REMEDIATION SYSTEM EVALUATION

BAIRD AND MCGUIRE SUPERFUND SITE
HOLBROOK, MASSACHUSETTS

Report of the Remediation System Evaluation,
Site Visit Conducted at the Baird and McGuire Superfund Site
April 18-19, 2001

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NOTICE

Work described herein was performed by GeoTrans, Inc. (GeoTrans) and the United States Army Corps of Engineers (USACE) for the U.S. Environmental Protection Agency (U.S. EPA). Work conducted by GeoTrans, including preparation of this report, was performed under Dynamac Contract No. 68-C-99-256, Subcontract No. 91517. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

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EXECUTIVE SUMMARY

The 32.5-acre Baird and McGuire Superfund Site, located in Holbrook, Massachusetts, addresses VOC, SVOC, and arsenic contamination from a chemical mixing and batching plant that operated between 1912 and 1983. South Street and residences border the site to the west, the Cochato River borders the site to the east, and woodlands border the site to the north and south. Excavation and onsite incineration of contaminated soils was completed in 1997. A pump and treat system, that initially treated water from the excavation and incineration, now operates to remediate contaminated groundwater. An LNAPL recovery system has also been installed and removes approximately 5 to 10 gallons of LNAPL per day. This long-term remediation action is led by the EPA with Superfund providing 90% of the approximate $2,880,000 annual operating costs (not including oversight by USACE). Site lead and full financial responsibility of the site is expected to be turned over to the Commonwealth of Massachusetts in 2004.

This pump and treat system currently consists of seven groundwater extraction wells. One of the wells also collects LNAPL, which is collected and transported offsite for incineration. The total groundwater extraction rate is approximately 127 gallons per minute. The groundwater treatment system consists of decommissioned activated sludge biotreatment units (now used as air strippers), a metals removal system, pressure filters, liquid and vapor phase activated carbon units, and sludge disposal system. The plant has 24-hour security, two operators on duty 24 hours per day, eight additional operators/technicians working normal business hours, and an onsite laboratory staff of five people also working normal business hours.

The RSE team found the pump and treat system at the Baird and McGuire site to be effective, but operating at a much higher cost than similar systems. Since the addition of an extraction well in 1998, the system has contained the plume based on water level measurements and modeling efforts. In addition, the treatment plant regularly meets its own design discharge criteria of drinking water standards for the contaminants of concern.

Recommendations included in this RSE suggest the potential to reduce annual O&M costs by more than $2 million per year, without any reduction in effectiveness. Additional savings would likely occur due to a decrease in USACE oversight. Recommendations to reduce costs include the following:

- Reducing process monitoring, decommissioning the onsite laboratory, and sending samples to a certified laboratory will reduce the costs by approximately $600,000 per year.

- Replacing 24-hour security with a hired patrol system (night only) will reduce costs by approximately $144,000 per year.

- Automating the treatment plant and reducing operator labor will save approximately $1.3 million per year.

- Transporting and disposing of the LNAPL as a liquid rather than a solid will save approximately $30,000 per year. The site managers should clarify with the relevant agencies the regulations and precautions regarding the transport of the recovered LNAPL. The recovered LNAPL should also be tested by an independent, offsite laboratory to verify that transporting it as a liquid conforms with all pertinent regulations.

- Although the contractor currently covers the cost associated with sludge disposal, changing the sludge disposal procedure will save approximately $6,000 per year in future contracts or if the scope of work is reduced and the contract is renegotiated.

- Replacing the current air strippers (converted activated sludge units) with a more efficient unit, such as a low-profile tray aerator, will improve mass removal of organics from the process water and would cost up to $400,000 but would result in savings of approximately $30,000 per year in electrical costs.

- Replacing the filter media in the pressure filters would likely cost $30,000 but would improve the lifetime of the granular activated carbon resulting in savings of approximately $50,000 per year in carbon replacement.

Note that removing the lab could free up office space, such that the office space in trailers might no longer be necessary. This would add to the cost savings, though no attempt was made to quantify those costs.

Finally, a preliminary investigation into the use of in situ chemical oxidation is recommended to attempt to eliminate the LNAPL, and thereby increase the potential for site closeout. Addition of oxidants to the subsurface could also change the oxidative state of arsenic to its more immobile state, potentially alleviating the arsenic impacts in the groundwater.

PREFACE

This report was prepared as part of a project conducted by the United States Environmental Protection Agency (USEPA) Technology Innovation Office (TIO) and Office of Emergency and Remedial Response (OERR). The objective of this project is to conduct Remediation System Evaluations (RSEs) of pump-and-treat systems at Superfund sites that are "Fund-lead" (i.e., financed by USEPA). RSEs are to be conducted for up to two systems in each EPA Region with the exception of Regions 4 and 5, which already had similar evaluations in a pilot project.

The following organizations are implementing this project.

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The project team is grateful for the help provided by the following EPA Project Liaisons.

Region 1	Darryl Luce and Larry Brill	**Region 6**	Vincent Malott
Region 2	Diana Cutt	**Region 7**	Mary Peterson
Region 3	Kathy Davies	**Region 8**	Armando Saenz and Richard Muza
Region 4	Kay Wischkaemper	**Region 9**	Herb Levine
Region 5	Dion Novak	**Region 10**	Bernie Zavala

They were vital in selecting the Fund-lead pump-and-treat systems to be evaluated and facilitating communication between the project team and the Remedial Project Managers (RPM's).

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1.0 INTRODUCTION

1.1 PURPOSE

In the *OSWER Directive No. 9200.0-33, Transmittal of Final FY00 - FY01 Superfund Reforms Strategy, dated July 7,2000*, the Office of Solid Waste and Emergency Response outlined a commitment to optimize Fund-lead pump-and-treat systems. To fulfill this commitment, the US Environmental Protection Agency (USEPA) Technology Innovation Office (TIO) and Office of Emergency and Remedial Response (OERR), through a nationwide project, is assisting the ten EPA Regions in evaluating their Fund-lead operating pump-and-treat systems. This nationwide project is a continuation of a demonstration project in which the Fund-lead pump-and-treat systems in Regions 4 and 5 were screened and two sites from each of the two Regions were evaluated. It is also part of a larger effort by TIO to provide USEPA Regions with various means for optimization, including screening tools for identifying sites likely to benefit from optimization and computer modeling optimization tools for pump and treat systems.

This nationwide project identifies all Fund-lead pump-and-treat systems in EPA Regions 1 through 3 and 6 through 10, collects and reports baseline cost and performance data, and evaluates up to two sites per Region. The site evaluations are conducted by EPA-TIO contractors, GeoTrans, Inc. and the United States Army Corps of Engineers (USACE), using a process called a Remediation System Evaluation (RSE), which was developed by USACE. The RSE process is meant to evaluate performance and effectiveness (as required under the NCP, i.e., and “five-year" review), identify cost savings through changes in operation and technology, assure clear and realistic remediation goals and exit strategy, and verify adequate maintenance of Government-owned equipment.

The Baird and McGuire Site was chosen based on initial screening of the pump-and-treat systems managed by USEPA Region 1 and discussions with the Project Liaison for that Region. This report provides a brief background on the site and current operations, a summary of the observations made during a site visit, and recommendations for changes and additional studies. The cost impacts of the recommendations are also discussed.

A report on the overall results from the RSEs conducted at Baird and McGuire and other Fund-lead pump-and-treat systems throughout the nation will also be prepared and will identify lessons learned and typical costs savings.

1.2 TEAM COMPOSITION

The team conducting the RSE consisted of the following individuals:

Frank Bales, Chemical Engineer, USACE Kansas City District
Rob Greenwald, Hydrogeologist, GeoTrans, Inc. (EPA TIO’s contractor)
Peter Rich, Civil and Environmental Engineer, GeoTrans, Inc.
Doug Sutton, Water Resources Engineer, GeoTrans, Inc.

1.3 DOCUMENTS REVIEWED

Author	Date	Title/Description
US EPA	9/30/1986	Record of Decision, Baird and McGuire, Holbrook, Massachusetts, September 30, 1986
Metcalf & Eddy, Inc.	2/24/1989	Final Design Analysis for the Baird and McGuire Groundwater Treatment Plant, Vol. 1
KSE, Inc.; USACE	1/1997 - 3/1997	Communications regarding a Value Engineering Proposal for use of an off-gas catalytic destruction unit
Metcalf & Eddy, Inc.	4/10/97	Value Engineering Proposal for Vapor Phase Carbon in Lieu of Fume Incineration
US EPA	9/1999	Final Five-year Review for the Baird and McGuire Superfund Site, Holbrook, Massachusetts
Professional Services Group	2/2000 - 2/2001	Monthly Process Summaries for February 2000 through February 2001
Professional Services Group	4/24/2000	Value Engineering Change Proposal for Metals Removal Using Potassium Permanganate
Metcalf & Eddy, Inc.	1/2001	Evaluation of Groundwater Remediation Progress at the Baird and McGuire Superfund Site
USACE	3/2001	Payment Estimate - Contract Performance (pages 4 and 5)

1.4 PERSONS CONTACTED

The following individuals were present for the site visit:

Chuck Sands, EPA OERR
Ed Cayous, EPA HQ
Robert Bacher, Project Manager, PSG/US Filter
Jack Connolly, Project Engineer, USACE, Northeast Region
Melissa Taylor, Remedial Project Manager, USEPA Region 1

Dorothy Allen from the Massachusetts Department of Environmental Protection was contacted via phone and email but was not present for the site visit

1.5 SITE LOCATION, HISTORY, AND CHARACTERISTICS

1.5.1 LOCATION

The Baird and McGuire Superfund Site is located at 775 South Street in Holbrook, Norfolk County, Massachusetts. The site is approximately 32.5 acres in area and is surrounded by a fence except along the

Cochato River which borders the site to the east. Woodlands border the site to the north and south, and South Street borders the site to the west. Holbrook is largely a residential and commercial community with residences to the west of the site across South Street. The site layout with contaminant plumes is depicted in Figure 1-1.

1.5.2 POTENTIAL SOURCES

This Superfund site addresses contamination associated with Baird and McGuire, Inc., a chemical mixing and batching company that operated from 1912 to 1983. The site-related contamination includes various volatile and semi-volatile organics compounds (VOCs and SVOCs), pesticides, and arsenic. The primary VOCs are BTEX (benzene, toluene, ethylbenzene, and xylene), tetrachlorethylene (PCE), and the daughter products of PCE degradation. The primary SVOCs are polyaromatic hydrocarbons (PAHs) such as naphthalene. This contamination stems from plant operations as well as disposal components and practices that included

- laboratory sinks that drained indirectly to a nearby surface water,
- storage tanks overflowed and leaked,
- an uncovered "beehive" cesspool,
- an unlined and undiked tank farm, and
- the breach of a creosote collection lagoon.

Present sources of contamination exist onsite, particularly in the form of light non-aqueous phase liquid (LNAPL) that provides a continuing source of VOCs and SVOCs, and possibly arsenic. Buried soil and ash from site excavation and subsequent incineration may also provide continuing sources of arsenic. However, the contribution of ash as a continuing source of the arsenic has not been investigated to date. In the early 1980's LNAPL from a breached lagoon was re-circulated from near the Cochato River into the subsurface near EW-8 as an interim measure, and pools of LNAPL are currently found in that area. Sheens of LNAPL have also been observed across much of the site.

1.5.3 HYDROGEOLOGIC SETTING

The site ranges from 170 feet above mean sea level (MSL) on the western boundary of the site where the present treatment plant is located to 119 feet above MSL along the bank of the Cochato River. Wetlands occupy approximately 44% of the site and more than 60% of the site lies within the 100 year flood plain of the river. Prior to site excavation, the subsurface at the Baird and McGuire site was mainly glacial outwash which extended from the surface to fractured bedrock at an elevation of 129 feet above MSL to the west and 20 feet above MSL to the east. However, the ash from excavation and onsite incineration was redeposited onsite to reshape the landscape to its near-original form. This ash is very impermeable and now serves limits recharge via infiltration especially in the western half of the site near the old process areas. However, no tests to date have been performed on the permeability of the backfilled ash. The majority of the glacial outwash is fine to coarse sand underlain by glacial till. Fine sands and silt underlay the river.

Groundwater elevations at the site range from approximately 130 feet above MSL in the west to approximately 120 feet above MSL in the east, thereby directing flow east toward the Cochato River. However, groundwater beneath the site is captured by the extraction system and does not discharge to the Cochato River from the west.

1.5.4 DESCRIPTION OF GROUND WATER PLUME

The groundwater plume was originally defined by remedial investigation activities beginning in 1983. The most recent full scale groundwater sampling event reported was for the first half of 2000. Plumes of VOCs, SVOCs, and arsenic have the following maximum concentrations according to the sampling in event in 2000: 5.5 ppm for total VOCs, 4,545 ppm for total SVOCs, and 1.9 ppm for arsenic. The VOC and SVOC plumes, which extend approximately 500 feet in length and/or width, are depicted in Figure 1-1. The highest concentrations of VOCs and SVOCs are associated with an area where LNAPL is present around EW-8. In addition to its location near former site operations, this area was the discharge point for pumping from a creosote lagoon breach in the 1980's. Elevated arsenic concentrations in groundwater generally correspond to the VOC and SVOC plume; however, an arsenic plume detached from the main plume is present in the overburden along the western bank of the river. Pesticides are present in the collected LNAPL at the site, but do not extend significantly in the dissolved phase plume. Contamination mostly exists in the glacial overburden, but small plumes with concentrations below drinking water standards are present in the underlying bedrock.

2.0 SYSTEM DESCRIPTION

2.1 SYSTEM OVERVIEW

The groundwater treatment and extraction systems have been used since 1993. During the onsite soils remedy (1993-1997) the treatment plant was primarily used to treat the discharge from the onsite incinerator and the dewatering water from deep excavations. LNAPL was discovered during deep excavation in the area of EW-8, and in 1999 a LNAPL recovery system was installed and began operation.

The system is continuously staffed by two operators and a security guard. Eight additional system operators/technicians and five laboratory chemists/technicians work normal business hours. The laboratory staff and equipment is utilized mainly for analyzing process samples including daily effluent samples.

2.2 EXTRACTION SYSTEM

The original extraction system included six groundwater extraction wells (EW-1 to EW-6). EW-1 was decommissioned due to low well yield and minimal contaminant removal. In 1998 EW-7 was installed and now is operating to prevent groundwater contamination from reaching the Cochato River downgradient to the east. EW-8 was added in 1999 in an area of pooled LNAPL. In addition, an extraction well control building was added in 1998 to manifold, control, and measure the flow from each of the wells.

The recent Evaluation of Groundwater Remediation Progress at the Baird and McGuire Superfund Site (M&E, 2001) has recommended that EW-4 be replaced with another well in a more highly contaminated area. This change and an additional extraction well (EW-9) to address the localized arsenic plume along the river are planned for the Summer of 2001. The extraction system currently operates at approximately 127 gpm and maintains hydraulic capture based on groundwater modeling.

2.3 GROUNDWATER TREATMENT SYSTEM

The original plant design included two activated sludge biotreatment units; a fume incinerator; a two-stage metals removal system that used lime for pH adjustment, ferric chloride, and a polymer; pressure filters; and granular activated carbon (GAC). Due to an insufficient supply of organics in the plant influent to support biological growth in the activated sludge, the biotreatment units were decommissioned and are now used as air strippers. In addition, two Value Engineering Proposals resulted in the replacement of the fume incinerator with vapor phase carbon in 1997 and the use of potassium permanganate for metals removal in 2000.

The current treatment train consists of the following processes:

- equalization tank
- rapid mix tank for metals removal
- clarifying tanks

- pH neutralization tanks (no longer required as pH adjustment is no longer needed for metals removal)
- air strippers converted from activated sludge units
- pressure filter feed tank
- pressure filters
- GAC units
- effluent tank

Water from the pressure filter feed tank is sent in semi-batch mode through the pressure filters and carbon. The treated water is discharged to one of four infiltration basins (on a rotating basis) at approximately 150 gpm.

A conceptual schematic of the treatment process is presented in Figure 2-1. Individual treatment processes and the typical pathway of water through the system are shown, but pumps, system controls, and pathways for recycling of process water are not shown.

2.4 LNAPL RECOVERY SYSTEM

Total fluids extraction from EW-8 and passive phase separation of phases results in recovery of five to ten gallons of LNAPL per day. The recovered LNAPL is solidified with corn cobs prior to shipping offsite for disposal by incineration. Water from the phase separation is discharged through a nearby monitoring well, captured by EW-8, and pumped to the plant for treatment with the other extracted groundwater.

2.5 MONITORING SYSTEM

The monitoring system consists of approximately 60 monitoring wells that screen the glacial overburden. In addition, 19 monitoring wells screen the underlying bedrock. Approximately 60 monitoring wells are sampled on an annual basis and the resulting plume maps are compared to those generated from previous sampling events. In addition, water in the extraction wells is sampled on a quarterly basis.

3.0 SYSTEM OBJECTIVES, PERFORMANCE AND CLOSURE CRITERIA

3.1 CURRENT SYSTEM OBJECTIVES AND CLOSURE CRITERIA

The goal of the extraction and treatment system as documented in the ROD (dated September 30, 1986) is to contain and remediate the groundwater "within a reasonable time" and to protect groundwater and surface water. Specific cleanup levels were not specified in the ROD. The ROD states that restoration target levels will be proposed during the design phase and reviewed after five years of operation for practicability and protectiveness, but this review has not yet occurred. The design (M&E, 2/24/89) states that the intent of the remediation is to restore the aquifer to drinking water quality. The system has operated since 1993, but prior to 1997, it was operated largely to support incinerator activities. Only since 1997 has groundwater remediation been the site priority. Therefore, the five year review (September 1999) utilized MCLs as an interim cleanup standard, and determined that the site was not close to cleanup completion. The five year review recommended that a review of restoration levels be part of the next five-year review, in concert with turning over the site operations to the State in 2004.

3.2 TREATMENT PLANT OPERATION GOALS

From 1997 to 1999 the extraction and treatment system was upgraded with the groundwater remediation objectives in mind. These upgrades, already mentioned in Section 2.0, include the following:

- LNAPL delineation was conducted and a recovery system was installed (vicinity of EW-8).
- EW-7 was installed to augment hydraulic containment that prevents migration of impacted groundwater to the Cochato River.
- An extraction well control building was installed to ease operation of the extraction system.
- The thermal oxidizer for VOC emissions was replaced by vapor phase GAC.
- The original metals removal system was replaced by use of potassium permanganate.
- Treatment system pumps and other units were upgraded to increase the plant hydraulic capacity to 180 gpm.

Although there is no permit for this discharge, according to the design the effluent must meet MCLs and State standards.

The plant has mainly operated without excursions with only infrequent exceedances. System emissions are captured and treated through vapor GAC to mitigate odors and avoid public concern.

3.3 ACTION LEVELS

Site cleanup levels and treatment plant effluent levels are described in Sections 3.1 and 3.2.

4.0 FINDINGS AND OBSERVATIONS FROM THE RSE SITE VISIT

4.1 FINDINGS

In general, the RSE team found the system to be well operated and maintained. The observations and recommendations given below are not intended to imply a deficiency in the work of either the designers or operators, but are offered as constructive suggestions in the best interest of the EPA and the public. These recommendations obviously have the benefit of the operational data unavailable to the original designers.

The RSE team found the site operators and the remedial project manager interested in improving the performance of the system. The site operators have been working to optimize the treatment plant and overcome unanticipated problems as demonstrated by the Value Engineering efforts.

4.2 SUBSURFACE PERFORMANCE AND RESPONSE

4.2.1 WATER LEVELS AND CAPTURE ZONES

Selected monitor wells are gauged at least monthly. A contour map drawn based on the field measurements for May 2000 and modeling efforts by M&E indicate containment of the plume.

4.2.2 CONTAMINANT LEVELS

Contaminant levels and plume configurations for most of the site have generally remained stable since 1998. However, concentrations near the river have decreased substantially, which is likely due to the addition of EW-7 in that location during 1998. Contaminant levels of VOCs and SVOCs are likely to remain high elsewhere at the site as long as the LNAPL is there to provide a continuing source. The presence of buried soils and ash contaminated with arsenic may provide a continuing source of that contaminant, although this has not yet been determined. LNAPL may also provide a continuing source of dissolved arsenic contamination.

4.2.3 NATURAL ATTENUATION POTENTIAL

As discussed by M&E (January 2001) the presence of chlorinated solvent breakdown products and the high levels of dissolved ferrous iron are direct evidence of biodegradation of chlorinated organics via reductive dechlorination. However, as a significant amount of LNAPL still exists at the site, biodegradation will have relatively little impact on contaminant mass reduction, and as long as a reducing environment prevails, arsenic likely will remain in its more mobile state, arsenite.

4.3 COMPONENT PERFORMANCE

4.3.1 EXTRACTION-WELL PUMPS AND PIPING

The Grundfos pumps in all seven extraction wells are working at their highest capacity and have low-level shutoff switches to prevent pump failures. No maintenance issues with pumps were identified.

Underground piping is double contained HDPE with separate branch lines from the motor/valve control building to each recovery well. The leak detection system is reportedly not functional for some intervals of piping. The piping from each of the well heads is brought together in a single header in an extraction well control building where control valves and flowmeters, and motor controls are installed for each well.

4.3.2 EQUALIZATION TANK

There is one 15,000 gallon equalization tank that receives water from the extraction system and provides process water to the metals removal system.

4.3.3 METALS REMOVAL SYSTEM

The metals precipitation system was converted from a lime and ferric chloride addition to potassium permanganate in 2000. This has resulted in less sludge production and the elimination of pH control requirements. The metals removal system has two stages in series each consisting of a flash mix tank, flocculation tank and clarifier only one of the two stages is actively used with potassium permanganate and polymer addition for metals removal. The second stage allows the process water to flow through without chemical addition and metals removal. Removal rates for arsenic and iron are about 90%. The arsenic concentration in the effluent, which is measured daily, is on average around 5 ug/L. The current metals removal system results in the treatment plant consistently meeting the arsenic effluent limits of 5 ug/L. This new metals removal system is improved in that it operates at lower cost and produces less sludge. This new system, like the old one, requires the filtration step (Section 4.3.7) to meet the effluent criteria.

4.3.4 SLUDGE HANDLING SYSTEM

Sludge is pumped from the clarifiers to a holding tank and then to thickeners prior to the filter press. The filter press is operated about once every three days and generates one ton of about 23% solid filter cake at each dump. The sludge is disposed as a hazardous waste even though it passes TCLP testing.

4.3.5 ACTIVATED SLUDGE SYSTEM (USED AS AIR STRIPPERS)

Two activated sludge units are installed at the plant but have been decommissioned due to difficulty in maintaining biological activity. Two 20 horsepower blowers are used to aerate the tanks and remove about 75% of the VOC and SVOC mass from the process water. The influent levels for VOCs and SVOCs are typically about 0.5 mg/L and 2 mg/L, respectively. The mass removed by the stripping is captured by vapor phase GAC.

4.3.6 VAPOR PHASE GRANULAR ACTIVATED CARBON UNITS

Two 3,000-pound vapor phase GAC units are located in the rear of the treatment plant. These units are arranged and plumbed to collect offgas from both the activated sludge unit, the metals removal system, and other plant tanks to minimize emissions inside the building. The vapor GAC units have been replaced once in the past two years, and remove approximately 3 pounds per day of contaminants.

4.3.7 PRESSURE FILTERS

Process water is fed in batch mode from a pressure filter feed tank to two multimedia units that are used for removal of solids prior to liquid GAC. Filtration effectiveness as measured by turbidity is not meeting objectives. The filters are backwashed at least daily; recent head loss data indicates that the media is fouled.

4.3.8 GRANULAR ACTIVATED CARBON SYSTEM

Two GAC vessels containing 8,500 pounds each are used in series to remove VOCs, SVOCs, pesticides, arsenic, iron, and turbidity remaining from upstream processes. The GAC has been effective at reaching treatment objectives. GAC is replaced at a rate of eight vessels per year. The lead vessel is replaced due to measured head loss through the unit, rather than exhaustion of carbon determined through chemical measurements.

4.3.9 LNAPL RECOVERY SYSTEM

Since 1999, LNAPL has been recovered at a rate of approximately 5-10 gallons per day from EW-8 and two nearby monitoring wells (MW-97-1 and MW-98-1). After passive phase separation, the LNAPL is collected in a storage tank, which when emptied fills approximately three transportation boxes packed with LNAPL plus corn cobs (for stabilization). When approximately 20 boxes are stockpiled, they are shipped to Texas for incineration. The water from the passive phase separation is discharged to MW-97-3, captured by groundwater extraction in EW-8, and transported to the plant for treatment.

4.3.10 CONTROLS

The plant is operator intensive, and the system is not setup to operate remotely. Despite large amounts of process monitoring, the plant operations are governed by readings from turbidity meters and oxidation-reduction potential (ORP) sensors. The plant operators target less than 10 NTU for turbidity and keep the ORP about 660 mV after dosing with potassium permanganate ($KMnO_4$). The plant has programmable logic controllers (PLCs) and uses Wonderware operator software with Fix software used for redundancy and backup.

4.4 COMPONENTS OR PROCESSES THAT ACCOUNT FOR MAJORITY OF COSTS

Professional Service Group (PSG) is the plant operator under contract to USACE. Metcalf & Eddy maintains a technical review role for the project under contract to EPA. PSG's average monthly expenditure based on a payment estimate provided by USACE and discussion during the RSE site visit is about $240,000/month. Cost for USACE and M&E were not provided although the USACE project manager is reportedly 50% dedicated to the Baird McGuire remedy. The ROD estimate for total O&M costs was about $58,000/month, but the actual cost, not including oversight by USACE, is four times higher than the ROD estimate.

4.4.1 LABOR (SYSTEM OPERATIONS, LABORATORY NOT INCLUDED)

Operating costs associated with maintaining two operators around the clock and a total operational staff of 10 during normal business hours is $127,000/month. This cost is about five to eight times higher than that seen for similar systems. The system operates largely without operator attention, and with minor upgrades, including a callout system, around the clock attention would not be necessary.

4.4.2 Chemical Analysis (On and Off Site)

Daily effluent samples and twice weekly process samples from several locations are analyzed for arsenic and iron, other metals, VOCs, SVOCs and pesticides based on a monitoring scope not provided for review by the RSE team. Additionally, extraction wells are sampled quarterly and about 60 monitoring wells are included in an annual sampling event.

The cost of the laboratory analysis is about $57,000/month plus approximately $100,000 per year for USACE certification. This is also five to eight times higher than that seen for similar systems. Over 95% of the analytical work is done by the onsite laboratory that is staffed by five full time employees. The large amount of data collection reportedly results from intense community involvement during previous project stages; however, the bulk of the data is not used or required. The plant is operated based on readings from turbidity meters and ORP sensors.

4.4.3 Equipment Maintenance

These costs total about $14,000/month. Well pumps and motors require replacement on a yearly basis. Portions of the maintenance budget have funded system upgrades to allow higher flow capacity and ease of operation; therefore, expenditures may decrease over time. The amount currently is higher than that for similar systems

4.4.4 Non Utility Consumables and Disposal Costs

LNAPL disposal costs are about $5,000/month (approximately $30/gallon). Sludge disposal is about $1,000/month. Liquid GAC and vapor GAC replacement costs are $6,000 and $500 per month, respectively.

4.4.5 Utility Costs

Electricity costs are about $12,000/month, natural gas costs are about $2,000/month, telephone costs are about $2,000/month, and water and sewer costs are $200/month.

4.4.6 Security

About $14,000/month is spent on around the clock security at the site. This high level of security is reportedly due to intense community involvement during previous project stages (mainly due to the incinerator).

4.5 Recurring Problems or Issues

Plant downtime has been minimized in recent months. Liquid GAC change outs and effluent screen cleaning contribute a few hours of downtime per month. Non-routine repairs to the electrical and control systems have also resulted in some downtime.

4.6 Regulatory Compliance

The plant does not have regulated discharge requirements; however, it regularly meets design requirements that are consistent with drinking water standards for the contaminants of concern.

4.7 Treatment Process Excursions and Upsets, Accidental Contaminant/Reagent Releases

Monthly averages of daily arsenic concentrations in the plant effluent as reported in the monthly updates did not exceed MCLs during 2000 and the period of 2001 before the RSE visit. In addition, there were only three times when monthly averages of total VOCs exceeded 5 ug/L (the MCL for PCE, TCE, and many other VOCs). There were, however, frequent excursions of the pH MCLs, with discharges reaching as high as 10.3, and occasional excursions in turbidity and iron. Excursions of the pH MCLs, have not occurred since July 2000 when the use of potassium permanganate for metals removal began.

4.8 Safety Record

The system has an excellent safety record.

4.9 Community Involvement

Community involvement in the remedy design and operation have been high and mainly surrounded the use of an onsite incinerator. Since the decommissioning of the incinerator, community involvement has dropped off significantly.

5.0 EFFECTIVENESS OF THE SYSTEM TO PROTECT HUMAN HEALTH AND THE ENVIRONMENT

5.1 GROUND WATER

The groundwater extraction system appears to have achieved containment of the plume. The system has been effectively designed and optimized with groundwater modeling to achieve this goal. Removal of contaminant mass with the groundwater extraction system is relatively slow with about 5 lbs/day removed in the treatment plant. With LNAPL acting as a continuing source of dissolved phase contamination in the subsurface, this removal rate will not result in cleanup goals in the foreseeable future. The LNAPL recovery system does remove approximately 5 to 10 gallons per day, but this recovery rate has not decreased significantly, which suggests large volumes remain in the subsurface.

The South Street well field that once supplied municipal water was turned off in 1973 because these wells were capturing a portion of the contaminant plume. Municipal water now comes from Richardi Reservoir which is located downstream of the site along the Cochato River. The inlet from the river to the reservoir has been closed since 1983; therefore, the public water supply is not currently affected by site-related contaminants.

5.2 SURFACE WATER

Samples from the Cochato River are analyzed annually for arsenic, PAHs and pesticides. Results of this analysis were not available for review.

5.3 AIR

Air from the activated sludge/air stripping units is treated with vapor phase carbon that effectively removes contaminants at a rate of 3 pounds per day.

5.4 SOILS

The ash from onsite incineration was placed back on site to reshape the landscape to its original or near original topography. As a result, remaining contaminated soils from the excavation are largely buried beneath the ash and topsoil.

5.5 WETLANDS

Wetlands adjacent to the Cochato River exchange water with the river, and the river is sampled frequently for site associated contaminants. The results of this sampling were not available to the RSE team for review.

6.0 RECOMMENDATIONS

Cost estimates provided have levels of certainty comparable to those done for CERCLA Feasibility Studies (-30/+50%), and these cost estimates have been prepared in a manner consistent with EPA 540-R-00-002, *A Guide to Developing and Documenting Cost Estimates During the Feasibility Study*, July 2000.

6.1 RECOMMENDATIONS TO ENSURE EFFECTIVENESS

The remedy at the Baird and McGuire site appears to be effective, although at a much higher cost than is actually necessary. The modeling studies have demonstrated that the plume is contained and has been since the operation of EW-7 in 1998. Furthermore, effluent monitoring suggests that the treatment plants is effectively removing contaminants and discharging water that meets the required levels. The RSE team concurs with the previous recommendations of M&E (January, 2001) to change the location of EW-4 and install a new extraction well (EW-9).

6.2 RECOMMENDATIONS TO REDUCE COSTS

6.2.1 REDUCE PROCESS MONITORING

Process operations for metals removal were reported to be monitored and controlled based on oxidation/reduction potential (ORP) and turbidity readings. For VOC removal, GAC has been changed out mainly based on pressure buildup in the lead vessel. The results of the chemical analysis conducted for process monitoring are not used for day to day adjustments. Additionally, the analyses have indicated relatively consistent influent and process performance. Table 6-1 includes a comparison of samples taken in February 2001 with a recommended number of samples for process monitoring and weekly effluent monitoring. The key process monitoring samples are for the metal precipitation check and the change out of GAC units. The recommended process monitoring should cost under $10,000 per month if sent to an offsite certified lab compared to the $57,000 per month used to operate and staff the laboratory and the $100,000 per year required to certify the laboratory. Thus, the reduction in process monitoring and decommissioning of the onsite lab would likely would save in excess of $50,000 per month.

Note that removing the lab could free up office space, such that the office space in trailers might no longer be necessary. This would add to the cost savings, though no attempt was made to quantify those costs.

6.2.2 REDUCE SECURITY

The on site security is not necessary at the site based on existing site activities and community relations. The site can be secured except from water access with the existing fence and a lock system (especially if over-night staff is eliminated as per other recommendations). A contracted security patrol at night could be considered if it is available locally. Reduction of the site security will save at least $12,000 per month.

Table 6-1: Analysis Frequency in February 2001 Versus Recommended Frequency.

Sample	Location	Samples taken per month (RSE recommendation in parentheses)					
		VOC	SVOC	Pesticides	Arsenic	Iron	Other Metals**
1C	Plant Influent	7(2)	6(2)	7(2)	27(2)	27(2)	7(1)
2*	Stage 1 Metal Removal Influent				27(0)	27(0)	
3	Stage 1 Metal Removal Effluent				27(1)	27(1)	
4	Stage 2 Metal Removal Effluent	7(0)	7(0)	7(0)	27(2)	27(2)	
11	Stripper Effluent***	7(1)	7(1)	7(0)	27(0)	27(0)	
12	Multimedia Filter Effluent				26(1)	26(1)	
13	After GAC#1?	7(2)	7(2)	7(2)	27(1)	27(1)	
17	Effluent	27(4)	27(4)	27(4)	27(4)	27(4)	27(1)
TOTAL		55(9)	54(9)	55(8)	215(11)	215(11)	34(2)

* 2 and 1C are redundant, and step 2 should be removed
** Barium, chromium, copper, mercury, lead, and zinc
*** The air stripping step should be removed as per Section 6.2.6

6.2.3 AUTOMATE SYSTEM TO ALLOW OVERNIGHT OPERATION WITHOUT STAFFING

The system currently operates with minimal operator attention. The addition of an autodialer, alarm interlocks, and minor process adjustments such as automating filter backwashes and $KMnO_4$ batching would allow the system operation to be conducted by two or three full time (40 to 50 hours per week) employees who would be alerted by plant alarms if problems occur while the plant is not manned. Less than $100,000 would be needed for system upgrades. Savings of over $105,000 per month can be achieved with these upgrades and associated reduction in staff.

6.2.4 LNAPL DISPOSAL

The cost for LNAPL disposal by incineration is doubled due to the solidification with corn cobs accomplished on site. Also, significant labor hours are spent in the solidification process. The RSE team is not aware of any regulations that require solidification, and this LNAPL could potentially be transported and disposed as a liquid as is done at other Superfund sites. The site managers should clarify with the relevant agencies the regulations and precautions regarding the transport of the recovered LNAPL. The recovered LNAPL should also be tested by an independent, offsite laboratory to verify that transporting it as a liquid conforms with all pertinent regulations. Discontinuing the solidification process and transporting the recovered LNAPL as a liquid will likely save in excess of $2,500 per month ($30,000 per year) plus allow for substantial reductions in labor costs.

6.2.5 SLUDGE DISPOSAL

The filter cake is currently disposed offsite as hazardous waste even though it reportedly passes the TCLP test and is not a listed waste. Although the contractor currently covers the cost associated with sludge disposal, disposal of this material in a lined Subtitle D facility could save $500/month. Thus, this savings would only be realized if the contract is negotiated or a new O&M contractor is hired.

6.2.6 REPLACE THE CURRENT AIR STRIPPER WITH A MORE EFFICIENT UNIT

The two activated sludge units have not supported a bacterial population and have therefore been used only as air strippers. Two 20 horsepower blowers supply air to these two units, and overall mass reduction of organics is around 75%. Together, these blowers require approximately $3,000 per month in electricity (assuming $0.10/kwh).

A low profile tray aerator using a 7.5 horsepower blower could provide substantially higher mass removal at approximately $500 per month in electricity (assuming $0.10/kwh). Thus, a savings of approximately $2,500 per month (or $30,000 per year) could result from installing and operating a tray aerator in place of the current activated sludge units. The improved reduction in the mass of organics in the process water could also extend the time of the GAC units if the pressure filtration media is improved to prevent fouling. Purchase, installation, and start up of the tray aerator should require approximately $400,000 in up front costs.

6.2.7 CHANGE FILTER MEDIA

Contaminant loading (SVOC, VOCs, Pesticides) to the liquid-phase GAC in February 2000 was less than 2 lbs/day. The organic compounds in the process water are approximately 75% SVOCs (such as naphthalene) and 25% VOCs such as toluene, ethylbenzene, and xylene. The combined concentration of VOCs and SVOCs currently exiting the stripping units is approximately 500 ug/L. At this concentration, approximately 10 pounds of carbon is required per pound of naphthalene. A lower usage is expected for ethylbenzene and xylene, but a higher carbon usage is expected for toluene. Based on an estimate of 20 to 25 pounds of carbon per pound of contaminant, changeout of the lead 8,500 pound carbon vessel under current operations (2 lbs/day loading which requires 50 lbs/day carbon) should occur about twice per year. However, site operations currently include much more frequent carbon changeouts (about eight vessel change outs per year) due to pressure buildup in the lead GAC vessel. This is likely due to clogging, which can be avoided by upgrading the filtration media to more effectively remove solids prior to the GAC. If that occurs, GAC changeouts will be required on the basis of chemical load from contaminants rather than the pressure drop due to clogging, and the efficiency of the carbon should increase as preferential flow paths caused by the clogging will be significantly reduced.

A carbon changeout twice a year would indicate an approximate reduction of six carbon changeouts per year. At approximately $8,500 per changeout (assumes $1 per pound of carbon), this would result in a savings of approximately $50,000 per year. More significant savings would be expected if a more efficient air stripping system is used because the stripping would remove more of the organic constituents of the process water prior to the GAC units. The cost of upgrading the filter would be approximately $30,000, so overall cost savings should be realized in less than one year.

6.3 TECHNICAL IMPROVEMENT

6.3.1 CONVERT BIOSYSTEM CLARIFIER TO AN EQUALIZATION TANK

The system equalization tank is about 15,000 gallons. This provides only 90 minutes to make system repairs without having extraction-well downtime. As the 150,000-gallon aeration tanks are not needed in the treatment process, one could be converted to an emergency equalization tank if desired. This would provide approximately 900 minutes to make system repairs without having extraction-well downtime.

6.4 RECOMMENDATIONS TO GAIN SITE CLOSEOUT

6.4.1 EXAMINE IN-SITU CHEMICAL OXIDATION

The total VOC and SVOC concentrations in the monitor wells around EW-8 have remained at a relatively high level since 1997. The LNAPL present in this area is a continuing source of dissolved contamination and, even with removal rates as high as 10 gallons per day, is not likely to be removed by current operations. The site setting, contaminants, and hydrogeology appear to be ideal for in-situ chemical oxidation in the area around EW-8. A site profile should be supplied to several commercial vendors to obtain proposals. Such a profile could be generated with the available materials for under $2,000. Based on information and estimates provided by the vendors, site managers could then determine if the technology should be further pursued through bench or pilot tests.

Removal of the LNAPL would lead to site cleanup of VOCs and SVOCs much more quickly than the current remedy. Also, the addition of oxidants to the subsurface would increase the likelihood of oxidizing arsenic to its more immobile oxidative state.

6.5 UNUSED GOVERNMENT-OWNED EQUIPMENT

If the recommendation to reduce process monitoring and decommission the onsite laboratory (Section 6.2.1) is implemented, a number of government-owned laboratory instruments will be available for use at EPA labs or other sites. These instruments include, but are not limited to, a Perkins Elmer Optima 3300 DV spectrophotometer, three Hewlett Packard 6890 gas chromatography systems, two Hewlett Packard 5973 mass selective detectors.

7.0 SUMMARY

The observations and recommendations given below are not intended to imply a deficiency in the work of either the designers or operators, but are offered as constructive suggestions in the best interest of the EPA and the public. These recommendations obviously have the benefit of the operational data unavailable to the original designers.

The RSE process is designed to help site operators and managers improve effectiveness, reduce operation costs, improve technical operation, and gain site closeout. In this report, no recommendations are made to assure system effectiveness as the contaminant plumes appear to be captured and the treatment plant regularly meets discharge targets. A number of recommendations, however, are made to reduce future operations and maintenance costs. The recommendations include reducing process monitoring, reducing security, automating the system and reducing labor, altering LNAPL and sludge disposal procedures, and replacing filter media.

Together, these recommendations could reduce the annual system costs associated with the plant operation by more than $2 million per year. This does not include further savings that would likely result from a decrease in costs associated with oversight by USACE. A number of technical improvements are suggested in the course of reducing operating costs, and in addition to those, the report recommends converting a decommissioned activated sludge unit into an equalization tank to provide a high capacity for extracted water if necessary. Finally, the RSE report recommends investigating the use of in situ chemical oxidation as a method of reducing or eliminating the presence of LNAPL, which will increase the potential for site closeout

Tables 7-1 summarizes the costs and cost savings associated with each recommendation. Both capital and annual costs are presented as well as the expected change in life-cycle costs over a 30-year period for each recommendation both with discounting (i.e., net present value) and without it.

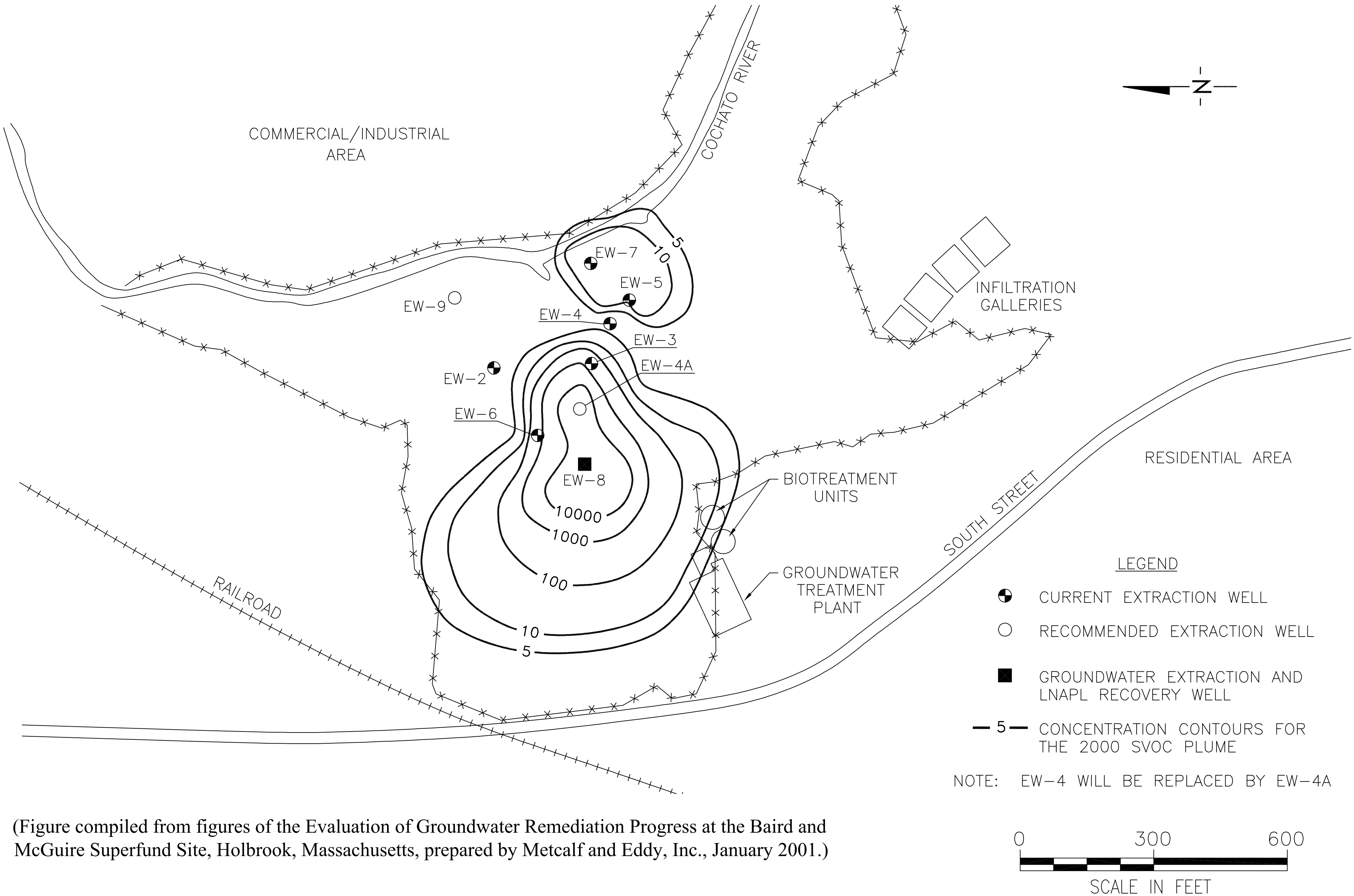
Table 7-1. Cost summary table for individual recommendations

Recommendation	Reason	Estimated Change in			
		Capital Costs	Annual Costs	Life-cycle Costs*	Life-cycle Costs **
6.2.1 Reduce process monitoring	Cost reduction	$0	($600,000)	($18,000,000)	($9,685,000)
6.2.2 Reduce security	Cost reduction	$0	($144,000)	($4,320,000)	($2,324,000)
6.2.3 Automating systems and reducing labor	Cost reduction	$100,000	($1,260,000)	($37,700,000)	($20,238,000)
6.2.4 Changing LNAPL disposal procedure	Cost reduction	$0	($30,000)	($900,000)	($484,000)
6.2.5 Changing sludge disposal procedure	Cost reduction	$0	($6,000)	($180,000)	($97,000)
6.2.6 Replace the current air stripper with a more efficient unit	Cost Reduction	$400,000	($30,000)	($500,000)	($84,000)
6.2.7 Changing filter media	Cost reduction	$30,000	($50,000)	($1,470,000)	($777,000)
6.3.1 Converting decommissioned activated sludge unit into an equalization tank	Technical Improvement / Effectiveness	$1,000	$0	$1,000	$1,000
6.4.1 Investigating in situ chemical oxidation	Technical Improvement	$2,000	$0	$2,000	$2,000
Total		**$533,000**	**($2,126,000)**	**($63,067,000)**	**($33,686,000)**

Costs in parentheses imply cost reductions.
* assumes 30 years of operation with a discount rate of 0% (i.e., no discount).
** assumes 30 years with a discount rate of 5% and no discounting in the first year.

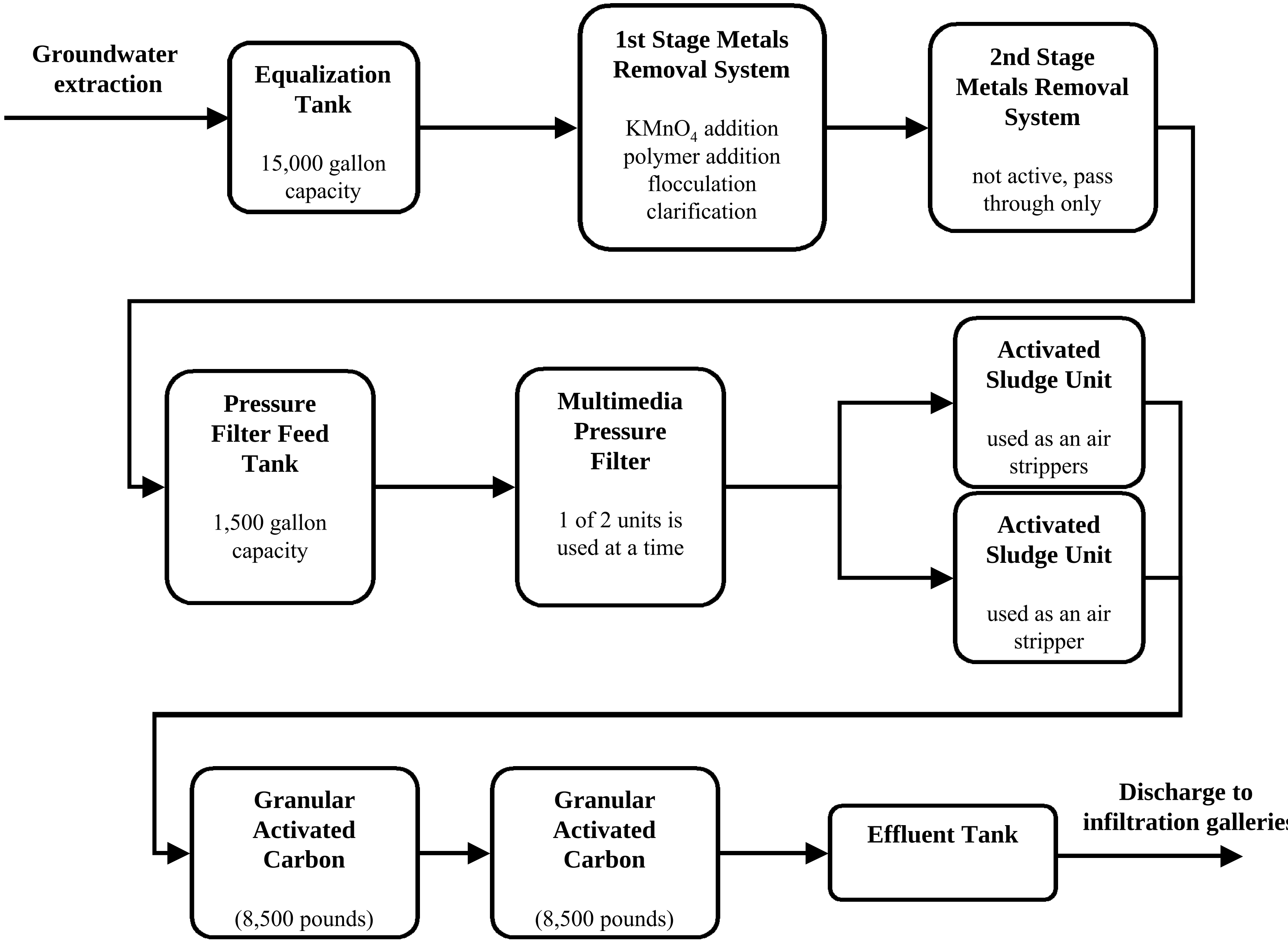
FIGURES

FIGURE 1-1. SITE LAYOUT SHOWING THE LOCATIONS OF THE EXTRACTION WELLS (CURRENT AND RECOMMENDED) AND THE SVOC PLUME FROM THE 2000 SAMPLING EVENT.



(Figure compiled from figures of the Evaluation of Groundwater Remediation Progress at the Baird and McGuire Superfund Site, Holbrook, Massachusetts, prepared by Metcalf and Eddy, Inc., January 2001.)

FIGURE 2-1. CONCEPTUAL DIAGRAM OF THE GROUNDWATER TREATMENT SYSTEM



(Note: This figure does not indicate recycling through the treatment plant.)

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