



*Strengthening Communities
One Parcel at a Time*

***ANALYSIS OF BROWNFIELDS CLEANUP ALTERNATIVES (ABCA)
FOR ENVIRONMENTAL RESPONSE ACTIONS***

***US EPA Brownfields Revolving Loan Fund Program
Cooperative Agreement: BF-00E00383-0***

***Hotel Indigo Site
223, 235, and 263 Grandview Parkway
Traverse City, Grand Traverse County, Michigan***

SME prepared this Analysis of Brownfields Cleanup Alternatives (ABCA) to present the results of technical and economic feasibility analyses of environmental response actions identified for potential application at the brownfields property known as the Hotel Indigo Site, 223, 235, and 263 Grandview Parkway, in Traverse City, Michigan (the Site). The Indigo Hotel project consists of an approximately 108,000 square-foot, boutique hotel with 105 rooms, a 3,000 square-foot conference facility, and underground parking. The Site is part of a larger, 23-parcel redevelopment area designated Traverse City Place.

The Michigan Landbank Fast Track Authority (MLB) has affirmed the eligibility of the Site to receive a loan (RLF Loan) of up to \$600,000 from their U.S. Environmental Protection Agency (USEPA) Brownfields Revolving Loan Fund (RLF) Hazardous Substances Grant to fund eligible environmental response activities at the Site. The USEPA has accepted the affirmative eligibility determination for use of the RLF Loan. The RLF Loan will be used to fund environmental response activities needed to address threats to the environment posed by hazardous substances contaminating groundwater beneath the Site. The groundwater contamination poses a threat to human health if consumed and to the waters of Grand Traverse Bay, which lie approximately 400 feet northeast. The groundwater contamination and related threats also have been found to in the larger Traverse City Place redevelopment area, in which the Site is located. The combined area of groundwater contamination poses a threat to the waters of Grand Traverse Bay and needs to be remediated as a single effort. The GTCBRA is providing additional funding to support expansion of the remediation project to address the groundwater contamination plume under the larger redevelopment area.

The environmental conditions of the Site are summarized in the following reports, which are available in the project document repositories located at the offices of the Michigan Land Bank Fast Track Authority, 3022 W. Grand Blvd., Suite 4-600, Detroit, MI 48202; the Grand Traverse County Planning and Development Department, 400 Boardman Avenue, Traverse City, MI 49684; and the following websites – www.mihcgan.gov/landbank and www.grandtraverse.org/planning:

- ***Brownfield Redevelopment Assessment Report for Traverse City Place Brownfield Area, ...***, Michigan Department of Environmental Quality, September 30, 2013.



soil and materials engineers, inc.

- ***Baseline Environmental Assessment, 263, 235, & 223 West Grandview Parkway, City of Traverse City, Grand Traverse County, Michigan***, Inland Seas Engineering, April 20, 2012.
- ***Phase I Environmental Site Assessment, 223, 235, & 263 West Grandview Parkway, City of Traverse City, Grand Traverse County, Michigan***, Inland Seas Engineering, April 20, 2010.
- ***Phase II Environmental Site Assessment, 263, 235, & 223 W. Grandview Parkway, City of Traverse City, Grand Traverse County, Michigan***, Inland Seas Engineering, November 29, 2010.
- ***Due Care Plan, Section 7a Compliance Analysis, 263, 235, & 223 West Grandview Parkway, City of Traverse City, Grand Traverse County, Michigan***, Inland Seas Engineering, April 20, 2012.

Additional information about the environmental conditions associated with the larger plume area beneath the Traverse City Place redevelopment area is also available in the document repositories.

The approximately 0.83-acre Hotel Indigo Site is part of the approximately 25-acre, Traverse City Place redevelopment area. The Site and larger redevelopment area have been used for industrial and commercial/retail purposes since the early- to mid-twentieth century. Historical uses of the Site included automobile repair, taxi operations and maintenance, commercial and retail operations, and residences. Historical uses of proximate properties in the Traverse City Place redevelopment area included manufactured gas production (MGP), agricultural products storage, food production, gasoline service stations, bulk oil storage, and commercial/retail operations.

Results of environmental investigations of the Site revealed the presence of cyanide, carbazole, manganese, lead, arsenic, iron and aluminum in groundwater at levels exceeding Part 201 generic residential and non-residential criteria (Michigan environmental remediation standards) for protection of human health (drinking water) and the environment (migration to surface water). Cyanide, polycyclic aromatic hydrocarbons, volatile chlorinated solvents, hexavalent chromium and other metals were present in the soil at levels exceeding Part 201 generic residential and non-residential criteria for protection of groundwater used for drinking and groundwater that migrates to surface water (e.g. Grand Traverse Bay).

Environmental response actions to mitigate unacceptable human exposures posed by soil contamination were undertaken during Site redevelopment to allow safe use of the Site for the Indigo Hotel development and operations. Environmental response actions to mitigate unacceptable human and natural resource exposures threats posed by groundwater contamination now will be undertaken. The response actions to address the groundwater contamination beneath the Site will be funded by the RLF Loan and will be supplemented by additional funding from the GTCBRA to develop a remediation approach that will also address the larger Traverse City Place redevelopment area. The remedial objectives for these actions are as follows: 1) mitigate risks of human exposure to Site groundwater contamination through the drinking water pathway on the Site and downgradient of the Site and 2) mitigate risks of natural resources damage from migration of groundwater contaminants to the Grand Traverse Bay. Protection of Grand Traverse Bay, which is a valuable fresh water resource and is extensively used for recreation in the vicinity of the Site, and other waters of the Great Lakes is a priority for Traverse City, Grand

Traverse County, the State of Michigan, the Great Lakes-St. Lawrence River Basin Water Resources Compact, and the Great Lakes Council of Governors. This ABCA presents the results of technical and economic feasibility analyses of potential environmental response action approaches for achieving these objectives.

Mitigation of Human and Natural Resources Exposure Pathways

Results of environmental assessments revealed the presence of cyanide and metals in groundwater beneath the Site and adjoining properties at levels posing threats to human health through consumption (drinking the water) and to natural resources through migration to surface water (Grand Traverse Bay). Environmental response activities are necessary to mitigate these threats to human health and the environment.

The potential for human exposures to contaminated groundwater through consumption will be mitigated through the use of institutional controls. The Indigo Hotel redevelopment and other properties in the Traverse City Place redevelopment area are served by the Traverse City municipal water system. These properties will use one or more of the following applicable institutional controls to prevent human consumption of contaminated groundwater:

- City ordinance requiring properties to be connected to the municipal water system; and/or
- a deed restriction, filed with the Register of deeds, prohibiting the installation of wells and all groundwater use on the property.

The potential for damage to the waters of Grand Traverse Bay and larger Great Lakes will be mitigated by preventing contaminants in the contaminant plume that underlies the Site from reaching surface water at levels posing a risk to natural resources or recreational uses. Since portions of the contaminant plume lie outside the boundaries of the Site, the only effective remedial approach to fully protect the Grand Traverse Bay is to implement response actions that mitigate risks posed by the portions of the plume that lie under adjoining properties, as well as under the Site. The technical and economic feasibility of the following environmental response approaches were evaluated:

- no action alternative;
- *in situ* chemical oxidation; and
- groundwater interception, extraction and *ex situ* treatment and disposal.

The results of the technical and feasibility analyses of these approaches are summarized below.

No Action Alternative

The no action alternative would not mitigate the threats to human health and natural resources posed by the contaminant plume underlying the Hotel Indigo redevelopment site. This result would be in contradiction to the goal of the Grand Traverse County Brownfield Redevelopment Authority (RLF Loan recipient), the City of Traverse City, and Grand Traverse County to prevent the contaminant plume from migrating to Grand Travers Bay, damaging that natural resource, and potentially posing a health threat to recreational users. SME does not recommend the no action alternative because it does not mitigate the current threat to the environment, is incompatible with the sustainable redevelopment goals of the City of Traverse City and Grand Traverse County, and does not achieve increased protection of human health.

In Situ Chemical Oxidation

In situ chemical oxidation of cyanide in groundwater to concentrations below levels that would pose a threat to surface water is one approach for mitigating the environmental threat posed by the Hotel Indigo site plume. The objective of this approach would be to reduce contaminant concentrations in the groundwater under the Hotel Indigo and Traverse City Place redevelopment areas to levels protective of the waters of Grand Traverse Bay.

The first step in the remediation program would be delineating the specific size and location(s) of the plume areas to be remediated. Hydrogeological testing, such as slug tests and pumping tests, also would be conducted to determine aquifer characteristics needed for system design. Potassium permanganate and hydrogen peroxide are two possible oxidants that could be used; however, little information on the design or success of these approaches for cyanide reduction is available in the literature. *In situ* cyanide oxidation of groundwater plumes with permanganate has been applied to small sites with limited success. The oxidation chemistry of cyanides is complex and highly dependent on the presence or absence of weak-acid and strong-acid dissociable metal complexes in the saturated zone; additional testing may be required to characterize these materials. Selecting an appropriate oxidation reagent and designing an injection and capture-recirculation remediation system would include extensive laboratory bench testing and field pilot studies.

Use of an *in situ* chemical reaction approach would require a reagent injection array to deliver the oxidants to the contaminated groundwater in the primary plume area. The size of the primary plume, approximately 12 – 15 acres, would require an extensive array of injection locations. Since these reagents are themselves hazardous, the *in situ* oxidation process would require a recirculating system to capture excess reagent at the downgradient edge of the plume and return it to the remediation area. The design and construction of the remediation system would be based on the results of the bench and field pilot tests and the ability to obtain access to properties for injection point and piping installation.

The following is a summary of the cost analysis for this remediation approach:

Response Activity	Unit Cost	Quantity	Cost
Plume definition, hydrogeological testing, chemical characterization, and modeling for remedial design	\$100,000	1 ea.	\$100,000
Laboratory feasibility and pilot system testing	\$250,000	1 ea.	\$250,000
Engineering design	\$75,000	1 ea.	\$75,000
Contracting and construction	\$1,800,000	1 ea.	\$1,800,000
Operations, maintenance and monitoring	\$100,000/yr.	5 yr.	\$500,000
TOTAL			\$2,725,000

The use of *in situ* oxidation as a remediation approach at the Site has the following disadvantages:

- The approach does not address provide permanent protection of Grand Traverse Bay because source areas are not addressed. Cyanide will continue to migrate from these areas to the groundwater after remediation of the existing plume. This will require additional remediation at additional cost in the future to provide the desired surface water protection.
- Neither the Grand Traverse Brownfield Redevelopment Authority nor Traverse City controls all parcels of land on which reagent injection points and associated piping would have to be installed. The presence of existing structures and inability to gain access to appropriate properties may significantly hinder implementation of the remediation system design.
- The presence of injection points, associated piping ,and other remediation infrastructure on the Hotel Indigo site and a large part of the Traverse City Place redevelopment area may interfere with hotel operations and will hinder additional redevelopment projects, respectively.
- The complex injection and recirculation system will require a high level of maintenance.

This response activity is marginally technically feasible, is not easily implemented, and achievement of the intended objectives is uncertain. It is also more expensive, consumes more resources, an inhibits further redevelopment more than other alternatives. SME does not recommend this approach.

Groundwater Interdiction, Extraction, Treatment and Disposal

Interdiction, extraction, treatment and disposal of the contaminant plume will create a barrier to migration of the contamination into Grand Traverse Bay. The objective of this approach would be to intercept contaminants in the groundwater under the Hotel Indigo and Traverse City Place redevelopment areas before they can migrate into Grand Traverse Bay. Groundwater withdrawal from extraction wells properly installed along the leading edge of the contaminant plume will create overlapping cones of depression that will capture contaminated groundwater and prevent further migration of the plume. Once the groundwater is captured and extracted, it will be treated to reduce contaminant concentrations, then discharged into the Traverse City sanitary wastewater management system for final treatment. This approach would be protective of the bay until contaminant source areas are identified and remediated during future redevelopment.

The first step in the remediation program would be delineating the specific plume boundaries to the extent needed for design of the remediation system. Hydrogeological testing, such as slug tests and pumping tests, would be conducted to define the aquifer characteristics. Since the extracted groundwater would have to be treated before discharge to the sanitary sewer system for final treatment, laboratory bench tests and larger pilot studies would be required to determine the appropriate treatment technology and system to reduce contaminant concentrations to discharge-permit levels.

The groundwater extraction and wastewater treatment systems would be designed and installed based on the cumulative results of the environmental, hydrogeological, bench ,and pilot testing. The physical locations of the extractions wells only need to be downgradient of the plume, and the location of the treatment system is flexible, as long as it is near an appropriate sewer. Since public property lies downgradient of the entire plume and is available for construction of the system, access for construction of the system will not be a problem. Furthermore, the system will not interfere with the Hotel Indigo development or operations or hinder further development of the Traverse City Place redevelopment area.

The following is a summary of the cost analysis for this remediation approach:

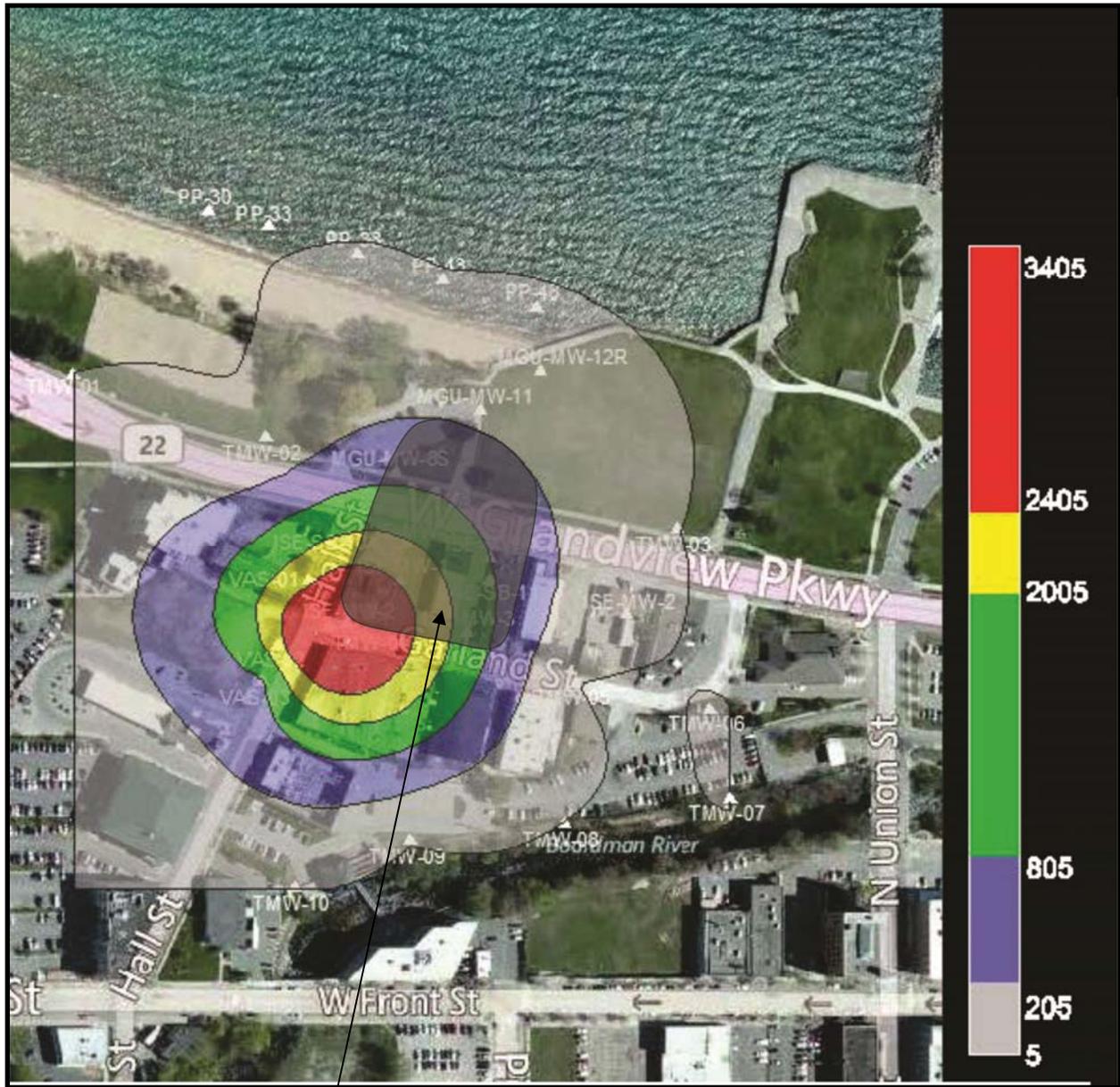
Response Activity	Unit Cost	Quantity	Cost
Plume definition, pump testing, and hydrogeological modeling for remedial design	\$75,000	1 ea.	\$75,000
Treatment feasibility testing	\$50,000	1 ea.	\$50,000
Engineering design	\$50,000	1 ea.	\$50,000
Contracting and construction	\$1,200,000	1 ea.	\$1,200,000
Operations, maintenance and monitoring	\$35,000/yr.	10 yr.	\$350,000
TOTAL			\$1,725,000

The use of groundwater interdiction, extraction, treatment and disposal as a groundwater remediation approach at the Property has the following disadvantages:

- The approach would not address remediation of the source(s) of contamination or result in direct reduction in contaminant concentrations in the groundwater.
- The remediation system would need to be operated for a longer period of time, until source remediation and/or natural attenuation reduces contaminant concentrations to levels below surface water risk levels.

This response activity is technically and economically feasible and implementable. The groundwater interdiction, extraction and treatment approach has been used for decades, and considerable hydrogeological and engineering design experience is available. Significant information and experience associated with treatment of cyanide in wastewater is also available. This is the least expensive alternative evaluated, imposes the least impact on use and redevelopment of the Hotel Indigo site and adjoining redevelopment areas, and can be located on public land. This approach will effectively block contaminant migration to the Grand Traverse Bay until sources areas are identified and remediated as part of the further redevelopment of Traverse City Place. SME recommends this environmental response alternative for mitigation of the threat to natural resources posed by the Hotel Indigo plume.

**APPROXIMATE CYANIDE CONTAMINATION IN GROUNDWATER
HOTEL INDIGO AND TRAVERSE CITY PLACE**



**Approximate Plume Area
Arising from Under
Indigo Hotel Site**

**Cyanide
Concentration**