Technical Memorandum

Taylor Instruments
95 Ames Street
Rochester, New York

Prepared for:

Combustion Engineering, Inc.
501 Merritt 7
Norwalk, CT 06851

Prepared by:

ABB Environmental Services, Inc.
1400 Center Point Boulevard
Suite 158
Knoxville, TN 37392-1968

April 1997

CONFIDENTIAL
SETTLEMENT COMMUNICATION

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I. Summary

Combustion Engineering (CE) has prepared this technical memorandum in order to propose cleanup goals for the two most important contaminants - mercury and TCE - at the Taylor Instruments/Ames Street Site ("Site"). Once final cleanup goals are established and additional investigations are completed, CE will submit a workplan, to be incorporated into a Voluntary Cleanup Agreement being negotiated with the Department, describing how it will achieve the goals and return the Site to beneficial industrial or commercial use.

The current planned redevelopment project for the Site is for it to be acquired by the City of Rochester Economic Development Corporation ("REDCO") for lease to TOPs Markets, Inc., for development as a food market and various other light commercial enterprises. This planned future use was specifically taken into account in CE's human health risks assessment and in establishing the proposed cleanup goals.

The following cleanup goals are proposed for the Site.

- Remove mercury-impacted soils that exceed 400 mg/kg..
- Remove defined areas of "concentrated glass shard wastes" to a depth of four feet below ground surface and any identified soils containing visible liquid mercury.
- Undertake a post-remediation perimeter groundwater monitoring program designed to confirm that mercury levels in overburden groundwater at the perimeter remain at or below New York's groundwater standard, and to track indicators of intrinsic bioremediation.
- Eliminate any introduction of mercury into off-site sewers via the on-site stormwater sewer system.
- Remediate TCE-impacted soils above the saturated zone above the saturated zone that exceed 2.7 mg/kg.
- Undertake a post-remediation perimeter groundwater monitoring program designed to confirm that TCE levels in overburden groundwater at the perimeter continue to pose no human health threat and are decreasing following source removal and through natural attenuation and intrinsic bioremediation.

In addition, CE will move forward immediately to do additional sampling to respond to Site characterization and other issues raised by NYSDEC and the Monroe County and New York State Health Departments. This is further detailed in a draft Supplemental Investigation Work Plan being submitted simultaneously with this Technical Memorandum. The proposed goals may be revised downward if the results of these investigations unexpectedly show: a) that TCE is present in groundwater at levels that pose a human health risk in basements off-site that would be addressed by on-site remedial measures; or 2) on-site mercury vapors in soils pose a human health risk to workers.

II. Memorandum Objectives

After discussion with NYSDEC, NYSDOH and MCDOH, CE has prepared this Technical Memorandum in order to accomplish the following:

- Propose cleanup levels for the Taylor Instrument Site primary Contaminants of Concern ("COCs") (mercury and TCE) which can serve as the basis for entering into a Voluntary Cleanup Agreement incorporating a detailed work plan for achieving the goals.

- Provide a summary of the comparison of proposed cleanup numbers (which are inherently tied to available remedial technologies) relative to NYSDEC's Policy on Voluntary Cleanup Program and, as requested by NYSDEC, to Part 375 remedy selection criteria.

This Technical Memorandum is meant to serve as a basis for additional discussions with the Department to settle on a VCA and workplan. It does not constitute a waiver of any rights or defenses in the event these discussions do not result in a VCA acceptable to CE or NYSDEC, in the event the Site is listed on the Registry, or in the event the future redevelopment of the Site is not commercial or industrial.

III. Mercury

1. Key Phase I Findings

CE's "Phase I" Voluntary Site Investigation (VSI) Report which included a Human Health Risk Assessment ("HHRA")[1/] generated a number of conclusions relative to Site history, nature and distribution of COCs, and potential human health and environmental risks.[2] These reports were developed with the understanding that future Site uses would be commercial or industrial and with the specifics of the City [REDCO] and TOPs proposed redevelopment being taken into consideration. Key findings relative to selecting and implementing an on-site remedy for mercury include the following:

[1/] November 1996_

[2] CE recognizes that several issues, e.g., the potential presence of bedrock groundwater contamination and off-Site impacts have not yet been completely characterized. Stated key conclusions are those which have greatest bearing on the remedy analysis and on which we believe there is general concurrence.

- The HHRA established that levels of 2,500 mg/kg of mercury or higher were protective of human health at the Site based on specific assumed receptors and future use scenarios.

- Higher (>100 mg/kg) levels of mercury are almost exclusively confined to soils within the upper 8 feet of ground surface, and generally are co-located with identified areas of concentrated glass shard wastes.

- Lower (0.1 to 1.0 mg/kg) levels of mercury are intermittently present throughout the overburden soil column over a significant portion of the Site.

- The observed mobility of mercury at the Site is low, similar to mobility reported in the scientific literature and for other Sites with a similar mercury speciation profile.

- Mercury was generally not measured at levels exceeding applicable standards in groundwater at the perimeter of the Site.

- Available data indicate that the vast majority of mercury at the Site is in a non-mobile, non-bioavailable and in a comparatively non-toxic form. Due to the length of time this material has been exposed to the environment (30-90 years) this speciation profile can be considered stable and unlikely to significantly change.

2. Remedial Obligation Under New York's Voluntary Cleanup Program

New York's Voluntary Remediation Program guidance indicates that the "appropriate cleanup levels [are ones which will be] consistent with the safe use of the property for [the intended] purpose." (NYSDEC Policy: Voluntary Cleanup Organization and Delegation Memorandum # 94-32 at 2, as updated.[3] See also, pages 3 and 4). Because of this, the focus of the VSI was to quantify human health risk as a basis for deriving cleanup goals that would be protective of human health for the intended future use of the Site. The Site is intended for use for a grocery store and light commercial businesses.

2.a. Soils

The HHRA (Volume II of the VSI Report) developed risk-based soil concentrations protective of human health of 2,500 mg/kg and higher based on various future use and receptor analyses scenarios for the Site. Table 5-1 of the VSI contained a proposed matrix of "Quality Goals" which reflected CE's desire to apply different cleanup numbers to different areas of the Site depending on how each area was to be used. Table 5-2 presented a matrix of on-site groundwater quality goals based upon the identified future

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[3] New York's program continues to be refined. The quoted elements are from the most recent version of this document which we received from the NYSDEC Division of Hazardous Waste on March 20, 1997.

use of the Site. NYSDEC was concerned that the matrix approach was too complex and requested a single, Site-wide number. Thus, in this Memorandum only one cleanup number is proposed for each COC in each media (soil and groundwater). Based upon the HHRA, 2,500 mg/kg is a mercury in soil level which meets the NYSDEC Voluntary Cleanup Program Objective of ensuring that the Site is safe for its future intended use.

2.b. Groundwater

Cleanup numbers under NYSDEC's Voluntary Remedial Program are based on Site specific risk-based assessments addressing future safe use of the Site, and according to NYSDEC's published statements, addressing contaminated groundwater situations (i.e "potential for use, discharge to surface water and the practicality of cleaning up to standards").[4] Table 5-2 of the VSI included human health-based groundwater goals predicated upon the fact that the potential use of groundwater on-Site will be precluded by deed restrictions and that there is no known or anticipated off-Site use of groundwater.

2.c. Sewers

Low levels of mercury have been detected by Monroe County Pure Waters ("MCPW") in samples obtained from near-Site sewers. Although the levels detected to date are below the current sewer use standards, the levels are expected to be above future standards being developed as part of the Great Lakes Initiative. MCPW's Pollution Prevention initiative is focusing on eliminating to the extent possible all sources of mercury entering their sewers and has identified the Taylor Instruments Site as requiring further evaluation as a potential source. There is currently uncertainty over whether the source of mercury in near-Site sewers is infiltration of mercury-impacted groundwater (believed unlikely based on measured groundwater concentrations at the Site perimeter), sediments within the MCPW sewers, or the Site sewers themselves. In conjunction with further discussions with MCPW relative to the first two potential sources, CE has included as a remedial goal the elimination of any direct contribution from the on-site sewers.

3. Evaluation of TAGM 4046 Derived Cleanup Levels

This Site is proceeding towards a Voluntary Cleanup Agreement and thus the risk-based criteria discussed in section III.2 above are applicable to selecting a cleanup number for a future commercial or industrial use under NYSDEC policy. However, NYSDEC stated it also intends to consider both the 6 NYCRR Part 375 remedy selection criteria and New York's Inactive Hazardous Waste Site's residential-based cleanup guidance set forth in TAGM 4046 when selecting the cleanup goals. Accordingly, without conceding the

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[4] See, for example, "The New York Department of Environmental Conservation's Voluntary Cleanup Program " by Charles E. Sullivan Jr. Chief, Inactive Hazardous Waste Site Enforcement Bureau, Division of Environmental Enforcement. November 6, 1995, and October 16, 1996.

applicability of those criteria, CE evaluated and factored them into the process of proposing cleanup numbers for the Site.

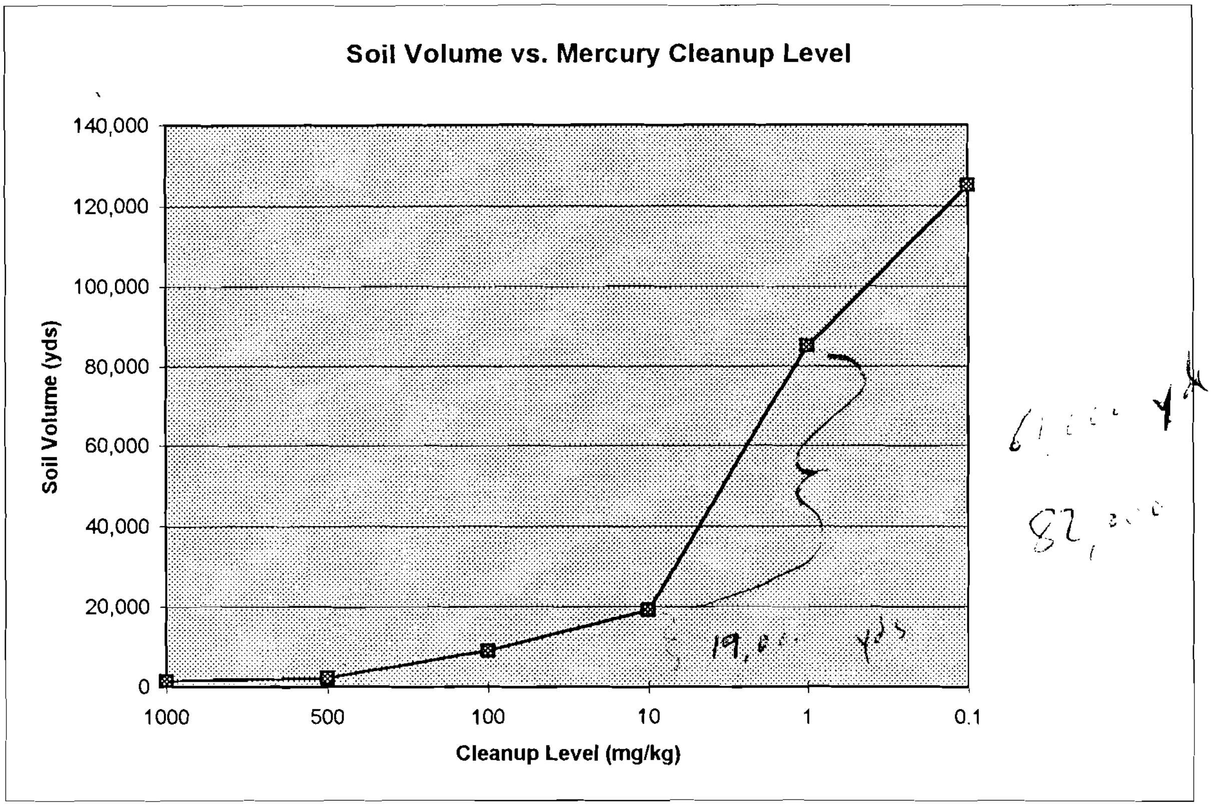
TAGM 4046 suggests a cleanup level for mercury in soil of 0.1 mg/kg, which is equal to the approximate "background" concentration of mercury in soil (i.e., no health-risk considerations were included in developing this level). Figure 1 contains CE's estimations of soil volumes and costs for a range of cleanup goals for mercury. Attachment 1 analyzes the TAGM 4046 levels in terms of the Part 375 remedy selection criteria, and Table 1 compares both the TAGM 4046 level and the proposed cleanup objective [400 ppm for mercury and removal of concentrated shard wastes] against the Part 375 remedy selection criteria. The following points summarize CE's conclusions based on these comparisons.

Remediating the Site to the TAGM 4046 residential Cleanup standard is impractical and unnecessary because:

1. Remediation to 0.1 mg/kg (background) involves the excavation of an estimated 125,000 or more cubic yards of material from the Site to depths of up to 25 feet, much of it under saturated soil conditions. The dewatering, shoring, trained personnel and equipment necessary to complete this would be enormously expensive, impractical, and unnecessary given that most of the higher concentrations of mercury in soils are in the unsaturated zone.

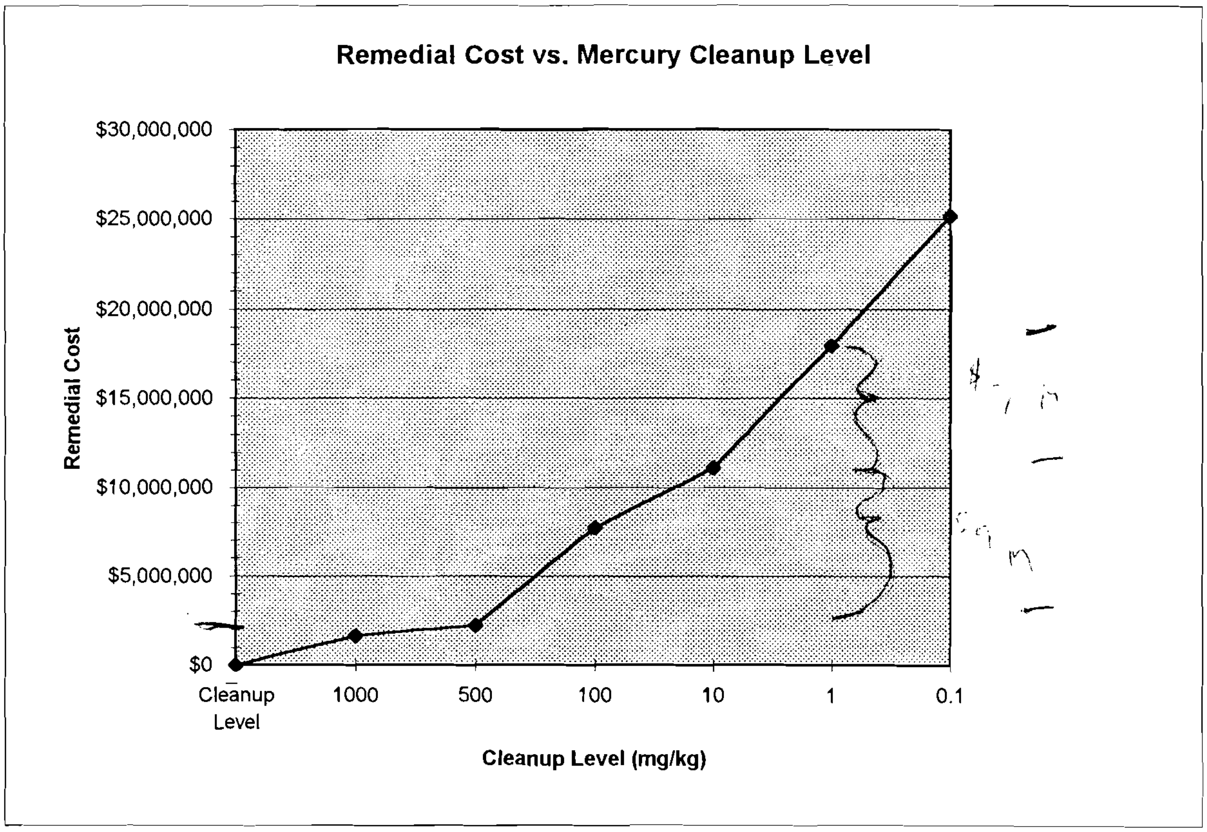
2. The very large excavation necessary to achieve the TAGM level would impact the community due to dust, noise, truck traffic (e.g., ≈5-10,000 truck trips, requiring several hundred truckloads daily, several dozen hourly, over many months) and other consequences of a large excavation project during the lengthy remedial period. Due to the large excavation and its intrusion into the saturated zone, some hazards (e.g., wall collapse) would be posed to site construction workers. Under the proposed remediation cleanup goal (400 mg/kg and removal of concentrated shard wastes) the extent of excavation is substantially reduced while still rendering the Site safe for its intended future use.

3. The most rapid remedial approach, excavation and off-site disposal, would achieve the TAGM level in about 6-8 months. However, the high cost of the most rapid approach, makes excavation and treatment the more probable remedy for achieving a TAGM level. Typical throughputs for such treatment systems show that achieving the TAGM cleanup level would require more than a year. Neither of these options meet theschedule required for the current property redevelopment project(construction in 1997). There is strong community support to fill a need for a food market in this underserved community, which has motivated the City to target this Site for the particular planned redevelopment project.



66,000 yds

82,000



$7 M

$9 M

FIGURE 1

4. Remediation of mercury at the Taylor Instrument Site to the TAGM level would be prohibitively expensive. Present worth costs of a remedy to achieve the TAGM level would probably exceed $20,000,000. This amount, when combined with the approximately $7,000,000 already spent by CE on property investigation and demolition and the anticipated cost for TCE remediation would represent an exorbitant cost to remediate a site that currently poses no human health risks.

5. Remediation to a 0.1 mg/kg standard, appears to achieve little or no incremental environmental benefit based on the lack of receptors (i.e., up to 25 feet below ground surface) and mercury's demonstrated low mobility at this Site. Significantly, the vast majority of the total mercury mass at the Taylor Instrument Site is concentrated in or closely associated with the concentrated glass shard wastes.

Although the above points relate specifically to the TAGM level of 0.1, it is important to recognize that very similar issues would face a remedial project necessary to achieve a cleanup level in the range of 0.1 to over 100 mg/kg. Each of these remedies would require a large excavation; would require removal, dewatering, etc. of saturated soils, pose potential impacts to the local community; and would be both time-consuming and very expensive. Similarly, due to the increasingly small amount of mercury mass recovered despite the rapid increase in soil volume, the incremental environmental benefit decreases in each case in direct proportion to the decrease in cleanup level.

4. Examples of Cleanup Levels at Other Sites

Because a cleanup level at or near the TAGM level would be very difficult to achieve and would be extremely costly, a review of soil cleanup numbers for mercury approved by state or federal environmental agencies at other Sites was undertaken.

Since detailed mercury speciation and bioavailability characterization has been done at the Taylor Instrument Site, CE looked for recent sites which had undergone a site-specific mercury speciation and bioavailability characterization study, or where industrial or commercial uses were assumed. In general CE found that the cleanup levels established for such sites were in the 100 mg/kg - 500 mg/kg range. For sites which had not undergone site-specific mercury speciation and bioavailability characterization, or where a future residential use of the property was assumed, the cleanup numbers were generally below 100 mg/kg. Similarly, general (i.e., non site-specific) guidance numbers for cleanup of mercury in soil for industrial/commercial uses range from approximately 300 mg/kg (e.g., New Jersey, 270 mg/kg, EPA Region III, 310 mg/kg) to approximately 600 mg/kg (e.g., Connecticut, 610 mg/kg) and below 100 mg/kg (e.g., New Jersey, 14 mg/kg, Connecticut 20 mg/kg) for residential direct contact assumptions.

Table 2 provides several recent examples of cleanup levels for mercury approved for use at Sites in Tennessee, Nevada and California. Attachment 2 to this Memorandum provides copies of excerpts from the referenced documents stating the cleanup level accepted by regulators and describing the evaluation criteria applied at each Site.

Table 2
Compare Mercury Soil Cleanup Levels

Site/Location	Lead Agency	Mercury Cleanup Level (mg/kg)	Source/Date
Alameda Quicksilver County Park Santa Clara County, CA	Cal-EPA	300-500 (for various areas of Site)	RAP, 12/94
Lower East Fork Poplar Creek Oak Ridge, TN	USEPA	400	ROD, 5/95
Carson River Mercury Site (OU1) Lyon/Churchill County, NV	USEPA	80	ROD, 3/93
Citric Block Site/Williamsburg Facility, Brooklyn, NY	NYSDEC	removal of all hazardous waste (fails TCLP test)	NYSDEC VCA signed July 1996

Although there are substantial differences in site conditions, intended land use, geologies, quantities of substances released and receptors among the four sites (the three cited plus the Taylor Instrument Site), there are several critical similarities:

- Human health risk assessments were performed at each Site;
- In addition to human and environmental risks, remedies at each Site were evaluated against criteria similar, or identical, to those found in New York's Part 375 regulations, including long-term effectiveness, cost, implementability, and protectiveness of human health and the environment; and
- Speciation/bioavailability work similar to that performed by CE at the Taylor Instrument Site was performed at each site and was used to adjust cleanup levels so as to be specific to the mercury species actually present.

Despite these similarities, several factors suggest that the range of cleanup levels at these Sites would be conservative if applied to the Taylor Instrument Site. Most importantly:

- Cleanup levels at each Site are protective for **residential or similar land use involving long term exposure to children.** This contrasts sharply with the intended future use at the Taylor Instrument Site, which will be restricted, by deed restrictions enforced by the new owner (REDCO), to future commercial/industrial uses.
- The Oak Ridge and California sites featured extensive examination of environmental receptors due **to widespread surface soil and (particularly at the Oak Ridge Site) sediment impacts.** This is again in contrast to Taylor Instrument Site where there exists neither identified environmental pathways nor receptors, and no sediment impacts.
- The Oak Ridge and California sites in particular feature **much greater overall releases in terms of volume/weight of mercury (hundreds of thousands of pounds in Tennessee) and**

areal extent over which the impact is spread. (The Carson River OU1 impact is limited to a few residential yards and a drainage ditch.) Mercury at the Taylor Instrument Site is confined to a few acres (and, possibly, off-site sewers) and is believed to have resulted from release of a much smaller total amount of the mercury.

In particular the Lower East Fork Poplar Creek number is of interest for several important reasons. First, the mercury-related issues at the Oak Ridge National Lab (of which Lower East Fork Poplar Creek is a part) are very high profile due to community concerns and the large amount (estimated to be several hundreds of thousands of pounds) of mercury that was released. Consequently, Lower East Fork Poplar Creek and associated sites are among the most well-studied mercury sites in the country and are indeed the source of much state-of-the-art knowledge relative to human health and environmental issues related to mercury. Second, its ROD is quite recent (1995) and therefore represents both the latest thinking on the part of both the technical community and a very recent record of local community reaction to a mercury cleanup project. While community reaction also clearly varies from site to site, it is worth noting that the cleanup numbers at Oak Ridge were commented upon by a very large and diverse group of interested individuals. Third, the cleanup levels were established in the 400 ppm range when the Site posed far more significant risks to human health and the environment [due to the magnitude of the mercury released, risk found to be posed to neighboring residences, and impacts detected in a wetland and flood plain] than posed at the Taylor Instrument Site, making the cleanup number a conservative one if applied here.

The New York site, which was cleaned up pursuant to a Voluntary Cleanup Agreement which was predicated upon a future industrial, commercial or recreational use. In fact, an anticipated potential future use for a portion of this Site was to pave it and turn it into a park/playground for an immediately adjacent school. NYSDEC's approval of the remedial approach was predicated on excavation of soils that exceeded the TCLP level for hazardous waste, an approach for which NYSDEC was subsequently praised at a Congressional hearing. Mercury speciation was done as a part of the VCA, but only after the cleanup goals was established.

5. Proposed Soil Quality Goal and Remedial Approach

Based CE proposes that the following be applied to the Taylor Instrument Site for mercury:

- The HHRA established that levels of 2,500 mg/kg of mercury or higher were protective of human health at the Site based on specific assumed receptors and future use scenarios.

- Higher (>100 mg/kg) levels of mercury are almost exclusively confined to soils within the upper 8 feet of ground surface, and generally are co-located with identified areas of concentrated glass shard wastes.

- Lower (0.1 to 1.0 mg/kg) levels of mercury are intermittently present throughout the overburden soil column over a significant portion of the Site.

- The observed mobility of mercury at the Site is low, similar to mobility reported in the scientific literature and for other Sites with a similar mercury speciation profile.

- Mercury was generally not measured at levels exceeding applicable standards in groundwater at the perimeter of the Site.

- Available data indicate that the vast majority of mercury at the Site is in a non-mobile, non-bioavailable and in a comparatively non-toxic form. Due to the length of time this material has been exposed to the environment (30-90 years) this speciation profile can be considered stable and unlikely to significantly change.

CE believes that the above represents the best approach to the Ames Street Site for the following reasons:

CE's proposed approach protects human health. ABB-ES' risk assessment calculated that both direct contact and inhalation exposures for the intended Site use would be protected by a soil cleanup level of 2,500 mg/kg. DOH has suggested that additional soil gas/exposure data be collected to verify this number and CE is willing to do this. Assuming this effort confirms 2,500 mg/kg is protective, the proposed cleanup level is at a level which is 85% lower than 2,500 mg/kg, which is protective of human health.

CE's proposed approach protects the environment. The Phase I investigation demonstrated that relative to mercury there are few if any environmental receptors and no significant off-Site impacts (except, possibly, sewers). The lack of environmental impact is a consequence of several factors:

1. The limited mobility of elemental mercury, which is well documented at the Taylor Instrument Site, at similar Sites, and in literature. Mercury forms in soils at the Site are unlikely to change appreciably in the near future, and mercuric sulfide (less bioaccessible form) would be the preferred soil alteration phase even in the event of further alteration.

2. The Site has not caused adverse impact to endangered species, threatened species or any designated species of concern because no such species have been found on the Site. Virtually the entire (urban) Site was covered by pavement or structures for decades. Since approximately the turn of the century, the Site has not presented an attractive (and hence not a significant) fish or wildlife habitat for local (or migrating) fauna or flora because of its urban location, its lack of significant cover and its lack of surficial water. Likewise there are no protected streams or tidal/freshwater wetlands or designated areas of critical environmental concern at, or in close proximity to, the Site.

3. The contaminants at the Site have not caused, and are not expected to cause in the future under reasonably foreseeable scenarios, a significant environmental impact due to a fire (no combustible material left on Site), spill (no chemicals currently stored at the Site) explosion (no explosive material on the Site) or similar incident.

CE's proposed approach removes all "gross" mercury contamination and identifiable manufacturing process waste. All Site observations, from the investigations of the Class 4 area in the 1980's through demolition and the Phase I Site Investigation suggest that the glass shard wastes and soils containing visible liquid mercury (e.g., the Building 2 trench area) are the source of mercury impact at the Site and represent the overwhelming mass of mercury present. Removing these materials would accomplish removal of the "source" of contamination and the actual manufacturing process-derived wastes from the Site.

CE's proposed approach would allow the proposed Site redevelopment to occur. The schedule of a TAGM-driven remedy would entirely preclude the currently proposed redevelopment project. The City's and TOPs' Technical representatives have been provided copies of all submissions to NYSDEC and have reviewed these proposed soil cleanup goals. Their specific redevelopment needs have been factored into the HHRA use and construction assumptions. Feedback from the City's Division of Environmental Quality has been factored into this memo.

Achieving the TAGM cleanup level of 0.1 mg/kg or any level below several hundred mg/kg would be impractical, difficult and enormously costly. Section III.3 illustrates that although cleanup to the TAGM meets the threshold criteria of protection of human health and the environment, it would be difficult to implement due to the very large and deep excavation required and the correspondingly huge soil volumes. Significant excavation would have to be done in saturated soils for cleanup levels set in the 10-100 mg/kg and below. In addition to soil volume, the other major factor driving practicality and cost is excavation below the top of the water table. The top of the water table at the Site is between 6 and 8 feet below grade. This level is beneath the lower-most levels of concentrated glass shards. In addition, mercury in soil levels in excess of 100 mg/kg generally do not occur deeper than 8 feet.

Figure 1 represents our preliminary estimates of costs as compared to potential cleanup numbers. As shown by this figure, the "cost inflection point," or point at which costs increase dramatically (based on soil volumes), is in the vicinity of several hundred mg/kg.

Community acceptance of CE's proposed approach is likely to be equal to a TAGM-based remedy. Community reaction relative to remedy at the Taylor Instrument Site is likely to focus as much on the Site's redevelopment and future use as on environmental issues. The proposed redevelopment project has community support and fills a long-standing need in the community for grocery stores. A longer implementation period, such as required to achieve numbers close to the TAGM 4046 level, would eliminate this development. In addition, questions relative to the impact of a TAGM-based remedy would be greater for CE's proposed approach due to the much greater project size and duration. Due to the cleanup goal precedents set at other sites - particularly Oak Ridge, Tennessee - and the results of the Phase I investigation and health risk assessment which demonstrate no off-site health threat or significant impact, CE believes there is substantial reason to believe that community questions relative to potential long-term impacts can be effectively answered.

CE's proposed approach is reasonable due to its conformance to precedent at other sites, and reliance on the latest risk assessment methodology, and minimal use of institutional control. The proposed approach is not only protective, it is demonstrably over-protective of human health and the environment yet still allows a project of importance to the community to proceed. This is supported by the incorporation of the latest risk assessment techniques and by the numbers being used by other state regulatory agencies as cleanup standards and as derived for other mercury-impacted sites nationally.

Unlike a TAGM-driven approach, CE's proposal is cost-effective. CE estimates that its proposed remedy will cost between $3,000,00 and $5,000,000, as compared to a $8,000,000 to $12,000,000 range for cleanup levels between 10 and 100 mg/kg and exceeding $20,000,000 for a cleanup to the TAGM level. The theoretical added benefit to human health and the environment simply does not justify this exorbitant additional cost.

CE's proposed approach minimizes the need for institutional controls and oversight by DEC. The "one number approach" will ensure that only two significant controls are required - no use of groundwater and restriction to commercial/industrial use. Any commercial/industrial-related operation, including direct contact with Site soils, is acceptable, minimizing the burden on the NYSDEC, NYSDOH and future property owners.

Mercury levels in Site perimeter groundwater generally meets the state groundwater standard. This is expected to remain the case even following remediation because of the non-mobility of the mercury. Therefore, no groundwater remediation for mercury is considered necessary (and thus none is planned) to achieve the State water quality goals over time. Long-term monitoring will be included in the VCA Workplan to ensure that perimeter groundwater mercury levels remain at or below levels of concern.

IV. TCE

1. Key Phase I Findings

Key Phase I investigation findings related to TCE are as follows:

- TCE is the predominant Site-related VOC in soil and groundwater.
- Low levels (0.7 to 2.0 mg/kg) of TCE are widely distributed in saturated soils downgradient of the two primary "source" areas.
- Because the Site will be restricted to industrial/commercial development, the lowest HHRA quality goal (2.7 mg/kg), if used as a remedial goal, would be protective of human health and the environment.
- Based on levels found in on-site perimeter wells, the presence of TCE at levels above the New York Class GA groundwater standard in off-site overburden groundwater is suspected. There are no known off-site users of this groundwater.

2. Remedial Obligation Under New York's Voluntary Remediation Program

2.a. Soils

The HHRA (Volume II of the November 1996 VSI Report) developed risk-based TCE soil goals of 2.7 mg/kg and higher based on various future use scenarios for the Site. Based upon the HHRA, 2.7 mg/kg of TCE in soil would meet the NYSDEC Voluntary Cleanup Program Objective of ensuring that the Site is safe for its future intended use, as long on-site groundwater (which will contain some residuals for some time after remediation), does not pose a vapor inhalation threat. Because of this concern, an additional remedial objective, verifying (through on-Site soil gas measurement) that TCE vapor levels are at or below "safe" levels before the initial phase of Site redevelopment begins, is proposed. If the soil vapor levels from groundwater and residual soil exceed a specified safe level (calculated by applying the model used in the HHRA to the measurements), engineering controls (such as a vapor barrier) will be installed under all buildings to be constructed in areas determined to be susceptible to elevated vapor levels. It is anticipated that TCE vapor levels on-Site will drop significantly within a fairly short amount of time (before the next construction phase) following completion of the TCE remediation.

2.b. Groundwater

In addition to addressing future safe use of the Site, setting cleanup numbers under NYSDEC's Voluntary Cleanup Program is to be based on contaminated groundwater situations (i.e "potential for use, discharge to surface water and the practicality of cleaning up to standards"). (NYSDEC 1996 Guidance at 5.) Table 5-2 of the VSI includes human health based groundwater goals predicated upon the fact that the potential use of groundwater on-site will be precluded by deed restrictions and there is no known or anticipated off-site use of groundwater. There are no discharges to surface water bodies at or near the Site. NYSDEC and the two Health Departments have indicated that Site-related groundwater migrating off-site must not pose a human health threat through potential exposures to either TCE vapors or contaminated groundwater seeping into basements. This issue is addressed below.

3. Evaluation of TAGM 4046 Level

Although this Site is proceeding towards a Voluntary Cleanup Agreement and the future use of the Site will be limited to industrial and commercial activities, and thus the criteria discussed in section IV.2 above are applicable to selecting a cleanup number under NYSDEC policy, NYSDEC stated that it intends to consider both the 6 NYCRR Part 375 remedy selection criteria and New York's Inactive Hazardous Waste Site's residential-based cleanup guidance set forth in TAGM 4046 when setting cleanup goals for this Site. Accordingly, without resolving the applicability of those criteria, CE factored them into the process of proposing TCE cleanup goals for the Site

Attachment 2 describes possible remedial approaches for the Taylor Instrument Site including using in-situ, ex-situ or possibly a combined in-situ/ex-situ remedy for TCE. Attachment 4 compares the TAGM 4046 levels to Part 375 remedy selection criteria, and Table 2 compares the TAGM 4046 level and CE's proposed cleanup objective (2.7 ppm TCE in soils above the saturated zone, plus groundwater monitoring) against the Part 375 remedy selection criteria.

The following points summarize CE's evaluation. Cleanup to the TAGM 4046 residential cleanup standard is unnecessary because:

a. There is significant uncertainty as to whether in-situ methods could achieve the TAGM or near TAGM cleanup numbers.

b. Due to the need to actively remediate saturated-zone soils in order to achieve the TAGM, cost and difficulty of the remedy are greatly increased. Wells would need to be deeper, more closely spaced, and the system would need to handle both air and liquid phases. Construction, operation and maintenance of such a system presents significant practical difficulties relative to the impending site development, for little incremental benefit in terms of protection of human health and the environment.

c. A minimum of several years would be required to achieve the TAGM cleanup values (if they could be achieved at all) throughout which CE, the site owner, DEC, etc. would need to be involved in oversight, reporting, technical analysis, etc.

d. Ex-situ methods are theoretically effective in achieving the TAGM cleanup number, but would present significant practical difficulties due to the need to excavate significant volumes of saturated soil with the associated dewatering, shoring, etc.

e. Ex-situ methods for achieving a TAGM cleanup number would have a significant potential for community impact due to noise, dust, trust traffic, air emissions and the like.

f. Costs to achieve the TAGM are high, ranging from an estimated $3.5MM to over $10MM for the most rapid ex-situ method.

4. Examples of Cleanup Levels at Other Sites

The following table provides several recent examples of cleanup levels approved by NYSDEC for TCE from sites in New York.

Site/Location	Lead Agency	TCE Cleanup Level (mg/kg)	Source/Date
Lehigh Valley RR Derailment (Site 819014)	NYSDEC	7	*
Rochester Fire Academy (Site 828015)	NYSDEC	10 for total VOCs**	ROD, March 1993
Grumman Aerospace-Bethpage OU A-1 (Site 130-003A)	NYSDEC	levels achievable by SVE	***

* According to David Napier, (NYSDOH) based on the PRAP and the draft ROD which was to be finalized and signed by NYSDEC on 3/31/97.

** According to Mark Gregor of the City of Rochester's Division of Environmental Quality, TCE was one of the 3 primary VOC contaminants at this Site.

*** Based upon information received from Andrew Barber, formerly of Geraghty & Miller, who was the Project Manager

It is difficult to directly compare cleanup levels at other Sites featuring different conditions and land uses. However, it is clear that the previously proposed, human health risk-derived cleanup levels for the Taylor Instrument Site (2.7 mg/kg without engineering controls) is within the range of levels previously approved by NYSDEC within the City of Rochester, as well as elsewhere in Region 8 and New York.

5. Proposed Cleanup Goals and Remedial Approach

CE proposes that the following TCE Cleanup Goals be applied to the Taylor Instrument Site:

- Remediate TCE-impacted soils that exceed 2.7 mg/kg. above the saturated zone.
- Verify (through soil gas measurement) that TCE vapor levels are at or below "safe" levels before the Site redevelopment begins. If the soil vapor levels from groundwater and residual soil exceed a safe level (determined by applying the model used in the HHRA to the measurements), engineering (vapor) controls must be installed in all buildings constructed over areas determined to be susceptible to elevated TCE vapor levels.
- Allow saturated-zone soils and overburden groundwater to be remediated through source area removal (as stated above) followed by a combination of intrinsic bioremediation and natural attenuation.
- Undertake a post-remediation long-term perimeter groundwater monitoring program designed to confirm that TCE levels in overburden ground water are decreasing and will

reach "acceptable levels" within a reasonable time and to track indicators of intrinsic bioremediation.

As discussed in Attachment 2, the follow conclusions with respect to the feasibility of the available remedial approaches were the primary considerations in selecting the top of the TCE soil cleanup goal[5]:

- Soil excavation and off-site disposal is practical above the top of the water table, but this technique experiences increasing difficulty with depth below the top of the water table.
- If significant volumes below the water table have to be excavated, an on-site dewatering, storage and off-site disposal will be necessary. This could lead to significant implementation and cost issues if the collected groundwater has to be handled as a hazardous waste due to the "derived from" rule or TCLP results.
- Both SVE and VER are proven technologies and are expected to work at this Site. There are no significant technical barriers to implementing an in-situ remedy for TCE at the Taylor Instrument Site for cleanup numbers set at the higher end of the range. There is significant question as to whether these systems can reach levels near the low end of the range at this Site.
- Both SVE and VER systems can be designed and constructed so that the collection systems are in the ground and not interfere with Site use. They will, however need to be protected from vehicular traffic during Site development and throughout their operational life.
- Operation of either type of an in-situ system after an asymptotic level (rate of removal of TCE mass) of TCE is reached will not be cost effective nor would it yield significant additional environmental improvement.
- Thermal desorption is an innovative technology which has been applied at full scale. It is easily managed above the top of the saturated zone.

Based upon the three available and implementable remedial approaches identified in Attachment 2, CE projected comparative cost estimates by both cleanup number (for the 0.1 to 140 mg/kg range) and remedial approach (in-situ [SVE], ex-situ with off-site disposal and ex-situ with low temperature thermal desorption). Figure 2 depicts these estimates. The projected costs contained in this figure are based upon the available data and reasonable assumptions regarding factors such as volumes of soil to be treated, spacing of in-situ wells, and the fraction of the removed material which would have to be handled as a hazardous waste. These assumptions will probably change as the Site moves into the remediation phase, but they served their intended purposes of insuring a consistent review of relative costs across the cleanup range and between remedial approaches.

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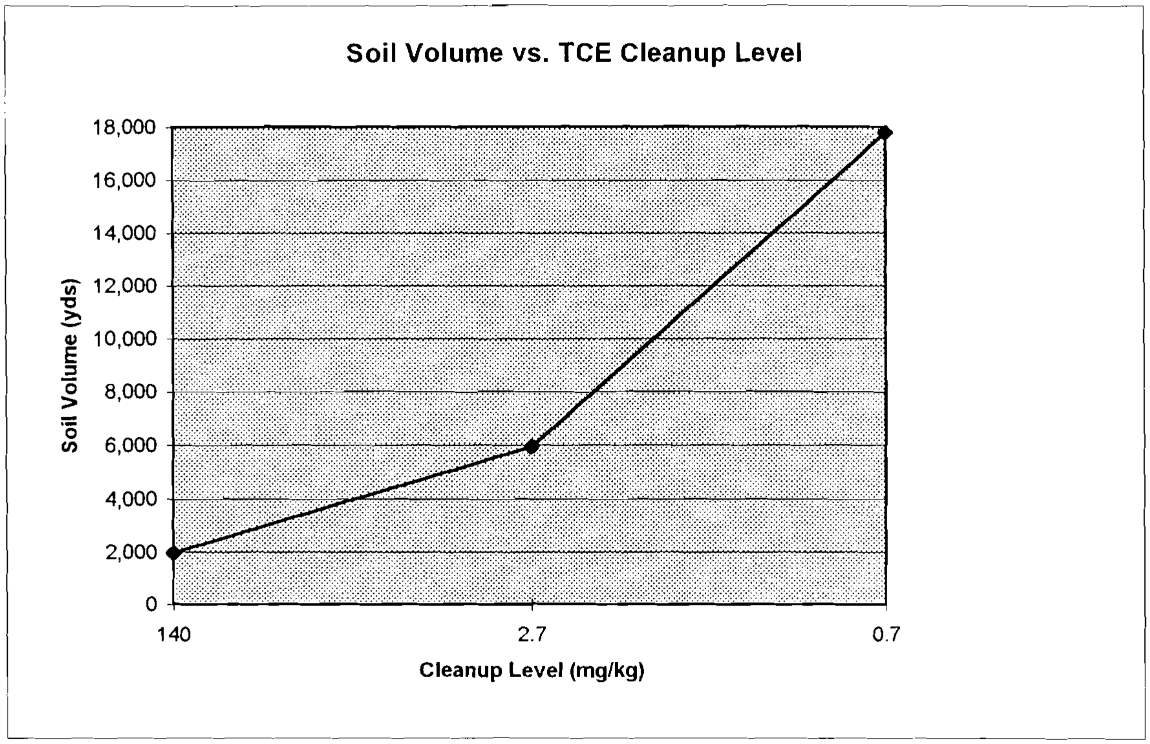
[5] As discussed during CE's April 21, 1997 meeting with representatives of NYSDEC, NYSDOH and MCDOH, the assumed range of numeric cleanup goals for TCE was 0.1 to 140 mg/kg. This range was based on the TAGM 4046 residential goal at the low end and the lowest human health goal established in the November 1996 HHRA report.


Soil Volume vs. TCE Cleanup Level
Soil Volume (yds)
18,000
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
140
2.7
0.7
Cleanup Level (mg/kg)

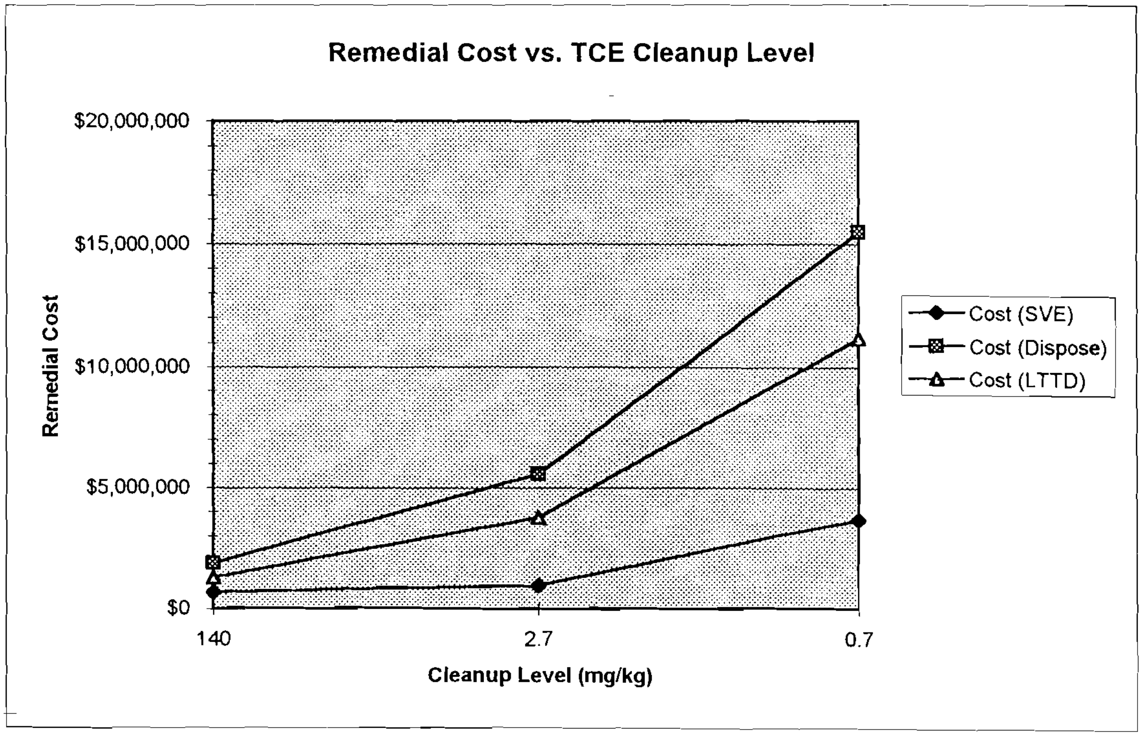

Remedial Cost vs. TCE Cleanup Level
Remedial Cost
$20,000,000
$15,000,000
$10,000,000
$5,000,000
$0
140
2.7
0.7
Cleanup Level (mg/kg)
Cost (SVE)
Cost (Dispose)
Cost (LTTD)

FIGURE 2

Based upon these factors, and the projected costs, CE proposes that a TCE cleanup level of 2.7 mg/kg be applied to the Taylor Instrument Site for all soils above the saturated layer (7 to 8 feet below ground surface), subject to confirmation (through the off-site groundwater and soil gas survey proposed in the accompanying workplan) that there is no off-site human health impacts in excess of levels demonstrated to be safe under the HHRA due to elevated TCE vapors or groundwater seeping into basements.

The proposed cleanup level and remedial approach represents the best approach to the Taylor Instrument Site for the following reasons:

Achieving the TAGM cleanup level of 0.7 mg/kg would require a lengthy remedial timeframe. As discussed in Attachment 2, there remains a significant concern as to whether the commercially available in-situ methods would be able to achieve 0.7 mg/kg in the saturated residual material before asymptotic conditions (beyond which little or no significant removal of TCE mass) were reached. The proposed cleanup goal (2.7 mg/kg average level in all soils above the saturated zone) would have substantially more certainty of being achieved within a reasonable timeframe. If an ex-situ method is used, excavation above the saturated zone is a fairly straightforward, common remedial technique.

CE's proposed goals are protective of human health with respect to the intended Site use. ABB-ES' HHRA calculated that both direct contact and inhalation exposures for the intended Site use would be protected by a cleanup level of 2.7 mg/kg. (or higher). Achieving this goal (or putting the system in-place that will allow the goal to be met within a reasonable timeframe) would allow commercial/industrial use within a few months of when the remediation is initiated. Based upon the HHRA, the TCE-related proposed remedial goals would meet the NYSDEC Voluntary Cleanup Program objective of ensuring that the Site is safe for its future intended use, as long as the site-related groundwater which will contain some residuals for some time after remediation, does not pose a vapor inhalation threat. To address this concern, CE proposed an additional remedial objective, to verify that TCE vapor levels (through soil gas measurement) are at or below "safe" levels before the Site redevelopment begins. If the soil vapor levels from groundwater and residual soil exceed a safe level (determined by applying model used in the HHRA to the measurements), engineering (vapor) controls will be installed in all buildings to be constructed over soils where vapor level exceedences exist. It is anticipated that TCE vapor levels on-site will drop significantly within a fairly short amount of time (before the next construction phase) following completion of the TCE remediation due to both soil source removal and falling groundwater concentrations.[6]

CE's proposed approach eliminates the "sources" of TCE. Removing TCE in unsaturated soils to a level of 2.7 mg/kg essentially eliminates the two source areas. Residual impacts would consist of a relatively low saturated-zone impact downstream of the two source areas which would be expected to naturally attenuate and/or be reduced through intrinsic bioremediation over time following source removal.

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[6] If TCE levels in unsaturated soils are reduced to below 2.7 mg/kg, it is expected that TCE levels in groundwater will drop below the 2.3 mg/l human health risk quality goal for on-site groundwater. (See Table 5-2 in the November 1996 VSI Report.)

CE's proposed approach is consistent with the uses and overall quality of groundwater in the area and on that basis does not reflect a meaningful departure from the TAGM-based levels. Groundwater is not used at or near the Site and is not used at all for human consumption. Future use of groundwater appears to be very unlikely given the Site's urban setting and the long established municipal public water supply that is available in the City. Deed restrictions will prevent the use of on-Site groundwater for any purpose, and the City (REDCO), as new owner, has procedures to ensure adherence to site restrictions. The ultimate effect of the difference between the TAGM and the proposed cleanup goals relative to groundwater quality as a whole will probably be small.

The proposed cleanup goals will significantly reduce TCE levels in overburden groundwater. Recent scientific literature indicates that intrinsic bioremediation and natural attenuation, both of which are recognized groundwater remedial approaches for groundwater, may reduce the TCE levels over time if source areas are addressed. Part of the proposed perimeter monitor will track indications of attenuation and bioremediations.

Community acceptance of CE's proposed approach is likely to be high. Community reaction relative to the TCE remedy at the Taylor Instrument Site is expected to focus on whether there is a health risk to nearby businesses or residences during and after remediation and on whether the community's desired redevelopment objective (a much needed food market) will occur within a safe setting. The lack of off-Site health risk is expected to be demonstrated by the various on-Site and off-Site sampling efforts CE will be undertaking. Timing considerations associated with particular remedial options and cleanup levels will affect whether the community's desired Site development can occur.

CE's proposed action level is consistent with other Sites in Region 8 and New York State. A cleanup number of 2.7 mg/kg is within the range (1.0 - 10.0 ppm) of other TCE/Total VOC cleanup levels approved locally.

V. Other COCs

CE is not proposing in this memorandum numeric cleanup numbers for lead, PCE, 1,2-DCE and some of the other Site-related constituents because of their co-location with the COCs for which cleanup numbers were proposed and CE's expectation that these other contaminants will, therefore, be addressed in conjunction with the remediation needed to achieve the proposed final cleanup goals. If NYSDEC does not agree upon.

- Lead is present in elevated (>400 mg/kg) concentrations in some soils, generally in soils which also contain high mercury concentrations. The 400 mg/kg is an EPA value which is based on residential exposures to children, which will not occur at this Site. Therefore no separate cleanup goal is proposed for lead, because lead will likely be addressed as the mercury is remediated.

- PCE and 1,2-DCE are present in strong association with TCE but at much lower concentrations.

- Other VOCs are present in either very limited areas or at such low concentrations that they appear to represent minimal human health or environmental threat.

TABLE 1
Comparison of Proposed Mercury Cleanup Goal to TAGM Against Part 375 Remedial Selection Criteria

Cleanup Goal **MERCURY**	**Complies with guidance**	**Protects human health**	**Protects environ-ment**	**Short term effectiveness**	**Long-term effectiveness**	**Reduces toxicity, mobility, volume**	**Implement-ability / Feasibility**	**Removes "gross" contam.**	**Cost / Cost Effective**	**Community acceptance**	**Precedents**
TAGM (0.01 mg/kg)	Meets Part 375 and TAGM 4046	Protective	Protective	Potentially greater impact due to longer duration	Effective and permanent	Does not change toxicity or mobility but 90-99% volume reduction	Very difficult to implement	Removes	>$ 20MM / Not cost effective (marginal env. health benefit for cost)	Acceptance affected by traffic, noise, duration and jeopardy to redevelopment project	Yes
Proposed (400 mg/kg)	Meets Vol. Cleanup Prog. and Part 375	Protective	Protective	Lower impacts due to shorter duration	Effective and permanent	Does not change toxicity or mobility but 90-99% volume reduction	Able to implement	Removes to 4 ft. and in excess of 400 mg/kg	>$3MM More cost effective	Likely acceptable. Enables community supported redevelopment project	Yes - recent, extensively studied sites which posed greater risks established comparable goals

TABLE 2
Comparison of Proposed TCE Cleanup Goal to TAGM Against Part 375 Remedial Selection Criteria

Cleanup Goal	Complies with guidance	Protects human health	Protects environment	Short term effectiveness	Long-term effectiveness	Reduces toxicity, mobility, volume	Implementability / Feasibility	Removes "gross" contam.	Cost / Cost Effective	Community acceptance	Precedents
TAGM (0.07 mg/kg)	Meets Part 375 and TAGM 4046	Protective	Protective	Potentially greater impact due to longer duration	Effective and permanent; long term control and monitoring required	Reduces volume and toxicity	Difficult to implement	Removes	$3MM - 10MM Not cost effective	Acceptance affected by duration, noise, dust and jeopardy to redevelopment project	Yes
Proposed (2.7 mg/kg) above saturated zone	Meets Vol. Cleanup Prog. and Part 375	Protective	Protective	Low impact due to shorter duration	Effective and permanent; long term control not necessary; less long term monitoring	Reduces volume and toxicity	Able to implement	Removes	$1MM - $4MM More cost effective	Acceptable; enables community supported redevelopment project	Yes

Attachment 1

Review of TAGM 4046 Residential Cleanup Goal for Mercury Against the Part 375 Remedy Selection Criteria

Protects Human Health and the Environment -- Cleaning up to the TAGM criteria would protect human health and the environment, although the TAGM is based on background levels rather than human health risk considerations. The TAGM 4046 level is designed to be protective for uses (e.g., residential) that would be prohibited at this Site by deed restriction, zoning and historical Site uses. The planned redevelopment option for the Site would not result in exposures anywhere close to a residential use, and thus, the TAGM number is over-protective for this Site's actual circumstances relative to human health. Due to the lack of environmental receptors, the TAGM level is also over-protective of the environment.

Short-Term Impacts and Effectiveness -- The TAGM 4046 residential soil mercury goal of 0.1 mg/kg would generally protect human health and the environment during implementation of the remedy. Due to the very large excavation necessary to achieve the TAGM level, there would be potential for significant impacts on the community from dust, noise, truck traffic and other outgrowths of large excavation projects. Certain of these items (e.g., dust) would be relatively easy to control, others (e.g., noise and traffic) less so. Similarly, impacts to workers could probably be minimized by appropriate hazard control, although due to the large excavation and its intrusion into the saturated zone, some hazards (such as wall collapse) would still remain.

Impacts arising from use of the TAGM number as a cleanup number from the Site stem from the lengthy and difficult excavation and the dewatering steps that would be integral to achieving a 0.1 mg/kg level. Utilizing the most rapid remedial approach, excavation followed by direct off-site disposal, achievement of the TAGM cleanup level would require at least 6-8 months. However, due to cost, the more probable remedy would be excavation and treatment (to avoid prohibitive disposal costs for volumes of soil required to be excavated to achieve a TAGM level cleanup). Based on typical throughputs for the available treatment systems, achieving the TAGM cleanup level would require 1-2 years or more.

Long-Term Effectiveness and Permanence -- CE's analysis of feasible remedial technologies indicates that excavation would be a part of any remedy. Therefore, hazardous wastes would not be left on Site. At the TAGM level, NYSDEC's concern with respect to both "gross contamination" and "insult" to soils and groundwater would be addressed through extensive excavation to levels below the water table. Little or no long-term controls or monitoring would be necessary.

Reduction of Toxicity, Mobility and Volume -- Mercury is present at the Site primarily in non-mobile and non-bioaccessible forms. The two most viable technologies to meet the TAGM cleanup level, excavation/direct disposal and excavation/treatment differ in their ability to further reduce toxicity, mobility and to reduce volume. Both remedial approaches (excavation and off-site disposal or excavation and treatment) would greatly reduce in-place waste volume by removing it from the ground, but neither would address the mobility of residuals, which would continue to be very low. Toxicity would not be improved for residual wastes, or probably for the waste itself (unless it was treated), because the non-bioaccessible form of mercury is considered stable and not likely to change due to excavation activities.

Implementability -- Although it is theoretically possible to cleanup to the TAGM cleanup level, doing so would be very difficult. The primary difficulty involves the excavation of an estimated 125,000 or more cubic yards of material from the Site to depths of up to 25 feet, under saturated soil conditions. The dewatering, shoring, and trained personnel and equipment necessary to complete this would be very expensive and hence infeasible. To reach a level even close to the TAGM, the selected remedy would be likely to feature both on-site treatment and replacement of soils, requiring construction of a physically large treatment and storage train (if the remedy was to be completed within any kind of reasonable time frame) along with the associated infrastructure. Administratively, the project would be difficult due to considerations such as noise, dust, traffic, community acceptance and other issues.

Cost -- Remediation of mercury at the Taylor Instrument Site to the TAGM cleanup levels would be prohibitively expensive and, thus, not cost effective or feasible. Although difficult to estimate, present worth costs would probably exceed $20,000,000 due to the volume of material requiring removal and excavation conditions.

Community Acceptance -- Community concerns relative to the Taylor Instrument Site which have been expressed to CE (via a "hot line" maintained during facility demolition and other inquiries to ABB Instrumentation, through working with the local City Council representative and from informal encounters with nearby residents since 1993) have exclusively centered on the future use of the Site and its perceived benefits or detriments to the community. Residents within this part of the City have repeatedly expressed a desire for a full service local grocery store. In the context of efforts to reach a cleanup level anywhere close to the 0.01mg/kg soil TAGM level, it is reasonable to assume that potentially significant concerns relative to short-term impact (steady, heavy truck traffic for 6 months or more and/or on-site treatment of mercury contaminated soil and groundwater, plus noise and dust issues) and schedule (including delay of the current development project) may be expressed by the community. Concerns relative to future or long-term health risk would presumably be minimal.

Attachment 2

Copies of Relevant Material for Other Mercury-Impacted Sites

CDM Camp Dresser & McKee

Report

State of California
California Environmental Protection Agency
Department of Toxic Substances Control
Region 2
700 Heinz Avenue
Berkeley, CA 94710-2737

Mark E. Piros
Hazardous Substances
~~Associate Waste Management~~ Engineer (510) 540-3832
Site Mitigation Branch CALNET 8-571-3832

Final Remedial Action Plan

Environmental Mercury Assessment Phase V Almaden Quicksilver County Park

December 6, 1994

DEPARTMENT OF TOXIC SUBSTANCES CONTROL
REGION 2
DEC 14 1994
STATE OF CALIFORNIA
EPA
RECEIVED

Prepared for:

Santa Clara County
Parks and Recreation Department
Los Gatos, California

Prepared by:

Camp Dresser & McKee Inc.
Walnut Creek, California

Table 4.7-1
Remediation Goals

Area	Remediation Goals (mg/kg)	
	General Child Scenario	Localized Child Scenario
Hacienda Furnace Yard	404 (400)(1)	NA(2)
Mine Hill Area	298 (300)	NA
Enriquita Mine Retort	465 (450)	NA
San Mateo Mine Retort	495 (500)	NA
Senator Mine	402 (400)	NA
North America Tunnel	500	NA
TOTAL	NA	382 (400)

(1) Field analytical techniques only allow estimation of soil concentrations to two significant figures. Thus, actual cleanup goals would be those in parentheses.
(2) NA = Not Applicable

The most restrictive goal is for the Mine Hill area (298 mg/kg), due mainly to the large component of exposure estimated for inhalation of mercury vapor. Since this area is the largest and most "attractive" area from a historical perspective, it may be reasonable to apply a strict cleanup criteria which reflects the anticipated intensive use of this part of the park.

The remediation goal calculated for the localized child scenario (382 mg/kg) can be applied to the Hacienda Furnace Yard and the Enriquita Mine Retort areas. These areas contributed significantly to exposures for children playing in specific areas.

Remediation goals of 500 mg/kg for the San Mateo Mine Retort and North America Tunnel areas and 400 mg/kg for the Senator Mine are appropriate based upon the method of proportions. Estimated mercury vapor concentrations are highest at the Senator Mine, yielding the lower remediation goal for this site.

4.7.2 Ecological Cleanup Goals

Potential risks to terrestrial wildlife were determined to be low and thus do not require separate ecological risk-based cleanup goals for surficial mine waste materials. As discussed in the ecological risk assessment, however, soil mercury concentrations greater than 50 mg/kg may be

Enriquita Mine Retort

Alternative No. 1 — No Action
Alternative No. 2 — Removal/Disposal
Alternative No. 3 — Containment

San Mateo Mine Retort

Alternative No. 1 — No Action
Alternative No. 2 — Institutional Controls
Alternative No. 3 — Removal/Disposal

5.4 Comparison of Alternatives

The assembled alternatives were then evaluated against seven criteria as established by EPA guidance for conducting feasibility studies. These evaluation criteria are:

- Overall Protection of Human Health and the Environment
- Compliance with Applicable or Relevant and Appropriate Requirements (ARARs)
- Long-term Effectiveness
- Reduction of Toxicity, Mobility, and Volume
- Short-term Effectiveness
- Implementability
- Cost

Table 5.4-1 provides a summary of the key components, including costs, of each alternative for all of the sites within the park.

The FS report concluded with the identification of a recommended, preferred remedial alternative for each area in the park. A discussion of each of the alternatives is presented below by area. The justification for selecting the preferred alternative and rejecting the other alternatives is included.

950601.0001

C.1

[redacted]

Key:

KC

OAK RIDGE [illegible] (ORNL)

Tennessee

Mercury

Soils, sediment, groundwater

Bioavailability

mercuric sulfide

elemental mercury

Bioavailability Adjustment Factor (BAF)

DOE/OR/02-1370&D1

BD JACOB000C

Record of Decision for Lower East Fork Poplar Creek

CLEARED FOR

PUBLIC RELEASE

KS

DOE/OR/02-1370&D1

Record of Decision
for
Lower East Fork Poplar Creek

Date Issued—May 1995

Prepared by
Jacobs ER Team
125 Broadway Avenue
Oak Ridge, Tennessee
under contract DE-AC05-93OR22028

Prepared for
U.S. Department of Energy
Office of Environmental Restoration and Waste Management

PREFACE

This record of decision for Lower East Fork Poplar Creek (EFPC) (DOE/OR/02-1370&D1) was prepared in accordance with requirements under the Comprehensive Environmental Response, Compensation, and Liability Act to present the selected remedy to the public. This work was performed under work breakdown structure 1.4.12.3.1.04 (Activity Data Sheet 9304, "Lower East Fork Poplar Creek"). (Publication of this document meets a Federal Facility Agreement milestone of June 1, 1995.) This document provides the Environmental Restoration Program with information about the selected remedy for Lower EFPC, which involves excavating floodplain soil with mercury concentrations > 400 parts per million and disposing of the soil at a landfill at the U.S. Department of Energy—Oak Ridge Y-12 Plant. Information in this document summarizes information from the remedial investigation (DOE/OR/02-1119&D2&V1 and V2), the feasibility study (DOE/OR/02-1185&D2&V1 and V2), and the proposed plan (DOE/OR/02-1209&D3).

ACKNOWLEDGEMENTS

This document was prepared by the Jacobs ER Team under prime contract to the U.S. Department of Energy. Team members are:

Jacobs Engineering Group Inc.
Geraghty & Miller, Inc.
Lockwood Greene Technologies, Inc.
PAI Corporation
Solutions To Environmental Problems
United Science Industries
University of Tennessee

Additional support was given to the team by Martin Marietta Energy Systems, Inc.

DESCRIPTION OF THE SELECTED REMEDY

This response action fits into the overall Oak Ridge Reservation (ORR) cleanup strategy by addressing floodplain soil, sediment, and groundwater contaminated by mercury originating from the DOE Oak Ridge Y-12 Plant (Y-12 Plant). Remediation of the surface water in Lower EFPC can best be accomplished through the DOE Y-12 Environmental Restoration Program, and the continuing mercury releases will be regulated under the Clean Water Act National Pollutant Discharge Elimination System permit for the Y-12 Plant. Therefore, Lower EFPC surface water is not within the scope of this ROD, but is discussed for informational purposes only. The objective of this remedial action is to minimize the risk to human health and the environment from mercury-contaminated soil and sediment in the Lower EFPC floodplain pursuant to CERCLA and the FFA (1992).

The selected remedy addresses the principal threats at the site by excavating and disposing of the identified floodplain soils contaminated above the remediation goal of 400 ppm mercury. The major components of the selected remedy include:

- excavating identified floodplain soils with mercury concentrations greater than 400 ppm from four areas. [Three of the areas are at the National Oceanic and Atmospheric Administration (NOAA) site (two areas in Parcels #571 and one area in #461), and the other area is at the Bruner's Center site (Parcel #564). The total in situ volume to be excavated is estimated to be 7,650 m^3 (10,000 yd^3)];
- disposing of the contaminated soil in a permitted landfill at the Y-12 Plant;
- performing confirmatory sampling in the excavated areas to ensure all mercury concentrations above 400 ppm have been removed;
- backfilling the excavated areas, including the 0.24-ha (0.6-acre) wetland at the Bruner's Center, with clean borrow soil and vegetating appropriately; and
- appropriate monitoring on Lower EFPC to ensure effectiveness of the remediation.

Groundwater does not present an unacceptable risk to human health and the environment. If sufficient quantities of groundwater could be extracted from the shallow soil horizon (0–20 ft) for residential use, such groundwater could pose an unacceptable risk. However, because residential use of the shallow soil horizon (shallow) groundwater is not realistic (as explained in more detail in the Decision Summary), groundwater is not considered an unacceptable risk. As a safeguard, DOE will monitor to detect any future residential use of the shallow groundwater. In the unlikely event such use is detected, DOE will mitigate, as appropriate, any risks associated with such use.

STATUTORY DETERMINATIONS

The selected remedy is protective of human health and the environment, complies with federal and state requirements that are legally applicable or relevant and appropriate, and is cost-effective. However, because treatment of the soils, which pose the principal threat at the site, was not found to be practicable, this remedy does not satisfy the statutory preference for treatment as a principal element of the remedy. This remedy will result in remediation of hazardous substances that allows for unlimited use of, and unrestricted exposure to, the Lower EFPC OU.

APPROVALS

Manager U.S. Department of Energy Oak Ridge Field Office	Date
Director, DOE Oversight Division State of Tennessee Tennessee Department of Environment and Conservation	Date
Regional Administrator U.S. Environmental Protection Agency Region IV	Date

maintenance and periodic environmental monitoring, including a 5-year recurring review, would ensure that levels of risk remain acceptable. Institutional actions would include future land-use limitations, construction permit restrictions, public education, and signs.

ALTERNATIVE 7: INSTITUTIONAL ACTIONS FOR COMMERCIAL/DOE AND OTHER REMEDIAL UNITS SOILS; EXCAVATION AND DISPOSAL OF RESIDENTIAL REMEDIAL UNIT SOILS

Alternative 7 addresses remedial actions on an area-specific basis. For this alternative, DOE would acquire the real estate rights to and fence the NOAA site. Soil containing mercury above the remediation goal would remain uncovered inside the fenced area. Institutional actions, including land-use restrictions, would be implemented.

In the Residential Remedial Unit, all remaining soil with mercury concentrations greater than the remediation goal would be excavated and disposed of in a permitted landfill at the Y-12 Plant. Clean borrow soil would be used to fill the excavation.

In the remaining areas of the Commercial/DOE and Other Remedial Units, institutional actions would be implemented to maintain nonagricultural and nonresidential land use. Institutional action in these areas and in the fenced areas would include future land-use limitations, construction permit restrictions, public education, signs, environmental monitoring, and a 5-year recurring review. Implementation of this alternative would involve activities very similar to those described for Alternatives 3 and 6.

SUMMARY OF COMPARATIVE ANALYSIS OF ALTERNATIVES

DOE, TDEC, and EPA evaluated all alternatives against the nine criteria provided by CERCLA for final remedial actions. This comparative analysis is provided here.

OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

Overall protection of human health and the environment addresses whether an alternative provides adequate long- and short-term protection of human health and the environment from unacceptable risks from hazardous substances by reducing, eliminating, or controlling exposure and describes how risks posed through each pathway are eliminated, reduced, or controlled through treatment, engineering controls, or institutional controls. All of the alternatives, with the exception of the no action alternative, adequately protect human health and the environment by eliminating, reducing, or controlling risk through treatment, engineering controls, or institutional actions.

The greatest risk associated with Alternatives 2 through 7 would be to ecological receptors. Alternatives 3 and 5 would eliminate unacceptable residual risk in the floodplain and would not permanently alter floodplain habitat. These alternatives would impact ecological receptors in small areas and recovery might be slow. Alternative 7 would provide a high degree of overall protection to human health but would leave residual risk for ecological receptors. Alternatives 2 and 4 would permanently alter habitat and land use, and residual contaminants would remain. Alternative 6 provides the least overall protection of the action alternatives because containment and extensive fencing throughout the floodplain would permanently alter habitat, and long-term maintenance of fencing and access controls is considered difficult.

The no action alternative is not considered further in this analysis because it does not protect human health and the environment.

COMPLIANCE WITH APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

Compliance with applicable or relevant and appropriate requirements (ARARs) addresses whether a remedy will meet all ARARs of all federal and state environmental statutes and/or provide grounds for invoking a waiver. Alternatives 2 through 7 would comply with identified federal and state ARARs. No waivers would be necessary to implement any of the remedial alternatives. The "Statutory Determinations" section summarizes the ARARs for the selected remedy.

LONG-TERM EFFECTIVENESS AND PERMANENCE

Long-term effectiveness and permanence refers to the magnitude of expected residual risk and the ability of a remedy to maintain reliable protection of human health and the environmental over time, once cleanup goals have been met. Alternatives 3 and 5 provide the greatest degree of long-term effectiveness and permanence because they would remove all contaminated material above levels of concern from the OU. Alternatives 2 and 4 provide slightly less long-term effectiveness and permanence because some of the contaminated material would remain in the floodplain and be covered by 45 cm (18 in.) of soil. Alternative 7 provides less long-term effectiveness and permanence than Alternatives 2 and 4 because only institutional actions limit contact with the contaminated material in the floodplain. Maintenance of fencing and land-use restrictions would be required for long-term effectiveness in some areas. Alternative 6 provides the least amount of long-term effectiveness and permanence because all contaminated material would remain in place, and access would be restricted by fencing.

REDUCTION OF TOXICITY, MOBILITY, OR VOLUME THROUGH TREATMENT

Reduction of toxicity, mobility, or volume through treatment addresses the anticipated performance of treatment that permanently and significantly reduces toxicity, mobility, or volume of waste. Alternatives 4 and 5 would reduce the toxicity of mercury-contaminated soil through low-temperature thermal desorption. None of the other alternatives include treatment processes.

SHORT-TERM EFFECTIVENESS AND ENVIRONMENTAL IMPACTS

Short-term effectiveness considers impact to community, site workers, and the environment during construction and implementation and includes the time until protection is achieved. All of the alternatives involve minimal transportation and construction accident risks. Risk to the community and to workers from exposure to contaminants would be within acceptable limits because engineering controls and a project-specific health and safety plan, including personal protective equipment, would be used. A floodplain statement of findings, provided as an appendix to the feasibility study (DOE 1994b), is the resultant document from the floodplain assessment of Lower EFPC. The statement of findings concludes that there is no practicable alternative to remediating the Lower EFPC floodplain soil that would not destroy any wetland areas.

Alternative 7 would have the least impact on the environment because only a small area of floodplain habitat would be destroyed. Alternatives 2, 3, and 6 would have a greater adverse effect on the environment than Alternative 7 because they involve excavation of a larger area of contaminated floodplain soil. Alternatives 4 and 5 would have the largest impact on the environment because implementation would destroy the largest area of habitat of the alternatives, and treatment would involve additional handling of the soil.

IMPLEMENTABILITY

Implementability is the technical and administrative feasibility of a remedy, including the availability of materials and services needed to implement the chosen solution. Alternatives 2 and 3 are most readily implementable because they involve only excavation, disposal, containment, and institutional actions that are commonly used and readily implementable. Alternative 7 would be slightly more difficult to implement because of the additional separate actions required to acquire a portion of land and restrict access by fencing. Alternative 6 would be less implementable if landowners were reluctant to negotiate agreements with DOE for contaminated portions of their property. Long-term maintenance of the soil cover and fencing may also be difficult. Alternatives 4 and 5 may be the hardest to implement because they include a treatment process, low-temperature thermal desorption, for which full-scale effectiveness and implementability have not been proven. Low-temperature thermal desorption is an EPA-accepted, best demonstrated available technology, effective in removing mercury from Lower EFPC soils in bench-scale and pilot-scale tests.

COST

Cost compares the differences in cost, including capital and operation and maintenance costs, expressed as estimated total present-worth cost. Alternative 7 is the least expensive action alternative. The next lowest-cost alternatives are Alternatives 6, 2, and 3. Alternatives 4 and 5 are the most expensive.

STATE ACCEPTANCE

State acceptance evaluates whether the state agrees with, opposes, or has no comment on the preferred alternative. The state of Tennessee concurs with the selected remedy.

COMMUNITY ACCEPTANCE

Community acceptance addresses the issues and concerns the public may have regarding each of the alternatives. The proposed plan (DOE 1995b) presented Alternative 3, as previously described, as DOE, EPA, and TDEC's preferred alternative. The "Selected Remedy" section reflects a compromise of the many public comments on the proposed plan. The "Highlights of Community Participation" section summarizes community participation. Part 3, the "Responsiveness Summary," summarizes and responds to comments submitted during the public comment period.

SELECTED REMEDY

Based on a comparative analysis of the alternatives presented in the feasibility study (DOE 1994b), Alternative 3 is selected as the remedial action. This alternative reflects the best balance of the evaluation criteria. The remediation goal that is protective of human health and the environment is 400 ppm mercury.

PB95-964504
EPA/ROD/R09-95/134
June 1995

EPA Superfund Record of Decision:

Carson River Mercury Site
(OU 1), Lyon/Churchill County, NV
3/30/1995

PART 1. DECLARATION

SITE NAME AND LOCATION

Carson River Mercury Site
Lyon, Storey and Churchill County, Nevada

STATEMENT AND PURPOSE

This Record of Decision ("ROD") presents the selected remedial action for Operable Unit 1 ("OU-1") of the Carson River Mercury Site ("CRMS") which is located in Lyon, Storey and Churchill Counties, Nevada. This document was developed in accordance with Comprehensive Environmental Response, Compensation, and Liability Act of 1980 ("CERCLA") as amended by the Superfund Amendments and Reauthorization Act of 1986 ("SARA"), 42 U.S.C. Section 9601 et seq., and in accordance with the National Oil and Hazardous Substances Pollution Contingency Plan, 40 C.F.R. Section 300 et seq., ("NCP"). This decision is based on the administrative record for this operable unit.

In a letter to EPA dated March 29, 1995, the State of Nevada, through the Nevada Division of Environmental Protection (NDEP) concurred with the selected remedy for this operable unit of the CRMS.

ASSESSMENT OF THE SITE

Actual or threatened release of hazardous substances from this site, if not addressed by implementing the response action selected in this ROD, may present an imminent and substantial endangerment to public health, welfare, or the environment.

DESCRIPTION OF THE REMEDY

The remedial action objective for OU-1 of the CRMS is to reduce human health risks by reducing direct exposure to surface soils containing mercury at concentrations equal to or greater than 80 milligrams per kilogram (mg/kg) in residential areas. There are six areas which are considered actionable based on this cleanup objective: five residential yards and one ditch ("Dayton Ditch").

The selected remedy for the five residential yards is to excavate contaminated surface soil (estimated to go to a depth of approximately 2 feet below ground surface), dispose of the soil at a RCRA municipal landfill if the soils do not exceed the TCLP standards, and restore the excavated areas. Approximately 5000 cubic yards of soil will be excavated and disposed of as part of this response action. If it is determined that all or part of the excavated soil exceeds the TCLP standards, then the excavated soil will either be treated and disposed of at a RCRA municipal landfill or disposed of at a RCRA hazardous waste landfill. Which of these sub-alternatives that will be used will depend on which sub-alternative is found to be more cost effective and the logistics of implementing each sub-alternative.

The selected remedy for the Dayton Ditch is no action. EPA selected no action for the Dayton Ditch because the health risks for this area are not great enough to warrant response actions such as capping or excavation and the State of Nevada and the community expressed opposition to institutional controls (i.e., restricting access with a fence). Although EPA has selected no action for the Dayton Ditch, additional samples will be collected from the ditch during the remedial design to further evaluate the level of impact. In the event that EPA determines that some form of remediation is warranted, then EPA will document this remedy selection in an "Explanation of Significant Differences (ESD)" or ROD amendment, or the area will be addressed as part of OU-2.

The response actions for the residential yards address the incidental soil ingestion exposure pathway which was found to be of potential concern for populations near impacted areas. Also found to be an exposure pathway of potential concern is consumption of fish or waterfowl from the Carson River system. However, this remedial action is not attempting to address this pathway. Operable unit 2 of the remedial investigation and feasibility study ("RI/FS") will evaluate methods to reduce mercury concentrations in fish and waterfowl.

The major components of the selected remedy include:

- Excavation of approximately 5000 cubic yards of contaminated soils, disposal at a RCRA municipal and/or hazardous waste landfill, and restoration of properties. In the event that subsurface soil (greater than or equal to 2 feet below ground surface) is impacted and is not addressed, then this alternative may also include institutional controls; and
- Implementation of institutional controls to ensure that any residential development in present open land use areas known or suspected to be impacted by mercury includes characterizing mercury levels in surface soils and, if necessary, addressing impacted soils. These institutional controls will be referred to as the "Long-term Sampling and Response Plan."

This remedial action addresses a principal risk at the CRMS by removing contaminants from surface soil, thereby significantly reducing the toxicity, mobility or volume of hazardous substances in surface soil. This remedial action will reduce the possibility of human contact with mercury and thereby reduce the human health risks.

STATUTORY DECLARATION

The selected remedy is protective of human health and the environment, complies with federal State requirements that are legally applicable or relevant and appropriate to the remedial action, and is cost-effective. This remedy utilizes permanent solutions and alternative treatment (or resource recovery) technologies to the maximum extent practicable. However, because treatment of soils may not occur, this remedy may not satisfy the statutory preference for treatment as a principal element of the remedy. Because this remedy will result in hazardous substances remaining on-site above health-based levels, a five-year review, pursuant to CERCLA Section 121, 42 U.S.C. Section 9621, will be conducted at least once every five years after initiation of the remedial action to ensure that the remedy continues to provide adequate protection of human health and the environment.

Keith Taka
Keith Takata
Deputy Director,
Hazardous Waste Management Division

3-30-95
Date

PART 2. DECISION SUMMARY

This Decision Summary provides an overview of the problems posed by the Carson River Mercury Site ("CRMS" or the "Site"), the alternatives considered for addressing those problems which are within the scope of operable unit ("OU-1"), and presents the analysis of the remediation alternatives. This Decision Summary also provides the rationale for the remedy selection and describes how the selected remedy satisfies the statutory requirements.

1.0 SITE DESCRIPTION

1.1 SITE DEFINITION

The Carson River Mercury Site (CRMS) consists of the portions of the Carson drainage and Washoe Valley in Northwestern Nevada which are affected by mercury released from milling operations during the Comstock Lode. The exact boundaries of the affected area were not defined as part of this remedial investigation because knowledge of these boundaries were considered to have little or no influence on the findings of the risk assessment.

The current definition of the CRMS study area is as follows: sediments in an approximately 70-mile stretch of the Carson River beginning near Carson City, Nevada and extending downstream through the Lahontan Reservoir to the terminal wetlands in the Carson Desert (Stillwater National Wildlife Refuge and Carson Lake); tailing piles, sediments and soil in Gold Canyon, Sixmile Canyon, and Sevenmile Canyon; and sediments and soil in Washoe Valley (Figure 1).

This Record of Decision ("ROD") calls for remedial action in Dayton and Silver City, Nevada. Both Dayton and Silver City are located in Lyon County.

1.2 SITE PHYSIOGRAPHY

The Carson River drainage basin drains approximately 3,980 square miles in east-central California and west-central Nevada. The Carson River heads in the eastern Sierra Nevada mountains south of Lake Tahoe and generally flows northeastward and eastward to the Carson Sink (Figure 1). The Carson River flows through a series of generally separate alluvial valleys from the headwaters area to the Carson Sink. In downstream order, the alluvial valleys passed by the river include Carson Valley, Eagle Valley, Dayton Plains, Stagecoach Valley, Churchill Valley, and Carson Desert (Figure 2). Between New Empire and Dayton the river flows through a narrow, high-gradient stretch along which large ore-processing mills were situated during the late 1800s. The flow of the river is interrupted west of Fallon by Lahontan Reservoir, which was constructed in 1915 as part of the Newlands Irrigation Project. Below Lahontan Dam, flow is routed through a complex network of ditches, drains, document prescribes criteria for evaluating if material is acceptable for alternate uses. Based on the FS, the technologies that would most likely be used for treating contaminated soil are either gravity separation or a conventional mining technology (i.e., cyanidation).

In the event that the excavated soil does not exceed the TCLP standard, then this alternative involves excavation of surface soil, disposal at a municipal landfill, and restoration of excavated areas. Both alternatives involve excavation of contaminated surface soil (estimated to go to depth of approximately 2 feet below ground surface), and site restoration. Site restoration would involve returning the affected area to pre-excavation conditions which may include replacing fences, structures, and vegetation. Potential institutional controls would be the same as described for Altemative 3.

Long-term Sampling and Response Plan

With exception for Alternative 1, certain institutional controls were considered to be an additional part of each of the described altematives. These institution controls, which will be known as the 'Long-term Sampling and Response Plan," are to manage impacted areas that will not be remediated as part of this operable unit. The FS did not evaluate remediation alternatives for impacted areas in Sixmile Canyon and adjacent to the Carson River between New Empire and Dayton because these areas do not pose health risks with the current land use (non-residential). In the event that residential development is proposed in these areas or other areas where mercury levels may exceed 80 mg/kg, then certain procedures described in the Long-term Sampling and Response Plan will be followed.

The Long-term Sampling and Response Plan will set forth specific sampling guidelines for characterizing mercury levels in surface soils and for addressing impacted areas. The areas where any residential development will be subject to the guidelines prescribed in this plan are generally described as follows:

Sixmile Canyon - Refers to the tributary of the Carson River that begins near Virginia City in the Virginia mountain range and meets the Carson River approximately five miles east of Dayton. The segment of concern is the canyon which begins just below Virginia City and extends to the mouth of the canyon just above the alluvial fan.

Alluvial Fan - Refers to the alluvial fan below the mouth of Sixmile Canyon. The fluvial channels extending across the fan from the mouth of Sixmile Canyon to the Carson River confluence are the areas of concern.

Brunswick Canyon - Refers to the Carson River flood plain between New Empire (the Mexican Mill) and Dayton.

Carson River Flood Plain Above Lahontan Dam - Refers to the Carson River flood plain extending between Dayton and Lahontan Reservoir.

Carson River Flood Plain Below Lahontan Dam - Refers to the flood plain of the South Branch of the Carson River beginning below Lahontan Dam and extending to Carson Lake.

In instances where residential development is proposed within these defined areas, Nevada Division of Environmental Protection (NDEP) will provide the interested parties with the Long-term Sampling and Response Plan Guidelines. The guidelines will provide specific instructions for sampling an area to assess mercury levels in surface soils, instructions for interpreting and reporting results, instructions for follow-up sampling, and instructions for addressing impacted areas.

The Long-term Sampling and Response Plan Guidelines will be developed by EPA as part of the remedial design for this operable unit. The guidelines will be administered through NDEP's Bureau of Corrective Actions. However, development within the boundaries of the specified areas will be monitored through NDEP's Bureau of Water Pollution Control which reviews sewerage facility plans for new developments made up of five or more subdivisions. For smaller developments, the county planning offices will notify NDEP of proposed developments and NDEP will contact the developer. The Long-term Sampling and Response Plan does not provide for NDEP to enforce the implementation of the guidelines. Rather, NDEP will notify EPA of any recalcitrant parties and EPA will have the discretion of using the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), Sections 104 and 106 authorities to enforce compliance with the guidelines..

9.2 DETAILED ANALYSIS OF ALTERNATIVES

This section provides an explanation of the criteria used to select the remedy, and the analyses of the remedial action alternatives in light of those criteria, highlighting the advantages and disadvantages of each of the alternatives.

9.2.1 CRITERIA

The alternatives were evaluated using nine criteria. These criteria, which are listed below, are derived from requirements contained in the National Contingency Plan (NCP), 40 C.F.R. § 300 et seq. and CERCLA Section 121(b) and 121(c).

Overall Protection of Human Health and the Environment - The assessment against this criterion describes how the alternative, as a whole, achieves and maintains protection of human health and the environment.

Compliance with ARARs - The assessment against this criterion describes how the alternative complies with ARARs as well as any advisories, criteria, and guidance that the lead and support agencies have agreed are "to be considered."

Long-term Effectiveness and Permanence - The assessment of alternatives against this criterion evaluates the long-term effectiveness of alternatives in maintaining protection of human health and the environment after response objectives have been met.

Reduction of Toxicity, Mobility, and Volume Through Treatment - The assessment against this criterion evaluates the anticipated performance of the specific treatment technologies an alternative may employ.

Short-term Effectiveness - The assessment against this criterion examines the effectiveness of alternatives in protecting human health and the environment during the construction and implementation of a remedy until response objectives are attained.

Implementability - This assessment evaluates the technical and administrative feasibility of alternatives and the availability of required goods and services.

Cost - This assessment evaluates the capital and operation and maintenance (O&M) costs of each alternative.

State Acceptance - This assessment reflects the State's (or support agency's) apparent preferences among or concerns about alternatives.

Community Acceptance - This assessment reflects the community's apparent preferences among or concerns about alternatives.

9.2.2 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARS)

Section 121(d) of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), 42 U.S.C. Section 121(d) requires that remedial actions at Superfund sites comply with all the requirements of Federal or State environmental or facility siting laws, which are known in the Superfund program as Applicable or Relevant and Appropriate Requirements (ARARs).

This section summarizes the Federal and State statutes and regulations which EPA has determined are the ARARs for the selected remedial alternative for OU 1 of the CRMS.

Definition of ARARs

ARARs are defined as standards or requirements that are found to be either "applicable" or "relevant and appropriate" to the conditions and circumstances found at the site. Guidance for identifying ARARs may be found in the National Contingency Plan (55 Fed. Reg. 8741 et. seq. March 8 1990) and CERCLA Compliance With Other Laws Manual, Part I, Overview of RCRA Clean Water Act and Safe Drinking Water Act, OSWER Directive 9234.1-01 (August 1988) and CERCLA Compliance with Other Laws Manual Part II Clean Air Act, State Requirements and Other Environmental Statutes, OSWER Directive 9234.1-02 (August 1989).

"Applicable" requirements are defined as those cleanup standards of control, and other substantive environmental protection requirements, criteria or limitations promulgated under Federal or State law that specifically address or regulate a hazardous substance, pollutant, contaminant, remedial action, location or other circumstance at a Superfund site. "Applicability" implies that the remedial action or the circumstances at the site satisfy all of the jurisdictional prerequisites of a requirement.

"Relevant and Appropriate" requirements are defined as those standards of control, and other substantive environmental protection requirements, criteria or limitations promulgated under Federal or State law, 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 or to the remedial action alternatives. For example, requirements may be relevant and appropriate if they would be "applicable" but for jurisdictional restrictions associated with the requirement.

In addition to legally binding laws and regulations, EPA or the State may identify other non-promulgated advisories, criteria or guidance as "To Be Considered" requirements (TBCs). If no ARARs address a particular situation, or if existing ARARs do not ensure protectiveness, then advisories, criteria or guidelines are to be considered (TBCs) to set cleanup goals. If such an advisory, criterion or guideline is selected in the ROD, then it becomes a requirement that the remedial action must meet.

Section 121(e) implicitly states that no Federal, State, or local permits (administrative requirements) are required for remedial actions conducted entirely on site. However, these on-site remedial actions must meet the substantive requirements of ARARs. Any action which takes place off-site, however, is subject to the full requirements of Federal, State, and local regulations. Requirements which are applicable to offsite actions are not ARARs and are not "frozen" at the time the ROD is signed. Rather, all requirements--whether substantive or administrative--which exist at the time of the offsite action must be met.

COPY

CITRIC BLOCK SITE INVESTIGATION AND INTERIM REMEDIAL MEASURES WORK PLAN

Citric Block Site
Williamsburg Facility

December 12, 1995

Prepared for:

Pfizer Inc
630 Flushing Ave.
Brooklyn, New York 11206

Prepared by:

ROUX ASSOCIATES, INC.
1377 Motor Parkway
Islandia, New York 11788

4.0 CURRENT AND POTENTIAL FUTURE CITRIC BLOCK SITE USE

Pfizer has decommissioned the Citric Block Site to prepare this property for future redevelopment and/or beneficial use. As part of this process, the Citric Block Site buildings were demolished. (Demolition activities were completed in August 1995.) Presently, the reinforced-concrete-slab foundation is the only aboveground remnant of the former buildings. This slab is continuous throughout the entire block, and varies in thickness between approximately 0.5 and 1.5 feet. The entire Citric Block Site is surrounded by an eight-foot-high chain-link fence topped with barbed wire, and is under continuous security surveillance.

As stated earlier, the Citric Block Subsurface Investigation Report concluded that under current site-use conditions, the eastern half of the Citric Block Site does not present a risk to public health or the environment. This conclusion was based upon the absence of exposure pathways, thereby preventing contact of contaminants with a potential receptor. Since exposures to site-related chemicals cannot occur under current site conditions, there are currently no potential risks identified for the Citric Block Site. It is noted, however, that the Citric Block Subsurface Investigation Report did not address potential future use(s) of the property.

Pfizer is currently contemplating several redevelopment (future-use) scenarios for the Citric Block Site, including commercial, light industrial, or recreational use (i.e., as a park/playground for the adjoining elementary school). Redevelopment of the property would be conducted in such a manner as to preclude *any* exposure of Citric Block Site contaminants to humans (e.g., through capping, barriers, soil excavation, or a combination of these technologies). Therefore, even considering potential future-use scenarios, the Citric Block Site will not present a risk to public health or the environment.

5.0 IRM RATIONALE

Although Citric Block Site soil does not pose a current or future risk while capped with concrete, Pfizer wishes to remove "hot spot" areas of soil contamination as an added safety measure.

Excavation of soil "hot spots" will likely remove any soils that might be considered a potential RCRA characteristically hazardous waste. This conservative, yet aggressive, remediation approach is designed to provide an additional level of safety to the site (the Citric Block Site is already capped with concrete, and is surrounded by an 8-foot-high fence with 24-hour security surveillance), while ensuring that soils that could be characterized as RCRA hazardous are removed in an expeditious manner.

The IRM is designed to proceed in a phased fashion. Specifically, delineation and soil excavation will be implemented first for the eastern half of the Citric Block Site, where significant environmental data are already available. Following completion of the soil excavation efforts on the eastern half of the Citric Block Site, IRM efforts on the western half of the Citric Block Site will commence, beginning with the delineation of soil (fill) quality conditions. In this manner, information developed during IRM efforts on the eastern half of the Citric Block Site can be used to rescope and improve IRM efforts on the western half of the Citric Block Site, if necessary or desirable.

To preliminarily identify "hot spots" in the portion of the Citric Block Site where soil quality data have been already developed, soil quality data for the eastern half of the Citric Block Site were evaluated to preliminarily estimate those locations where soil could be characterized as RCRA hazardous, based upon Toxicity Characteristic Leaching Procedure (TCLP) testing. The results of this evaluation show that for the eastern portion of the Citric Block Site Soil Borings CB-1, CB-3, CB-4, CB-6, CB-8, CB-9, CB-10, CB-11, and CB-12 yield soil concentrations that could potentially "fail" a TCLP test and, therefore, be classified as a characteristically hazardous waste. Preliminarily, these borings will serve as "markers" for approximating "hot spot" areas to be removed on the eastern half of the Citric Block Site during the IRM. These "hot spots" are shown in red in Figure 6. Additional delineation efforts (Task II of this Work Plan), including TCLP testing, will be performed around each of these borings to better define "hot spot" areas prior to implementation of the IRM.

The highest concentrations of contaminants are limited to the 0- to 2-ft interval directly below the existing concrete slab. In almost all cases, soil concentrations decreased significantly at depths deeper than 2 feet below the existing slab. An exception to this is at borings CB-1 and CB-4, where lead (CB-1) and mercury (CB-4) concentrations remain elevated down to 4 feet below the concrete slab. Based upon this information, the IRM soil "hot spot" removal effort in the eastern half of the Citric Block Site will be preliminarily limited to removing the 0- to 2-foot interval immediately underlying the concrete slab in the "hot spot" areas centered on borings shown in Figure 6, with the exception of the areas around borings CB-4 and CB-1, where excavation may proceed down to 4 feet below the slab.

At each soil boring, soil samples will be collected continuously at 2-ft intervals down to the perched ground water or clay layer, whichever is first encountered. Each soil sample will be inspected by the field geologist to characterize lithology and any evidence of contamination (e.g., staining, odors). A portion of each sample will be placed in a plastic Ziploc™ bag or glass jar and screened in the field for VOCs using a photoionization detector (PID). Detailed soil boring and sampling procedures are further discussed in the SAP (Appendix A).

The soil sample collected from the 0 to 2 ft interval (i.e., immediately below the concrete slab) and the soil sample that exhibits the highest degree of contamination (e.g., staining and odors) will be selected for laboratory analysis to assess the nature and extent of any impacts. However, if no impacts are discernible, the samples collected from the 0 to 2 ft interval and the 2 ft interval immediately above the perched ground water (if present) or clay layer will be submitted for analysis.

Each soil sample submitted for laboratory analysis will be analyzed for VOCs using NYSDEC ASP Method 91-1, SVOCs using NYSDEC ASP Method 91-2, metals using Superfund Contract Laboratory Program (CLP) Inorganics Method, TOC using USEPA Method 9060, pH using USEPA Method 9045 and Eh using American Standards & Testing Method (ASTM) Method 4646. Quality assurance samples (e.g., field blanks, matrix spike) will be collected for the above analyses as described in Appendix B.

Each soil boring will be surveyed for horizontal and vertical coordinates relative to the NGVD by a New York State licensed surveyor.

Background Sampling

The need for Citric Block Site-specific background soil quality is based upon the natural occurrence of certain constituents (i.e., metals) at the Citric Block Site, the nature of the media (non-native fill) in which these constituents are found, and the urban setting on which the Pfizer plant resides. In these areas, naturally occurring elements such as metals, and other pervasive compounds such as PAHs are commonly present in urban fill materials at levels above regional background concentrations and even above NYSDEC RSCOs. For example, ash cinders and asphalt are common components of fill that contain high concentrations of metals (e.g., mercury, lead, etc.) and PAHs.

Therefore, to determine the significance of these constituent concentrations at a given urban site, Citric Block Site-specific background soil quality data need to be developed. These data are collected from areas of the Citric Block Site where operations were not performed and are therefore not suspected as being potentially impacted from Citric Block Site operations. These background data will be used to develop Citric Block Site-specific ranges of concentrations for naturally occurring metals and PAHs. These background data will, in turn, be compared to soil metals and base neutral compounds (i.e., PAHs) data in the known areas of concern to identify environmental impacts from these constituents. To accomplish this, five soil samples will be collected from selected locations that will be situated away from known or suspected source areas of contamination. These locations will be established during the Citric Block Site reconnaissance (Task I). Each soil sample will be collected and analyzed from the 0 to 2 ft interval.

The background soil samples will be analyzed for base neutral compounds (i.e., PAHs) using the NYSDEC ASP Method 91-2 and metals using the Superfund CLP Inorganics Method. A further discussion of background sampling can be found in the SAP (Appendix A).

Metals Speciation

To assist in the evaluation of risk, fate and transport and the development of remedial alternatives, metals speciation will be performed for certain metals on all soil samples collected from soil borings at the Citric Block Site including the background samples (but excluding monitoring well pilot boreholes). Speciation will be performed for arsenic, chromium and mercury. A brief discussion of the metals to be speciated is provided below and in Appendix A.

Arsenic speciation (i.e., As^{+3} and As^{+5}) will be performed to determine if the predominant form present in the soil is As^{+3} (carcinogenic) or As^{+5} (non-carcinogenic). It is noted that, provided an exposure pathway exists (no known exposure pathways exist at the Citric Block

Site), the risk imposed by the As^{+3} (i.e., 0.37 parts per million [ppm] for ingestion) is several orders of magnitude greater than the risk imposed by the As^{+5} (i.e., 23 ppm for ingestion) due to its known behavior as a carcinogen.

Determination of Cr^{+3} and Cr^{+6} will be performed to identify the form of chromium in the soil samples. It is noted that, provided an exposure pathway exists (no known exposure pathways exist at the Citric Block Site), the risk imposed by Cr^{+6} (i.e., 390 ppm for ingestion) is several orders of magnitude greater than the risk imposed by Cr^{+3} (i.e., 78,000 ppm for ingestion).

Determination of metallic and non-metallic mercury including organic mercury will be performed to identify the form of mercury present in the soil samples. It is noted that, provided an exposure pathway exists (no known exposure pathways exist at the Citric Block Site), the risk for organic forms of mercury (i.e., methyl mercury) and metallic mercury are greater than the risk for inorganic/non-metallic mercury. In addition, in order to evaluate the form of mercury present in the soil, a mercury vapor meter will be employed to screen the vapor emanating from the boreholes created during soil sampling. The observation of mercury in the vapor phase, will be used to indicate the presence of metallic mercury in the soils. In addition, using the concentrations for mercury in the vapor phase, as measured during screening, coupled with temperature and barometric data, estimates of soil concentrations of metallic mercury may be calculated. The significance of the presence of metallic mercury, as compared to its non-metallic forms, is that provided an exposure pathway exists (no known exposure pathways exist at the Citric Block Site), it imposes a considerably higher health risk due to its inherent toxicity, high volatilization (i.e., inhalation risk), and high trans-dermal absorption.

Data Evaluation

Soil delineation work proposed in Task II is expected to require five to six weeks to complete (i.e., including laboratory analysis). These soil quality data will be evaluated in an expedited fashion to complete the general definition of soil "hot spot" areas across the eastern portion of the Citric Block Site. Specifically, soil borings yielding soil concentrations above the TCLP limits, as discussed in Section 5.0, will be shown in a map (similar to

Figure 6) and will serve as "markers" for approximating "hot spot" areas to be removed during implementation of the IRM. The results of this work will be provided in a technical memorandum to the NYSDEC.

7.3 Task III: IRM Implementation - Eastern Portion of the Citric Block Site

The IRM for the Citric Block Site will consist of the following tasks:

- further refinement of "hot spot" areas through focused soil sampling and analysis;
- pre-excavation analysis of contaminated soil for waste characterization through TCLP analysis;
- removal of the concrete slab over the delineated soil "hot spots";
- anticipated excavation of soil in "hot spot" areas down to 2 ft below the existing slab (except near CB-1 and CB-4), based upon soil quality conditions encountered on the eastern half of the Citric Block Site;
- disposal of excavated soil; and
- backfill and regrading of excavated areas.

7.3.1 Focused Soil Boring Program

A focused soil boring program will be implemented around the "hot spot" marker borings (known "hot spot" marker borings are shown in Figure 6) in order to:

- provide a high level of definition of "hot spot" areas in an effort to minimize the volume of soil requiring excavation, and eliminate the need for post-excavation sampling; and
- expedite the soil removal process by performing waste characterization sampling prior to soil removal, thereby eliminating the need for stockpiling excavated soils onsite.

The soil boring program will include the drilling and sampling of shallow soil borings (i.e., to a depth of 2 feet below the existing concrete slab) at regular (e.g., 5-foot or 10-foot) intervals radiating outward from each "hot spot" marker boring. For example, based upon existing Citric Block Site data, additional borings would be performed around existing soil borings CB-1, CB-3, CB-4, CB-6, and CB-8 through CB-12. Soil sampling will continue radially outward from each existing soil boring until the area containing constituents of concern at concentrations exceeding their respective TCLP limits has been completely delineated. For example, as shown in Figure 8, four initial soil borings will be drilled in a "ring" around each existing soil boring. These initial borings are shown in green in Figure 8. For each initial soil boring that contains constituents of concern at concentrations above their respective TCLP limit, sampling will continue outward incrementally (e.g., in 5- and/or 10-foot intervals) from that location until concentrations of all constituents of concern are below their respective TCLP limit. The outermost, or "perimeter", borings will define the limits of the "hot spot" area. In the vicinity of borings CB-1 and CB-4, soil borings will extend downward to a depth of 4 feet below land surface, since the 2- to 4-foot horizon at these locations were also shown to be contaminated during the recent subsurface investigation.

Soil samples will be collected using a Geoprobe™, and submitted to an analytical laboratory for analysis of the toxicity characteristics of metals using the TCLP and total mercury, with a 72-hour turnaround time requested. The analytical results will be used to delineate the extent of the soils requiring excavation.

In order to expedite the removal of contaminated soil and reduce the amount of time an excavation is left open, contaminated soils targeted for excavation will be analyzed for full waste characterization prior to excavation. Specifically, additional soil will be collected from each boring and stored on ice for later compositing to determine full waste characteristics for disposal purposes.

Once a "hot spot" area has been completely delineated, the extra soil samples from those borings within the "hot spot" area will be composited, and submitted to the analytical laboratory for waste characterization. At present, Roux Associates anticipates analyzing the composite samples for RCRA characteristics using TCLP, reactivity, ignitability, and corrosivity. However, the actual analytical suite, and the number of composite samples required, will be dictated by the receiving disposal facility.

These data will be used to precisely determine the actual "hot spot" areas to be excavated. Excavation will proceed up to, but not beyond, the perimeter borings that define the limits of each "hot spot" area. The actual "hot spot" areas to be excavated during the IRM will be shown on a map. This map, along with the focused soil boring data, will be provided in a technical memorandum to the NYSDEC.

7.3.2 Soil Excavation and Disposal

Based on the results of the focused "hot spot" delineation efforts described above, an excavation contractor will remove those portions of the concrete slab that overlie contaminated soil. All soil within the uppermost two feet of each delineated "hot spot" will then be removed, based upon our current understanding of the vertical distribution of contaminants. Since the soils within the "hot spot" areas will already have been characterized for disposal, excavated soils will be loaded directly into dump trucks standing by, thereby precluding the need to stockpile the excavated soil. Roux Associates will track soil volumes and examine waste manifests for accuracy and completeness.

Upon completion of soil-removal activities, the open excavations will be backfilled with clean fill from an off-site source. Post-excavation sampling will not be required since the extent of each "hot spot" area will be well defined by a series of "perimeter" borings where concentrations of all constituents of concern are below their respective TCLP limits. These "perimeter" soil borings will serve as substitutes for the more commonly collected post-excavation samples of the sidewalls of an excavation.

Following the backfilling of the excavations, the portion of the concrete slab which was removed to permit removal of contaminated soil will be restored. Concrete will be poured over the backfilled excavations until flush with the surrounding concrete slab (or sidewalk). Roux Associates will provide oversight during the excavation and disposal of the "hot spot" area soils and concrete slab, backfilling and Site restoration. Monitoring of air quality will be conducted using a PID and a particulate monitor. All activities will be documented in a field logbook.

7.4 Task IV: Soil Boring and Sampling - Western Portion of Citric Block Site

Soil samples will be collected on the western portion of the Citric Block Site to delineate soil quality and hydrogeologic conditions. The soil boring and sampling objectives are to:

- determine the nature and extent of contamination beneath the western portion of the Citric Block Site (i.e., former Buildings 5, 8, 9 and 11);
- determine additional subsurface hydrogeologic conditions (e.g., vertical permeability [hydraulic conductivity]); and
- determine geochemical characteristics of the soil (e.g., metals speciation).

A total of 27 soil borings will be drilled and sampled using the Geoprobe™ method at the western portion of the Citric Block Site. The locations of the 22 soil borings within the former buildings on the eastern half of the Citric Block Site are shown in Figure 7 (i.e., CB-25 through CB-46). The locations were selected to achieve the above-referenced objectives and may be modified based upon the results of the Citric Block Site reconnaissance (Task I).

At each soil boring, soil samples will be collected continuously at 2-ft intervals down to the perched ground water or clay layer, whichever is first encountered. Two of the 27 soil borings will be drilled to the base of the clay layer beneath the western portion of the Citric Block Site. The locations of the deeper soil borings will be selected in the field, and will be spaced throughout the western portion of the Citric Block Site.

Each soil sample will be inspected by the field geologist to characterize lithology and any evidence of contamination (e.g., staining, odors). A portion of each sample will be placed in a plastic Ziploc™ bag or glass jar and screened in the field for VOCs using a photoionization detector (PID). Detailed soil boring and sampling procedures are further discussed in the SAP (Appendix A).

The soil sample collected from the 0 to 2 ft interval (i.e., immediately below the concrete slab) and the soil sample that exhibits the highest degree of contamination (e.g., staining and odors) will be selected for laboratory analysis to assess the nature and extent of any impacts.

However, if no impacts are discernible, the samples collected from the 0 to 2 ft interval and the 2 ft interval immediately above the perched ground water (if present) or clay layer will be submitted for analysis.

Each soil sample submitted for laboratory analysis will be analyzed for VOCs using NYSDEC ASP Method 91-1, SVOCs using NYSDEC ASP Method 91-2, metals using Superfund Contract Laboratory Program (CLP) Inorganics Method, TOC using USEPA Method 9060, pH using USEPA Method 9045 and Eh using American Standards & Testing Method (ASTM) Method 4646. Quality assurance samples (e.g., field blanks, matrix spike) will be collected for the above analyses as described in Appendix B.

Grain size distribution and vertical permeability (i.e., hydraulic conductivity) will also be established for the samples of fill material and the underlying clay at two locations (i.e., a total of four samples). Determination of these parameters will supplement existing data and assist during the evaluation, if necessary, of fate and transport of potential migration of contaminants vertically through the clay. These four samples will be collected using Shelby™ tubes driven by a truck-mounted drill rig. The locations for these samples will be selected immediately after the completion of samples collected for chemical analyses.

Each soil boring will be surveyed for horizontal and vertical coordinates relative to the NGVD by a New York State licensed surveyor.

Metals Speciation

As discussed in Section 7.2, metals speciation will be performed for certain metals on all soil samples collected from soil borings at the Citric Block Site. Speciation will be performed for arsenic, chromium and mercury. A brief discussion of the metals to be speciated is provided below and in Appendix A.

Data Evaluation

Soil delineation work proposed in Task IV is expected to require five to six weeks to complete (i.e., including laboratory analysis). These soil quality data will be evaluated in an expedited fashion to complete the general definition of soil "hot spot" areas across the western portion of the Citric Block Site. Specifically, soil borings representing "markers" for approximating "hot spot" areas to be removed during implementation of the IRM, as discussed in Section 5.0, will be shown in a map (similar to Figure 6). The results of this work will be provided in a technical memorandum to the NYSDEC.

7.5 Task V: IRM Implementation - Western Portion of the Citric Block Site

The IRM for the western portion of the Citric Block Site will consist of the following tasks:

- further refinement of "hot spot" areas through focused soil sampling and analysis;
- pre-excavation analysis of contaminated soil for waste characterization through TCLP analysis;
- removal of the concrete slab over the delineated soil "hot spots";
- anticipated excavation of soil in "hot spot" areas down to 2 ft below the existing slab, based upon soil quality conditions encountered on the eastern half of the Citric Block Site;
- disposal of excavated soil; and
- backfill and regrading of excavated areas.

The scope of IRM efforts for the western half of the Citric Block Site may be modified based upon results of IRM efforts on the eastern portion of the Citric Block Site.

7.5.1 Focused Soil Boring Program

A focused soil boring program will be implemented around the "hot spot" marker borings in order to:

- provide a high level of definition of "hot spot" areas in an effort to minimize the volume of soil requiring excavation, and eliminate the need for post-excavation sampling; and
- expedite the soil removal process by performing waste characterization sampling prior to soil removal, thereby eliminating the need for stockpiling excavated soils onsite.

The soil boring program will include the drilling and sampling of shallow soil borings (i.e., to a depth of 2 feet below the existing concrete slab) at regular (e.g., 10-foot) intervals radiating outward from each "hot spot" marker boring. Soil sampling will continue radially outward from each existing soil boring until "hot spot" areas have been completely delineated.

Soil samples will be collected using a Geoprobe™, and submitted to an analytical laboratory for analysis of the toxicity characteristic metals using TCLP and total mercury, with a 72-hour turnaround time requested. The analytical results will be used to delineate the extent of the soils requiring excavation.

In order to expedite the removal of contaminated soil and reduce the amount of time an excavation is left open, contaminated soils will be analyzed for full waste characterization prior to excavation. Specifically, additional soil will be collected from each boring and stored on ice for later compositing to determine waste characteristics for disposal purposes.

Once a "hot spot" area has been completely delineated, the extra soil samples from those borings within the "hot spot" area will be composited, and submitted to the analytical laboratory for waste characterization. At present, Roux Associates anticipates analyzing the composite samples for RCRA characteristics using TCLP, reactivity, ignitability, and corrosivity. However, the actual analytical suite, and the number of composite samples required, will be dictated by the receiving disposal facility.

These data will be used to precisely determine the actual "hot spot" areas to be excavated. Excavation will proceed up to, but not beyond, the perimeter borings that define the limits of each "hot spot" area. The actual "hot spot" areas to be excavated during the IRM will be shown on a map. This map, along with the focused soil boring data, will be provided in a technical memorandum to the NYSDEC.

7.5.2 Soil Excavation and Disposal

Based on the results of the focused "hot spot" delineation efforts described above, an excavation contractor will remove those portions of the concrete slab that overlie contaminated soil. All soil within the uppermost two feet of each delineated "hot spot" will then be removed, based upon our current understanding of the vertical distribution of contaminants. Since the soils within the "hot spot" areas will already have been characterized for disposal, excavated soils will be loaded directly into dump trucks standing by, thereby precluding the need to stockpile the excavated soil. Roux Associates will track soil volumes and examine waste manifests for accuracy and completeness.

Upon completion of soil-removal activities, the open excavations will be backfilled with clean fill from an off-site source. Post-excavation sampling will not be required since the extent of each "hot spot" area will be well defined by a series of "perimeter" borings. These "perimeter" soil borings will serve as substitutes for the more commonly collected post-excavation samples of the sidewalls of an excavation.

Following the backfilling of the excavations, the portion of the concrete slab which was removed to permit removal of contaminated soil will be restored. Concrete will be poured over the backfilled excavations until flush with the surrounding concrete slab (or sidewalk). Roux Associates will provide oversight during the excavation and disposal of the "hot spot" area soils and concrete slab, backfilling and Site restoration. Monitoring of air quality will be conducted using a PID and a particulate monitor. All activities will be documented in a field logbook.

7.6 Task VI: Perched Ground-Water Investigation

The objective of the perched ground-water investigation is to determine the occurrence, nature and continuity of perched ground water, and if migration of contaminants in the perched ground water is occurring onsite. This will be accomplished through the installation and sampling of perched zone monitoring wells and water-level monitoring. A description of each component of the perched ground-water investigation is provided below.

Table 1. Summary of Metals Previously Detected in Soil During the Citric Block Subsurface Investigation, Pfizer Inc, Brooklyn, New York.

	Sample Designation:	CB-1	CB-1	CB-2	CB-2	CB-3
	Sample Depth (ft bls):	0-2	2-4	0-2	2-4	0-2
	Sample Date:	7/13/95	7/13/95	7/13/95	7/13/95	7/13/95
Metals (Concentrations in mg/kg)	NYSDEC RSCOs (mg/kg)					
Aluminum	33,000[1]	6,260	7,280	4,530	7,090	2,980
Antimony	--	11.7	7.1 B	3.4 B	6.4 B	9.2 B
Arsenic	7.5	**10.9**	**30.2**	**72.0**	**20.9**	4.3
Barium	300	157	56.6	60.7	97.9	38.5 B
Beryllium	0.16	0.10 B	0.10 B	0.11 B	**0.18 B**	0.04 U
Cadmium	1	**1.5**	**2.9**	0.80 B	**3.9**	0.75 B
Calcium	35,000[1]	10,100	24,000	13,900	4,410	16,200
Chromium	10	**11.9**	**14.0**	7.9	**22.1**	**26.8**
Cobalt	30	3.1 B	5.2 B	22.1	6.9 B	12.6
Copper	25	**255**	**220**	**222**	**654**	**118**
Iron	2,000	**6,880**	**10,900**	**12,500**	**7,590**	**6,090**
Lead	400	**4,220**	**1,660**	360	**484**	**734**
Magnesium	5,000[1]	968	1,480	1,670	976 B	958 B
Manganese	5,000[1]	330	146	197	54.3	102
Mercury	0.1	**484**	**95.5**	**64.1**	**49.4**	**69.2**
Nickel	13	8.5	**29.0**	**15.5**	**42.1**	8.0
Potassium	43,000[1]	377 B	791 B	454 B	530 B	557 B
Selenium	2	1.7	1.4	1.5	0.84 B	0.75 B
Silver	--	14.8	1.5 B	0.12 U	0.13 U	4.5
Sodium	8,000[1]	147 B	744 B	295 B	163 B	215 B
Thallium	--	1.8 B	1.4 B	1.8 B	0.78 B	0.79 B
Vanadium	150	15.4	34.1	16.4	17.1	8.8 B
Zinc	20	**435**	**1,110**	**831**	**532**	**269**

Table 1. Summary of Metals Previously Detected in Soil During the Citric Block Subsurface Investigation, Pfizer Inc, Brooklyn, New York.

	Sample Designation:	CB-3	CB-4	CB-4	CB-5	CB-5
	Sample Depth (ft bls):	4-6	0-2	2-4	0-2	2-4
	Sample Date:	7/13/95	7/13/95	7/13/95	7/12/95	7/12/95
Metals (Concentrations in mg/kg)	NYSDEC RSCOs (mg/kg)					
Aluminum	33,000[1]	604	4,430	7,430	3,830	4,100
Antimony	--	2.1 B	2.3 B	1.4 B	4.4 B	2.5 B
Arsenic	7.5	**8.2**	**31.2**	**26.4**	5.6	3.6
Barium	300	9.6 B	183	119	55.7	59.4
Beryllium	**0.16**	0.04 U	0.05 U	**0.19 B**	0.04 U	**0.19 B**
Cadmium	1	0.08 B	0.47 B	0.53 B	0.38 B	0.07 U
Calcium	35,000[1]	303 B	27,100	57,600	32,300	7,930
Chromium	10	0.41 B	8.7	**14.3**	9.7	7.1
Cobalt	30	4.0 B	3.9 B	4.8 B	8.8 B	4.1 B
Copper	25	12.7	**93.8**	**107**	**31.6**	**29.9**
Iron	2,000	**2,090**	**10,300**	**18,000**	**7,830**	**8,750**
Lead	400	66.3	273	158	316	190
Magnesium	5,000[1]	124 B	1,790	7,940	4,070	1,310
Manganese	5,000[1]	8.1	493	858	241	88.1
Mercury	0.1	**2.7**	**2640**	**499**	**68.8**	**85.5**
Nickel	13	**24.1**	7.9 B	12.1	11.5	11.3
Potassium	43,000[1]	209 B	1820	1610	604 B	668 B
Selenium	2	0.43 U	**11.5**	**4.4**	1.2	**5.9**
Silver	--	0.12 U	0.15 U	0.14 U	0.13 U	0.13 U
Sodium	8,000[1]	188 B	368 B	501 B	182 B	250 B
Thallium	--	0.69 U	2.9	3.3	0.71 U	1.6 B
Vanadium	150	1.3 B	20.7	30.0	11.5	13.8
Zinc	20	**714**	**150**	**307**	**93.1**	**53.1**

Table 1. Summary of Metals Previously Detected in Soil During the Citric Block Subsurface Investigation, Pfizer Inc, Brooklyn, New York.

	Sample Designation:	CB-6	CB-6*	CB-6	CB-7	CB-7
	Sample Depth (ft bls):	0-2	0-2	2-4	0-2	2-4
	Sample Date:	7/12/95	7/12/95	7/12/95	7/12/95	7/12/95
Metals (Concentrations in mg/kg)	NYSDEC RSCOs (mg/kg)					
Aluminum	33,000'	4,020	6,510	5,330	3,350	6,000
Antimony	--	70.0	43.1	2.0 B	5.2 B	0.78 U
Arsenic	7.5	22.6	20.5	10.7	9.8	1.3 B
Barium	300	130	164	63.0	91.7	18.1 B
Beryllium	0.16	0.04 U	0.05 U	0.12 B	0.22 B	0.04 U
Cadmium	1	0.23 B	0.29 B	1.5	0.34 B	0.07 U
Calcium	35,000'	3,430	12,000	52,000	4,880	650 B
Chromium	10	19.0	20.6	12.0	8.5	9.7
Cobalt	30	3.1 B	4.6 B	5.0 B	6.1 B	2.7 B
Copper	25	179	212	78.0	54.4	8.8
Iron	2,000	20,300	23,300	10,900	13,300	5,330
Lead	400	2,050	1,240	541	145	5.8
Magnesium	5,000'	1,160	2,180	3,640	561 B	1,390
Manganese	5,000'	83.0	123	277	169	48.8
Mercury	0.1	28.3	57.8	30.1	7.9	2.5
Nickel	13	16.4	29.7	61.7	16.6	9.6
Potassium	43,000'	685 B	872 B	679 B	664 B	308 B
Selenium	2	3.2	4.2	2.0 U	2.5	0.79 B
Silver	--	0.12 U	0.14 U	0.11 U	0.14 U	0.13 U
Sodium	8,000'	102 U	118 U	150 B	381 B	114 U
Thallium	--	2.0	3.7	1.5 B	2.0 B	0.74 U
Vanadium	150	26.4	26.0	18.4	24.8	9.2 B
Zinc	20	123	142	194	107	22.0

Table 1. Summary of Metals Previously Detected in Soil During the Citric Block Subsurface Investigation, Pfizer Inc, Brooklyn, New York.

Metals (Concentrations in mg/kg)	Sample Designation: Sample Depth (ft bls): Sample Date: NYSDEC RSCOs (mg/kg)	CB-8 0-2 7/14/95	CB-8 2-4 7/14/95	CB-9 0-2 7/14/95	CB-9* 0-2 7/14/95	CB-9 2-4 7/14/95
Aluminum	33,000[1]	4,490	3,890	2,890	5,030	10,900
Antimony	--	6,550	7.7 B	58.7	66.7	12.5
Arsenic	7.5	7.2	5.7	**10.0**	**11.1**	**57.0**
Barium	300	55.2	37.2 B	65.0	118	39.7 B
Beryllium	0.16	**0.20 B**	0.04 U	0.04 U	0.11 B	0.04 U
Cadmium	1	0.63 B	0.06 U	0.21 B	**4.1**	0.06 U
Calcium	35,000[1]	14,000	1,070	16,500	25,200	2,900
Chromium	10	7.3	4.3	7.8	8.7	**18.4**
Cobalt	30	3.4 B	4.2 B	**57.4**	**46.8**	5.9 B
Copper	25	**151**	9.9	**42.0**	**53.3**	11.4
Iron	2,000	**5,960**	**7,300**	**6,440**	**7,880**	**5,820**
Lead	400	**4,630**	28.1	362	**919**	34.7
Magnesium	5,000[1]	816 B	771 B	1,470	1,790	1,280
Manganese	5,000[1]	83.9	24.4	108	157	54.6
Mercury	0.1	**17.9**	**0.43**	**52.9**	**56.8**	**0.78**
Nickel	13	10.5	**13.2**	10.1	10.3	**25.4**
Potassium	43,000[1]	651 B	461 B	718 B	994 B	879 B
Selenium	2	0.70 B	1.2	1.4	1.7	1.2
Silver	--	0.13 U	0.12 U	3.9	2.6	0.12 U
Sodium	8,000[1]	448 B	106 U	117 U	352 B	141 B
Thallium	--	0.81 B	0.81 B	1.3 B	1.3 B	0.70 U
Vanadium	150	11.7	4.2 B	14.2	15.6	19.0
Zinc	20	**192**	**78.2**	**87.4**	**131**	**534**

Table 1. Summary of Metals Previously Detected in Soil During the Citric Block Subsurface Investigation, Pfizer Inc, Brooklyn, New York.

Sample Designation: Sample Depth (ft bls): Sample Date:		CB-10 0-2 7/13/95	CB-10 2-4 7/13/95	CB-11 0-2 7/14/95	CB-11 2-4 7/14/95	CB-12 0-2 7/12/95
Metals (Concentrations in mg/kg)	NYSDEC RSCOs (mg/kg)					
Aluminum	33,000[1]	6,040	4,150	7,910	10,200	6,240
Antimony	--	2.6 B	0.74 U	3.1 B	0.79 U	4.2 B
Arsenic	7.5	**20.3**	4.6	**33.4**	**12.1**	5.4
Barium	300	**599**	15.0 B	152.0	58.6	**411**
Beryllium	0.16	0.06 B	0.04 U	0.16 B	**0.20 B**	0.08 B
Cadmium	1	**1.9**	0.06 U	0.39 B	0.12 B	**2.7**
Calcium	35,000[1]	60,200	4,510	43,400	8,820	46,300
Chromium	10	**28.4**	7.5	**23.7**	**31.9**	**23.2**
Cobalt	30	5.5 B	2.5 B	5.2 B	6.2 B	5.6 B
Copper	25	**124**	11.2	**72.2**	**35.5**	**123**
Iron	2,000	**18,000**	6,840	**19,700**	**17,600**	**19,700**
Lead	400	665	77.9	536	54.4	427
Magnesium	5,000[1]	7,730	1.290	3,830	2,560	5.150
Manganese	5,000[1]	534	52.0	453	303	375
Mercury	0.1	**30.3**	**18.9**	**108**	**15.2**	**32.4**
Nickel	13	**24.0**	8.7	**22.1**	**20.5**	**24.1**
Potassium	43,000[1]	1430	300 B	1640	840 B	957 B
Selenium	2	**2.2**	0.43 U	**2.2**	**2.1**	**2.5**
Silver	--	0.11 U	0.12 U	0.60 B	0.13 U	0.13 U
Sodium	8,000[1]	1,050	593 B	308 B	242 B	471 B
Thallium	--	1.6 B	0.70 U	2.6	2.0 B	2.2 B
Vanadium	150	24.1	8.5 B	22.1	28.9	17.3
Zinc	20	**1,510**	**35.8**	**317**	**117**	**931**

Table 1. Summary of Metals Previously Detected in Soil During the Citric Block Subsurface Investigation, Pfizer Inc, Brooklyn, New York.

	Sample Designation:	CB-12	CB-13	CB-13
	Sample Depth (ft bls):	4-6	0-2	2-4
	Sample Date:	7/12/95	7/12/95	7/12/95
Metals (Concentrations in mg/kg)	NYSDEC RSCOs (mg/kg)			
Aluminum	33,000[1]	4,580	6,410	6,410
Antimony	--	0.75 U	10.8 B	1.4 B
Arsenic	7.5	1.9 B	**24.0**	**17.9**
Barium	300	46.4	186	83.3
Beryllium	0.16	**0.21 B**	0.09 B	0.06 B
Cadmium	1	0.06 U	**1.1**	0.74 B
Calcium	35,000[1]	1,110	53,600	29,900
Chromium	10	7.8	**20.7**	**11.9**
Cobalt	30	1.8 B	7.3 B	4.8 B
Copper	25	8.9	**405**	**62.6**
Iron	2,000	**3,980**	**34,700**	**8,870**
Lead	400	8.9	**557**	219
Magnesium	5,000[1]	571 B	5,220	3,590
Manganese	5,000[1]	13.1	410	208
Mercury	0.1	**4.3**	**24.0**	**24.0**
Nickel	13	5.0 B	**32.2**	**14.1**
Potassium	43,000[1]	538 B	1,350	981 B
Selenium	2	0.99 B	**6.2**	**2.4**
Silver	--	0.12 U	0.12 U	0.12 U
Sodium	8,000[1]	192 B	567 B	522 B
Thallium	--	1.0 B	3.6	1.9 B
Vanadium	150	15.5	25.3	27.9
Zinc	20	16.1	**517**	**119**

mg/kg - Milligrams per kilogram
ft bls - Feet below land surface
NYSDEC - New York State Department of Environmental Conservation
RSCOs - Recommended Soil Cleanup Objectives
U - Indicates compound not detected
B - Estimated value
[1] - Eastern U.S.A. background
* - Field duplicate
Boldface - Data highlighted in bold represent results detected above the NYSDEC RSCOs.

Attachment 3

Screening Evaluation of Available Remedial Technologies

MERCURY

I. Range of Cleanup Goals

For the purposes of this evaluation, it is assumed that after remediation, remaining average mercury levels in soil will be at or below an agreed upon level within the range of 0.1 mg/kg to 2500 mg/kg.

II. Basis of Review:

CE has examined a number of potential remedial techniques for mercury in soil using a variety of resources, particularly those published by EPA and the Environment and Safety Research Group of the Gas Research Institute, which has sponsored a number of in-depth studies of elemental mercury contamination due to the issue's prominence within the natural gas industry.

Based upon this review and the cleanup goals outlined above, the first issue that CE evaluated was whether remediation can be done by in-situ and/or ex-situ methods.

A. In-Situ Methods

In general, in-situ remedial techniques such as in-place fixation/stabilization are, for a variety of reasons, not suitable for use at the Taylor Instrument Site. First, most of the in-situ mercury remedial technologies rely on solidification or chemical fixation which are intended to immobilize but not remove the mercury, i.e., they would result in no net mass removal. Because of this, the preliminary goal of having final soil mercury levels in the range between 0.1 and 2500 mg/kg will not be met. In addition, because the mercury at the Site is largely already in a non-mobile, non-bioavailable form[1] (the same characteristics which would be the outcome of these remedial technologies), there would be little or no environmental or human health benefit from the application of those technologies.

Second, although a number of in-situ mercury treatment methods have been developed, the majority lack a full or even pilot-scale demonstration of either short-term or long-term effectiveness. For example, vitrification is a commonly mentioned in-situ technique. However, it remains both an extraordinarily costly method and one with limited full-scale application. Although the short-term effectiveness may be demonstratable through extensive bench scale and then pilot scale testing under saturated as well as unsaturated conditions, the long-term effectiveness would remain in question for many years. The Taylor Instrument Site does not currently pose (i.e., unremediated conditions) long-term adverse mercury human health or environmental effects, so remedial approaches which would result in no net mass contaminant removal or which had uncertain long-term effectiveness were not considered further.

B. Ex-Situ Methods

In contrast, there are a number of well-established ex-situ methods for addressing mercury contaminated soils. Most prominent are direct disposal and thermal treatment with fixation/stabilization technologies has also been successfully used. Studies reported by both the Gas Research Institute and EPA's SITE program indicate these methods are generally effective, and several are readily available commercially in both mobile and fixed-base applications.

1. Conceptual Approaches

a. Excavation

- Excavate soils within pre-determined areas that include known exceedances of mercury soil cleanup goal.

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[1] See Appendix A to Volume II of the November 1996 VSI Report on this site.

- If significant excavation below the top of the water table is necessary, dewater the area and treat the collected groundwater in accordance with applicable requirements.

b. Off-site Direct Disposal

- Stage excavated soils on-site temporarily while conducting composite sampling and analyses.
    - Directly load and remove soils if possible. If not, manage excavation by segregating debris soils (shards, metal, ash, wood fill) and non-debris soils ("clean cover soils", elemental mercury soils, soils with lower expected mercury levels, etc.).
    - Load and transport soils to appropriate landfill based on composite sample results.
    - Load and transport any hazardous waste to an approved off-site treatment and disposal facility.
    - Import clean fill to replace excavated soils.

c. Treat Excavated Soil by Thermal Desorption, Restore Treated Soils On-site or Dispose Off-site

- Ex-situ treatment using an X TRAX (or similar) thermal desorber including off-gas control (carbon filtration) and compliance scaling.
- Return treated soils to excavation (if this approach is selected).
- Load and transport debris fill (or treated soil) that is not suitable for restoration to appropriate disposal facility based on composite sample results.

- Import clean fill to replace off-site landfilled debris/soils.

2. Evaluation of Suitability and Effectiveness

Excavation and off-site disposal would be clearly effective at meeting the assumed soil quality goals. The suitability of off-site disposal can also be assumed since that disposal would have to be carried out in full accordance with federal and state hazardous and solid waste requirements.

As shown in subsection 1 above, for any ex-situ technique excavation of the contaminated material and a certain amount of handling/processing is the first step in an remedial approach. It is here, primarily in the excavation stage, that the greatest difficulties could occur at the Taylor Instrument Site if the mercury cleanup level is set at the lower end of the assumed range. Excavation is practical above the water table. For the reasons discussed below it becomes increasing difficulty with depth below water table (as the cleanup goal decreases). Excavation below the top of bedrock is not practical.

Sampling results to date indicate that the higher mercury concentrations are confined to soils above approximately 8 feet in depth. The available data also strongly indicate that these higher concentrations are, in most locations, further concentrated in the glass shard-bearing soils. These glass-shard bearing materials occur intermittently over a fairly large (several acre) area of the Site. The depth and volume of material to be excavated will greatly impact the implementability, the duration and the cost of the remediation.

Although a specific threshold is difficult to pinpoint, the available data indicate that the volume of soil to be excavated will be significantly increased if the mercury cleanup goal requires removal of soils containing mercury at levels lower than about 500 mg/kg. Soils with lower mercury concentrations extend intermittently across a broader area of the site and to significantly greater depths (e.g., 16-25 feet or to bedrock) as compared to the soils with mercury levels above the 500 mg/kg threshold. Removal of these materials would therefore involve excavating a significant portion of the almost 15 acre site. This would raise the potential for soil collapse, greatly adding to worker risks. To address this, sloped excavation walls and/or the shoring up of walls would be required. This in turn will increase the size, time and cost of the excavation.

This effort would be further complicated because the saturated zone begins at 6 to 7 feet below ground surface, therefore requiring a major dewatering effort as the excavation proceeds across a several acre portion of the Site. The excavation, dewatering and handling of potentially contaminated groundwater would add greatly to the time and cost of performing the remedy.

It is estimated that it would take from 2 months to over 1 year to complete the excavation and off-site disposal depending on volume/depth of excavation. This time is driven primarily by the off-site transport time. To reach the 0.1 mg/kg low end of the mercury cleanup range, it is estimated that it would take 40 trucks a day approximately six months just to haul the excavated soils off-site. At lower cleanup goals the extensive breadth and depth of excavation will lead to such high levels of vehicle traffic as well as extended dust and noise issues that community acceptance will be problematic.

Evaluation of the available literature indicates that mercury soil treatment levels have largely been oriented to removing the hazardous characteristic, i.e., in removing sufficient mercury to allow the treated material to "pass" the TCLP test. As demonstrated by the data submitted to NYSDEC on March 18, 1997, the vast majority of the soils on site do not exhibit the hazardous waste characteristic of toxicity (i.e. they "pass" TCLP). Residual total concentrations of mercury in the treated material reportedly range from 0.07-0.12 mg/kg for thermal methods, and from less than 5 mg/kg up to several hundred mg/kg for the chemical methods.

While the X TRAX thermal desorber (and other similar systems) technology has been proven at other sites with similar levels of mercury, it may not be practical at low soil volumes (i.e at the higher end of the assumed cleanup range). At cleanup levels in the lower end of the assumed range, pilot testing would be necessary to confirm that the technologies would achieve the cleanup goal at this Site.

Because of the need for pilot testing at the lower end of the cleanup range, there would be a longer lead time before remediation could begin. It is estimated that remediation of the Site would take six months to several years (after any pilot testing etc. were completed)

TCE

I. Range of Cleanup Goals

For the purposes of this evaluation, it is assumed that after remediation remaining average TCE levels in soil will be at or lower than an agreed upon level within the range of 0.7 mg/kg to 140 mg/kg.

II. Basis of Review:

A. In-Situ Methods

There are a number of proven, commercially available in-situ technologies for addressing TCE in soils. Although the effectiveness of the various technologies can vary widely dependant upon site conditions and other factors, proper engineering analysis, pilot testing, etc. would enable design and implementation of an in-situ approach to achieve soil cleanup goals within the proposed ppm range and higher. Common methods include:

Soil Vapor Extraction (SVE) is designed to physically remove volatile compounds from the vadose (unsaturated) zone. It employs vapor extraction wells alone or in combination with air sparging wells. Vacuum blowers supply the negative pressure, inducing air flow through the soil matrix. The air strips the volatile compounds from the soil and carries them to screened extraction wells.

SVE is a developed technology that is frequently used in commercial operations. It can be used alone or in conjunction with other technologies to treat a site. SVE, in combination with groundwater remediation (such as air sparging or dual-phase extraction), can also address shallow overburden groundwater contamination. Site-specific treatability studies may be necessary to determine the applicability and performance of an SVE system. SVE appears to be a viable remedial option at this site.

Vacuum Enhanced Recovery (VER) is a technique that has been used to increase the performance of conventional SVE systems at sites with contamination in shallow saturated and/or low permeability soils. This technique works by applying a high vacuum to a well and utilizing a liquid ring pump. The applied vacuum causes the groundwater to be removed from the well.

Biological Treatment - In-situ biological treatment such as bioventing has the potential to destroy organic contaminants in place without the high costs of excavation and materials handling, and minimizing the potential release of volatile contaminants into the air. Bioventing circulates air through the contaminated soil area, and due to the addition of oxygen, the biodegradation of the contaminants can be achieved. In-situ enhanced biodegradation (as opposed to intrinsic biodegradation) of halogenated compounds in soils such as TCE has not been conclusively demonstrated to be effective, particularly in tight soils. This technology was, therefore, not considered further given Site hydrogeologic characteristics.

B. Conceptual Approach (In-Situ)

Remediation of in-place soils and perhaps shallow groundwater using either SVE or VER.

Implementation of this approach would involve:

- Conducting pilot tests decide whether to conduct remediation by SVE or VER methods.
- Designing and installing either a SVE or a VER system.
- Due to the distribution of TCE at the site (i.e., associated with two widely separated source areas) and the nature of site soils ("tight" till), two separate systems would need to be installed, although they could be piped to a common vapor/water treatment system.
- On-going O&M and, if needed, off gas control
- Conducting monitoring programs at selected monitoring wells to track effectiveness and indicators of intrinsic bioremediation.

C. Evaluation of Effectiveness and Suitability (In-Situ)

Both SVE and VER are proven technologies expected to be effective at this Site, although pilot testing would be necessary. There are no significant technical barriers to implementing an in-situ remedy for TCE at the Taylor Instrument Site for cleanup numbers set in the ppm and higher range, but there is significant question as to whether these systems would be effective in achieving the low end of the range of cleanup numbers.

Both SVE and VER systems can be designed and constructed so as to not unduly interfere with future Site uses. CE would need long term access to the small part of the site housing the treatment system and to the portions of the Site where the collection system is installed. It would be necessary to do site-specific pilot tests to confirm suitability, decide between SVE and VER and identify design parameters, especially if remediation will extend into deeper, saturated soils. This would result in a longer lead time then ex-situ methods. It is estimated that it would take 1-2 months to do a pilot test workplan and pilot test, an additional 1-2 months to evaluate results and design the system and then 1-2 months to install the system and start it up. If the soil cleanup goal was set near the low end of the range, it is expected that it would take 3-5 years (or longer) to reach cleanup goals or asymptotic rate of decline in TCE levels .

Use of SVE or VER would achieve a substantial reduction in waste toxicity and volume of wastes at the Site. It would not affect the toxicity of the residuals. Implementation of air sparging in conjunction with SVE or use of a VER system would also treat some overburden groundwater. Therefore, a more active reduction of overburden groundwater TCE levels would occur. The remaining TCE would remain on-site where a groundwater monitoring program could track the effectiveness of the remediation and natural attenuation/intrinsic bioremediation.

D. Ex-Situ Methods

Ex-situ remedies potentially applicable to the TCE impact at the Taylor Instrument Site are relatively abundant and well-tested. Similar to mercury, once the impacted material is excavated there are a number of direct disposal and treatment options which can be utilized with a variety of advantages and disadvantages in terms of time, cost and implementability. After an initial review of the available technologies, two ex -situ methods are believed to be most applicable, thermal treatment and off-site disposal of untreated soils.

Thermal desorption involves the application of elevated temperatures to volatilize organic contaminants from soil particles. Application of this technology requires the collection and treatment of contaminated off-gases that are produced during the process. The temperature used for thermal desorption (typically from around 400 to 1,100°F) depends upon the volatility and boiling point of the target organic contaminants. The lower end of this temperature range is adequate for the Taylor Instrument site. Commercial units are readily available.

E. Conceptual Approach (Ex-Situ)

Two alternative approaches ex-situ were evaluated. Both involve excavation as the first step. While there may be variations on these two approaches, they are suitable for this screening evaluation.

i. Excavation

- Excavate soils within pre-determined areas that include known exceedances of TCE soil cleanup goal.

- If significant excavation below the top of the water table is necessary, dewater the area and treat the collected groundwater in accordance with applicable requirements.

ii. Ex-Situ Low Temperature Thermal Desorption

- Performing on or off-site low temperature desorption of soil contaminants (if necessary).

iii. Excavation and Off-site Treatment/Disposal

- Stage soils on-site temporarily while conducting composite sampling and analyses.

- Load and transport soils to appropriate treatment, storage or disposal facility.

- Import clean soils to replace excavated soils.

F. Evaluation of Suitability and Effectiveness (Ex-Situ)

Soil excavation and off-site disposal is practical above the top of the water table, but this technique experiences increasing difficulty with depth below water table (i.e. at cleanup numbers lower in the range), excavation below the top of bed rock not practical. At some combination of volume and depth, excavation would become impractical. If soil cleanup goals are selected near the lower end of the range, this technique is impractical. If significant volumes below the water table have to be excavated, an on-site dewatering and groundwater treatment system will be necessary but will be very difficult.

Thermal desorption is proven technology. It is easily managed above the top of the water table.

If excavation must be carried out below the water table, it will be necessary to dewater and handle/treat water. This could lead to significant implementation and cost issues if the collected groundwater has to be handled as a hazardous waste due to the hazardous waste "derived from" rule or TCLP results.

It is estimated that it would require 2-6 months to carry out thermal desorption , depending on soil volume and depths. It is estimated that excavation and off-site disposal would take between one and six months (and perhaps longer), depending on volume and depth.

At lower cleanup goals the extensive breadth and depth of excavation will lead to such high levels of vehicle traffic (40 trucks per day, daily for six months), as well as extended dust and noise issues, that community acceptance will be problematic. Even if this material is treated on-site, the extended timeframe and extended dust and noise issues could make community acceptance problematic.

Cost effectiveness will vary significantly depending on the extent and depth of excavation. The volume of soil that has to be managed as a hazardous waste will also greatly impact cost. If excavation below water table is necessary, costs will rise dramatically.

G. Combined In-Situ and Ex-Situ Methods

Clearly there is a possibility of combining in-situ and ex-situ methods, e.g., “source” removal in the unsaturated soils combined with long-term treatment to ultimately achieve a very low cleanup goal. The advantage of this option is that lower cleanup goals could possibly be achieved. This approach retains all the disadvantages from the in-situ approach and is, due to the high fixed costs involved in implementing both the in-situ and ex-situ approaches, probably not cost-effective. It is therefore eliminated from further consideration.

Attachment 4

Review of TAGM 4046 Residential Cleanup Goal for TCE Against the Part 375 Remedy Selection Criteria

Protects of Human Health and the Environment -- These primary criteria would be achieved by cleaning up to the TAGM criteria.

Short-Term Impacts and Effectiveness -- The short-term effectiveness is expected to be limited due to probable use of in-situ methods requiring an estimated 1-3 years to achieve the TAGM-based cleanup goals. Because in-situ methods treat the impacted soil over an extended period of time, workers and others involved in initial Site redevelopment and ongoing commercial uses could potentially be exposed to contaminated media during handling for treatment or during the long period the treatment/storage system will be operated.

Long-Term Effectiveness and Permanence -- Although ex-situ methods of achieving the TAGM would be effective in the long term, the effectiveness of the more likely-to-be-used in-situ methods is uncertain. Because these methods rely on contaminant removal from the site, they would be permanent.

Reduction of Toxicity, Mobility and Volume -- The feasible in-situ methods for achieving the TAGM-based number would generally result in treatment of the majority of in-place waste present at the Site. Because they are removal technologies, a concentrated waste stream would be produced which would require treatment or disposal. The TCE in this material can be physically destroyed to irreversibly reduce its toxicity/mobility/volume. For the residual materials left in the ground, there would be no reduction in mobility or toxicity, although, following source removal, this would probably be further reduced through attenuation and biodegradation.

Implementability -- Implementability issues would probably eliminate use of an ex-situ remedy for achieving a TAGM-based cleanup level. The feasible in-situ methods are somewhat difficult to construct but generally reliable, administratively feasible and available, although they would require long-term involvement by the site owner, PRPs and Agency. Another implementability factor is how the remedy at TAGM levels would affect the redevelopment opportunity at the Site.

Cost -- The estimated cost for achieving the TAGM-based cleanup levels is in the range of $3.5 million to over $10 million, with the in-situ methods at the low end of the range and ex-situ at the high end.

Community Acceptance -- Community acceptance of a TAGM-based cleanup is expected to be high, unless the remedy eliminates the planned redevelopment project.