FEASIBILITY EVALUATION

OF

ALTERNATIVE GREEN REMEDIATION APPLICATIONS

Former Delco Chassis Plant (Livonia)

March 2010

INTRODUCTION

Toxicological & Environmental Associates, Inc. (TEA) reviewed the Motors Liquidation Company (MLC) site portfolio to determine if there are candidates for Alternative Green Remedial approaches, either solely or in combination with other remedies previously identified for those sites. Alternative Green Remedial approaches were defined in a memorandum submitted on October 2, 2009, entitled "Site Selection Criteria for the Identification of Candidate Sites for Alternative Green Remediation" and included, but were not limited to, phytoremediation, source area reduction of dense non-aqueous phase liquid (DNAPL), and various in-situ technologies. Eight sites from the MLC portfolio were identified for conceptual development. These eight sites included:

1. Former Delco Chassis Plant (Livonia)
2. Willow Run Company Vehicle Operations
3. GMPT Bay City
4. Danville Central Foundry
5. Stamping - Grand Rapids
6. Buick City
7. Former GM Delco Plant 5 (Kokomo)
8. Delphi - Moraine

In addition to these sites, GMPT Massena (New York), Buick City and others were targeted for feasibility evaluation of an emerging polychlorinated biphenyl (PCB) abatement technology for paints, soils, sediment, sludge, and light non-aqueous phase liquid (LNAPL) treatment for oils containing PCBs.

TEA prepared "Conceptual Design and Preliminary Cost" reports for these sites which were uploaded to the IDEA database in October 2009. Based on subsequent discussions among the remedial and planning team members, TEA evaluated these sites in further detail to assess the practical feasibility of incorporating alternative green technologies into remedial plans for those specific sites. Assessments of potential cost impacts were also evaluated during the current assignment.

The limited information and data available for TEA's "Conceptual Design and Preliminary Cost" reports were expanded to generate this document. The feasibility evaluations presented herein are based solely on data available on the IDEA database and telephone discussions with site project managers.

The objectives of this submittal are to evaluate practical, logistical, technical, regulatory, and financial issues related to these sites in which alternative green remedies may be considered within the course of proposed remediation schemes. Considered during the evaluations were implementability, effectiveness, cost, and green sustainable principles and practices. Estimates of capital costs, O&M costs, and monitoring costs were refined for the alternative green remedies proposed for each site. The results of the evaluation are presented succinctly using the following general outline:

I. Problem Statement
   - compounds/contaminants
   - media
   - saturated/unsaturated zones
   - landfill, etc.

II. Site Characteristics
   - Hydrogeology
     a. depth to groundwater
     b. groundwater flow direction
     c. hydraulic conductivity, groundwater velocity, etc.
   - Extent of contaminant plume
   - Potential receptors

III. Proposed Alternative Green Remedy
   - Purpose and objectives
   - Description of alternative green remedial technology
   - Sustainability
   - Analysis of Green and Sustainable Remediation
   - Monitoring program
   - Term of operation
   - Advantages and disadvantages

IV. Regulatory Outlook
   - Existing order
   - Regulatory agency
   - Potential obstacles

V. Green and Sustainable Remediation (GSR) Comparison

VI. Costs

- Capital/O&M/Monitoring
- Assumptions
- Potential savings

VII. Conclusions

Estimated costs for the proposed alternative green remedies proposed in this submittal were refined based on all information and data gathered by TEA to date. At this time, costs are not necessarily intended to modify overall remediation estimates necessary for these sites. These estimates are mostly intended for consideration during future planning and design of site remediation as proven, implementable, sustainable, and effective cost-saving measures.

Former Delco Chassis/Delphi C – Livonia Groundwater
MLC #1104/1302

I. Problem Statement

The primary environmental issue at the Former Delco Chassis site in Livonia, Michigan is located in AOI 1 which is an approximately a 950-ft by 650-ft area enclosed by a slurry wall partially covered by a concrete slab. Within the slurry wall, groundwater is extracted from a French drain at rates up to 70 gpm. The extracted groundwater is then treated in an on-site treatment plant and discharged to the municipal sewer under an NPDES permit. Constituents of concern are chromium (III and VI) and nickel. A 2007 Administrative Order on Consent (AOC) requires maintenance of the barrier wall, concrete covering, and groundwater extraction system for 30 years. Based upon the first two years of operation, the annual O&M costs for the next 28 years will be approximately $290,000 per year.

II. Site Characteristics

Although there are two or three other environmental issues at the site, AOI 1 is the only one that represents a significant long-term cost at this time. AOI 1 consists of a 950-ft by 650-ft area enclosed by a barrier wall consisting of a combination of slurry wall and jet-grouted wall. Within the barrier wall a French drain groundwater collection system installed in 1980 operates to control the migration of nickel and chromium contaminated groundwater. The barrier wall was installed in 2004 to eliminate the off-site migration of nickel-impacted groundwater. Groundwater from the French drain is treated on site and discharged to the public sewer system. A Special Discharge Permit allows for the discharge of 100,000 gallons per day (70 gpm). The extraction and treatment systems currently operate at 70- 80 gpm, four days a week.

The general lithologic sequence in the top 225 feet includes:

- 0 – 5 ft bgs: fill sand;
- 5 – 25 ft bgs: native sand;
- 25 – 75 ft bgs: lacustrine clay unit; and
- 75 – 225 ft bgs: discontinuous sand, gravel, clay, and cobble layers.

Groundwater is encountered approximately 5 to 12 ft bgs. Saturated thickness is approximately 15 ft bgs. Groundwater flows southeasterly in a surficial sand layer towards Rouge River at average velocities of approximately 50 to 100 feet/year.

III. Proposed Alternative Green Remedy

Purpose and Objectives

The purpose of the remedial solution proposed herein is to provide an alternative green remedy for some portion of the site's environmental issues to reduce the overall costs for meeting long-term requirements. This objective can most readily be met by reducing the costs associated with the long-term extraction and treatment of groundwater.

Description of Technology

ENGINEERED_PHYTOREMEDIATION℠ can be used in Area 1 to reduce the volume of groundwater extracted, treated and disposed. Trees can transpire water and filter metals from groundwater. Phytoremediation is very well suited for removing groundwater from areas where recharge is limited, such as within a capped and contained area. Past experience with phytoremediation at sites in similar climates indicates that phreatophytic trees such as willows or poplars planted on 20-ft spacing across the area would transpire an average annual rate of at least 10 gpm. The efficiency of the hydraulic effect of the trees can be increased by concentrating the placement of the trees around the perimeter of the barrier wall and then demonstrating that the inward gradient occurs locally around the edge. The current French drain extraction system withdraws water from along the southern edge of the site.

Whether or not trees are ultimately utilized, it is imperative that the existing containment system, (i.e., barrier wall and concrete cap) work correctly. Thus, the first task is to perform a hydraulic study of the barrier wall. The study would involve the installation of a grid of piezometers within and around the outer perimeter of the barrier wall to identify areas of seepage through the wall. These sections of barrier wall could then be fixed.

The second task is to provide a competent cap which would direct precipitation to runoff outside the barrier wall, minimizing infiltration to the interior from the surface. Aerial photographs indicate that the existing concrete does not cover the entire area and does not appear to be sloped to direct runoff off from the site.

The third task is to plant trees using the *ENGINEERED_PHYTOREMEDIATION*[SM] system to use water from below the cap while inhibiting surface infiltration. Trees would be concentrated around the inside perimeter of the barrier wall and in areas that are not covered with concrete. Where concrete does interfere with planting, holes would be cut to plant trees and some means such as grout would be used to seal around the root sleeve. The general planting procedure would be as follows:

- A hole is augered through the cap to a predetermined target depth;
- A root sleeve liner is installed in the hole with a root aeration tube;
- The hole is filled to the surface with a mixture of auger cuttings and planting mix; and
- An 8- to 10-ft bare root tree is planted at the surface and the root sleeve/boot closed around the tree and aeration tube.

If the containment cap and barrier wall are brought up to standard, the proposed 1,200 trees will be more than sufficient to maintain an inward gradient across the barrier wall, thereby preventing migration of nickel-impacted groundwater.

Description of Monitoring Program

The monitoring requirements for the phytoremediation remedy consist of a standard groundwater monitoring program (hydraulics and groundwater quality) with semi-annual assessments of tree health during the initial five years of implementation.

Although trees use water during the initial growing season, full hydraulic effects of the trees are expected 3 to 5 years after planting. Thus, supplemental water extraction may be necessary during the early years unless temporary relief from the requirement for in-ward hydraulic gradients can be obtained from the regulatory agency. Although early stages of

contaminant reduction are often observed within the first two growing seasons, concentration trends of site contaminants due to phytoremediation are typically more demonstrable and quantifiable between years three and ten of the monitoring program.

Term of Operation

The phytoremediation system would be designed, implemented, and maintained to operate in perpetuity. Once regulatory objectives are achieved, the phytoremediation system can be left in place or easily removed using inexpensive methods. Tree waste from phytoremediation systems can be reused, destroyed, or transported to a construction waste landfill for disposal.

Advantages and Disadvantages

The principal advantage of the phytoremediation system is its simplicity and low operation and maintenance costs. Once the tree growth is established, there is very little to do to maintain the system. Advantages associated with phytoremediation systems include the following:

Advantages

- Reduced long-term cost of ownership due to:
    a. No external energy inputs required during operation;
    b. No operation requirements;
    c. Low maintenance requirements;
- Pumping capacity is spread out over many natural pumping units;
- Effectiveness of technology has been demonstrated at many environmental sites under various conditions by numerous regulatory agencies;
- In addition to creating desired hydraulic effects, can effectively reduce contamination in situ;
- Utilizes standard groundwater monitoring programs; and
- Eliminates monitoring of permitted discharges.

Disadvantages

- The cover area can be so great that the property cannot be used for anything else until remediation is successful;
- Average of 3- to 5-year lag time until full hydraulic effects of trees likely to be observed;
- Necessary to change AOC and OMM Plan;
- Does not eliminate downgradient groundwater monitoring outside barrier wall; and
- More trees will need to be planted to compensate for the limited growing season.

IV. Regulatory Outlook

The site is under a May 2007 Administrative Order on Consent (AOC) which is the driver for current remediation activities. The lead regulatory agency overseeing this site is the US Environmental Protection Agency (EPA) Region V. Also, a Special Discharge Permit has been obtained from the Detroit Water and Sewerage Department (DWSD). The potential regulatory obstacles for this proposed alternative green remedy most likely include:

- Modifications to the approved OMM Plan; and
- Questions regarding the ability of trees to consume sufficient water to eliminate the requirement for a water treatment plant.

Current restrictive covenant restricts use of site to industrial/commercial, and prohibits the use of groundwater, among other requirements.

V. GSR Comparison

	Proposed Remedy	Alternative
Technology	Pump and Treat	Phytoremediation
Energy Inputs		
Materials	High – manufacturing of pumps, piping, and treatment chemicals	Low – growing trees, manufacturing of root sleeve and boot, fertilizer
Installation	Moderate	Moderate
O&M	High – electricity to run system	Low
Waste Generation	Waste from treatment process Discharge of treated water to sewer	None other than vegetative matter
Effectiveness	Able to maintain hydraulic gradient	Able to maintain hydraulic gradient
CO2 sequestration	None	Sequesters carbon in trees
Land and Ecosystem Impacts	Neutral compared to existing system in place	Positive impact on ecosystem
Air Emissions	Depends upon power source	No emissions, positive effect on ambient air quality
Maintenance	High – requires constant O&M	Low – Once established, system is essentially self-sustaining
Risk Reduction	Risk reduction only through containment of contaminants	Risk reduction through containment and destruction of contaminants
Site Reuse	Possible	Possible, trees provide natural habitat if left in place or may be removed if site redeveloped
Water usage	Does not require additional water inputs	Engineered phytoremediation system does not require additional water inputs
Natural Processes Utilization	Does not use natural processes	Utilizes all natural processes
Renewable Resources	Not renewable	Trees are renewable
Reduction/destruction of contaminant mass	Does not reduce contaminants other than in extracted water transferred to activated carbon	Potential to stimulate in situ degradation of contaminants

VI. Costs

Capital Costs

The estimated capital cost for the course of action recommended here is $2,300,000, broken out as follows.

- Hydraulic evaluation of the barrier wall performance $100,000
- Repair of barrier wall $500,000
- Clay cap $500,000
- Plant 1,200 *ENGINEERED_PHYTOREMEDIATION*[SM] trees $1,200,000

O&M/Monitoring Costs

While there would still be monitoring required for the groundwater ($50,000/yr for 28 yrs), costs associated with pumping, treating and discharging would be eliminated.

Potential Savings

The total estimated cost savings would be approximately $4,000,000.

VII. Conclusions

1. It appears that the existing barrier wall/concrete cap/groundwater extraction system is not working efficiently. Pumping at 70 gpm from within a capped area surrounded by a barrier wall may indicate a failure in one or more of the system components. In addition, the AOC requires that the existing concrete slab, barrier wall and pumping system be maintained without the requirement that the slab effectively eliminate infiltration.

2. If the entire area was effectively capped and the barrier wall operated properly, engineered phytoremediation would be able to maintain an inward gradient to prevent migration of contaminated water from within the area of concern. Our recommendation would be to:

    a. Perform a hydraulic evaluation of the barrier wall performance ($100,000);
    b. Fix areas of slurry wall that are substandard ($500,000);
    c. Create a sloped clay cap over the entire area to shed precipitation ($500,000); and
    d. Plant approximately 1,200 trees for hydraulic control ($1,200,000).

3. While there would still be monitoring required for the groundwater ($50,000/yr for 28 years), costs associated with pumping, treating and discharging would be eliminated. The total estimated cost savings would be approximately $4,000,000.