ASSOCIATED
ENVIRONMENTAL
GROUP, LLC

September 30, 2011

Mr. Robert Rau
Office of Compliance and Enforcement
United States Environmental Protection Agency - Region 10
1200 6th Avenue, Suite 900
Mail Stop OCE-082
Seattle, Washington 98101

RE: **FINAL Proposed Cleanup Action Plan**
Former Smitty's Conoco #140 – Toppenish (Former Spirit Gas Station)
EPA Facility Identification No. 4260087
102 East Toppenish Avenue
Toppenish, Washington 98948

Dear Mr. Rau:

Associated Environmental Group, LLC (AEG) has prepared this Final Cleanup Action Plan (CAP) for your consideration of Corrective Action at the former Smitty's Conoco #140 – Toppenish property, located at 102 East Toppenish Avenue in Toppenish, Yakima County, Washington (the Site) and nearby offsite areas. The scope of work (SOW) section of this CAP describes the property, environmental conditions, cleanup objectives, and the appropriate cleanup action standards selected under the Washington State Department of Ecology (Ecology) Model Toxics Control Act (MTCA). It also describes the Performance Groundwater Monitoring/Sampling Events that is proposed for the Site after completion of the bioremediation phase.

Recently AEG had submitted a *Supplemental Remedial Investigation* (RI) report (dated March 17, 2011) and a *Quarterly Groundwater Event – May 2011* report to EPA Region 10 Office of Compliance and Enforcement Site Manager. A review of these documents in conjunction with this proposed CAP is recommended for full details on the Site's background and recent environmental investigation activities.

SITE BACKGROUND

The Site, a former Spirit brand retail fueling station and associated convenience store, is located on the southeast corner of East Toppenish Avenue and Asotin Avenue in Toppenish, Washington. This gasoline station has also been known as Toppenish Pik-A-Pop and Toppenish Smitty Store #140. The Site, Yakima County Assessor Parcel Number 201003-34510, is triangular and approximately 24,000 square feet in area (or 0.55 acres in size). It is located in Township 10 North, Range 20 East, Section 3 WM. The gasoline station and convenience store ceased operation in the November 2009. Figure 1, *Site &Vicinity Map*, presents the general boundaries of the Site and vicinity area.

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A petroleum release occurred prior to 2004 at the Site when it was a former Spirit brand retail fueling station. Other businesses which operated at the Site included the Toppenish Pik-A-Pop facility and most recently, the Smitty Conoco #140 gasoline station. The site is currently under remedial investigation for petroleum release (EPA Facility ID Number 4260087). The EPA has jurisdiction over the Site since the property is located within the boundaries of the Yakama Indian Reservation.

PREVIOUS ENVIRONMENTAL WORK SUMMARY

A brief summary of the most recent environmental work/investigation at the Site is provided below.

Interim Site Remediation – October 2009

On November 9, through November 20, 2009 AEG along with subcontractor Belsaas & Smith Construction (Belsaas) completed decommissioning and removal of five USTs at the Site: 1) one 8,000-gallon gasoline fuel UST; 2) one 6,000-gallon gasoline fuel UST; 3) one 4,000-gallon diesel fuel UST; 4) one 1,000-gallon UST filled with CDF which was presumably used for containing diesel fuel; and 5) one 500-gallon waste oil UST. During excavation and investigative activities at the Site, AEG encountered the two abandoned USTs: 1) one 1,000-gallon UST; 2) one 500-gallon UST. The 1,000 gallon UST had been closed-in-place. It was filled with CDF, and the fill port on the 500-gallon UST had been removed. However, the 500-gallon UST contained approximately 300 gallons of waste oil, based on site observation. All of the USTs appeared to be slightly corroded; however, upon close visual inspection, no obvious holes were found on any of the tanks. Petroleum contaminated soil (PCS) was encountered in the overburden soil around the fill ports at all three active tanks (the 4,000 gallon, 6,000 gallon, and 8,000 gallon USTs), near the turbines and beneath the USTs to approximately 12 feet bgs where groundwater was encountered. A total of 1,535 tons of PCS was excavated and removed from the Site and disposed of at an authorized landfill, Anderson Rock & Demolition Pits, in Yakima, Washington.

Based on the elevated concentrations of gasoline range total petroleum hydrocarbons (TPH) and associated volatile organic compounds (VOC) exhibited in soil samples collected in the overburden soil, throughout the excavation pit, and beneath the fuel tanks, AEG concluded that it appears that the potential source of the petroleum hydrocarbons impacted soil and groundwater may have been repeated occurrences of overfilling at the fill ports coupled with the containment leak detected at dispenser island #1/2 (as exhibited during helium testing). The product lines connecting to areas above the USTs may have also contributed to the PCS, as observed in the petroleum impacted overburden soil (above the USTs). Figure 2, *Previous Site Excavation*, presents the layout of the former pump islands and locations of the USTs at the Site.

Supplemental Remedial Investigation – July 2010 & January/February 2011

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Supplemental Remedial Investigation (RI) was conducted to further characterize the lateral and vertical extent of the dissolved phase gasoline petroleum hydrocarbons at offsite areas downgradient and crossgradient of the Site including at the following locales: 1) to the southeast on Asotin Avenue; 2) to the east at El Charrito Restaurant property, East Toppenish Ave., and B Street right-of-ways; and 3) adjacent west of Site at the City of Toppenish right-of-way on Asotin Avenue. The Offsite Preliminary Investigation was conducted in July 2010, and the Supplemental RI was conducted in January/February 2011.

AEG concluded that "*soil remedial activities during the UST decommissioning and product lines removal have removed the bulk of petroleum contaminated soil at the Site. However, residual PCS remains, at depths greater than 10 feet bgs, and will continue to serve as a source of residual contamination to groundwater*" (refer to Table 1, *Summary of Groundwater Analytical Results*). The Supplemental RI confirmed that the lateral extent of the dissolved phase petroleum hydrocarbons extends from the west area of the property (in the vicinity of the previous USTs) to off-property areas to the east of the facility including the adjoining El Charrito restaurant property and to B Street. However, it appears that diesel range TPH and halogenated VOC are not constituents of concern associated with the Site based on the lack of detectable concentrations of these analytes in both the February and May 2011 quarterly events. The groundwater flow direction during the February and May 2011 groundwater events was generally to the east-southeast.

CONCEPTUAL SITE MODEL

The conceptual site model reflects the findings of previous environmental investigations and presents an exposure assessment for the Site. The exposure assessment involved evaluating the distribution of the dissolved and adsorbed phases of gasoline range petroleum hydrocarbons in soil and groundwater onsite and at adjacent downgradient locales, potential pathways, and potential receptors. The conceptual site model is used to support an evaluation of feasible remediation technology for the cleanup of petroleum contaminated soil (PCS) and impacted groundwater at the Site and impacted areas off-property.

The primary conceptual release model for the Site appears to be repeated occurrences of overfilling of gasoline fuel at the fill ports coupled with the containment leak detected at former dispenser island #1/2 (located near the center of the Site) and subsequent incorporation of spilled gasoline fuel into the subsurface soils throughout the property due to the porous media of the matrix (silty gravelly sand to sandy gravel) and shallow depth to groundwater to allow for the diffusion of petroleum hydrocarbons and its dissolution into groundwater, and sorption of the dissolved chemicals from water to solid surfaces.

It also appeared that the presence of cohesionless soils at the Site enabled the vertical migration of

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dissolved phase gasoline range petroleum hydrocarbons to where groundwater was encountered (at approximately 10 feet to 12 feet bgs) and beyond the vadose zone. It appears that the likelihood exists that the local shallow groundwater regime (depth-to-water and direction of groundwater flow) may fluctuate seasonally due to the local irrigation practices.

Soil analytical laboratory results from the Interim Site Remediation and Supplemental Remedial Investigation indicated that residual petroleum contaminated soil is present at the Site and at offsite locales, at depths ranging from 10 feet to 14 feet below ground surface (at the soil-water bearing zone). Soil and groundwater laboratory analytical results indicate that the lateral extent of the dissolved phase gasoline petroleum hydrocarbons, associated with the Site, extends from the west area of the Site (in the vicinity of the previous USTs) to off-property areas to the east of the property including the adjoining El Charrito Mexican restaurant and to B Street. Gasoline range petroleum hydrocarbons impact to the subsurface (soil and groundwater media) is related to the fill ports of the former underground storage tanks at the Site.

The constituents of concern (COCs) at the Site and associated off-property areas include the following constituents and the methods of laboratory analysis:

- Gasoline range TPH via Northwest Method TPH-Gx
- Gasoline associated VOC as per Ecology MTCA Cleanup Regulation Table 830–1, *Required Testing for Petroleum Releases*:
    - ❖ Specific aromatic hydrocarbons including benzene, toluene, ethylbenzene, total xylenes (BTEX), methyl tertiary-butyl ether (MTBE), total naphthalenes, 1-2 dibromoethane (EDB), and 1-2 dichloroethane (EDC) via EPA Method 8260B; and
- Total lead via EPA Method 7421

CORRECTIVE ACTION OBJECTIVE

The objective of the Corrective Action is to clean up the impacted vadose zone and restore the groundwater quality at the Site and associated off-property downgradient areas (as represented by wells MW-5 through MW-10) to concentrations below Ecology MTCA Method A groundwater cleanup levels and minimize the potential for exposure to humans and the environment. Table 1 presents analytical results for all monitoring wells at the Site and the offsite wells. Elevated concentrations of gasoline range TPH and selected VOC constituents are above Ecology MTCA Method A groundwater cleanup levels at MW-4, MW-5, and MW-7, as of the May 2011 groundwater monitoring/sampling event.

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PROPOSED CORRECTIVE ACTION

Ecology MTCA Method A cleanup levels are designed for facilities undergoing routine cleanup actions that involve relatively few hazardous substances (WAC 173-340-700(5)(a)). The conditions for using Ecology MTCA Method A cleanup levels are met at this Site because numerical standards are available for all indicator hazardous substances in all media of concern (WAC 173-340-704(1)(b)). In addition, Method A cleanup levels are appropriate because gasoline range TPHs and its VOC constituents have been identified at concentrations above cleanup levels (WAC 173-340-700(2)). Therefore, Ecology MTCA Method A groundwater cleanup levels will be used at the Site and off-property areas since the conditions for using this Method are met.

Table 2 - Selected MTCA Cleanup Levels for Corrective Action

Media	Contaminants	Cleanup Levels	Reference
Groundwater	TPH-Gasoline	800 µg/L	MTCA Method A
	Benzene	5 µg/L	MTCA Method A
	Toluene	1,000 µg/L	MTCA Method A
	Ethylbenzene	700 µg/L	MTCA Method A
	Total Xylenes	1,000 µg/L	MTCA Method A
	Total Napthalenes	160 µg/L	MTCA Method A
Soil	TPH-Gasoline	30 mg/Kg	MTCA Method A
	Benzene	0.03 mg/Kg	MTCA Method A
	Toluene	7 mg/Kg	MTCA Method A
	Ethylbenzene	6 mg/Kg	MTCA Method A
	Total Xylenes	9 mg/Kg	MTCA Method A
	Total Napthalenes	5 mg/Kg	MTCA Method A

Based on the conceptual site model and analytical results for the impacted soil and groundwater media, the selected remediation technologies for the cleanup action at the Site, proposed by Regenesis engineers (San Clemente, California) and AEG, is a staged approach to in-situ bioremediation comprising of chemical oxidation and aerobic biodegradation of petroleum hydrocarbon. Regenesis evaluated the Site based on site specific soil, groundwater, and aquifer data/information in addition to the vertical and areal extent of the impacted areas and COCs. Water quality indicator field parameters were also used in the evaluation process.

Regenesis and AEG have found this cleanup action approach to be successful at similar properties impacted by petroleum hydrocarbons. The primary components of this Corrective Action, as designed by Regenesis engineers, are as follows:

- In-Situ chemical oxidation using Regenesis RegenOx[1] to reduce sorbed and soil-matrix bound petroleum hydrocarbon in the zone of contamination including the vadose zone and saturated zone, as well as the dissolved phase in groundwater.

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- Regenesis Oxygen Release Compound[1] (ORC) Advanced will be used to accelerate the microbial degradation of remaining petroleum hydrocarbon impacted zone of contamination including the vadose zone and groundwater.

[1]RegenOx and ORC® product information provided by Regenesis (www.regenesis.com)

Confirmation soil samples within the vadose zone after completion of similar in-situ bioremediation activities at facilities where AEG and Regenesis have completed remedial action have confirmed that this staged approach is effective for cleanup action in both the vadose zone and groundwater.

RegenOx chemical oxidation involves injecting an oxidizer and activator directly into the source area, impacted soil areas, and the petroleum hydrocarbon plume onsite. The oxidants in the RegenOx are a mixture of sodium percarbonate, sodium carbonate, sodium silicate and silica gel. The oxidant chemicals react with the contaminants producing innocuous substances such as carbon dioxide ($C0_2$), water (H_20), and inorganic chloride.

RegenOx directly oxidizes contaminants and generates a range of highly oxidizing free radicals that remediates the constituents of concern - gasoline range petroleum hydrocarbon and its associated volatile organic compounds. The sustained chemical reaction created in the subsurface by the injection of RegenOx can last up to 30 days on a single application (Regenesis).

ORC Advanced will also be applied by direct injection into the source zone and the petroleum hydrocarbon plume onsite. The depth of the injection will account for both the impacted vadose zone and the saturated zone below it. ORC Advanced is a phosphate-intercalated magnesium peroxide, that when hydrated, produces a controlled release of oxygen for periods of up to 12 months on a single application (Regenesis). This controlled release of oxygen assists in accelerating the naturally occurring aerobic contaminant biodegradation in groundwater and saturated soils. Technical brochures and Material Safety Data Sheets for both products are provided as attachments.

RegenOx/ORC Advanced Rationale

Following preliminary screening of other feasible remedial technologies, RegenOx followed by an injection of ORC Advanced was selected because additional soil excavation was deemed impractical at the Site due to the previous Interim Remedial Action activities where with the exception of the subsurface under the former convenience store building and a small area in the southeast section of the property the remaining area of the Site was excavated to remove PCS and backfilled. In addition, RegenOx/ORC Advanced are more tailored for remediation at properties where the relative permeability of soils ranges from semi-pervious to pervious with hydraulic

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conductivity values ranging from 10^{-5} to 10^{-2} cm/s and presence of high groundwater table (Regenesis, 2009), as compared to other remedial technologies such as soil vapor extraction/air sparging (SVE/AS) and groundwater extraction for hydrocarbon remediation.

Furthermore, the selection of this remedial action approach for the Site was undertaken based on the following considerations: remedial action objectives for the Site, feasibility analyses, regulatory requirements, and the Site's retail operation. Enhanced bioremediation via ORC Advanced was selected as a secondary remedial technology to address the remaining petroleum hydrocarbon impacts to achieve the required regulatory cleanup levels for groundwater.

The specific RegenOx/ORC Advanced injection/application is designed using typical parameters based on the type of soil identified during the previous Site work. The in-situ hydraulic conductivity was estimated at 10^{-5} to 10^{-2} cm/s based on the predominantly sandy gravel soil in the area. The injection spacing, proposed by Regenesis, is based on site specific criteria considered for the minimum effective area. A conservative injection spacing recommendation of approximately 20 feet for RegenOx and 10 feet for ORC Advanced is proposed based on site specific characteristics, the nature and concentrations of the constituents of concern in both soil and groundwater media, and the estimated area for applying RegenOx and ORC Advanced into the vadose zone and saturated zone of the impacted area and nearby vicinity.

The in-situ bioremediation will begin with the injection of RegenOx and will be followed by ORC Advanced (see below for further details). AEG estimates based on Regenesis and actual product application experience by AEG and subcontractors that both RegenOx and ORC Advanced will be injected at approximately 8 to 10 lbs per foot. *"Generally it is applied at a rate of between 0.1% and 1.0% by weight of the soil matrix and field conditions"* (Regenesis).

The injection depth is targeted from a depth of 4 feet to 15 feet bgs during both applications based on previous soil laboratory analytical results and the depth to groundwater at the Site and vicinity area.

RegenOx product will be injected into boreholes by a direct push probe drilling rig and a pump hopper using the "bottom up" injection method where the probe will be driven down and RegenOx will be injected at pre-determined intervals as the probe is slowly brought up toward ground surface. RegenOx is a chemical oxidation technology developed by Regenesis and consists of two parts that, when mixed cause controlled chemical reactions in the subsurface that can effectively remediate petroleum hydrocarbons in soil and groundwater.

Regenesis' ORC Advanced product will also be injected by a direct push probe drilling rig and a pump hopper using the "bottom up" injection method where the probe will be driven down and

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ORC Advanced will be injected into boreholes in pre-determined intervals as the probe is slowly brought up toward ground surface. ORC Advanced is an oxygen release technology developed by Regenesis that produces a sustained oxygen release when combined with water and remediates the contamination through biological means. The sustained biological reaction created in the subsurface by the injection of ORC Advanced can last up to 12 months on a single application (Regenesis).

The proposed in-situ bioremediation will focus on the following areas: 1) around well MW-4, located at the north-northwest area of the Site, and areas downgradient to the east towards the building on the property; 2) around well MW-1, located on the southwest side of the Site, and areas downgradient to the east and southeast; 3) adjacent to the east of the building on the Site and around well MW-5; 4) at off-property well MW-7 and nearby areas to the east; and 5) around off-property wells MW-9 and MW-10. RegenOx/ORC Advanced injection points will be set in these areas at depths of 2 feet to 14 feet and at lateral intervals of approximately 10 to 15 feet (depending on the bioremediation product).

Bioremediation products will be injected at an angle under the foundation of the building at the Site, on both the east and west sides, in order to address the likely impacted subsurface beneath the building.

Case studies of similar impacted facilities engaged in bioremediation via RegenOx have shown that this remedial action technology is effective in gross reduction of the contaminant mass by oxidizing the sorbed contamination and changing the contaminant mass equilibrium (by increasing its solubility) which result in a shift from a sorbed phase to a dissolved phase. Application of ORC Advanced to the more soluble partially oxidized contaminants (as a result of RegenOx) would expedite the rate of aerobic biodegradation. Due to the changes in the contaminants and soil matrix chemistry, a "*temporary increase in the soluble fractions may occur post-application*" (Regenesis, 2009). AEG has observed this temporary increase within approximately two to four months after the application at several facilities where these products were injected. Groundwater analytical results

AEG proposes the following schedule for in-situ bioremediation:

- Initial Phase of Bioremediation via injection of RegenOx chemical oxidation product (approximately 4,590 pounds) into the subsurface at the Site and adjacent/nearby downgradient areas to be followed by;
- A Secondary Phase of Bioremediation via injection of ORC Advanced (approximately 1,400 pounds) at three months after the Initial Phase of work; and
- Third Phase of Bioremediation (if necessary) via the last injection of ORC Advanced (approximately 1,000 pounds) at six months after the Secondary Phase of work.

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Previous groundwater analytical results collected during the February and May 2011 groundwater events from the Site and offsite eight monitoring wells will serve as the Baseline analytical data. Performance Monitoring of Groundwater events are proposed during and intervening each Phase of work (refer to the next section below). The time period proposed for the Corrective Action is approximately three years – involving the Initial Phase of Bioremediation through the last quarterly event of Compliance Monitoring. However, groundwater analytical results from the last quarterly event along with the EPA will determine whether additional groundwater monitoring is necessary.

PERFORMANCE & COMPLIANCE MONITORING OF GROUNDWATER

The MTCA regulations, WAC 173-340-720(8), require that groundwater cleanup levels be attained in all groundwater monitoring locales from the point of compliance to the outer boundary of the offsite contamination. The point of compliance for groundwater that will meet the MTCA groundwater cleanup level will be measured in groundwater monitoring wells specifically at selected wells onsite and offsite to the east-southeast.

Compliance with groundwater cleanup levels at the southern and western areas of the Site will be measured at monitoring wells MW-1 and MW-4, respectively. Monitoring well MW-5, located adjacent to the east of the convenience store at the Site will serve as the most eastern compliance well for the Site. By measuring the compliance monitoring wells at these locales, the former Smitty Toppenish facility will be able to confirm that the proposed corrective action of in-situ bioremediation processes of RegenOx chemical oxidation and ORC Advanced aerobic biodegradation, in addition to the previous Interim Remedial Action will achieve MTCA groundwater cleanup levels.

The offsite compliance wells will include MW-7 (east of the Site at El Charrito Restaurant) and MW-9 (further east on B Street); MW-6 and MW-10 (southeast of the Site); and MW-8 (northeast of the Site). Consecutive quarterly groundwater events will be conducted at these core wells onsite (MW-1, MW-4, and MW-5) and offsite (MW-6 through MW-10) for eight quarters for the Performance Monitoring phase.

AEG will also monitor the natural attenuation of constituents of concern through ongoing assessment of field parameters. Natural attenuation is the reduction in concentration of compounds in soil or groundwater over time or distance from the source due to naturally occurring physical, chemical, and biological processes, such as biodegradation, dispersion, dilution, adsorption, and volatilization. Therefore, nitrate, sulfate, and chloride will be analyzed at selected monitoring wells (MW-4, MW-5, and MW-9). Field parameters such as dissolved oxygen and oxygen-reduction-potential will also be monitored to assist in the evaluation of biodegradation activities in the

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groundwater media. Other water quality field parameters to be monitored will include temperature, conductivity, total dissolved solids, salinity, and pH.

The performance monitoring/sampling of groundwater will include the tasks presented below to assess the changes to the groundwater quality subsequent to the in-situ bioremediation of residual petroleum contaminated soil and impacted groundwater (via RegenOx and ORC Advanced).

A total of 10 to 12 staged quarterly groundwater events, conducted over a period of three calendar years, are proposed based on the timing of the in-situ bioremediation injection. The first eight quarterly events will be conducted for the Performance Monitoring of Groundwater at the Site as the events are interspersed with bioremediation activities. The final two to four quarterly events will be conducted for the Compliance Monitoring of Groundwater after completion of all bioremediation activities. The number of required Compliance quarterly events may change depending on the groundwater analytical results and gaining approval from the EPA Site Manager.

The tasks for the first eight Quarterly Events (i.e., Performance Monitoring) as they are scheduled in between the phases of in-situ bioremediation injections are as follows:

- Initial injection of RegenOx will be referred to as the starting point of site cleanup action where time (T) = 0, and will be referred to as the Initial Phase of Bioremediation (November 2011).

- 1st Quarterly Event - conducted three months after the Initial Phase of Bioremediation where the scheduled time period is T + 3 months (early February 2012).

- Secondary Phase of Bioremediation – where ORC Advanced is injected approximately three months after the Initial Phase of Bioremediation (late February 2012).

- 2nd Quarterly Event – conducted approximately six months after the Initial Phase of Bioremediation where the scheduled time period is T + 6 months (May 2012).

- 3rd and 4th Quarterly Events – conducted approximately nine and 12 months, respectively, after the Initial Phase of Bioremediation where the scheduled time periods are T + 9 months and T + 12 months, respectively (August and November 2012).

- Third Phase of Bioremediation (if necessary) – where a secondary phase of ORC Advanced is injected approximately six months after the Secondary Phase of Bioremediation (August 2012).

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- After the Third Phase of Bioremediation, AEG will conduct four additional consecutive quarterly events (i.e., the 5th through the 8th Quarterly Events – February through November 2013).

- Groundwater samples for the first eight Quarterly Events will be analyzed only for gasoline range petroleum hydrocarbon and BTEX constituents.

The tasks for the final two to four Quarterly Events (i.e., Compliance Monitoring) are as follows:

- Following the completion of all eight Performance Quarterly Events, AEG will conduct two to four additional and final Compliance Quarterly Events (9th through 12th Quarterly Events – February through November 2014) at the Site and offsite for final evaluation of the groundwater quality condition.

- Groundwater samples for the final 9th through 12th Quarterly Events (as necessary) will be analyzed for gasoline range organics as per MTCA Cleanup Regulation Table 830-1, *Required Testing for Petroleum Releases.* The analyses would include:
    - Gasoline range TPHs by Northwest Method NWTPH-Gx;
    - VOCs including BTEX, methyl tertiary-butyl ether (MTBE), total naphthalenes, 1-2 dibromoethane (EDB), and 1-2 dichloroethane (EDC) via EPA Method 8260B; and
    - Total lead via EPA Method 7421.

- Compliance Quarterly Events will cease if no detectable concentrations or detections below MTCA Method A groundwater cleanup levels of constituents of concern are exhibited at the end of these events.

- Prepare and submit two *Bi-Annual Quarterly Events Reports* documenting the first eight consecutive Performance Quarterly Events. The final two to four Compliance Quarterly Events will also be presented in a bi-annual phase. These reports would present the depth-to-water, groundwater migration direction, and summarizing analytical results of the performance groundwater monitoring/sampling activities. All reports generated by AEG will be reviewed by a WA State licensed hydrogeologist.

- All data and report generated will be submitted as drafts to EPA for review and will be finalized upon receipt of comments/edits from the EPA Site Manager. The final reports will be submitted in both written and electronic format.

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CONFIRMATION SOIL SAMPLING

AEG will conduct a final phase of subsurface investigation at the Site and associated offsite locales for the purpose of collecting confirmation soil samples to ensure that the concentrations of constituents of concern in the previous impacted areas are below Ecology MTCA Method A soil cleanup levels. Angle borings beneath the foundation of the building at the Site via a direct push probe drilling rig will also be conducted during the confirmation soil sampling phase. Soil samples will be collected from the vadose zone and/or smear zone at all locales to evaluate the subsurface (soil) condition after completion of the in-situ bioremediation activities.

Future work at the Site subsequent to the confirmation soil sampling phase, if applicable, may involve the decommissioning of all monitoring wells onsite and at off-property locales by a Washington State certified well driller in accordance with WAC 173-360-381 regulations upon gaining the approval from the EPA Site Manager.

POTENTIAL ADDITIONAL CLEANUP TASKS

In accordance with 40 CRF 280 parts 66 and 67(d), additional cleanup measures and/or a risk-based site closure may be necessary at this Site should cleanup goals are not met.

CLOSING

Before proceeding with the proposed scope of work presented above, AEG's client requests EPA prepare comments for the Site indicating approval of the proposed Cleanup Action Plan. Please contact the undersigned at (360) 352-9835 with questions, comments, and/or your approval.

Regards,
Associated Environmental Group, L.L.C.

Yen-Vy Van, P.G., P. H.G.
Principal Hydrogeologist

Enclosures: Figure 1, *Site & Vicinity Map*
Figure 2, *Previous Site Excavation*
Figure 3, *Proposed Bioremediation Injection Points*
Table 1, *Summary of Groundwater Analytical Results*
Table 2, *Selected MTCA Cleanup Levels for Corrective Action*
Brochures: RegenOx and ORC Advanced
Material Safety Data Sheets: RegenOx Parts A & B and ORC Advanced

cc: Sue Smith, R.H. Smith Distributing, Inc.

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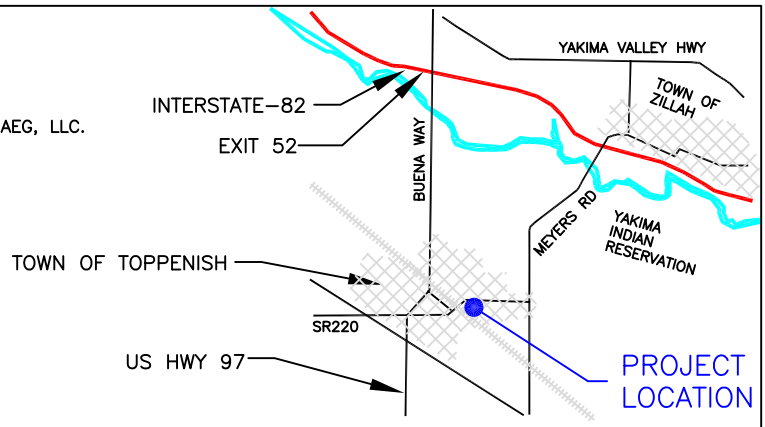
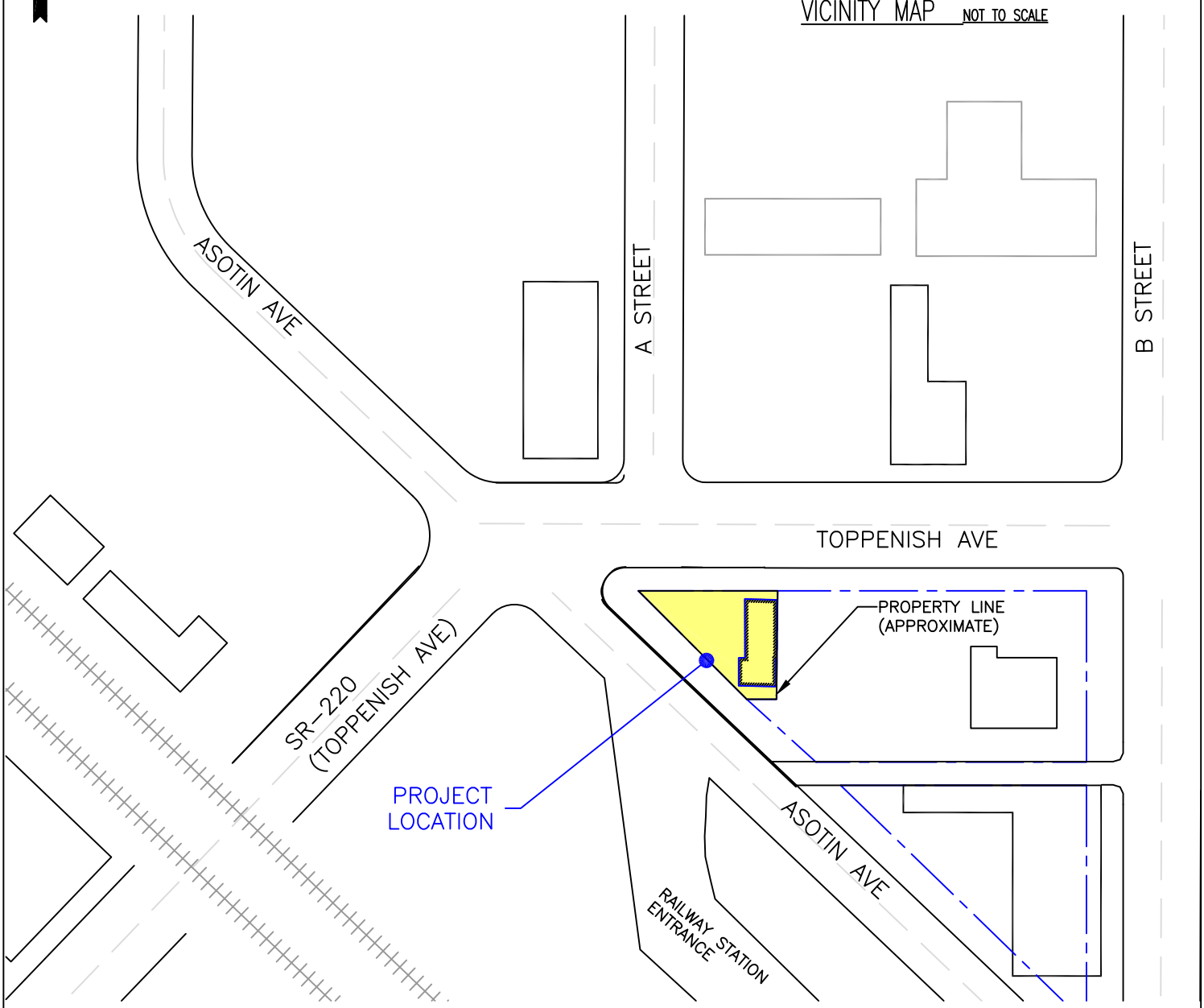
Notes:
(1) The locations of all features shown are approximate.
(2) This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document.

Reference: Drawing created from satellite photograph and notes provided by AEG, LLC.



VICINITY MAP NOT TO SCALE



DRAWING SCALE: 1"= 100'

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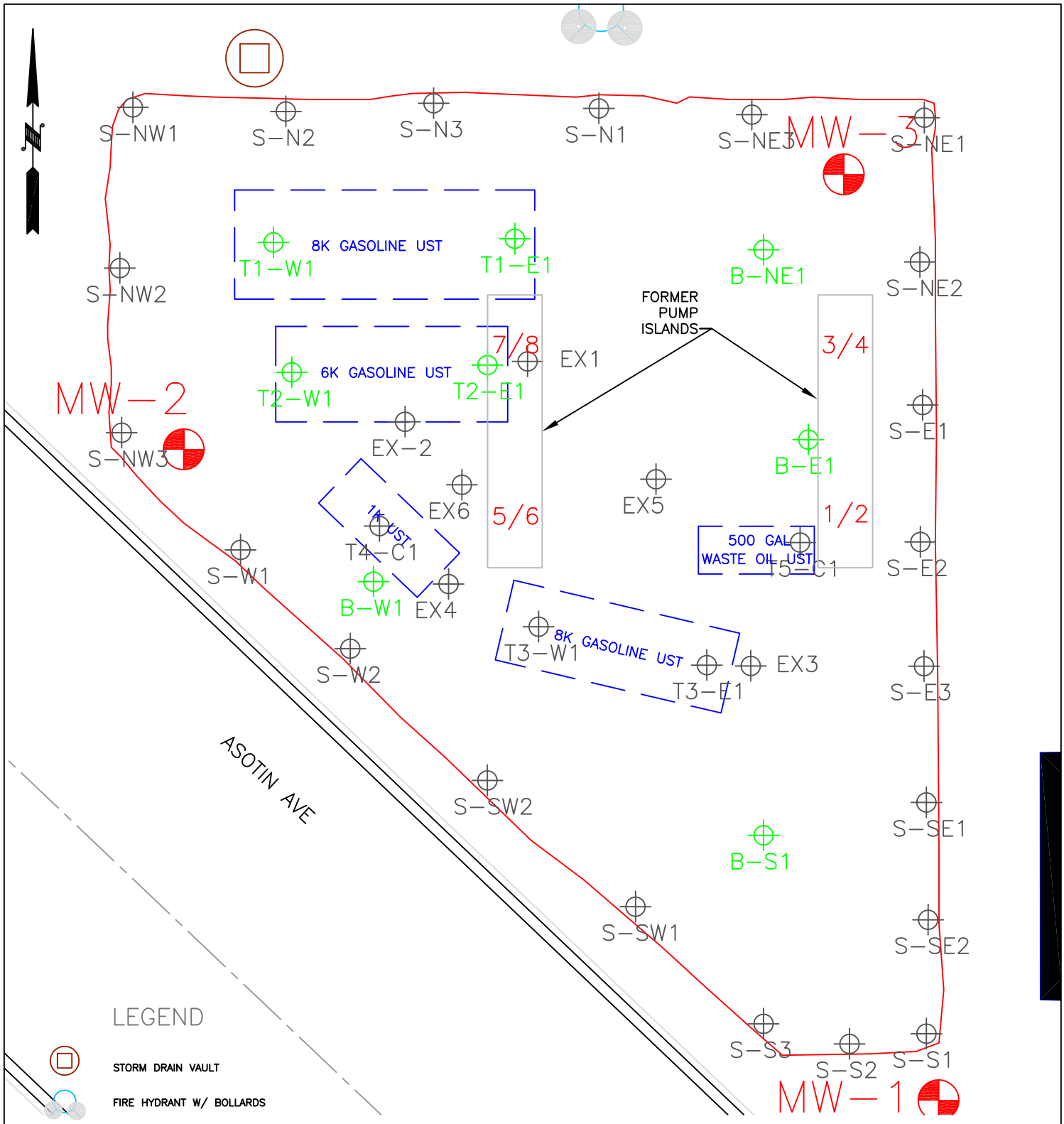
FIGURE 1

SITE & VICINITY MAP

SMITTY CONOCO #140
102 E TOPPENISH AVE
TOPPENIISH, WA

Project# 09–171	Date: 10/20/2009
File: SMITTY'S T	Sheet 1 OF 3



LEGEND

- STORM DRAIN VAULT
- FIRE HYDRANT W/ BOLLARDS
- 1/2 FORMER PUMP DESIGNATION NUMBERS
- S-SW2 SIDEWALL/EXCAVATION SAMPLE
- B-S1 BOTTOM SAMPLE
- MW-1 MONITORING WELL (MW-2 & MW-3 REMOVED)

DRAWING SCALE: 1"= 20'

Notes: (1) The locations of all features shown are approximate.
(2) This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document.

Reference: Drawing created from survey drawing provided by Pacific Geomatic Services Inc.

ASSOCIATED ENVIRONMENTAL GROUP, LLC
1728 State Avenue NE, Suite 101
Olympia, WA 98506
(360) 352-9835 Fax (360) 352-8164

FIGURE 2

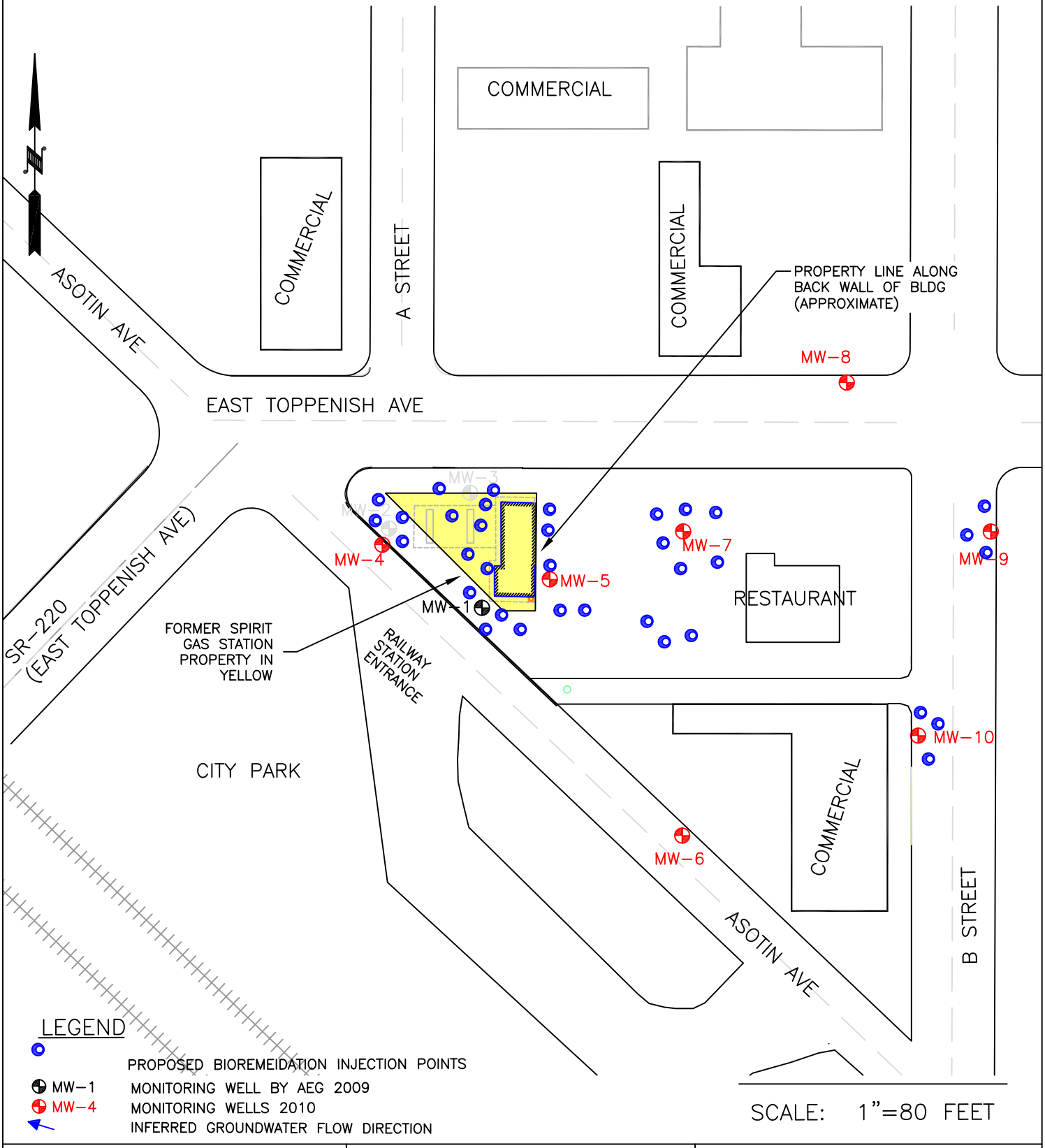
PREVIOUS SITE EXCAVATION

SMITTY'S #140 – TOPPENISH
102 E TOPPENISH AVE
TOPPENISH, WA

Project# 09-171	Date: 10/19/2009
File: SMITTY'S T	Sheet 3 OF 3

Notes:
(1) The locations of all features shown are approximate.
(2) This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document.

Reference: Drawing created from satellite photograph and notes provided by AEG, LLC.



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(360) 352-9835 Fax (360) 352-8164

FIGURE 3 – PROPOSED BIOREMEDIATION INJECTION POINTS

SMITTY CONOCO #140
102 E. TOPPENISH AVE
TOPPENISH, WA

Project#	Date: 09/15/2011
File: FILE NAME	Sheet 1 OF 1

Table 1 Summary of Groundwater Analytical Results - GRO
Former Smitty Conoco #140 (Former Spirit Gas Station)
Toppenish, WA

Well Number[1]	Date Sampled	**Gasoline TPH[2]** (ug/L)	Table 830-1 GRO Volatile Organic Constituents[3] (ug/L)								Total Lead[5] (ug/L)	Diesel TPH Extended[4] (ug/L)		
			Benzene	Toluene	Ethylbenzene	**Total Xylenes**	EDC	EDB	**Total Naphthalenes**	MTBE		Diesel	Heavy Oil	Mineral Oil
MW-1	9/8/2009	657	**64.4**	21.7	<1.0	39.5	--	--	--	--	--	--	--	--
	10/13/2009 [2]	--	**58**	2.6	23	9.0	--	--	--	--	--	--	--	--
	2/1/2011	<100	<1.0	<1.0	2.2	7.2	<1.0	<0.01	<5.0	<5.0	<5.0	--	--	--
	5/18/2011	<100	<1.0	<1.0	<1.0	<1.0	<1.0	<0.01	<5.0	<5.0	<5.0			
MW-2[7]	9/8/2009	108	2.3	3.2	<1.0	5.8	--	--	--	--	--	--	--	--
	10/13/2009 [2]	--	**14**	10	31	130	--	--	--	--	--	--	--	--
MW-3[7]	9/8/2009	**84,900**	**2,500**	**4,800**	639	**7,450**	--	--	--	--	--	--	--	--
	10/13/2009 [2]	**--**	**1,500**	**3,600**	440	**4,100**	--	--	--	--	--	--	--	--
MW-4	2/1/2011	**18,800**	**22.4**	62.8	435	**2,730**	<1.0	<0.01	115	<5.0	<5.0	--	--	--
	5/18/2011	**6,880**	**13.9**	15.9	<1.0	688	<1.0	<0.01	10.8	<5.0	<5.0			
MW-5	2/1/2011	**10,100**	**11.9**	5.6	186	242	<1.0	<0.01	155	<5.0	<5.0	<200	<400	<400
	5/18/2011	**1,790**	<1.0	<1.0	<1.0	4.1	<1.0	<0.01	5.4	<5.0	8.2	<200	<400	<400
MW-6	2/1/2011	<100	<1.0	<1.0	<1.0	<1.0	<1.0	<0.01	<5.0	<5.0	<5.0	--	--	--
	5/18/2011	<100	<1.0	<1.0	<1.0	<1.0	<1.0	<0.01	<5.0	<5.0	<5.0			
MW-7	2/1/2011	**42,300**	**215**	692	**1,570**	**11,500**	<1.0	<0.01	**311**	<5.0	7.9	<200	<400	<400
	5/18/2011	**68,200**	**90.5**	120	411	**15,500**	<1.0	<0.01	**1,540**	<5.0	11.5	<200	<400	<400
MW-8	2/1/2011	**1,440**	<1.0	2.2	18.6	164	<1.0	<0.01	35.0	<5.0	<5.0	--	--	--
	5/18/2011	<100	<1.0	1.4	<1.0	4.8	<1.0	<0.01	16.8	<5.0	<5.0			
MW-9	2/1/2011	660	**9.0**	<1.0	9.2	24.7	<1.0	<0.01	<5.0	<5.0	8.6	--	--	--
	5/18/2011	<100	<1.0	<1.0	<1.0	<1.0	<1.0	<0.01	<5.0	<5.0	<5.0			
MW-10	2/1/2011	<100	<1.0	<1.0	<1.0	<1.0	<1.0	<0.01	<5.0	<5.0	<5.0	--	--	--
	5/18/2011	<100	<1.0	<1.0	<1.0	<1.0	<1.0	<0.01	<5.0	<5.0	<5.0			
PQL		100	1.0	1.0	1.0	1.0	1.0	0.01	5.0	5.0	5.0	200	400	400
Ecology MTCA Method A Clean Up Levels		800 [6]	5	1,000	700	1,000	5	0.010	160	20	15	500	500	500

Notes:
[1]Monitoring well locations are shown in figure 1
[2]Gasoline range total petroleum hydrocarbons (TPH). Analyzed by Northwest Method NWTPH-Gx.
[3]Select Volatile Organic Compounds in gasoline range organics (GRO) per Table 830-1. Analyzed by EPA Method 8260B.
[4]Analyzed by Northwest Method NWTPH-D/Dx Extended
[5]Analyzed by EPA Method 7421
[6]Cleanup level with presence of benzene
[7]Monitoring wells decommissioned in 2009 due to UST removal/soil excavation activities.
Groundwater results from White Shield, Inc.'s and US EPA's sampling activities.
Bold indicates the detected concentration exceeds Ecology MTCA Method A cleanup level

EDC = 1,2-Dichloroethane
EDB = 1,2-Dibromoethane
MTBE = methyl tertiary-butyl ether
PQL = Practical Quantification Limit
ug/L= micrograms per liter
-- = not analyzed for constituent
< = not detected above laboratory limits

RegenOx™

CHEMICAL OXIDATION REDEFINED...

RegenOx™ is an advanced in situ chemical oxidation technology designed to treat organic contaminants including high concentration source areas in the saturated and vadose zones*

PRODUCT FEATURES:

- Rapid and sustained oxidation of target compounds
- Easily applied with readily available equipment
- Destroys a broad range of contaminants
- More efficient than other solid oxidants
- Enhances subsequent bioremediation
- Avoids detrimental impacts to groundwater aquifers

RegenOx product application

HOW IT WORKS:

RegenOx maximizes in situ performance using a solid alkaline oxidant that employs a sodium percarbonate complex with a multi-part catalytic formula. The product is delivered as two parts that are combined and injected into the subsurface using common drilling or direct-push equipment. Once in the subsurface, the combined product produces an effective oxidation reaction comparable to that of Fenton's Reagent without a violent exothermic reaction. RegenOx safely, effectively and rapidly destroys a wide range of contaminants in both soil and groundwater (Table 1).

ACHIEVES RAPID OXIDATION VIA A NUMBER OF MECHANISMS

RegenOx directly oxidizes contaminants while its unique catalytic complex generates a suite of highly charged, oxidative free radicals that are responsible for the rapid destruction of contaminants. The mechanisms by which RegenOx operates are:

- Surface- Mediated Oxidation: (see Figure 1 and description below)
- Direct Oxidation: $C_2Cl_4 + 2\ Na_2CO_3 \bullet 3\ H_2O_2 + 2\ H_2O \longleftrightarrow 2CO_2 + 4\ NaCl + 4\ H_2O + 2\ H_2CO_3$
- Free Radical Oxidation:
  - Perhydroxyl Radical ($HO_2\bullet$)
  - Hydroxyl Radical ($OH\bullet$)
  - Superoxide Radical ($O_2\bullet$)

Figure 1. RegenOx™ Surface-Mediated Oxidation

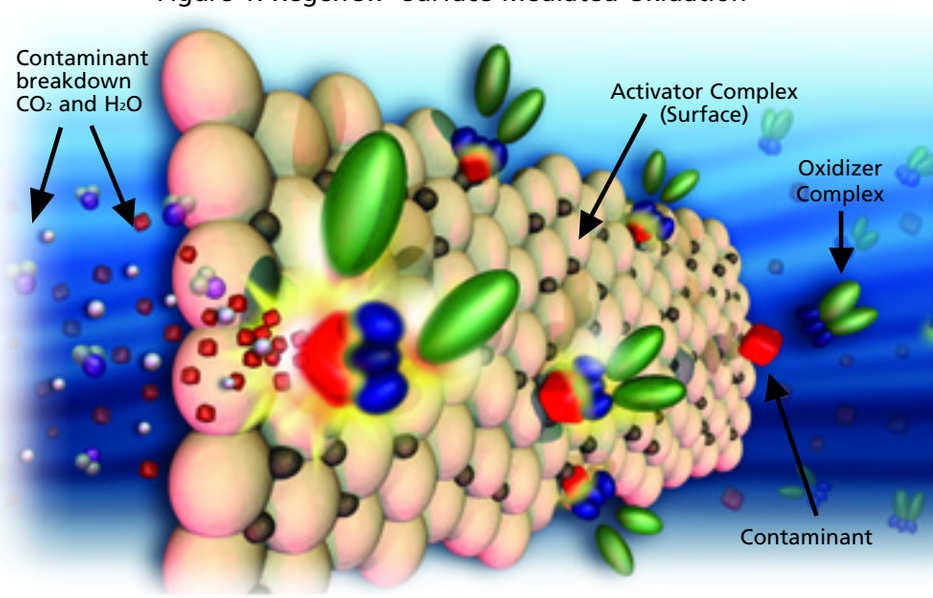

Figure 1. Surface-Mediated Oxidation is responsible for the majority of RegenOx contaminant destruction. This process takes place in two stages. First, the RegenOx activator complex coats the subsurface. Second, the oxidizer complex and contaminant react with the activator complex surface destroying the contaminant.

* Patent applied for

RegenOx™

From Mass Reduction to Bioremediation:

RegenOx™ is an effective and rapid contaminant mass reduction technology. A single injection will remove significant amounts of target contaminants from the subsurface. Strategies employing multiple Regenox injections coupled with follow-on accelerated bioremediation can be used to treat highly contaminated sites to regulatory closure. In fact, RegenOx was designed specifically to allow for a seamless transition to low-cost accelerated bioremediation using any of Regenesis controlled release compounds.

Significant Longevity:

RegenOx has been shown to destroy contaminants for periods of up to one month.

Product Application Made Safe and Easy:

RegenOx produces minimal heat and as with all oxidants proper health and safety procedures must be followed. The necessary safety guidance accompanies all shipments of RegenOx and additional resources are available on request. Through the use of readily available, highly mobile, direct-push equipment and an array of pumps, RegenOx has been designed to be as easy to install as other Regenesis products like ORC® and HRC®.

Effective on a Wide Range of Contaminants:

RegenOx has been rigorously tested in both the laboratory and the field on petroleum hydrocarbons (aliphatics and aromatics), gasoline oxygenates (e.g., MTBE and TAME), polyaromatic hydrocarbons (e.g., naphthalene and phenanthrene) and chlorinated hydrocarbons (e.g., PCE, TCE, TCA).

Oxidant Effectiveness vs. Contaminant Type:

Table 1

Contaminant	RegenOx™	Fenton's Reagent	Permanganate	Persulfate	Activated Persulfate	Ozone
Petroleum Hydrocarbons	A	A	B	B	B	A
Benzene	A	A	D	B	B	A
MTBE	A	B	B	C	B	B
Phenols	A	A	B	C	B	A
Chlorinated Ethenes (PCE, TCE, DCE, VC)	A	A	A	B	A	A
Chlorinated Ethanes (TCA, DCA)	A	B	C	D	C	B
Polycyclic Aromatic Hydrocarbons (PAHs)	A	A	B	B	A	A
Polychlorinated Biphenyls (PCBs)	B	C	D	D	D	B
Explosives (RDX, HMX)	A	A	A	A	A	A

Based on laboratory kinetic data, thermodynamic calculations, and literature reports.

Oxidant Effectiveness Key:

A = Short half life, low free energy (most energetically favored), most complete
B = Intermediate half life, low free energy, intermediate degree of completion
C = Intermediate half life, intermediate free energy, low degree of completion
D = Long half life, high free energy (least favored), very low degree of completion

REGENESIS
Advanced Technologies for Groundwater Resources

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REGENESIS

ORC ADVANCED® OXYGEN RELEASE COMPOUND

Highest amount of active oxygen in a controlled-release, oxygen producing compound

PRODUCT OVERVIEW

ORC Advanced® is the state-of-the-art technology for stimulating aerobic bioremediation. It offers unparalleled, maximum oxygen release for periods up to 12 months on a single injection and is specifically designed to minimize oxygen waste while maximizing contaminated site remediation.

ORC Advanced is a formulation of calcium oxyhydroxide which, upon hydration, releases oxygen and forms simple calcium hydroxide and water.

$$CaO(OH)_2 + H_2O \longrightarrow \tfrac{1}{2}O_2 + Ca(OH)_2 + H_2O$$

PRODUCT BENEFITS

PRODUCT BENEFITS

HIGHEST AVAILABLE OXYGEN CONTENT

More active oxygen (17%) plus Regenesis' patented controlled-release technology (CRT™) saves time and money by increasing degradation rates and improving remediation performance by providing more oxygen on a single injection. It is particularly effective at higher demand sites where oxygen may be limited and scavenged by competing carbon sources.

PATENTED CONTROLLED-RELEASE TECHNOLOGY (CRT™)

Based on the same proven technology employed in the industry standard Oxygen Release Compound (ORC®), CRT allows for an efficient, long-term release of oxygen providing the optimal conditions for sustained aerobic biodegradation. This can save time and money by reducing the potential need for multiple applications. Also, oxygen release "lock-up" is avoided – an unfortunate problem experienced with commodity chemicals.

IN SITU APPLICATION

Remediation with ORC Advanced is typically more cost-effective than *ex situ* treatments. With the use of ORC Advanced there is minimal site disturbance with no above-ground piping or mechanical equipment, no operations and maintenance costs and no hazardous materials handling or disposal.

CRT

DEFINING THE SCIENCE BEHIND CONTROLLED-RELEASE TECHNOLOGY (CRT™)

Early on, Regenesis researchers noted that in order to optimally stimulate the natural attenuation of aerobically degradable contaminants, biologically usable oxygen was best supplied in low but constant concentrations. Big bursts of oxygen are wasteful and simply "bubble off", often generating undesirable foaming and producing unwanted preferential flow paths in the subsurface. Regenesis sought to solve this problem by controlling the rate of oxygen release from solid oxygen sources.

The answer was provided by the development of CRT. The CRT process involves intercalating (embedding) phosphates into the crystal structure of solid peroxygen molecules. This patented feature, now available in the ORC Advanced® formulation, slows the reaction that yields oxygen within the crystal, minimizing "bubble off" which can waste the majority of oxygen available in common solid peroxygen chemicals.

FIGURE 1:
FILLING A PUMP WITH ORC ADVANCED SLURRY

CRT provides "balance" – it slows down the rate of oxygen release while at the same time preventing "lock-up". Commodity solid peroxygen chemicals, when in contact with water, will produce an initial rapid and uncontrolled-release of oxygen. Then, as hydroxides form, a significant portion of the oxygen deeper in the crystal is made unavailable or becomes"locked-up." This undesirable effect is inefficient and costly. CRT prevents lock up and controls the rate of oxygen release, representing the state-of-the-art technology in passive oxygen delivery.

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REGENESIS

The original controlled-release oxygen compound, since 1994

ORC® OXYGEN RELEASE COMPOUND

PRODUCT OVERVIEW

The original Oxygen Release Compound (ORC®) is a fine, powdery material comprised of a patented formulation of phosphate-intercalated magnesium peroxide. The intercalation or embedding of phosphates within the magnesium peroxide is Regenesis' patented, controlled-release mechanism.

Upon hydration, ORC is designed to produce a controlled-release of oxygen (10% by weight) into the subsurface in accordance with the following reaction:

$$MgO_2 + H_2O \longrightarrow \tfrac{1}{2}O_2 + Mg(OH)_2$$

This process can proceed for periods of up to one year depending on site conditions. In the presence of this long-lasting oxygen source, aerobic microbes flourish - accelerating the naturally slow rates of aerobic biodegradation.

BENEFITS

PRODUCT BENEFITS

By enhancing bioremediation using ORC, in situ treatment of contaminants can result in an efficient, simple and cost-effective alternative to traditional technologies. With low capital costs, no operations and maintenance, minimal site disturbance and proven effectiveness, ORC can restore water quality and property values at a reasonable cost.

PRODUCT APPLICATION

MATERIAL APPLICATION

Most contaminated sites are treated using ORC slurry which is a prescribed and easily injectable water and ORC mixture (Figure 2). The direct - injection of ORC slurry maximizes ORC and oxygen distribution in the subsurface increasing the range of enhanced biodegradation. ORC is dosed in pounds per vertical foot of material treated. The amount of ORC recommended depends greatly on various factors such as contaminant concentrations, oxygen sinks, groundwater flow rates and subsurface geology. It is recommended that a Regenesis Technical Services Representative be contacted for detailed design information.

ORC treatment approaches or designs may consist of one, or combinations of the following: Source Area Grids, Plume Area Grids or Barriers, Excavations and Biopiles.

SUBSURFACE EMPLACEMENT

- Direct – Push Injection
- Hollow Stem Augers
- Existing Wells
- Recirculating Wells
- Replaceable Filter Socks (existing wells)
- Excavations
- Trenches

CONTAMINANTS

TREATABLE CONTAMINANTS

ORC can treat a wide range of contaminants and most any aerobically degradable compound including: gasoline and fuel additives (BTEX and MTBE), diesel, kerosene, jet fuel, gas condensates, fuel oils, lubricants, bunker oil, PAHs, certain metals (arsenic), certain pesticides/herbicides and certain industrial solvents (alcohols and ketones).

FIGURE 2: ORC SLURRY

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Oxygen Release Compound – Advanced (ORC *Advanced*™)
MATERIAL SAFETY DATA SHEET (MSDS)

Last Revised: March 13, 2007

Section 1 - Material Identification

Supplier:

REGENESIS

1011 Calle Sombra
San Clemente, CA 92673

Phone:	**949.366.8000**
Fax:	**949.366.8090**
E-mail:	**info@regenesis.com**

Chemical Description:	A mixture of Calcium OxyHydroxide [$CaO(OH)_2$] and Calcium Hydroxide [$Ca(OH)_2$].
Chemical Family:	Inorganic Chemical
Trade Name:	Advanced Formula Oxygen Release Compound (ORC *Advanced*™)
Chemical Synonyms	Calcium Hydroxide Oxide; Calcium Oxide Peroxide
Product Use:	Used to remediate contaminated soil and groundwater (environmental applications)

Section 2 – Composition

CAS No.	Chemical
682334-66-3	**Calcium Hydroxide Oxide [$CaO(OH)_2$]**
1305-62-0	**Calcium Hydroxide [$Ca(OH)_2$]**
7758-11-4	**Dipotassium Phosphate (HK_2O_4P)**
7778-77-0	**Monopotassium Phosphate (H_2KO_4P)**

Section 3 – Physical Data	
Form:	Powder
Color:	White to Pale Yellow
Odor:	Odorless
Melting Point:	527 °F (275 °C) – Decomposes
Boiling Point:	Not Applicable (NA)
Flammability/Flash Point:	NA
Auto- Flammability:	NA
Vapor Pressure:	NA
Self-Ignition Temperature:	NA
Thermal Decomposition:	527 °F (275 °C) – Decomposes
Bulk Density:	0.5 – 0.65 g/ml (Loose Method)
Solubility:	1.65 g/L @ 68° F (20° C) for calcium hydroxide.
Viscosity:	NA
pH:	11-13 (saturated solution)
Explosion Limits % by Volume:	Non-explosive
Hazardous Decomposition Products:	Oxygen, Hydrogen Peroxide, Steam, and Heat
Hazardous Reactions:	None

Section 4 – Reactivity Data

Stability:	Stable under certain conditions (see below).
Conditions to Avoid:	Heat and moisture.
Incompatibility:	Acids, bases, salts of heavy metals, reducing agents, and flammable substances.
Hazardous Polymerization:	Does not occur.

Section 5 – Regulations

TSCA Inventory List:	Listed

CERCLA Hazardous Substance (40 CFR Part 302)

Listed Substance:	No
Unlisted Substance:	Yes
Reportable Quantity (RQ):	100 pounds
Characteristic(s):	Ignitibility
RCRA Waste Number:	D001

SARA, Title III, Sections 302/303 (40 CFR Part 355 – Emergency Planning and Notification)

Extremely Hazardous Substance:	No

SARA, Title III, Sections 311/312 (40 CFR Part 370 – Hazardous Chemical Reporting: Community Right-To-Know

Hazard Category:	Immediate Health Hazard Fire Hazard
Threshold Planning Quantity:	10,000 pounds

Section 5 – Regulations (cont)

SARA, Title III, Section 313 (40 CFR Part 372 – Toxic Chemical Release Reporting: Community Right-To-Know

Extremely Hazardous Substance:	No	
WHMIS Classification:	C	Oxidizing Material Poisonous and Infectious Material
	D	Material Causing Other Toxic Effects – Eye and Skin Irritant
Canadian Domestic Substance List:	Not Listed	

Section 6 – Protective Measures, Storage and Handling

Technical Protective Measures

Storage:	Keep in tightly closed container. Store in dry area, protected from heat sources and direct sunlight.
Handling:	Clean and dry processing pipes and equipment before operation. Never return unused product to the storage container. Keep away from incompatible products. Containers and equipment used to handle this product should be used exclusively for this material. Avoid contact with water or humidity.

Section 6 – Protective Measures, Storage and Handling (cont)

Personal Protective Equipment (PPE)

Engineering Controls:	Calcium Hydroxide ACGIH® TLV® (2000) 5 mg/m^3 TWA OSHA PEL Total dust–15 mg/m^3 TWA Respirable fraction– 5 mg/m^3 TWA NIOSH REL (1994) 5 mg/m^3
Respiratory Protection:	For many conditions, no respiratory protection may be needed; however, in dusty or unknown atmospheres use a NIOSH approved dust respirator.
Hand Protection:	Impervious protective gloves made of nitrile, natural rubbber or neoprene.
Eye Protection:	Use chemical safety goggles (dust proof).
Skin Protection:	For brief contact, few precautions other than clean clothing are needed. Full body clothing impervious to this material should be used during prolonged exposure.
Other:	Safety shower and eyewash stations should be present. Consultation with an industrial hygienist or safety manager for the selection of PPE suitable for working conditions is suggested.
Industrial Hygiene:	Avoid contact with skin and eyes.
Protection Against Fire & Explosion:	NA

Section 7 – Hazards Identification

Emergency Overview:	Oxidizer – Contact with combustibles may cause a fire. This material decomposes and releases oxygen in a fire. The additional oxygen may intensify the fire.
Potential Health Effects:	Irritating to the mucous membrane and eyes. If the product splashes in ones face and eyes, treat the eyes first. Do not dry soiled clothing close to an open flame or heat source. Any

	clothing that has been contaminated with this product should be submerged in water prior to drying.
Inhalation:	High concentrations may cause slight nose and throat irritation with a cough. There is risk of sore throat and nose bleeds if one is exposed to this material for an extended period of time.
Eye Contact:	Severe eye irritation with watering and redness. There is also the risk of serious and/or permanent eye lesions.
Skin Contact:	Irritation may occur if one is exposed to this material for extended periods.
Ingestion:	Irritation of the mouth and throat with nausea and vomiting.

Section 8 – Measures in Case of Accidents and Fire

After Spillage/Leakage/Gas Leakage:	Collect in suitable containers. Wash remainder with copious quantities of water.
Extinguishing Media:	See next.
Suitable:	Large quantities of water or water spray. In case of fire in close proximity, all means of extinguishing are acceptable.
Further Information:	Self contained breathing apparatus or approved gas mask should be worn due to small particle size. Use extinguishing media appropriate for surrounding fire. Apply cooling water to sides of transport or storage vessels that are exposed to flames until the fire is extinguished. Do not approach hot vessels that contain this product.
First Aid:	After contact with skin, wash immediately with plenty of water and soap. In case of contact with eyes, rinse immediately with plenty of water and seek medical attention. Consult an opthalmologist in all cases.

Section 8 – Measures in Case of Accidents and Fire

Eye Contact:	Flush eyes with running water for 15 minutes, while keeping the eyelids wide open. Consult with an ophthalmologist in all cases.
Inhalation:	Remove subject from dusty environment. Consult with a physician in case of respiratory symptoms.

Ingestion:	If the victim is conscious, rinse mouth and admnister fresh water. DO NOT induce vomiting. Consult a physician in all cases.
Skin Contact:	Wash affected skin with running water. Remove and clean clothing. Consult with a physician in case of persistent pain or redness.
Special Precautions:	Evacuate all non-essential personnel. Intervention should only be done by capable personnel that are trained and aware of the hazards associated with this product. When it is safe, unaffected product should be moved to safe area.
Specific Hazards:	Oxidizing substance. Oxygen released on exothermic decomposition may support combustion. Confined spaces and/or containers may be subject to increased pressure. If product comes into contact with flammables, fire or explosion may occur.

Section 9 – Accidental Release Measures

Precautions:	Observe the protection methods cited in Section 3. Avoid materials and products that are incompatible with product. Immediately notify the appropriate authorities in case of reportable discharge (> 100 lbs).
Cleanup Methods:	Collect the product with a suitable means of avoiding dust formation. All receiving equipment should be clean, vented, dry, labeled and made of material that this product is compatible with. Because of the contamination risk, the collected material should be kept in a safe isolated place. Use large quantities of water to clean the impacted area. See Section 12 for disposal methods.

Section 10 – Information on Toxicology

Toxicity Data

Acute Toxicity:	Oral Route, LD_{50}, rat, > 2,000 mg/kg (powder 50%) Dermal Route, LD_{50}, rat, > 2,000 mg/kg (powder 50%) Inhalation, LD_{50}, rat, > 5,000 mg/m^3 (powder 35%)
Irritation:	Rabbit (eyes), severe irritant

Sensitization:	No data
Chronic Toxicity:	In vitro, no mutagenic effect (Powder 50%)
Target Organ Effects:	Eyes and respiratory passages.

Section 11 – Information on Ecology

Ecology Data	
	10 mg $Ca(OH)_2$/L: pH = 9.0 100 mg $Ca(OH)_2$/L: pH = 10.6
Acute Exotoxicity:	Fishes, Cyprinus carpio, LC_{50}, 48 hrs, 160 mg/L Crustaceans, Daphnia sp., EC_{50}, 24 hours, 25.6 mg/L (Powder 16%)
Mobility:	Low Solubility and Mobility
Abiotic Degradation:	Water – Slow Hydrolysis. Degradation Products: Calcium Hydroxide Water/soil – complexation/precipitation. Carbonates/sulfates present at environmental concentrations. Degradation products: carbonates/sulfates sparingly soluble
Biotic Degradation:	NA (inorganic compound)
Potential for Bioaccumulation:	NA (ionizable inorganic compound)

Section 11 – Information on Ecology (cont)

Comments:	Observed effects are related to alkaline properties of the product. Hazard for the environment is limited due to the product properties of: • No bioaccumulation • Weak solubility and precipatation as carbonate or sulfate in an aquatic environment. Diluted product is rapidly neutralized at environmental pH.
Further Information:	NA

Section 12 – Disposal Considerations

Waste Disposal Method:	Consult current federal, state and local regulations regarding the proper disposal of this material and its emptied containers.

Section 13 – Shipping/Transport Information

D.O.T Shipping Name:	Oxidizing Solid, N.O.S [A mixture of Calcium OxyHydroxide [$CaO(OH)_2$] and Calcium Hydroxide [$Ca(OH)_2$].
UN Number:	1479
Hazard Class:	5.1
Label(s):	5.1 (Oxidizer)
Packaging Group:	II
STCC Number:	4918717

Section 14 – Other Information

HMIS® Rating	Health – 2 Flammability – 0	Reactivity – 1 PPE - Required

HMIS® is a registered trademark of the National Painting and Coating Association.

NFPA® Rating	Health – 2 Flammability – 0	Reactivity – 1 OX

NFPA® is a registered trademark of the National Fire Protection Association.

Reason for Issue: Update toxicological and ecological data

Section 15 – Further Information

The information contained in this document is the best available to the supplier at the time of writing, but is provided without warranty of any kind. Some possible hazards have been determined by analogy to similar classes of material. The items in this document are subject to change and clarification as more information become available.

RegenOx® – Part A (Oxidizer Complex)

Material Safety Data Sheet (MSDS)

Last Revised: June 24, 2010

Section 1 – Supplier Information and Material Identification

Supplier:

REGENESIS
1011 Calle Sombra
San Clemente, CA 92673
Telephone: 949.366.8000
Fax: 949.366.8090
E-mail: info@regenesis.com

Chemical Description:	A mixture of sodium percarbonate [$2Na_2CO_3 \cdot 3H_2O_2$], sodium carbonate [Na_2CO_3], sodium silicate and silica gel.
Chemical Family:	Inorganic Chemicals
Trade Name:	RegenOx® – Part A (Oxidizer Complex)
Product Use:	Used to remediate contaminated soil and groundwater (environmental applications)

Section 2 – Chemical Information/Other Designations

CAS No.	Chemical	Percentage
15630-89-4	Sodium Percarbonate	60 -100 %
5968-11-6	Sodium Carbonate Monohydrate	10 – 30 %
7699-11-6	Silicic Acid	< 1 %
63231-67-4	Silica Gel	< 1 %

Section 3 – Physical Data

Form:	Powder
Color:	White
Odor:	Odorless
Melting Point:	NA
Boiling Point:	NA

Section 3 – Physical Data (cont)

Flammability/Flash Point:	NA
Vapor Pressure:	NA
Bulk Density:	0.9 – 1.2 g/cm^3
Solubility:	Min 14.5g/100g water @ 20 ºC
Viscosity:	NA
pH (3% solution):	≈ 10.5
Decomposition Temperature:	Self-accelerating decomposition with oxygen release starts at 50 ºC.

Section 4 – Reactivity Data

Stability:	Stable under normal conditions
Conditions to Avoid/Incompatibility:	Acids, bases, salts of heavy metals, reducing agents, and flammable substances
Hazardous Decomposition Products:	Oxygen. Contamination with many substances will cause decomposition. The rate of decomposition increases with increasing temperature and may be very vigorous with rapid generation of oxygen and steam.

Section 5 – Regulations

TSCA Inventory Listed:	Yes
CERCLA Hazardous Substance (40 CFR Part 302)	
Listed Substance:	*No*
Unlisted Substance:	*Yes*
SARA, Title III, Sections 313 (40 CFR Part 372) – Toxic Chemical Release Reporting: Community Right-To-Know	
Extremely Hazardous Substance:	No
WHMIS Classification:	C, D2B
Canadian Domestic Substance List:	Appears

Section 6 – Protective Measures, Storage and Handling

Technical Protective Measures

Storage:

Oxidizer. Store in a cool, well ventilated area away from all sources of ignition and out of the direct sunlight. Store in a dry location away from heat and in temperatures less than 40 ˚C.

Keep away from incompatible materials and keep lids tightly closed. Do not store in improperly labeled containers.

Protect from moisture. Do not store near combustible materials. Keep containers well sealed.

Store separately from reducing materials. Avoid contamination which may lead to decomposition.

Handling:

Avoid contact with eyes, skin and clothing. Use with adequate ventilation.

Do not swallow. Avoid breathing vapors, mists or dust. Do not eat, drink or smoke in the work area.

Label containers and keep them tightly closed when not in use.

Wash hands thoroughly after handling.

Personal Protective Equipment (PPE)

Engineering Controls:

General room ventilation is required if used indoors. Local exhaust ventilation, process enclosures or other engineering controls may be needed to maintain airborne levels below recommended exposure limits. Avoid creating dust or mists. Maintain adequate ventilation at all times. Do not use in confined areas. Keep levels below recommended exposure limits. To determine actual exposure limits, monitoring should be performed on a routine basis.

Respiratory Protection:

For many conditions, no respiratory protection is necessary; however, in dusty or unknown conditions or when exposures exceed limit values a NIOSH approved respirator should be used.

Hand Protection:

Wear chemical resistant gloves (neoprene, rubber, or PVC).

Section 6 – Protective Measures, Storage and Handling (cont)

Eye Protection:	Wear chemical safety goggles. A full face shield may be worn in lieu of safety goggles.
Skin Protection:	Try to avoid skin contact with this product. Chemical resistant gloves (neoprene, PVC or rubber) and protective clothing should be worn during use.
Other:	Eye wash station.
Protection Against Fire & Explosion:	Product is non-explosive. In case of fire, evacuate all non-essential personnel, wear protective clothing and a self-contained breathing apparatus, stay upwind of fire, and use water to spray cool fire-exposed containers.

Section 7 – Hazards Identification

Potential Health Effects	
Inhalation:	Causes irritation to the respiratory tract. Symptoms may include coughing, shortness of breath, and irritations to mucous membranes, nose and throat.
Eye Contact:	Causes irritation, redness and pain.
Skin Contact:	Causes slight irritation.
Ingestion:	May be harmful if swallowed (vomiting and diarrhea).

Section 8 – Measures in Case of Accidents and Fire

After Spillage/Leakage:	Eliminate all ignition sources. Evacuate unprotected personnel and never exceed any occupational exposure limit. Shovel or sweep spilt material into plastic bags or vented containers for disposal. Do not return spilled or contaminated material to the inventory.
Extinguishing Media:	Water
First Aid	
Eye Contact:	Flush eyes with running water for at least 15 minutes with eyelids held open. Seek a specialist.
Inhalation:	Remove affected person to fresh air. Seek medical attention if the effects persist.
Ingestion:	If the individual is conscious and not convulsing, give two-four cups of water to dilute the chemical and seek medical attention immediately. **Do Not** induce vomiting.

Section 8 – Measures in Case of Accidents and Fire (cont)

Skin Contact:	Wash affected areas with soap and a mild detergent and large amounts of water.

Section 9 – Accidental Release Measures

Precautions:	
Cleanup Methods:	Shovel or sweep spilt material into plastic bags or vented containers for disposal. Do not return spilled or contaminated material to the inventory.

Section 10 – Information on Toxicology

Toxicity Data	
LD50 Oral (rat):	2,400 mg/kg
LD50 Dermal (rabbit):	Min 2,000 mg/kg
LD50 Inhalation (rat):	Min 4,580 mg/kg

Section 11 – Information on Ecology

Ecology Data	
Ecotoxicological Information:	NA

Section 12 – Disposal Considerations

Waste Disposal Method	
Waste Treatment:	Dispose of in an approved waste facility operated by an authorized contactor in compliance with local regulations.
Package (Pail) Treatment:	The empty and clean containers are to be recycled or disposed of in conformity with local regulations.

Section 13 – Shipping/Transport Information

D.O.T. Shipping Name:	Oxidizing Solid, N.O.S. [A mixture of sodium percarbonate [$2Na_2CO_3 \cdot 3H2O_2$], sodium carbonate [Na_2CO_3], sodium silicate and silica gel.]
UN Number:	1479
Hazard Class:	5.1
Labels:	5.1 (Oxidizer)
Packaging Group:	III

Section 14 – Other Information

HMIS® Rating	Health – 1 (slight)	Reactivity – 1 (slight)
	Flammability – 0 (none)	Lab PPE – goggles, gloves, and lab coat

HMIS® is a registered trademark of the National Painting and Coating Association.

Section 15 – Further Information

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RegenOx® – Part B (Activator Complex)

Material Safety Data Sheet (MSDS)

Last Revised: June 4, 2010

Section 1 – Supplier Information and Material Identification

Supplier:

REGENESIS

1011 Calle Sombra
San Clemente, CA 92673
Telephone: 949.366.8000
Fax: 949.366.8090
E-mail: info@regenesis.com

Chemical Description:	A mixture of sodium silicate solution, silica gel and ferrous sulfate
Chemical Family:	Inorganic Chemicals
Trade Name:	RegenOx® – Part B (Activator Complex)
Product Use:	Used for environmental remediation of contaminated soils and groundwater

Section 2 – Chemical Information/Other Designations

CAS No.	Chemical
1344-09-8	Silicic Acid, Sodium Salt, Sodium Silicate
63231-67-4	Silica Gel
7720-78-7	Ferrous Sulfate
7732-18-5	Water

Section 3 – Physical Data

Form:	Liquid
Color:	Blue/Green
Odor:	Odorless
Melting Point:	NA
Boiling Point:	NA
Flammability/Flash Point:	NA
Vapor Pressure:	NA

Section 3 – Physical Data (cont)

Specific Gravity	1.39 g/cm^3
Solubility:	Miscible
Viscosity:	NA
pH (3% solution):	11
Hazardous Decomposition Products:	Oxides of carbon and silicon may be formed when heated to decomposition.

Section 4 – Reactivity Data

Stability:	Stable under normal conditions.
Conditions to Avoid:	None.
Incompatibility:	Avoid hydrogen fluoride, fluorine, oxygen difluoride, chlorine trifluoride, strong acids, strong bases, oxidizers, aluminum, fiberglass, copper, brass, zinc, and galvanized containers.

Section 5 – Regulations

TSCA Inventory Listed:	Yes

CERCLA Hazardous Substance (40 CFR Part 302)

Listed Substance:	*No*
Unlisted Substance:	*Yes*

SARA, Title III, Sections 302/303 (40 CFR Part 355) – Emergency Planning and Notification

Extremely Hazardous Substance:	No

SARA, Title III, Sections 311/312 (40 CFR Part 370) – Hazardous Chemical Reporting: Community Right-To-Know

Hazard Category:	Acute

SARA, Title III, Sections 313 (40 CFR Part 372) – Toxic Chemical Release Reporting: Community Right-To-Know

Extremely Hazardous Substance:	No

Section 6 – Protective Measures, Storage and Handling

Technical Protective Measures

Storage:	Keep in a tightly closed container (steel or plastic) and store in a cool, well ventilated area away from all incompatible materials (acids, reactive metals, and ammonium salts). Store in a dry location away from heat above 60 degrees C and colder than 10 degrees C. Do not store in aluminum, fiberglass, copper, brass, zinc or galvanized containers.
Handling:	Avoid contact with eyes, skin and clothing. Avoid breathing spray mist. Use with adequate ventilation. Do not use product if it is brownish-yellow in color.

Personal Protective Equipment (PPE)

Engineering Controls:	General room ventilation is required if used indoors. Local exhaust ventilation, process enclosures or other engineering controls may be needed to maintain airborne levels below recommended exposure limits. Safety shower and eyewash station should be within direct access.
Respiratory Protection:	Use NIOSH-approved dust and mist respirator where spray mist exists. Respirators should be used in accordance with 29 CFR 1910.134.
Hand Protection:	Wear chemical resistant gloves.
Eye Protection:	Wear chemical safety goggles. A full face shield may be worn in lieu of safety goggles.
Skin Protection:	Try to avoid skin contact with this product. Gloves and protective clothing should be worn during use.
Other:	
Protection Against Fire & Explosion:	Product is non-explosive and non-combustible.

Section 7 – Hazards Identification

Potential Health Effects

Inhalation:	Causes irritation to the respiratory tract. Symptoms may include coughing, shortness of breath, and irritations to mucous membranes, nose and throat.
Eye Contact:	Causes irritation, redness and pain.
Skin Contact:	Causes irritation. Symptoms include redness, itching and pain.
Ingestion:	May cause irritation to mouth, esophagus, and stomach.

Section 8 – Measures in Case of Accidents and Fire

After Spillage/Leakage (small):	Mop up and neutralize liquid, then discharge to sewer in accordance with local, state and federal regulations.
After Spillage/Leakage (large):	Keep unnecessary personnel away; isolate hazard area and do not allow entrance into the affected area. Do not touch or walk through spilled material. Stop leak if possible without risking injury. Prevent runoff from entering into storm sewers and ditches that lead to natural waterways. Isolate the material if at all possible. Sand or earth may be used to contain the spill. If containment is not possible, neutralize the contaminated area and flush with large quantities of water.
Extinguishing Media:	Material is compatible with all extinguishing media.
Further Information:	

First Aid

Eye Contact:	Flush eyes with running water for at least 15 minutes with eyelids held open. Seek a specialist.
Inhalation:	Remove affected person to fresh air. Give artificial respiration if individual is not breathing. If breathing is difficult, give oxygen. Seek medical attention if the effects persist.
Ingestion:	If the individual is conscious and not convulsing, give two-four cups of water to dilute the chemical and seek medical attention immediately. **DO NOT** induce vomiting.
Skin Contact:	Wash affected areas with soap and a mild detergent and large amounts of water. Remove contaminated clothing and shoes.

Section 9 – Accidental Release Measures

Precautions:

PPE:	Wear chemical goggles, body-covering protective clothing, chemical resistant gloves, and rubber boots (see Section 6).
Environmental Hazards:	Sinks and mixes with water. High pH of this material may be harmful to aquatic life. Only water will evaporate from a spill of this material.
Cleanup Methods:	Pick-up and place in an appropriate container for reclamation or disposal. US regulations (CERCLA) require reporting spills and releases to soil, water and air in excess of reportable quantities.

Section 10 – Information on Toxicology

Toxicity Data

Sodium Silicate:	When tested for primary eye irritation potential according to OECD Guidelines, Section 405, a similar sodium silicate solution produced corneal, iridal and conjunctival irritation. Some eye irritation was still present 14 days after treatment, although the average primary irritation score has declined from 29.7 after 1 day to 4.0 after 14 days. When tested for primary skin irritation potential, a similar sodium silicate solution produced irritation with a primary irritation index of 3 to abraded skin and 0 to intact skin. Human experience confirms that irritation occurs when sodium silicates get on clothes at the collar, cuffs, or other areas where abrasion may exist. The acute oral toxicity of this product has not been tested.
Ferrous Sulfate:	LD50 Oral (rat): 319 mg/kg not a suspected carcinogen.

Section 11 – Information on Ecology

Ecology Data

Ecotoxicological Information:	Based on 100% solid sodium silicate, a 96 hour median tolerance for fish of 2,320 mg/l; a 96 hour median tolerance for water fleas of 247 mg/L; a 96 hour median tolerance for snail eggs of 632 mg/L; and a 96 hour median tolerance for Amphipoda of 160 mg/L.

Section 12 – Disposal Considerations

Waste Disposal Method

Waste Treatment:	Neutralize and landfill solids in an approved waste facility operated by an authorized contactor in compliance with local regulations.
Package (Pail) Treatment:	The empty and clean containers are to be recycled or disposed of in conformity with local regulations.

Section 13 – Shipping/Transport Information

D.O.T.	This product is not regulated as a hazardous material so there are no restrictions.

Section 14 – Other Information

HMIS® Rating	Health – 2 (moderate)	Reactivity – 0 (none)
	Flammability – 0 (none)	Lab PPE – goggles, gloves, and lab coat
	Contact – 1 (slight)	

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Section 15 – Further Information

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