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GROUNDWATER & SOIL REMEDIATION STRATEGIES -- A PRACTICAL APPROACH

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Conventional approaches to groundwater and soil contamination remediation projects typically involve costly investigations and remedial designs that frequently are over or under designed, do not function effectively, are expensive to operate and maintain, or have been designed around technically unachievable cleanup goals.

Groundwater and soil remediations that are field demonstrated and expanded in a modular fashion offers industry an opportunity to control remediation costs, minimize costly investigation studies, focus more resources towards site remediation, and develop an environmental compliance data base. Four case histories will be presented that illustrate the advantages of this approach: groundwater and soil remedial system integrated with the construction of a 55,000 square foot publication facility; chemical landfill leachate groundwater treatment system; a groundwater/biovent treatment system for a beverage distribution facility; and a biosparge/biovent design for a petroleum contaminated LUST site.

Publication Facility Remediation - Building construction was stopped by state fire authorities when gasoline contamination (initial estimate over 250,000 gallons) was discovered during rock foundation blasting operations. Characterization and quantification of petroleum hydrocarbons in groundwater is extremely difficult to predict in weathered and fractured granite schists. Remtech mobilized a package groundwater treatment plant and began extraction operations using existing monitoring wells. Remtech demonstrated that the initial estimate of free product (prepared by others) was grossly overstated (i.e. less than 1000 gallons). Free product was present in bedrock fractures at the groundwater interface and not distributed over the entire site. Aquifer interconnectivity was demonstrated during early pumping operations indicating that groundwater recovery wells could be used to contain and recover gasoline. Foundation, sub-floor, and elevator shaft membrane systems were designed to prevent vapor migration. A ventilation network was constructed under floors to exhaust vapors. Sixteen 4 - inch diameter recovery wells were installed to draw vapors and gasoline away from the building foundation. Double diaphragm air driven recovery pumps were installed to create a cone of depression, remove free product, and vapors without complex level switches and hydrocarbon sensors.

During construction activities, the gasoline plume was confined to the Metro parking garage area. The remedial system designed by Remtech reduced vapor levels and free product thickness and demonstrated to fire authorities that fire and explosion hazards could be controlled which facilitated the issuance of building and occupancy permits.

Chemical Landfill Leachate Treatment System - Remtech was commissioned by a petrochemical industry to design a groundwater treatment facility for leachates from an industrial waste landfill located in a flood plain. Two foot diameter extraction wells were alternated inside and outside a bentonite slurry wall circumventing and a synthetic membrane cap placed over the landfill. Design criteria focused on creating a treatment facility that could be operated under variable hydraulic loadings and as a biological and physicochemical treatment system by changing plant operating conditions to fit site specific conditions. A variable design capacity of 10,000 to 75,000 gallons per day was employed to accommodate dynamic waste loadings by altering reactor detention times, overflow rates, sludge wasting rates, pump recycling rates, and treating waste streams in series or parallel. Optional treatment paths were incorporated into the design by establishing various directional flow/reactor piping with flow and valve controllers. Treatment plant reactors, quartz lighting, and safety railing were retrofitted into the new design from an abandoned, client-owned, phenoxy plant located 300 feet from the designated construction site. The plant was designed to operate in a batch or continuous mode. Floating surface aerators (with submerged motors) were selected to supply oxygen for aeration, stripping of volatile organic compounds, and mixing for suspension and removal of sludges. A PVDF air driven recovery well pump was selected to extract groundwater from one recovery well containing 5% sulfuric acid which was neutralized by a flash mixer and pH controller feeding 20% caustic. This treatment plant was designed to withstand flood waters up to five feet deep and has been operating for over 5 years while complying with local effluent pretreatment requirements.

Groundwater Treatment Facility for Beverage Facility - A truck fleet fueling facility developed a leaking gasoline fuel line that released several hundred gallons and threatened underground sewers and an intermittent stream. A significant portion of the contamination was located under site structures. The facility was constructed over a former creek bed and fill area (clays and silts) that created preferential contaminant pathways and the potential for short circuiting of recovery well capture zones and bioventing systems. Remtech performed pilot vent tests to develop a biovent grid system that could be operated in conjunction with a pump and treat system. Conductivity tests and sustainable flow tests produced highly variable results. An interceptor trench and electronic passive hydrocarbon removal system (installed by others) had proved ineffective. Remtech implemented a phased free product recovery system by demonstrating the number of recovery wells that would be required to provide hydraulic capture and free product recovery. The initial treatment system consisted of an oil/water separator, single stripping tower, sand filter and three recovery wells. A second stripping tower (combined capacity of

20 gpm) was added in series to meet municipal pretreatment requirements of 20 ppb benzene. Two additional recovery wells were installed to enhance hydraulic capture. This technique also identified site preferential pathways and the desired location of biovent wells. Following review of the CAP, the state approved installation and funding of the BioVent system to complete site remediation. This site has qualified for reimbursement under the GUST fund.

BioVent/BioSparge Treatment Design - Remtech conducted pilot biovent and biosparge tests at a LUST site in South Carolina to develop design criteria for a full scale remedial system. Seasonal fluctuations of the groundwater table varied from 22 to 32 feet below grade. Soils consisted of coarse grained sands with lenses of clay and bedrock. The aerial foot print of the contamination plume is approximately 1.2 acres and is located under offsite buildings including a Shopping Center and Garage Repair facility separated from the service station by a secondary road. Apparent lithology heterogeneity has been demonstrated to be well connected due to pilot vent and sparge tests yielding an estimated 50 foot radius of influence for both remedial strategies. Insitu bioventing/biosparging supplemented by pump and treat/hydraulic capture was designed to remove an estimated 770 gallons of gasoline from soils and groundwater. A ring of sparge wells are located around the perimeter of the hydrocarbon plume with biovent wells located to direct exhausted vapors and respiration byproducts towards the center of the plume. Existing monitoring wells were utilized in the design (where possible) to minimize vent well construction costs. Interior sparge wells will be pulsed by a timer to treat the heart of the solution and adsorbed phase hydrocarbons. Groundwater will be reinjected via an infiltration gallery and five injection wells. Startup vent and pump and treat operations are expected to require carbon off gas treatment during the first 4 to 6 months of plant operation(this equipment will be rented to minimize capital costs). This soil and groundwater treatment facility will be operated to maximize biosparging and bioventing thereby minimizing volatile emissions and maximizing metabolic aerobic biodegradation byproduct production.

Summary - This treatise summarizes several case histories where a practical approach to remediate soils and groundwater is illustrated. Physical barriers limit engineers and scientists from accurately defining underground remedial solutions since "we can not scope what we can not see". By demonstrating solutions and preparing designs that facilitate flexible and expandable remedial strategies, expensive and frequently non-productive site investigations can be minimized. Building data bases of compliance through remediation rather that problem definition(remedial investigations) minimizes legal liabilities. Cleanup targets need to be set depending on surrounding land and groundwater use, the potential for contaminant migration, technology limitations, economic constraints, and site specific risk assessments.