



October 17, 2019  
G-Logics Project Number: 01-0410-M

Washington Department of Ecology, Northwest VCP  
Mr. Dale Myers  
3190 160th Avenue SE, Northwest Regional Office  
Bellevue, WA 98008-5452

**Subject: Proposed Cleanup Action Alternatives  
Boeing Field Chevron  
Ecology Facility/Site No.: 2551  
Agreed Order No.: DE-10947**

Dear Mr. Myers:

This letter has been prepared to provide a preliminary listing and description of cleanup action alternatives (CAAs) that G-Logics is proposing to include for evaluation in the Feasibility Study (FS) for the Boeing Field Chevron site (the Site). This document is being submitted for review and comment by Ecology in order to facilitate completion of the forthcoming FS for the Site. Please note that the CAAs proposed below have been developed based on an assumption that the Site will remain as an operating retail petroleum service station for the foreseeable future.

***CAA 1 Monitored Natural Attenuation and Institutional Controls***

Under CAA 1, no further “active” remediation measures at the Site would be conducted. Instead, future compliance with cleanup levels established for the Site could be achieved by long-term monitored natural attenuation (MNA) of petroleum impacts to soil and groundwater. MNA is a proven and industry-accepted remediation strategy that consists of actively monitoring naturally occurring physical, chemical, and/or biological processes that are acting without human intervention to reduce the mass, toxicity, mobility, volume, or

**G-Logics, Inc.**  
40 2<sup>nd</sup> Avenue SE  
Issaquah, WA 98027  
T: 425-391-6874  
F: 425-313-3074  
01-0410-M CAA Descriptions

concentration of constituents of concern (COCs) in the environment. This remediation strategy is well suited for petroleum-impacted sites with low potential risks to human health or the environment, or where exposure pathways can be readily mitigated using institutional controls, such as deed restrictions, soil management plans, and maintenance of impervious surface covers. Institutional controls would be included as a component of CAA 1 in order to limit or prohibit activities that may result in exposure to residual hydrocarbons at the Site until compliance with cleanup levels can be achieved.

***CAA 2 LNAPL Removal, Oxygen Diffusion (upper and lower saturated zone), MNA, and Institutional Controls***

CAA 2 is similar to CAA 1, but includes additional active remediation components to address the recurrence of light non-aqueous phase liquid (LNAPL) at the Site and potential further downgradient migration of petroleum-impacted groundwater.

Under this alternative, additional LNAPL removal measures would be undertaken to address the recurrence of LNAPL routinely observed in monitoring well IP-7. LNAPL-removal may involve the use of surfactant and one or more extraction events, followed by subsequent installation of passive skimmers or absorbent “socks”. LNAPL removal measures would be undertaken until a remediation level (RL), to be established by the Cleanup Action Plan (CAP) for the Site, is met.

CAA 2 would also include installation and operation of an oxygen diffusion system along the downgradient boundary of the service station property. The goal of this system would be to increase oxygen levels in Site groundwater in order to enhance naturally occurring biodegradation of petroleum contaminants in groundwater at and beyond the downgradient property boundary in both the lower and upper saturated zones. The oxygen diffusion system would be operated until a RL, to be established for source area groundwater, is met.

Like CAA 1, this alternative is also expected to include MNA and institutional control components. Following compliance with the RLs for LNAPL removal and operation of the oxygen diffusion system, MNA would be implemented to achieve final compliance with the Site cleanup levels. Institutional controls would be required throughout the duration of the cleanup action in order to limit or prohibit activities that may result in exposure to residual hydrocarbons at the Site until compliance with cleanup levels can be achieved.

**CAA 3 *DPE (upper saturated zone) Oxygen Diffusion (lower saturated zone) LNAPL Removal, MNA, and Institutional Controls***

This alternative is similar to CAA 2, except that active remediation by dual-phase extraction (DPE) would be performed in the upper saturated zone instead of oxygen diffusion. This alternative would provide for a more aggressive active remedy in the upper saturated zone, as DPE would address petroleum impacts to vadose zone soils, upper saturated zone soils, and groundwater in the upper saturated zone. Due to high groundwater recharge rates, DPE cannot be effectively implemented in the lower saturated zone. Therefore, oxygen diffusion would be implemented in that zone.

LNAPL removal, MNA, and institutional controls associated with CAA 3 would be similar to those described above for CAA 2.

**CAA 4 *Hot-Spot Excavation and Off-Site Disposal, MNA, and Institutional Controls***

Under CAA 4, active remediation of the primary source area, to the west of the western pump islands, would be addressed through a focused “hot-spot” excavation. The goal of this excavation would be to remove the maximum amount of petroleum impacted soil to the extent practicable with no, or limited, removal of any existing service station infrastructure. Due to several site-specific constraints (proximity of Site to State Highway 99, municipal utilities, etc.) this excavation would be focused in the area of highest petroleum concentrations in soil (west of the western pump islands) and would be expected to extend to a maximum depth of approximately 15 to 18 feet below ground surface (bgs).

Following implementation of the hot-spot excavation, it is expected that petroleum impacts in soil and groundwater will remain above Site cleanup levels. Therefore, a subsequent period of MNA would be implemented to achieve final compliance with the Site cleanup levels. Institutional controls would be required throughout the duration of the cleanup action in order to limit or prohibit activities that may result in exposure to residual hydrocarbons at the Site until compliance with cleanup levels can be achieved.

**CAA 5 *Shallow Excavation (upper saturated zone), In-Situ Chemical Oxidation (lower saturated zone), MNA, and Institutional Controls***

Under CAA 5, active remediation of the Site would be achieved by excavation of shallow petroleum impacted soil in the upper saturated zone and in-situ chemical oxidation (ISCO) in the lower saturated zone.

The shallow excavation would be different from the “hot spot” excavation described above for CAA 4, in that it would include the removal of impacted soils to the lateral points of compliance and to a depth of approximately 12 feet bgs. This approach would address residual hydrocarbons within the vadose zone, upper saturated zone, and a portion of the semi-confining layer.

For the lower saturated zone, oxidizing compounds such as persulfate, permanganate, ozone, or peroxides would be introduced, resulting in the destruction of petroleum hydrocarbons. Oxidizers could be delivered by multiple direct injections into the subsurface or installation of permanent injection points/galleries, using simple pumps and perforated-piping systems.

Following implementation of the shallow excavation and ISCO components of this CAA, it is expected that petroleum impacts in soil and groundwater will remain above Site cleanup levels. Therefore, a subsequent period of MNA would be implemented to achieve final compliance with the Site cleanup levels. Institutional controls would be required throughout the duration of the cleanup action in order to limit or prohibit activities that may result in exposure to residual hydrocarbons at the Site until compliance with cleanup levels can be achieved.

#### ***CAA 6 In-Situ Carbon Adsorption and Enhanced Bioremediation, MNA, and Institutional Controls***

Under CAA 6, in-situ carbon adsorption and enhanced bioremediation would be used to address impacted soil and groundwater at the Site. Enhanced bioremediation, using oxygen, microbes, and trace nutrients directly injected into the subsurface, can result in biodegradation of residual hydrocarbons. Specifically, this method would include the use of multiple injections of a liquid media containing oxygen-releasing compounds and microbes. Additionally, this approach can be combined with activated carbon injections. This approach is often referred to as a “trap and treat” method, because hydrocarbons are “trapped” by adsorption onto the introduced carbon molecules, effectively slowing their migration and providing more exposure time to the bioremediation amendments.

As with CAA 5 above, it is expected that petroleum impacts in soil and groundwater will remain above Site cleanup levels following implementation of carbon adsorption and enhanced bioremediation. Therefore, a subsequent period of MNA would be implemented to achieve final compliance with the Site cleanup levels. Institutional controls would be

required throughout the duration of the cleanup action in order to limit or prohibit activities that may result in exposure to residual hydrocarbons at the Site until compliance with cleanup levels can be achieved.

***CAA 7 Site-Wide Excavation, MNA, and Institutional Controls***

CAA 7 would consist of a Site-wide excavation with the goal of removing all accessible petroleum impacted soils at the Site to the lateral and vertical points of compliance. This alternative would be expected to include:

- Removal and replacement of portions of the existing service station infrastructure, including the pump island canopy, fuel piping, and dispensers;
- Removal of soils to a depth of up to 25 feet bgs;
- Managing groundwater infiltration from the lower saturated zone;
- Excavating in close proximity to a state highway; and
- Excavating in close proximity to municipal utilities (water main, storm drain, sanitary sewer).

Despite the aggressive nature of this alternative, it is likely that petroleum impacted soil would remain present at the Site in the vicinity of municipal utilities or beneath the adjacent right-of-way. Low-level groundwater impacts above Site cleanup levels may also remain. Therefore, CAA 7 would also include an MNA component to achieve final compliance with the Site cleanup levels. Institutional controls would be required throughout the duration of the cleanup action in order to limit or prohibit activities that may result in exposure to residual hydrocarbons at the Site until compliance with cleanup levels can be achieved.

**Closing**

We look forward to working with Ecology on completion of the FS for the Site; and would appreciate any questions or comments that Ecology may have regarding the proposed CAAs. Should you have any questions regarding this information, please contact us at your convenience.

Sincerely,  
**G-Logics, Inc.**

Dan Hatch  
Remediation Manager

Zackary S. Wall, LG  
Project Geologist