FEASIBILITY EVALUATION

OF

ALTERNATIVE GREEN REMEDIATION APPLICATIONS

Danville Central Foundry

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.

Danville, Illinois, Foundry Landfill
MLC# 1233

I. Problem Statement

The primary environmental concern at the Danville, Illinois Foundry Landfill is due to the discharge of seeps emanating from the landfill. Toe drains were installed prior to final cover construction at four locations. The intent of the toe drains was to control groundwater seeps that were degrading the integrity of the slopes. The discharge from the toe drains is to an unnamed tributary to the Vermillion River. The unnamed tributary is a zero low flow stream and contraventions of water quality standards have occurred.

- Compounds/contaminants - iron, fluoride and pH are the constituents of concern;
- Media – groundwater and surface water;
- Saturated/unsaturated – the majority of the landfill area is unsaturated. At the seep locations, it would be considered saturated due to the discharge of the seeps to surface water; and
- Landfill/etc. – This is a foundry landfill. Fill materials included coke ash, core sand, slag, scrubber sludge, excess systems sand, and nodular sand.

II. Site Characteristics

- Depth to water – Depth to water varies significantly throughout the landfill area depending on the location and nature of fill practices. The groundwater elevations have been estimated from previous studies. The IDEA database information indicates the depth to water within the landfill ranges from a few feet on the south to as much as 80 feet at the northern end;
- Size – site/plume/etc. – A plume size has not been determined, although additional studies are planned. The area of the seeps is well defined;
- Flow velocity/hydrologic conductivity – The seeps average approximately 4 gpm and the maximum reported flow is 11 gpm. The flow rate is highly influenced by precipitation events, as the landfill cover was designed to support vegetative growth but not as an infiltration barrier; and
- Receptors – The principal receptors are the aquatic wildlife in the Vermillion River.

III. Proposed Alternative Green Remedy

Purpose and Objectives

Phytoremediation is proposed at this site primarily as a means for hydraulic containment. By capturing the groundwater, the seeps would be eliminated, and the associated compliance issues with fluoride, pH, and iron in the NPDES discharge would be eliminated.

Description of Technology

It is defined as the use of green plants (including grasses, forbs, and woody species) to remove, contain, or render harmless environmental contaminants such as heavy metals, organic compounds, and radioactive compounds in soil or water. In this case, phytoremediation would be the engineered or non-engineered use of green plants (including primarily willows and poplars) to remove inorganic compounds in, and contain the flow of, groundwater at the Danville foundry landfill. The trees would be planted at a density of 100 trees per acre.

Description of Monitoring Program

The monitoring program would be the regulatory requirements of the NPDES permit in the surface water discharge. The monitoring of the phytoremediation system would include semi-annual tree assessments to ensure healthy tree growth.

Term of Operation

Although trees will begin using water during the initial growing season in which they are planted, 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 operating the pump and treat system is obtained. The phytoremediation system would operate in perpetuity.

Advantages and Disadvantages

Advantages

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:

- Reduced long-term cost of ownership due to:
    a. a. No external energy inputs required during operation;
    b. b. No operation requirements;
    c. 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;
- Extreme depths to groundwater, steep topography and subsurface debris can be practical limitations to the technology;
- Average of three year lag time until full hydraulic effects of trees likely to be observed;
- Necessary to change NPDES Permit requirements;
- More trees will need to be planted to compensate for the limited growing season.

At Danville, there are areas where groundwater depths and topography could be a limiting factor; however, phytoremediation is not proposed in these areas at this time.

IV. Regulatory Outlook

The existing NPDES permit with a compliance schedule combines the individual seeps into one discharge point and monitored outfall. A number of other activities have also been approved and include an annual groundwater flow and hydraulic gradient evaluation, a statistical evaluation of background values for selected parameters in a number of wells, installing of new wells and monitoring requirements, a groundwater seepage inspection, and closure of selected existing monitoring wells.

Agency – Illinois Environmental Protection Agency (IEPA).

Potential obstacles – No known potential obstacles.

V. GSR Comparison

	Proposed Remedy	Alternative
Technology	Collection and pumping of seeps, pH adjustment, discharge and monitoring	Non-*ENGINEERED_PHYTOREMEDIATION*℠
Energy Inputs		
Materials	High – manufacturing of energy source, pump materials, collection system, etc.	Low – growing trees, manufacturing of root sleeve, fertilizer
Installation	High – equipment for chemical feed system	Moderate
O&M	High – electricity to run system	Low
Waste Generation	Unused portion of chemical containers for disposal	None other than vegetative matter
Effectiveness	Able to meet NPDES permit requirements	Minimize and possibly eliminate off-site migration
CO_2 sequestration	None	Sequesters carbon in trees
Land and Ecosystem Impacts	Neutral compared to existing site condition	Positive impact on ecosystem
Air Emissions	Depends upon power source, necessary to control volatile off-gassing with capture and treatment system	No emissions, positive effect on ambient air quality
Maintenance	High – requires constant O&M and inputs of energy and activated carbon	Low – Once established, system is essentially self-sustaining
Risk Reduction	Risk reduction through off-gassing collection/treatment, and destruction of contaminants	Risk reduction through hydraulic control and destruction of contaminants
Site Reuse	Long-term site land and groundwater use restrictions will apply	Long-term site land and groundwater use restrictions will apply. Phytoremediation trees also provide a natural habitat

Water usage	Does not require additional water inputs	Phytoremediation 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	Reduces on-site contaminant mass only through off-gassing volatiles	Potential to stimulate *in-situ* reduction of contaminants

VI. Costs

Capital Costs

For the non-engineered method, a unit price of $100 – 150 per tree is assumed. A non-engineered system is simply the planting of trees without the installation of the *TreeWell*® system. For 1,000 trees (based on 100 trees per acre and a 10-acre area), the cost of planting would be $100,000 to $150,000.

The estimate for the *ENGINEERED_PHYTOREMEDIATION*℠ system is based on the planting of 1,000 trees using the methods described above. Costs include the caisson rig drilling for the boreholes, oversight costs, the sleeve and aeration tube materials, backfill material, 10-foot target depth for trees, and the associated labor to install the trees in the proper manner. Experience with these types of systems and this order of magnitude indicates a unit cost of approximately $560 per tree. The tree installation estimate would be $560,000. Actual costs would be based on the final design considerations.

For either method, there would be additional project management costs of approximately 10%. Therefore, the non-engineered method would cost about $110,000 to $160,000. The *ENGINEERED_PHYTOREMEDIATION*℠ system would cost about $616,000.

Potential Savings

Should the IEPA agree that the focused phytoremediation system could be effective in achieving hydraulic control of the westernmost seep, then the proposed pump system could be eliminated. The original remediation estimate for this site included all of the costs for the combination of the toe drains into one outfall. It is unclear how much just the pump system for the westernmost seep is, but assuming one third of the outfall costs, then it is estimated that

approximately $250,000 in capital costs could be eliminated. The operation and maintenance of the pump system (including power consumption, pump replacement and repair, etc.) would also be eliminated.

Using a focus non-engineered phytoremediation system for hydraulic control would result in a net savings of $140,000, plus the savings from pump operation and maintenance over a 30-year, or more, period.

VII. Conclusions

1. No cost changes or changes in scope of proposed work can be justified at this time. Currently, about $6.2 million is designated for landfill operations and maintenance and monitoring.

2. Phytoremediation, either as a non-engineered or engineered approach on the west side of the landfill may potentially be used at this site primarily as a means for hydraulic containment. By capturing the groundwater, the seeps would be eliminated, and the associated compliance issues with fluoride, pH, and iron in the NPDES discharge would be eliminated. Should the IEPA agree that the focused phytoremediation system could be effective in achieving hydraulic control of the westernmost seep, then the proposed pump system could be eliminated.