Colorado Department of Labor and Employment
Division of Oil and Public Safety – Remediation Section
633 17th Street, Suite 500
Denver, CO 80202-3610

Phone: 303-318-8500
Fax: 303-318-8546
Email: cdle_remediation@state.co.us
Web: www.colorado.gov/cdle/remediation

GREEN AND SUSTAINABLE REMEDIATION

Environmental remediation can generally be summarized as the removal or destruction of contaminants from a media through physical, chemical or biological processes. The ultimate goal of environmental remediation is to be protective of human health and the environment. Historically, remedial options have been selected based on economic and technical feasibility, ease of implementation and other land use considerations.

In order to maximize net positive impacts resulting from environmental remediation, it is important to consider the cleanup actions from a holistic perspective and not protect one medium or one receptor at the expense of another. The practice of Green and Sustainable Remediation (GSR) intends to bring the concept of environmental stewardship into the realm of realistic, existing cleanup strategies.

The incorporation of GSR principles and practices into remediation is evolving, coinciding with the growth and maturation of the remediation industry. GSR is broadly defined by the Interstate Technology & Regulatory Council (ITRC) as "*a remedy or combination of remedies whose net benefit to human health and the environment is maximized through the judicious use of resources and the selection of remedies that consider how the community, global society, and the environment would benefit, or be adversely affected by, remedial investigation and corrective actions.*"

The Colorado Department of Labor and Employment Division of Oil and Public Safety (OPS) recognizes the importance of GSR and believes that incorporating GSR practices into the assessment and cleanup of our leaking petroleum storage tanks program will enhance the protectiveness of human health and the environment.

This document provides an overview of three areas that are related to GSR.

- Core Elements
- Best Management Practices
- Links and References

Core Elements

Many remedies in place today were implemented with best of intentions, but with little consideration to public health or the environment at large. It has become increasingly apparent over the years that solving one environmental problem should not result in the creation of another one.

The current state of the practice of storage tank remediation in the State of Colorado does not heavily weigh the production of greenhouse gases, the consumption of energy, the use of material resources or the generation of fugitive air emissions in the remedy selection process. Considering these factors in advance can significantly enhance the net positive benefit of environmental remediation while remaining protective of human health and the environment.

The US Environmental Protection Agency (EPA) has identified the five core elements, depicted in brief above, to be considered as part of a GSR assessment. A summary of the core elements that most prominently impact our storage tank program is mentioned here.

Minimize Total Energy Use and Maximize Use of Renewable Energy

The use of energy is omnipresent in the assessment and remediation of our storage tank sites. Energy is consumed from the advancement of the first soil boring, during remediation system construction, into system operation and through closure.

It is, however, possible to significantly reduce the amount of energy input into a cleanup project through efficient site planning, selection of appropriately sized equipment, remediation system optimization and other commonsense applications. ITRC's Triad Approach and Remediation Process Optimization guidance documents offer an abundance of valuable tips.

Many public utility providers within the State of Colorado offer the purchase of renewable energy credits to promote the production of renewable energy in Colorado. Additionally, the Colorado Carbon Fund supports certified carbon offset projects in Colorado, helps create local jobs and expands Colorado's clean economy.

Minimize Air Pollutants and Greenhouse Gas Emissions

Air pollutants, including petroleum hydrocarbons and greenhouse gases, are emitted both directly as a result of common remediation approaches and indirectly by vehicular sources associated with site activities.

The industry generally measures the success of a remedy by how effectively it has removed or otherwise destroyed a contaminant from a particular medium. However, reducing the prevalence of simply transferring contamination from one media to another is a core element of GSR. OPS strongly recommends utilizing emissions capture or destruction devices on technologies that purge vapors or contaminants from the subsurface.

An analysis of the anticipated emissions associated with a site's cleanup would be incomplete without considering those emissions resulting from mobilizations to and from the site. Reducing unnecessary site visits or duplicative vehicles, utilizing telemetric system monitoring and adjustments, when appropriate, and utilizing local subcontractors are effective ways to reduce greenhouse gas emissions.

Reduce, Reuse and Recycle Material and Waste

GSR promotes a more thoughtful approach to handling investigation-derived waste including asphalt or concrete pavement and overlying uncontaminated soils. The industry has traditionally considered materials derived from assessment or remedial activities as burdensome waste products that necessitate disposal. However, in a finite world, recycling and reuse of these products makes both economic and practical sense.

Several recycling facilities accept concrete and asphalt throughout Colorado. In some cases, concrete can be pulverized and reused onsite as fill. Overburden, uncontaminated soil can be reused onsite as excavation backfill or nearby as clean fill soil. Recycling and reusing unwanted, clean materials from a construction site helps reduce the burden our industry puts on our public landfills.

Remediation projects commonly achieve cleanup goals in much less time than the engineered useful lives of the mechanical equipment being utilized. Durable remediation equipment including blowers, compressors, pumps and sheds can often be refurbished and reused following completion of a site's cleanup, thereby reducing resource use for manufacturing and transport.

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Best Management Practices

Incorporating Green and Sustainable Remediation (GSR) best management practices (BMPs) is the first step toward maximizing the net positive impacts of your storage tank cleanup. BMPs can and should be utilized before the first site visit is made. Alternatively, BMPs can be incorporated in the middle of an ongoing cleanup project and still have a positive impact.

OPS has created a checklist of BMPs intended to aid responsible parties and consultants in the preparation of Corrective Action Plans. The EPA has also released a series of fact sheets on BMPs that are related to remediation. Following is a list and brief description of BMPs that are considered to positively impact the GSR Core Elements.

Utilize local consultants and contractors when available

Utilizing local consultants and contractors minimizes mobilization energy consumption and supports local economies.

Utilize real-time measurement tools when technically feasible

Real-time data collection is considered to be one of the three legs of the Triad Approach and can cost-effectively aid in source area and plume delineation. Proper usage of real-time data collection tools can result in fewer site assessment mobilizations, precise identification of monitoring well locations and enhancement of a Conceptual Site Model (CSM).

Utilize direct push technology when technically feasible

Direct push technology (DPT) can be utilized to collect soil and groundwater samples and produces a fraction of Investigation Derived Waste (IDW) compared to conventional drilling methods. Additionally, DPT allows for probed locations to be continuously sampled and documented, which makes it easier to identify lithologic transitions, moisture content and contaminant-bearing zones.

Develop a Conceptual Site Model for the project

A Conceptual Site Model (CSM) forms a basis to the overall remediation approach at a given site. A comprehensive CSM should summarize the lithologic and hydrologic features, contaminant characteristics, current and future land uses and a remediation approach. The CSM should be continuously updated (at least on an annual basis) to modify and optimize the remediation approach as necessary.

Utilize emission capture or destruction devices on vapor extraction systems

Emission control significantly reduces the emission of greenhouse gases and air pollutants to the atmosphere, which is a Core Element of GSR. Emission capture control should be considered for both permanent (e.g., SVE system) and temporary (e.g., mobile SVE or EFR) exhausted systems.

Utilize renewable energy

Incorporating renewable energy and/or carbon offsets into a remediation approach is another Core Element of GSR. There are multiple ways, of which three are listed below, to incorporate renewable energy or carbon offsets.

- Purchase renewable energy credits (RECs) from the local utility provider
- Purchase carbon offsets in Colorado through the Colorado Carbon Fund
- Utilize stand-alone renewable energy systems when economically and technically feasible

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Develop a materials management plan

Concrete, asphalt, clean soil and other materials unearthed during excavation or installation activities can often be reused or recycled at a lesser cost, and much lesser impact, than taking them to the landfill. Several recycling facilities exist within the Denver Metro area and throughout Colorado. When feasible, concrete can be crushed onsite and used as fill. Materials should always be taken to the nearest permitted facility, regardless of their final deposition.

Perform remediation system optimization

Continuous remediation system optimization can have a significant impact on the amount of energy consumption and overall duration of a remediation project. A properly designed remediation system will result in reduced energy input and expenditures and achieve cleanup in a shorter timeframe by

completing optimization efforts.

Utilize refurbished equipment when feasible

Durable remediation equipment including blowers, compressors, pumps, sheds, etc., can often be refurbished and reused following completion of a site's cleanup.

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Links and References

The following websites and documents provide information on various components of Green and Sustainable Remediation.

Websites

- EPA's Green Remediation Website –contains several green remediation best management practices summary sheets along with a vast amount of other information on green remediation.
- Colorado Carbon Fund - supports greenhouse gas reduction projects in Colorado that produce permanent, verifiable carbon offsets.

Documents

- Green Remediation: Incorporating Sustainable Environmental Practices into Remediation of Contaminated Sites (EPA April 2008)
- Green and Sustainable Remediation – State of the Practice (ITRC May 2011)
- Green and Sustainable Remediation: A Practical Framework (ITRC Nov 2011)
- Remediation Process Optimization (ITRC Sept 2004)
- The Triad Approach
    - The Triad Approach (ITRC Dec 2003)
    - Triad Implementation Guide (ITRC May 2007)
- Recycling centers in the State of Colorado

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