone are polar nonionic compounds. For polar non-ionic compounds, the equilibrium-partitioning model, which was used to develop the benchmarks for these compounds, provides a conservative model of exposure (Efroymson, et al., 1996), thus, resulting in a conservative estimate of risk.

Of the SVOCs detected in sediment, several individual PAHs and the total PAH concentration each exceeded their most stringent (i.e., lowest) sediment benchmark (Table 6-33). While several individual PAHs (i.e., fluorene, phenanthrene, anthracene, pyrene, benzo(a)anthracene, chrysene, and dibenzo(a, h)anthracene) exceeded the highest sediment benchmark, the total PAH concentration in quarry sediments did not exceed its highest benchmark.

Aldrin, 4,4-DDT, alpha-chlordane, and gamma-chlordane each exceeded their most stringent (i.e., lowest) sediment benchmark (Table 6-34). Only alpha-chlordane exceeded the highest sediment benchmark at one location (SD-106; Appendix C).

Arsenic, cadmium, chromium, copper, iron, lead, manganese, mercury, nickel and zinc each exceeded their most stringent (i.e., lowest) sediment benchmark (Table 6-35). Copper, iron, manganese, and nickel each exceeded their highest sediment benchmark.

Thus, potential exists for adverse effects to occur to benthic organisms inhabiting the quarry. It should be noted that the sediment benchmarks provide a indication of the likelihood of adverse effects on benthic community. Any proposed remediation of sediments must also consider the adverse effects on habitat and remobilization of contaminants caused by removal or remediation of sediments (Jones et al., 1996).

6.6.3.2 Summary of Uncertainty

The ecological risk assessment process is subject to a variety of uncertainties. Almost every step involves assumptions based on professional judgment. The primary purpose of an uncertainty analysis is to reiterate that predicted risks are relative in nature and do not represent an absolute quantification. General sources of uncertainty include:

- Environmental chemistry and sampling analysis.
- Fate and transport parameters.
- Exposure assumptions.
- Toxicological data.

Uncertainties specific to this ecological risk assessment include the following:

- The diet of the shrew in a given location is based on food availability and can consist of earthworms, insects, slugs and snails, plants, fungi, millipedes, centipedes, and arachnids. Small animals are also consumed (U.S. EPA, 1993b). Since data are not available to estimate chemical concentrations in other available food sources, exposure dose estimates were based on exclusive consumption of earthworms for the shrew. Since earthworms inhabit and ingest soil, they may be more efficient accumulators of soil contaminants than other soil invertebrates. Thus, the assumption of an exclusive earthworm diet may overestimate the hazard to the shrew.

- The diet of the kingfisher consists primarily of fish, but can also consist of the following organisms: crayfish, mussels, lizards, frogs, toads, insects, small snakes, young birds, mice, and berries (U.S. EPA, 1993b). Thus, the assumption that 100 percent of the kingfisher diet is composed of fish from the quarry or Black River may overestimate the hazard to this receptor.

- It is not known how available metals and other inorganics in earthworms tissues are to predators. The presence of high levels of metals in earthworm tissue is not adequate proof that they will be absorbed by the predator (Lee, 1985). Thus, if metals are not in a bioavailable form in earthworm tissue, they may not pose a hazard to wildlife at the site.

- The chemical form of a metal is an important factor in determining the level of exposure at which toxicity appears (Lee, 1985). The metal concentrations in earthworm tissues were estimated as total concentrations and total metal concentrations were measured in soil and sediment. As a general rule, the form of the metal in an earthworm, in soil, and in sediment at the site is a less bioavailable form than that used in the study on which the TRV is based. In such a case, the estimated hazard quotient from exposure to such a chemical would be overestimated.

- No toxicity data were available specifically for the short-tailed shrew and the belted kingfisher. Therefore, data from other small mammal and avian species were used which may overestimate or underestimate the hazard.

- Limited plant earthworm, and soil microorganism toxicity data were available for the COPCs in soil. Therefore, this portion of the assessment does not reflect the total potential hazard.

- Since toxic effects on plants, and soil organisms are species -specific and directly related to ambient conditions (e.g., soil type, pH, moisture content), comparison of literature-based toxic concentrations in soil is extremely simplistic and may not accurately illustrate potential hazards.

- Metals are a primary contributor of risk to benthic organisms. Background metals concentrations should be used as a check for metals benchmarks because some benchmarks may be lower than background sediment concentrations (Jones et al., 1996). (Background metals concentrations that were taken were not directly applicable to the evaluation of benthic organism hazards, therefore, these hazards may be overestimated).

Figure 6-1

Conceptual Site Model
Republic Steel Quarry
Elyria, Ohio

Source Medium	Transport Mechanism	Exposure Medium	Exposure Route	Receptors: Current Trespasser	Receptors: Future Park Patron – Adult	Receptors: Future Park Patron – Child	Receptors: Future Resident – Adult	Receptors: Future Resident – Child
Quarry surface water/sediment	None	Surface water	Incidental ingestion	●	●	●	●	●
			Dermal absorption	●	●	●	●	●
			Fish ingestion	●	●	●	●	●
	None	Sediment	Incidental ingestion	○	○	○	○	○
			Dermal absorption	○	○	○	○	○
Black River surface water/sediment	None	Surface water	Incidental ingestion	○	○	○	○	○
			Dermal absorption	○	○	○	○	○
			Fish ingestion	●	●	●	●	●
	None	Sediment	Incidental ingestion	○	○	○	○	○
			Dermal absorption	○	○	○	○	○
Groundwater	None	Groundwater	Ingestion	○	○	○	●	●
			Dermal absorption	○	○	○	●	●
			Inhalation	○	○	○	●	●
Boat launch/pickle liquor ditch soil	None	Soil	Incidental ingestion	●	●	●	●	●
			Dermal absorption	●	●	●	●	●
	Dust entrainment/ volatilization	Air	Dust inhalation	●	●	●	●	●
			Vapor inhalation	○	○	○	○	○

● Potential exposure route determined to be significant for this receptor - included in quantitative analysis.
○ Potential exposure route determined to be insignificant, unnecessary, or cannot be evaluated for this receptor - not included in quantitative analysis.

Figure 6-2

Conceptual Site Model: Ecological Risk Assessment
RSQ Site
Elyria, Ohio

Source Medium	Transport Mechanism	Exposure Medium	Exposure Route	Aquatic Receptors		Terrestrial Receptors				
				Fish	Macrobenthos	Plants	Soil-dwelling Organisms	Mammals	Birds	Reptiles/ Amphibians
Quarry surface water/sediment	None	Surface water	Incidental ingestion	●	○	---	---	○	○	○
			Dermal absorption	●	○	---	---	○	○	○
			Inhalation	●	○	---	---	○	○	○
	Bioaccumulation	Fish, other aquatic organisms	Food source	●	○	---	---	○	●	○
	None	Sediment	Incidental ingestion	○	●	---	---	○	○	○
			Dermal absorption	○	●	---	---	○	○	○
			Inhalation	○	●	---	---	---	---	---
	Bioaccumulation	Fish, other aquatic organisms	Food source	○	●	---	---	○	○	○
Black River surface water	None	Surface water	Incidental ingestion	●	○	---	---	○	○	○
			Dermal absorption	●	○	---	---	○	○	○
			Inhalation	●	○	---	---	○	○	○
	Bioaccumulation	Fish, other aquatic organisms	Food source	●	○	---	---	○	●	○

Figure 6-2

Conceptual Site Model: Ecological Risk Assessment
Republic Steel Quarry
Elyria, Ohio
(Continued)

Source Medium	Transport Mechanism	Exposure Medium	Exposure Route	Aquatic Receptors		Terrestrial Receptors				
				Fish	Macrobenthos	Plants	Soil-dwelling Organisms	Mammals	Birds	Reptiles/ Amphibians
Boat launch/pickle liquor ditch soil	None	Soil	Incidental ingestion	---	---	---	●	●	○	○
			Dermal absorption	---	---	---	●	○	○	○
			Growth medium	---	---	●	---	---	---	---
	Bioaccumulation	Soil-dwelling organisms, plants	Food source	---	---	---	●	●	○	○
	Dust entrainment / volatilization	Air	Dust inhalation	---	---	---	---	○	○	○
			Vapor inhalation	---	---	---	---	○	○	○

--- Not considered to be a potential exposure route for this receptor.
● Potential exposure route determined to be significant for this receptor - included in quantitative analysis.
○ Potential exposure route determined to be insignificant, unnecessary, or cannot be evaluated for this receptor - not included in quantitative analysis.

Table 6-1

Summary of Previously Calculated Potential Risks*
Republic Steel Quarry
Elyria, Ohio

Exposure Scenario	Total Cancer Risks		Noncarcinogenic Hazard Index	
	Average	Maximum	Average	Maximum
CURRENT-USE (TRESPASSERS)				
Direct Contact with Soil	2×10^{-9}	1×10^{-7}	< 1	< 1
Swimming in the Quarry	8×10^{-12}	3×10^{-10}	< 1	< 1
Consumption of Fish	8×10^{-9}	6×10^{-7}	< 1	= 1
Combined Risk to Trespassers	1×10^{-8}	7×10^{-7}	< 1	= 1
FUTURE-USE				
Park Patron–Direct Contact with Soil	5×10^{-9}	4×10^{-7}	< 1	< 1
Residential Use–Direct Contact with Soil	5×10^{-8}	5×10^{-6}	< 1	< 1
Residential Use–Ingestion of Groundwater	1×10^{-4}	3×10^{-4}	< 1	> 1
Combined Residential Risk	1×10^{-4}	3×10^{-4}	< 1	> 1

* Revised Endangerment Assessment (Republic Steel Quarry Supplemental Report, CH2M Hill, 26 September 1990).

Table 6-2

Groundwater Data Summary
Republic Steel Quarry
Elyria, Ohio
(All Concentrations in ug/L)

Chemical	Frequency of Detection	Range of Detected Concentrations		Background Concentrations	
		Minimum	Maximum	Minimum	Maximum
Organics					
Bis(2-ethylhexyl)phthalate	3/5	0.7	1	---	1
Inorganics					
Aluminum	4/5	52.1	334	17	21.4
Antimony	1/5	---	8.9	---	--
Arsenic	1/5	---	28.8	---	--
Barium	5/5	3.6	78.9	33.9	46.8
Beryllium	1/5	---	1.2	---	--
Cadmium	2/5	1.1	5.2	---	--
Calcium	5/5	36,500	381,000	125,000	167,000
Chromium	2/5	1.8	3.7	---	1.3
Cobalt	4/5	1.4	14.9	---	--
Copper	2/5	2.4	2.6	---	--
Iron	5/5	286	568,000	27.1	215
Magnesium	5/5	10,200	52,600	63,000	64,400
Manganese	5/5	36.3	7,870	135	312
Nickel	3/5	2.4	13.4	---	1.1
Potassium	5/5	840	10,000	3,220	3,740
Selenium	1/5	---	13.7	---	--
Sodium	5/5	16,500	398,000	50,500	52,600
Thallium	4/5	2.4	43.6	2.3	2.7
Zinc	4/5	2.5	17.7	3.2	3.5
Cyanide	1/5	---	3.3	2.1	2.6

Table 6-3

Surface Water Data Summary: Quarry
Republic Steel Quarry
Elyria, Ohio
(All Concentrations in ug/L)

Chemical	Unfiltered Data			Filtered Data		
	Frequency of Detection	Range of Detected Concentrations		Frequency of Detection	Range of Detected Concentrations	
		Minimum	Maximum		Minimum	Maximum
Inorganics						
Barium	5/5	27.6	41.5	5/5	27.6	43.4
Calcium	5/5	53,600	210,000	5/5	53,100	220,000
Chromium	0/5	---	---	1/5	---	3.4
Cobalt	1/5	---	47.2	1/5	---	50.7
Copper	1/5	---	299	1/5	---	299
Iron	1/5	---	800,000	1/5	---	847,000
Lead	0/5	---	---	1/5	---	2.4
Magnesium	5/5	14,300	59,000	5/5	14,100	61,700
Manganese	5/5	152	12,300	5/5	123	12,800
Potassium	5/5	3,030	5,040	5/5	3,080	5,350
Silver	1/5	---	280	1/5	---	280
Sodium	5/5	40,500	47,600	5/5	42,100	48,300
Vanadium	1/5	---	34.1	1/5	---	37.5
Cyanide	1/5	---	1.5	---	---	---
Chloride	5/5	38,000	85,000	---	---	---
Sulfate	5/5	103,000	2,090,000	---	---	---

Table 6-4

Surface Water Data Summary: Black River
Republic Steel Quarry
Elyria, Ohio
(All Concentrations in ug/L)

Chemical	Unfiltered Data			Filtered Data		
	Frequency of Detection	Range of Detected Concentrations		Frequency of Detection	Range of Detected Concentrations	
		Minimum	Maximum		Minimum	Maximum
Organics						
Diethylphthalate	1/2	---	0.9	---	---	---
Inorganics						
Aluminum	2/2	1,030	1,180	2/2	62.2	70.8
Barium	2/2	27.7	30.6	2/2	22.8	22.9
Calcium	2/2	39,200	41,900	2/2	40,400	41,100
Copper	2/2	5	5.4	1/2	---	3.5
Iron	2/2	1,470	1,590	1/2	---	219
Lead	2/2	1.2	1.3	0/2	---	--
Magnesium	2/2	10,700	11,600	2/2	11,000	11,000
Manganese	2/2	35.3	37.3	2/2	21.2	22.9
Potassium	2/2	3,690	3,860	2/2	3,500	4,010
Sodium	2/2	9,310	10,100	2/2	9,800	9,860
Cyanide	2/2	1.2	2.1	---	---	--
Chloride	2/2	20,000	20,000	---	---	--
Sulfate	2/2	49,000	52,000	---	---	--

Table 6-5

Soil Data Summary
Republic Steel Quarry
Elyria, Ohio

Chemical	Frequency of Detection	Range of Detected Concentrations		Background Concentrations		
		Minimum	Maximum	Frequency of Detection	Minimum	Maximum
Organics (ug/kg)						
Naphthalene	4/8	24	44	6/6	26	210
2-Methylnaphthalene	5/8	26	76	6/6	36	280
Dibenzofuran	3/8	22	28	2/6	44	65
Pentachlorophenol	4/8	120	350	---	---	---
Phenanthrene	3/8	31	120	6/6	31	180
Anthracene	1/8		120	1/6	---	24
Fluoranthene	3/8	34	78	6/6	34	190
Pyrene	2/8	67	120	6/6	28	210
Benzo(a)anthracene	3/8	48	250	4/6	35	100
Chrysene	3/8	63	300	6/6	28	130

Table 6-5

Soil Data Summary
Republic Steel Quarry
Elyria, Ohio
(Continued)

Chemical	Frequency of Detection	Range of Detected Concentrations		Background Concentrations		
		Minimum	Maximum	Frequency of Detection	Minimum	Maximum
Indeno(1,2,3-cd)pyrene	4/8	34	280	2/6	61	70
Benzo(g,h,i)perylene	4/8	30	260	1/6	---	48
Inorganics (mg/kg)						
Aluminum	7/7	658	1,530	6/6	2,420	12600
Antimony	5/7	1.4	3.0	3/6	1.3	2.6
Arsenic	7/7	6.8	16.2	6/6	8.5	29.1
Barium	7/7	4.4	53.3	6/6	18.6	105
Cadmium	6/7	0.31	1.4	6/6	0.62	0.94
Calcium	7/7	446	1,130	6/6	1,080	3,220
Chromium	7/7	5.7	18.4	6/6	6	17.1
Cobalt	7/7	2.0	4.1	6/6	3.7	15.6
Copper	7/7	16.8	45.8	6/6	10.8	21.7

Table 6-5

Soil Data Summary
Republic Steel Quarry
Elyria, Ohio
(Continued)

Chemical	Frequency of Detection	Range of Detected Concentrations		Background Concentrations		
		Minimum	Maximum	Frequency of Detection	Minimum	Maximum
Iron	7/7	7,730	107,000	6/6	13,100	26,300
Lead	7/7	8.2	38.6	6/6	22.3	118
Magnesium	7/7	154	551	6/6	618	2,430
Manganese	7/7	61.5	376	6/6	110	964
Mercury	3/7	0.12	0.24	6/6	---	---
Nickel	7/7	1.7	9.0	6/6	9.9	17.9
Potassium	7/7	327	2,000	6/6	479	978
Selenium	3/7	3.2	4.1	5/6	1.4	1.7
Sodium	7/7	171	400	6/6	217	264
Thallium	1/7	---	1.9	6/6	---	---

Table 6-5

Soil Data Summary
Republic Steel Quarry
Elyria, Ohio
(Continued)

Chemical	Frequency of Detection	Range of Detected Concentrations		Background Concentrations		
		Minimum	Maximum	Frequency of Detection	Minimum	Maximum
Vanadium	7/7	4.6	12.8	6/6	8.7	25.8
Zinc	7/7	14.7	30.6	6/6	49.6	178
Cyanide	6/7	0.12	0.44	6/6	0.14	0.41

Table 6-6

Sediment Data Summary: Quarry
Republic Steel Quarry
Elyria, Ohio

Chemical	Frequency of Detection	Range of Detected Concentrations	
		Minimum	Maximum
Volatile Organics (ug/kg)			
Methylene chloride	7/7	5	58
Acetone	7/7	38	2,800
Carbon disulfide	3/7	16	26
2-Butanone	7/7	7	830
Benzene	2/7	8	16
Tetrachloroethene	2/7	34	48
Toluene	3/7	9	79
Ethylbenzene	1/7	---	17
Xylene	1/7	---	70
Semivolatile Organic Compounds (ug/kg)			
1,3-Dichlorobenzene	1/7	---	180
1,4-Dichlorobenzene	1/7	---	200
4-Methylphenol	1/7	---	390
1,2,4-Trichlorobenzene	1/7	---	170
Naphthalene	2/7	94	240
4-Chloro-3-methylphenol	1/7	---	280
2-Methylnaphthalene	2/7	130	600
Acenaphthene	1/7	---	230
Fluorene	5/7	150	1,900
Phenanthrene	5/7	44	10,000
Anthracene	3/7	160	2,600
Di-n-butylphthalate	1/7	---	3,500
Fluoranthene	7/7	70	3,400

Table 6-6

Sediment Data Summary: Quarry
Republic Steel Quarry
Elyria, Ohio
(Continued)

Chemical	Frequency of Detection	Range of Detected Concentrations	
		Minimum	Maximum
Pyrene	7/7	1,000	5,500
Butylbenzylphthalate	1/7	---	42
Benzo(a)anthracene	6/7	33	3,000
Chrysene	7/7	61	3,800
Bis(2-ethylhexyl)phthalate	1/7	---	1,700
Di-n-octylphthalate	1/7	---	960
Benzo(b)fluoranthene	2/7	110	1,200
Benzo(k)fluoranthene	1/7	---	1,400
Benzo(a)pyrene	3/7	56	650
Indeno(1,2,3-cd)pyrene	5/7	710	1,400
Dibenz(a,h)anthracene	1/7	---	410
Benzo(g,h,i)perylene	6/7	470	1,400
Pesticides (ug/kg)			
Heptachlor	1/7	---	29
Aldrin	2/7	21	69
4,4'-DDT	1/7	---	14
alpha-Chlordane	3/7	7.6	75
gamma-Chlordane	1/7	---	34
Inorganics (mg/kg)			
Aluminum	7/7	6,400	30,300
Arsenic	6/7	7.2	43.9
Barium	7/7	54.5	129
Beryllium	1/7	---	0.88

Table 6-6

Sediment Data Summary: Quarry
Republic Steel Quarry
Elyria, Ohio
(Continued)

Chemical	Frequency of Detection	Range of Detected Concentrations	
		Minimum	Maximum
Cadmium	7/7	0.58	1.6
Calcium	7/7	4,110	19,900
Chromium	7/7	12.9	117
Cobalt	6/7	8.2	23.3
Copper	7/7	24.5	333
Iron	7/7	27,200	214,000
Lead	7/7	24.5	192
Magnesium	7/7	1,860	7,420
Manganese	7/7	170	3,470
Mercury	3/7	0.34	0.72
Nickel	7/7	8.9	84.1
Potassium	7/7	1,150	3,960
Selenium	2/7	4.8	6.0
Sodium	7/7	177	1,420
Thallium	2/7	4.0	10.5
Vanadium	7/7	15.0	50.5
Zinc	7/7	41.1	371

Table 6-7

Fish Tissue Data Summary
Republic Steel Quarry
Elyria, Ohio
(All Concentrations in ug/kg)

Chemical	Frequency of Detection	Range of Detected Concentrations	
		Minimum	Maximum
Quarry			
Cadmium	2/3	9.3	75.2
Copper	3/3	283	409
Manganese	3/3	124	402
Mercury	3/3	49.1	357
Black River (upstream of quarry outfall)			
Cadmium	1/5	---	7.8
Copper	5/5	328	736
Manganese	5/5	172	1,170
Mercury	5/5	55.5	251
Black River (downstream of quarry outfall)			
Cadmium	1/6	---	4.9
Copper	6/6	306	1,020
Manganese	6/6	111	584
Mercury	6/6	74.1	235

Table 6-8

Screening of Chemicals of Potential Concern in Soil -- Semivolatile Organic Compounds
Republic Steel Quarry
Elyria, Ohio

	Maximum Detected Concentration	Soil Screening Level			
		U.S. EPA Soil ScreeningLevel[a]		U.S. EPA Region III Risk-Based Concentration[a] Residential	U.S. EPA Region IX Preliminary Remedlation Goals[a] Residential
		Ingestion	Inhalation		
	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg
Naphthalene	44	310,000	---	310,000 nc	240,000 sat
2-Methylnaphthalene*	76	310,000	---	310,000 nc	---
Dibenzofuran	28	---	---	31,000 nc	140,000 sat
Pentachlorophenol	350	3,000	---	5,300 c	2,500 c
Phenanthrene*	120	230,000	---	310,000 nc	---
Anthracene	120	2,300,000	---	2,300,000 nc	5,700 sat
Fluoranthene	78	310,000	---	310,000 nc	260,000 nc
Pyrene	120	230,000	---	230,000 nc	100,000 sat
Benzo(a)anthracene	250	900	---	880 c	610 c
Chrysene	300	88,000	---	88,000 c	7,200 sat
Indeno(1,2,3-cd)pyrene	280	900	---	880 c	610 c
Benzo(g,h,i)perylene*	260	230,000	---	310,000 nc	---
Tentatively Identified Compounds (TICs)					
Phenol, 2,3,4,6-Tetrachloro	210	---	---	---	200,000 nc
Acenaphtho(1,2-B)Pyridine	1,400	---	---	---	---
2H-1-Benzopyran-2-one	130	---	---	---	---
2,5-Hexanedione	90	---	---	---	---
Copane	86	---	---	---	---
P-Benzoquinone,2-methyl	300	---	---	---	---
Benzoic acid	390	---	---	---	1.00E+08 max
2-Furanmethanol,tetrahydro-A	180	---	---	---	
Tridecanol,2-ethyl-2-methyl	250	---	---	---	---
Tridecanoic acid	280	---	---	---	---

[a] Screening level for noncarcinogens based on target hazard quotient of 0.1 (U.S. EPA, 1996a;1996b;199c).
sat - Soil saturation concentration
max - Non-risk based “ceiling limit” for relatively less toxic contaminants.

--- No screening level available.
nc - Noncarcinogenic.
c - Carcinogenic.

Table 6-9

Screening of Chemicals of Potential Concern in Soil -- Inorganic Compounds
Republic Steel Quarry
Elyria, Ohio
(All Concentrations in mg/kg)

Analyte	Maximum Detected Concentration	Site-Specific Background			Screening Levels			
					U.S. EPA Soil Screening Level[a]		U.S. EPA Region III Risk-based Concentration[a]	U.S. EPA Region IX Preliminary Remediation Goals[a]
		Minimum	Maximum Maximum	2x Average	Ingestion	Inhalation	Residential	Residential
Aluminum	1,660	2,420	12,600	15,870	--	--	7,800 nc	7,700 nc
Antimony	3	1.3	2.6	2.42	31	--	3.1 nc	3.1 nc
Arsenic	16.2	8.5	29.1	27.5	0.4	750	0.43 c	0.38 c
Barium	53.3	18.6	105	122	5,500	6.90E+05	550 nc	530 nc
Cadmium	1.4	0.62	0.94	1.62	78	1,800	3.9 nc	3.8 nc
Calcium	1,130	1,080	3,220	4,050	--	--	--	--
Chromium (total)	18.4	6	17.1	22.8	390	270	39 nc	21 nc
Cobalt	4.1	3.7	15.6	17.6	--	--	470 nc	460 nc
Copper	45.8	10.8	21.7	32.4	--	--	310 nc	280 nc
Iron	107,000	13,100	90	39,533	---	--	2,300 nc	-- nc
Lead	38.6	22.3	118	99.7	400	--	--	400
Magnesium	551	618	2,430	3,299	--	--	--	--
Manganese	376	110	964	971	--	--	39 nc	320 nc
Mercury	0.24	ND	ND	ND	23	10	2.3 nc	2.3 nc
Nickel	9	9.9	17.9	26.3	1,600	13,000	160 nc	150 nc
Potassium	2,000	479	978	1,431	--	--	--	--
Selenium	4.1	1.4	1.7	2.88	390	--	39 nc	38 nc
Sodium	400	217	264	469	--	--	--	--
Thallium	1.9	ND	ND	ND	--	--	0.63 nc[b]	0.61 nc[b]
Vanadium	12.8	8.7	25.8	37.4	550	--	55 nc	54 nc
Zinc	30.6	49.6	178	171	23,000	--	2,300 nc	2,300 nc
Cyanide	0.44	0.14	0.41	0.533	1,600	--	160 nc	130 nc

Note: Shading indicates constituent exceeds screening level.

[a] Screening levels for noncarcinogens based on a target hazard quotient of 0.1 (U.S. EPA, 1996a; 1996b; 1996c).

[b] Value based on thallium sulfate.

nc - noncarcinogenic.

c - carcinogenic.

Table 6-10

Screening of Chemicals of Potential Concern: Groundwater
Republic Steel Quarry
Elyria, Ohio

Constituent	Maximum Detected Concentration µg/L	Site Background		Screening Levels			
		Minimum µg/L	Maximum µg/L	Ohio MCL[d] µg/L	U.S. EPA MCL[a] µg/L	U.S. EPA Region III Risk-based Concentration[a] µg/L	U.S. EPA Region IX PRG[a] µg/L
BNAs							
Bis(2-ethylhexyl)phthalate	1	<10	1	6	6	4.8 c	4.8 c
TAL							
Aluminum	334	21.4	17.0	--	50 - 200 (smcl)	3,700 nc	3,700 nc
Antimony	8.9	ND	ND	6	6	1.5 nc	1.5 nc
Arsenic	28.8	ND	ND	50	50	0.045 c	0.045 c
Barium	78.9	33.9	46.8	2,000	2,000	260 nc	260 nc
Beryllium	1.2	ND	ND	4	4	0.016 c	0.016 c
Cadmium	5.2	ND	ND	5	5	1.8 nc	1.8 nc
Calcium	381,000	125,000	167,000	--	--	--	--
Chromium	3.7	<1	1.3	100	100	18 nc[b]	18 nc[b]
Cobalt	14.9	ND	ND	--	--	220 nc	220 nc
Copper	2.6	ND	ND	1000*	1300**	150 nc	140 nc
Iron	568,000	27.1	215	300*	300 (smcl)	1,100 nc	--
Magnesium	52,600	63,000	64,400	--		--	--
Manganese	7,870	135	312	50*	50 (smcl)	18 nc	170 nc
Nickel	13.4	<1	1.1	100	100	73 nc	73 nc
Potassium	10,000	3,220	3,740	--		--	--
Selenium	13.7	ND	ND	50	50	18 nc	18 nc
Sodium	398,000	50,500	52,600	--	--	--	--
Thallium	43.6	2.3	2.7	2	2	2.9=0.1* nc[c]	0.29 nc[c]
Zinc	17.7	3.2	3.5	5000*	5,000 (smcl)	1,100 nc	1,100 nc
Cyanide	3.3	2.1	2.6	200	200	73 nc	73 nc

Note: Shading indicates constituent exceeds screening level.
smcl - Secondary MCL.
* Secondary MCL.
** Action level.
nc - Noncarcinogenic.
c - Carcinogenic.

[a] Screening level for noncarcinogens based on a target hazard quotient of 0.1 (U.S. EPA, 1996b, 1996c).
[b] Value based on chromium VI.
[c] Value based on thallium chloride.
[d] Ohio Administrative Code, Section 3745-81 and Section 3745-82.
[e] U.S. EPA, 1996d.

Table 6-11

Screening of Chemicals of Potential Concern: Quarry Surface Water
Republic Steel Quarry
Elyria, Ohio

Analyte	Maximum Detected Concentration µg/L	Groundwater Background (Quarry) µg/L	Screening Levels			
			Ohio MCL[c] µg/L	U.S. EPA MCL[a] µg/L	U.S. EPA Region III RBC[a] µg/L	U.S.EPA Region IX PRG[a] µg/L
Barium	43.4	33.9 - 46.8	2,000	2,000	260 nc	260 nc
Calcium	220,000	125,000 - 167,000	--	--	--	--
Chromium	3.4	<1 - 1.3	100	100	18 nc[b]	18 nc[b]
Cobalt	50.7	ND	--	--	220 nc	220 nc
Copper	299	ND	1,000*	1,300**	150 nc	150 nc
Iron	847,000	27.1 - 215	300*	300 smcl	1,100 nc	1,100 nc
Lead	2.4	ND	50*	15**	--	--
Magnesium	61,700	63,000 - 64,400	--	--	--	--
Manganese	12,800	135 - 312	50*	50 smcl	18 nc	170 nc
Potassium	5,350	3,220 - 3,740	--	--	--	--
Silver	280	ND	50*	100 smcl	18 nc	18 nc
Sodium	48,300	50,500 - 52,600	--	--	--	--
Vanadium	37.5	ND	--	--	26 nc	26 nc
Cyanide	1.5	21-2.6	200	200	73 nc	73 nc
Chloride (mg/L)	85	NA	--	250 (smcl)	--	--
Sulfate (mg/L)	2,090	NA	--	250 (smcl)	--	--

Shading indicates constituent exceeds screening level.
[a] Screening level based on a target hazard quotient of 0.1 (U.S. EPA, 1996b; 1996c).
[b] Based on chromium VI.
[c] Ohio Administrative Code, Section 3745-81 and Section 3745-82.
[d] U.S. EPA, 1996d.
nc - Noncarcinogenic.
smcl - Secondary MCL.
* = Secondary MCL.
** = Action level.

Table 6-12

Screening of Chemicals of Potential Concern -- Black River Surface Water
Republic Steel Quarry
Elyria, Ohio

Constituent	Maximum Detected Concentration µg/L	Screening Levels Ohio MCL[b] µg/L	U.S. EPA MCL[c] µg/L	U.S. EPA Region III RBC[a] µg/L	U.S.EPA Region IX PRG[a] µg/L
SVOCs					
Diethylphthalate	0.9	--	--	2,900 nc	2,900 nc
TAL					
Aluminum	1,180	--	50- 200 smcl	3,700 nc	3,700 nc
Barium	30.6	2,000	2,000	260 nc	260 nc
Calcium	41,900	--	--	--	--
Copper	5.4	1,000*	1,300**	150 nc	140 nc
Iron	1,590	300	300 smcl	1,100 nc	--
Lead	1.3	50*	15**	--	0.4 nc
Magnesium	11,600	--	--	--	--
Manganese	37.3	50*	50 smcl	18 nc	170 nc
Potassium	4,010	--	--	--	--
Sodium	10,100	--	--	--	--
Cyanide	2.1	200	200	73 nc	73 nc
Chloride (mg/L)	20	--	250 smcl	--	--
Sulfate (mg/L)	52	--	250 smcl	--	--

Shading indicates constituent exceeds screening level.
[a] Screening level based on a target hazard quotient of 0.1 (U.S. EPA, 1996b; 1996c).
[b] Ohio Administrative Code, Section 3745-81 and Section 3745-82.
[c] U.S. EPA, 1996d.
* Secondary MCL.
** Action level.
nc - Noncarcinogenic.
smcl - Secondary MCL.

Table 6-13

Screening of Chemicals of Potential Concern: Fish Tissue
Republic Steel Quarry
Elyria, Ohio

Analyte	Maximum Detected Concentration		U.S. EPA Region III Risk-based Concentration[a]
	Quarry	Black River	
	µg/kg		µg/kg
Cadmium	75.2	7.8	68 nc
Copper	409	1020	5,400 nc
Manganese	402	1170	680 nc
Mercury	357	215	41 nc

Note: Shaded values indicate constituent exceeds screening level.
nc - Noncarcinogenic.
[a] Screening level for noncarcinogens based on a target hazard quotient of 0.1 (U.S. EPA, 1996b).

Table 6-14

Model for Calculating Intakes from Soil Exposure
Republic Steel Quarry
Elyria, Ohio

$$\text{Ingestion Intake (mg/kg-day)} = \frac{\mathbf{CS \times IRs \times CF \times EF \times ED}}{\mathbf{BW \times AT}}$$

$$\text{Dermally Absorbed Dose (mg/kg-day)} = \frac{\mathbf{CS \times CF \times SA \times ABS \times AF \times EF \times ED}}{\mathbf{BW \times AT}}$$

$$\text{Inhalation Intake (mg/kg-day)} = \frac{\mathbf{CS \times IRa \times 1/PEF \times EF \times ED}}{\mathbf{BW \times AT}}$$

where:

CS	=	Chemical concentration in soil (mg/kg)
IRs	=	Soil ingestion rate (mg/day)
IRa	=	Inhalation rate (m^3/day)
CF	=	Conversion factor (10^{-6} kg/mg)
SA	=	Skin surface area available for contact (cm^2/day)
AF	=	Soil to skin adherence factor (mg/cm^2)
ABS	=	Dermal absorption factor (unitless)
PEF	=	Particulate emission factor (kg/m^3)
EF	=	Exposure frequency (days/year)
ED	=	Exposure duration (years)
BW	=	Body weight (kg)
AT	=	Averaging time (days)

Table 6-14

Model for Calculating Intakes from Soil Exposure
Republic Steel Quarry
Elyria, Ohio
(Continued)

Variable	Receptor Group									
	Current Trespasser		Future Park Patron				Future Resident			
			Adult		Child		Adult		Child	
	RME	RAE	RME	RAE	RME	RAE	RME	RAE	RME	RAE
CS (mg/kg)	Table 6-5									
IRs (mg/day)	100[a]		100		200		100		200	
IRa (m^3/day)	17		20		12		20		12	
CF (kg/mg)	1E-06									
SA (cm^2)[e]	4,300[f]	5,000[f]	5,700	6,600	2,900	3,400	5,700	6,600	2,900	6,600
AF (mg/cm^2)[d]	0.03	0.03	0.03	0.03	0.2	0.8	0.03	0.03	0.2	0.8
ABS (unitless)[c]	0.01									
EF (days/year)[a]	60	30	60	30	60	30	350	350	350	350
ED (years)[a,b]	10		30	9	6	2	30	9	6	2
BW (kg)	43[a]		70		15		70		15	
AT (days) noncarcinogens										
AT (days) carcinogens	25,550									

Source: U.S. EPA, 1991c, unless indicated.
RME - Reasonable maximum exposure.
RAE - Representative average exposure.

[a] U.S. EPA, 1992e.
[b] U.S. EPA, 1992a.
[c] U.S. EPA, 1996c.
[d] Kissel et al., 1996.
[e] U.S. EPA, 1996g.
[f] Value estimated as average of child and adult surface area.

Table 6-15

Model for Calculating Intakes from Surface Water Exposure
Republic Steel Quarry
Elyria, Ohio

$$\text{Ingestion Intake(mg/kg-day)} = \frac{\mathbf{Csw \times CR \times EF \times ED}}{\mathbf{BW \times AT}}$$

$$\text{Dermally Absorbed Dose (mg/kg-day)} = \frac{\mathbf{Csw \times CF \times SA \times PC \times ET \times EF \times ED}}{\mathbf{BW \times AT}}$$

where:

Csw	=	Chemical concentration in surface water (mg/L)
CR	=	Surface water contact rate (L/day)
CF	=	Volumetric conversion factor (liter/cm^3)
SA	=	Skin surface area available for contact (cm^2 /day)
PC	=	Dermal permeability constant (cm/hr)
ET	=	Exposure time (hours/day)
EF	=	Exposure frequency (days/year)
ED	=	Exposure duration (years)
BW	=	Body weight (kg)
AT	=	Averaging time (days)

Variable	Receptor Group					
			Future Park Patron/Future Resident[e]			
	Current Trespasser		Adult		Child	
	RME	RAE	RME	RAE	RME	RAE
Csw (mg/L)	Table 6-3		Table 6-3			
CR (L/day)[a]	0.05		0.05			
CF (L/cm^3)	1E-03		1E-03			
SA (cm^2)[a]	14,750[c]	12,250[c]	22,000[d]	18,000[d]	75,000[d]	6,500[d]
PC (cm/hr)[a]	1E-03		1E-03			
ET (hours/day)[a]	1	0.5	1	0.5	1	0.5
EF (days/year)	90[c]	5[a]	90[c]	5[a]	90[c]	5[a]
ED (years)[b]	10		30	9	6	2
BW (kg)[b]	43		70		15	
AT (days)	3,650		10,950	3,285	2,190	730

RME - Reasonable maximum exposure.
RAE - Representatie average exposure.
[a] U.S. EPA, 1992a.
[b] U.S. EPA, 1992e.
[c] Estimated.
[d] U.S. EPA, 1996g.
[e] The same exposure values assumed for the future park patron and the future resident.

Table 6-16

Model for Calculating Intakes from Fish Ingestion
Republic Steel Quarry
Elyria, Ohio

$$\text{Fish Intake(mg/kg-day)} = \frac{\mathbf{Cfish \times IRf \times EF \times ED}}{\mathbf{BW \times AT}}$$

where:

Cfish	=	Chemical concentration in fish (mg/kg)
IRf	=	Fish ingestion rate (kg/day)
EF	=	Exposure frequency (days/year)
ED	=	Exposure duration (years)
BW	=	Body weight (kg)
AT	=	Averaging time (days)

	Receptor Group					
			Future Park Patron/Future Resident[c]			
	Current Trespasser		Adult		Child	
Variable	RME	RAE	RME	RAE	RME	RAE
Cfish (mg/kg)	Table 6-7		Table 6-7			
IRf (kg/day)	0.054	0.0065[a]	0.054	0.0065[a]	0.0075[d]	0.0028[d]
EF (days/year)	350	175[b]	350	175[b]	350	175[b]
ED (years)	30	9	30	9	6	2
BW (kg)	70		70		15	
AT (days)	10,950	3,285	10,950	3,285	2,190	730

Source: U.S. EPA, 1991c, unless indicated.

RME - Reasonable maximum exposure.
RAE - Representative average exposure.

[a] U.S. EPA, 1992e.
[b] Estimated, based on ½ year exposure.
[c] The same exposure values are assumed for the future park patron and future resident.
[d] U.S. EPA, 1990.

Table 6-17

Model for Calculating Intakes from Groundwater Exposure
Republic Steel Quarry
Elyria, Ohio

$$\text{Ingestion Intake(mg/kg-day)} = \frac{\mathbf{Cgw \times IRw \times EF \times ED}}{\mathbf{BW\ x\ AT}}$$

$$\text{Dermally Absorbed Dose (mg/kg-day)} = \frac{\mathbf{Cgw \times CF \times SA \times PC \times ET \times EF \times ED}}{\mathbf{BW \times AT}}$$

where:

Cgw	=	Chemical concentration in groundwater (mg/L)
IRw	=	Drinking water ingestion rate (L/day)
CF	=	Volumetric conversion factor (liter/cm^3)
SA	=	Skin surface area available for contact (cm^2 /day)
PC	=	Dermal permeability constant (cm/hr)
ET	=	Exposure time (hours/day)
EF	=	Exposure frequency (days/year)
ED	=	Exposure duration (years)
BW	=	Body weight (kg)
AT	=	Averaging time (days)

Variable	Receptor Group			
	Future Resident			
	Adult		Child	
	RME	RAE	RME	RAE
Cgw (mg/L)	Table 6-10			
IRw (L/day)	2	1.4[a]	1	0.7[a]
CF (L/cm^3)	1E-03			
SA (cm^2)[b]	23,000	20,000	8,000	6,800
PC (cm/hr)[b]	1E-03			
ET (hours/day)[b]	0.3	0.2	0.3	0.2
EF (days/year)	350			
ED (years)[b]	30	9	6	2
BW (kg)	70		15	
AT (days) noncarcinogens	10,950	3,285	2,190	730
AT (days) carcinogens	25,550			

Source: U.S. EPA, 1991c, unless indicated.
RME - Reasonable maximum exposure.
RAE - Representative average exposure.

[a] U.S. EPA, 1989b.
[b] U.S. EPA, 1992a.

Table 6-18

Oral and Inhalation Chronic Reference Doses (RfDs)
Republic Steel Quarry
Elyria, Ohio

Chemical	Oral RfD (mg/kg-d)	Species/ Critical Effect	Oral RfD Basis/Source	Uncertainty Factor	Inhalation RfD (mg/kg-day)	Species/ Critical Effect	Inhalation RfD Basis/Source	Uncertainty Factor
Inorganics								
Antimony	4.00E-04	rat / longevity, blood glucose, and chloesterol	chronic oral bioassay / IRIS, 1996	1,000	ND	---	---	---
Cadmium	1E-03 (food) 5E-04 (water)	human / significant proteinuria	human studies involving chronic exposure / IRIS	10	ND	---	---	---
Copper	3.70E-02	human / gastrointestinal irritation	human single dose	---	ND	---	---	---
Iron	3.00E-01	---	--- / EPA-NCEA, U.S. EPA, 1996b	---	ND	---	---	---
Manganese	4.7E-02 (soil and water)	human / CNS effects	chronic ingestion data / IRIS	3 (soil and water)	1.40E-05	human / impairment of neurobehavioral function	occupational exposure to manganese oxides and salts / IRIS, 1996	1,000
	1.4E-01 (food)			1 (food)				
Mercury	3.0E-04 (mercuric chloride)	rat / autoimmune effects	subchronic feeding and subcutaneous studies / IRIS, 1996		8.6E-05 (elemental)	human / hand tremor; increases in memory disturbances; slight subjective and objective evidence of autonomic dysfunction	human occupational inhalation studies / IRIS, 1996	30
Silver	5.00E-03	human / argyria	2-to 9-year human i.v. study/ IRIS, 1996	3	ND	---	---	---
Sulfate	ND	---	---	---	ND	---	---	---
Thallium (thallium chloride)	8.00E-05	rat / increased levels of SGOT and LDH	subchronic oral study / IRIS, 1996	3,000	ND	---	---	---
Vanadium	7.00E-03	rat / decreased cystine	2.5 year diet study / HEAST, U.S. EPA, 1994b	100	ND	---	---	---
Arsenic	3.00E-04	human/hypurpigmentation, keratosis, and possible vascular complications	human chronic oral exposure/IRIS	3	ND	---	---	---
Beryllium	5.00E-03	rat / no adverse effects	chronic oral bioassay	100	ND	---	---	---

ND=No Data

Table 6-19

Oral and Inhalation Cancer Slope Factors (SFs)
Republic Steel Quarry
Elyria, Ohio

Constituent	Weight-of-Evidence Classification	Oral Slope Factor (mg/kg/day)	Species/ Type of Cancer	Slope Factor Basis/Source	Inhalation Slop Factor (mg/kg-day)	Species/Type of Cancer	Slope Factor Basis/Source
Arsenic	A	1.50E + 00	human/skin	drinking water study/ IRIS	1.50E + 01	human/lung	occupational exposure/IRIS
Beryllium	B2	4.30E + 00	rat/gross tumors, all sites combined	drinking water study/ IRIS	8.40E + 00	human/respiratory system	occupational exposure/IRIS

IRIS - Integrated Risk Information System.

Table 6-20

Summary of Noncarcinogenic Hazard Indices
Republic Steel Quarry
Elyria, Ohio

Exposure Route	Current Trespasser		Future Park Patron				Future Resident			
			Adult		Child		Adult		Child	
	RME	RAE	RME	RAE	RME	RAE	RME	RAE	RME	RAE
Soil										
Ingestion	0.17	0.042	0.084	0.021	0.95	0.24	0.60	0.30	4.6	2.3
Dermal absorption	0.0025	0.0011	0.00018	0.00087	0.13	0.014	0.012	0.01	0.76	0.16
Inhalation of Dust	NTV	NTV	NTV	NTV	NTV	NTV	NTV	NTV	NTV	NTV
Total	0.2	0.04	0.08	0.02	1.0	0.3	0.6	0.3	5	2
Surface Water										
Ingestion	0.91	0.025	0.56	0.015	2.6	0.072	0.56	0.015	2.6	0.072
Dermal absorption	0.27	0.0062	0.25	0.0056	0.39	0.0094	0.25	0.0056	0.39	0.0094
Total	1	0.03	0.8	0.02	3	0.08	0.8	0.02	3	0.08
Fish Ingestion										
Quarry	0.95	0.057	0.95	0.057	0.61	0.11	0.95	0.057	0.61	0.11
Black River	0.65	0.039	0.65	0.039	0.42	0.079	0.65	0.039	0.42	0.079

Table 6-20

Summary of Noncarcinogenic Hazard Indices
Republic Steel Quarry
Elyria, Ohio
(Continued)

Exposure Route	Current Trespasser		Future Park Patron				Future Resident			
			Adult		Child		Adult		Child	
	RME	RAE	RME	RAE	RME	RAE	RME	RAE	RME	RAE
Groundwater										
Ingestion	---	---	---	---	---	---	7.5	52	170	120
Dermal absorption	---	---	---	---	---	---	0.82	0.34	0.33	0.19
Total	---	---	---	---	---	---	80	50	200	100

NTV - No toxicity value available for this exposure route.
--- - Exposure pathway not complete for this receptor.

Table 6-21

Summary of Cancer Risks
Republic Steel Quarry
Elyria, Ohio

Exposure Route	Current Trespasser		Future Park Patron				Future Resident			
			Adult		Child		Adult		Child	
	RME	RAE	RME	RAE	RME	RAE	RME	RAE	RME	RAE
Soil										
Ingestion	1.3E-06	3.3E-07	2.4E-06	1.8E-07	4.6E-06	3.8E-07	1.4E-5	2.1E-6	1.2E-5	2.0E-6
Dermal absorption	2.0E-07	8.6E-08	4.4E-09	6.3E-09	6.2E-07	2.2E-08	5.6E-11	1.5E-11	3.6E-6	2.6E-7
Inhalation of Dust	1.7E-09	8.6E-10	3.7E-09	5.6E-10	2.1E-09	3.5E-10	2.2E-08	6.5E-09	1.2E-08	4.0E-09
Total	2.0E-06	4.0E-07	2.0E-06	2.0E-07	5.0E-06	4.0E-07	1.0E-05	2.0E-06	2.0E-05	2.0E-06
Surface Water										
Ingestion	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Dermal absorption	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Total	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Fish Ingestion										
Quarry	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Black River	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC

Table 6-21

**Summary of Cancer Risks
Republic Steel Quarry
Elyria, Ohio
(Continued)**

Exposure Route	Current Trespasser		Future Park Patron				Future Resident			
			Adult		Child		Adult		Child	
	RME	RAE	RME	RAE	RME	RAE	RME	RAE	RME	RAE
Groundwater										
Ingestion	---	---	---	---	---	---	5.7E-4	1.2E-4	3.1E-3	2.2E-03
Dermal absorption	---	---	---	---	---	---	1.5E-5	6.0E-6	5.8E-6	3.3E-6
Total	---	---	---	---	---	---	6E-04	1E-04	3E-03	2E-03

NTV - No toxicity value available for this exposure route.
--- - Exposure pathway not complete for this receptor.
NC - COPCs are not carcinogenic.

Table 6-22

Summary of Uncertainty Analysis
Republic Steel Quarry
Elyria, Ohio

	Effect on Risk Estimates		
Uncertainty Element	Potential for Overestimation	Potential for Underestimation	Potential for Over- or Underestimation
Environmental Data			
Insufficient data to characterize media being evaluated			Low
Systematic or random errors in the chemical analysis yielding erroneous data			Low
Elimination of chemicals from quantitative analysis based on background levels and risk-based screening		Low	
Well B-4 not sampled		Low	
Sampling and analysis of fish tissue			Low
Use of current exposure concentrations to represent future conditions (i.e., assumption of no attenuation of site chemicals)	Moderate		
Toxicity Data			
Use of U.S. EPA RfDs/SFs	Moderate-High		
Use of oral toxicity criteria for dermal exposure		Low	
Use of oral slope factor for arsenic	Low		
Exposure Parameter Estimation			
Standard assumptions regarding body weights, skin surface areas, inhalation rates, and life expectancy			Low
Media intake rates	Moderate		
Dermal absorption factors	Moderate		
Future groundwater use	Moderate		

Table 6-23

Assessment Endpoints
Republic Steel Quarry
Elyria, Ohio

Assessment Endpoint	
•	Potential reduction in mammal populations resulting from chronic exposure to COPCs in surface soil.
•	Contaminant bioacculumation and biomagnification in soil fauna associated with adverse effects.
•	Potential reduction in piscivorous bird population resulting from chronic exposure to COPCs in fish from the Quarry and Black River.
•	Changes in aquatic community structure and function attributable to COPCs measured in sediment and surface water in the Quarry.
•	Changes in structure and function of vegetative community and soil-dwelling organisms attributable to COPCs in site soil.

Table 6-24

Target Receptors by Habitat
Republic Steel Quarry
Elyria, Ohio

Habitat	Receptor	Exposure Route(s)
Terrestrial	Short-tailed shrew	Earthworm ingestion Soil ingestion
	Plants	Growth medium
	Earthworms	Ingestion, dermal absorption, inhalation, food source
	Soil microorganisms	Ingestion, dermal absorption, inhalation, food source
Aquatic	Fish, other aquatic organisms	Ingestion, dermal absorption, inhalation, food source
	Benthic organisms	Ingestion, dermal absorption, inhalation, food source
	Belted kingfisher	Fish ingestion

Table 6-25

Risk to Short-tailed Shrew
Republic Steel Quarry
Elyria, Ohio

Intake = [(Cs * IRs) + ((Cs * BAF) * IRew)] / BW
HQ = Intake / TRV

Constituent	Soil Concentration	Earthworm BAF		Earthworm Concentration	Intake			TRV	Hazard Quotient		
					Soil	Earthworm	Total		Soil	Earthworm	Total
Organics											
Anthracene	0.12	0.32	a	0.0384	0.00936	0.02304	0.0324	155	0.00006	0.00015	0.00021
Benzo(a)anthracene	0.25	0.27	a	0.0675	0.0195	0.0405	0.06	155	0.00013	0.00026	0.00039
Chrysene	0.3	0.44	a	0.132	0.0234	0.0792	0.1026	155	0.00015	0.00051	0.00066
Indeno(1,2,3-cd)pyrene	0.28	0.41	a	0.1148	0.02184	0.06888	0.09072	155	0.00014	0.00044	0.00059
Benzo(g,h,i)perylene	0.26	0.15	a	0.039	0.02028	0.0234	0.04368	155	0.00013	0.00015	0.00028
Inorganics											
Antimony	3	0.27		0.81	0.234	0.486	0.72	0.308	0.76	1.60	2.30
Copper	45.8	0.52	a	23.816	3.5724	14.2896	17.862	309.4	0.0115	0.046	0.058
Iron	107000	0.38	a	40660	8346	24396	32742	1760	4.74	14.0	19.0
Mercury	0.24	0.96	a	0.2304	0.01872	0.13824	0.15696	69.3	0.00027	0.0020	0.0023
Selenium	4.1	1.9	b	7.79	0.3198	4.674	4.9938	0.44625	0.717	11.0	11.0
Thallium	1.9	1	c	1.9	0.1482	1.14	1.2882	1.32	0.112	0.860	0.980

Symbol	Parameter	Value	Source
Cs	Soil concentration (mg/kg)	–	–
IRs	Soil intake rate (g dw/day)	0.00117	Sample and Suter, 1994
IRew	Earthworm intake rate (g dw/ day)	0.009	Sample and Suter, 1994
BAF	Bioaccumulation factor (unitless)	Chemical-specific	–
BW	Body weight (kg)	0.015	Sample and Suter, 1994
TRV	Toxicity reference value (mg/kg/day)	Chemical-specific	--

a - Beyer and Stafford, 1993.

b - Beyeer and Cromartie, 1987

c - BAF not available; applied a value of 1.

Table 6-26

Hazard Quotients:
Plants, Earthworms, and Soil Microorganisms -- Semivolatile Organic Compounds
Republic Steel Quarry
Elyria, Ohio

	Maximum Detected Concentration	ORNL Preliminary Remediation Goals			Hazard Quatient		
		Plant	Earthworm	Soil Microorganisms	Plant	Earthworm	Soil Microorganisms
Analyte	µg/kg	µg/kg	µg/kg	µg/kg	unitless		
Pentachlorophenol	350	3,000	4,000	50,000	0.12	0.088	0.007
Anthracene	120	---	---	---	---	---	---
Benzo(a)anthracene	250	---	---	---	---	---	---
Chrysene	300	---	---	---	---	---	---
Indeno(1,2,3-cd)pyrene	280	---	---	---	---	---	---
Benzo(g,h,i)perylene*	260	---	---	---	---	---	---

Screening Benchmark Sources: Will and Suter, 1995a; 1995b.
ORNL - Oak Ridge National Lab.
--- No PRG available.

Table 6-27

Hazard Quotients for Plants, Earthworms, and Soil Microorganisms -- Inorganic Compounds
Republic Steel Quarry
Elyria, Ohio

Analytes	Maximum Detected Concentration mg/kg	ORNL Screening Benchmark			Hazard Quatient		
		Plant mg/kg	Earthworm mg/kg	Soil Microorganisms mg/kg	Plant	Earthworm	Soil Microorganisms
					Unitless		
Antimony	3	5	---	---	0.6	---	---
Copper	45.8	100	50	100	0.46	0.92	0.46
Iron	107,000	---	---	200	---	---	540
Mercury	0.24	0.3	0.1	30	0.8	2.4	0.008
Selenium	4.1	1	70	100	4.1	0.059	0.041
Thallium	1.9	1	---	---	1.9	---	---

Screening Benchmark Sources: Will and Suter, 1995a; 1995b.
ORNL - Oak Ridge National Lab.

Table 6-28

Risk to Belted Kingfisher
Republic Steel Quarry
Elyria, Ohio

Intake - (Cf x IRf) / BW
HQ - Intake / TRV

Constituent	Fish Concentration	Intake	Toxicity Reference Value (TRV)	Hazard Quotient (HQ)
Black River (downstream)				
Cadmium	0.0049	0.002483	0.59	0.0042
Copper	0.573	0.290372	56	0.0052
Manganese	1.17	0.592905	228.5	0.0026
Mercury	0.246	0.124662	0.179	0.70
Quarry				
Cadmium	0.0752	0.038108	0.59	0.065
Copper	0.409	0.207264	56	0.0037
Manganese	0.402	0.203716	228.5	0.00089
Mercury	0.357	0.180912	0.179	1.0

Symbol	Parameter	Value	Source:
Cf	Fish concentration (mg/kg)	---	
IRf	Fish intake rate (kg/day)	0.075	Sample and Suter, 1994
BW	Body weight (kg)	0.148	Sample and Suter, 1994

Table 6-29

Hazard Quotients: Surface Water in Quarry
Republic Steel Quarry
Elyria, Ohio

Parameter	Maximum Detected Concentration Upstream Unfiltered µg/L	Maximum Detected Concentration Upstream Filtered µg/L	Ohio Water Quality Standards[a] Upstream Average µg/L	Ohio Water Quality Standards[a] Downstream Maximum µg/L	U.S. EPA Ambient Water Quality Criteria[b] Downstream Acute µg/L	U.S. EPA Ambient Water Quality Criteria[b] Chronic µg/L	Hazard Quotient Unfiltered Acute (Unitless)	Hazard Quotient Unfiltered Chronic (Unitless)	Hazard Quotient Filtered Acute (Unitless)	Hazard Quotient Filtered Chronic (Unitless)
Inorganics										
Calcium	210,000	220,000	---	---	---	116,000 #	---	1.8	---	1.9
Chromium	---	3.4	210	1,800	16 VI	11 VI	---	---	0.21	0.3
Cobalt	47.2	50.7	---	---	1,500 *	23 *	0.031	2.1	0.034	2.2
Copper	299	299	60.8 +	121.7 +	121.7 +	60.8 +	2.5	4.92	2.5	4.9
Iron	800,000	847,000	1,000	---	---	1,000	---	800	---	847
Lead	---	2.4	629.5 +	1,259 +	1,259 +	630 +	---	---	0.0019	0.0038
Manganese	12,300	12,800	---	---	2,300 *	120 *	5.4	103	5.6	107
Potassium	5,040	5,350	---	---	---	53,000 #	---	0.095	---	0.10
Silver	280	280	1.3	1.6	4.1 +	0.36 *	180	780	180	780
Vanadium	47,600	37.5	---	---	280 *	20 *	170	2,400	170	1.9
Other Parameters										
Oil and Grease	9,000	---	---	10,000	---	---	0.9	---	---	---
Total Suspended Solids in Water (mg TSS/L)	192	---	---	---	---	---	---	---	---	---
Total Dissolved Solids in Water (mg TDS/L)	408	---	1,500	---	---	---	---	0.27		
Acidity in Water (mg $CaCO_3$/L)	-1,370	---	---	---	---	---	---	---	---	---
Total Alkalinity in Water (mg $CaCO_3$/L)	147	---	---	---	---	---	---	---	---	---
Chloride in Water (mg Cl^-/L)	85	---	---	---	---	---	---	---	---	---
Sulfate in Water (mg $SO4_2$)	2,090	---	---	---	---	---	---	---	---	---

Note: Shaded value indicates criteria was exceeded.
VI - Based on chromium VI.
* Tier II value (Suter and Tsao, 1996).
+ Hardness dependent criteria; see Appendix C.

Lowest chronic value (Suter and Tsao, 1996).
[a] OEPA, 1993.
[b] U.S. EPA, 1992f.

Table 6-30

Hazard Quotients for Benthic Organisms -- Volatile Organic Compounds
Republic Steel Quarry
Elyria, Ohio

Analyte	Maximum Detected Concentration ug/kg	U.S. EPA EcoTox Threshold[a] ug/kg	ORNL Sediment PRG[b] ug/kg	Hazard Quotient Unitless
Methylene Chloride	58	---	18,000	0.0032
Acetone	2800	---	9.10	308
Carbon Disulfide	26	---	0.86	30
2-Butanone	830	---	270	3.1
Benzene	16	57	160	0.10
Tetrachloroethene	48	530	3,200	0.091
Toluene	73	670	50	1.5
Ethylbenzene	17	3,600	5,400	0.0047
Xylene (total)	70	25	160	2.8

Note: Lowest (i.e., most stringent) criterion used in calculation of hazard quotient.
No criteria were available for these compounds from OMOE and NOAA.
PRG - Preliminary remediation goal.

Source: Jones et al., 1996; Sample et al., 1996.

Table 6-31

Hazard Quotients for Benthic Organisms -- Semivolatile Organic Compounds
Republic Steel Quarry
Elyria, Ohio

Parameter	Maximum Detected Concentration ug/kg	OMOE Effect Guideline[a] Low ug/kg	OMOE Effect Guideline[a] Severe ug/kg	NOAA Effects Level[a] ER-L ug/kg	NOAA Effects Level[a] ER-M ug/kg	U.S. EPA EcoTox Threshold[a] ug/kg	ORNL Sediment PRG[a] ug/kg	Hazard Quotient Unitless
1,3-Dichlorobenzene	180	---	---	---	---	1,700	1,700	0.11
1,4-Dichlorobenzene	200	---	---	---	---	350	350	0.57
4-Methylphenol	390	---	---	---	---	---	---	---
1,2,4-Trichlorobenzene	170	---	---	---	---	9,200	9,700	0.018
Naphthalene	240	---	---	160	2,100	---	390	1.5
4-Chloro-3-methylphenol	280	---	---	---	---	---	---	---
2-Methylnaphthalene	600	---	---	70	670	---	---	8.6
Acenaphthene	230	---	---	16	500	620	89	14
Fluorene	1,900	---	---	19	540	---	140	100
Phenanthrene	10,000	---	---	240	1,500	---	540	42
Anthracene	2,600	---	---	85	1,100	---	250	30
Di-n-butylphthalate	3,500	---	---	---	---	11,000	240,000	0.32
Fluoranthene	3,400	---	---	600	5,100	2,900	1,500	1.2
Pyrene	5,500	---	---	665	2,600	660	1,400	8.3
Butylbenzylphthalate	42	---	---	---	---	11,000	---	0.0038
Benzo(a)anthracene	3,000	---	---	261	1,600	---	690	12
Chrysene	3,800	---	---	384	2,800	---	850	9.9
bis(2-Ethylhexyl)phthalate	1,700	---	---	---	---	---	2,700	0.63
Di-n-octylphthalate	960	---	---	---	---	---	---	---
Benzo(b)fluoranthene	1,200	---	---	---	---	---	---	---
Benzo(k)fluoranthene	1,400	---	---	---	---	---	---	---
Benzo(a)pyrene	650	---	---	430	1,600	430	760	1.5
Indeno(1,2,3-cd)pyrene	1,400	---	---	---	---	---	---	---
Dibenz(a,h)anthracene	410	---	---	63	260	---	140	6.5
Benzo(g,h,i)perylene	1,400	---	---	---	---	---	---	---
Total PAH	37,730	2,000	110,000	4,022	44,792	---	---	19

Note: Lowest (most stringent) sediment guidline used in calculation of hazard quotient.
--- Value not available.
Source: Jones et al., 1996; Sample et al., 1996.

Table 6-32

Hazard Quotients for Benthic Organisms -- Pesticides
Republic Steel Quarry
Elyria, Ohio

Parameter	Maximum Detected Concentration ug/kg	Ontario Sediment Guideline[a] Low ug/kg	Ontario Sediment Guideline[a] Severe ug/kg	NOAA Effect Range[a] ER-L ug/kg	NOAA Effect Range[a] ER-M ug/kg	U.S. EPA EcoTox Threshold[a] ug/kg	ORNL PRG[a] ug/kg	Hazard Quotient Unitless
Heptachlor	29	---	---	---	---	---	13,000	0.0022
Aldrin	69	2	80	---	---	---	80	35
4,4'-DDT	14	7	120	1.58	46.1	---	52	8.9
alpha-Chlordane	75	7*	60*	0.5	6	---	4.8*	150
gamma-Chlordane	34	7*	60*	0.5	6	---	4.8*	68

Note: Lowest (most stringent) sediment guidline used in calculation of hazard quotient.
* Value is for total chlordane.
--- Value not available.

Source: Jones et al., 1996; Sample et al., 1996.

Table 6-33

Hazard Quotients for Benthic Organisms -- Inorganic Compounds
Republic Steel Quarry
Elyria, Ohio

Analyte	Maximum Detected Concentration mg/kg	OMOE Effects Guideline		NOAA Effect Level[a]		U.S. EPA EcoTox Threshold[a] mg/kg	ORNL Sediment PRG[a] mg/kg	Hazard Quotient Unitless
		LEL mg/kg	SEL mg/kg	ER-L mg/kg	ER-M mg/kg			
Aluminum	30300	---	--	--	--		--	--
Arsenic	43.9	6	33	8.2	70	8.2	42	7.3
Barium	129	--	--	--	--	--	--	--
Beryllium	0.88	--	--	--	--	--	--	--
Cadmium	1.6	0.6	10	1.2	9.6	1.2	4.2	2.7
Calcium	19900	--	--	--	--	--	--	--
Chromium	117	26	110	81	370	81	160	4.5
Cobalt	23.3	--	--	--	--	--	--	--
Copper	333	16	110	34	270	34	110	21
Iron	214000	20,000	40,000	--	--	--	--	11
Lead	192	31	250	46.7	218	47	110	6.2
Magnesium	7420	--	--	--	--	--	--	--
Manganese	3470	460	1110	--	--	--	--	7.5
Mercury	0.72	0.2	2	0.15	0.71	0.15	0.7	4.8
Nickel	84.1	16	75	20.9	51.6	21	43	5.3
Potassium	3960	--	--	--	--	--	--	--

Table 6-33

Hazard Quotients for Benthic Organisms -- Inorganic Compounds
Republic Steel Quarry
Elyria, Ohio
(Continued)

Analyte	Maximum Detected Concentration mg/kg	OMOE Effects Guideline		NOAA Effect Level[a]		U.S. EPA EcoTox Threshold[a] mg/kg	ORNL Sediment PRG[a] mg/kg	Hazard Quotient Unitless
		LEL mg/kg	SEL mg/kg	ER-L mg/kg	ER-M mg/kg			
Selenium	6	--	--	--	--	--	--	--
Sodium	1420	--	--	--	--	--	--	--
Thallium	10.5	--	--	--	--	--	--	--
Vanadium	50.5	--	--	--	--	--	--	--
Zinc	371	120	820	150	410	150	270	3.1

Note: Lowest (i.e., most stringent) sediment benchmark used in calculation of hazard quotient.
Source: Jones et al., 1996; Sample et al., 1996.

Table 6-34

Hazard Quotients for Benthic Organisms -- Pesticides
Republic Steel Quarry
Elyria, Ohio

Parameter	Maximum Detected Concentration ug/kg	Ontario Sediment Guideline[a]		NOAA Effect Range[a]		U.S. EPA EcoTox Threshold[a] ug/kg	ORNL PRG[a] ug/kg	Hazard Quotient Unitless
		Low ug/kg	Severe ug/kg	ER-L ug/kg	ER-M ug/kg			
Heptachlor	29	---	---	---	---	---	13,000	0.0022
Aldrin	69	2	80	---	---	---	80	35
4,4'-DDT	14	7	120	1.58	46.1	---	52	8.9
alpha-Chlordane	75	7*	60*	0.5	6	---	4.8*	150
gamma-Chlordane	34	7*	60*	0.5	6	---	4.8*	68

Note: Lowest (most stringent) sediment guidline used in calculation of hazard quotient.
* Value is for total chlordane.
--- Value not available.

Source: Jones et al., 1996; Sample et al., 1996.

Table 6-35

Hazard Quotients for Benthic Organisms -- Inorganic Compounds
Republic Steel Quarry
Elyria, Ohio

Analyte	Maximum Detected Concentration mg/kg	OMOE Effects Guideline		NOAA Effects Level[a]		U.S. EPA EcoTox Threshold[a] mg/kg	ORNL Sediment PRG[a] mg/kg	Hazard Quotient Unitless
		LEL mg/kg	SEL mg/kg	ER-L mg/kg	ER-M mg/kg			
Aluminum	30300	--	--	--	--		--	--
Arsenic	43.9	6	33	8.2	70	8.2	42	7.3
Barium	129	--	--	--	--	--	--	--
Beryllium	0.88	--	--	--	--	--	--	--
Cadmium	1.6	0.6	10	1.2	9.6	1.2	4.2	2.7
Calcium	19900	--	--	--	--	--	--	--
Chromium	117	26	110	81	370	81	160	4.5
Cobalt	23.3	--	--	--	--	--	--	--
Copper	333	16	110	34	270	34	110	21
Iron	214000	20,000	40,000	--	--	--	--	11
Lead	192	31	250	46.7	218	47	110	6.2
Magnesium	7420	--	--	--	--	--	--	--
Manganese	3470	460	1110	--	--	--	--	7.5
Mercury	0.72	0.2	2	0.15	0.71	0.15	0.7	4.8
Nickel	84.1	16	75	20.9	51.6	21	43	5.3
Potassium	3960	--	--	--	--	--	--	--
Selenium	6	--	--	--	--	--	--	--
Sodium	1420	--	--	--	--	--	--	--
Thallium	10.5	--	--	--	--	--	--	--
Vanadium	50.5	--	--	--	--	--	--	--
Zinc	371	120	820	150	410	150	270	3.1

Note: Lowest (i.e., most stringent) screening benchmark used in calculation of hazard quotient.
Source: Jones et al., 1996; Sample et al., 1996.

SECTION 7
RECOMMENDATIONS

7.1 CONCLUSIONS

The risk assessment based on the data collected during November of 1996, shows that the site continues to pose a moderate on-site risk. In review, groundwater consumption and soil ingestion, carry unacceptable risk, but only in a residential aspect. The risk assessment shows no unacceptable off-site risk, or unacceptable risk to casual trespassers.

Apart from the CERCLA-regulated chemical risks, physical risks are also present at the RSQ site. In particular, the quarry pond's sheer-cliff walls could lead trespassers to fall into the pond and also complicate rescue efforts.

As previously discussed, the existing perimeter fence no longer excludes trespassers. The field crew observed many signs of extensive recreational activity within the site perimeter, suggesting that exposure to humans does occur on a regular basis, particularly during the summer.

Also, as previously discussed, monitoring well B-4 remains an unresolved issue. While it is thought to be upgradient and beyond the influence of the contaminants, the nature of its obstruction remains unknown.

7.2 SPECIFIC RECOMMENDATIONS

Accordingly, the following specific actions are recommended:

1. Repair the site perimeter fence.

The City of Elyria should repair the existing holes and gaps in and beneath the fence around the site perimeter. All posts, chain link fabric, and barbed wire should be restored to functional condition. New warning signs should be posted.

2. Establish a security inspection schedule.

The City of Elyria should inspect the perimeter fence at least quarterly, and at least monthly during the summer months during which trespassing is likely to occur. When damage is discovered, the fence should be repaired within a week. The City of Elyria should maintain a log of all inspections and repairs.

3. Formalize and codify land use restrictions.

It is recommended that the City of Elyria should bar residential use of the site and require use of City of Elyria water as a source of potable water for any industrial or commercial development or public use.

4. Continue groundwater monitoring.

There are currently no users of groundwater on-site or within one-half mile of the site. However, there is a risk to potential future users of groundwater. At this time, it appears unlikely there will be actual future users as there are no plans for residential or commercial development on or near the site, and any users would likely be required to connect to the City of Elyria municipal water supply. While the site is on the NPL, future groundwater monitoring to comport with the requirements of CERCLA 121(c), will be continued.

SECTION 8

STATEMENT ON PROTECTIVENESS

I, as Director of the Superfund Division, Region V, certify that the remedies selected for this site and the recommendations detailed in the previous section remain protective of human health and the environment.

Wm. E. Muno

William E. Muno, Director
Superfund Division
Region V

6/26/98

Date

SECTION 9
NEXT REVIEW

The next Five-Year Review will be conducted by FY 2002. OSWER Directive 9355.7-02A ("Supplemental Five Year Review Guidance," July 26, 1994) changed the "trigger date" (i.e., the date from which the due date is calculated for each five-year review) for statutory sites to the date of remedial action construction. The guidance also changed the trigger date for policy sites to completion of physical construction--the date a site qualifies for listing on the Construction Completion List. For Republic Steel Quarry (RSQ), this would be signified by the date of the Preliminary Closeout Report, December 31, 1992. Since RSQ had been classified as a policy site, the present Five-Year Review due date was set at FY 1997. Accordingly, the next Five-Year Review is due five years from FY 1997, in FY 2002.

SECTION 10
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Appendix A

APPENDIX A

SCREENING OF CHEMICALS OF POTENTIAL CONCERN

Table A-1

Screening of Chemicals of Potential Concern in Soil -- Inorganic Compounds
RSQ Site
Elyria, Ohio

EPA Sample No.:	MEXG81	MEXG82	MEXG94	MEXG83	MEXG84	MEXG85	MEXG86	MEXG87	Background Concentrations			Soil Screening Level[a]		U.S. EPA Region III	U.S. EPA Region IX
Sample I.D.:	SS-102	SS-103	SS-115	SS-104	SS-105	SS-106	SS-107	SS-108						Risk-Based[a]	Preliminary Remediation
Matrix:	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil				Ingestion	Inhalation	Concentration	Goal[a]
Sample Location:	Ditch -S	Ditch -N	Ramp	Ramp	Ditch -S	Ditch -N	Ramp	Ramp			2x				
Sample Depth:	0-8”	0-8”	Dup of 103	0-8”	12”	12”	12”	12”	Minumum	Maximum	Average			Residential	Residential
Sample Date:	11/16/96	11/16/96	11/16/96	11/16/96	11/16/96	11/16/96	11/16/96	11/16/96							
Units:	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Aluminum	741	1,530	1,460	1,170	658	1,360	1,660	1,220	2,420	12,600	15,870	--	--	7,800 nc	7,700 nc
Antimony	2.8	1.2 U	1.4	1.1 U	2.2	3.0	1.7	1.2 U	1.3	2.6	2.42	3.1	--	3.1 nc	3.1 nc
Arsenic	11.6 J	16.2 J	14.6 J	6.8 J	8.8 J	13.8 J	15.2 J	7.8 J	8.5	29.1	27.5	0.4	750	0.43 c	0.38 c
Barium	45.0	6.5	6.3	4.4	32.2	53.3	6.5	5.0	18.6	105	122	550	6.90E+04	550 nc	530 nc
Cadmium	1.3	0.45	0.43	0.23 U	1.2	1.4	0.55	0.31	0.62	0.94	1.62	7.8	180	3.9 nc	3.8 nc
Calcium	467	633	754	578	1,130	446	601	744	1,080	3,220	4,050	--	--	--	--
Chromium (total)	11.4	12.7	13.2	5.7	8.9	15.6	18.4	9.7	6	17.1	22.8	39	27	39 nc	21 nc
Cobalt	2.0	3.4	2.9	4.1	2.0	3.9	3.2	3.3	3.7	15.6	17.6	--	--	470 nc	460 nc
Copper	19.1	30.2	27.6	16.8	34.7	24.4	45.8	31.2	10.8	21.7	32.4	--	--	310 nc	280 nc
Iron	91,800	28,300	25,000	7,730	82,900	107,000	29,600	10,900	13,100	26,300	39,533	--	--	2,300 nc	-- nc
Lead	33.5	18.7	16.2	8.2	22.7	38.6	22.3	15.2	22.3	118	99.7	400	--	--	400
Magnesium	154	480	470	518	255	241	491	551	618	2,430	3,299	--	--	--	--
Manganese	209	69.3	61.5	87.6	145	376	72.7	83.2	110	964	971	--	--	39 nc	320 nc
Mercury	0.12 U	0.12 U	0.14	0.11 U	0.24	0.12	0.12 U	0.12 U	ND	ND	ND	2.3	1	2.3 nc	2.3 nc
Nickel	2.1	8.2	8.0	9.7	1.7	5.2	8.4	9.0	9.9	17.9	26.3	160	1,300	160 nc	150 nc
Potassium	2,160	373	374	338	1,690	2,000	407	327	479	978	1,431	--	--	--	--
Selenium	3.5	1.2 U	1.2 U	1.1 U	3.2	4.1	1.2 U	1.2 U	1.4	1.7	2.88	390	--	39 nc	38 nc
Sodium	390	188	204	182	400	360	171	173	217	264	469	--	--	--	--
Thallium	1.2 U	1.2 U	1.2 U	1.1 U	1.2 U	1.9	1.2 U	1.2 U	ND	ND	ND	--	--	0.63 nc-sulfate	0.61 nc-sulfate
Vanadium	10.0	5.8	5.7	4.6	9.9	12.8	6.3	4.8	8.7	25.8	37.4	55	--	55 nc	54 nc
Zinc	14.7	25.4	22.1	24.6	20.6	18.1	27.4	30.6	49.6	178	171	2,300	--	2,300 nc	2,300 nc
Cyanide	0.30 J	0.28 J	0.15 J	0.12 J	0.44 J	0.36 J	0.19 J	0.12 UJ	0.14	0.41	0.533	160	--	160 nc	130

Shading indicates constituent exceeds screening level.
[a] Screening levels for noncarcinogens based on a target hazard quotient of 0.1.
[b] Value based on thallium sulfate.
nc - Noncarcinogenic.
c - Carcinogenic.

Table A-2

Screening of Chemicals of Potential Concern in Soil -- Semivolatile Organic Compounds
RSQ Site
Elyria, Ohio

EPA Sample No.:	EXX27	EXX28RE	EXX29	EXX30	EXX31	EXX32RE	EXX54RE	EXX55RE	U.S. EPA Soil Screening Level[a]		U.S. EPA Region III Risk-Based Concentration[a] Residential	U.S. EPA Region IX Preliminary Remediation Goal[a] Residential
Sample I.D.:	SS-101MSD	SS-102	SS-103	SS-104	SS-105	SS-106	SS-107	SS-108				
Matrix:	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Ingestion	Inhalation		
Sample Date:	11/16/96	11/16/96	11/16/96	11/16/96	11/16/96	11/16/96	11/16/96	11/16/96				
Sample Location:	Ditch -S	Ditch -N	Ramp	Ramp	Ditch -S	Ditch -N	Ramp	Ramp				
Sample Depth:	0-8”	0-8”	0-8”	0-8”	12”	12”	12”	12”				
Units:	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg
PARAMETER												
Naphthalene	24 J	26 J	390 U	380 U	36 J	44 J	400 U	390 U	310,000	--	310,000 nc	240,000 sat
2-Methylnaphthalene*	63 J	45 J	390 U	380 U	71 J	76 J	400 U	26 J	310,000	--	310,000 nc	--
Dibenzofuran	400 U	20 J	390 U	380 U	22 J	28 J	400 U	390 U	--	--	31,000 nc	140,000 sat
Pentachlorophenol	230 J	350 J	950 UJ	930 UJ	120 J	250 J	980 U	940 U	3,000	--	5,300 c	2,500 c
Phenanthrene**	31 J	84 J	390 U	380 U	42 J	120 J	400 U	390 U	230,000	--	310,000 nc	--
Anthracene	400 U	380 UJ	390 U	380 U	420 U	120 J	400 U	390 U	2,300,000	--	2,300,000 nc	5,700 sat
Floranthene	34 J	78 J	390 U	380 U	50 J	400 U	400 U	390 U	310,000	--	310,000 nc	260,000 nc
Pyrene	400 U	120 J	390 U	380 U	67 J	R	400 UJ	390 UJ	230,000	--	230,000 nc	100,000 sat
Benzo(a)anthracene	48 J	250 J	390 U	380 U	52 J	R	400 UJ	390 UJ	900	--	880 c	610 c
Chrysene	63 J	300 J	390 U	380 U	77 J	R	400 UJ	390 UJ	88,000	--	88,000 c	7,200 sat
Indeno(1,2,3-cd)pyrene	34 J	180 J	390 U	380 U	58 J	280 J	400 UJ	390 UJ	900	--	880 c	610 c
Benzo(g,h,i)perylene**	30 J	180 J	390 U	380 U	49 J	260 J	400 UJ	390 UJ	230,000	--	310,000 nc	--
Tentatively Identified Compounds (TICs)												
Phenol, 2,3,4,6-Tetrachloro	160 NJ	120 NJ				210 NJ			--	--	--	200,00 nc
Acenaphtho(1,2-B)Pyridine	1400 NJ								--	--	--	--
2H-1-Benzopyran-2-one			130 NJ						--	--	--	--
2,5-Hexanedione				90 NJ					--	--	--	--
Copane				86 NJ					--	--	--	--
P-Benzoquinone,2-methyl					300 NJ				--	--	--	--
Benzoic acid					390 NJ				--	--	--	1.00E+08 max
2-Furanmethanol,tetrahydro-A					180 NJ				--	--	--	
Tridecanol,2-ethyl-2-methyl					250 NJ				--	--	--	--
Tridecanoic acid					280 NJ				--	--	--	--

[a] Screening value for noncarcinogens based on a hazard quotient of 0.1.
sat - Soil saturation concentration.
max - non-risk based “ceiling limit” for relatively less toxic contaminants.
nc - noncarcinogenic.
c - carcinogenic.
* Screening value for napthalene used as a proxy value.
** Screening value for pyrene used as a proxy value.

Table A-3

Screening of Chemicals of Potential Concern -- Quarry Surface Water
Republic Steel Quarry
Elyria, Ohio

EPA Sample No.:	MEXJ13	MEXJ14	MEXJ15	MEXJ16	MEXJ17	MEXJ29	MEXJ18	MEXJ19	MEXJ20	MEXJ23	MEXJ24		Ohio	U.S. EPA	U.S.EPA Region III	U.S.EPA Region IX
Sample I.D.:	SW-201MSD	SW-202	SW-203	SW-204	SW-205	SW-217	SW-206	SW-207	SW-208	SW-211	SW-212	Groundwater	MCL	MCL	RBC[a]	PRG[a]
Matrix:	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Background				
Depth:	17 ft UF	17ft F	60 ft UF	60 ft F	0 ft UF	DUP OF 205 UF	0 ft F	17 ft UF	17 ft F	Outfall UF	Outfall F					
Sample Date:	11/12/96	11/12/96	11/12/96	11/12/96	11/12/96	11/12/96	11/12/96	11/12/96	11/12/96	11/12/96	11/12/96					
Units:	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
TAL																
Barium	29.5	29.3	41.5	43.4	28.8	27.6	29.9	28.6	27.9	31.9	28.4	33.9 - 46.8	2,000	2,000	260 nc	260 nc
Calcium	55,300	56,400	210,000	220,000	54,900	53,600	56,600	54,500	53,100	56,20	55,400	125,000 - 167,000	--	--	--	--
Chromium	3.4 U	3.4 U	3.4 U	3.4 J	3.4 U	3.4 U	3.4 U	3.4 U	3.4 U	3.4 U	3.4 U	<1 - 1.3	100	100	18 nc-vi	18 nc-vi
Cobalt	3.1 U	3.1 U	47.2	50.7	3.1 U	3.1 U	3.1 U	3.1 U	3.1 U	3.1 U	3.1 U	ND	--	--	220 nc	220 nc
Copper	3.0 U	3.0 U	299	292	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	ND	1,000*	1,300**	150 nc	150 nc
Iron	136 U	24.9 U	800,000	847,000	166 U	109 U	40.5 U	130 U	26.7 U	136 U	25.3 U	27.1 - 215	300*	300 smcl	1,100 nc	1,100 nc
Lead	0.80 UJ	2.4 J	0.80 UJ	0.80 UJ	0.80 UJ	0.80 UJ	0.8 UJ	0.80 UJ	0.80 UJ	0.80 UJ	0.80 UJ	ND	50*	15**	--	--
Magnesium	14,800	15,100	59,000	61,700	14,700	14,300	15,000	14,600	14,100	14,900	14,800	63,000 - 64,400	--	--	--	--
Maganese	179	147	12,300	12,800	182	177	151	176	138	152	123	135 - 312	50*	50 smcl	18 nc	170 nc
Potassium	3,030	3,480	5,040	5,350	3,450	3,140	3,200	3,490	3,460	3,160	3,080	3,200 - 3,740	--	--	--	--
Silver	3.4 U	3.4 U	280	272	3.4 U	3.4 U	3.4 U	3.4 U	3.4 U	3.4 U	3.4 U	ND	50*	100 smcl	18 nc	18 nc
Sodium	47,600 J	48,300 J	40,500 J	42,100 J	47,000 J	46,000 J	48,200 J	46,500 U	45,000 J	47,600 J	47,500 J	50,500 - 52,600	--	--	--	--
Vanadium	6.0 U	6.0 U	34.1	37.5	6.0 U	6.0 U	6.0 U	6.0 U	6.0 U	6.0 U	6.0 U	ND	--	--	26 nc	26 nc
Cyanide	1.7 UJ	NA	1.5 J	NA	1.7 UJ	1.7 UJ	NA	1.7 UJ	NA	1.7 UJ	NA	21 - 2.6	200	200	73 nc	73 nc
Chloride (mg/L)	85	--	38	--	83.0	84	--	85	--	85.0	--	NA	--	250 (smcl)	--	--
Sulfate (mg/L)	103	--	2,090	--	106	104	--	104	--	104	--	NA	--	250 (smcl)	--	--

Shading indicates screening value was exceeded.
[a] Screening level based on a target hazard quotient of 0.1.
F - Filtered.
UF - Unfiltered.
* Secondary MCL.
** Action level.
nc - Noncarcinogenic.
smcl - Secondary MCL.

MCL + Maximum contaminant level.
RBC - Risk-based concentration.
PRG - Preliminary remediation goal.

Table A-4

Screening of Chemicals of Potential Concern - Black River Surface Water
RSQ Site
Elyria, Ohio

EPA Sample No.:	MEXJ21	MEXJ22	MEXJ25	MEXJ26	Ohio	U.S. EPA	U.S. EPA Region III	U.S. EPA Region IX
Sample I.D.:	SW-209	SW-210	SW-213	SW-214	MCL	MCL	RBC[a]	PRG[a]
Matrix:	Surface Water	Surface Water	Surface Water	Surface Water				
Location:	Upstream UF	Upstream F	Downstream UF	Downstream F				
Sample Date:	11/12/96	11/12/96	11/12/96	11/12/96				
Units:	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
BNAs								
Diethylphthalate	0.9 J	--	10 U	--	--	--	2,900 nc	2,900 nc
TAL								
Aluminum	1,030	70.8	1,180	62.2	--	50 - 200 (smcl)	3,700 nc	3,700 nc
Barium	27.7	22.9	30.6	22.8	2,000	2,000	260 nc	260 nc
Calcium	39,200	41,100	41,900	40,400	--	--	--	--
Copper	5.4	3.5	5.0	3.0 U	1,000*	1,300**	150 nc	140 nc
Iron	1,470	187 U	1,590	219	300*	300 smcl	1,100 nc	--
Lead	1.2 J	0.80 UJ	1.3 J	0.80 UJ	50*	15**	--	4
Magnesium	10,700	11,000	11,600	11,000	--	--	--	--
Manganese	35.3	21.2	37.3	22.9	50*	50 smcl	18 nc	170 nc
Potassium	3,690	4,010	3,860	3,500	--	--	--	--
Sodium	9,310 J	9,800 J	10,100 J	9,860 J	--	--	--	--
Cyanide	2.1 J	NA	1.2	NA	200	200	73 nc	73 nc
Chloride (mg/L)	20.0	--	20.0	--	--	250 (smcl)	--	--
Sulfate (mg/L)	52	--	49	--	--	250 (scml)	--	--

Shading indicates screening value was exceeded.
[a] Screening level based on a target hazard quotient of 0.1.
F = filtered.
UF = Unfiltered.
* = secondary MCL.
** = action level.
nc = noncarcinogenic.
smcl - secondary MCL.
MCL = Maximum contaminant level.
RBC = Risk-based concentration.
PRG = Preliminary Remediation Goal.

Table A-5

Screening of Chemicals of Potential Concern: Groundwater
RSQ Site
Elyria, Ohio

EPA Sample No.:	MEXJ01	MEXJ05	MEXJ06	MEXJ11	MEXJ07	MEXJ08	Site Background		Ohio MCL	U.S. EPA MCL	U.S. EPA Region III Risk-based Concentration[a]	U.S. EPA Region IX Preliminary Remediation Goal[a]
Sample I.D.:	GW-301MSD	GW-305	GW-306	GW-311	GW-307	GW-308						
Matrix:	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater						
Location:	NE	SE	SW	Dup of 306	NE	E of river						
Sample Date:	11/15/96	11/14/96	11/14/96	11/14/96	11/15/96	11/15/96	Minimum	Maximum				
Units:	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
BNAs												
Bis(2-ethylhexyl)phthalate	0.7 J	10 U	0.08 J	0.9 U	10 U	1 J	<10	1	6	6	4.8 c	4.8 c
TAL												
Aluminum	52.1	17.0 U	85.7	92.9 J	334	217	21.4	17.0	--	50 - 200 (smcl)	3,700 nc	3,700 nc
Antimony	8.9	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	ND	ND	6	6	1.5 nc	1.5 nc
Arsenic	3.0 U	3.0 U	3.0 U	3.0 U	28.8	3.0 U	ND	ND	50	50	0.045 c	0.045 c
Barium	11.3	21.1	13.1	3.6	14.8	78.9	33.9	46.8	2,000	2,000	260 nc	260 nc
Beryllium	1.2	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	ND	ND	4	4	0.016 c	0.016 c
Cadmium	5.2	1.0 U	1.0 U	1.0 U	1.1	1.0 U	ND	ND	5	5	1.8 nc	1.8 nc
Calcium	242,000	381,000	150,000	36,500	42,200	168,000	125,000	167,000	--	--	--	--
Chromium	1.0 U	1.0 U	3.7	1.8	2.3	1.0 U	<1	1.3	100	100	18 nc-vi	18 nc-vi
Cobalt	1.0 U	1.4	1.5	1.0 U	14.9	2.6	ND	ND	--	--	220 nc	220 nc
Copper	1.0 U	1.0 U	1.0 U	1.0 U	2.6	2.4	ND	ND	1000*	1300**	150 nc	140 nc
Iron	568,000 J	10,000 J	434 J	286 J	47,000 J	2,170 J	27.1	215	300*	300 (smcl)	1,100 nc	--
Magnesium	52,600	20,200	41,900	10,200	14,200	37,100	63,000	64,400	--		--	--
Manganese	7,870	157	137	36.3	1,380	524	135	312	50*	50 (smcl)	18 nc	170 nc
Nickel	1.0 U	1.0 U	6.2	2.4	13.4	7.0	<1	1.1	100	100	73 nc	73 nc
Potassium	10,000	4,130	3,190	840	5,650	3,530	3,220	3,740	--		--	--
Selenium	13.7	4.0	4.0 U	4.0 U	4.0 U	4.0 U	ND	ND	50	50	18 nc	18 nc
Sodium	43,800 J	44,700 J	52,600 J	16,500 J	40,600 J	398,000 J	50,500	52,600	--	--	--	--
Thallium	43.6	2.0 U	2.9	2.0 U	8.9	2.4	2.3	2.7	2	2	0.29 nc-chloride	0.29 nc-chloride
Zinc	2.0 U	2.5 J	3.9 J	5.4 J	17.7 J	7.9 J	3.2	3.5	5000*	5,000 (smcl)	1,100 nc	1,100 nc
Cyanide	3.3	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.1	2.6	200	200	73 nc	73 nc

Bold indicates constituent exceeds screening level.
[a] Screening level for noncarcinogens based on a hazard quotient of 0.1.
MCL - Maximum contaminant level.
smcl - Secondary MCL.
* Secondary MCL.
** Action level.

Appendix B

APPENDIX B

DOSE ESTIMATION AND RISK CHARACTERIZATION

Table B-1

Current Trespasser Exposure:
Potential Ingestion of Chemicals in On-Site Soils
Noncarcinogenic Effects
Republic Steel Quarry
Elyria, Ohio

CHEMICAL	SOIL CONCENTRATION (mg/kg)	DAILY INTAKE (DI) (mg/kg-day)		CHRONIC REFERENCE DOSE (mg/kg-day)	HAZARD QUOTIENT (DI/RfD)	
		RME	RAE		RME	RAE
Inorganics						
Arsenic	16.2	6.2E-06	1.5E-06	3.0E-04	2.1E-02	5.2E-03
Iron	107,000	4.1E-02	1.0E-02	3.0E-01	1.4E-01	3.4E-02
Thallium	1.9	7.3E-07	1.8E-07	8.0E-05	9.1E-03	2.3E-03
TOTAL HAZARD INDEX:					**1.7E-01**	**4.2E-02**

DI = (Soil Concentration x IR x CF x FI x EF x ED)/(BW x AT)

RME = Reasonable maximum exposure.

RAE = Representative average exposure.

EXPOSURE ASSUMPTIONS

MAXIMUM	AVERAGE		SOURCE
100	100	IR = INGESTION RATE (mg/day)	EPA, 1992a/Estimated
1E-06	1E-06	CF = CONVERSION FACTOR (kg/mg)	--
1.0	0.5	FI = FRACTION INGESTED FROM CONTAMINATED SOURCE (unitless)	Estimated
60	30	EF = EXPOSURE FREQUENCY (days/year)	EPA, 1992a / Estimated
10	10	ED = EXPOSURE DURATION (years)	EPA, 1992a
43	43	BW = BODY WEIGHT (kg)	EPA, 1992a
3650	3650	AT = AVERAGING TIME (days)	ED x 365 days/yr

Table B-2

Current Trespasser Exposure:
Potential Ingestion of Chemicals in On-Site Soils
Carcinogenic Effects
Republic Steel Quarry
Elyria, Ohio

CHEMICAL	SOIL CONCENTRATION (mg/kg)	DAILY INTAKE (DI) (mg/kg-day)		CANCER SLOPE FACTOR CSF (mg/kg-day)-1	POTENTIAL CANCER RISK (DI x CSF)	
		RME	RAE		RME	RAE
Inorganics						
Arsenic	16.2	8.8E-07	2.2E-07	1.5E+00	1.3E-06	3.3E-07
Iron	107,000	5.8E-03	1.5E-03	NC	--	
Thallium	1.9	1.0E-07	2.6E-08	NC	--	
TOTAL CANCER RISK:					**1.3E-06**	**3.3E-07**

DI = (Soil Concentration x IR x CF x FI x EF x ED)/(BW x AT)

EXPOSURE ASSUMPTIONS

	MAXIMUM	AVERAGE		SOURCE
	100	100	IR = INGESTION RATE (mg/day)	EPA, 1992a/Estimated
	1E-06	1E-06	CF = CONVERSION FACTOR (kg/mg)	--
	1.0	0.5	FI = FRACTION INGESTED FROM CONTAMINATED SOURCE (unitless)	Estimated
	60	30	EF = EXPOSURE FREQUENCY (days/year)	EPA, 1992a / Estimated
RME = Reasonable maximum exposure.	10	10	ED = EXPOSURE DURATION (years)	EPA, 1992a
RAE = Representative average exposure.	43	43	BW = BODY WEIGHT (kg)	EPA, 1992a
NC = Not carcinogenic	25550	25550	AT = AVERAGING TIME (days)	ED x 365 days/yr

Table B-3

Current Trespasser Exposure:
Potential Dermal Absorption of Chemicals in On-Site Soils
Noncarcinogenic Effects
Republic Steel Quarry
Elyria, Ohio

CHEMICAL	SOIL CONCENTRATION (mg/kg)	DAILY INTAKE (DI) (mg/kg-day)		CHRONIC REFERENCE DOSE (RfD) (mg/kg-day)	HAZARD QUOTIENT (DI/RfD)	
		RME	RAE		RME	RAE
Inorganics						
Iron	107,000	6.1E-04	2.6E-04	3.0E-01	2.0E-03	8.8E-04
Arsenic	16	9.3E-08	4.0E-08	3.0E-04	3.1E-04	1.3E-04
Thallium	1.9	1.1E-08	4.7E-09	8.0E-05	1.4E-04	5.9E-05
TOTAL HAZARD INDEX:					**2.5E-03**	**1.1E-03**

DI = (Soil Conc. x CF x SA x AF x ABS x EF x ED)/(BW x AT)

RME = Reasonable maximum exposure.

RAE = Representative average exposure.

EXPOSURE ASSUMPTIONS

MAXIMUM	AVERAGE		SOURCE
1.0E-06	1.0E-06	CF = CONVERSION FACTOR (kg/mg)	--
5000	4300	SA = SKIN SURFACE AREA (cm^2/day)	EPA, 1996g
0.0	0.0	AF = ADHERENCE FACTOR (mg/cm^2)	Kissel et al., 1996
0.01	0.01	ABS = ABSORPTION FACTOR (unitless)	EPA, 1992c / Schaum, 1984
60	30	EF = EXPOSURE FREQUENCY (days/year)	EPA, 1992a / Estimated
10	10	ED = EXPOSURE DURATION (years)	EPA, 1992a
43	43	BW = BODY WEIGHT (kg)	EPA, 1992a
3650	3650	AT = AVERAGING TIME (days)	ED x 365 days/yr

Table B-4

Current Trespasser Exposure:
Potential Dermal Absorption of Chemicals in On-Site Soils
Carcinogenic Effects
Republic Steel Quarry
Elyria, Ohio

CHEMICAL	SOIL CONCENTRATION (mg/kg)	DAILY INTAKE (DI) (mg/kg-day)		CANCER SLOPE FACTOR CSF (mg/kg-day)-1	POTENTIAL CANCER RISK (DI x CSF)	
		RME	RAE		RME	RAE
Inorganics						
Iron	107,000	8.8E-05	3.8E-05	NC	0.0E+00	0.0E+00
Arsenic	16	1.3E-08	5.7E-09	1.5E+01	2.0E-07	8.6E-08
Thallium	1.9	1.6E-09	6.7E-10	NC	00E+00	0.0E+00
TOTAL CANCER RISK:					**2.0E-07**	**8.6E-08**

DI = (Soil Conc. x CF x SA x AF x ABS x EF x ED)/(BW x AT)

RME = Reasonable maximum exposure.

RAE = Representative average exposure.

NC = Not carcinogenic

EXPOSURE ASSUMPTIONS

MAXIMUM	AVERAGE		SOURCE
1.0E-06	1.0E-06	CF = CONVERSION FACTOR (kg/mg)	--
5000	4300	SA = SKIN SURFACE AREA (cm^2/day)	EPA, 1996g
0.03	0.03	AF = ADHERENCE FACTOR (mg/cm^2)	Kissel et al., 1996
0.01	0.01	ABS = ABSORPTION FACTOR (unitless)	EPA, 1992c / Schaum, 1984
60	30	EF = EXPOSURE FREQUENCY (days/year)	EPA, 1992a / Estimated
10	10	ED = EXPOSURE DURATION (years)	EPA, 1992a
43	43	BW = BODY WEIGHT (kg)	EPA, 1992a
25550	25550	AT = AVERAGING TIME (days)	70 x 365 days/yr

Table B-5

Current Trespasser Exposure:
Potential Inhalation of Chemicals from On-Site Soils
Noncarcinogenic Effects
Republic Steel Quarry
Elyria, Ohio

CHEMICAL	SOIL CONCENTRATION (mg/kg)	DAILY INTAKE (DI) (mg/kg-day)		CHRONIC REFERENCE DOSE (RfD) (mg/kg/day)	HAZARD QUOTIENT (DI/RfD)	
		RME	RAE		RME	RAE
Inorganics						
Iron	107000	5.3E-06	2.6E-06	NTV	--	--
Arsenic	16.2	8.0E-10	4.0E-10	NTV	--	--
Thallium	1.9	9.4E-11	4.7E-11	NTV	--	--
				TOTAL CANCER RISK:	–	--

DI = (Soil Concentration x IR x EF x ED x (1/PEF))/(BW x AT)

RME = Reasonable maximum exposure.
RAE = Representative average exposure.
NTV = No toxicity value available.

EXPOSURE ASSUMPTIONS

MAXIMUM	AVERAGE		SOURCE
17	17	IR = INHALATION RATE (m^3/day)	EPA, 1996a
1.32E+09	1.32E+09	PEF = PARTIC. EMISSION FACTOR (m^3/kg)	EPA, 1996b
60	30	EF = EXPOSURE FREQUENCY (days/year)	EPA, 1992a / Estimated
10	10	ED = EXPOSURE DURATION (years)	EPA, 1992a
43	43	BW = BODY WEIGHT (kg)	EPA, 1992a
3650	3650	AT = AVERAGING TIME (days)	ED x 365 days/yr

Table B-6

Current Trespasser Exposure:
Potential Inhalation of Chemicals from On-Site Soils
Carcinogenic Effects
Republic Steel Quarry
Elyria, Ohio

CHEMICAL	SOIL CONCENTRATION (mg/kg)	DAILY INTAKE (DI) (mg/kg-day)		CANCER SLOPE FACTOR CSF (mg/kg/day)-1	POTENTIAL CANCER RISL (DI x CSF)	
		RME	RAE		RME	RAE
Inorganics						
Iron	107000	7.5E-07	3.8E-07	NTV	0.00E+00	0.00E+00
Arsenic	16.2	1.1E-10	5.7E-11	1.50E+01	1.71E-09	8.55E-10
Thallium	1.9	1.3E-11	6.7E-12	NTV	0.00E+00	0.00E+00
			TOTAL CANCER RISK:		1.71E-09	8.55E-10

DI = (Soil Concentration x IR x EF x ED x (1/PEF))/(BW x AT)	EXPOSURE ASSUMPTIONS MAXIMUM	AVERAGE		SOURCE
	17	17	IR = INHALATION RATE (m^3/day)	EPA, 1996a
	1.32E+09	1.32E+09	PEF = PARTIC. EMISSION FACTOR (m^3/kg)	EPA, 1996b
RME = Reasonable maximum exposure.	60	30	EF = EXPOSURE FREQUENCY (days/year)	EPA, 1992a / Estimated
RAE = Representative average exposure.	10	10	ED = EXPOSURE DURATION (years)	EPA, 1992a
NTV = No toxicity value available.	43	43	BW = BODY WEIGHT (kg)	EPA, 1992a
NC = Not carcinogenic	25550	25550	AT = AVERAGING TIME (days)	70 x 365 days/yr

Table B-7

Current Trespasser Exposure
Potential Ingestion of Chemicals in Quarry Surface Water
Noncarcinogenic Risk
Republic Steel Quarry
Elyria, Ohio

CHEMICAL	SURFACE WATER CONCENTRATION (mg/L)	DAILY INTAKE (DI) (mg/kg-day)		CHRONIC REFERENCE DOSE (mg/kg-day)	HAZARD QUOTIENT (DI/RfD)	
		RME	RAE		RME	RAE
Inorganics						
Copper	0.299	8.6E-05	2.4E-06	3.7E-02	2.32E-03	6.44E-05
Iron	847	2.4E-01	6.7E-03	3.0E-01	8.09E-01	2.25E-02
Manganese	12.8	3.7E-03	1.0E-04	4.7E-02	7.81E-02	2.17E-03
Silver	0.28	8.0E-05	2.2E-06	5.0E-03	1.61E-02	4.46E-04
Sulfate	2090	6.0E-01	1.7E-02	NTV	--	--
Vanadium	0.0375	1.1E-05	3.0E-07	7.0E-03	1.54E-03	4.27E-05
				TOTAL HAZARD INDEX:	**9.1E-01**	**2.5E-02**

	EXPOSURE ASSUMPTIONS		
DI = (Groundwater Concentration x CR x ET x EF x ED) / (BW x AT)	MAXIMUM	AVERAGE	
	0.05	0.05	CR = CONTACT RATE (L water/hour)
	1.0	0.5	ET = EXPOSURE TIME (hr/day)
RME = Reasonable maximum exposure.	90	5	EF = EXPOSURE FREQUENCY (days/year)
RAE = Representative average exposure.	10	10	ED = EXPOSURE DURATION (years)
NTV = No toxicity value.	43	43	BW = BODY WEIGHT (kg)
	3650	3650	AT = AVERAGING TIME (days)

Table B-8

Current Trespasser Exposure
Potential Dermal Absorption of Chemicals in Quarry Surface Water
Noncarcinogenic Risk
Republic Steel Quarry
Elyria, Ohio

CHEMICAL	SURFACE WATER CONCENTRATION (mg/L)	PERMEABILITY COEFFICIENT (PC) (cm/hr)	DAILY INTAKE (DI) (mg/kg-day)		CHRONIC ORAL REFERENCE DOSE (RfDo) (mg/kg-day)	HAZARD QUOTIENT (DI/RfD)	
			RME	RAE		RME	RAE
Inorganics							
Copper	0.299	0.001	2.5E-05	5.8E-07	3.7E-02	6.84E-04	1.58E-05
Iron	847	0.001	7.2E-02	1.7E-03	3.0E-01	2.39E-01	5.51E-03
Manganese	12.8	0.001	1.1E-03	2.5E-05	4.7E-02	2.30E-02	5.31E-04
Silver	0.28	0.001	2.4E-05	5.5E-07	5.0E-03	4.74E-03	1.09E-04
Sulfate	2090	0.001	1.8E-01	4.1E-03	NTV	--	--
Vanadium	0.0375	0.001	3.2E-06	7.3E-08	7.0E-03	4.53E-04	1.05E-05
					TOTAL HAZARD INDEX:	**2.7E-01**	**6.2E-03**

DI = (Surface Water Conc. x CF x SA x PC
x ET x EF x ED) / (BW x AT)

RME = Reasonable maximum exposure.
RAE = Representative average exposure; maximum exposure parameters from RI Risk Assessment Applied.

EXPOSURE ASSUMPTIONS

MAXIMUM	AVERAGE	
1.0E-03	1.0E-03	CR = CONVERSION FACTOR (L/1000 cm3)
14750	12250	SA = SKIN SURFACE AREA (cm^2/day).
1.0	0.5	ET = EXPOSURE TIME (hr/day)
90	5	EF = EXPOSURE FREQUENCY (days/year)
10	10	ED = EXPOSURE DURATION (years)
43	43	BW = BODY WEIGHT (kg)
3650	3650	AT = AVERAGING TIME (days)

Table B-9

Current Trespasser Exposure
Potential Ingestion of Chemicals in Fish from the Quarry
Noncarcinogenic Risk
Republic Steel Quarry
Elyria, Ohio

CHEMICAL	FISH CONCENTRATION (mg/kg)	DAILY INTAKE (DI) (mg/kg-day)		CHRONIC REFERENCE DOSE (mg/kg-day)	HAZARD QUOTIENT (DI/RfD)	
		RME	RAE		RME	RAE
Inorganics						
Cadmium	0.0752	5.6E-05	3.3E-06	1.0E-03	5.56E-02	3.35E-03
Copper	0.409	3.0E-04	1.8E-05	3.7E-02	8.18E-03	4.92E-04
Manganese	0.402	3.0E-04	1.8E-05	1.4E-01	2.12E-03	1.28E-04
Mercury	0.357	2.6E-04	1.6E-05	3.0E-04	8.80E-01	5.30E-02
				TOTAL HAZARD INDEX:	**9.5E-01**	**5.7E-02**

DI = (Fish Concentration x IR x EF x ED) / (BW x AT)

RME = Reasonable maximum exposure.

RAE = Representative average exposure.

EXPOSURE ASSUMPTIONS		
MAXIMUM	AVERAGE	
0.054	0.0065	IR = INGESTION RATE (kg/day)
350	175	EF = EXPOSURE FREQUENCY (days/year)
30	9	ED = EXPOSURE DURATION (years)
70	70	BW = BODY WEIGHT (kg)
10950	3285	AT = AVERAGING TIME (days)

Table B-10

Current Trespasser Exposure
Potential Ingestion of Chemicals in Fish from the Black River
Noncarcinogenic Risk
Republic Steel Quarry
Elyria, Ohio

CHEMICAL	FISH CONCENTRATION (mg/kg)	DAILY INTAKE (DI) (mg/kg-day)		CHRONIC REFERENCE DOSE (mg/kg-day)	HAZARD QUOTIENT (DI/RfD)	
		RME	RAE		RME	RAE
Inorganics						
Cadmium	0.0078	5.8E-06	3.5E-07	1.0E-03	5.77E-03	3.47E-04
Copper	1.02	7.5E-04	4.5E-05	3.7E-02	2.04E-02	1.23E-03
Manganese	1.17	8.7E-04	5.2E-05	1.4E-01	6.18E-03	3.72E-04
Mercury	0.251	1.9E-04	1.1E-05	3.0E-04	6.19E-01	3.72E-02
				TOTAL HAZARD INDEX:	**6.5E-01**	**3.9E-02**

DI = (Fish Concentration x IR x EF x ED) / (BW x AT)

RME = Reasonable maximum exposure.

RAE = Representative average exposure.

EXPOSURE ASSUMPTIONS

MAXIMUM	AVERAGE	
0.054	0.0065	IR = INGESTION RATE (kg/day)
350	175	EF = EXPOSURE FREQUENCY (days/year)
30	9	ED = EXPOSURE DURATION (years)
70	70	BW = BODY WEIGHT (kg)
10950	3285	AT = AVERAGING TIME (days)

Table B-11

Future Recreational Exposure: Adult
Potential Ingestion of Chemicals in On-Site Soils
Noncarcinogenic Effects
Republic Steel Quarry
Elyria, Ohio

CHEMICAL	SOIL CONCENTRATION (mg/kg)	DAILY INTAKE (DI) (mg/kg-day)		CHRONIC REFERENCE DOSE (mg/kg-day)	HAZARD QUOTIENT (DI/RfD)	
		RME	RAE		RME	RAE
Inorganics						
Iron	107,000	2.5E-02	6.3E-03	3.0E-01	8.4E-02	2.1E-02
Arsenic	16.2	3.8E-06	9.5E-07	3.0E-04	1.3E-02	3.2E-03
Thallium	1.9	4.5E-07	1.1E-07	8.0E-05	5.6E-03	1.4E-03
				TOTAL HAZARD INDEX:	**1.0E-01**	**2.6E-02**

DI = (Soil Concentration x IR x CF x FI x EF x ED) / (BW x AT)

RME = Reasonable maximum exposure.
RAE = Representative average exposure.

EXPOSURE ASSUMPTIONS

MAXIMUM	AVERAGE		SOURCE
100	100	IR = INGESTION RATE (mg/day)	EPA, 1992a/Estimated
1E-06	1E-06	CF = CONVERSION FACTOR (kg/mg)	--
1.0	0.5	FI = FRACTION INGESTED FROM CONTAMINATED SOURCE (unitless)	Estimated
60	30	EF = EXPOSURE FREQUENCY (days/year)	EPA, 1992a / Estimated
30	9	ED = EXPOSURE DURATION (years)	EPA, 1992a
70	70	BW = BODY WEIGHT (kg)	EPA, 1992a
10950	3285	AT = AVERAGING TIME (days)	ED x 365 days/yr

Table B-12

Future Recreational Exposure: Adult
Potential Ingestion of Chemicals in On-Site Soils
Carcinogenic Effects
Republic Steel Quarry
Elyria, Ohio

CHEMICAL	SOIL CONCENTRATION (mg/kg)	DAILY INTAKE (DI) (mg/kg-day)		CANCER SLOPE FACTOR CSF (mg/kg-day)-1	POTENTIAL CANCER RISK (DI x CSF	
		RME	RAE		RME	RAE
Inorganics						
Iron	107,000	1.1E-02	8.1E-04	NC	--	--
Arsenic	16.2	1.6E-06	1.2E-07	1.5E+00	2.4E-06	1.8E-07
Thallium	1.9	1.9E-07	1.4E-08	NC	--	--
TOTAL CANCER RISK:					**2.4E-06**	**1.8E-07**

DI = (Soil Concentration x IR x CF x FI x EF x ED) / (BW x AT)

EXPOSURE ASSUMPTIONS

	MAXIMUM	AVERAGE		SOURCE
	100	100	IR = INGESTION RATE (mg/day)	EPA, 1992a/Estimated
	1E-06	1E-06	CF = CONVERSION FACTOR (kg/mg)	--
	1.0	0.5	FI = FRACTION INGESTED FROM CONTAMINATED SOURCE (unitless)	Estimated
	60	30	EF = EXPOSURE FREQUENCY (days/year)	EPA, 1992a / Estimated
RME = Reasonable maximum exposure.	30	9	ED = EXPOSURE DURATION (years)	EPA, 1992a
RAE = Representative average exposure.	70	70	BW = BODY WEIGHT (kg)	EPA, 1992a
NC = Not carcinogenic.	25550	25550	AT = AVERAGING TIME (days)	ED x 365 days/yr

Table B-13

Future Recreational Exposure: Adult
Potential Dermal Absorption of Chemicals in On-site Soils
Noncarcinogenic Effects
Republic Steel Quarry
Elyria, Ohio

CHEMICAL	SOIL CONCENTRATION (mg/kg)	DAILY INTAKE (DI) (mg/kg-day)		CHRONIC REFERENCE DOSE (RfD) (mg/kg-day)	HAZARD QUOTIENT (DI/RfD)	
		RME	RAE		RME	RAE
Inorganics						
Iron	107,000	4.52E-05	2.15E-04	3.0E-01	1.5E-04	7.2E-04
Arsenic	16	6.85E-09	3.25E-08	3.0E-04	2.3E-05	1.1E-04
Thallium	1.9	8.03E-10	3.81E-09	8.0E-05	1.0E-05	4.8E-05
TOTAL HAZARD INDEX:					**1.8E-04**	**8.7E-04**

DI = (Soil Conc. x CF x SA x AF x ABS x EF x ED) / (BW x AT)

EXPOSURE ASSUMPTIONS

MAXIMUM	AVERAGE		SOURCE
1.0.E-06	1.0E-06	CF = CONVERSION FACTOR (kg/mg)	--
600	5,700	SA = SKIN SURFACE AREA (cm^2/day)	EPA, 1996g
0.01	0.01	ABS = ABSORPTION FACTOR (unitless)	EPA, 1992b
0.03	0.03	AF = ADHERENCE FACTOR (mg/cm^2)	Kissel et al., 1996
60	30	EF = EXPOSURE FREQUENCY (days/year)	EPA, 1992a / Estimated
30	9	ED = EXPOSURE DURATION (years)	EPA, 1992a
70	70	BW = BODY WEIGHT (kg)	EPA, 1992a
10,950	3,285	AT = AVERAGING TIME (days)	ED x 365 days/yr

RME = Reasonable maximum exposure.
RAE = Representative average exposure.
NA = Not available.

Table B-14

Future Recreational Exposure: Adult
Potential Dermal Absorption of Chemicals in On-site Soils
Carcinogenic Effects
Republic Steel Quarry
Elyria, Ohio

CHEMICAL	SOIL CONCENTRATION (mg/kg)	DAILY INTAKE (DI) (mg/kg-day)		CANCER SLOPE FACTOR (CSF) (mg/kg-day)-1	POTENTIAL CANCER RISK (DI x CSF)	
		RME	RAE		RME	RAE
Inorganics						
Iron	107,000	1.94E-05	2.76E-05	NC	0.0E+00	0.0E+00
Arsenic	16.2	2.93E-09	4.18E-09	1.5E+00	4.4E-09	6.3E-09
Thallium	1.9	3.44E-10	4.90E-10	NC	0.0E+00	0.0E+00
			TOTAL CANCER RISK:		**4.4E-09**	**6.3E-09**

DI = (Soil Conc. x CF x SA x AF x ABS x EF x ED) / (BW x AT)

EXPOSURE ASSUMPTIONS

	MAXIMUM	AVERAGE		SOURCE
	1.0.E-06	1.0E-06	CF = CONVERSION FACTOR (kg/mg)	--
	600	5,700	SA = SKIN SURFACE AREA (cm^2/day)	EPA, 1996g
	0.01	0.01	ABS = ABSORPTION FACTOR (unitless)	EPA, 1992b
	0.03	0.03	AF = ADHERENCE FACTOR (mg/cm^2)	Kissel et al., 1996
RME = Reasonable maximum exposure.	60	30	EF = EXPOSURE FREQUENCY (days/year)	EPA, 1992a / Estimated
RAE = Representative average exposure.	30	9	ED = EXPOSURE DURATION (years)	EPA, 1992a
NA = Not available.	70	70	BW = BODY WEIGHT (kg)	EPA, 1992a
	25,550	25,550	AT = AVERAGING TIME (days)	ED x 365 days/yr

Table B-15

Future Recreational Exposure: Adult
Potential Inhalation of Chemicals from On-Site Soils
Noncarcinogenic Effects
Republic Steel Quarry
Elyria, Ohio

CHEMICAL	SOIL CONCENTRATION (mg/kg)	DAILY INTAKE (DI) (mg/kg-day)		CHRONIC REFERENCE DOSE (RfD) (mg/kg/day)	HAZARD QUOTIENT (DI/RfD)	
		RME	RAE		RME	RAE
Inorganics						
Iron	107000	3.8E-06	1.9E-06	NTV	--	--
Arsenic	16.2	5.8E-10	2.9E-10	NTV	--	--
Thallium	1.9	6.8E-11	3.4E-11	NTV	--	--
TOTAL HAZARD INDEX:					--	--

DI = (Soil Concentration x IR x EF x ED x (1/PEF)) / (BW x AT)

RME = Reasonable maximum exposure.
RAE = Representative average exposure.
NTV = No toxicity value available.
NDA = No data available.

EXPOSURE ASSUMPTIONS

MAXIMUM	AVERAGE		SOURCE
20	20	IR = INHALATION RATE (m^3/day)	EPA, 1996a
1.32E+09	1.32E+09	PEF = PARTIC. EMISSION FACTOR (m^3/kg)	EPA, 1996b
60	30	EF = EXPOSURE FREQUENCY (days/year)	EPA, 1992a / Estimated
30	9	ED = EXPOSURE DURATION (years)	EPA, 1992a
70	70	BW = BODY WEIGHT (kg)	EPA, 1992a
10950	3285	AT = AVERAGING TIME (days)	ED x 365 days/yr

Table B-16

Future Recreational Exposure: Adult
Potential Inhalation of Chemicals from On-Site Soils
Carcinogenic Effects
Republic Steel Quarry
Elyria, Ohio

CHEMICAL	SOIL CONCENTRATION (mg/kg)	DAILY INTAKE (DI) (mg/kg-day)		CANCER SLOPE FACTOR (CSF) (mg/kg/day)-1	POTENTIAL CANCER RISK (DI x CSF)	
		RME	RAE		RME	RAE
Inorganics						
Iron	107,000	1.6E-06	2.4E-07	NTV	--	--
Arsenic	16.2	2.5E-10	3.7E-11	1.50E+01	3.71E-09	5.56E-10
Thallium	1.9	2.9E-11	4.3E-12	NTV	--	--
TOTAL CANCER RISK:					3.71E-09	5.56E-10

DI = (Soil Concentration x IR x EF x ED x (1/PEF)) / (BW x AT)

RME = Reasonable maximum exposure.
RAE = Representative average exposure.
NTV = No toxicity value available.
NDA = No data available.
NC = Not carcinogenic.

EXPOSURE ASSUMPTIONS

MAXIMUM	AVERAGE		SOURCE
20	20	IR = INHALATION RATE (m^3/day)	EPA, 1996a
1.32E+09	1.32E+09	PEF = PARTIC. EMISSION FACTOR (m^3/kg)	EPA, 1996b
60	30	EF = EXPOSURE FREQUENCY (days/year)	EPA, 1992a / Estimated
30	9	ED = EXPOSURE DURATION (years)	EPA, 1992a
70	70	BW = BODY WEIGHT (kg)	EPA, 1992a
25550	25550	AT = AVERAGING TIME (days)	ED x 365 days/yr

Table B-17

Future Recreational Exposure: Child
Potential Ingestion of Chemicals in On-Site Soils
Noncarcinogenic Effects
Republic Steel Quarry
Elyria, Ohio

CHEMICAL	SOIL CONCENTRATION (mg/kg)	DAILY INTAKE (DI) (mg/kg-day)		CHRONIC REFERENCE DOSE (mg/kg-day)	HAZARD QUOTIENT (DI/RfD)	
		RME	RAE		RME	RAE
Inorganics						
Iron	107,000	2.3E-01	5.9E-02	3.0E-01	7.8E-01	2.0E-01
Arsenic	16	3.6E-05	8.9E-06	3.0E-04	1.2E-01	3.0E-02
Thallium	1.9	4.2E-06	1.0E-06	8.0E-05	5.2E-02	1.3E-02
TOTAL HAZARD INDEX:					**9.5E-01**	**2.4E-01**

DI = (Soil Concentration x IR
x CF x FI x EF x ED) / (BW x AT)

RME = Reasonable maximum exposure.
RAE = Representative average exposure.

EXPOSURE ASSUMPTIONS

MAXIMUM	AVERAGE		SOURCE
200	200	IR = INGESTION RATE (mg/day)	EPA, 1992a/Estimated
1E-06	1E-06	CF = CONVERSION FACTOR (kg/mg)	--
1.0	0.5	FI = FRACTION INGESTED FROM CONTAMINATED SOURCE (unitless)	Estimated
60	30	EF = EXPOSURE FREQUENCY (days/year)	EPA, 1992a / Estimated
6	2	ED = EXPOSURE DURATION (years)	EPA, 1992a
15	15	BW = BODY WEIGHT (kg)	EPA, 1992a
2190	730	AT = AVERAGING TIME (days)	ED x 365 days/yr

Table B-18

Future Recreational Exposure: Child
Potential Ingestion of Chemicals in On-Site Soils
Carcinogenic Effects
Republic Steel Quarry
Elyria, Ohio

CHEMICAL	SOIL CONCENTRATION (mg/kg)	DAILY INTAKE (DI) (mg/kg-day)		CANCER SLOPE FACTOR (CSF) (mg/kg-day)-1	POTENTIAL CANCER RISK (DI x CSF)	
		RME	RAE		RME	RAE
Inorganics						
Iron	107,000	2.0E-02	1.7E-03	NC	0.0E+00	0.0E+00
Arsenic	16	3.0E-06	2.5E-07	1.5E+00	4.6E-06	3.8E-07
Thallium	1.9	3.6E-07	3.0E-08	NC	0.0E+00	0.0E+00
TOTAL CANCER RISK:					**4.6E-06**	**3.8E-07**

DI = (Soil Concentration x IR x CF x FI x EF x ED) / (BW x AT)

RME = Reasonable maximum exposure.
RAE = Representative average exposure.

EXPOSURE ASSUMPTIONS

MAXIMUM	AVERAGE		SOURCE
200	200	IR = INGESTION RATE (mg/day)	EPA, 1992a/Estimated
1E-06	1E-06	CF = CONVERSION FACTOR (kg/mg)	--
1.0	0.5	FI = FRACTION INGESTED FROM CONTAMINATED SOURCE (unitless)	Estimated
60	30	EF = EXPOSURE FREQUENCY (days/year)	EPA, 1992a / Estimated
6	2	ED = EXPOSURE DURATION (years)	EPA, 1992a
15	15	BW = BODY WEIGHT (kg)	EPA, 1992a
25550	25550	AT = AVERAGING TIME (days)	ED x 365 days/yr

Table B-19

Future Recreational Exposure: Child
Potential Dermal Absorption of Chemicals in On-Site Soils
Noncarcinogenic Effects
Republic Steel Quarry
Elyria, Ohio

CHEMICAL	SOIL CONCENTRATION (mg/kg)	DAILY INTAKE (DI) (mg/kg-day)		CHRONIC REFERENCE DOSE (RfD) (mg/kg-day)	HAZARD QUOTIENT (DI/RfD)	
		RME	RAE		RME	RAE
Inorganics						
Iron	107,000	3.19E-02	3.40E-03	3.0E-01	1.1E-01	1.1E-02
Arsenic	16	4.83E-06	5.15E-07	3.0E-04	1.6E-02	1.7E-03
Thallium	1.9	5.66E-07	6.04E-08	8.0E-05	7.1E-03	7.5E-04
TOTAL HAZARD INDEX:					**1.3E-01**	**1.4E-02**

DI = (Soil Conc. X CF x SA x AF x ABS x EF x ED) / (BW x AT)

EXPOSURE ASSUMPTIONS

MAXIMUM	AVERAGE		SOURCE
1.0.E-06	1.0.E-06	CF = CONVERSION FACTOR (kg/mg)	--
3,400	2,900	SA = SKIN SURFACE AREA (cm^2/day)	EPA, 1996g
0.01	0.01	ABS = ABSORPTION FACTOR (unitless)	EPA, 1992b
0.8	0.2	AF = ADHERENCE FACTOR (mg/cm^2)	Kissel et al., 1996
60	30	EF = EXPOSURE FREQUENCY (days/year)	EPA, 1992a / Estimated
6	2	ED = EXPOSURE DURATION (years)	EPA, 1992a
15	15	BW = BODY WEIGHT (kg)	EPA, 1992a
2,190	730	AT = AVERAGING TIME (days)	ED × 365 days/yr

RME = Reasonable maximum exposure.
RAE = Representative average exposure.
NA = Not available.

Table B-20

Future Recreational Exposure: Child
Potential Dermal Absorption of Chemicals in On-Site Soils
Carcinogenic Effects
Republic Steel Quarry
Elyria, Ohio

CHEMICAL	SOIL CONCENTRATION (mg/kg)	DAILY INTAKE (DI) (mg/kg-day)		CANCER SLOPE FACTOR (CSF) (mg/kg-day)	HAZARD QUOTIENT (DI/RfD)	
		RME	RAE		RME	RAE
Inorganics						
Iron	107,000	2.73E-03	9.72E-05	NC	0.0E+00	0.0E+00
Arsenic	16	4.14E-07	1.47E-08	1.5E+00	6.2E-07	2.2E-08
Thallium	1.9	4.85E-08	1.73E-09	NC	0.0E+00	0.0E+00
TOTAL CANCER RISK:					**6.2E-07**	**2.2E-08**

DI = (Soil Conc. × CF × SA × AF × ABS × EF × ED) / (BW × AT)

EXPOSURE ASSUMPTIONS

	MAXIMUM	AVERAGE		SOURCE
	1.0.E-06	1.0.E-06	CF = CONVERSION FACTOR (kg/mg)	--
	3,400	2,900	SA = SKIN SURFACE AREA (cm^2/day)	EPA, 1996g
	0.01	0.01	ABS = ABSORPTION FACTOR (unitless)	EPA, 1992b
	0.8	0.2	AF = ADHERENCE FACTOR (mg/cm^2)	Kissel et al., 1996
RME = Reasonable maximum exposure.	60	30	EF = EXPOSURE FREQUENCY (days/year)	EPA, 1992a / Estimated
RAE = Representative average exposure.	6	2	ED = EXPOSURE DURATION (years)	EPA, 1992a
NA = Not available.	15	15	BW = BODY WEIGHT (kg)	EPA, 1992a
NC = Not carcinogenic	25,550	25,550	AT = AVERAGING TIME (days)	ED × 365 days/yr

Table B-21

Future Recreational Exposure: Child
Potential Inhalation of Chemicals from On-Site Soils
Noncarcinogenic Effects
Republic Steel Quarry
Elyria, Ohio

CHEMICAL	SOIL CONCENTRATION (mg/kg)	DAILY INTAKE (DI) (mg/kg-day)		CHRONIC REFERENCE DOSE (RfD) (mg/kg/day)	HAZARD QUOTIENT (DI/RfD)	
		RME	RAE		RME	RAE
Inorganics						
Iron	107000	1.1E-05	5.3E-06	NTV	--	--
Arsenic	16.2	1.6E-09	8.1E-10	NTV	--	--
Thallium	1.9	1.9E-10	9.5E-11	NTV	--	--
TOTAL HAZARD INDEX:					--	--

DI = (Soil Concentration × IR × EF × ED × (1/PEF)) / (BW × AT)

RME = Reasonable maximum exposure.
RAE = Representative average exposure.
NTV = No toxicity value available.
NDA = No data available.

EXPOSURE ASSUMPTIONS

MAXIMUM	AVERAGE		SOURCE
12	12	IR = INHALATION RATE (m^3/day)	EPA, 1996a
1.32E+09	1.32E+09	PEF = PARTIC. EMISSION FACTOR (m^3/kg)	EPA, 1996b
60	30	EF = EXPOSURE FREQUENCY (days/year)	EPA, 1992a / Estimated
6	2	ED = EXPOSURE DURATION (years)	EPA, 1992a
15	15	BW = BODY WEIGHT (kg)	EPA, 1992a
2190	730	AT = AVERAGING TIME (days)	ED × 365 days/yr

Table B-22

Future Recreational Exposure: Child
Potential Inhalation of Chemicals from On-Site Soils
Carcinogenic Effects
Republic Steel Quarry
Elyria, Ohio

CHEMICAL	SOIL CONCENTRATION (mg/kg)	DAILY INTAKE (DI) (mg/kg-day)		CANCER SLOPE FACTOR (CSF) (mg/kg/day)-1	HAZARD QUOTIENT (DI/RfD)	
		RME	RAE		RME	RAE
Inorganics						
Iron	107000	9.1E-07	1.5E-07	NC	--	--
Arsenic	16.2	1.4E-10	2.3E-11	1.50E+01	2.08E-09	3.46E-10
Thallium	1.9	1.6E-11	2.7E-12	NC	--	--
				TOTAL CANCER RISK:	2.08E-09	3.46E-10

DI = (Soil Concentration × IR × EF × ED × (1/PEF)) / (BW × AT)

NC = Not carcinogenic.
RME = Reasonable maximum exposure.
RAE = Representative average exposure.
NTV = No toxicity value available.
NDA = No data available.

EXPOSURE ASSUMPTIONS

MAXIMUM	AVERAGE		SOURCE
12	12	IR = INHALATION RISK (m^3/day)	EPA, 1996a
1.32E+09	1.32E+09	PEF = PARTIC. EMISSION FACTOR (m^3/kg)	EPA, 1996b
60	30	EF = EXPOSURE FREQUENCY (days/year)	EPA, 1992a / Estimated
6	2	ED = EXPOSURE DURATION (years)	EPA, 1992a
15	15	BW = BODY WEIGHT (kg)	EPA, 1992a
25550	25550	AT = AVERAGING TIME (days)	ED × 365 days/yr

Table B-23

Future Park Patron/Resident: Adult
Potential Ingestion of Chemicals in Quarry Surface Water
Noncarcinogenic Risk
Republic Steel Quarry
Elyria, Ohio

CHEMICAL	SURFACE WATER CONCENTRATION (mg/L)	DAILY INTAKE (DI) (mg/kg-day)		CHRONIC REFERENCE DOSE (mg/kg-day)	HAZARD QUOTIENT (DI/RfD)	
		RME	RAE		RME	RAE
Inorganics						
Copper	0.299	5.3E-05	1.5E-06	3.7E-02	1.42E-03	3.95E-05
Iron	847	1.5E-01	4.1E-03	3.0E-01	4.97E-01	1.38E-02
Manganese	12.8	2.3E-03	6.3E-05	4.7E-02	4.80E-02	1.33E-03
Silver	0.28	4.9E-05	1.4E-06	5.0E-03	9.86E-03	2.74E-04
Sulfate	2090	3.7E-01	1.0E-02	NTV	--	--
Vanadium	0.0375	6.6E-06	1.8E-07	7.0E-03	9.44E-04	2.62E-05
				TOTAL HAZARD INDEX:	**5.6E-01**	**1.5E-02**

DI = (Groundwater Concentration × CR
× ET × EF × ED) / (BW × AT)

RME = Reasonable maximum exposure.
RAE = Representative average exposure.
NTV = No toxicity value.

EXPOSURE ASSUMPTIONS MAXIMUM	AVERAGE	
0.05	0.05	CR = CONTACT RATE (L water/hour)
1.0	0.5	ET = EXPOSURE TIME (hr/day)
90	5	EF = EXPOSURE FREQUENCY (days/year)
30	9	ED = EXPOSURE DURATION (years)
70	70	BW = BODY WEIGHT (kg)
10950	3285	AT = AVERAGING TIME (days)

Table B-24

Future Park Patron/Resident: Adult
Potential Dermal Absorption of Chemicals in Quarry Surface Water
Noncarcinogenic Risk
Republic Steel Quarry
Elyria, Ohio

CHEMICAL	SURFACE WATER CONCENTRATION (mg/L)	PERMEABILITY COEFFICIENT (PC) (cm/hr)	DAILY INTAKE (DI) (mg/kg-day)		CHRONIC ORAL REFERENCE DOSE (RfDo) (mg/kg-day)	HAZARD QUOTIENT (DI/RfD)	
			RME	RAE		RME	RAE
Inorganics							
Copper	0.299	0.001	2.3E-05	5.3E-07	3.7E-02	6.26E-04	1.42E-05
Iron	847	0.001	6.6E-02	1.5E-03	3.0E-01	2.19E-01	4.97E-03
Manganese	12.8	0.001	9.9E-04	2.3E-05	4.7E-02	2.11E-02	4.80E-04
Silver	0.28	0.001	2.2E-05	4.9E-07	5.0E-03	4.34E-03	9.86E-05
Sulfate	2090	0.001	1.6E-01	3.7E-03	NTV	--	--
Vanadium	0.0375	0.001	2.9E-06	6.6E-08	7.0E-03	4.15E-04	9.44E-06
					TOTAL HAZARD INDEX:	**2.5E-01**	**5.6E-03**

DI = (Surface Water Conc. × CF × SA × PC × ET × EF × ED) / (BW × AT)

RME = Reasonable maximum exposure.
RAE = Representative average exposure; maximum exposure parameters from RI Risk Assessment Applied.

EXPOSURE ASSUMPTIONS

MAXIMUM	AVERAGE	
1.0E-03	1.0E-03	CF = CONVERSION FACTOR (L/1000 cm3)
22000	18000	SA = SKIN SURFACE AREA (cm^2/day)
1.0	0.5	ET = EXPOSURE TIME (hr/day)
90	5	EF = EXPOSURE FREQUENCY (days/year)
30	9	ED = EXPOSURE DURATION (years)
70	70	BW = BODY WEIGHT (kg)
10950	3285	AT = AVERAGING TIME (days)

Table B-25a

Future Park Patron/Residential: Adult
Potential Ingestion of Chemicals in Fish from the Quarry
Noncarcinogenic Risk
Republic Steel Quarry
Elyria, Ohio

CHEMICAL	FISH CONCENTRATION (mg/kg)	DAILY INTAKE (DI) (mg/kg-day)		CHRONIC REFERENCE DOSE (mg/kg-day)	HAZARD QUOTIENT (DI/RfD)	
		RME	RAE		RME	RAE
Inorganics						
Cadmium	0.0752	5.6E-05	3.3E-06	1.0E-03	5.56E-02	3.35E-03
Copper	0.409	3.0E-04	1.8E-05	3.7E-02	8.18E-03	4.92E-04
Manganese	0.402	3.0E-04	1.8E-05	1.4E-01	2.12E-03	1.28E-04
Mercury	0.357	2.6E-04	1.6E-05	3.0E-04	8.80E-01	5.30E-02
				TOTAL HAZARD INDEX:	**9.5E-01**	**5.7E-02**

DI = (Fish Concentration × IR × EF × ED) / (BW × AT)

RME = Reasonable maximum exposure.

RAE = Representative average exposure.

EXPOSURE ASSUMPTIONS MAXIMUM	AVERAGE	
0.054	0.0065	IR = INGESTION RATE (kg/day)
350	175	EF = EXPOSURE FREQUENCY (days/year)
30	9	ED = EXPOSURE DURATION (years)
70	70	BW = BODY WEIGHT (kg)
10950	3285	AT = AVERAGING TIME (days)

Table B-25b

Future Park Patron/Residential: Adult
Potential Ingestion of Chemicals in Fish from the Black River
Noncarcinogenic Risk
Republic Steel Quarry
Elyria, Ohio

CHEMICAL	FISH CONCENTRATION (mg/kg)	DAILY INTAKE (DI) (mg/kg-day)		CHRONIC REFERENCE DOSE (mg/kg-day)	HAZARD QUOTIENT (DI/RfD)	
		RME	RAE		RME	RAE
Inorganics						
Cadmium	0.0078	5.8E-06	3.5E-07	1.0E-03	5.77E-03	3.47E-04
Copper	1.02	7.5E-04	4.5E-05	3.7E-02	2.04E-02	1.23E-03
Manganese	1.17	8.7E-04	5.2E-05	1.4E-01	6.18E-03	3.72E-04
Mercury	0.251	1.9E-04	1.1E-05	3.0E-04	6.19E-01	3.72E-02
TOTAL HAZARD INDEX:					**6.5E-01**	**3.9E-02**

DI = (Fish Concentration × IR × EF × ED) / (BW × AT)

RME = Reasonable maximum exposure.

RAE = Representative average exposure.

EXPOSURE ASSUMPTIONS

MAXIMUM	AVERAGE	
0.054	0.0065	IR = INGESTION RATE (kg/day)
350	175	EF = EXPOSURE FREQUENCY (days/year)
30	9	ED = EXPOSURE DURATION (years)
70	70	BW = BODY WEIGHT (kg)
10950	3285	AT = AVERAGING TIME (days)

Table B-26

Future Park Patron/Resident: Child
Potential Ingestion of Chemicals in Quarry Surface Water
Noncarcinogenic Risk
Republic Steel Quarry
Elyria, Ohio

CHEMICAL	SURFACE WATER CONCENTRATION (mg/L)	DAILY INTAKE (DI) (mg/kg-day)		CHRONIC REFERENCE DOSE (mg/kg-day)	HAZARD QUOTIENT (DI/RfD)	
		RME	RAE		RME	RAE
Inorganics						
Copper	0.299	2.5E-04	6.8E-06	3.7E-02	6.64E-03	1.84E-04
Iron	847	7.0E-01	1.9E-02	3.0E-01	2.32E+00	6.45E-02
Manganese	12.8	1.1E-02	2.9E-04	4.7E-02	2.24E-01	6.22E-03
Silver	0.28	2.3E-04	6.4E-06	5.0E-03	4.60E-02	1.28E-03
Sulfate	2090	1.7E+00	4.8E-02	NTV	--	--
Vanadium	0.0375	3.1E-05	8.6E-07	7.0E-03	4.40E-03	1.22E-04
				TOTAL HAZARD INDEX:	**2.6E+00**	**7.2E-02**

DI = (Groundwater Concentration × CR × ET × EF × ED) / (BW × AT)

RME = Reasonable maximum exposure.
RAE = Representative average exposure.
NTV = No toxicity value.

EXPOSURE ASSUMPTIONS MAXIMUM	AVERAGE	
0.05	0.05	CR = CONTACT RATE (L water/hour)
1.0	0.5	ET = EXPOSURE TIME (hr/day)
90	5	EF = EXPOSURE FREQUENCY (days/year)
6	2	ED = EXPOSURE DURATION (years)
15	15	BW = BODY WEIGHT (kg)
2190	730	AT = AVERAGING TIME (days)

Table B-27

Future Park Patron/Resident: Child
Potential Dermal Absorption of Chemicals in Quarry Surface Water
Noncarcinogenic Risk
Republic Steel Quarry
Elyria, Ohio

CHEMICAL	SURFACE WATER CONCENTRATION (mg/L)	PERMEABILITY COEFFICIENT (PC) (cm/hr)	DAILY INTAKE (DI) (mg/kg-day)		CHRONIC ORAL REFERENCE DOSE (RfDo) (mg/kg-day)	HAZARD QUOTIENT (DI/RfD)	
			RME	RAE		RME	RAE
Inorganics							
Copper	2.99	0.001	3.7E-05	8.9E-07	3.7E-02	9.96E-04	2.40E-05
Iron	847	0.001	1.0E-01	2.5E-03	3.0E-01	3.48E-01	8.38E-03
Manganese	12.8	0.001	1.6E-03	3.8E-05	4.7E-02	3.36E-02	8.08E-04
Silver	0.28	0.001	3.5E-05	8.3E-07	5.0E-03	6.90E-03	1.66E-04
Sulfate	2090	0.001	2.6E-01	6.2E-03	NTV	--	--
Vanadium	0.0375	0.001	4.6E-06	1.1E-07	7.0E-03	6.60E-04	1.59E-05
					TOTAL HAZARD INDEX:	**3.9E-01**	**9.4E-03**

DI = (Surface Water Conc. × CF × SA × PC × ET × EF × ED) / (BW × AT)

RME = Reasonable maximum exposure.
RAE = Representative average exposure; maximum exposure parameters from RI Risk Assessment Applied.

EXPOSURE ASSUMPTIONS

MAXIMUM	AVERAGE	
1.0E-03	1.0E-03	CF = CONVERSION FACTOR (L/1000 cm3)
7500	6500	SA = SKIN SURFACE AREA (cm^2/day)
1.0	0.5	ET = EXPOSURE TIME (hr/day)
90	5	EF = EXPOSURE FREQUENCY (days/year)
6	2	ED = EXPOSURE DURATION (years)
15	15	BW = BODY WEIGHT (kg)
2190	730	AT = AVERAGING TIME (days)

Table B-28a

Future Park Patron/Residential: Child
Potential Ingestion of Chemicals in Fish from the Quarry
Noncarcinogenic Risk
Republic Steel Quarry
Elyria, Ohio

CHEMICAL	FISH CONCENTRATION (mg/kg)	DAILY INTAKE (DI) (mg/kg-day)		CHRONIC REFERENCE DOSE (mg/kg-day)	HAZARD QUOTIENT (DI/RfD)	
		RME	RAE		RME	RAE
Inorganics						
Cadmium	0.0752	2.6E-04	1.6E-05	1.0E-03	2.60E-01	1.56E-02
Copper	0.409	1.4E-03	8.5E-05	3.7E-02	3.82E-02	2.30E-03
Manganese	0.402	1.4E-03	8.4E-05	1.4E-01	9.91E-03	5.97E-04
Mercury	0.357	1.2E-03	7.4E-05	3.0E-04	4.11E+00	2.47E-01
				TOTAL HAZARD INDEX:	**4.4E+00**	**2.7E-01**

DI = (Fish Concentration × IR × EF × ED) / (BW × AT)

RME = Reasonable maximum exposure.

RAE = Representative average exposure.

EXPOSURE ASSUMPTIONS MAXIMUM	AVERAGE	
0.054	0.0065	IR = INGESTION RATE (kg/day)
350	175	EF = EXPOSURE FREQUENCY (days/year)
6	2	ED = EXPOSURE DURATION (years)
15	15	BW = BODY WEIGHT (kg)
2190	730	AT = AVERAGING TIME (days)

Table B-28b

Future Park Patron/Residential: Child
Potential Ingestion of Chemicals in Fish from the Black River
Noncarcinogenic Risk
Republic Steel Quarry
Elyria, Ohio

CHEMICAL	FISH CONCENTRATION (mg/kg)	DAILY INTAKE (DI) (mg/kg-day)		CHRONIC REFERENCE DOSE (mg/kg-day)	HAZARD QUOTIENT (DI/RfD)	
		RME	RAE		RME	RAE
Inorganics						
Cadmium	0.0078	2.7E-05	1.6E-06	1.0E-03	2.69E-02	1.62E-03
Copper	1.02	3.5E-03	2.1E-04	3.7E-02	9.52E-02	5.73E-03
Manganese	1.17	4.0E-03	2.4E-04	1.4E-01	2.88E-02	1.74E-03
Mercury	0.251	8.7E-04	5.2E-05	3.0E-04	2.89E+00	1.74E-01
				TOTAL HAZARD INDEX:	**3.0E+00**	**1.8E-01**

DI = (Fish Concentration × IR × EF × ED) / (BW × AT)

RME = Reasonable maximum exposure.
RAE = Representative average exposure.

EXPOSURE ASSUMPTIONS MAXIMUM	AVERAGE	
0.054	0.0065	IR = INGESTION RATE (kg/day)
350	175	EF = EXPOSURE FREQUENCY (days/year)
6	2	ED = EXPOSURE DURATION (years)
15	15	BW = BODY WEIGHT (kg)
2190	730	AT = AVERAGING TIME (days)

Table B-29

Future Residential Exposure: Adult
Potential Ingestion of Chemicals in On-Site Soils
Noncarcinogenic Effects
Republic Steel Quarry
Elyria, Ohio

CHEMICAL	SOIL CONCENTRATION (mg/kg)	DAILY INTAKE (DI) (mg/kg-day)		CHRONIC REFERENCE DOSE (mg/kg-day)	HAZARD QUOTIENT (DI/RfD)	
		RME	RAE		RME	RAE
Inorganics						
Iron	107,000	1.5E-01	7.3E-02	3.0E-01	4.9E-01	2.4E-01
Arsenic	16	2.2E-05	1.1E-05	3.0E-04	7.4E-02	3.7E-02
Thallium	1.9	2.6E-06	1.3E-06	8.0E-05	3.3E-02	1.6E-02
TOTAL HAZARD INDEX:					**6.0E-01**	**3.0E-01**

DI = (Soil Concentration x IR x CF x FI x EF x ED) / (BW x AT)

RME = Reasonable maximum exposure.

RAE = Representative average exposure.

EXPOSURE ASSUMPTIONS

MAXIMUM	AVERAGE		SOURCE
100	100	IR = INGESTION RATE (mg/day)	EPA, 1992a/Estimated
1E-06	1E-06	CF = CONVERSION FACTOR (kg/mg)	--
1.0	0.5	FI = FRACTION INGESTED FROM CONTAMINATED SOURCE (unitless)	Estimated
350	350	EF = EXPOSURE FREQUENCY (days/year)	EPA, 1992a / Estimated
30	9	ED = EXPOSURE DURATION (years)	EPA, 1992a
70	70	BW = BODY WEIGHT (kg)	EPA, 1992a
10950	3285	AT = AVERAGING TIME (days)	ED x 365 days/yr

Table B-30

Future Residential Exposure: Adult
Potential Ingestion of Chemicals in On-Site Soils
Carcinogenic Effects
Republic Steel Quarry
Elyria, Ohio

CHEMICAL	SOIL CONCENTRATION (mg/kg)	DAILY INTAKE (DI) (mg/kg-day)		CANCER SLOPE FACTOR CSF (mg/kg-day)-1	POTENTIAL CANCER RISK (DI x CSF)	
		RME	RAE		RME	RAE
Inorganics						
Iron	107,000	6.3E-02	9.4E-03	NC	0.0E+00	0.0E+00
Arsenic	16	9.5E-06	1.4E-06	1.5+00	1.4E-05	2.1E-06
Thallium	1.9	1.1E-06	1.7E-07	NC	0.0E+00	0.0E+00
TOTAL CANCER RISK:					**1.4E-05**	**2.1E-06**

DI = (Soil Concentration x IR x CF x FI x EF x ED) / (BW x AT)

RME = Reasonable maximum exposure.

RAE = Representative average exposure.

EXPOSURE ASSUMPTIONS

MAXIMUM	AVERAGE		SOURCE
100	100	IR = INGESTION RATE (mg/day)	EPA, 1992a/Estimated
1E-06	1E-06	CF = CONVERSION FACTOR (kg/mg)	--
1.0	0.5	FI = FRACTION INGESTED FROM CONTAMINATED SOURCE (unitless)	Estimated
350	350	EF = EXPOSURE FREQUENCY (days/year)	EPA, 1992a / Estimated
30	9	ED = EXPOSURE DURATION (years)	EPA, 1992a
70	70	BW = BODY WEIGHT (kg)	EPA, 1992a
25550	25550	AT = AVERAGING TIME (days)	ED x 365 days/yr

Table B-31

Future Residential Exposure: Adult
Potential Dermal Absorption of Chemicals in On-site Soils
Noncarcinogenic Effects
Republic Steel Quarry
Elyria, Ohio

CHEMICAL	SOIL CONCENTRATION (mg/kg)	DAILY INTAKE (DI) (mg/kg-day)		CHRONIC REFERENCE DOSE (RfD) (mg/kg-day)	HAZARD QUOTIENT (DI/RfD)	
		RME	RAE		RME	RAE
Inorganics						
Iron	107,000	2.9E-03	2.5E-03	3.0E-01	9.7E-03	8.4E-03
Arsenic	16.2	4.4E-07	3.8E-07	3.0E-04	1.5E-03	1.3E-03
Thallium	1.9	5.2E-08	4.5E-08	8.0E-05	6.4E-04	5.6E-04
TOTAL HAZARD INDEX:					**1.2E-02**	**1.0E-02**

DI = (Soil Conc. x CF x SA x AF x ABS x EF x ED) / (BW x AT)

RME = Reasonable maximum exposure.
RAE = Representative average exposure.
NA = Not available.

EXPOSURE ASSUMPTIONS

MAXIMUM	AVERAGE		SOURCE
1.0E-06	1.0E-06	CF = CONVERSION FACTOR (kg/mg)	--
6600	5700	SA = SKIN SURFACE AREA (cm^2/day)	EPA, 1996g
0.01	0.01	ABS = ABSORPTION FACTOR (unitless)	EPA, 1992b/Schaum, 1984
0.03	0.03	AF = ADHERENCE FACTOR (mg/cm^2)	EPA, 1992b
350	350	EF = EXPOSURE FREQUENCY (days/year)	EPA, 1992a / Estimated
30	9	ED = EXPOSURE DURATION (years)	EPA, 1992a
70	70	BW = BODY WEIGHT (kg)	EPA, 1992a
10950	3285	AT = AVERAGING TIME (days)	ED x 365 days/yr

Table B-32

Future Residential Exposure: Adult
Potential Dermal Absorption of Chemicals in On-site Soils
Carcinogenic Effects
Republic Steel Quarry
Elyria, Ohio

CHEMICAL	SOIL CONCENTRATION (mg/kg)	DAILY INTAKE (DI) (mg/kg-day)		CANCER SLOPE FACTOR CSF (mg/kg-day)-1	POTENTIAL CANCER RISK (DI x CSF)	
		RME	RAE		RME	RAE
Inorganics						
Iron	107,000	1.2E-03	3.2E-04	NC	0.0E+00	0.0E+00
Arsenic	16.2	1.9E-07	4.9E-08	3.0E-04	5.6E-11	1.5E-11
Thallium	1.9	2.2E-08	5.7E-09	NC	0.0E+00	0.0E+00
				TOTAL CANCER RISK:	**5.6E-11**	**1.5E-11**

DI = (Soil Conc. x CF x SA x AF x ABS x EF x ED) / (BW x AT)

EXPOSURE ASSUMPTIONS

	MAXIMUM	AVERAGE		SOURCE
	1.0E-06	1.0E-06	CF = CONVERSION FACTOR (kg/mg)	--
	6600	5700	SA = SKIN SURFACE AREA (cm^2/day)	EPA, 1996g
	0.01	0.01	ABS = ABSORPTION FACTOR (unitless)	EPA, 1992b/Schaum, 1984
	0.03	0.03	AF = ADHERENCE FACTOR (mg/cm^2)	EPA, 1992b
RME = Reasonable maximum exposure.	350	350	EF = EXPOSURE FREQUENCY (days/year)	EPA, 1992a / Estimated
RAE = Representative average exposure.	30	9	ED = EXPOSURE DURATION (years)	EPA, 1992a
NA = Not available.	70	70	BW = BODY WEIGHT (kg)	EPA, 1992a
NC = Not carcinogenic.	25550	25550	AT = AVERAGING TIME (days)	70 x 365 days/yr

Table B-33

Future Residential Exposure: Adult
Potential Inhalation of Chemicals from On-Site Soils
Noncarcinogenic Effects
Republic Steel Quarry
Elyria, Ohio

CHEMICAL	SOIL CONCENTRATION (mg/kg)	DAILY INTAKE (DI) (mg/kg-day)		CHRONIC REFERENCE DOSE (RfD) (mg/kg/day)	HAZARD QUOTIENT (DI/RfD)	
		RME	RAE		RME	RAE
Inorganics						
Iron	107,000	2.2E-05	2.2E-05	NTV	--	--
Arsenic	16.2	3.4E-09	3.4E-09	NTV	--	--
Thallium	1.9	3.9E-10	3.9E-10	NTV	--	--
TOTAL HAZARD INDEX:					--	--

DI = (Soil Concentration x IR x EF x ED x (1/PEF)) / (BW x AT)

RME = Reasonable maximum exposure.

RAE = Representative average exposure.

NTV = No toxicity value available.

EXPOSURE ASSUMPTIONS

MAXIMUM	AVERAGE		SOURCE
20	20	IR = INHALATION RATE (m^3/day)	EPA, 1996a
1.32E+09	1.32E+09	PEF = PARTIC. EMISSION FACTOR (m^3/kg)	EPA, 1996b
350	350	EF = EXPOSURE FREQUENCY (days/year)	EPA, 1992a / Estimated
30	9	ED = EXPOSURE DURATION (years)	EPA, 1992a
70	70	BW = BODY WEIGHT (kg)	EPA, 1992a
10950	3285	AT = AVERAGING TIME (days)	ED x 365 days/yr

Table B-34

Future Residential Exposure: Adult
Potential Inhalation of Chemicals from On-Site Soils
Carcinogenic Effects
Republic Steel Quarry
Elyria, Ohio

CHEMICAL	SOIL CONCENTRATION (mg/kg)	DAILY INTAKE (DI) (mg/kg-day)		CANCER SLOPE FACTOR CSF (mg/kg/day)-1	POTENTIAL CANCER RISK (DI x CSF)	
		RME	RAE		RME	RAE
Inorganics						
Iron	107000	9.5E-06	2.9E-06	NC	--	--
Arsenic	16.2	1.4E-09	4.3E-10	1.50E+01	2.16E-08	6.48E-09
Thallium	1.9	1.7E-10	5.1E-11	NC	--	--
TOTAL CANCER RISK:					2.16E-08	6.48E-09

DI = (Soil Concentration x IR x EF x ED x (1/PEF)) / (BW x AT)

RME = Reasonable maximum exposure.
RAE = Representative average exposure.
NTV = No toxicity value available.
NC = Not carcinogenic

EXPOSURE ASSUMPTIONS

MAXIMUM	AVERAGE		SOURCE
20	20	IR = INHALATION RATE (m^3/day)	EPA, 1996a
1.32E+09	1.32E+09	PEF = PARTIC. EMISSION FACTOR (m^3/kg)	EPA, 1996b
350	350	EF = EXPOSURE FREQUENCY (days/year)	EPA, 1992a / Estimated
30	9	ED = EXPOSURE DURATION (years)	EPA, 1992a
70	70	BW = BODY WEIGHT (kg)	EPA, 1992a
25550	25550	AT = AVERAGING TIME (days)	70 x 365 days/yr

Table B-35

Future Residential Exposure: Child
Potential Ingestion of Chemicals in On-Site Soils
Noncarcinogenic Effects
Republic Steel Quarry
Elyria, Ohio

CHEMICAL	SOIL CONCENTRATION (mg/kg)	DAILY INTAKE (DI) (mg/kg-day)		CHRONIC REFERENCE DOSE (mg/kg-day)	HAZARD QUOTIENT (DI/RfD)	
		RME	RAE		RME	RAE
Inorganics						
Iron	107,000	1.4E+00	6.8E-01	3.0E-01	4.6E+00	2.3E+00
Arsenic	16	2.1E-04	1.0E-04	3.0E-04	6.9E-01	3.5E-01
Thallium	1.9	2.4E-05	1.2E-05	8.0E-05	3.0E-01	1.5E-01
TOTAL HAZARD INDEX:					**4.6E+00**	**2.3E+00**

DI = (Soil Concentration x IR x CF x FI x EF x ED) / (BW x AT)

RME = Reasonable maximum exposure.
RAE = Representative average exposure.

EXPOSURE ASSUMPTIONS

MAXIMUM	AVERAGE		SOURCE
200	200	IR = INGESTION RATE (mg/day)	EPA, 1992a/Estimated
1E-06	1E-06	CF = CONVERSION FACTOR (kg/mg)	--
1.0	0.5	FI = FRACTION INGESTED FROM CONTAMINATED SOURCE (unitless)	Estimated
350	350	EF = EXPOSURE FREQUENCY (days/year)	EPA, 1992a / Estimated
6	2	ED = EXPOSURE DURATION (years)	EPA, 1992a
15	15	BW = BODY WEIGHT (kg)	EPA, 1992a
2190	730	AT = AVERAGING TIME (days)	ED x 365 days/yr

Table B-36

Future Residential Exposure: Child
Potential Ingestion of Chemicals in On-Site Soils
Carcinogenic Effects
Republic Steel Quarry
Elyria, Ohio

CHEMICAL	SOIL CONCENTRATION (mg/kg)	DAILY INTAKE (DI) (mg/kg-day)		CANCER SLOPE FACTOR CSF (mg/kg-day)-1	POTENTIAL CANCER RISK (DI x CSF)	
		RME	RAE		RME	RAE
Inorganics						
Iron	107,000	1.2E-01	2.0E-02	NC	--	--
Arsenic	16	1.8E-05	3.0E-06	1.5E+00	1.2E-05	2.0E-06
Thallium	1.9	2.1E-06	3.5E-07	NC	--	--
			TOTAL CANCER RISK:		**1.2E-05**	**2.0E-06**

DI = (Soil Concentration x IR x CF x FI x EF x ED) / (BW x AT)

EXPOSURE ASSUMPTIONS

	MAXIMUM	AVERAGE		SOURCE
	200	200	IR = INGESTION RATE (mg/day)	EPA, 1992a/Estimated
	1E-06	1E-06	CF = CONVERSION FACTOR (kg/mg)	--
	1.0	0.5	FI = FRACTION INGESTED FROM CONTAMINATED SOURCE (unitless)	Estimated
	350	350	EF = EXPOSURE FREQUENCY (days/year)	EPA, 1992a / Estimated
RME = Reasonable maximum exposure.	6	2	ED = EXPOSURE DURATION (years)	EPA, 1992a
RAE = Representative average exposure.	15	15	BW = BODY WEIGHT (kg)	EPA, 1992a
NC = Not carcinogenic.	25550	25550	AT = AVERAGING TIME (days)	70 x 365 days/yr

Table B-37

Future Residential Exposure: Child
Potential Dermal Absorption of Chemicals in On-Site Soils
Noncarcinogenic Effects
Republic Steel Quarry
Elyria, Ohio

CHEMICAL	SOIL CONCENTRATION (mg/kg)	DAILY INTAKE (DI) (mg/kg-day)		CHRONIC REFERENCE DOSE (RfD) (mg/kg-day)	HAZARD QUOTIENT (DI/RfD)	
		RME	RAE		RME	RAE
Inorganics						
Iron	107,000	1.9E-01	4.0E02	3.0E-01	6.2E-01	1.3E-01
Arsenic	16	2.8E-05	6.0E-06	3.0E-04	9.4E-02	2.0E-02
Thallium	1.9	3.3E-06	7.0E-07	8.0E-05	4.1E-02	8.8E-03
TOTAL HAZARD INDEX:					**7.6E-01**	**1.6E-01**

DI = (Soil Conc. x CF x SA x AF x ABS x EF x ED) / (BW x AT)

EXPOSURE ASSUMPTIONS

	MAXIMUM	AVERAGE		SOURCE
	1.0E-06	1.0E-06	CF = CONVERSION FACTOR (kg/mg)	--
	3400	2900	SA = SKIN SURFACE AREA (cm^2/day)	EPA, 1996g
	0.01	0.01	ABS = ABSORPTION FACTOR (unitless)	EPA, 1992b/Scahum, 1984
	0.8	0.2	AF = ADHERENCE FACTOR (mg/cm^2)	Kissel et al., 1996
RME = Reasonable maximum exposure.	350	350	EF = EXPOSURE FREQUENCY (days/year)	EPA, 1992a / Estimated
RAE = Representative average exposure.	6	2	ED = EXPOSURE DURATION (years)	EPA, 1992a
NA = Not available.	15	15	BW = BODY WEIGHT (kg)	EPA, 1992a
	2190	730	AT = AVERAGING TIME (days)	ED x 365 days/yr

Table B-38

Future Residential Exposure: Child
Potential Dermal Absorption of Chemicals in On-site Soils
Carcinogenic Effects
Republic Steel Quarry
Elyria, Ohio

CHEMICAL	SOIL CONCENTRATION (mg/kg)	DAILY INTAKE (DI) (mg/kg-day)		CANCER SLOPE FACTOR (CSF) (mg/kg-day)-1	POTENTIAL CANCER RISK (DI x CSF)	
		RME	RAE		RME	RAE
Inorganics						
Iron	107,000	1.6E-02	1.1E-03	NC	0.0E+00	0.0E+00
Arsenic	16	2.4E-06	1.7E-07	1.5E+00	3.6E-06	2.6E-07
Thallium	1.9	2.8E-07	2.0E-08	NC	0.0E+00	0.0E+00
				TOTAL CANCER RISK:	**3.6E-06**	**2.6E-07**

DI = (Soil Conc. x CF x SA x AF x ABS x EF x ED) / (BW x AT)

EXPOSURE ASSUMPTIONS

	MAXIMUM	AVERAGE		SOURCE
	1.0E-06	1.0E-06	CF = CONVERSION FACTOR (kg/mg)	--
	3400	2900	SA = SKIN SURFACE AREA (cm^2/day)	EPA, 1996g
	0.01	0.01	ABS = ABSORPTION FACTOR (unitless)	EPA, 1992b/Scahum, 1984
	0.8	0.2	AF = ADHERENCE FACTOR (mg/cm^2)	Kissel et al., 1996
RME = Reasonable maximum exposure.	350	350	EF = EXPOSURE FREQUENCY (days/year)	EPA, 1992a / Estimated
RAE = Representative average exposure.	6	2	ED = EXPOSURE DURATION (years)	EPA, 1992a
NA = Not available.	15	15	BW = BODY WEIGHT (kg)	EPA, 1992a
NC = Not carcinogenic	25550	25550	AT = AVERAGING TIME (days)	70 x 365 days/yr

Table B-39

Future Residential Exposure: Child
Potential Inhalation of Chemicals from On-Site Soils
Noncarcinogenic Effects
Republic Steel Quarry
Elyria, Ohio

CHEMICAL	SOIL CONCENTRATION (mg/kg)	DAILY INTAKE (DI) (mg/kg-day)		CHRONIC REFERENCE DOSE (RfD) (mg/kg/day)	HAZARD QUOTIENT (DI/RfD)	
		RME	RAE		RME	RAE
Inorganics						
Iron	107,000	6.2E-05	6.2E-05	NTV	- -	- -
Arsenic	16	9.4E-09	9.4E-09	NTV	- -	- -
Thallium	1.9	1.1E-09	1.1E-09	NTV	- -	- -
TOTAL HAZARD INDEX:					- -	- -

DI = (Soil Concentration x IR x EF x ED x (1/PEF)) / (BW x AT)

RME = Reasonable maximum exposure.

RAE = Representative average exposure.

NTV = No toxicity value available.

EXPOSURE ASSUMPTIONS

MAXIMUM	AVERAGE		SOURCE
12	12	IR = INHALATION RATE (m^3/day)	EPA, 1996a
1.32E+09	1.32E+09	PEF = PARTIC. EMISSION FACTOR (m^3/kg)	EPA, 1996b
350	350	EF = EXPOSURE FREQUENCY (days/year)	EPA, 1992a / Estimated
6	2	ED = EXPOSURE DURATION (years)	EPA, 1992a
15	15	BW = BODY WEIGHT (kg)	EPA, 1992a
2190	730	AT = AVERAGING TIME (days)	ED x 365 days/yr

Table B-40

Future Residential Exposure: Child
Potential Inhalation of Chemicals from On-Site Soils
Noncarcinogenic Effects
Republic Steel Quarry
Elyria, Ohio

CHEMICAL	SOIL CONCENTRATION (mg/kg)	DAILY INTAKE (DI) (mg/kg-day)		CANCER SLOPE FACTOR CSF (mg/kg/day)-1	POTENTIAL CANCER RISK (DI x CSF)	
		RME	RAE		RME	RAE
Inorganics						
Iron	107,000	5.3E-06	1.8E-06	NC	- -	- -
Arsenic	16	8.1E-10	2.7E-10	1.50E+01	1.21E-08	4.03E-09
Thallium	1.9	9.5E-11	3.2E-11	NC	- -	- -
				TOTAL HAZARD INDEX:	1.21E-08	4.03E-09

DI = (Soil Concentration x IR x EF x ED x (1/PEF)) / (BW x AT)

RME = Reasonable maximum exposure.
RAE = Representative average exposure.
NTV = No toxicity value available.
NC = Not carcinogenic

EXPOSURE ASSUMPTIONS

MAXIMUM	AVERAGE		SOURCE
12	12	IR = INHALATION RATE (m^3/day)	EPA, 1996a
1.32E+09	1.32E+09	PEF = PARTIC. EMISSION FACTOR (m^3/kg)	EPA, 1996b
350	350	EF = EXPOSURE FREQUENCY (days/year)	EPA, 1992a / Estimated
6	2	ED = EXPOSURE DURATION (years)	EPA, 1992a
15	15	BW = BODY WEIGHT (kg)	EPA, 1992a
25550	25550	AT = AVERAGING TIME (days)	ED x 365 days/yr

TABLE B-41
FUTURE RESIDENTIAL EXPOSURE: ADULT
POTENTIAL INGESTION OF CHEMICALS IN GROUNDWATER
NONCARCINOGENIC RISK
REPUBLIC STEEL QUARRY
ELYRIA, OHIO

CHEMICAL	GROUNDWATER CONCENTRATION (mg/kg)	DAILY INTAKE (DI) (mg/kg-day)		CHRONIC ORAL REFERENCE DOSE (mg/kg-day)	HAZARD QUOTIENT (DI/RfD)	
		RME	RAE		RME	RAE
Inorganics						
Antimony	0.0089	2.4E-04	1.7E-04	4.0E-04	6.10E-01	4.27E-01
Arsenic	0.0288	7.9E-04	5.5E-04	3.0E-04	2.63E+00	1.84E+00
Beryllium	0.0012	3.3E-05	2.3E-05	5.0E-03	6.58E-03	4.60E-03
Cadmium	0.0052	1.4E-04	1.0E-04	5.0E-04	2.85E-01	1.99E-01
Iron	568	1.6E+01	1.1E+01	3.0E-01	5.19E+01	3.63E+01
Manganese	7.87	2.2E-01	1.5E-01	4.7E-02	4.59E+00	3.21E+00
Thallium	0.0436	1.2E-03	8.4E-04	8.0E-05	1.49E+01	1.05E+01
				TOTAL HAZARD INDEX:	**7.5E+01**	**5.2E+01**

DI = (Groundwater Concentration × CR x ET x EF x ED) / (BW x AT)

RME = Reasonable maximum exposure.
RAE = Representative average exposure.
NTV = No toxicity value.

EXPOSURE ASSUMPTIONS

MAXIMUM	AVERAGE	
2	1.4	IR = INGESTION RATE (L/day)
350	350	EF = EXPOSURE FREQUENCY (days/year)
30	9	ED = EXPOSURE DURATION (years)
70	70	BW = BODY WEIGHT (kg)
10950	3285	AT = AVERAGING TIME (days)

TABLE B-42
FUTURE RESIDENTIAL EXPOSURE: ADULT
POTENTIAL INGESTION OF CHEMICALS IN GROUNDWATER
CARCINOGENIC RISK
REPUBLIC STEEL QUARRY
ELYRIA, OHIO

CHEMICAL	GROUNDWATER CONCENTRATION (mg/L)	DAILY INTAKE (DI) (mg/kg-day)		CANCER SLOPE FACTOR CSF (mg/kg-day)-1	POTENTIAL CANCER RISK (DI x CSF)	
		RME	RAE		RME	RAE
Inorganics						
Antimony	0.0089	1.0E-04	2.2E-05	NC	0.00E+00	0.00E+00
Arsenic	0.0288	3.4E-04	7.1E-05	1.5E+00	5.07E-04	1.07E-04
Beryllium	0.0012	1.4E-05	3.0E-06	4.3E+00	6.06E-05	1.27E-05
Cadmium	0.0052	6.1E-05	1.3E-05	NC	0.00E+00	0.00E+00
Iron	568	6.7E+00	1.4E+00	NC	0.00E+00	0.00E+00
Manganese	7.87	9.2E-02	1.9E-02	NC	0.00E+00	0.00E+00
Thallium	0.0436	5.1E-04	1.1E-04	NC	0.00E+00	0.00E+00
				TOTAL HAZARD INDEX:	**5.7E-04**	**1.2E-04**

	EXPOSURE ASSUMPTIONS MAXIMUM	AVERAGE	
DI = (Groundwater Concentration × CR x ET × EF × ED) / (BW × AT)			
	2	1.4	IR = INGESTION RATE (L/day)
RME = Reasonable maximum exposure.	350	350	EF = EXPOSURE FREQUENCY (days/year)
RAE = Representative average exposure.	30	9	ED = EXPOSURE DURATION (years)
NTV = No toxicity value.	70	70	BW = BODY WEIGHT (kg)
NC = Not carcinogenic.	25550	25550	AT = AVERAGING TIME (days)

TABLE B-43
FUTURE RESIDENTIAL EXPOSURE: ADULT
POTENTIAL DERMAL ABSORPTION OF CHEMICALS IN GROUNDWATER
NONCARCINOGENIC RISK
REPUBLIC STEEL QUARRY
ELYRIA, OHIO

CHEMICAL	GROUNDWATER CONCENTRATION (mg/L)	PERMEABILITY COEFFICIENT (PC) (cm/hr)	DAILY INTAKE (DI) (mg/kg-day)		CHRONIC ORAL REFERENCE DOSE (RfDo) (mg/kg-day)	HAZARD QUOTIENT (DI/RfD)	
			RME	RAE		RME	RAE
Inorganics							
Antimony	0.0089	0.001	2.7E-06	1.1E-06	4.0E-04	6.71E-03	2.74E-03
Arsenic	0.0288	0.001	8.7E-06	3.6E-06	3.0E-04	2.89E-02	1.18E-02
Beryllium	0.0012	0.001	3.6E-07	1.5E-07	5.0E-03	7.23E-05	2.96E-05
Cadmium	0.0052	0.001	1.6E-06	6.4E-07	5.0E-04	3.13E-03	1.28E-03
Iron	568	0.001	1.7E-01	7.0E-02	3.0E-01	5.71E-01	2.33E-01
Manganese	7.87	0.001	2.4E-03	9.7E-04	4.7E-02	5.05E-02	2.06E-02
Thallium	0.0436	0.001	1.3E-05	5.4E-06	8.0E-05	1.64E-01	6.72E-02
					TOTAL HAZARD INDEX:	**8.2E-01**	**3.4E-01**

DI = (Surface Water Conc. × CF × SA × PC × ET × EF × ED) / (BW × AT)

RME = Reasonable maximum exposure.
RAE = Representative average exposure
NTV = No toxicity value available.

EXPOSURE ASSUMPTIONS

MAXIMUM	AVERAGE	
1.0E-03	1.0E-03	CF = CONVERSION FACTOR (L/1000 cm3)
22000	18000	SA = SKIN SURFACE AREA (cm^2/day).
1.0	0.5	ET = EXPOSURE TIME (hr/day)
350	350	EF = EXPOSURE FREQUENCY (days/year)
30	9	ED = EXPOSURE DURATION (years)
70	70	BW = BODY WEIGHT (kg)
10950	3285	AT = AVERAGING TIME (days)

TABLE B-44
FUTURE RESIDENTIAL EXPOSURE: ADULT
POTENTIAL DERMAL ABSORPTION OF CHEMICALS IN GROUNDWATER
CARCINOGENIC RISK
REPUBLIC STEEL QUARRY
ELYRIA, OHIO

CHEMICAL	GROUNDWATER CONCENTRATION (mg/L)	PERMEABILITY COEFFICIENT (PC) (cm/hr)	DAILY INTAKE (DI) (mg/kg-day)		CANCER SLOPE FACTOR CSF (mg/kg-day)-1	POTENTIAL CANCER RISK (DI x CSF)	
			RME	RAE		RME	RAE
Inorganics							
Antimony	0.0089	0.001	2.7E-06	1.1E-06	NC	0.00E+00	0.00E+00
Arsenic	0.0288	0.001	8.7E-06	3.6E-06	1.5E+00	1.30E-05	5.33E-06
Beryllium	0.0012	0.001	3.6E-07	1.5E-07	4.3E+00	1.56E-06	6.36E-07
Cadmium	0.0052	0.001	1.6E-06	6.4E-07	NC	0.00E+00	0.00E+00
Iron	568	0.001	1.7E-01	7.0E-02	NC	0.00E+00	0.00E+00
Manganese	7.87	0.001	2.4E-03	9.7E-04	NC	0.00E+00	0.00E+00
Thallium	0.0436	0.001	1.3E-05	5.4E-06	NC	0.00E+00	0.00E+00
					TOTAL HAZARD INDEX:	**1.5E-05**	**6.0E-06**

DI = (Surface Water Conc. × CF × SA × PC × ET × EF × ED) / (BW × AT)

RME = Reasonable maximum exposure.
RAE = Representative average exposure
NTV = No toxicity value available.
NC = Not carcinogenic.

EXPOSURE ASSUMPTIONS

MAXIMUM	AVERAGE	
1.0E-03	1.0E-03	CF = CONVERSION FACTOR (L/1000 cm3)
22000	18000	SA = SKIN SURFACE AREA (cm^2/day).
1.0	0.5	ET = EXPOSURE TIME (hr/day)
350	350	EF = EXPOSURE FREQUENCY (days/year)
30	9	ED = EXPOSURE DURATION (years)
70	70	BW = BODY WEIGHT (kg)
10950	3285	AT = AVERAGING TIME (days)

TABLE B-45
FUTURE RESIDENTIAL EXPOSURE: CHILD
POTENTIAL INGESTION OF CHEMICALS IN GROUNDWATER
NONCARCINOGENIC RISK
REPUBLIC STEEL QUARRY
ELYRIA, OHIO

CHEMICAL	GROUNDWATER CONCENTRATION (mg/L)	DAILY INTAKE (DI) (mg/kg-day)		CHRONIC ORAL REFERENCE DOSE (mg/kg-day)	HAZARD QUOTIENT (DI/RfD)	
		RME	RAE		RME	RAE
Inorganics						
Antimony	0.0089	5.7E-04	4.0E-04	4.0E-04	1.42E+00	9.96E-01
Arsenic	0.0288	1.8E-03	1.3E-03	3.0E-04	6.14E+00	4.30E+00
Beryllium	0.0012	7.7E-05	5.4E-05	5.0E-03	1.53E-02	1.07E-02
Cadmium	0.0052	3.3E-04	2.3E-04	5.0E-04	6.65E-01	4.65E-01
Iron	568	3.6E+01	2.5E+01	3.0E-01	1.21E+02	8.47E+01
Manganese	7.87	5.0E-01	3.5E-01	4.7E-02	1.07E+01	7.49E+00
Thallium	0.0436	2.8E-03	2.0E-03	8.0E-05	3.48E+01	2.44E+01
				TOTAL HAZARD INDEX:	**1.7E+02**	**1.2E+02**

DI = (Groundwater Concentration × IR × EF × ED) / (BW × AT)

RME = Reasonable maximum exposure.
RAE = Representative average exposure.

EXPOSURE ASSUMPTIONS MAXIMUM	AVERAGE	
1	0.7	IR = INGESTION RATE (L/day)
350	350	EF = EXPOSURE FREQUENCY (days/year)
6	2	ED = EXPOSURE DURATION (years)
15	15	BW = BODY WEIGHT (kg)
2190	730	AT = AVERAGING TIME (days)

TABLE B-46
FUTURE RESIDENTIAL EXPOSURE: CHILD
POTENTIAL INGESTION OF CHEMICALS IN GROUNDWATER
CARCINOGENIC RISK
REPUBLIC STEEL QUARRY
ELYRIA, OHIO

CHEMICAL	GROUNDWATER CONCENTRATION (mg/L)	DAILY INTAKE (DI) (mg/kg-day)		CANCER SLOPE FACTOR CSF (mg/kg-day)-1	POTENTIAL CANCER RISK (DI x CSF)	
		RME	RAE		RME	RAE
Inorganics						
Antimony	0.0089	5.7E-04	4.0E-04	NC	0.00E+00	0.00E+00
Arsenic	0.0288	1.8E-03	1.3E-03	1.5E+00	2.76E-03	1.93E-03
Beryllium	0.0012	7.7E-05	5.4E-05	4.3E+00	3.30E-04	2.31E-04
Cadmium	0.0052	3.3E-04	2.3E-04	NC	0.00E+00	0.00E+00
Iron	568	3.6E+01	2.5E+01	NC	0.00E+00	0.00E+00
Manganese	7.87	5.0E-01	3.5E-01	NC	0.00E+00	0.00E+00
Thallium	0.0436	2.8E-03	2.0E-03	NC	0.00E+00	0.00E+00
				TOTAL HAZARD INDEX:	**3.1E-03**	**2.2E-03**

DI = (Groundwater Concentration × IR × EF × ED) / (BW × AT)

RME = Reasonable maximum exposure.

RAE = Representative average exposure.

EXPOSURE ASSUMPTIONS MAXIMUM	AVERAGE	
1	0.7	IR = INGESTION RATE (L/day)
350	350	EF = EXPOSURE FREQUENCY (days/year)
6	2	ED = EXPOSURE DURATION (years)
15	15	BW = BODY WEIGHT (kg)
2190	730	AT = AVERAGING TIME (days)

TABLE B-47
FUTURE RESIDENTIAL EXPOSURE: CHILD
POTENTIAL DERMAL ABSORPTION OF CHEMICALS IN GROUNDWATER
NONCARCINOGENIC RISK
REPUBLIC STEEL QUARRY
ELYRIA, OHIO

CHEMICAL	GROUNDWATER CONCENTRATION (mg/L)	PERMEABILITY COEFFICIENT (PC) (cm/hr)	DAILY INTAKE (DI) (mg/kg-day)		CHRONIC ORAL REFERENCE DOSE (RfDo) (mg/kg-day)	HAZARD QUOTIENT (DI/RfD)	
			RME	RAE		RME	RAE
Inorganics							
Antimony	0.0089	0.001	1.1E-06	6.2E-07	4.0E-04	2.67E-03	1.54E-03
Arsenic	0.0288	0.001	3.5E-06	2.0E-06	3.0E-04	1.15E-02	6.65E-03
Beryllium	0.0012	0.001	1.4E-07	8.3E-08	5.0E-03	2.88E-05	1.66E-05
Cadmium	0.0052	0.001	6.2E-07	3.6E-07	5.0E-04	1.25E-03	7.20E-04
Iron	568	0.001	6.8E-02	3.9E-02	3.0E-01	2.27E-01	1.31E-01
Manganese	7.87	0.001	9.4E-04	5.5E-04	4.7E-02	2.01E-02	1.16E-02
Thallium	0.0436	0.001	5.2E-06	3.0E-06	8.0E-05	6.53E-02	3.77E-02
					TOTAL HAZARD INDEX:	**3.3E-01**	**1.9E-01**

DI = (Surface Water Conc. × CF × SA × PC × ET × EF × ED) / (BW × AT)

RME = Reasonable maximum exposure.
RAE = Representative average exposure
NTV = No toxicity value available.

EXPOSURE ASSUMPTIONS

MAXIMUM	AVERAGE	
1.0E-03	1.0E-03	CF = CONVERSION FACTOR (L/1000 cm3)
7500	6500	SA = SKIN SURFACE AREA (cm^2/day).
0.3	0.2	ET = EXPOSURE TIME (hr/day)
350	350	EF = EXPOSURE FREQUENCY (days/year)
6	2	ED = EXPOSURE DURATION (years)
15	15	BW = BODY WEIGHT (kg)
2190	730	AT = AVERAGING TIME (days)

TABLE B-48
FUTURE RESIDENTIAL EXPOSURE: CHILD
POTENTIAL DERMAL ABSORPTION OF CHEMICALS IN GROUNDWATER
CARCINOGENIC RISK
REPUBLIC STEEL QUARRY
ELYRIA, OHIO

CHEMICAL	GROUNDWATER CONCENTRATION (mg/L)	PERMEABILITY COEFFICIENT (PC) (cm/hr)	DAILY INTAKE (DI) (mg/kg-day)		CANCER SLOPE FACTOR CSF (mg/kg-day)-1	POTENTIAL CANCER RISK (DI x CSF)	
			RME	RAE		RME	RAE
Inorganics							
Antimony	0.0089	0.001	1.1E-06	6.2E-07	NC	0.00E+00	0.00E+00
Arsenic	0.0288	0.001	3.5E-06	2.0E-06	1.5E+00	5.18E-06	2.99E-06
Beryllium	0.0012	0.001	1.4E-07	8.3E-08	4.3E+00	6.18E-07	3.57E-07
Cadmium	0.0052	0.001	6.2E-07	3.6E-07	NC	0.00E+00	0.00E+00
Iron	568	0.001	6.8E-02	3.9E-02	NC	0.00E+00	0.00E+00
Manganese	7.87	0.001	9.4E-04	5.5E-04	NC	0.00E+00	0.00E+00
Thallium	0.0436	0.001	5.2E-06	3.0E-06	NC	0.00E+00	0.00E+00
TOTAL HAZARD INDEX:						**5.8E-06**	**3.3E-06**

DI = (Surface Water Conc. × CF × SA × PC
× ET × EF × ED) / (BW × AT)

RME = Reasonable maximum exposure.
RAE = Representative average exposure
NTV = No toxicity value available.

EXPOSURE ASSUMPTIONS

MAXIMUM	AVERAGE	
1.0E-03	1.0E-03	CF = CONVERSION FACTOR (L/1000 cm3)
7500	6500	SA = SKIN SURFACE AREA (cm^2/day).
0.3	0.2	ET = EXPOSURE TIME (hr/day)
350	350	EF = EXPOSURE FREQUENCY (days/year)
6	2	ED = EXPOSURE DURATION (years)
15	15	BW = BODY WEIGHT (kg)
2190	730	AT = AVERAGING TIME (days)

Appendix C

APPENDIX C

COMPARISONS TO ECOLOGICAL SCREENING BENCHMARKS

Table C-1

Comparison of Soil Concentrations to Soil Screening Benchmarks -- Semivolatile Organic Compounds
RSQ Site
Elyria, Ohio

EPA Sample No.:	EXX27	EXX28RE	EXX29	EXX30	EXX31	EXX32RE	EXX54RE	EXX55RE	Site-Specific Background		ORNL Preliminary Remediation Goals		
Sample I.D.:	SS-101MSD	SS-102	SS-103	SS-104	SS-105	SS-106	SS-107	SS-108					
Matrix:	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil					
Sample Date:	11/16/96	11/16/96	11/16/96	11/16/96	11/16/96	11/16/96	11/16/96	11/16/96	Minimum	Maximum	Plant	Earthworm	Soil Microorganisms
Sample Location:	Ditch -S	Ditch-N	Ramp	Ramp	Ditch-S	Ditch-N	Ramp	Ramp					
Sample Depth:	0-8"	0-8"	0-8"	0-8"	12"	12"	12"	12"					
Units:	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg
PARAMETER													
Naphthalene	24 J	26 J	390 U	380 U	36 J	44 J	400 U	390 U	26	210	--	--	--
2-Methylnaphthalene*	63 J	45 J	390 U	380 U	71 J	76 J	400 U	26 J	36	280	--	--	--
Dibenzofuran	400 U	20 J	390 U	380 U	22 J	28 J	400 U	390 U	44	65	--	--	--
Pentachlorophenol	230 J	350 J	950 UJ	930 UJ	120 J	250 J	980 U	940 U	--	--	3,000	4,000	50,000
Phenanthrene*	31 J	84 J	390 U	380 U	42 J	120 J	400 U	390 U	31	180	--	--	--
Anthracene	400 U	380 UJ	390 U	380 U	420 U	*120 J*	400 U	390 U	--	24	--	--	--
Fluoranthene	34 J	78 J	390 U	380 U	50 J	400 U	400 U	390 U	34	190	--	--	--
Pyrene	400 U	120 J	390 U	380 U	67 J	R	400 UJ	390 UJ	28	210	--	--	--
Benzo(a)anthracene	48 J	*250 J*	390 U	380 U	52 J	R	400 UJ	390 UJ	35	100	--	--	--
Chrysene	63 J	*300 J*	390 U	380 U	77 J	R	400 UJ	390 UJ	28	130	--	--	--
Indeno(1,2,3-cd)pyrene	34 J	*180 J*	390 U	380 U	58 J	*280 J*	400 UJ	390 UJ	61	70	--	--	--
*Benzo(g,h,i)perylene**	30 J	*180 J*	390 U	380 U	*49 J*	*260 J*	400 UJ	390 UJ	--	48	--	--	--

Screening Benchmark Sources: Will and Suter, 1995a; 1995b.
ORNL - Oak Ridge National Lab.
Italics indicates constituent exceeded background.

Table C-2

Comparison of Soil Concentrations to Soil Screening Benchmarks -- Inorganic Compounds
Republic Steel Quarry
Elyria, Ohio

EPA Sample No.:	MEXG81	MEXG82	MEXG94	MEXG83	MEXG84	MEXG85	MEXG86	MEXG87	Background			Screening Benchmark		
Sample I.D.:	SS-102	SS-103	SS-115	SS-104	SS-105	SS-106	SS-107	SS-108	Minimum	Maximum	2x Average	Plant	Earthworm	Soil Microorganisms
Matrix:	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil						
Sample Location:	Ditch -S	Ditch-N	Ramp	Ramp	Ditch-S	Ditch-N	Ramp	Ramp						
Sample Depth:	0-8"	0-8"	Dup of 103	0-8"	12"	12"	12"	12"						
Sample Date:	11/16/96	11/16/96	11/16/96	11/16/96	11/16/96	11/16/96	11/16/96	11/16/96						
Units:	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg			mg/kg		
PARAMETER														
Aluminum	741	1,530	1,460	1,170	658	1,360	1,660	1,220	2,420	12,600	15,870	50	--	600
Antimony	*2.8*	1.2 U	1.4	1.1 U	2.2	*3.0*	1.7	1.2 U	1.3	2.6	2.42	5	--	--
Arsenic	11.6 J	16.2 J	14.6 J	6.8 J	8.8 J	13.8 J	15.2 J	7.8 J	8.5	29.1	27.5	10	60	100
Barium	45.0	6.5	6.3	4.4	32.2	53.3	6.5	5.0	18.6	105	122	500	--	3000
Cadmium	1.3	0.45	0.43	0.23 U	1.2	1.4	0.55	0.31	0.62	0.94	1.62	3	20	20
Calcium	467	633	754	578	1,130	446	601	744	1,080	3,220	4,050	--	--	--
Chromium (total)	11.4	12.7	13.2	5.7	8.9	15.6	18.4	9.7	6	17.1	22.8	1	0.4	10
Cobalt	2.0	3.4	2.9	4.1	2.0	3.9	3.2	3.3	3.7	15.6	17.6	20	--	1000
Copper	19.1	30.2	27.6	16.8	*34.7*	24.4	*45.8*	31.2	10.8	21.7	32.4	100	50	100
Iron	91,800	28,300	25,000	7,730	82,900	107,000	29,600	10,900	13,100	26,300	39,533	--	--	200
Lead	33.5	18.7	16.2	8.2	22.7	38.6	22.3	15.2	22.3	118	99.7	50	500	900
Magnesium	154	480	470	518	255	241	491	551	618	2,430	3,299	--	--	--
Manganese	209	69.3	61.5	87.6	145	376	72.7	83.2	110	964	971	500	--	100
Mercury	0.12 U	0.12 U	0.14	0.11 U	0.24	0.12	0.12 U	0.12 U	ND	ND	ND	0.3	0.1	30
Nickel	2.1	8.2	8.0	9.7	1.7	5.2	8.4	9.0	9.9	17.9	26.3	30	200	90
Potassium	2,160	373	374	338	1,690	2,000	407	327	479	978	1,431	--	--	--
Selenium	3.5	1.2 U	1.2 U	1.1 U	3.2	4.1	1.2 U	1.2 U	1.4	1.7	2.88	1	70	100
Sodium	390	188	204	182	400	360	171	173	217	164	469	--	--	--
Thallium	1.2 U	1.2 U	1.2 U	1.1 U	1.2 U	1.9	1.2 U	1.2 U	ND	ND	ND	1	--	--
Vanadium	10.0	5.8	5.7	4.6	9.9	12.8	6.3	4.8	8.7	25.8	37.4	2	--	1
Zinc	14.7	25.4	22.1	24.6	20.6	18.1	27.4	30.6	49.6	178	171	50	200	100
Cyanide	0.30 J	0.28 J	0.15 J	0.12 J	0.44 J	0.36 J	0.19 J	0.12 UJ	0.14	0.41	0.533	--	--	--

Italics indicates constituent exceeded background only.
Shading indicates constituent exceeded background and all available PRGs.
Underline indicates constituent exceeded earthworm PRG.
Screening Benchmark Sources: Will and Suter, 1995a; 1995b.
ORNL - Oak Ridge National Lab.

Table C-3

Comparison of Surface Water Concentrations of Water Quality Criteria: Quarry
RSQ Site
Elyria, Ohio

EPA Sample No.:	MEXJ13	MEXJ14	MEXJ15	MEXJ16	MEXJ17	MEXJ29	MEXJ18	MEXJ19	MEXJ20				U.S. EPA	
Sample I.D.:	SW-201MSD	SW-202	SW-203	SW-204	SW-205	SW-217	SW-206	SW-207	SW-208	Groundwater	Ohio		Ambient	
Matrix:	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Background	Water Quality Standards		Water Quality Criteria	
LOCATION:	Upstream UF	Upstream F	Downstrea UF	Downstrea F	0 ft UF	DUP OF 205	0 ft F	17 ft UF	17 ft F		30-Day			
Sample Date:	11/12/96	11/12/96	11/12/96	11/12/96	11/12/96	11/12/96	11/12/96	11/12/96	11/12/96		Average	Maximum	Acute	Chronic
Units:	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L		µg/L	
Inorganics														
Barium	29.5	29.3	41.5	43.4	28.8	27.6	29.9	28.6	27.9	33.9 - 46.8			110*	4.0*
Calcium	55,300	56,400	210,000	220,000	54,900	53,600	56,600	54,500	53,100	125,000 - 167,000			--	116,000#
Chromium	3.4 U	3.4 U	3.4 U	3.4 J	3.4 U	3.4 U	3.4 U	3.4 U	3.4 U	<1 - 1.3	210	1800	16 (VI)	11 (VI)
Cobalt	3.1 U	3.1 U	47.2	50.7	3.1 U	3.1 U	3.1 U	3.1 U	3.1 U	ND			1,500*	23*
Copper	3.0 U	3.0 U	299	292	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	ND	60.8+	121.7+	60.8+	121.7+
Iron	136 U	24.9 U	800,000	647,000	166 U	109 U	40.5 U	130 U	26.7 U	27.1 - 215	1000	--	--	1,000
Lead	0.80 UJ	2.4 J	0.80 UJ	0.80 UJ	0.80 UJ	0.80 UJ	0.8 UJ	0.80 UJ	0.80 UJ	ND	629.5+	1259.4+	630+	1,259+
Magnesium	14,800	15,100	59,000	61,700	14,700	14,300	15,000	14,600	14,100	63,000 - 64,400			--	82,000#
Manganese	179	147	12,300	12,800	182	177	151	176	138	135 - 312			2,300*	120*
Potassium	3,030	3,480	5,040	5,350	3,450	3,140	3,200	3,490	3,460	3,220 - 3,740			--	53,000#
Silver	3.4 U	3.4 U	280	272	3.4 U	3.4 U	3.4 U	3.4 U	3.4 U	ND	1.3	1.6	4.1+	0.36*
Sodium	47,600 J	48,300 J	40,500 J	42,100 J	47,000 J	46,000 J	48,200 J	46,500 J	45,000 J	50,500 - 52,600			--	680,000#
Vanadium	6.0 U	6.0 U	34.1	37.5	6.0 U	6.0 U	6.0 U	6.0 U	6.0 U	ND			280*	20*
Cyanide	1.7 UJ	NA	1.5 J	NA	1.7 UJ	1.7 UJ	NA	1.7 UJ	NA	21 - 2.6	12	46	22	5.2
Other Parameters														
Oil and Grease	3,600	--	5,800	--	9,000	6,700	--	4,900	--	--		10,000	--	--
Total Suspended Solids in Water (mg TSS/L)	5 U	--	192	--	5 U	5 U	--	5 U	--	--	--	--	--	--
Total Dissolved Solids in Water (mg TDS/L)	1,100	--		--	402	390	--	408	--	--	1,500	--	--	--
Acidity in Water (mg $CaCO_3$/L)	-118	--	-1,370	--	-110	-110	--	-110	--	--	--	--	--	--
Total Alkalinity in Water (mg $CaCo_3$/L)	114	--	147	--	118	109	--	118	--	--	--	--	--	--
Chloride in Water (mg Cl^-/L)	85	--	38	--	83	84	--	85	--	--	--	--	--	--
Sulfate in Water (mg $SO4^{2-}$)	103	--	2,090	--	106	104	--	104	--	--	--	--	--	--

Shaded value indicates criteria was exceeded.
UF - Unfiltered.
F - Filtered.
* Tier II value (Suter and Tsao, 1996).
\+ Hardness dependent criteria; see Table 6-x.
\# Lowest chronic value (Suter and Tsao, 1996).

Table C-4

Comparison of Surface Water Concentrations to Water Quality Criteria: Quarry Outfall
RSQ Site
Elyria, Ohio

Sample I.D.:	SW-211	SW-212	Background	Ohio		Ambient	
Matrix:	Surface Water	Surface Water	(Based on	Water Quality Standards		Water Quality Criteria	
LOCATION:	Outfall UF	Outfall F	Groundwater)	30-day			
Sample Date:	Upstream	Upstream	Downstream	Average	Downstream	Acute	Chronic
Units:	µg/L	µg/L	µg/L	µg/L		µg/L	
Inorganics							
Barium	31.9	28.4	33.9 - 46.8	--	--	110*	4.0*
Calcium	56,200	55,400	125,000 - 167,000	--	--	116,000#	--
Magnesium	14,900	14,800	63,000 - 64,400	--	--	82,000#	--
Manganese	152	123	135 - 312	--	--	2,300*	120*
Potassium	3,160	3,080	3,220 - 3,740	--	--	53,000#	--
Sodium	47,600 J	47,500 J	50,500 - 52,600	--	--	680,000#	--
Other Parameters							
Oil and Grease	5,100	--	--	–	10,000.00	--	--
Total Suspended Solids in Water (mg TSS/L)	5 U	--	--	--	--	--	--
Total Dissolved Solids in Water (mg TDS/L)	400	--	--	1,500.00	--	--	--
Acidity in Water (mg $CaCO_3$/L)	-108	--	--	--	--	--	--
Total Alkalinity in Water (mg $CaCO_3$/L)	95	--	--	--	--	--	--
Chloride in Water (mg Cl^-/L)	85	--	--	--	--	--	--
Sulfate in Water (mg $SO4^{2-}$)	104	--	--	–	--	--	--

Shaded value indicates criteria was exceeded.
UF - Unfiltered.
F - Filtered.
* Tier II value (Suter and Tsao, 1996).
# Lowest chronic value (Suter and Tsao, 1996).

Table C-5

Comparison of Surface Water Concentrations of Water Quality Criteria: Black River
RSQ Site
Elyria, Ohio

EPA Sample No.:	MEXJ21	MEXJ22	MEXJ25	MEXJ26	Ohio Water Quality Standards		U.S. EPA Ambient Water Quality Criteria	
Sample I.D.:	SW-209	SW-210	SW-213	SW-214				
Matrix:	Surface Water	Surface Water	Surface Water	Surface Water				
LOCATION:	Upstream UF	Upstream F	Downstream UF	Downstream F	30-day Average	Maximum	Acute	Chronic
Sample Date:	11/12/96	11/12/96	11/12/96	11/12/96				
Units:	µg/L	µg/L	µg/L	µg/L	µg/L		µg/L	
Organics								
Diethylphthalate	0.9	--	10 U	--	120	2,600	210*	800*
Inorganics								
Aluminum	1,030	70.8	1,180	62.2	--	--	750	87
Barium	27.7	22.9	30.6	22.8	--	--	110*	4.0*
Calcium	39,200	41,100	41,900	40,400	--	--	116,000#	--
Copper	5.4	3.5	5.0	3.0 U	26.1+	52.3+	26.1+	52.3+
Iron	1,470	187 U	1,590	219	1,000	--	--	1,000
Lead	1.2 J	0.80 UJ	1.3 J	0.80 UJ	216+	432+	216+	432+
Magnesium	10,700	11,000	11,600	11,000	--	--	82,000#	--
Manganese	35.3	21.2	37.3	22.9	--	--	2,300*	120*
Potassium	3,690	4,010	3,860	3,500	--	--	53,000#	--
Sodium	9,310 J	9,800 J	10,100 J	9,860 J	--	--	680,000#	--
Cyanide	2.1 J	NA	1.2 J	NA	12	46	22	5.2
Other Parameters								
Oil and Grease	7,900	--	4,200	--	--	10,000	--	--
Total Suspended Solids in Water (mg TSS/L)	25.5	--	10.3	--	--	--	--	--
Total Dissolved Solids in Water (mg TDS/L)	264	--	258	--	1,500	--	--	--
Acidity in Water (mg $CaCO_3$/L)	-98	--	-96	--	--	--	--	--
Total Alkalinity in Water (mg $CaCO_3$/L)	95	--	104	--	--	--	--	--
Chloride in Water (mg Cl^-/L)	20	--	20	--	--	--	--	--
Sulfate in Water (mg $SO4^{2-}$)	52		49	--	--	--	--	--

Shaded value indicates criteria was exceeded.
UF - Unfiltered.
F - Filtered.
* Tier II value (Suter and Tsao, 1996).
+ Hardness dependent criteria; see Table 6-x.
# Lowest chronic value (Suter and Tsao, 1996).

Table C-6

Calculation of Hardness- Dependent Water Quality Criteria
RSQ Site
Elyria, Ohio

	Quarry-total		River-total	
	Hardness	339.4	Hardness	147.1
	ln (hardness)	5.83	ln (hardness)	4.99
Hardness-dependent Criteria	Avg	Max	Avg	Max
Copper (total)	61	122	26	52
Chromium (total)	4,907	9,813	2,475	4,949
Lead (total)	629	1,259	216	432
Silver (total)	--	13	--	3
Zinc (total)	57	62	28	31

Table C-7

Comparison of Sediment Concentrations to Sediment Benchmarks -- Volatile Organic Compounds
RSQ Site
Elyria, Ohio

EPA Sample No.:	EXX18	EXX19	EXX20	EXX21	EXX22	EXX25	EXX23	EXX24	OSWER EcoTox Threshold	ORNL Sediment PRG
Sample I.D.:	SD-101MSD	SD-102	SD-103	SD-104	SD-105	SD-108	SD-106	SD-107		
Matrix:	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment		
Location:	Center East	Southeast	Southwest	Center West	North	Dup of 105	Far North	Outfall		
Sample Date:	11/13/96	11/13/96	11/13/96	11/13/96	11/13/96	11/13/96	11/13/96	11/13/96		
Units:	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg
PARAMETER										
Methylene Chloride	13 J	41 J	5 J	28 J	58 J	48 J	37 J	6 J	--	18,000
Acetone	230 J	920 J	300 J	2,800 J	1,300 J	1,400 J	910 J	38 J	--	9.10
Carbon Disulfide	45 U	77 U	40 U	16 J	150 U	26 J	22 J	18 U	--	0.86
2-Butanone	62	280	91	830	440	530 J	300 J	7 J	--	270
Benzene	45 UJ	77 U	40 U	140 U	150 U	16 J	8 J	18 U	57	160
Tetrachloroethene	45 UJ	77 UJ	40 UJ	140 U	150 UJ	34 J	48 J	18 U	530	3,200
Toluene	45 UJ	9 J	40 UJ	140 U	150 UJ	10 J	73 J	18 U	670	50
Ethylbenzene	45 UJ	77 UJ	40 UJ	140 U	150 UJ	R	17 J	18 U	3,600	5,400
Xylene (total)	45 UJ	77 UJ	40 UJ	140 U	150 UJ	R	70 J	18 U	25	160

No criteria were available for these compounds from OMOE, and NOAA.
Shading indicates criteria was exceeded.
PRG - Preliminary remediation goal.

Table C-8

Comparison to Sediment Concentration to Screening Benchmarks -- Semivolatile Organic Compounds
RSQ Site
Elyria, Ohio

EPA Sample No.:	EXX18	EXX19	EXX20	EXX21	EXX22	EXX23	EXX24	EXX25	OMOE Effect Guideline		NOAA Effects Level		OSWER EcoTox Threshold	ORNL Sediment PRG
Sample I.D.:	SD-101MSD	SS-102	SS-103	SS-104	SS-105	SS-106	SS-107	SS-108						
Matrix:	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment						
Location:	Center East	Southeast	Southwest	Center West	North	Far North	Outfall	Dup of 105						
Sample Date:	11/13/96	11/13/96	11/13/96	11/13/96	11/13/96	11/13/96	11/13/96	11/13/96	Low	Severe	ER-L	ER-M		
Units:	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg
PARAMETER														
1,3-Dichlorobenzene	1,500 U	2,500 U	1300 U	4,700 U	160 J	1,900 U	610 U	2,800 U	--	--	--	--	1700	1700
1,4-Dichlorobenzene	1,500 U	200 J	1300 U	4,700 U	2,500 U	1,900 U	610 U	2,800 U	--	--	--	--	350	350
4-Methylphenol	1,500 U	2,500 U	1300 U	4,700 U	2,500 U	390 J	610 U	2,800 U	--	--	--	--	--	--
1,2,4-Trichlorobenzene	1,500 U	170 J	1300 U	4,700 U	2,500 UJ	1,900 UJ	610 U	2,800 U	--	--	--	--	9200	9700
Naphthalene	1,500 U	2,500 U	94 J	4,700 U	2,500 UJ	240 J	610 U	2,800 U	--	--	160	2100		390
4-Chloro-3-methylphenol	1,500 U	280 J	1,300 U	4,700 U	2,500 UJ	1,900 UJ	610 U	2,800 U	--	--	--	--	--	--
2-Methylnaphthalene	1,500 U	2,500 U	130 J	4,700 U	2,500 UJ	600 J	610 U	2,800 U	--	--	70	670	--	--
Acenaphthene	1,500 UJ	230 J	1,300 UJ	4,700 UJ	2,500 UJ	1,900 UJ	610 U	2,800 UJ	--	--	16	500	620	89
Fluorene	570 J	150 J	1,300 UJ	730 J	1,500 J	1,900 J	610 U	1,000 J	--	--	19	540	--	140
Phenanthrene	R	300 J	360 J	1,200 J	1,800 J	10,000 J	44 J	1,300 J	--	--	240	1500	--	540
Anthracene	R	170 J	160 J	1,800 J	2,600 J	1,900 UJ	610 U	1,500 J	--	--	85.3	1100	--	250
Di-n-butylphthalate	R	2,500 U	1,300 UJ	4,700 UJ	R	3,500 J	610 U	2,800 UJ	--	--	--	--	11000	240000
Fluoranthene	1,800 J	460 J	510 J	1,800 J	3,400 J	3,200 J	70 J	1,700 J	--	--	600	5100	2900	1500
Pyrene	2,400 J	1,300 J	1,300 J	3,800 J	4,600 J	5,500 J	1,000 J	4,200 J	--	--	665	2800	660	1400
Butylbenzylphthalate	R	R	R	R	R	R	42 J	R	--	--	--	--	11000	--
Benzo(a)anthracene	1,300 J	330 J	400 J	R	2,500 J	3,000 J	33 J	R	--	--	261	1600	--	690
Chrysene	2,100 J	510 J	700 J	2,200 J	3,200 J	3,800 J	61 J	1,900 J	--	--	384	2800	--	850
bis(2-Ethylhexyl)phthalate	1,700 J	R	R	R	R	R	610 U	R	--	--	--	--	--	2700
Di-n-octylphthalate	R	R	960 J	R	R	R	610 UJ	R	--	--	--	--	--	--
Benzo(b)fluoranthene	R	R	R	1,200 J	R	R	110 J	R	--	--	--	--	--	--
Benzo(k)fluoranthene	R	R	R	1,400 J	R	R	610 UJ	R	--	--	--	--	--	--
Benzo(a)pyrene	R	380 J	650 J	R	R	R	56 J	R	--	--	430	1600	430	760
Indeno(1,2,3-cd)pyrene	710 J	R	800 J	1,100 J	710 J	760 J	610 UJ	1,400 J	--	--	--	--	--	--
Dibenz(a,h)anthracene	410 J	R	R	R	R	R	610 UJ	R	--	--	63.4	260		140
Benzo(g,h,i)perylene	860 J	470 J	770 J	1,100 J	1,100 J	800 J	610 UJ	1,400 J	--	--	--	--	--	--
Total PAH	10,150	4,300	7,044	16,300	21,410	29,800	1,374	14,400	2,000	110,000	4,022	44,792	--	--

Shading indicates at least one benchmark was exceeded.

Table C-9

Comparison of Sediment Concentrations to Screening Benchmarks -- Pesticides
Republic Steel Quarry
Elyria, Ohio

EPA Sample No.:	EXX18	EXX19	EXX20	EXX21	EXX22	EXX25	EXX23	EXX24	Ontario Sediment Guideline		NOAA Effect Range		U.S. EPA EcoTox Threshold	ORNL PRG
Sample I.D.:	SD-101MSD	SD-102	SD-103	SD-104	SD-105	SD-108	SD-106	SD-107						
Matrix:	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment						
Location:	Center East	Southeast	Southwest	Center West	North	Dup of 105	Far North	Outfall						
Sample Date:	11/13/96	11/13/96	11/13/96	11/13/96	11/13/96	11/13/96	11/13/96	11/13/96	Low	Severe	ER-L	ER-M		
Units:	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg
PARAMETER														
Heptachlor	7.7 UJ	13 U	6.8 U	24 U	29 J	19 J	R	3.2 U	--	--	--	--	--	13,000
Aldrin	7.7 UJ	21	6.8 U	24 U	13 U	14 U	69 J	3.2 U	2	80	--	--	--	80
4,4'-DDT	15 U	25 U	14 J	47 U	25 U	28 U	R	6.1 U	7	120	1.58	46.1	--	42
alpha-Chlordane	7.7 U	13 U	7.6 J	24 U	19 J	14 U	75 J	3.2 U	7*	60*	0.5	6	--	4.8*
gamma-Chlordane	7.7 U	13 U	6.8 U	24 U	34 J	14 U	R	3.2 U	7*	60*	0.5	6	--	4.8*

Shaded value indicates at least one screening benchmark was exceeded.
* Value is for total chlordane.

Table C-10

Comparison of Sediment Concentrations to Screening Benchmarks -- Inorganic Compounds
RSQ Site
Elyria, Ohio

EPA Sample No.:	MEXG71	MEXG72	MEXG73	MEXG74	MEXG75	MEXG78	MEXG76	MEXG77	OMOE Effect Guideline		NOAA Effects Level		EPA EcoTox Threshold	ORNL Sediment PRG
Sample I.D.:	SD-101MSD	SD-102	SD-103	SD-104	SD-105	SD-108	SD-106	SD-107						
Matrix:	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment						
Location:	CE	SW	SW	CW	North	Dup of 105	Far north	Outfall						
Sample Date:	11/13/96	11/13/96	11/13/96	11/13/96	11/13/96	11/13/96	11/13/96	11/13/96	LEL	SEL	ER-L	ER-M		
Units:	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
PARAMETER														
Aluminum	14,700 EJ	30,300 EJ	11,100 EJ	21,600 EJ	9,160 EJ	12,700 EJ	12,200 EJ	6,400 EJ	--	--	--	--		--
Arsenic	24.0	43.9	12.4	26.9	4.6 U	4.7 U	16.7	7.2	6	33	8.2	70	8.2	42
Barium	125 B	109 B	62.5 B	73.8 B	56.8 B	84.3 B	129 B	54.5 B	--	--	--	--	--	--
Beryllium	0.35 U	0.56 U	0.18 U	0.88 B	0.50 U	0.50 U	0.34 U	0.11 U	--	--	--	--	--	--
Cadmium	1.5 B	1.6 B	1.4 B	1.3 B	0.66 U	0.94 B	0.64 B	0.58 B	0.6	10	1.2	9.6	1.2	4.2
Calcium	4,320 B	10,900	19,900	9,240	4,110 B	6,260 B	4,280 B	6,610	--	--	--	--	--	--
Chromium	45.9	117	28.2	58.2	26.7	39.8	27.5	12.9	26	110	81	370	81	160
Cobalt	12.4 B	18.6 B	11.3 B	13.6 B	8.5 B	23.3 B	2.6 U	8.2 B	--	--	--	--	--	--
Copper	126	161	83.2	164	58.4	75.5	333	24.5	16	110	34	270	34	110
Iron	58,700 EJ	214,000 EJ	56,100 EJ	87,500 EJ	58.700 EJ	116,000 EJ	35,500 EJ	27,200 EJ	2%	4%	--	--	--	--
Lead	52.4	192	75.7	73.3	33.4	46.0	96.8	24.5	31	250	46.7	218	47	110
Magnesium	3,380 B	4,920 B	7,420	6,480 B	2,430 B	3,430 B	1,860 B	3,480	--	--	--	--	--	--
Manganese	417 EJ	3,470 EJ	1,840 EJ	588 EJ	784 EJ	1,480 EJ	170 EJ	808 EJ	460	1110	--	--	--	--
Mercury	0.34 B	0.42 U	0.72	0.49 U	0.61 B	0.62 B	0.44 B	0.10 U	0.2	2	0.15	0.71	0.15	0.7
Nickel	56.8	84.1	22.6 B	75.9	47.2 B	80.2	8.9 B	19.4	16	75	20.9	51.6	21	43
Potassium	2,730 B	2,090 B	2,040 B	3,210 B	1,480 B	2,210 B	3,960 B	1,150 B	--	--	--	--	--	--
Selenium	4.8 BNJ	6.0 BNJ	1.9 NJU	5.6 NJU	5.1 NJU	5.2 NJU	3.6 NJU	1.2 NJU	--	--	--	--	--	0.005 mg/L
Sodium	610 B	969 B	449 B	1,420 B	511 U	953 B	940 B	177 BJ	--	--	--	--	--	--
Thallium	4.1 U	10.5 BJ	4.0 BJ	6.5 U	6.0 U	6.0 U	4.1 U	1.4 U	--	--	--	--	--	0.012 mg/L
Vanadium	29.6 B	50.5 B	27.4 B	41.9 B	18.4 B	26.6 B	33.3 B	15.0 B	--	--	--	--	--	--
Zinc	163 EJ	371 EJ	216 EJ	234 EJ	123 EJ	170 EJ	41.1 EJ	139 EJ	120	820	150	410	150	270

Appendix D

APPENDIX D

YELLOW SUBSTANCE IN WELL B-4

WESTON MANAGERS DESIGNERS CONSULTANTS

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Vernon Hills, Illinois 60061-1450
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12 March 1997

Ms. Sheila A. Sullivan
Work Assignment Manager
U.S. Environmental Protection Agency, SR-6J
77 West Jackson Boulevard
Chicago, Illinois 60604-3590

EPA Contract No.: 68-W8-0089
Work Assignment No.: 86-5WE/RSQ Site
Document Control No.: 4500-86-ANVJ

Subject: Yellow Substance in Well B-4

Dear Ms. Sullivan:

WESTON has considered the conditions at Monitoring Well B-4 at the Republic Steel Quarry (RSQ) Site and offers the following suggested approach for your consideration.

BACKGROUND

As you recall, Monitoring Well B-4 at the RSQ Site was not sampled during the recent field work at the site in November 1996. Sampling was precluded because of an unknown, gelatinous yellow substance inside the well's protective casing, and inside and outside of the well's riser pipe. The substance is odorless, or at least odorless at arm's length. Photoionization detectors do not register any elevated readings near the substance. In February 1997, WESTON briefly visited Monitoring Well B-4 and confirmed that the yellow substance is still present. (Photo 1 from February visit attached.)

TENTATIVE INFERENCES

WESTON has formed the following tentative inferences about the yellow substance:

(1) The yellow substance probably bioligical.

Literature research and discussions with microbiologists have disclosed the existence of various biological materials with properties resembling the yellow substance in Well B-4. Yellow slime mold, for example, is known to appear from time to time as a yellow gelatinous substance. (See literature, attached.)

(2) The yellow substance probably does not indicate site-related contamination.

If the biological theory holds true, then the presence of the yellow substance does not necessarily indicate contamination. Yellow slime mold, as one example, can thrive in clean but moist environments, and is found with some regularity in garden hoses, for example. Further, it is worth noting that the RI report classified the well as a background well, and the RI analytical work found nothing remarkable about the well's chemical composition and nothing indicating contamination. (See RI data, attached.) Of all the groundwater monitoring wells at the RSQ Site, B-4 is the most distant from the quarry, lying over 250 feet west of the quarry pond.

(3) The yellow substance is probably not a foreign substance introduced by vandals.

Although the site security as a whole is poor, the individual protective casings at the RSQ Site are locked with padlocks. The field team was thoroughly debriefed on the condition of Well B-4 in November 1996, and the team members clearly recall that the well was secured with a rusty padlock, which the team had to cut off to gain access to the well. In fact, during the site visit in October 1996, WESTON photographed Well B-4 with its padlock intact. See Photo 2, attached. There is no reason to believe that the well was tampered with during the 6 years between the RI field work and the arrival of the WESTON field crew. You may note, however, that the well does show some signs of damage by impact. Note the bent bumper post and cracked concrete near the well's protective casing. Perhaps the damage to the aboveground structures is related to the presence of the yellow substance.

SUGGESTED APPROACH

To learn the true identity of the yellow substance, WESTON recommends a two-track approach: one track biological, and one track chemical. That way, whether the material is biological or not, we will have a good database for understanding it.

Recommended Biological Examination

Write a description of the intended biological studies as an amendment to the existing QAPP and SAP, but do not carry the description to the level of detail used in a SAS request. (See recommendations on DQOs, below.)

Secure the subcontracting services of a consulting mycologist (biologist specializing in fungi). We are aware of at least one consulting mycologist engaged in such examinations on a routine basis.

Collect a 100 mL sample of the yellow substance in a sterile container. Collect 1 L of water from the well. Measure the temperatures of the air and water in the well. Ship the sample of the yellow substance overnight at 4˚C in a cooler to the mycologist. Examine the substance under sterile conditions. Subject the substance to microscopic examination using various biological stains. If the material is not biological, stop work on the biological track.

If the material is biological, continue. Subculture the substance on various agars, using water from the well. Make five subcultures on each medium type, and incubate two at room temperature and three at the well's temperature. Examine the cultures daily for growth. If more than one organism is present in a culture plate, subculture it in a new clean plate. Identify all fungi or bacteria to species. Identify yeast as "yeast."

Recommended Chemical Examination

Write a description of the intended chemical studies as an amendment to the existing QAPP and SAP, but do not carry the description to the level of detail used in a SAS request (see recommendations on DQOs below).

Secure the subcontracting services of a water chemistry laboratory.

Collect a sample of the yellow substance in a sterile container. Ship the substance overnight to the chemistry laboratory.

Test the solubility of the substance in ultra-pure water and reagent-grade hexane. If the foreign substance is soluble in either, subject the solvent-substance mixture to IR or GC analysis. Report the identities of hydrocarbons in the substance.

Recommended Report

After the biological and chemical analyses are complete, WESTON recommends evaluating the results, and attempting to identify the yellow substance.

Recommendations on DQOs

Because the material is poorly understood, it is not possible or even desirable to specify the apparent optimal analytical approaches as exactly as we are accustomed to doing with dilute aqueous samples. We believe that the data quality and economy of effort require granting more latitude to the laboratories examining the substance.

We recommend that the samples be considered what used to be called "Engineering" level data, or DQO Level III. The low level of DQO is justified because the data is only expected to confirm that the yellow substance is not site related. The data is not expected to become part of the site characterization. In the unlikely event that the yellow substance is related to the site, a detailed SAS request would be much easier to write for follow-up work once the nature of the contaminant is understood.

Recommendations on Schedule

We recommend acting quickly, to return to the field at Well B-4, as both observations of the yellow substance took place during cool weather. If the yellow substance prefers cool growing conditions, warm weather might make the substance diminish or disappear. Accordingly, we recommend resampling in April, or May at the latest.

Observations on Health and Safety

Given that the well was sampled and confirmed to be background in 1989, that the well gas does not register on a PID, and that the growth is probably biological, Level D protection should be adequate for protection of the sampling crew.

RECOMMENDED ACTION

WESTON recommends that U.S. EPA formally direct the collection and examination of the yellow substance as described. If the examination confirmed that the yellow substance were harmless and biological, WESTON recommends no further action. If the examination disclosed that the yellow substance were a site-related contaminant, WESTON would then recommend scoping a more thorough follow-up sampling and analysis tailored to the suspected contaminant.

Very truly yours,

ROY F. WESTON, INC.

Robert H. Gilbertsen, P.E.
Site Manager

Dean F. Geers
Program Manager

RHG:DFG:pw
Attachments: Photos of Well B-4, February 1997 and October 1996
Literature discussing yellow slime mold
RI analytical data for Well B-4

PHOTO #1: WELL B-4 FILLED WITH YELLOW SUBSTANCE, FEBRUARY 1997.

PHOTO #2: WELL B-4 SECURELY PADLOCKED, OCTOBER 1996.

Plant & Pest Diagnostic Laboratory

P&PDL Home Page | Ask Our Experts | Purdue Ag Servers | Purdue Home Page

Slime Mold

The following question was sent to the P&PDL diagnosticians here at Purdue University:

Q: Help! What is this yellow goopy, fast growing mold like stuff growing around my home and on the mulch in my garden? My neighbor has it too. We have even found it in the soil next to the foundation. Do I need to be concerned? How do I get rid of it? Could it be contributing to my recent development of allergies? Hope you can help! Thanks so much.

A: What you are likely observing is a type of fungus, called a slime mold. These fungi live on

dead organic matter, such as wood mulch. The slime mold is yellow-tan in color and has no definite shape. Although slime molds may grow on plants, they do not harm plants. They thrive in moist conditions, therefore, they may be appearing now as a result of recent watering. Slime molds will eventually disappear on their own. If you want to speed this process, rake the mulch to promote air drying.

As to your allergies, I do not know whether the slime molds are causing your problem. There are a number of plants that are pollinating now that could be causing your allergies; however, you could also be allergic to something in your home. It is best to consult with a physician concerning your allergies. You might want to consider having someone else rake your mulch.

(Photo of slime mold courtesy of George Knaphus at Iowa State University.)

-- Peggy Sellers, Director of the Plant and Pest Diagnostic Laboratory

COOPERATIVE EXTENSION SERVICE Mississippi State University

Department of Entomology and Plant Pathology

Slime Molds - No Danger
To Your Plants

County Extension Offices over the state have received calls about brown to pinkish layers of growth which are currently showing up in home landscapes. This growth is actually a harmless type of fungus known as a slime mold. Slime molds come in a variety of shapes and colors, but none are known to cause plant health problems.

Slime molds never fail to attract the attention of gardeners and home landscapers who are convinced these creatures are ready to attack landscape plants and turf grass. Although slime molds have an alarming appearance, they grow externally on the surfaces of leaves and stems without parasitizing plants.

Slime molds normally live on or close to the soil surface where they feed on decaying organic matter. They move about in a manner more closely akin to animal than plant life, creeping along by forming finger-like projections. These projections pull the body of the slime mold across the soil surface.

When the slime mold is ready to reproduce, at some point during spring or summer generally following a period of rainy weather, it "crawls" up on grass blades, lower stems and foliage of landscape plants, the surface of landscape mulch, or even garden hoses. From these locations, the slime mold releases millions of dusty-gray spores. Spores are tiny "seeds" which will insure future generations of slime molds. Its only purpose for selecting locations above the soil line is to insure distribution of spores over a further distance than it would be possible from the soil surface.

Since slime molds don't feed on living plants, control measures aren't necessary. However, if they become too numerous and unsightly, break up the spore masses by raking, brushing, or hosing down with water. Fungicide sprays as a means of slime mold control are not recommended.

If you need further information, please feel free to give us a call at the County Extension Office.

--- Frank Killebrew
Extension Plant Pathologist
Department of Entomology and Plant Pathology
Box 9655; Mississippi State, MS 39762
email: frankk@mces.msstate.edu
date:06-28-96

Cooperative Extension Service
Kansas State University

SLIME MOLD

Ned Tisserat
Extension Specialist, Plant Pathology

Slime molds are commonly found in turf, ornamental, and garden plantings in the home landscape. Slime molds are primitive organisms that feed on bacteria, other fungi and dead organic matter. Slime molds often cause concern to homeowners because their reproductive phase is colorful and quite noticeable on plant parts. On turf, large numbers of small gray, white, or purple fruiting structures, called sporangia, form on the leaf blades during cool, humid weather throughout spring, summer, and fall. Generally, these fruiting structures, ranging in size from small pinhead-size flecks to lumps several inches in diameter, form in small patches (less than one foot diameter) in the lawn. In these small patches, turfgrass foliage may be dotted with the fine specks of the slime mold, or in some cases completely covered by the fungal mass. During wet weather, the fruiting structures may appear slimy. As the structures dry out in hot weather, they become powdery, and break up easily upon touching. Although unsightly, the slime molds do not parasitize living plants. Plant structures, such as leaves and stems, serve only as a means of support for the development of the slime mold fruiting structures. Heavy infestations of slime mold may cause a slight leaf yellowing resulting from partial shading of the photosynthetic area. Nevertheless, slime molds rarely, if ever, cause permanent damage to plants.

Chemical control of slime mold is not necessary. Frequent mowing and removal of the fruiting structures from plant parts by raking or watering is generally sufficient to improve the appearance of the plant. Excessive thatch or accumulation of organic matter may increase the incidence of slime mold. Therefore, thatch control may help alleviate this problem.

2/95

Slime Mold: The Blob on the Lawn

Russell Friesen

After an extended period of heavy rain an organism known as Slime Mold (Mucilago sp., Physarum sp., Fuligo sp.) may appear in your lawn. Slime mold takes many forms. The most common forms on turf resemble small purple or black ball attacked to a blade of grass or a readily noticeable creamy-white to yellow-orange jelly-like mass situated on the lawn.

Life Cycle and Description

Slime mold must have been the inspiration for many "B" grade monster movies.

Slime mold is a primitive organism that has properties of both an amoeba and a fungus. The slime mold produces spores that are capable of amoeba-like movement. The motile spores feed on fungi, bacteria, other micro-organisms, and decaying organic mater. The slime mold spores consume food by simply engulfing particles as they move. The single cell spores multiply by division. The spores pair off and become a shapeless slimy mass, that may flow to the soil surface. Movement of the slimy mass is encouraged by moist cool conditions. The slimy mass flows on to low-lying but upright objects such a blades of grass and garden walls. Once the slime mold mass is located on an upright object, it produces fruiting bodies that produce new spores.

Damage and Control

Slime mold for the most part is a beneficial organism that decays dead plant material, returning nutrients to the soil. It is not a disease, but turf that has been shaded by slime mold may be more susceptible to turf diseases.

Chemical control is usually not necessary. Raking up, and disposing of the slime mold is usually all that is required. If you choose a chemical control, mancozeb (Dithane) is effective.

The slime mold will go away in warm-dry weather conditions.

Sources:

Compendium of Turfgrass Diseases. Richard W. Smiley Ed. The American Phytopathological Society, 1983.

Turfgrass Management. A.J. Turgeon. Reston Pulishing Co. Inc. 1980

Return to fact sheet index

TABLE 7-7 (Continued)
INORGANICS DETECTED IN GROUNDWATER
REPUBLIC STEEL QUARRY RI

SAMPLE NO:	GW015	GW016	GW017	GW018	GW019	GW020	GW021	GW022	GW023	GW024	GW025	GW026
SAMPLE DATE:	08/19/87	08/19/87	08/19/87	08/19/87	08/19/87	08/19/87	08/20/87	08/20/87	08/20/87	08/20/87	08/20/87	08/20/87
SAMPLE LOCATION:	WELL B-1	WELL B-1	WELL B-8	WELL B-8	WELL B-6	WELL B-6	WELL B-5	WELL B-5	WELL B-4	WELL B-4	WELL B-3	WELL B-3
ALUMINUM	11600	--	5840	--	10800	[17]	482	--	2180	[24]	[188]	--
ANTIMONY	--	--	--	--	--	--	--	--	--	82	--	--
ARSENIC	--	--	--	--	21	--	--	--	--	--	26	21 R
BARIUM	[104]	[70]	[114]	[88]	[48]	[15]	[20]	[18]	[16]	[8.2]	38	[38]
BERYLLIUM	[2.1]	--	[1]		[1.6]	--	--	--	--	--	--	--
CADMIUM	--	--	6.4	[4.6]	--	--	[4.1]	--	--	[4.5]	--	6.8
CALCIUM	348000	352000	238000	233000	170000	161000	477000	464000	31500	30200	130000	129000
CHROMIUM	[8.5]	--	[9.7]	--	20	--	--	--	[7]	--	--	--
COBALT	--	--	[13]	--	[18]	--	--	--	--	--	--	--
COPPER	--	--	[15]	--	28	--	--	--	[7.9]	--	--	--
IRON	571000	554000	15500	738	46900	[61]	17400	15800	2450 R	[70] R	647 R	186 R
LEAD	--	--	--	--	19	--	--	--	--	--	--	--
MAGNESIUM	88000	83300	50800	49300	53100	45400	33500	32300	16600	15700	63300	62700
MANGANESE	11600	11400	842	672	799	189	286	274	32	[6.2]	661	658
NICKEL	131	[96]	[24]		48	--	--	--	[8.5]	--	[14]	[15]
POTASSIUM	37200	31400	[4790]	[2780]	6580	[3700]	[4850]	[4600]	5360	[4720]	[3070]	[3070]
SILVER	--	--	--	--	--	--	--	--	--	--	--	--
SODIUM	91100	87200	324000	330000	62700	64400	55800	54000	143000	139000	75400	75500
TIN	[73]	--	--	--	--	--	--	--	--	115	--	--
VANADIUM	[57]	--	[14]	--	[33]	--	--	--	--	[7]	--	--
ZINC	99	[44]	35	[15]	106	[9.5]	[15]	[11]	[13]	[7.7]	[9.3]	[9.1]
CYANIDE	--	NA	--	NA	--	NA	--	NA	--	NA		NA
HEXACHROME	--	--	--	--	--	--	--	--	--	--	--	--
TOTAL SUSPENDED SOLIDS	224000	NA	180000	NA	948000	NA	34000	NA	37000	NA	13000	NA
TOTAL DISSOLVED SOLIDS	3320000	NA	548000	NA	899000	NA	2220000	NA	744000	NA	952000	NA
TOTAL ALKALINITY	62500	NA	--	NA	209000	NA	280000	NA	417000	NA	414000	NA
ACIDITY	587000	NA	158000	NA	--	NA	--	NA	--	NA	--	NA
CHLORIDE	38100	NA	37900	NA	154000	NA	42500	NA	6500	NA	5500	NA
SULFATE	1760000	NA	360000	NA	270000	NA	935000	NA	27200	NA	264000	NA

NOTE: All concentrations are presented in ug/l. Even numbered samples represent the previous odd numbered sample which was filtered through a 0.45 micron filter prior to preservation and shipment for analysis

[ ] The value presented in brackets is greater than or equal to the instrument detection limit, but less than the contract required detection limit.
NA The sample was not analyzed for this parameter. Laboratory analysis was not requested for the sample for the given parameters.
R The spike sample recovery is not within control limits.
-- Not Detected

SOURCE: RI REPORT, CH2MHILL, 1988.

TABLE 7-5
GROUND WATER SAMPLE DESCRIPTIONS
REPUBLIC STEEL QUARRY RI

SAMPLE NUMBER	SAMPLE LOCATION	SAMPLING DATE	SAMPLING TIME	pH	SPECIFIC CONDUCTANCE (UMHOS/CM.)	TEMPERATURE (C)	DISSOLVED OXYGEN (MG/L)
GW001/002	BOTTLE BLANK	08/18/87	0800	5.16	002	23.5	4.2
GW003/004	TEFLON BAILER RINSATE	08/18/87	0900	5.09	002	26.0	3.6
GW007/008	CITY OF ELYRIA-DRILLING WATER USED	08/18/87	1000	6.15	218	24.5	3.1
GW009/010	MONITORING WELL B-7	08/19/87	0905	5.55	600	12.0	1.8
GW011/012	MONITORING WELL B-2	08/18/87	1600	7.04	800	15.0	9.3
GW013/014	MONITORING WELL B-2 (SPLIT)	08/18/87	1600	7.04	800	15.0	9.3
GW015/016	MONITORING WELL B-1	08/19/87	1000	5.70	1800	14.0	0.7
GW017/018	MONITORING WELL B-8	08/19/87	1215	6.79	1710	14.0	2.3
GW019/020	MONITORING WELL B-6	08/19/87	1445	7.30	800	13.0	2.4
GW021/022	MONITORING WELL B-5	08/20/87	1150	6.84	1200	11.0	2.2
GW023/024	MONITORING WELL B-4	08/20/87	1248	7.33	770	11.0	1.7
GW025/026	MONITORING WELL B-3	08/20/87	1110	6.83	810	12.0	1.5
GW101	BOTTLE BLANK	03/14/88	0730	8.60	25	3.0	10.5
GW102	TEFLON BAILER RINSATE	03/14/88	0740	8.60	25	3.0	10.5
GW103	MONITORING WELL B-1	03/14/88	0930	7.30	2030	1.0	2.5
GW104	MONITORING WELL B-3	03/14/88	1030	8.40	2010	13.0	1.0

NOTE: EVEN NUMBERED SAMPLES WERE COLLECTED AT THE SAME SAMPLE LOCATION AS THE PREVIOUS ODD NUMBER, AND WERE FILTERED THROUGH A 0.45 MICRON FILTER PRIOR TO PRESERVATION AND SHIPMENT FOR LABORATORY ANALYSES.

SOURCE: R1 REPORT, CH2MHILL, 1988.

TABLE 7-6
VOLATILE & SEMI-VOLATILE ORGANICS DETECTED IN GROUNDWATER
REPUBLIC STEEL QUARRY RI

		Volatile Organics					Semi-Volatile Organics					
Sample Number	Sample Location	Methylene Chloride	Chloroform	Bromodichloro-Methane	Toluene	Acetone	Pentachloro-phenol	Butylbenzyl-phthalate	Di-n-butyl-phthalate	bis(2-Ethylhexyl) phthalate	Phenol	Benzoic Acid
GW001	Bottle Blank	4 J	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
GW003	Bailer Blank	8	- -	- -	3 J	- -	- -	3 J	- -	- -	- -	- -
GW007	Elyria Water	11	74	19	2 J	- -	- -	- -	- -	- -	- -	- -
GW009	Well B-7	- -	- -	- -	- -	- -	5 J	- -	- -	- -	- -	- -
GW011	Well B-2	6	- -	- -	1 J	- -	- -	- -	- -	- -	- -	- -
GW013	Well B-2 Split	- -	- -	- -	- -	- -	- -	- -	3 J	10	- -	- -
GW015	Well B-1	140	9	- -	4 J	55	- -	- -	- -	11 B	10	42 J
GW017	Well B-8	- -	- -	- -	2 J	- -	- -	- -	- -	- -	- -	- -
GW023	Well B-4	3 J	- -	- -			- -	- -	- -	- -	- -	- -
GW101	Bottle Blank	- -	- -	- -	1 J	- -	- -	- -	- -	- -	- -	- -
GW103	Well B-1	- -	- -	- -	1 J	- -	- -	- -	- -	- -	- -	- -
GW104	Well B-3	- -	- -	- -	4 J	- -	- -	- -	- -	- -	- -	- -

NOTES: All concentrations are presented in micrograms per liter, ug/l.

J Indicates an estimated value.

B Indicates the analyte was found in the laboratory blank sample as well as the sample.

- - Not Detected

GW001 series samples were collected during August 1987.

GW101 series samples were collected during March 1988.

SOURCE: RI REPORT, CH2MHILL, 1988.