

Environment

Prepared for: NYSDEC 625 Broadway Albany, NY 12233 Prepared by: AECOM Latham, NY Project 60279080 March 2013

Enhanced In-Situ Bioremediation Pilot Study Work Plan Former Duso Chemical Site Poughkeepsie, New York NYSDEC Site # 3-14-103

Final



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Final

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Engineering Certification

I certify that I am currently a New York State registered professional engineer and that this Enhanced In-Situ Bioremediation Pilot Study Work Plan for the Former Duso Chemical Site (Site Number # 3-14-103) was prepared in accordance with all applicable statutes and regulations and in substantial conformance with the DER Technical Guidance for Site Investigation and Remediation (DER-10).

Respectfully submitted,

AECOM Technical Services Northeast, Inc.



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March 27, 2013 Date

1.0 Introduction

This Enhanced In-Situ Bioremediation (EISB) Pilot Study Work Plan has been prepared for the Former Duso Chemical site (Site), a Class 2 inactive hazardous waste disposal site, by AECOM Technical Services Northeast, Inc. (AECOM) for New York State Department of Environmental Conservation (NYSDEC). The NYSDEC reference number for the site is 3-14-103. This design document has been prepared in accordance with the Record of Decision (ROD) issued by the NYSDEC in March 2008.

1.1 Site Background

The pilot test described in this work plan will be implemented on the Former Duso Chemical property, where the site was historically occupied by the Duso Chemical Company. As a result of a chemical fire and historic site operations, releases of various volatile organic compounds (VOCs) occurred to the environment.

Goals for the remedial program were established in the ROD through the remedy selection process stated in 6 NYCRR Part 375. At a minimum, the remedy selected must eliminate or mitigate all significant threats to public health and the environment, presented by the hazardous waste disposed at the site through the proper application of scientific and engineering principles. As defined in the ROD, the remediation goals for this site are to eliminate or reduce to the extent practicable:

- Exposures of persons at or around the site to VOCs in soil and groundwater;
- The release of contaminants from the saturated soil into groundwater that may create exceedances of groundwater quality standards; and
- The release of contaminants from groundwater into indoor air through soil vapor intrusion.

Further, the remediation goals for the site include attaining to the extent practicable:

- Commercial soil criteria; and
- Ambient groundwater quality standards

1.2 Pilot Test Objectives

The objective of the pilot study described herein will be to evaluate the field-scale effectiveness of implementing EISB via reductive dechlorination for reducing concentrations of chlorinated VOCs (CVOCs) in groundwater. The pilot test will be evaluated by the following performance objectives:

- Achieve satisfactory distribution of the carbon substrate solution into the subsurface;
- Establish and maintain anaerobic (reducing) conditions in the subsurface throughout the targeted treatment area; and
- Reduce CVOC concentrations in groundwater and soils and/or observe the formation and subsequent decrease of biodegradation daughter products.

Performance data collected during implementation will be compared to historical data and evaluated against the performance objectives. EISB will be implemented with the objective of meeting the goals of the ROD.

The Former Duso Chemical Site is defined as the approximately three-acre triangle-shaped property located located off of Route 9 at 33 Fulton Street, in the City of Poughkeepsie, New York . A site plan is included as **Figure 1**.

2.1 Site History and Regulatory Conditions

The site was occupied by the Duso Chemical Company, a distributor of bulk chemicals from 1950 through 1963. In 1963, a chemical fire occurred at the Duso Chemical Company warehouse and is believed to have resulted in a large scale release of various VOCs to the environment. In 1990, the Duso Chemical property was purchased and Star Gas Products, Incorporated subsequently began operating there. Immediately to the west of the Former Duso site is the Mid Hudson Business Park (MHBP), which has a long industrial past including automobile manufacturing operation by FIAT between 1910 and 1917 and various operations by West & Publishing after 1935. Elevated levels of chlorinated solvents were detected in the soil and groundwater at MHBP during an investigation in 1990. The investigation revealed the origin of the contamination to be the Former Duso Chemical property. In April of 1999, the NYSDEC listed the Former Duso Chemical property as a Class 2 site in the State's Registry of Inactive Hazardous Waste Disposal Sites. A Class 2 site is a site where hazardous waste has been deemed to pose a significant threat to the public health or the environment, and action is required.

A Remedial Investigation (RI) was initiated for the Former Duso Chemical Site in 2005 and conducted in several phases. The first phase was conducted from June to August of 2005 and a second sampling event was conducted in March of 2007. A Feasibility Study (FS) was developed in the fall of 2007. NYSDEC prepared the ROD in March 2008 based on the findings of the RI and the FS.

An Interim Remedial Measure (IRM) was conducted at the Former Duso Chemical site to address the source of contamination or exposure pathway from elevated soil vapor levels before completion of the RI/FS. The detected levels of tetrachloroethene (PCE) and trichloroethene (TCE) in the sub-slab and indoor air samples of the Star Gas building were above New York State Department of Health (NYSDOH) guidance for the protection of human health. Thus mitigation measures were undertaken in the form of a sub-slab depressurization system (SSDS) for the Star Gas facility which aimed to address current human exposures (via inhalation) to volatile organic compounds associated with soil vapor intrusion. The system was installed in February of 2006. Confirmatory samples were collected to ensure that the SSDS was operating effectively. The concentrations of all compounds of concern in indoor air were reduced to below their respective action levels.

2.2 Current Site Features and Use

The property is currently operated by Star Gas Products, Inc., a propane distribution facility. There are three buildings, a shed, and an above ground storage tank located on the site currently (**Figure 1**). The topography of the site and surrounding properties is relatively level, sloping gently to the west. A steep embankment borders the property to the east and a former railroad track bed and intermittent stream/swale border the property to the west. The site is located within a mixed neighborhood of commercial establishments and residential properties.

2.3 ROD-Selected Remedy for Former Duso Chemical Site

Goals for the remedial program were established in the ROD through the remedy selection process stated in 6 NYCRR Part 375. At a minimum, the remedy selected must eliminate or mitigate all significant threats to public health and the environment, presented by the hazardous waste disposed at the site through the proper application of scientific and engineering principles.

The remediation goals for this site are to eliminate or reduce to the extent practicable:

- Exposures of persons at or around the site to VOCs in soil and groundwater;
- The release of contaminants from the saturated soil into groundwater that may create exceedances of groundwater quality standards; and
- The release of contaminants from groundwater into indoor air through soil vapor intrusion.

Further, the remediation goals for the site include attaining to the extent practicable:

- Commercial soil criteria as defined in 6 NYCRR Part 375; and
- NYSDEC "Ambient Water Quality Standards and Guidance Values" for groundwater

Based on the Administrative Record in the ROD, NYSDEC selected EISB for the former Duso Chemical property and in-situ thermal treatment for the MHBP property, as the remedies. The selected remedy was based on the results of the RI and the evaluation of alternatives presented in the FS. These technologies were selected because they satisfy the threshold criteria, provide the best balance of the primary balancing criteria of the FS, achieve the remediation goals for the site by reducing the residual source material at the site, and creating conditions conducive to the restoration of groundwater quality to the extent practicable.

EISB via reductive dechlorination is a remediation technology applied for treating CVOCs in groundwater. Through the process of biologically-mediated reductive dechlorination, CVOCs are transformed through a series of sequential biochemical reactions where chloride atoms are replaced by hydrogen atoms by naturally occurring bacteria under reducing conditions to eventually form non-toxic ethene and less toxic chloroethane (see Appendix D, Figure 1).

 $PCE \rightarrow TCE \rightarrow cis-1,2$ -dichloroethene \rightarrow vinyl chloride \rightarrow ethene

- 1,1,1-trichloroethane \rightarrow 1,1-dichloroethane \rightarrow chloroethane
- 1,1-dichloroethene \rightarrow vinyl chloride \rightarrow ethene

These biologically-mediated reactions occur favorably in anaerobic (negligible dissolved oxygen), reducing (oxidation reduction potential or ORP is less than -75 millivolts [mV]), circum-neutral (pH between 6.0 and 8.5) groundwater. Current groundwater conditions beneath the Former Duso Chemical Site are slightly aerobic to slightly reducing (ORP between -57 and 40 mV, DO between 0.4 and 3.0 milligrams per liter [mg/L]); limited reductive dechlorination is occurring or has occurred based on the detection of dechlorination daughter products, but conditions are not ideal for reductive biodegradation. Remediation will be performed by modifying groundwater geochemistry to create reducing conditions that are conducive to the progressive dechlorination of CVOCs by bacteria through the addition of a carbon substrate, which serves as a source of an electron donor (hydrogen) and a microbial energy source. As the naturally-occurring microbial population utilizes the added carbon substrate (electron donor), dissolved oxygen in groundwater will be consumed and generation

of anaerobic reducing conditions will proceed. These reducing conditions, along with the presence of electron acceptors enable the reductive dechlorination process to occur.

Anaerobic microbial dechlorination of chloroethane is not a pathway that has been observed in bench- or field-scale studies. However, chloromethane, as well wel 1,1,1-TCA, has been observed to be biodegraded by aerobic methane-oxidizing bacteria. Methane generated as a result of addition of carbon substrate may support natural attenuation of the chloroethane as groundwater conditions return to baseline.

Per the ROD, the EISB selected remedy for the Former Duso Chemical property would be implemented using the following approach:

- Characterization of groundwater geochemistry (inorganic and organic), the oxidationreduction (redox) conditions, and bacterial populations in site groundwater.
- Bench scale testing to evaluate biological processes for treatment of site VOCs.
- Application of soluble electron donors to the groundwater beneath the site.
- Evaluation of EISB performance by post-injection geochemical and biological groundwater monitoring as part of the Site Management Plan.

Groundwater characterization and bench scale testing was performed in 2011 through 2012. Details are provided in Sections 2.4 and 3.4, respectively.

A remedial component to treat source areas by in-situ thermal remediation will be designed for the adjacent MHBP site. In addition, institutional controls in the form of an environmental easement may be implemented as part of the selected remedy.

2.4 2012 Supplemental Investigation

In August 2012, 12 additional 2-inch PVC monitoring wells were installed at the Former Duso Chemical Site, including five multi-level pairs (BIW-1S/D, BIW-2S/D, BIW-3S/D, BIW-5S/D, and BIW-6S/D) and two singlet wells (BIW-4 and BIW-7), as shown on **Figure 1**. The new monitoring wells were developed, after at least seven days following construction, and sampled using low-flow methods in November 2012. In addition to the 12 new wells, groundwater samples were also collected from wells MHC-23, MHC-25S, and MHC-26 at the Former Duso Chemical property, and a comprehensive round of groundwater sampling was performed at the adjacent MHBP property. A summary of monitoring wells sampled and laboratory analyses for each well is presented as **Table 2-1**.

The 2012 Supplemental Investigation was conducted in order to support design and planning to implement the EISB remedy for the Former Duso Chemical site, including delineating the extents requiring treatment for CVOCs, quantification of current dechlorinating bacteria, and evaluation of nutrients and competing electron acceptors for biotic reductive dechlorination reactions. Generally nitrate was not detected, or detected at very low concentrations, but sulfate was measured between approximately 2 and 80 micrograms per liter (μ g/L). This combination of observations, in conjunction with numerous ORP measurements between -50 and 0 mV, indicates that site groundwater is sufficiently reducing for nitrate-reduction but not for sulfate-reducing conditions, which are favorable for reductive dechlorination to occur. Low concentrations of bacteria capable of complete dechlorination of PCE to ethene (Dehalococcoides [Dhc]) and 1,1,1-Trichloroethane (1,1,1-TCA) to ethane (Dehalobacter [Dhb]) were quantified. Dhc cell counts ranged from 2 x10² to 7x10² cells/milliliter (mL), and Dhb cell counts ranged from 1 x10³ to 4x10³ cells/mL. Cell counts greater

than 10⁶ are considered favorable for in-situ reductive dechlorination. The highest cell enumerations were observed in samples from wells MHC-23, BIW-5S, and BIW-5D.

Total VOC concentrations on the Former Duso Chemical site are shown spatially on **Figure 2**. All laboratory analytical results from the 2012 investigation are presented in tabular form in **Appendix A**, along with geologic cross-sections generated from soil borings advanced in 2012 during installation of the new monitoring wells.

3.0 Basis of Design

3.1 Primary Contaminants of Concern

Groundwater and soil sampling has been conducted at the Former Duso Chemical property as part of numerous historic investigation activities. Groundwater sampling conducted in 2011 and 2012 will be given the greatest attention for design and planning of the EISB pilot test in this work plan and will be used for pre-pilot test baseline data. CVOCs are the primary contaminants of concern at the Former Duso Chemical site; specific CVOC analytes and respective NYSDEC Ambient Water Quality Standard are presented below.

Chemical	Ambient Water Quality Standard (ug/L)	Maximum Concentration (ug/L)
1,1,1-trichloroethane (1,1,1-TCA)	5	33,000
1,1-dichloroethane (1,1-DCA)	5	80,000
1,2-dichloroethane (1,2-DCA)	0.6	6,800
chloroethane	5	1,000
tetrachloroethene (PCE)	5	56
trichloroethene (TCE)	5	340
cis-1,2-dichloroethene (cis-1,2-DCE)	5	910
1,1-dichloroethene (1,1-DCE)	5	1,900
vinyl chloride (VC)	2	210

The CVOCs measured at the highest concentrations are 1,1,1-TCA and 1,1-DCA. Within the extent of the pilot test area, 1,1,1-TCA concentration was observed to range from 1,500 to 33,000 μ g/L, and 1,1-DCA ranging from 590 to 80,000 μ g/L.

3.2 Hydrogeologic Considerations for Pilot Test

Based on measurements collected during the Remedial Investigation (RI) for the Former Duso Chemical site [O'Brien and Gere, 2007], Supplemental Remedial Investigation (SRI) for the MHBP site [Chazen Companies, 1998] and by AECOM, the following hydrogeologic considerations will be incorporated into the design for the EISB pilot test:

- Depth to water in monitoring wells within the EISB pilot test area generally ranges from 3 to 4 feet below ground surface (bgs).
- Groundwater in the overburden beneath the Former Duso Chemical site generally flows to the west (towards the MHBP site).
- Hydraulic conductivity testing during the RI focused on the MHBP site. The results of the hydraulic conductivity testing for the unconsolidated hydrogeologic unit ranged from 9.62x10⁻⁵ cm/sec (0.27 ft/day) in well OBG-5S to 2.18x10⁻² cm/sec (61.68 ft/day) in well OBG-6S. The average hydraulic conductivity estimate for the unconsolidated hydrogeologic unit is 1.44x10⁻³ cm/sec (4.09 ft/day).
- Hydraulic gradients in the EISB pilot study area overburden soils is estimated to be between 0.02 and 0.04 foot per foot based on a sitewide groundwater gauging event in December 2012 (Figures 3A and 3B), which is consistent with sitewide hydraulic gradient reported in the RI of 0.028 to 0.039 foot per foot [O'Brien and Gere, 2007].
- Using a hydraulic conductivity of 1.44x10⁻³ cm/sec (4.09 ft/day), a hydraulic gradient of 0.03 ft/ft and a porosity of 0.3 result in an average groundwater velocity of 0.41 ft/day (150 ft/year).
- Soils beneath the Former Duso Chemical site, and within the EISB pilot test area, have been generalized to consist of (in descending vertical order):
 - o an uppermost layer of gravelly sands (top two to four feet);
 - o silty sands, beneath the gravelly sands;
 - o clayey silt, beneath the silty sands, starting at approximately 20 to 24 feet; and
 - glacial till, beneath the clayey silt, but the till was not observed in most borings within the EISB pilot test area.

3.3 Conceptual Fate and Transport of Site Contaminants

The major source of VOC contamination at the Former Duso Chemical Site was the surficial release of VOCs that occurred as a result of a warehouse fire in 1963. VOC field screen sampling and analysis during the SRI observed concentrations greater than 50,000 parts per billion of 1,1,1-TCA at a depth of 2-4 feet near well MHC-22, and the highest concentrations of 1,1,1-TCA in soil at the property were detected in the portion of the site between wells MHC-22 and BIW-2S. The VOC release impacted the shallow groundwater table. CVOCs have densities greater than water, and with groundwater flow direction from east to west, CVOCs moved west and downward over time. At the western boundary of the Former Duso Chemical property, as well as the MHBP site downgradient to the transition to clayey silt. Less impacts are currently measured in shallow groundwater, compared to deeper intervals, along the western boundary of the property. Over time due to contaminant migration, dilution, and partial biodegradation by native bacteria, concentrations have decreased at the Former Duso Chemical property.

The primary chemical released from the Former Duso Chemical operations was 1,1,1-TCA. As a result of partial reductive dechlorionaion by native bacteria in the slightly anaerobic groundwater 1,1-DCA is also currently presented in the subsurface at high concentrations. 1,1-DCE measured in groundwater is an abiotic breakdown product of 1,1,1-TCA.

3.4

The pilot test described in this work plan is intended to evaluate the effectiveness of EISB for treating VOC contamination in groundwater at the Former Duso Chemical property. The identified treatment extent by the EISB pilot test is shown on **Figure 4**. This area was delineated primarily using groundwater sampling results from 2011 and 2012 where total CVOC exceeded 50 ug/L in a monitoring well (**Figure 2** and **Appendix A**); sampling results from the Remedial Investigation and Supplemental Remedial Investigation were used to refine the extents. The extent of the EISB treatment area is approximately 10,200 square feet (0.25 acres). Within the eastern portion of this area (east and between the buildings), injection will target the vertical interval between the groundwater table and approximately 16 feet bgs. In the western portion of this area, VOC contamination is observed deeper, particularly immediately above and in the upper most portion of the clayey silt (transition to clayey silt observed between 20 and 22 feet bgs). In the western portion of the yill test, injections will focus on the vertical interval from approximately 4 to 6 feet bgs to 24 to 26 feet bgs.

No injections will be completed immediately below the active buildings on the property as the combination of the injection delivery and hydraulic will allow the substrate to treat beneath the buildings. In addition, several groundwater monitoring wells with samples that exhibited low VOC concentrations in excess of the NYSDEC "Ambient Water Quality Standards and Guidance Values" in monitoring wells are not included in the pilot test treatment zone (BIW-2D, BIW-3S, BIW-6D, MHC-24, MHC-25S/D). Treatment in adjacent areas to the building and these wells, and subsequent natural attenuation, will result in decreases in VOC concentrations at these locations over time.

3.5 Bench Scale Treatability Study

SiREM Laboratory (SiREM) was retained by AECOM to perform a laboratory biotreatability study to assess the potential for natural and stimulated in-situ bioremediation of chlorinated ethenes (PCE; TCE; cis-1,2-DCE; 1,1-DCE; and VC) and chlorinated ethanes (1,1,1-TCA; 1,2-DCA; and 1,1-DCA) in subsurface samples collected from the Former Duso Chemical site.

SiREM conducted the study using groundwater and soil collected at the site from the following locations: SGSB3, MHC-22, MHC-24, and MHC-26 (groundwater); SB-1, SB-2, SB-3, and SB-4 (soil). The study consisted of a total of nine microcosms. Three microcosms were prepared using the site soil and groundwater: an anaerobic sterile control, an anaerobic active control, and an emulsified oil substrate (EOS® 598 B42) amended and bioaugmented set of microcosms. Each microcosm set was prepared in triplicate for QA/QC purposes. **Appendix D** contains the laboratory report prepared by SiREM for AECOM. The results from the study indicate the following:

- 1. The rate and extent of intrinsic (natural) degradation of the chlorinated ethenes and ethanes in site groundwater is limited by the lack of available electron donors and/or nutrients at the site.
- 2. EOS® 598 B42 amendment promoted the appropriate geochemical conditions (i.e., sulfate reducing conditions).
- 3. The pH of the treatment microcosms decreased only slightly following addition of EOS® 598 B42 amendment over the incubation period, reaching an average value of 6.60 after 119 days. This maintenance of suitable pH for continued bioremediation of chlorinated ethenes and ethanes suggests that application of buffering agents is not likely to be required to support enhanced reductive dechlorination at the site. Other electron

donors may also provide the same or similar results, however no other donors were tested.

- 4. EOS® 598 B42 supported significant increases of indigenous populations (three orders of magnitude) at levels associated with complete dechlorination of PCE to ethene (Dhc) and 1,1,1-TCA to ethane (Dhb).
- 5. Indigenous bacteria present at the site appear to be capable of completely dechlorinating the chlorinated ethenes to ethene, 1,1,1-TCA and 1,1-DCA to CA and partial dechlorination of 1,2-DCA with the addition of EOS® 598 B42 as the electron donor.

3.6 Permits

Injection of remedial substrates falls under the requirements of United States Environmental Protection Agency's (USEPA) Underground Injection Control (UIC) program. Currently NYS has not requested program primacy for the federal UIC program. The Former Duso Chemical Site is a state-lead site, the NYSDEC Division of Environmental Remediation (DER), or its consultant (AECOM), is responsible for making the notification to USEPA. In accordance with DER Internal Guidance Procedure 22 (IGP-22), AECOM prepared the inventory spreadsheet, which was created by USEPA Region 2 for exclusive use by NYSDEC. The inventory spreadsheet is included as **Appendix E**. Email notification was provided to USEPA Region 2 on March 13, 2013 by AECOM on behalf of by DER. It is not necessary to wait for a response from EPA, as injections used to enhance or effect remediation are generally authorized by rule and the notification is all that is required at least 30 prior days prior to commencement of direct-push injection or well construction.

4.0 EISB Pilot Test Design

This section details the design components for planning and implementing the EISB pilot test. A summary of design parameters for the EISB Pilot Study is presented in **Table 4-1**.

4.1 EISB Amendments

Several proprietary and non-proprietary reductive amendments are available for groundwater remediation including emulsified vegetable oil (EVO), Hydrogen Release Compound®, molasses, lactate, and soluble oils. Proprietary formulations include readily available carbon as well as slow-release carbon, which allows for extended time-release availability, and nutrients required for biotic growth. Variations of these products include addition of zero valent iron or reduced (ferrous) iron complexes for promotion of abiotic, chemical dechlorination in addition to biodegradation. EOS PRO (formerly EOS® 598 B42) is a nutrient-enriched, food-grade, oil/water emulsion and will be the primary carbon substrate for the EISB pilot test. Selection was based on the following factors:

- As an EVO, the active lifetime of EOS products is approximately three to five years, which is longer than other carbon substrates used for enhanced reductive dechlorination.
- At the bench scale this carbon substrate successfully demonstrated complete dechlorination of PCE to ethene and 1,1,1-TCA to ethane in addition to supporting significant increases of Dhc and Dhb microbial populations.
- At the bench scale, minimal decrease in pH was observed with this carbon substrate.
- This is a commonly applied EVO product that is water-miscible concentrate and relatively easy to handle in the field.
- This substrate includes Vitamin B12 Supplement that provides additional nutrients to further enhance microbial activity and the rate of reductive dechlorination.
- This specific remedial substrate has been demonstrated to be effective for enhancing bioremediation of CVOCs in-situ, including on more than 10 AECOM projects.

Other electron donors may also provide the same or similar results; however, no other donors were tested in the bench-scale study (Section 3.5). During planning for the bench-scale testing, an extensive evaluation was performed of carbon substrate options, including reviewing literature and AECOM case studies and discussions with the treatability lab and vendors, and EOS was chosen balancing the site objectives with the advantages and disadvantages of each amedment option. Following the excellent bench-scale results, other donors were evaluated; however, implementation with a substrate demonstrated to attain treatment for site materials, compared with an un-tested substrate, was a critical decision factor in selecting EOS Pro as the primary carbon substrate.

A second carbon substrate source will be applied to the portion of the pilot test area with the highest concentrations of CVOCs (greater than 100,000 μ g/L, target blue injection subarea on **Figure 4**). EHC consists of a controlled-release organic carbon of fibrous organic material in addition to zero valent iron (ZVI). EHC, like EOS, has persistence after injection of three to five years. The reduced iron generates highly reducing conditions, and accelerates the creation of conditions favorable for reductive dechloration. In addition, the added ZVI reacts directly with CVOCs by an abiotic process (beta-elimination) that does not generate daughter products (i.e. cis-

1,2-DCE, vinyl chloride, 1,1-DCA, or chloroethane). In the reaction time, the bench scale testing did observe accumulation of chloroethane, from incomplete dechlorination, and the abiotic reactions would decrease the generation of this intermediate product. Therefore, the combination of ZVI and carbon substrate utilizes both abiotic and biotic processes for treatment of CVOCs in groundwater, and AECOM has successfully implemented at several sites across the United States and Canada.

Product information, including the Material Safety Data Sheets (MSDS) for EOS PRO and EHC, are presented in **Appendix B**.

The respiration of added carbon substrate by soil microbes can result in a decrease in groundwater pH, and a buffering agent (i.e., sodium bicarbonate) is sometimes injected with the carbon substrate to minimize changes in pH. However, based on the results of the bench scale test, no buffer will be applied for the pilot test.

Calculations supporting amendment dosages are presented in **Appendix C**. The *Substrate Estimating Tool for Enhanced Anaerobic Bioremediation of Chlorinated Solvents* developed for the Environmental Security Technology Certification Program (ESTCP) was used to support emulsified vegetable oil (EOS Pro) quantities for remediation.

4.2 Injection Volume

Delivery of amendments is a primary factor to achieving a successful remediation. Based on AECOM experience on other enhanced reductive dechlorination projects, carbon substrate solutions will be injected at volumes equivalent to 15 to 20 percent of the pore volume in the pilot test treatment area (injection volume calculations provided in **Appendix C**). This volume is sufficient to generate reducing conditions favorable for dechlorinating bacteria, not cause significant mounding during injections, and allow additional distribution of carbon substrates by advection of groundwater over the active lifetime of the EVO. Based on this injection volume range, and the estimated total mass of EVO specified in **Appendix C**, EVO solutions will be diluted to approximately 10 percent (v/v) to attain both the carbon loading and injection volume objectives. This percentage is within the range commonly applied by AECOM and other remediation practitioners.

The EHC product is injected as a slurry due to the presence of micron-scale iron particles. Based on manufacturer's recommendations, EHC will be injected at approximately 0.35 percent of the soil mass in this area and at volumes equivalent to 8-9 percent of the soil pore volume in this portion of the pilot test area where groundwater concentrations are greater than 100,000 μ g/L.

4.3 Injection Points

Injection of carbon substrates can be performed through semi-permanent PVC wells or directly through direct-push (i.e., GeoProbe®) rods. Advantages of semi-permanent wells are that future, follow-up injections can be completed without additional drilling activity and wells and allow additional data collection points. Advantages of direct-push injections are that there is no well construction required so there is no added cost for well installation and abandonment. Additional advantages of direct-push injection points include the greater flexibility for treatment of vertical intervals and in moving injection locations if follow-up injections are required for improved distribution of injected amendments. For the EISB pilot test, all carbon substrates will be injected into the subsurface using direct-push tooling, for the following reasons:

- Avoiding installing injection wells (more than 60 locations, including some with two screened intervals) will offer cost savings, elimination of soils for disposal, and reduction of engineering oversight effort;
- Avoiding installing injection wells limits the on-site period of remediation activities that would
 potentially be disruptive to on-site operations by Star Gas;
- Follow-up injection is not anticipated for the near-future based on the active lifetime of the selected carbon substrates (three to five years); and
- The ZVI particles in EHC cannot be injected through a well-screen and require direct-push injection.

Injections to the groundwater will be performed using a regular-spaced injection grid to stimulate biodegradation throughout the pilot test area (**Figure 4**). Spacing of injection points will be approximately 12 feet, but actual spacing may vary in the field due to adjustments for surface and subsurface features. This grid spacing is selected based on observed subsurface stratigraphy from soil boring logs (predominance of silty ands and clayey silts), local hydrogeologic parameters (hydraulic conductivity and hydraulic gradient), and AECOM in-situ remediation in New York and New England in low permeability and/or heterogeneous silty, fine sand and tills. As a result, a total of 75 injection points will be used. When setting the grid, injection points will be offset at least five feet (or to the extent practicable) from existing injection wells and known underground utilities to minimize damage to utilities during drilling and to reduce the potential that the injected amendment does not short circuit through the utility conduits or well sand packs. Overhead utilities will also factor into the final location due to the safety concerns posed by the lines during injection point installation.

4.4 Field Injection Activities

Prior to commencing injections for the EISB pilot test, DigSafely New York notifications and private underground utility clearance will be conducted.

The EVO amendment will be shipped to the site as a liquid and will be stored in drums, totes, or other vendor supplied containers. The EHC amendment will be shipped to the site as a powder in 50 pound bags. The EVO containers and bags of EHC will be stored inside a storage container or other protective structure.

An injection system for preparation, mixing, and injection of biodegradation substrate solutions will consist of mixing tanks, mixers, pumps, piping, meters, valves, and fittings. All components will be selected from materials that are compatible for use with the selected amendments. Injection batches would be prepared by adding appropriate quantities of water to achieve the selected dilution concentration. A ChemGrout, or equivalent mixing unit, will be used for preparing the EHC slurry due to the granular ZVI. It is anticipated that no hard pipe or trenching will be used between the solution mixing station and the injection point, and that mobile above-ground, hoses will be used to convey remedial solutions directly to the injection points. A manifold would likely be employed to inject into multiple injection wells simultaneously. Flow totalizers, pressure gauges, and shut-off valves will be included on each active injection leg connected to an injection point to monitor injection pressure, flow rates, and total volume added to each point. All systems will be leak-checked daily prior to chemical injection by pressurizing the system with water to prevent spills from the injection system. An example process flow diagram for an EISB injection system is provided as **Figure 5**.

At each injection point, a direct-push drill rig will advance injection tooling to a targeted depth. Injection tooling can consist of a specialized injection tip, a screened interval, or similar device. A predetermined volume will be injected, and then the injection tip will be advanced to the subsequent injection target depth (generally two to four feet deeper), and the process is repeated. This method of direct-push injection is referred to as top-down injection; however, tooling to inject from deepest depth upward (bottom-up) will also be mobilized. To the extent practical, injections of EVO will be performed at low pressures (less than 10 pounds per square inch [PSI]); however, much higher injection pressures (100 to 200 PSI) are required to inject the ZVI particle slurry required for the EHC amendment. Based on AECOM in-situ remediation experience with the selected amendments and working in similar soil types, it is estimated that the injection flow rates will range from 1 to 3 gallons per minute at each point. Generally low pressures will be used to inject EOS, <5 to 10 pounds PSI with maximum allowable pressure of 20 PSI. Higher pressures are required to inject the micron-scale ZVI particles associated with EHC, with an anticipated pressure ranges of 100 to 200 PSI. To minimize mounding and improve delivery, injection will generally not be performed at adjacent wells at the same time. A field log will be maintained to record the solution composition, the volume of solution delivered into each injection well, the length of time required for injection, and the injection pressure. For performance of in-situ remediation, decontamination of subsurface injection materials will not be completed in between different injection locations, with the exception of observation (visual or olfactory) of gross contamination. No injection will be performed into any existing monitoring well in order to better evaluate performance of the pilot test activities.

Electricity to power remediation equipment will be provided by a gasoline-powered generator. Potable water for batching and injection will be delivered by tanker truck; prior to commencing injections the potable water source will be identified and laboratory analysis performed for VOCs and metals.

Remediation derived waste will consist of empty totes, empty bags, pallets, PPE, and miscellaneous trash. The empty totes will be shipped back to the EVO manufacturer for re-use. The other remediation derived waste will be placed in a dumpster and disposed of as municipal trash, as none of this waste is anticipated to come in contact with contaminated materials in the subsurface.

Following completion of all injection activities, all injection points will be surveyed, in addition to any additional site features (historic monitoring well MHC-23 was located after the most recent survey).

4.5 Community Air Monitoring Requirements

Air monitoring will be conducted during implementation of the EISB pilot test for protection of on-site workers and potential off-site receptors. The NYSDOH Generic Community Air Monitoring Plan (CAMP) will be used as guidance. Direct-push injection methods are generally non-intrusive activities and do not include any significant exposure to site workers to subsurface contamination. Consistent with monitoring well installation activities in 2012 at the Star Gas and MHBP sites, monitoring for VOCs will consist of periodic measurements in breathing zone of site workers using a photoionization detector (PID). Additional details will be included in a site-specific health and safety plan to be signed by a Certified Hazardous Materials Manager (CHMM).

4.6 Shallow Soil Sampling

As noted, the major source of VOC contamination at the property was the surficial release of VOCs that occurred as a result of a warehouse fire in 1963. During the in-situ injection event, while a direct-push rig is mobilized to the site, several shallow soil borings (to a depth of four feet) will be advanced to perform soil screeing with a PID and submit a limited number of soils samples for laboratory analysis of CVOCs. The objective of these soils borings will be to determine if any high concentrations of residual CVOCs are present that could provide a long-term source of contamination and re-contaminate areas that will be treated by EISB. To the extent possible, boring locations will be advanced in proximity to locations included in the 1998 SRI and 2007 RI reports; approximate locations of soil samples are shown on **Figure 4**.

4.7 Groundwater Performance Monitoring

Remediation performance monitoring will be performed to assess contaminant concentrations and transformation, the distribution of the ZVI and carbon substrate in the subsurface (using TOC analysis as well as field geochemistry parameters), and groundwater geochemistry. Groundwater samples for pilot test performance monitoring will be collected by low-flow techniques. Groundwater quality parameters will be measured in the field, with particular attention to pH, specific conductance (uS/cm), oxidation reduction potential (mV), and dissolved oxygen (mg/L) which will be used to evaluate the generation and distribution of reducing conditions. As a result of the generation of reducing conditions in groundwater, temporary mobilization of some metals may result. Laboratory analysis of select metals will be conducted as part of performance monitoring in select wells. **Table 4-2** presents the wells and monitoring parameters for the pilot test performance monitoring, and the monitoring wells include wells already installed at the Former Duso Chemical site (**Figures 2 and 4**). An overview of the pilot test performance monitoring sampling is shown below.

Monitoring Well	Sampling Frequency and Laboratory Analyses
BIW-1S	
BIW-1D	
BIW-2S	
BIW-2D	1 month after pilot injection
BIW-5S	All wells: TOC
BIW-5D	Quarterly for one year after pilot injectionAll wells: VOCs and TOC
BIW-6S	 Select wells: microbes, sulfate, select metals, methane/ethane/ethene
MHC-22	
MHC-23	
MHC-26	
BIW-6D	
BIW-3S	
BIW-3D	One year after pilot injection All wells: VOCs
BIW-4	
MHC-24	
MHC-25S	

Groundwater sampling results from 2012 will be used as baseline conditions to evaluate the performance of the pilot test.

Purged water from groundwater sampling will be containerized in labeled, DOT approved 55-gallon drums for future off-site disposal/recycling.

4.8 Bioaugmentation and Polishing Treatment

Bioaugmentation has been performed following addition of carbon substrate and ZVI to enhance biodegradation at other sites, as the addition of carbon substrates and ZVI generate reducing conditions favorable for microbial reductive dechlorination. Advantages of bioaugmentation following addition of carbon substrate and is accelerated degradation of CVOCs by increasing the number of cells capable of dechlorinating site CVOCs. Microbial analysis of groundwater samples during 2012 indicated that dehalogenating bacteria (Dhc and Dhb) were observed within the pilot test area, but at relatively low cell counts. Cell counts of both microbial groups did significantly increase after EVO addition during the bench scale testing, and PCE and TCE were observed to fully dechlorinate to ethene and 1,1,1-TCA was dechlorinated to chloroethane. Based on these observations from the treatability test, no bioaugmentation is proposed as part of the field pilot study. However, bioaugmentation could be proposed in the future to further optimize in-situ treatment.

The bench-scale study observed reductive dechlorination of 1,1,1-TCA and 1,1-DCA to chloroethane. If significant concentrations of chloroethane are observed to accumulate following pilot test injections, additional treatment may be applied to reduce concentrations of this CVOC. As noted in Section 2.3, aerobic methane-oxidizing bacteria have been demonstrated to biodegrade chloroethane, including methods to increase dissolved oxygen to further stimulate aerobic bacteria that could perform these reactions.

Several groundwater monitoring rounds (Section 4.5) would be collected and evaluated prior to making any decision regarding bioaugmentation or additional treatments for residual CVOCs.

5.0 Schedule and Coordination

5.1 Schedule of Activities

The major activities for performance of the EISB pilot test include:

- Procurement of materials, equipment, and subcontractors
- Mobilization and delivery of materials and equipment
- Pilot Test Injections
- Pilot test performance monitoring

An anticipated schedule is provided on Table 5-1.

5.2 Subcontractors

Implementation of the EISB pilot test will require the services of the following subcontracted services:

- Direct-Push Injection
 - o Direct-push drilling
 - o Injection equipment and labor
- Remediation Amendment Suppliers
 - o EOS Remediation (EOS PRO with vitamin supplements)
 - FMC Environmental (EHC)
- Analytical Laboratories
- Waste Disposal
- Utility Clearance
- Survey

5.3 Cost Estimate

A cost estimate for implementing the EISB pilot test as detailed in this work plan is provided in **Appendix F**.

5.4 Access Agreements

As identified by the treatment area described in **Figure 4**, implementation of the EISB pilot test will require access to several private properties. These include the Star Gas property (property 042826), the Conrail right of way spur property (011773), and the MHBP property (property 005836). Remediation activities to be conducted on each of these properties is summarized on the table below. Additional information on these properties is included in **Appendix G**. NYSDEC will be responsible for obtaining formal access to these properties, however the Contractor will be required to abide by the terms in the access agreement(s) during all phases of work.

Property	EISB Pilot Test Activities
Star Gas property (property 042826)	Remedial amendment batching/dilution activities
33 Fulton St, Poughkeepsie NY 12601	Direct-push injection of remedial solutions into 63 locations
Conrail right of way spur property (011773)	Direct-push injection of remedial solutions into 12
Spur N & E Of City, Poughkeepsie NY 12601	locations
MHBP property (property 005836)	Bulk remedial amendment storage
3440-3444 North Rd, Poughkeepsie NY 12601	Storage of select remediation equipment for nights and weekends

6.0 References

The Chazen Companies. 1998. Supplemental Remedial Investigation, MidHudson Business Park, Poughkeepsie, New York. February 1998.

New York State Department of Environmental Conservation (NYSDEC), 2008. *Record of Decision*. March 2008.

O'Brien and Gere. 2007. *Remedial Investigation, Former Duso Chemical Site, Poughkeepsie, New York.* August 2007.

SiREM Laboratories, 2011. Laboratory Biotreatability Study Report - Draft. August 2011.

Tables

Table 5-1 EISB Pilot Test Schedule of Activities Former Duso Chemical Site Poughkeepsie, NY

Month	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24 2	25 2	26	27 2	8 2	9 30	31	32	33	34	35	36	37	38	39	40	41	42
Activity																																									
Finalize Pilot Study Work Plan																																									
UIC Permit Approval																																									
Procure Subcontractors																																									
Procure and Deliver Chemicals																																									
Injection					20-30	d																																			
Performance Monitoring						1 mo.		3 mo.			6 mo.			9 mo.			12 mo.						18 mo.					24	mo.											36 mo.	
Evaluate Need for Bioaugmentation																																									

 Table 2-1

 December 2012 Groundwater Sampling Summary

 Former Duso Chemical Site

 Poughkeepsie, NY

Well	ORP, pH, DO	тос	VOCs	DHC	DHB	vcrA	M/E/E	Nitrate/ Nitrite	Phosphates	Sulfate	Chloride	VFA	Bromide
MHC-23	1	1	1	1	1	1	1	1	1	1	1	1	1
MHC-25S	1	1	1	1	1	1	1	1	1	1	1	1	1
MHC-26	1	1	1										
BIW-1D	1	1	1	1	1		1	1	1	1	1	1	1
BIW-1S	1	1	1	1	1		1	1	1	1	1	1	1
BIW-2D	1	1	1	1	1		1		1	1	1	1	1
BIW-2S	1	1	1	1	1	1	1		1	1	1	1	1
BIW-3D	1	1	1	1	1		1	1	1	1	1	1	1
BIW-3S	1	1	1	1	1	1	1	1	1	1	1	1	1
BIW-4	1	1	1	1	1		1	1	1	1	1	1	1
BIW-5D	1	1	1	1	1	1	1	1	1	1	1	1	1
BIW-5S	1	1	1	1	1	1	1	1	1	1	1	1	1
BIW-6D	1	1	1	1	1		1	1	1	1	1	1	1
BIW-6S	1	1	1	1	1	1	1	1	1	1	1	1	1
BIW-7	1	1	1	1	1	1	1	1	1	1	1	1	1
Total	15	15	15	14	14	8	14	12	14	14	14	14	14

Notes:

TOC = Total Organic Carbon

VOCs = Volatile Organic Compounds

DHC = <u>Dehalococcoides</u>

DHB = <u>Dehalobacter</u>

vcrA = Vinyl Chloride Reductase

M/E/E = Methane, Ethane, Ethene

VFA = Volatile Fatty Acids

Table 4-1 Summary of Design Parameters for Enhanced In-Situ Bioremediation Pilot Study Former Duso Chemical Site - Poughkeepsie, NY

Parameter	East Area	Northeast Area	Center Area	Northwest	West Center	Southwest	Total
Area Description	Eastern Portion of Site in vicinity and between wells BIW-2S/D and MHC-22	North of BIW-2S to BIW-6S	Between two buildings, upgradient of well MHC-26	In vicinity of well BIW-1S/D	In vicinity of well BIW-5S/D	In vicinity of well MHC-23	
Depth to Ground Water			3 - 4 feet be	low ground surface			
Depth to Clayey Silt			19.5 to 22 feet	below ground surface			
Target Treatment Thickness	4 - 16 (12 feet)	4 - 12 (8 feet)	4 - 18 (14 feet)	6 - 26 (20 feet)	4 - 24 (20 feet)	4 - 24 (20 feet)	
Target Treatment Area (sq ft)	2,035	1,855	1,170	2,485	1,525	1,120	10,190
Injection Well Spacing				12' grid			
Direct-Push Injection Points	17	14	8	18	9	9	75
Injectoin Volume Per Linear Foot	50	42	50	42	65	40	
Emulsified Vegetable Oil (EOS Pro)	1,018	468	558	1,508	348	720	4,620
(gallons of 60%) Emulsified Vegetable Oil Dilution for Injection				10%			16 totes + 4 drums
Emulsified Vegetable Oil Solution Injection Volume (gallons)	10,200	4,704	5,600	15,120	3,510 (Inject EVO 4-10' bgs)	7,200	46,334
ZVI + Carbon (EHC)					7,850 lbs 3,830 total gallons (Inject EHC 10-24' bgs) 30 gallons per vertical linear foot, 0.35% soil dosage		
Max. cVOC concentrations (μg/L) (2011-2012)	1,1,1-TCA = 5,200 1,1-DCA = 8,500		1,1,1-TCA = 1,500 1,1-DCA = 1,100	1,1,1-TCA = 3,600 1,1-DCA = 2,400	Shallow 1,1,1-TCA = 560 1,1-DCA = 810 Deep 1,1,1-TCA = 30,000 1,1-DCA = 80,000 1,2-DCA = 6,800	1,1,1-TCA = 3,900 1,1-DCA = 590 TCE = 340 cis-1,2-DCE = 490	

Table 4-2 Enhanced In-Situ Bioremediation Pilot Study Performance Monitoring Former Duso Chemical Site Poughkeepsie, NY

				Poughkeep	sie, NY			
Well				Time After	Pilot Test Injection			
	1 month	3 months	6 months	9 months	12 months	18 months	24 months	36 months
Pilot Stud	y Area Monito	ring Wells				[1	1
BIW-1S	TOC	VOCs, TOC, Sulfate	VOCs, TOC, Sulfate	VOCs, TOC	VOCs, TOC	VOCs	VOCs	VOCs
BIW-1D	тос	VOCs, TOC, Sulfate, As/Mn/Fe	VOCs, TOC, Sulfate, M/E/E	VOCs, TOC, M/E/E, Dhc/Dhb	VOCs, TOC, M/E/E, As/Mn/Fe, Dhc/Dhb			
BIW-2S	TOC	VOCs, TOC, Sulfate	VOCs, TOC, Sulfate	VOCs, TOC	VOCs, TOC, M/E/E	VOCs, TOC, M/E/E	VOCs, TOC, M/E/E	VOCs, TOC, M/E/E
BIW-2D	TOC	VOCs, TOC, Sulfate	VOCs, TOC, Sulfate	VOCs, TOC	VOCs, TOC	VOCs	VOCs	VOCs
BIW-5S	TOC	VOCs, TOC, Sulfate, As/Mn/Fe	VOCs, TOC, Sulfate, M/E/E	VOCs, TOC, M/E/E, Dhc/Dhb	VOCs, TOC, M/E/E, As/Mn/Fe, Dhc/Dhb			
BIW-5D	TOC	VOCs, TOC, Sulfate, As/Mn/Fe	VOCs, TOC, Sulfate, M/E/E	VOCs, TOC, M/E/E, Dhc/Dhb	VOCs, TOC, M/E/E, As/Mn/Fe, Dhc/Dhb			
BIW-6S	TOC	VOCs, TOC, Sulfate	VOCs, TOC, Sulfate	VOCs, TOC	VOCs, TOC, M/E/E, Dhc/Dhb	VOCs, TOC, M/E/E, Dhc/Dhb	VOCs, TOC	VOCs, TOC
MHC-22	TOC	VOCs, TOC, Sulfate	VOCs, TOC, Sulfate	VOCs, TOC	VOCs, TOC, M/E/E, Dhc/Dhb	VOCs, TOC, M/E/E, Dhc/Dhb	VOCs, TOC	VOCs, TOC
MHC-23	TOC	VOCs, TOC, Sulfate, As/Mn/Fe	VOCs, TOC, Sulfate, M/E/E	VOCs, TOC, M/E/E, Dhc/Dhb	VOCs, TOC, M/E/E, As/Mn/Fe, Dhc/Dhb			
MHC-26	тос	VOCs, TOC, Sulfate, As/Mn/Fe	VOCs, TOC, Sulfate, M/E/E	VOCs, TOC, M/E/E, Dhc/Dhb	VOCs, TOC, M/E/E, As/Mn/Fe, Dhc/Dhb			
Monitoring	g Wells Outsic	le of Pilot Study Area				1		
BIW-6D					VOCs		VOCs	VOCs
BIW-3S					VOCs		VOCs	VOCs
BIW-3D					VOCs		VOCs	VOCs
BIW-4					VOCs		VOCs	VOCs
MHC-24					VOCs		VOCs	VOCs
MHC-25S					VOCs		VOCs	VOCs
# of wells	10	10	10	10	16	10	16	16

Notes:

Additional analyses and/or wells may be added to the sampling program as necessary to further evaluate performance

As/Mn/Fe = Arsenic, Manganese, Iron

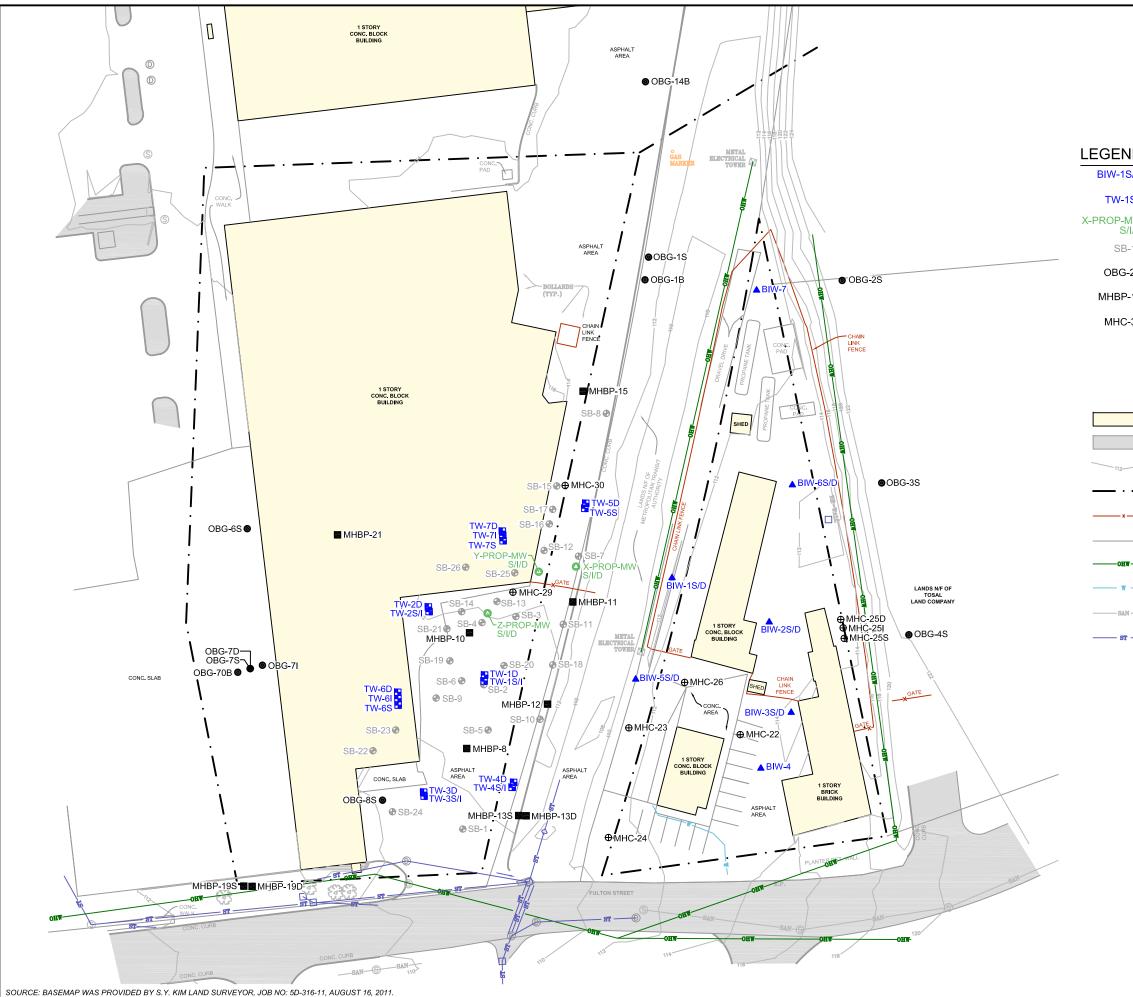
M/E/E = Methane, Ethane, Ethene

TOC = Total Organic Carbon

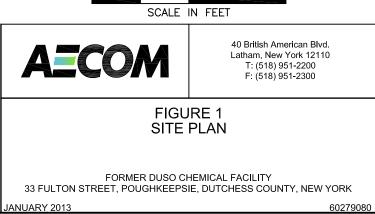
VOCs = Volatile Organic Compounds Dhc = <u>Dehalococcoides</u>

Dhb = <u>Dehalobacter</u>

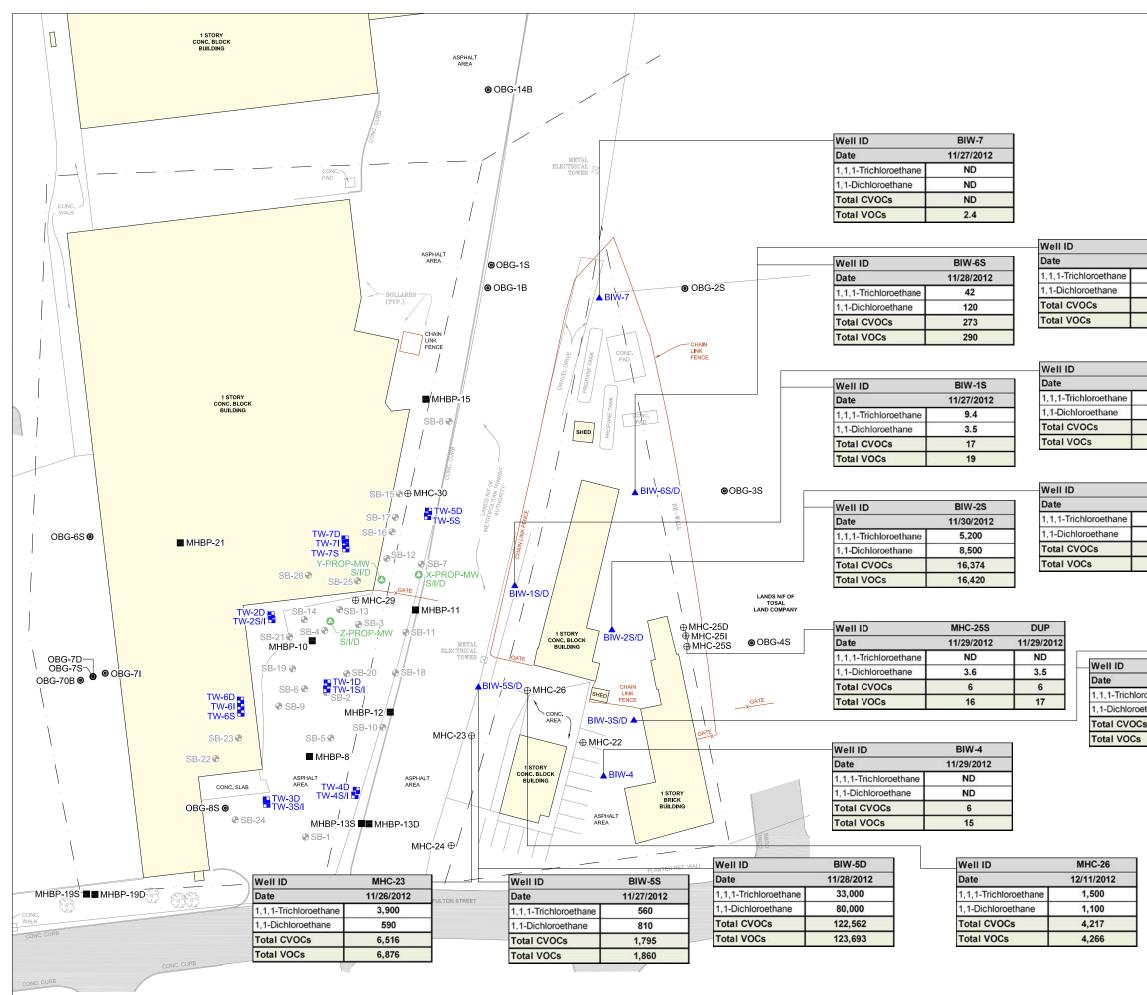
Figures



 NESTED THERMAL WELL LOCATION (2012) TRI-LEVEL STAINLESS STEEL WELL LOCATION (2011) AECOM MEMBRANE INTERFACE PROBE BORING LOCATION (2017) AECOM MEMBRANE INTERFACE PROBE BORING LOCATION (2017) O'BRIEN & GERE WELL LOCATION (2005 & 2007) MID HUDSON BUSINESS PARK WELL LOCATION (1993-1994) WELL LOCATION (1990s) CATCH BASIN MANHOLES TREES BUILDING ROAD / PAVEMENT TOPOGRAPHIC CONTOURS PROPERTY BOUNDARY (APPROXIMATE) FENCE (APPROXIMATE) PARCEL BOUNDARY OVERHEAD WIRES UNDERGROUND WATER SANITARY SEWER LINE STORMWATER LINE 		
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		SANITARY SEWER LINE
		STORMWATER LINE
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SOURCE: BASEMAP WAS PROVIDED BY S.Y. KIM LAND SURVEYOR, JOB NO: 5D-316-11, AUGUST 16, 2011.

	4
LEGEND	P
BIW-1S/D ▲	NESTED BIOREMEDIATION INJECTION WELL LOCATION (2012)
TW-1S/I 🖪	NESTED THERMAL WELL LOCATION (2012)
X-PROP-MW O	TRI-LEVEL STAINLESS STEEL WELL LOCATION (2011)
SB-15 🤀	AECOM MEMBRANE INTERFACE PROBE BORING LOCATION (2011)
OBG-2S 🛛	O'BRIEN & GERE WELL LOCATION (2005 & 2007)
MHBP-11	MID HUDSON BUSINESS PARK WELL LOCATION (1993-1994)
MHC-30 ⊕	WELL LOCATION (1990s)
	TREES
	BUILDING

BIW-6D	
11/28/2012	
0.82	
34	
38	
47	

BIW-1D
11/27/2012
3,600
2,400
6,233
6,233

BIW-2D	
11/30/2012	
3.3	
21	1
46	1
50	-

MHC-30 ⊕	WELL LOCATION (1990s)
	TREES
	BUILDING
	ROAD / PAVEMENT
·	PROPERTY BOUNDARY (APPROXIMATE)
x	FENCE (APPROXIMATE)
	PARCEL BOUNDARY

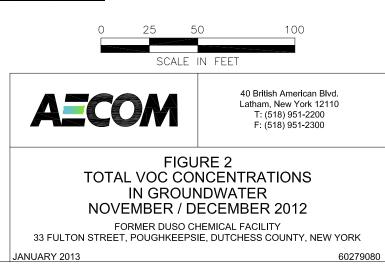
VOC CONCENTRATIONS IN GROUNDWATER

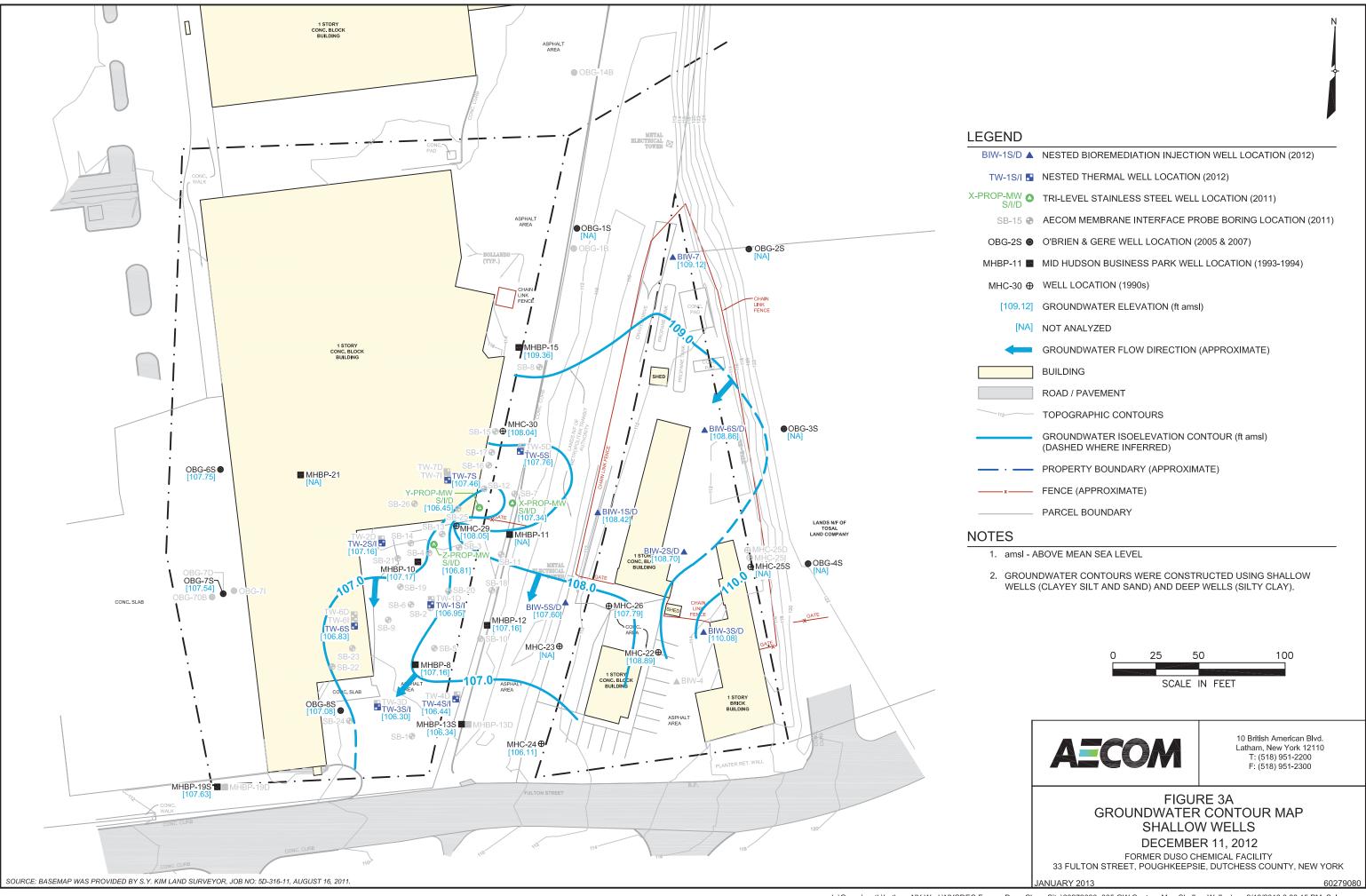
NOTES

- 1. AWQS FOR 1,1,1-TCA AND 1,1-DCA ARE 5μ g/L.
- 2. ND THE COMPOUND(s) WAS NOT DETECTED AT A CONCENTRATION GREATER THAN OR EQUAL TO THE METHOD DETECTION LIMIT (MDL).

	BIW-3S
	11/28/2012
oethane	ND
thane	ND
5	12
	19

Well ID	BIW-3D
Date	11/29/2012
1,1,1-Trichloroethane	ND
1,1-Dichloroethane	ND
Total CVOCs	2
Total VOCs	16





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BEND	
W-1S/D 🔺	NESTED BIOREMEDIATION INJECTION WELL LOCATION (2012)
TW-1S/I 🖪	NESTED THERMAL WELL LOCATION (2012)
OP-MW O S/I/D	TRI-LEVEL STAINLESS STEEL WELL LOCATION (2011)
SB-15	AECOM MEMBRANE INTERFACE PROBE BORING LOCATION (2011)
DBG-2S 🔘	O'BRIEN & GERE WELL LOCATION (2005 & 2007)
HBP-11	MID HUDSON BUSINESS PARK WELL LOCATION (1993-1994)
MHC-30 ⊕	WELL LOCATION (1990s)
[109.12]	GROUNDWATER ELEVATION (ft amsl)
[NA]	NOT ANALYZED
	GROUNDWATER FLOW DIRECTION (APPROXIMATE)
	BUILDING
	ROAD / PAVEMENT
112	TOPOGRAPHIC CONTOURS
	GROUNDWATER ISOELEVATION CONTOUR (ft amsl) (DASHED WHERE INFERRED)
_ · 	PROPERTY BOUNDARY (APPROXIMATE)
x	FENCE (APPROXIMATE)
	PARCEL BOUNDARY
ΓES	
1. amsl - A	BOVE MEAN SEA LEVEL
	DWATER CONTOURS WERE CONSTRUCTED USING DW WELLS (CLAYEY SILT AND SAND) AND DEEP WELLS CLAY).



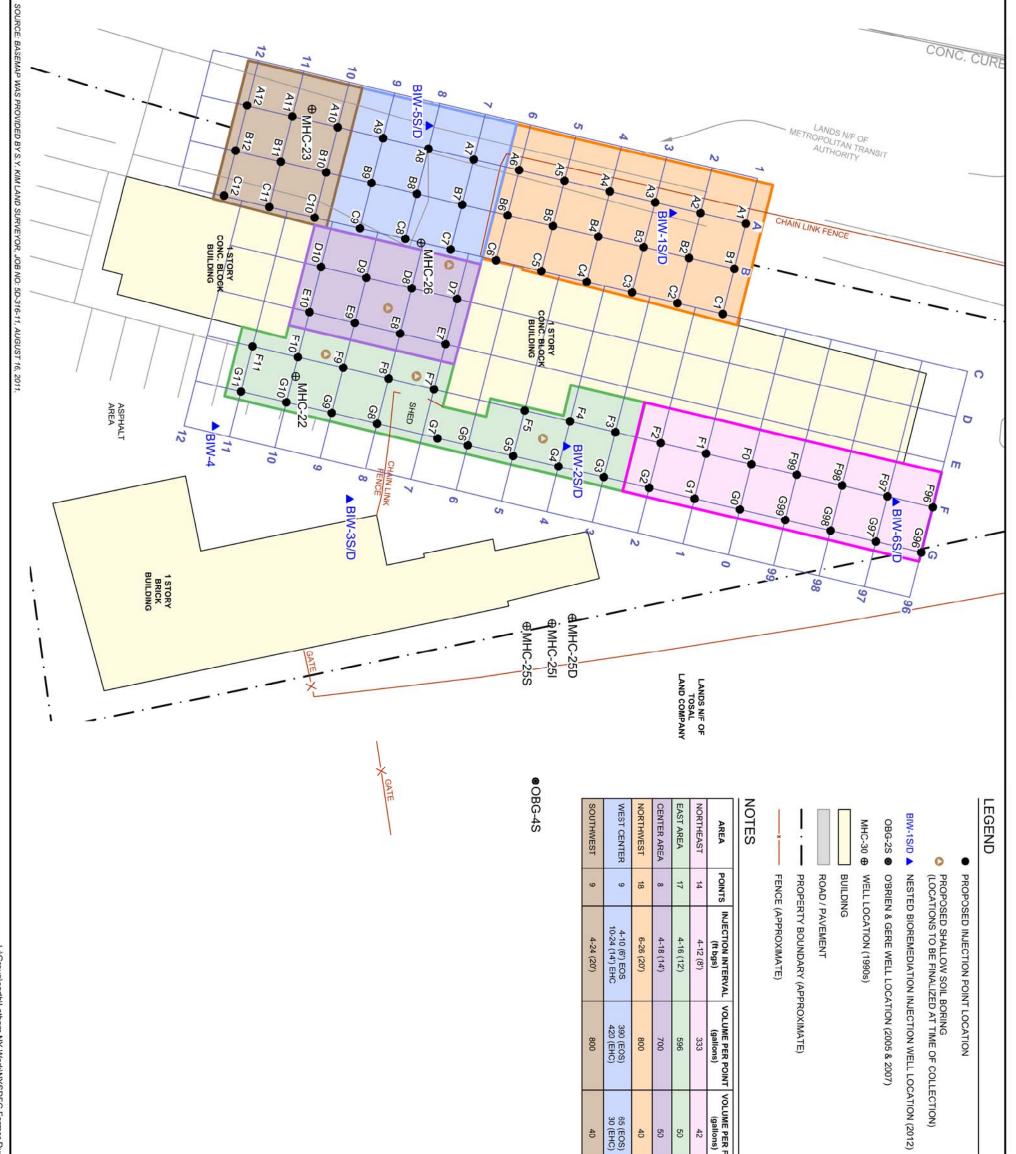
50

SCALE IN FEET

25

100

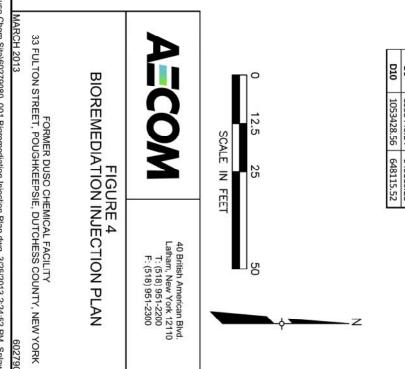
L:\Group\earth\Latham NY Work\NYSDEC Former Duso Chem Site\60279080_006 GW Contour Map Deep Wells.dwg, 1/31/2013 1:39:58 PM, Splawnm



POINTS INJECTION INTERVAL VOLUME PER POINT VOLUME PER FOOT (ft bgs) (gallons) (gallons) 390 (EOS) 420 (EHC)

(EOS) (EHC)

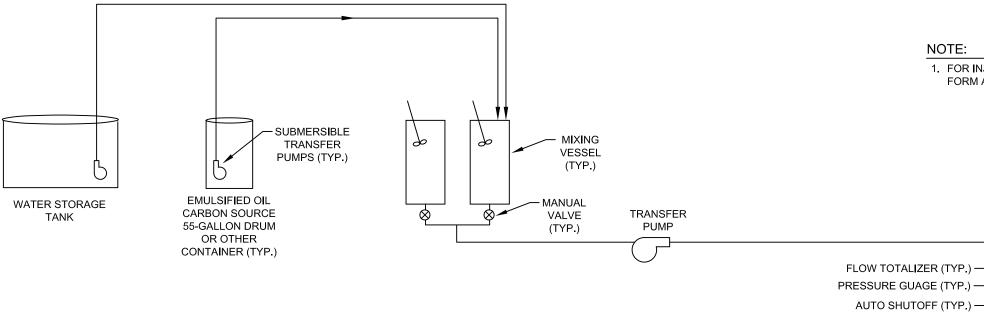
L\Group\earth\Latham NY Work\NYSDEC Former Duso Chem Site\60279080_001 Bioremediation Injection Plan.dwg, 3/25/2013 2:24:52 PM, Splawnm



			048118.28	1003440.24	L S
			648121.04	1053451.92	88
			648123.80	1053463.60	D7
			648097.16	1053403.58	C12
648147.	1053407.95	G11	648100.05	1053415.23	C11
648150.41	1053419.63	G10	648102.81	1053426.91	C10
648153.17	1053431.31	69	648105.57	1053438.59	60
648155.92	1053442.99	89	648108.32	1053450.27	83
648159.67	1053458.55	67	648111.08	1053461.96	Ŋ
648161.44	1053466.36	66	648113.84	1053473.64	C 6
648164.20	1053478.04	G5	648116.60	1053485.32	ß
648166.96	1053489.72	G4	648119.36	1053497.00	C 4
648169.72	1053501.40	G3	648122.12	1053508.68	ß
648172.48	1053513.08	G2	648124.88	1053520.36	ß
648175.24	1053524.76	G1	648127.63	1053532.04	2
648177.99	1053536.44	60	648085.53	1053406.56	B12
648180.75	1053548.12	699	648088.42	1053418.21	B11
648183.51	1053559.80	86D	648091.18	1053429.89	B10
648186.27	1053571.48	G97	648093.94	1053441.57	89
648189.03	1053583.16	696	648096.70	1053453.25	B 8
648136.02	1053410.93	F11	648099.45	1053464.93	B7
648138.78	1053422.61	F10	648102.21	1053476.61	B 6
648141.54	1053434.29	F9	648104.97	1053488.29	B2
648144.30	1053445.97	F8	648107.73	1053499.97	B4
648147.06	1053457.65	F7	648110.49	1053511.65	B3
648152.57	1053481.01	F5	648113.25	1053523.33	B2
648155.33	1053492.69	F4	648116.01	1053535.01	B1
648158.09	1053504.37	F3	648073.90	1053409.53	A12
648160.85	1053516.05	F2	648076.79	1053421.18	A11
648163.61	1053527.73	EI	648079.55	1053432.86	A10
648166.37	1053539.41	FO	648082.31	1053444.54	A9
648169.13	1053551.10	F99	648085.07	1053456.22	A8
648171.88	1053562.78	F98	648087.83	1053467.90	AJ
648174.64	1053574.46	F97	648090.59	1053479.59	A6
648177.40	1053586.14	F96	648093.34	1053491.27	A5
648127.15	1053425.58	E10	648096.10	1053502.95	A4
648129.91	1053437.26	E9	648098.86	1053514.63	A3
648132.67	1053448.94	E8	648101.62	1053526.31	A2
648135.43	1053460.62	E7	648104.38	1053537.99	AI
Easting	Northing	WellID	Easting	Northing	Well ID

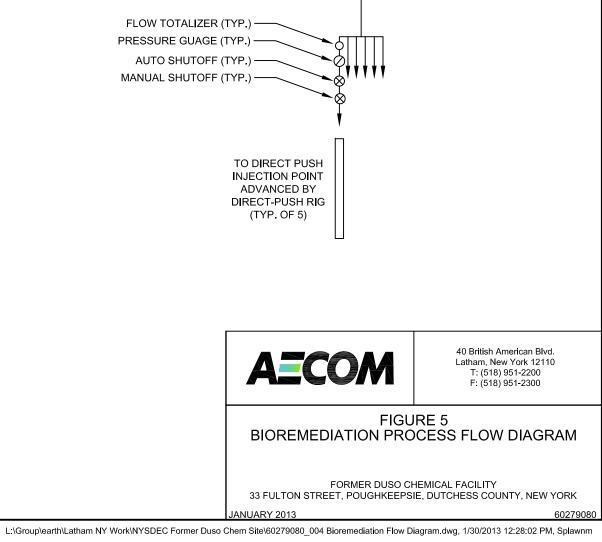
INJECTION POINT COORDINATES

EISB PILOT STUDY



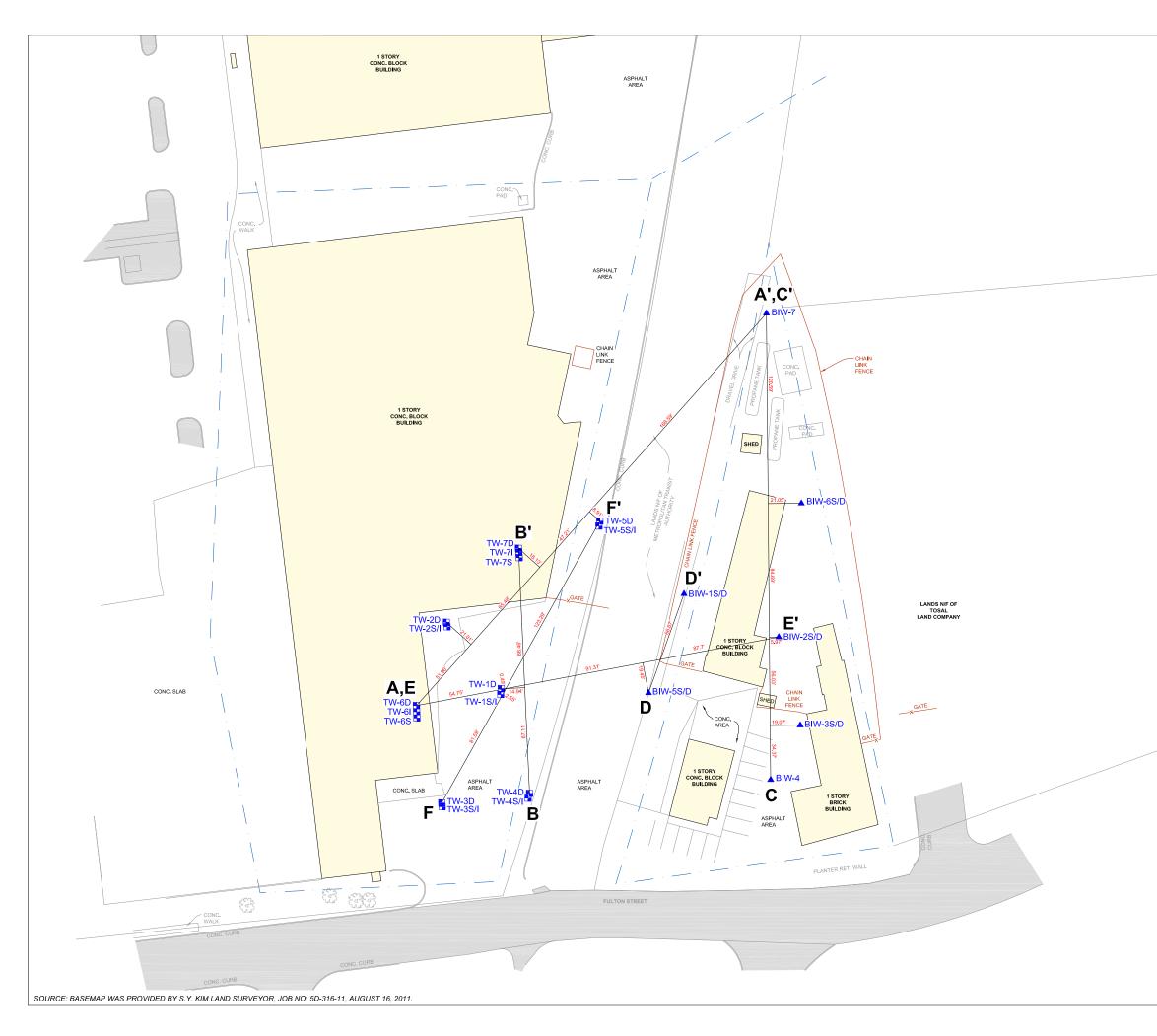


1. FOR INJECTION OF EHC, MIX EHC POWDER WITH WATER TO FORM A SLURRY USING ChemGrout PUMP OR EQUIVALENT.



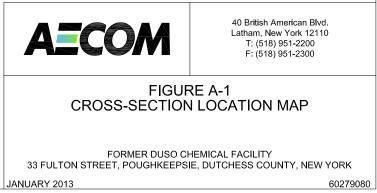
2012 Field Investigation and Groundwater Sampling Results

Cross-Section Location Map

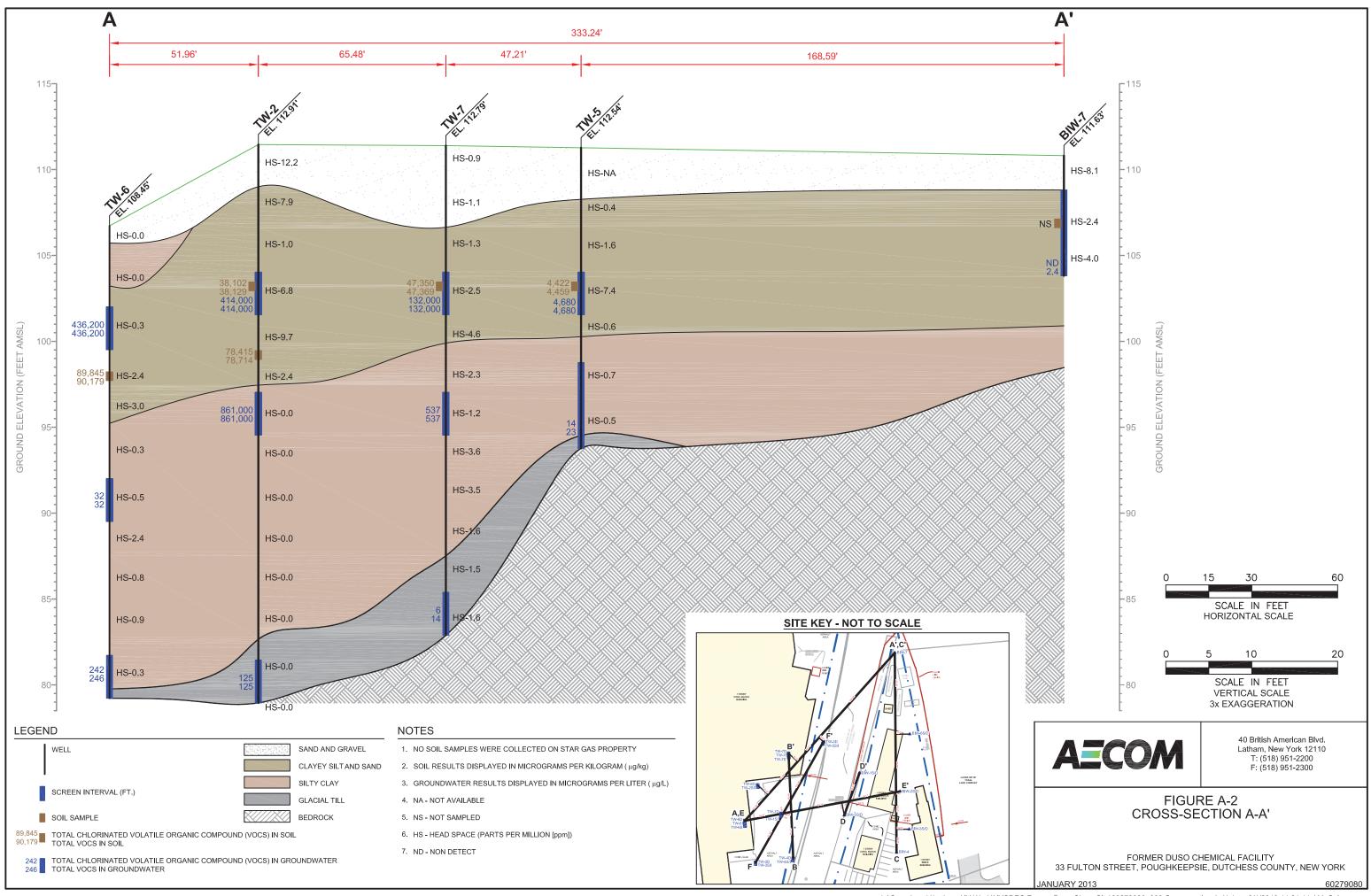


LEGEND	
BIW-1S/D ▲	NESTED BIOREMEDIATION INJECTION WELL LOCATION (2012)
TW-5S/I 🖥	NESTED THERMAL WELL LOCATION (2012)
	CATCH BASIN
	TREES
	BUILDING
	ROAD / PAVEMENT
A—A'	CROSS-SECTION CUT
· ·	PROPERTY BOUNDARY (APPROXIMATE)
x	FENCE (APPROXIMATE)
	PARCEL BOUNDARY



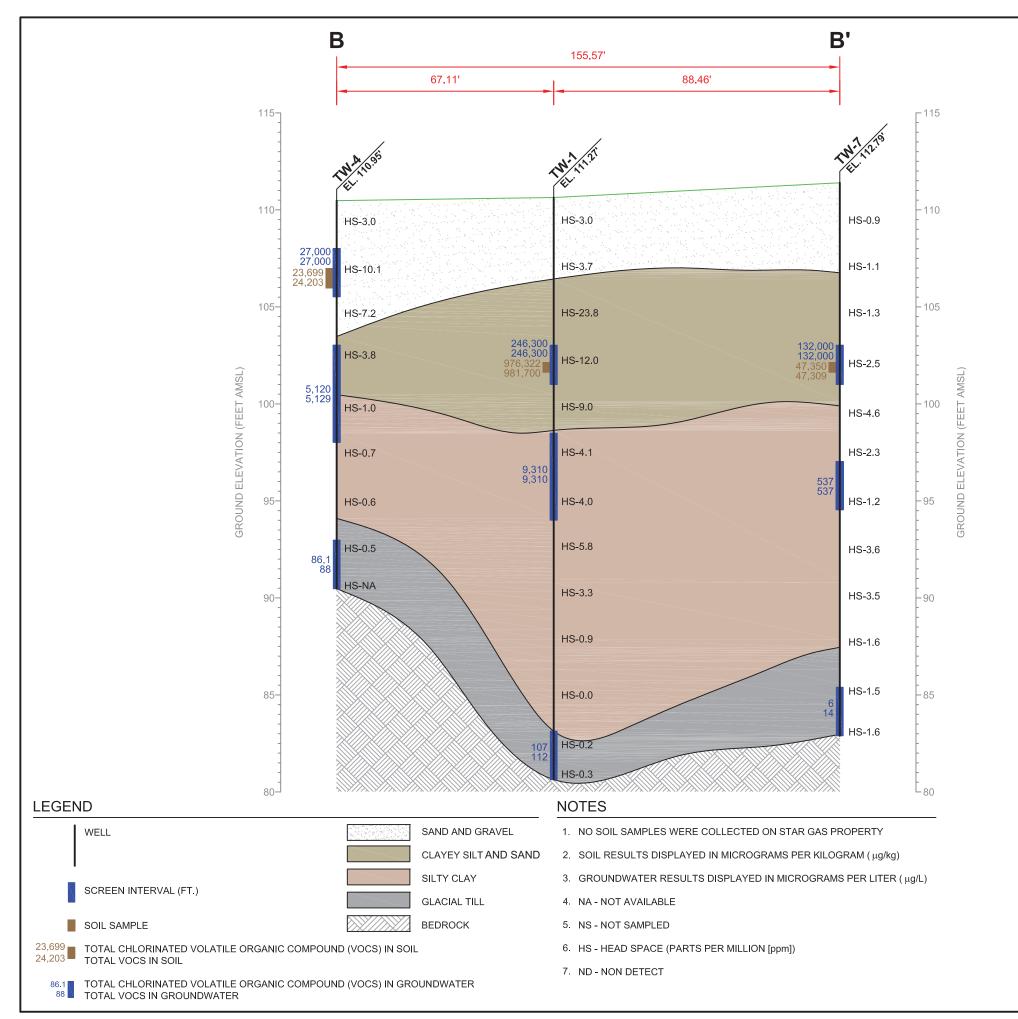


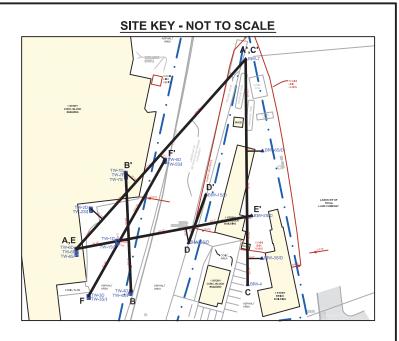
Cross-Section A-A'

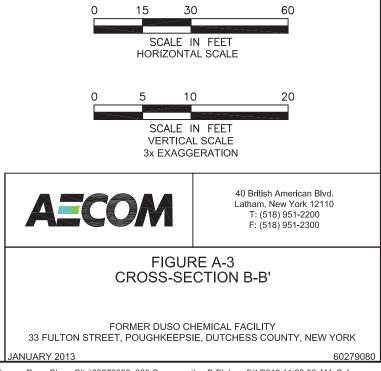


L:\Group\earth\Latham NY Work\NYSDEC Former Duso Chem Site\60279080_003 Cross-section A-A'.dwg, 2/1/2013 11:24:11 AM, Splawnm

Cross-Section B-B'







L:\Group\earth\Latham NY Work\NYSDEC Former Duso Chem Site\60279080_008 Cross-section B-B'.dwg, 2/1/2013 11:23:59 AM, Splawnm

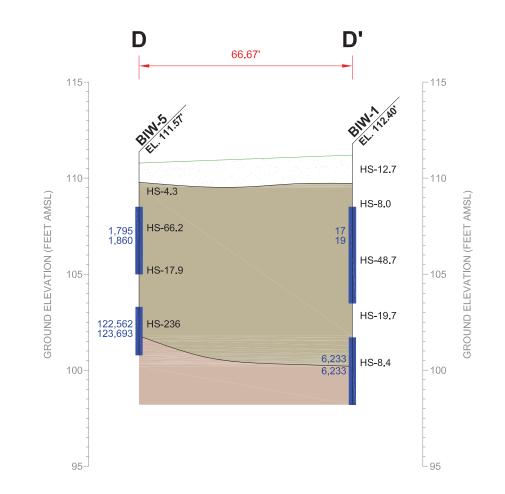
Cross-Section C-C'

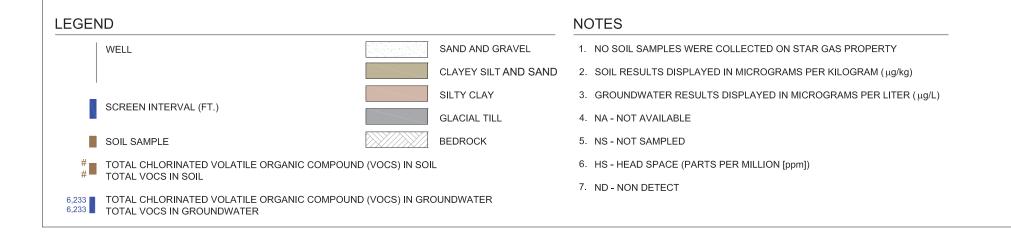
С **C'** 295.68' 84.69' 120.59' 34.37' 56.03' 115-BIN 11163 HS-882.1 HS-560.1 HS-8.1 110-12 GROUND ELEVATION (FEET AMSL) HS-1.8 HS-625.5 HS-163.7 16,374 16,420 273 290 HS-283.6 HS-2.4 HS-1.3 HS-637.6 ND 2.4 HS-20.9 HS-49.7 HS-4.0 HS-47.6 105-HS-1.4 HS-35.5 HS-6.9 HS-0.4 HS-44.5 100-95-LEGEND NOTES SAND AND GRAVEL 1. NO SOIL SAMPLES WERE COLLECTED ON STAR GAS PROPERTY WELL CLAYEY SILT AND SAND 2. SOIL RESULTS DISPLAYED IN MICROGRAMS PER KILOGRAM (µg/kg) SILTY CLAY 3. GROUNDWATER RESULTS DISPLAYED IN MICROGRAMS PER LITER ($\mu\text{g/L})$ SCREEN INTERVAL (FT.) GLACIAL TILL 4. NA - NOT AVAILABLE BEDROCK SOIL SAMPLE 5. NS - NOT SAMPLED ND TOTAL CHLORINATED VOLATILE ORGANIC COMPOUND (VOCS) IN SOIL 6. HS - HEAD SPACE (PARTS PER MILLION [ppm]) 7. ND - NON DETECT ² 16 TOTAL CHLORINATED VOLATILE ORGANIC COMPOUND (VOCS) IN GROUNDWATER TOTAL VOCS IN GROUNDWATER

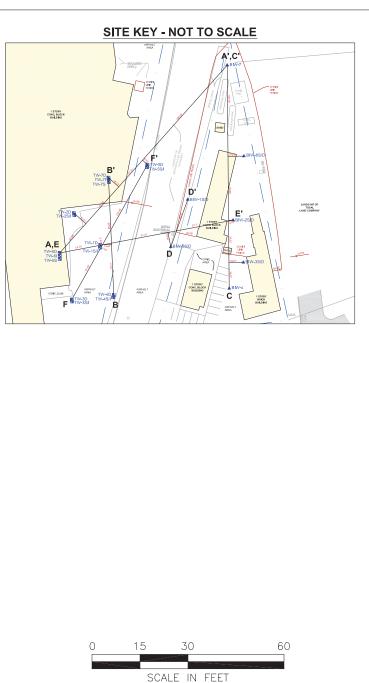


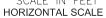
L:\Group\earth\Latham NY Work\NYSDEC Former Duso Chem Site\60279080_009 Cross-section C-C'.dwg, 2/1/2013 11:23:48 AM, Splawnm

Cross-Section D-D'

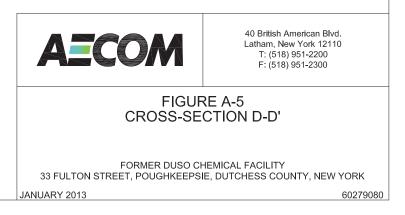




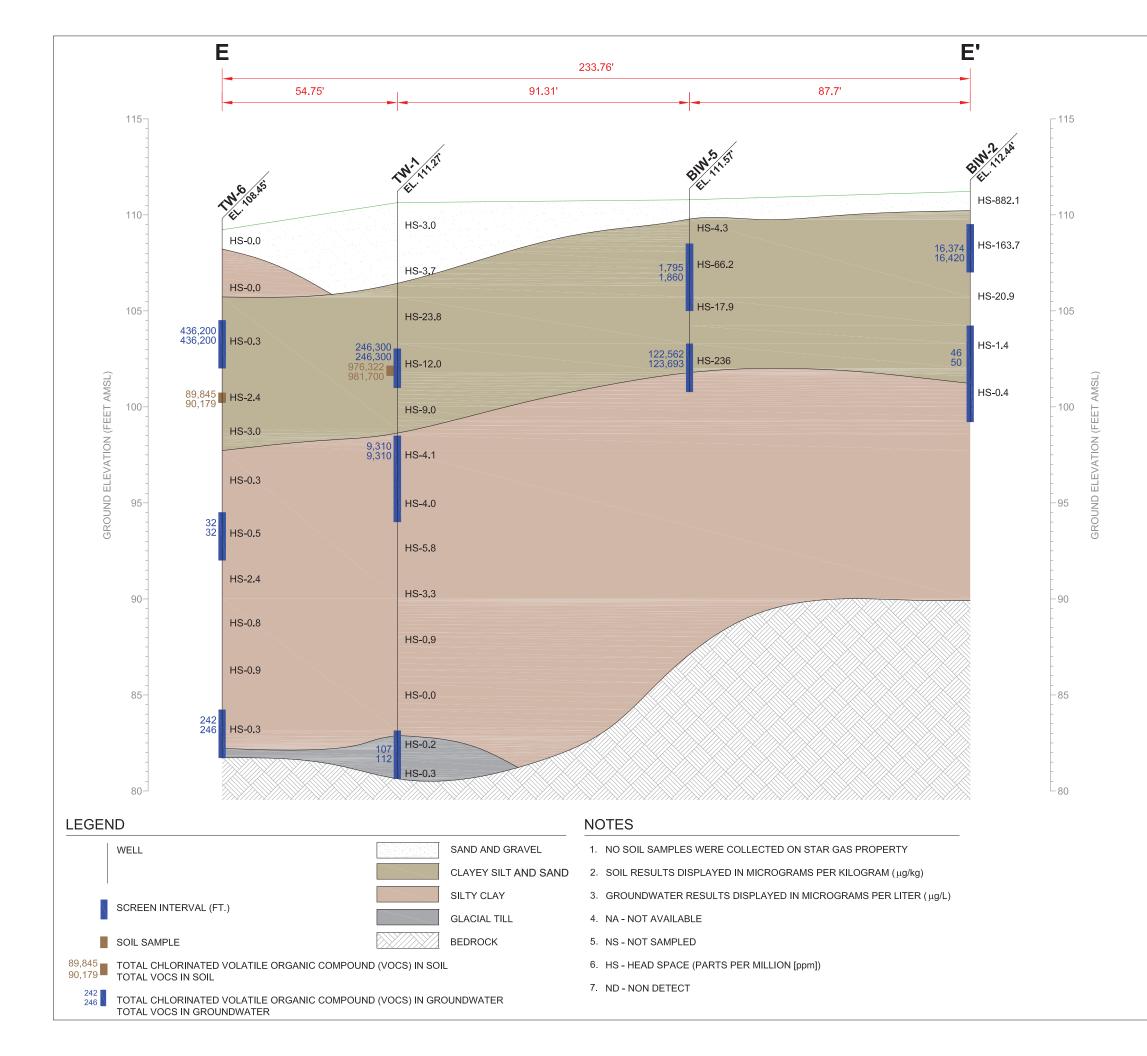


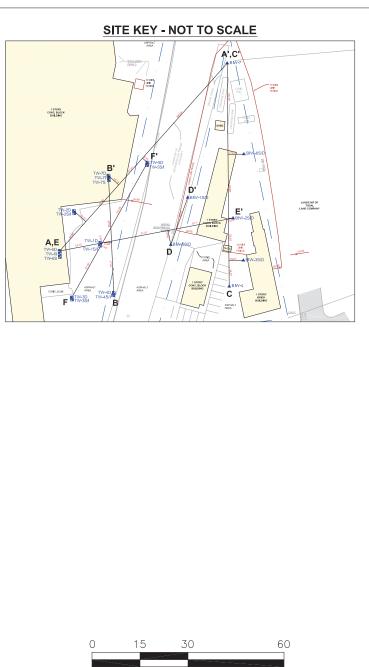






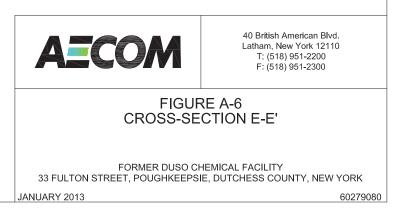
Cross-Section E-E'



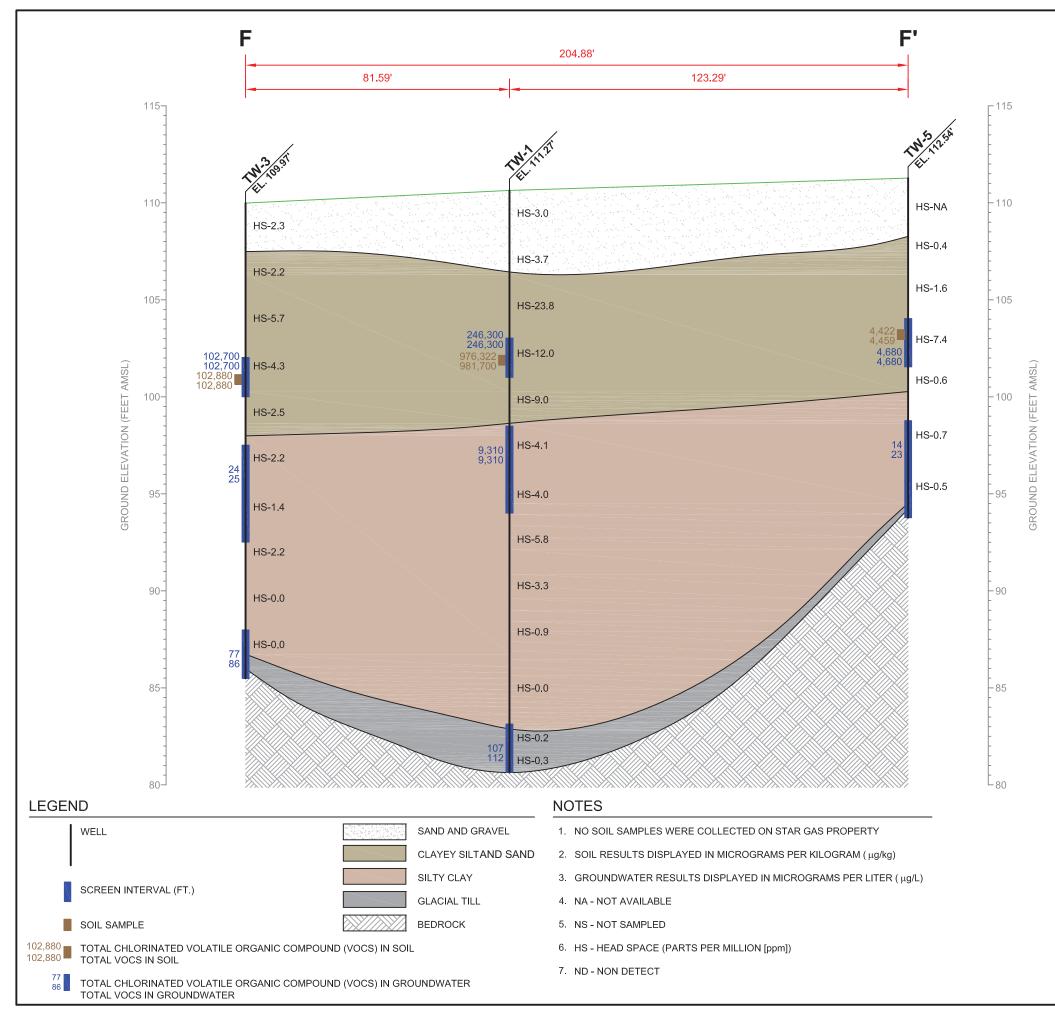


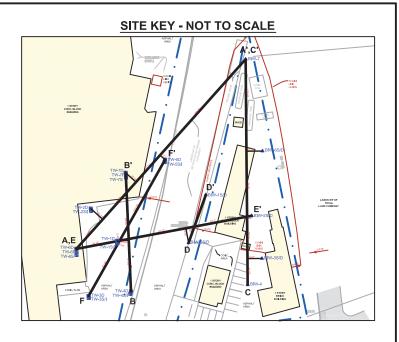


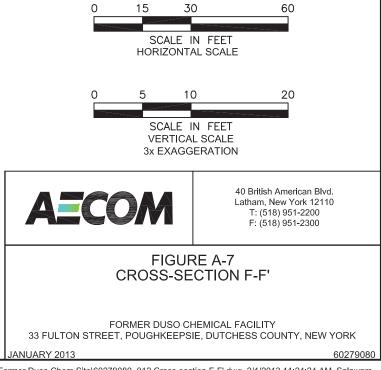




Cross-Section F-F'







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Boring Logs

	A		CC		Ν							DREHOLE LOG #: BIW-1S/D 14/12 END DATE: 8/14/12 Lindsay Mitchell		
SITE LO DRILLI BOREH	OCAT NG CO IOLE I DEPI	ION: D.: DIAM TH RE	Poughkee GeoLogic	epsie, 6.25''	New Y		BORI DRILI DEPT INSPI	NG LOCATIO LER: Scott and H TO BEDRO	N: 1 John	DRILLIN TOTAL I WEATHI	" MANAGER: G METHOD: DEPTH DRILLED: ER CONDITIONS: ION AND DATUM:	HSA with 2' Split Spoon 26' 112.40/ UTM 18		
F	IELD	SAMI	PLE INFO	RMA	TION		WEIGHT(S)	HAMMER	<u>SAMPLER</u>	<u>ST. WATER</u> LEVELS	DATE 1: DATE 2:	DEPTH 1: DEPTH 2:	TIME 1: TIME 2:	
				0		Е	FALL			CASING	TUBE	CORE	RIG TYPE:	
gs)				RVEI	SIS	DUC	TYPE ID/OD						-	
DEPTH (feet bgs)	Blow Counts	RECOVERY	PID (ppm)	ODOR OBSERVED	LAB ANALYSIS	VISIBLE PRODUCT	10/00	G	EOLOGIC DES	SCRIPTION		LITHOLOGY/ SOIL TYPE	WATER LEVEL	
<u>م</u> 0.0	函 35	R	Ы	0	L	7	Gray fine SAN	D, some Grave	1			Dry; compact	REMARKS	
	37 31 22	1.2	1.0	N	N	Ν	Turns brown ar	nd silty last 2" v	with dark gray 1	ve				
2.0	16 14 10 7	0.9	12.7	N	N	N	2-2.5' SAA, the Last 1" is Gray	1.57	, dry coal ash race fine Sand, (Dry			
4.0	7 3 3 5 6	1.0	1.1 / 0.8	N	N	N	4-4.25' Gray br 4.25-4.5' Coars	rown SILTY SA		Moist Wet @ 4.25'				
6.0	6 3 4	1.8	1.1	N	N	N	6-6.75' SAA 6.75-7.6' Orang 7.6' Gray fine S	-		with a 1 cm clay	lense at 7.4'	Wet		
8.0	6 5 8 7	1.3	8.0	Y	N	N	-			depth; last 1" SIL	Γ, little fine SAND,	Wet		
10.0	8 5 6 8	1.4	48.7	Y	N	Y	10-10.5' SAA 10.5 Gray fine	SAND, trace S	ilt; Slight sheen	last 2"		Wet		
12.0	6 5 4 3 6	2.0	34.7	Y	N	N	12.8-13.2' Fine 13.2-13.6' SILT	SILT, little fine SAND, trace S Γ, little fine Sar ID, little Silt; 1		Wet				
14.0	4 3 4 6	1.7	19.7	Y	N	Y			content - sheen in	Wet				
16.0	4 3 2	2.0	11.8	Y	N	Y		ine SAND, littl	oottom; Sheen/odor	Wet				
18.0	1 3 2 3	1.9	6.3	Y	N	Y	-		Silt, trace Clay; y, trace fine San	heen r, no sheen observed	Wet			
	2												PG 1 of 2	

			CC				40 British American Boulevard Latham, New York 12110 BORING II Phone: (518) 951-2200 START DATE:8 Fax: (518) 951-2300 START DATE:8 Company PROJECT NO.: 60279080.1					DREHOLE LOG #: BIW-1S/D /14/12 END DATE: 8/14/12 Lindsay Mitchell		
SITE LO DRILLI BOREH	OCAT NG C OLE I DEPI	ION: 1 D.: 0 DIAMI TH RE.	Former I Poughke GeoLogi ETER: ACHED: 3101.8	epsie, c 6.25''	New Y		BORI DRIL DEPT INSPI	ECT NO.: NG LOCATIO LER: Scott and 'H TO BEDRO ECTOR: I'HING:	N: d John	DRILLIN TOTAL E WEATHE ELEVAT	' MANAGER: G METHOD: DEPTH DRILLED: ER CONDITIONS: ION AND DATUM:	HSA with 2' Spl 26'	it Spoon	
Fl	ELD	SAMP	LE INFC	RMA	TION		WEIGHT(S)	HAMMER	SAMPLER	<u>ST. WATER</u> LEVELS	DATE 1: DATE 2:	DEPTH 1: DEPTH 2:	TIME 1: TIME 2:	
()				ED		UCT	FALL TYPE			<u>CASING</u>	TUBE	CORE	RIG TYPE:	
DEPTH (feet bgs)	2					VISIBLE PRODUCT	ID/OD	G	EOLOGIC DE	SCRIPTION		LITHOLOGY/ SOIL TYPE	WATER LEVEL	
20.0	2 2 3	1.8	8.4	Y	N	N	SAA; odor at t	op only		Wet	REMARKS			
22.0	3 3 4 4	1.9	5.2	N	N	N	Gray CLAYEY	SILT, trace fir	Wet					
24.0	3 2 2 4 3	1.5	3.6	Y	N	N	24-24.6' Gray S 24.6-25.5' Gray	-	lor	Wet				
26.0	-													
28.0														
30.0														
32.0														
34.0														
36.0														
38.0													PG 2 of 2	

	A		CC)/	Λ		4	0 British Am Latham, No	OM, Inc. Ierican Boule ew York 1211		BORING ID #	REHOLE L # BIW-2S	
									518) 951-2200 8) 951-2300		START DATE: 8/9/	/12 END DAT	E: 8/9/12
SITE LO	OCAT	ION:	Former D Poughkee	psie, l			BORI	ECT NO.: NG LOCATIO			MANAGER:	Lindsay Mitchel	
BOREH	IOLE . DEP	DIAM FH RE	GeoLogic ETER: EACHED: 1 8161.7	6.25'	,		DEPT INSP	LER: Scott and TH TO BEDRO ECTOR: FHING:		TOTAL E WEATHE	G METHOD: DEPTH DRILLED: ER CONDITIONS: ION AND DATUM:	HSA with 2' Spl 24' 112.44/ UTM 18	-
F	TELD	SAM	PLE INFO	RMA	TION		WEIGHT(S)	HAMMER	SAMPLER	ST. WATER LEVELS	DATE 1: DATE 2:	DEPTH 1: DEPTH 2:	TIME 1: TIME 2:
				ED		JCT	FALL TYPE			CASING	TUBE	CORE	RIG TYPE:
t bgs)	s	Y		ERVI	YSIS	SODU	ID/OD						-
DEPTH (feet bgs)	Blow Counts	RECOVERY	PID (ppm)	ODOR OBSERVED	LAB ANALYSIS	VISIBLE PRODUCT		G	EOLOGIC DE	SCRIPTION		LITHOLOGY/ SOIL TYPE	WATER LEVEL
		REC	DII	ODO	LAF	VIS					REMARKS		
0.0	25 28	1.0	100.0		ът		Brown SAND	and GRAVEL;	backfill; turns		Dry		
	27	1.0	122.0	N	N	N							
2.0	31 2					-	2-3' Black SIL	T, little fine Sar		Dry			
	2 3	1.4	882.1	N	Ν	N	3' Olivey brow	n SILT, little fi	ne Sand, trace (om	Moist @ 3.3'		
	3												
4.0	1 1	0.0	162.7	ŊŢ			Dark gray fine	SAND, little Si	ilt; strong odor			Moist Wet @4.7'	
	2	0.8	163.7	N	N	N							
6.0	3						6-6.4' SAA; in	creasing sand c	ontent and grain	size with depth		Wet	
	4 4	1.3	11.5 / 15.4	N	Ν	Ν		lly coarse SANI					
	4							SILTY CLAY with depth; she		e, medium SAND,	trace Silt and Clay;		
8.0	6 9						No recovery af	ter two attempt	s				
	9												
10.0	7 7						Gray fine SAN	D, little Silt, tra	ace Clay; plastic	; slight odor		Wet	
	4	1.4	20.9	N	N	Ν							
	4												
12.0	3 3						-		trace Clay; very	v soft plastic; slight odor		Wet	
	3 4	1.4	4.6	N	Ν	N	12.7 Gray IIIe	, STAD, HUIC S	m, nace clay;]	moue, siight 0001			
14.0	4						Grav fine SAN	D, some Silt, tr	ace Clav			Wet	
1-1.0	3	1.5	1.4	N	N	N	Sity file SAI	, some ont, u	and Chuy				
	2 3												
16.0	3						Gray SILTY S	AND, little Cla	y/some Clay (la	st 1"); plastic		Wet	
	2 3	1.8	0.8	Y	Ν	Ν							
	3												
18.0	3 2	1 7	0.6	v	N.	N T	Gray SILTY S	AND, little Cla	y; plastic			Wet	
	3	1.7	0.6	Y	N	N						DC 1. CO	
	2			<u> </u>	<u> </u>	1							PG 1 of 2

	A		CC)/	Ν		AECOM, Inc. 40 British American Boulevard Latham, New York 12110 Phone: (518) 951-2200 Fax: (518) 951-2300 1 Company PROJECT NO.: 60279080.1 PROJECT MANAGER:						/D
SITE LO DRILLI BOREH	DCAT NG C IOLE DEP1	ION: O.: DIAM TH RE	Former I Poughke GeoLogi ETER: ACHED: 8161.7	epsie, c 6.25''	New Y		BORI DRIL DEPT INSPI	ECT NO.: NG LOCATIO LER: Scott and 'H TO BEDRO ECTOR: [HING:	DN: d John	DRILLIN TOTAL I WEATHE	MANAGER: G METHOD: DEPTH DRILLED: ER CONDITIONS: ION AND DATUM:	Lindsay Mitchel HSA with 2' Spl 24' 112.44/ UTM 18	it Spoon
F	IELD	SAMF	PLE INFC	ORMA	TION		WEIGHT(S)	HAMMER	SAMPLER	<u>ST. WATER</u> LEVELS	DATE 1: DATE 2:	DEPTH 1: DEPTH 2:	TIME 1: TIME 2:
				~		L	FALL			CASING	TUBE	CORE	RIG TYPE:
gs)				VEL	IS	DUC	TYPE						-
DEPTH (feet bgs)	Blow Counts	RECOVERY	PID (ppm)	ODOR OBSERVED	LAB ANALYSIS	VISIBLE PRODUCT	ID/OD	G	EOLOGIC DE	SCRIPTION		LITHOLOGY/	WATER LEVEL
DEP	Blov	REC	DID	ODO	LAB	VISI						SOIL TYPE	REMARKS
20.0		1.7	0.4	Y	N	N	Gray SILT, sor	ne Clay, trace t	Wet				
22.0		1.7	0.3	Y	N	N	SAA					Wet	
24.0													
26.0													
28.0													
30.0													
32.0													
34.0													
36.0													
38.0													PG 2 of 2

	A	_	CC		Ν							DREHOLE LOG #: BIW-3S/D 8/7/12 END DATE: 8/7/12 Lindsay Mitchell		
SITE LO DRILLI BOREH	DCAT NG C IOLE	ION: O.: DIAM FH RE	Former I Poughkee GeoLogie ETER: ACHED:2 8175.3	epsie, c 6.25''	New Y		BORI DRIL DEPT INSPI	ECT NO.: ING LOCATIO LER: Scott an TH TO BEDRO ECTOR: THING:)N: d John	DRILLIN TOTAL I WEATHI	[°] MANAGER: G METHOD: DEPTH DRILLED: ER CONDITIONS: ION AND DATUM:	HSA with 2' Spli 24'	it Spoon	
F	IELD	SAMF	PLE INFO	RMA	TION		WEIGHT(S)	HAMMER	SAMPLER	<u>ST. WATER</u> LEVELS	DATE 1: DATE 2:	DEPTH 1: DEPTH 2:	TIME 1: TIME 2:	
				D		CT	FALL TYPE			CASING	<u>TUBE</u>	CORE	RIG TYPE:	
bgs)				RVE	SIS	DUUC	ID/OD						-	
DEPTH (feet bgs)	v Counts	 Blow Counts RECOVERY PID (ppm) PID (ppm) DOR OBSERVED LAB ANALYSIS 				VISIBLE PRODUCT			EOLOGIC DES	SCRIPTION	<u> </u>	LITHOLOGY/ SOIL TYPE	WATER LEVEL	
DEF	Blov	REC	PID	OD(LAF	VIS						SOILTIFE	REMARKS	
0.0	8 36 17	0.9	226.7	N	N	N	0-0.5' Asphalt 0.5' Gray brow	n SAND and C		Dry				
2.0	74 7 3 2	0.8	625.5	Y	N	N	Dark gray, slig	thtly olive fine	ım-like odor	Wet				
4.0	2 4 3 3	1.4	637.6	Y	N	N	4-4.75' SAA 4.75-5' Mediur 5-5.4' SILT, so			Wet				
6.0	4 4 3 3	1.0	7.1	N	N	N	Olivey brown S	SILT, little Cla	y, trace fine San	d; firm; plastic		Moist		
8.0	3 4 5 6	1.4	22.2	N	N	N	8-8.4' SAA 8.4-9.4' Olivey	y brown SILT, 1	little fine Sand, t	race Clay (in lens	es); firm; plastic	Moist		
10.0	7 5 5 6	1.2	47.6 / 17.0	Y	N	N	10-10.7' SAA; 10.7-11.2' Gray	5,	ilight odor some Silt; firm; p	plastic		Wet		
12.0	6 4 6 5 6	1.0	3.2	N	N	N	SAA			Wet				
14.0	6 4 4 3 8	1.0	30.3	Y	N	N	SAA; slight od	lor				Wet		
16.0	8 3 4 4 6	1.2	14.1	N	N	N	-		me Silt and suba RAVEL; loose	ngular Gravel; pla	istic	Wet Moist Wet		
18.0	6 3 4 4 4	1.0	35.5	N	N	N	18.4-18.7' Bro	wn SAND and	me Silt and suba GRAVEL; loos EL, little Silt and	istic	Moist Wet	PG 1 of 2		

	A		CC		Ν		4	0 British Am	OM, Inc. Ierican Boule ew York 1211		BORING ID #	REHOLE L # BIW-3S	
2.5									518) 951-2200 8) 951-2300		START DATE: 8/7	12 END DAT	E: 8/7/12
			Former I Poughke				ompany PROJ	ECT NO.: NG LOCATIO	60279080.1	PROJECT	MANAGER:	Lindsay Mitchel	1
DRILLI BOREH	NG CO OLE I DEPI	O.: DIAM TH RE	GeoLogic ETER: ACHED:2 8175.3	c 6.25''		IUK	DRIL DEPT INSPI	LER: Scott and TH TO BEDRO ECTOR: THING:	d John	TOTAL E WEATHE	G METHOD: DEPTH DRILLED: ER CONDITIONS: ION AND DATUM:	HSA with 2' Spl 24' 112.28/ UTM 18	_
Fl	IELD	SAMP	LE INFO	RMA	TION		WEIGHT(S)	HAMMER	SAMPLER	<u>ST. WATER</u> LEVELS	DATE 1: DATE 2:	DEPTH 1: DEPTH 2:	TIME 1: TIME 2:
				_		L	FALL			CASING	<u>TUBE</u>	<u>CORE</u>	RIG TYPE:
ogs)				RVEI	SIS	DUC	TYPE ID/OD						-
DEPTH (feet bgs)	Blow Counts	RECOVERY	PID (ppm)	ODOR OBSER VED	LAB ANALYSIS	VISIBLE PRODUCT		G	EOLOGIC DES	SCRIPTION		LITHOLOGY/	WATER LEVEL
DEP	Blow	REC	PID (ODO	LAB	USIV			202001022			SOIL TYPE	REMARKS
20.0	14 10						SAA			Wet			
	11	0.5	44.5	N	N	N							
22.0	14 20						22-22.3' Gray I	prown coarse(+) medium, fine(-) SAND; loose		Wet	
	20 27	1.8	35.2	N	N	N	22.3' Gray shal						
24.0	74												
2													
26.0													
28.0													
30.0													
32.0													
34.0													
36.0													
38.0													
													PG 2 of 2

		_			_				OM, Inc. erican Boule	vard	BORING ID #	REHOLE L	
	A		CC	Л	Λ			Latham, No Phone: (5	ew York 1211 518) 951-2200	0	START DATE: 8/8		
			Former D				1 0	ECT NO.:	8) 951-2300 60279080.1	PROJEC	T MANAGER:	Lindsay Mitche	1
DRILLI BOREH	NG CO OLE I DEPI	O.: DIAM TH RE	Poughkee GeoLogic ETER: ACHED:1 8156.5	6.25"		ork	DRIL DEPT INSP	ING LOCATIO LER: Scott and TH TO BEDRO ECTOR: THING:	l John	TOTAL WEATH	NG METHOD: DEPTH DRILLED: ER CONDITIONS: FION AND DATUM:	HSA with 2' Spl 12.1' 112.07/	it Spoon 7 UTM 18
F	IELD	SAMI	PLE INFO	RMA	TION		WEIGHT(S)	HAMMER	SAMPLER	ST. WATER LEVELS	DATE 1: DATE 2:	DEPTH 1: DEPTH 2:	TIME 1: TIME 2:
(ED		JCT	FALL TYPE			CASING	TUBE	CORE	RIG TYPE:
DEPTH (feet bgs)	Blow Counts	RECOVERY	(undd	ODOR OBSERVED	LAB ANALYSIS	VISIBLE PRODUCT	ID/OD	G	EOLOGIC DE	SCRIPTION		LITHOLOGY/	WATER LEVEL
DEPT	Blow	RECC	PID (ppm)	IODOI	LAB .	VISIE		0		SOIL TYPE	REMARKS		
0.0	10 11 50+			N	N	N	0-0.3' Asphalt 0.3-3' Concrete	2					
3.0	10 7 4	0.1	1.8	N	N	N	Brown angular	GRAVEL, son	Wet				
5.0	5 5 3 3	0.9	1.3	N	N	N	Orange brown sand/clay conte	SILT, little Cla ent	`higher/lower	Moist			
7.0	4 3 4 7	0.7	1.2	N	N	N	Orange brown	SILT, some Cla	ay; plastic			Moist	
9.0	14 11 29 31	0.9	1.3	N	N	N	9-9.4' Coarse(- 9.4-9.5' Orang 9.5' Gray till	+), medium(-), f e brown SILT, s		tic		Moist	
11.0	30 17 55 50+	0.6	1.3	N	N	N	11-11.5' SAA 11.5' Broken si Refusal @ 12.					Moist	
13.0													
15.0													
17.0													
19.0													
													Page 1 of 1

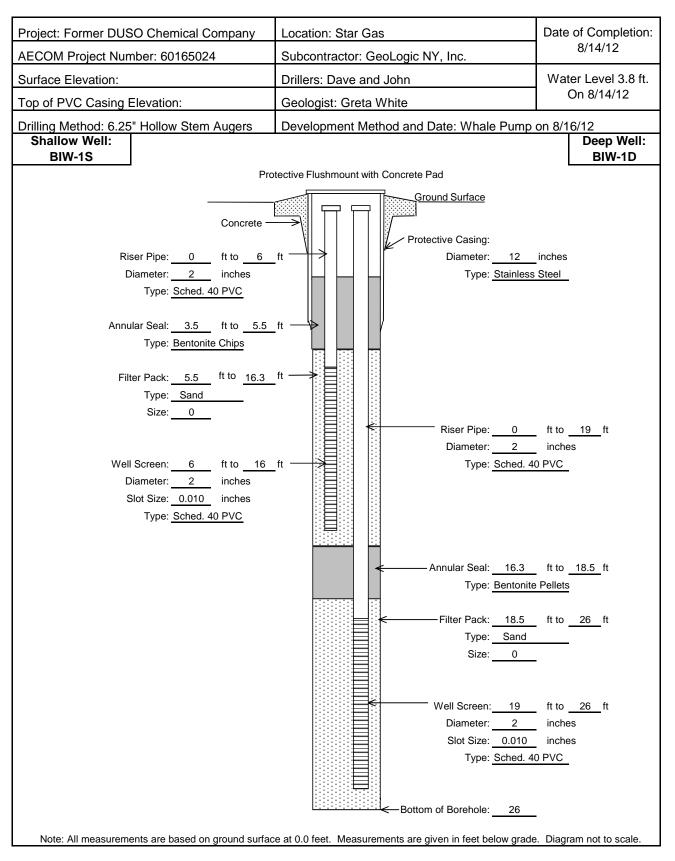
			CC				40 British American Boulevard Latham, New York 12110 Phone: (518) 951-2200 Fax: (518) 951-2300 BORING IC Company PROJECT NO.: 60279080.1 PROJECT MANAGER:					PREHOLE LOG #: BIW-5 S/D 16/12 END DATE: 8/16/12 Lindsay Mitchell		
SITE LO DRILLI BOREH	DCAT NG C IOLE	ION: O.: DIAM FH RE	Former I Poughke GeoLogi ETER: ACHED: 8079.1	epsie, c 6.25''	New Y		BORI DRIL DEPT INSPI	ECT NO.: NG LOCATIO LER: Scott and 'H TO BEDRO ECTOR: THING:	N: 1 John	DRILLIN TOTAL I WEATHI	" MANAGER: G METHOD: DEPTH DRILLED: GR CONDITIONS: ION AND DATUM:	HSA with 2' Spli 20'	it Spoon	
F	IELD	SAMF	PLE INFC	ORMA	TION		WEIGHT(S)	HAMMER	SAMPLER	<u>ST. WATER</u> <u>LEVELS</u>	DATE 1: DATE 2:	DEPTH 1: DEPTH 2:	TIME 1: TIME 2:	
				Ð		CT	FALL TYPE			<u>CASING</u>	TUBE	CORE	RIG TYPE:	
t bgs)		N.		ERVI	YSIS	toDU	ID/OD							
DEPTH (feet bgs)	Blow Counts	RECOVERY	PID (ppm)	ODOR OBSERVED	LAB ANALYSIS	VISIBLE PRODUCT		G		LITHOLOGY/ SOIL TYPE	WATER LEVEL			
<u> </u> 0.0	18 4	RI	Id	ō	Γ	5	0-0.8' Grav bro	own SAND and		Dry; loose	KEWI KKS			
	5 12 15	1.2	2.8	N	N	N	2	ichy coal ash; ro	,					
2.0	4						Brown SILT, s	ome fine Sand;		Dry				
	4 3 4	0.9	2.8	N	N	N	Last 1.5" is lig	ht brown						
4.0	5							en fine(+), medi	um(-), coarse SA	el, trace Silt; non	Moist			
	5 5 3	0.7	4.3	N	N	Ν	plastic							
6.0	4 4 4	1.2	66.2	Y	N	N	6-6.25' SAA 6.25' Dark gray	y fine(-), mediu	m, coarse(+) SA	ND, some Grave	l, trace Silt	Wet; loose		
8.0	4 4 6 6	0.2	3.7	Y	N	N	Dark gray SIL'	ΓΥ SAND, trac	e Clay; plastic;	slight acetone-like	e odor.	Wet		
10.0	5						Dark grav fine	SAND. little Si	ilt; slightly plast	ic: slight odor		Wet		
	5 5	0.8	17.9	Y	N	N	g,	,	, <u>8</u> , F	,				
12.0	4						12-12.7' SAA					Wet		
	3 5 7	1.7	15.0	Y	N	N	12.7-13.4' Darl 13.4' Fine SAN	k gray fine SAN	eds >1" thick					
14.0	2			1			1		ilt; slightly plast	ic; chemical-like	odor	Wet		
	2 2 2	1.4	12.9	Y	N	N								
16.0	2			F			SAA; 1" clay l	ense at 17'				Wet		
	2 3 3	1.7	23.6	Y	N	N								
18.0	3 3	1.1	4.0	Y	N	N		gray SILTY SA ne Clay; plastic	DL	Wet Dry; firm				
	3 2											PG 1 of 1		

	A		CC)/	Ν		40 British American Boulevard Latham, New York 12110 Phone: (518) 951-2200 Fax: (518) 951-2300 BORING ID Company PROJECT NO.: 60279080.1 PROJECT MANAGER:					DREHOLE LOG #: BIW-6S/D 15/12 END DATE: 8/15/12 Lindsay Mitchell Lindsay Mitchell		
SITE LO DRILLI BOREF	OCAT ING C IOLE L DEP	ΊΟΝ: Ο.: DIAM ΓΗ RE	Former I Poughke GeoLogi IETER: EACHED: 8176.0	epsie, c 6.25'	New		BORI DRIL DEPT INSPI	NG LOCATIO LER: Scott and H TO BEDRO	N: 1 John	DRILLIN TOTAL D WEATHE	' MANAGER: G METHOD: DEPTH DRILLED: R CONDITIONS: ION AND DATUM:	HSA with 2' Spli 20'	it Spoon	
F	TELD	SAMI	PLE INFC	ORMA	TION		WEIGHT(S)	HAMMER	SAMPLER	ST. WATER LEVELS	DATE 1: DATE 2:	DEPTH 1: DEPTH 2:	TIME 1: TIME 2:	
				D		CT	FALL TYPE			CASING	TUBE	CORE	RIG TYPE:	
bgs)				RVE	(SIS	VISIBLE PRODUCT	ID/OD						-	
DEPTH (feet bgs)	Blow Counts	RECOVERY PID (ppm) ODOR OBSERVED LAB ANALYSIS						G	EOLOGIC DES	SCRIPTION		LITHOLOGY/ SOIL TYPE	WATER LEVEL	
0.0	函 40	RI	Id	ō	L/	5	0-0.8' Fine, me	dium, course S	AND and GRA	VEL: backfill		Dry	REWARKS	
	51 19 12	1.3	5.5	N	N	N	· · ·	<i>,</i>	lack crunchy coal ash					
2.0	11 5 3 3	1.4	560.1	Y	N	N	2.8' Dark gray	and black crush SILT, trace fine odor at bottom	astic	Dry Moist				
4.0	2 2 4	1.6	283.6	N	N	N		sh gray brown S			Moist Wet @ 4.75'			
6.0	5 5 6 4 4	1.9	4.2	Y	N	N	6.5-7' Fine SA		GRAVEL, trace	epth; slight petrole e Silt; loose	um-like odor	Wet		
8.0	3 5 8 7	1.9	105.9	Y	N	N	content; plastic	2. 1" lense of SA		; varying degrees o wel at 8.75'; loose or at bottom		Wet		
10.0	6 6 7 7	1.0	28.9	Y	N	N	Dark gray fine	SAND, little Si	ilt, trace Clay; p	lastic; slight petro	leum-like odor	Wet		
12.0	4 6 7 7	1.4	49.7	N	N	N	SAA			Wet				
14.0		1.8	6.9	N	N	N	14-14.75' SAA 14.75' 1" layer 14.8' SILTY S.	of dark gray SI	LT; firm			Wet Dry Wet		
16.0		1.8	4.2	N	N	N		of dark gray SIL AND, trace Cla				Wet Dry Wet		
18.0	2 2 2 3	1.7	2.5	N	N	N	18-18.4' Dark ; 18.4' SILT, litt >1" thick		e Sand; clay is in	es of various sizes, all	Wet	PG 1 of 1		

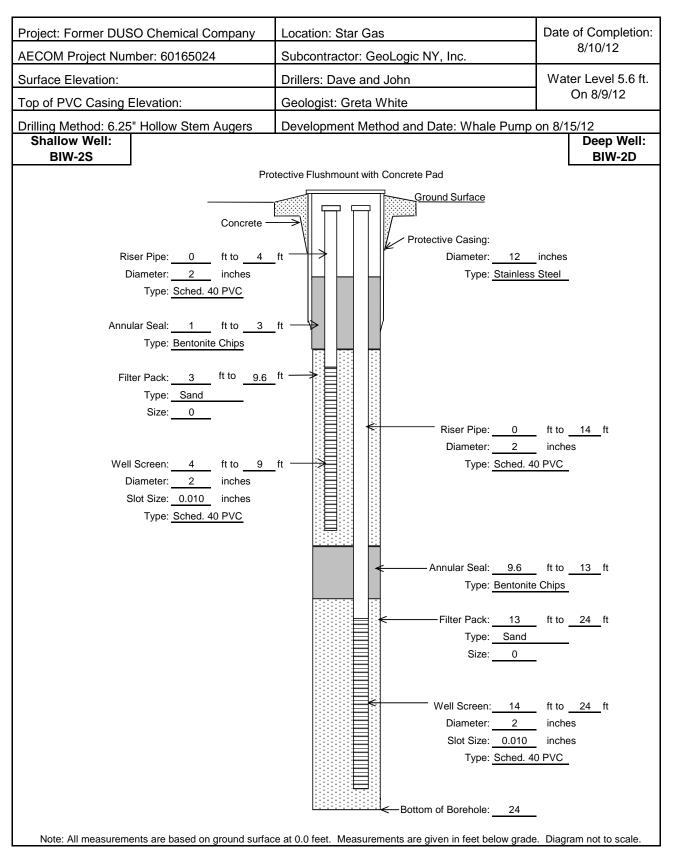
		_	~						OM, Inc. Terican Bouley	vord		REHOLE L		
	A		CC	J	И			Latham, No Phone: (5	ew York 1211 518) 951-2200	0	BORING ID #			
PROJEC	CT NA	ME:	Former	Duso (Chemi	ical C	ompany PROJ		8) 951-2300 60279080.1	PROJECT	MANAGER:	Lindsay Mitchel	1	
SITE LO DRILLI BOREH	DCAT NG C IOLE I DEPT	ION: O.: DIAM TH RE	Poughke GeoLogi ETER: ACHED: 8153.8	epsie, c 6.25''	New Y		BORI DRIL DEPT INSPI	NG LOCATIO LER: Scott and H TO BEDRO ECTOR: THING:	N: d John	DRILLIN TOTAL I WEATHI	G METHOD: DEPTH DRILLED: CR CONDITIONS: ON AND DATUM:	HSA with 2' Spli 14'	it Spoon	
F	IELD	SAMP	LE INFO	DRMA	TION			HAMMER	SAMPLER	ST. WATER	DATE 1:	DEPTH 1:	TIME 1:	
			EE IIII (WEIGHT(S) FALL			LEVELS CASING	DATE 2: TUBE	DEPTH 2: CORE	TIME 2: RIG TYPE:	
(\$				ÆD	s	UCT	TYPE							
st bgs	s	Y		SERV	'YSI	ROD	ID/OD							
DEPTH (feet bgs)	Blow Counts RECOVERY PID (ppm) ODOR OBSERVED LAB ANALYSIS					VISIBLE PRODUCT		G	EOLOGIC DES	SCRIPTION		LITHOLOGY/ SOIL TYPE	WATER LEVEL	
DEI	Blor	REC	DID	OD	LAI	VIS					REMARKS			
0.0	13			1			Olivey gray SA	ND and GRA	VEL, trace Silt;	backfill; compact		Dry		
	16 8 5	1.6	1.9	ches from bottom										
2.0	3						Slight odor at b Olivey gray SI		and; organics; p	plastic; slight odor		Dry		
	2 2	0.6	8.1	Y	N	N								
	2											-		
4.0	3 3						4-4.8' SAA 4.8' Grav fine 9	SAND, trace Si	lt: slight adar			Dry Wet		
	5	1.4	2.4	Y	N	N	4.8 Gray fille	SAND, liace SI	it, slight odol			wei		
6.0	6 5						SAA					Wet		
	4 5	1.2	2.3	Y	N	N								
8.0	7						8-8.8' Olivey g	ray SILT trace	Sand: plastic			Moist		
0.0	5	1.7	2.4	N	N	N	8.8' Fine SANI	-	, Sand, plastic			Wet		
	5	1./	2.4	N	N	IN								
10.0	7							1. (<u></u>		XX 7 4		
10.0	1 2						Gray fine(+) m	edium, coarse(-) SAND, trace	Silt and Gravel		Wet		
	3	1.0	4.0	N	N	N								
	4													
12.0	3 3 3	1.3	2.4	N	N	N	SAA 1 cm layer of b	rown SILTY S	AND at 12.7'			Wet		
	4													
14.0														
16.0														
18.0														
													PG 1 of 1	

Well Construction Diagrams

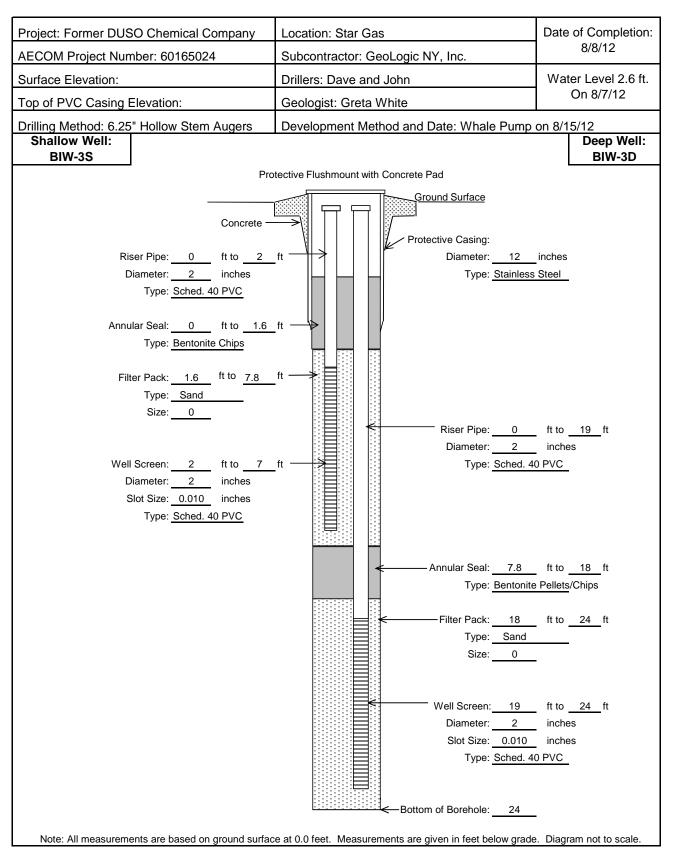




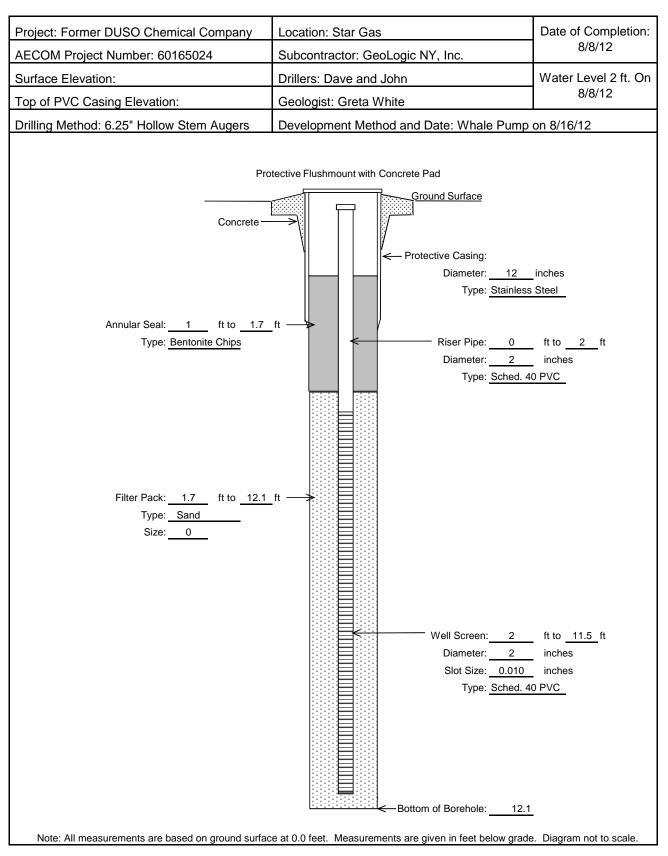




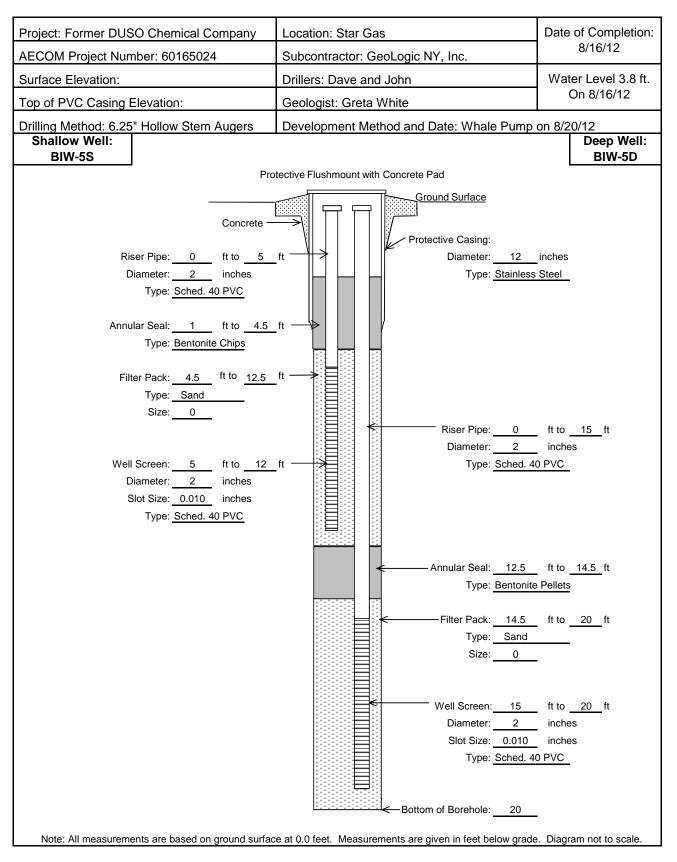




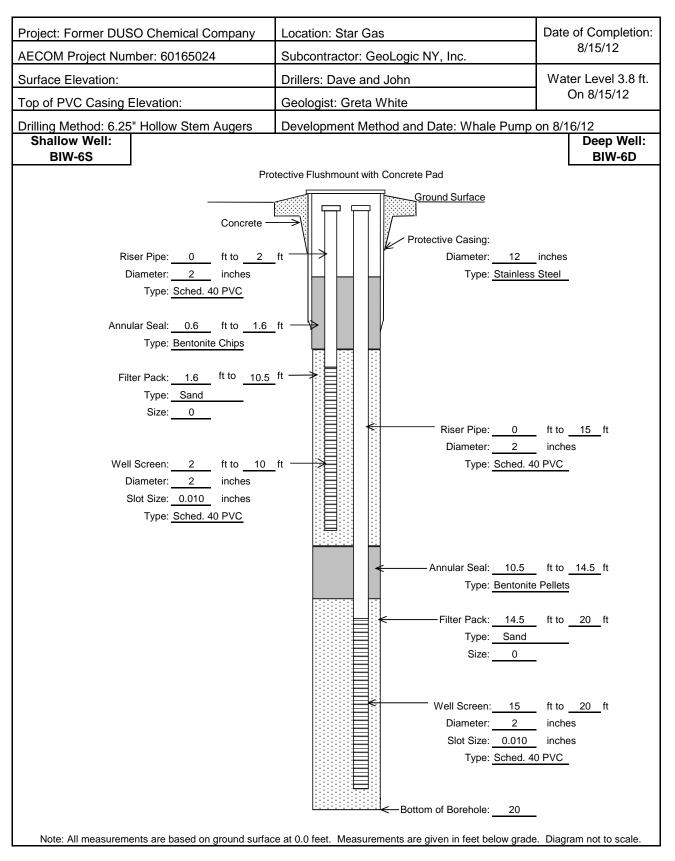




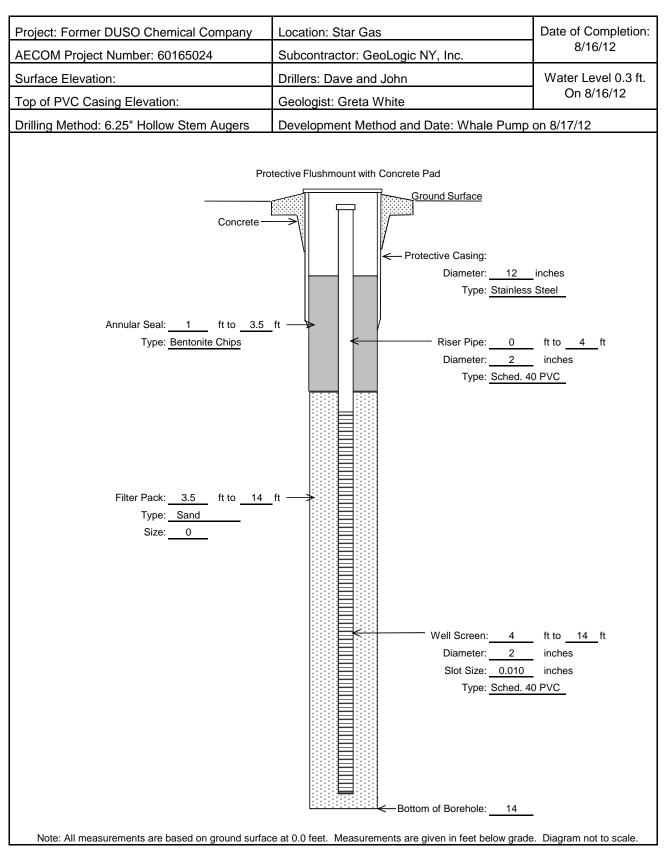












Monitoring Well Purging/Sampling Forms

Project Name and Number:		Former Dus	o Chemical C	Company	6027	9080.3		
Monitoring Well Number:		MHC-	23	Date:	11/21	6/12		
Samplers:		Mark Howar	rd and Sam F	Rowe				
Sample Number:		MHC-23	-112612	QA/Q0	C Collected?	no		
Purging / Sampling Method:		Peristaltic P	ump with De	dicated Tub	ing/Low-Flo	w		
 L = Total Well Depth: D = Riser Diameter (I.D.): W = Static Depth to Water (T 4. C = Column of Water in Casi 				11.60 0.17 4.11 7.49	feet feet feet feet	D (inches) 1-inch 2-inch 3-inch	D (feet) 0.08 0.17/ 0.25]
5. V = Volume of Water in Wel 6. D2 = Pump Setting Depth (ft 7. C2 = Column of water in Pur 8. Tubing Volume = C2(0.0057): np/Tubing (f		8)	10-40	_gal feet feet gal	4-inch 6-inch	0.33 0.50	
			1200 \$	V	stermine V g			
		D (inches) V (gal / ft)	1-inch 0.041	2-inch 0.163	3-inch 0.37	4-inch 0.65	6-inch	
Water Quality Readings Collect			YSI-556 an	d-LaMotte 2		-		
Parameter Time	Units 24 hr	13.48	12 53	13:58	Readings	14:08	114:13	14 19
Water Level (0.33)	feet	4.13	13 53	4.12	4.12	4.13	4.13	4.13
Volume Purged	gal	-	0-25	0.50	045	0.75	1.0	1.25
Flow Rate	mL/min	150	以 50	150 79	150	150	150	150
Turbidity (+/- 10%)	NTU	363	142	79	45.7	33.4	21.9	15.5
Dissolved Oxygen (+/- 10%)	%	150	10.6	7.3	6.5	6.9	6.2	5.50
Dissolved Oxygen (+/- 10%)	mg/L	1.35	1.12	0.75	0-42	6.9	0.45	051
Eh / ORP (+/- 10)	MeV	- 33.2	-8.7	-8.2	- 6-5	-5.4	-6.9	-2.0
Specific Conductivity	mS/cm ^c	0.473	0-467	0.465	0-464	0.465	0-465	0.46
Conductivity (+/- 3%)	mS/cm	0368	0.364	0-362	0360	0-359	0.360	0.35
pH (+/- 0.1)	pH unit	7.34	7-12	7.13	2.11	7.10	7.13 _	7-1
Temp (+/- 0.5)	С	1346	13 43	13.41	13.27	13.16	13.15	13:0
Color	Visual	Cloudy	Cloudy	Cloudy	Clouing	Chicy	(100107	Cleux
Odor	Olfactory	Phenotis Chic	Chlo	chio'	Chlo '	Chlo	Into	Chic
Comments: Start Pus Dans	AD B	48						
								29

	Мо	nitoring W	Vell Purgi	ng/Samplin	ig Form		
Project Name and Number:		Former Dus	o Chemical	Company	60279	9080.3	
Monitoring Well Number:		MHC-2	23	Date:	1/24/12		_
Samplers:		Mark Howa	rd and Sam	Rowe			
Sample Number:		MHC -2	3-112612	QA/QC	Collected?	NO	
Purging / Sampling Method:		Peristaltic P	ump with D	edicated Tubi	ng/Low-Flov	v	
 D = Riser Diameter (I.D.): W = Static Depth to Water (C = Column of Water in Cas V = Volume of Water in We D2 = Pump Setting Depth (f C2 = Column of water in Pu Tubing Volume = C2(0.0057) 	sing: II = C(3.1415 t): mp/Tubing (fi		8)	10-60	feet (feet (gal (feet (feet (gal (gal ())))	1-inch 2-inch 3-inch 4-inch 6-inch	0.08 0.17 0.25 0.33 0.50
		D (inches)	Conversior	factors to det	termine V gi 3-inch	ven C 4-inch	6-inch
		V (gal / ft)	0.041	0.163	0.37	0.65	1.5
Water Quality Readings Collec	ted Using		YSI-556 ar	nd LaMotte 20	20		
Parameter	Units				Readings		
Time	24 hr	14:23	14:28	14:33			
Water Level (0.33)	feet	4-13	4.13				1
	gal	1.5	i-loc	1.75			
	mL/min	150	150	150			1
Flow Rate		17.3	10.52	150 K.53 5.3			
Flow Rate Turbidity (+/- 10%)	NTU	EH		2. 7	the second second		
Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%)	NTU %	5-4	9.49	0.55			
Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%)	NTU % mg/L	5.4	0.49	0.55		1. <u>-</u> 1.	
Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10)	NTU % mg/L MeV	5-4 0-57 -4-3	0.49	-8.7	×		
Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10) Specific Conductivity	NTU % mg/L MeV mS/cm ^c	5.4 0.57 - 4.3 0.465	0.49	0.55 -2.7 0.465			
Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10) Specific Conductivity Conductivity (+/- 3%)	NTU % mg/L MeV mS/cm ^c mS/cm	5.4 0.57 - 4.3 C.465 0-357	0.49 -4.9 0.465	0.55 - 8.7 0.465 0.357			
Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10) Specific Conductivity Conductivity (+/- 3%) pH (+/- 0.1)	NTU % mg/L MeV mS/cm ^c mS/cm pH unit	5-4 0.57 -4.3 C.465 O-357 7-01	0.49 -4.9 0.465 0.357 7.02	0.55 - 2.7 0.465 0.357 7.06			
Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10) Specific Conductivity Conductivity (+/- 3%) pH (+/- 0.1) Temp (+/- 0.5)	NTU % mg/L MeV mS/cm ^c mS/cm pH unit C	5.7 0.57 -4.3 C.465 0.357 7.01 12.82	0.49 -4.9 0.45 0.357 7.02 12.88	0.55 - 2.7 0.465 0.357 7.06			
Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10) Specific Conductivity Conductivity (+/- 3%) pH (+/- 0.1) Temp (+/- 0.5) Color Odor	NTU % mg/L MeV mS/cm ^c mS/cm pH unit	5.7 -4.3 C.465 O.357 7.01 12.82 Clouds	0.49 -4.9 0.465 0.357 7.02	0.55 - 8.7 0.465 0.357 7.66			

	Former Dust MHC - 2 Mark Dec Mark Howar MHC - 2	255 rd and Sam I	Company Date:	1 9	9080.3		
	Mark Dec Mark Howard	rd and Sam I	Date:	11/20	1.0		
	Mark Howa	rd'and Sam I		-11/2-02	112		
	MHC-2		Rowe				
		551129	2 QA/QO	C Collected?	NO		
	Peristaltic P	ump with De	edicated Tub	ing/Low-Flo	w		
			13.19	feet	D (inches)	D (feet)	1
			0.17	feet	1-inch	0.08	
OC):			2.43	feet	2-inch	0.17	
ng:				feet	3-inch_	0.25	
	$(0.5D)^{2}(7.4)$	8)	-	gal	4-inch	0.33	
	Manage Maria		12.19	feet	100000000000000000000000000000000000000	10.105	
)·		- A A A A	-			
	<i>P</i> .			-			
				- ⁵⁴¹			
		Conversion	factors to de	etermine V gi	iven C		
	D (inches)	1-inch	2-inch	3-inch	4-inch	6-inch	1
	V (gal / ft)	0.041	0.163	0.37	0.65	1.5	
	And the second se		/				
ed Using		YSI-556 an	d LaMotte 2	020			
ed Using		YSI-556 an	d LaMotte 2	020	-		
ed Using Units		YSI-556 an		Readings			
	9:04	9:09	9:14	Readings	9:24	9:29	9:30
Units		7.09	9:14	Readings 9:19 3:4 c	3.40	340	9.3
Units 24 hr	9:04 3.03	7.09 3.40 0.25	9:14 3.40	Readings 9:19 3:4:0 C-loC	3.40		
Units 24 hr feet	3.03	9.09 3.40 0.25 80	9:14 3:40 0:50 80	Readings 9:19 3:4:0 0:60 8:0	3.40	3 40 1.0 Ko	3.4
Units 24 hr feet gal	3.03	9.29 3.40 0.25 80 423	9:14 3:40 0:50 20 316	Readings 9:19 3.40 0:60 200 200	3.40 0.80 80 232	340	3.4
Units 24 hr feet gal mL / min	3.03	9.29 3.40 0.25 80 423	9:14 3:40 0:50 20 316	Readings 9:19 3.4.0 6:60 270 10.9	3.40	340	2-200- W
Units 24 hr feet gal mL / min NTU	3.03	7.09 3.40 0.25 80 423 15.0 1.62	9:14 3:40 0:50 3:6 11:0 1.27	Readings 9:19 3.40 0:60 200 200	3.40 0.80 23.2 9.7	340	N - 201 x
Units 24 hr feet gal mL / min NTU %	7.03 1200 34.9 37.8 57.5	7.09 3.40 0.25 80 423 15.0 1.62	9:14 3:40 0:50 3:6 11:0 1.27	Readings 9:19 3:40 0:60 2:70 10:9 1:18 7:8	3.4C C.80 232 9.7 1.05 3.1	3 (0 1.0 207 2.7 2.93	2-200- W
Units 24 hr feet gal mL / min NTU % mg/L MeV	7.03 1200 34.9 37.8 57.5	7.29 3.40 0.25 80 423 15.02 1.62 29.1	9:14 3.40 0:50 316 11:0 1.27 13.7	Readings 9:19 3:40 0:60 2:70 10:9 1:18 7:8	3.40 0.80 23.2 9.7	3.40 1.0 207 2.3 1.8	3-200 x D
Units 24 hr feet gal mL / min NTU % mg/L MeV mS/cm ^c	3.03 1200 34.9 87.5 87.5 1.166	9.29 3.40 0.25 80 423 15.02 29.1 1.184	9:14 3.40 0.50 316 11.0 1.27 13.7 1.196 0.896	Readings 9:19 3.40 0:60 270 109 1.18 7.8 1.197	3.40 C.80 80 232 9.7 1.05 3.1 1.97	3 (0 1.0 207 207 1.9 2 1.9 2 1.9 2 1.9 2	M-2007 P 2009 -
Units 24 hr feet gal mL / min NTU % mg/L MeV mS/cm ^c mS/cm	7.03 1200 34.9 37.8 57.5	7.29 3.40 0.25 80 423 15.02 1.62 29.1	9:14 3.40 0.50 316 11.0 1.27 13.7 1.196 0.896	Readings 9:19 3.40 0:60 270 10.9 1.18 7.8 1.197 0.292	3.40 0.80 232 9.7 1.05 3.197 0.896	3 (0 1.0 207 2.7 1.9 1.198 0.898	1 - 0 - 0 - 0 - 0 - 0 - 0 - 0 - 0 - 0 - 0
Units 24 hr feet gal mL / min NTU % mg/L MeV mS/cm ^c mS/cm pH unit	3.03 1200 34.9 87.5 87.5 87.5 1.166	9.29 3.40 0.25 80 423 15.0 1.62 29.1 1.184 0.884 7.21	9:14 3:40 0:50 20 316 11:0 13:7 1.196 0.896 7:40	Readings 9:19 3.40 0:60 270 10.9 1.18 7.8 1.197 0.292 7.45	3.40 0.80 232 9.7 1.05 3.1 1.05 3.1 1.05 3.1 1.05 3.1 1.05 3.1 1.05 3.1 1.05 3.1 1.05 3.1 1.05 3.1 1.05 3.1 7.48	3.40 1.0 207 2.93 1.92 1.198 0.898 7.46	3 - 80 × P 20 20 1 - 1 85 - 1
Units 24 hr feet gal mL / min NTU % mg/L MeV mS/cm ^c mS/cm	3.03 1200 34.9 87.5 87.5 87.5 1.166	9.29 3.40 0.25 80 423 15.02 29.1 1.184	9:14 3.40 0.50 316 11.0 1.27 13.7 1.196 0.896	Readings 9:19 3.40 0:60 270 10.9 1.18 7.8 1.197 0.292	3.40 0.80 232 9.7 1.05 3.197 0.896	3 (0 1.0 207 2.7 1.9 1.198 0.898	1 - 0 - 0 - 0 - 0 - 0 - 0 - 0 - 0 - 0 - 0
	ng: = C(3.1415 :	ng: = C(3.14159)(0.5D) ² (7.4 : pp/Tubing (ft): 37088) D (inches)	ng: = C(3.14159)(0.5D) ² (7.48) : pr/Tubing (ft): 37088) Conversion D (inches) 1-inch	ng: = $C(3.14159)(0.5D)^2(7.48)$: p/Tubing (ft): 37088) Conversion factors to de D (inches) 1-inch / 2-inch	ng: = $C(3.14159)(0.5D)^2(7.48)$: mp/Tubing (ft): 37088) Conversion factors to determine V gi D (inches) 1-inch / 2-inch 3-inch	$\begin{array}{c c} & & & & & & & & & & & & & & & & & & &$	$\begin{array}{c cccc} & & & & & & & & & & & & & & & & & $

Project Name and Number: Monitoring Well Number: Samplers: Sample Number: Purging / Sampling Method: 1. L = Total Well Depth:		MHC-	co Chemical	Company			
Samplers: Sample Number: Purging / Sampling Method:			255		6027	9080.3	
Sample Number: Purging / Sampling Method:		Mark Howa	-01	Date:	11/20	2/12	
Purging / Sampling Method:			rd and Sam	Rowe			
		MAC-2	55112912	QA/Q	C Collected?	NO	_
1. L = Total Well Depth:		Peristaltic P	ump with De	edicated Tub	ing/Low-Flo	w	
r. D Total men Deptil.					feet	D (inches)	D (feet)
2. D = Riser Diameter (I.D.):					feet	1-inch	0.08
3. $W = $ Static Depth to Water (7)	TOCY				feet	2-inch	0.08
4. $C = Column of Water in Cas$				-	-	2-inch 3-inch	0.17
			(0)		_feet		
5. $V = Volume of Water in Well$		9)(0.5D) ⁻ (7.4	-8)		_gal	4-inch	0.33
6. $D2 = Pump$ Setting Depth (ft					feet	6-inch	0.50
7. $C2 = Column of water in Pur$):		100 100	feet		
8. Tubing Volume = $C2(0.0057)$	/37088)				_gal		
		D (inches) V (gal / ft)	1-inch 0.041	2-inch 0.163	3-inch 0.37	4-inch 0.65	6-inch 1.5
Water Quality Readings Collec			0.041	and the second se	0.37	and the second	and the second sec
Water Quality Readings Collec Parameter	Units	V (gal / ft)	0.041 YSI-556 an	0.163 nd LaMotte 2	0.37 020 Readings	and the second	and the second sec
Parameter Time	Units 24 hr	V (gal / ft)	0.041 YSI-556 an	0.163 nd LaMotte 2	0.37 020 Readings	and the second	and the second sec
Parameter Time Water Level (0.33)	Units 24 hr feet	V (gal / ft) ९:३१ ३.५०	0.041 YSI-556 an	0.163 ad LaMotte 2 9:49 3.40	0.37 020 Readings 9:34 3 4 0	and the second	and the second sec
Parameter Time Water Level (0.33) Volume Purged	Units 24 hr feet gal	V (gal / ft) 9:39 3.40 1.40	0.041 YSI-556 an	0.163 nd LaMotte 2 9:49 3.40 1.75	0.37 020 Readings 9:34 3.40 1.90	and the second	and the second sec
Parameter Time Water Level (0.33) Volume Purged Flow Rate	Units 24 hr feet gal mL / min	V (gal / ft) 9:39 3.40 1.40 20	0.041 YSI-556 an	0.163 nd LaMotte 2 9:49 3:40 1.75 80	0.37 020 Readings 9:34 3.40 1.90	and the second	and the second sec
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%)	Units 24 hr feet gal mL / min NTU	V (gal / ft) 9:39 3.40 1.40 20 1.42	0.041 YSI-556 an	0.163 nd LaMotte 2 9:49 3.40 1.75 80 89.4	0.37 020 Readings 9:34 3:40 1.90 2:0 7:3.7	and the second	and the second sec
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%)	Units 24 hr feet gal mL / min NTU %	V (gal / ft) 9:39 3:40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40	0.041 YSI-556 an 9.44 3.40 1.60 80 1.15 6.9	0.163 nd LaMotte 2 9-49 3.40 1.75 80 89.4	0.37 020 Readings 9:34 3.40 1.90 8.0 7.3.7 5.7	and the second	and the second sec
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%)	Units 24 hr feet gal mL / min NTU % mg/L	V (gal / ft) 9:39 3.40 1.40 20 1.40 20 1.43 7.6 0.82	0.041 YSI-556 an 9.44 3.40 1.60 80 1.5 6.9	0.163 nd LaMotte 2 9:49 3:40 1.75 80 89:4 6:5 0:71	0.37 020 Readings 9:34 3:40 1:90 8:0 7:3.7 5.7 2-62	and the second	and the second sec
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10)	Units 24 hr feet gal mL / min NTU % mg/L MeV	V (gal / ft) 3:39 3:40 1.40 1.40 1.40 1.40 1.43 7.6 0:82 -6.3	0.041 YSI-556 an 9 . 44 3 . 46 1. 60 80 115 6.9 0.74 . 5, 9	0.163 10 LaMotte 2 175 20 29.4 29.4 29.4 29.4 29.4 2.5 0.71 -7.9	0.37 Readings 9:34 3:40 1:90 2:0 7:3.7 5.7 2.62 - 10.2	and the second	and the second sec
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10) Specific Conductivity	Units 24 hr feet gal mL / min NTU % mg/L MeV mS/cm ^c	V (gal / ft) 3:37 3:40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.	0.041 YSI-556 an 9.44 3.40 1.40 80 1.5 1.5 6.9 0.74 -5,9 1.201	0.163 nd LaMotte 2 9:49 3.40 1.75 80 89.4 6.5 0.71 -7.9 1.201	0.37 Readings 9:34 3:40 1:90 2:0 7:3.7 5.7 2.62 -10.2 1.201	and the second	and the second sec
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10) Specific Conductivity Conductivity (+/- 3%)	Units 24 hr feet gal mL / min NTU % mg/L MeV mS/cm ^c mS/cm	V (gal / ft) 9:39 3:40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 0.57 1.40 1.40 0.57 1.40 0.57 1.40 0.57 1.40 0.57 1.40 0.57 1.40 0.57 1.40 0.57 1.40 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57 0.57	0.041 YSI-556 am 9.44 3.40 1.40 80 1.5 6.9 0.74 -5,9 1.201 0.896	0.163 nd LaMotte 2 9:49 3.40 1.75 80 89.4 6.5 0.71 -7.9 1.201	0.37 Readings 9:34 3:40 1:90 2:0 7:3.7 5.7 2:62 -10.2 1:201 0:891	and the second	and the second sec
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10) Specific Conductivity Conductivity (+/- 3%) pH (+/- 0.1)	Units 24 hr feet gal mL / min NTU % mg/L MeV mS/cm ^c mS/cm pH unit	V (gal / ft) 9:39 3.40 1.40 1.40 200 1.40 200 1.40 200 1.40 200 1.40 200 1.40 200 1.40 200 1.40 200 1.40 200 1.40 200 1.40 200 1.40 200 1.40 200 1.40 200 1.40 200 1.40 200 1.40 200 1.40 200 1.40 200 1.40 200 1.40 200 1.40 200 1.40 200 1.40 200 1.40 200 1.40 200 1.40 200 1.40 200 1.40 200 1.40 200 1.40 200 1.40 200 1.40 200 1.40 200 1.40 200 1.40 200 1.40 200 1.40 200 1.40 200 1.40 200 1.40 200 1.40 200 1.40 200 1.40 200 1.40 200 1.40 200 1.40 200 1.40 200 1.40 200 1.40 200 1.40 200 1.40 200 1.40 1.40 1.40 2.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40	0.041 YSI-556 am 9.44 3.40 1.40 80 1.40 80 1.40 80 1.5 6.9 0.74 -5,9 1.201 0.696 7.44	0.163 nd LaMotte 2 9:49 3.40 1.75 80 89.4 6.5 0.71 -7.9 1.201 0.893 7.43	0.37 Readings 9:34 3:40 1:90 2:0 7:3.7 5.7 0.62 -10.2 1.201 0.891 7:42	and the second	and the second sec
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10) Specific Conductivity Conductivity (+/- 3%) pH (+/- 0.1) Temp (+/- 0.5)	Units 24 hr feet gal mL / min NTU % mg/L MeV mS/cm ^c mS/cm pH unit C	V (gal / ft) 9:39 3:40 1.40 1.40 20 1.40 20 1.40 20 1.40 20 1.40 20 1.40 20 1.40 20 1.40 20 1.40 20 1.40 20 1.40 20 1.40 20 1.40 20 1.40 20 1.40 20 1.40 20 1.40 20 1.40 20 1.40 20 1.40 20 1.40 20 1.40 20 1.40 20 1.40 20 1.40 20 1.40 20 1.40 20 1.40 20 1.40 20 1.40 20 1.40 20 1.40 20 1.40 20 1.40 20 1.40 20 1.40 20 1.40 20 1.40 20 1.40 20 1.40 20 1.40 20 1.40 20 1.40 20 1.40 20 1.40 20 1.40 20 1.40 20 1.40 20 1.40 20 1.40 20 1.40 1.40 20 1.40 1.40 1.40 2.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40	0.041 YSI-556 am YSI-556 am 9 . 44 3 . 40 1.60 80 1.5 6.9 0.74 .5,9 1.201 0.696 7.44 11.69	0.163 nd LaMotte 2 9:49 3.4C 1.75 80 89.4 6.5 0.71 -7.9 1.2C1 0.893 7.43 11.5 9	0.37 Readings 9:34 3:40 1.90 2:57 0:62 -10.2 1.201 0.891 7:42 11.50	and the second	and the second sec
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10) Specific Conductivity Conductivity (+/- 3%) pH (+/- 0.1)	Units 24 hr feet gal mL / min NTU % mg/L MeV mS/cm ^c mS/cm pH unit	V (gal / ft) 9:39 3.40 1.40 1.40 200 1.40 200 1.40 200 1.40 200 1.40 200 1.40 200 1.40 200 1.40 200 1.40 200 1.40 200 1.40 200 1.40 200 1.40 200 1.40 200 1.40 200 1.40 200 1.40 200 1.40 200 1.40 200 1.40 200 1.40 200 1.40 200 1.40 200 1.40 200 1.40 200 1.40 200 1.40 200 1.40 200 1.40 200 1.40 200 1.40 200 1.40 200 1.40 200 1.40 200 1.40 200 1.40 200 1.40 200 1.40 200 1.40 200 1.40 200 1.40 200 1.40 200 1.40 200 1.40 200 1.40 200 1.40 200 1.40 200 1.40 200 1.40 200 1.40 200 1.40 200 1.40 200 1.40 1.40 1.40 2.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40 1.40	0.041 YSI-556 am 9.44 3.40 1.40 80 1.40 80 1.40 80 1.5 6.9 0.74 -5,9 1.201 0.696 7.44	0.163 nd LaMotte 2 9:49 3.40 1.75 80 89.4 6.5 0.71 -7.9 1.201 0.893 7.43	0.37 Readings 9:34 3:40 1:90 2:0 7:3.7 5.7 0.62 -10.2 1.201 0.891 7:42	and the second	and the second sec

	Moi	nitoring W	ell Purgi	ng/Samplin	ng Form			
Project Name and Number:		Former Dus	o Chemical (Company	6027	9080.3		
Monitoring Well Number:		MHBP	- 26	Date:	12/	11/12		
Samplers:		Mark Howa	rd and Sam I	Rowe				
Sample Number:	ſ	MHBP-2	6121112	QA/QC	Collected?	<u>no</u>		
Purging / Sampling Method:		Peristaltic P	ump with De	edicated Tubi	ng/Low-Flo	W/		
 L = Total Well Depth: D = Riser Diameter (I.D.): W = Static Depth to Water (TG 4. C = Column of Water in Casir V = Volume of Water in Well D2 = Pump Setting Depth (ft): C2 = Column of water in Pum Tubing Volume = C2(0.00573) 	ng: = C(3.14159 p/Tubing (ft		8)	12.01	feet feet feet gal feet feet gal	D (inches) 1-inch 2-inch 3-inch 4-inch 6-inch	D (feet) 0.08 0.17 0.25 0.33 0.50	
		D (inches) V (gal / ft)	Conversion	factors to de 2-inch 0.163	termine V gi	iven C <u>4-inch</u> 0.65	6-inch 1.5	
Water Quality Readings Collecte	ed Using	v (gal / It)	1	d LaMotte 20	<u> </u>		1.5	1
Parameter	Units				Readings			
Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10) Specific Conductivity Conductivity (+/- 3%) pH (+/- 0.1) Temp (+/- 0.5) Color Odor Comments: Start	feet gal mL / min NTU % mg/L MeV mS/cm ^c mS/cm ^c mS/cm ^c pH unit C Visual Olfactory	13-33 	13-38 -1.94 25 100 110 4.1 0.13 -76-6 0.910 0.95 7.75 12.63 Cloudy Chilo	13:43 4.94 0.40 100 90 3.3 0.35 -102.1 2.92 12.42 Clendor Chile	4.94 6.60 100 63 2.6 0.27 -107.4 0.916 6.646 7.70 12.41 Clored Chile	12:53 4.94 0.20 100 45 2.7 0.24 -109.8 0.914 0.094 7.67 1.2.37 Clea- Chic	13:5° 4.94 1.0 35 2.1 0,22 -110.0 0.913 0.61 12.33 C(20- Chic	14:03 4:94 1.20 100 26 2.3 0.22 -109.0 0.91C 0.91C 0.91C 0.087 7.60 12.33 Clear Chio
* Three consecutive readings wit	hin range inc	licates stabili	zation of the	t parameter.				

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	Mo	nitoring W	ell Purgin	g/Samplin	g Form			
Project Name and Number:		Former Dus	o Chemical C	ompany	60279	9080.3		
Monitoring Well Number:		MHOP-	26	Date:	12	/11/12		
Samplers:		Mark Howa	rd and Sam R	owe				
Sample Number:	ſ	HBP-2	612/112	QA/QC	Collected?	<u> </u>	***	
Purging / Sampling Method:		Peristaltic P	ump with Dec	licated Tubi	ng/Low-Flow	N	<u></u>	
 L = Total Well Depth: D = Riser Diameter (I.D.): W = Static Depth to Water (TC C = Column of Water in Casin V = Volume of Water in Well D2 = Pump Setting Depth (ft): C2 = Column of water in Pum Tubing Volume = C2(0.00573) 	ng: = C(3.14159 p/Tubing (ft		· · · · · · · · · · · · · · · · · · ·		feet feet feet gal feet gal	D (inches) 1-inch 2-inch 3-inch 4-inch 6-inch	D (feet) 0.08 0.17 0.25 0.33 0.50	
			Conversion	factors to de	ermine V gi	ven C		
		D (inches) V (gal / ft)	1-inch 0.041	2-inch 0.163	3-inch 0.37	<u>4-inch</u> 0.65	6-inch 1.5	
Water Quality Readings Collecte	ed Using		YSI-556 and	LaMotte 20	20	-		
Parameter	Units				Readings			
Time	24 hr	14:08	14:13					
Water Level (0.33)	feet	4,94	4.94					
Volume Purged	gal	1.40	1.60					
Flow Rate	mL/min	100	100					
Turbidity (+/- 10%)	NTU	21	16					
Dissolved Oxygen (+/- 10%)	%	2.0	1.9					
Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10)	mg/L	0.21	0.20		·			
	MeV	• • • • • • • • • • • • • • • • • • •	-101.4					
Specific Conductivity	mS/cm ^c	0.904	0.898					
Conductivity (+/- 3%) pH (+/- 0.1)	mS/cm	0.086 7.58	2-620 7-56					
Temp $(+/- 0.5)$	pH unit C	12-36	1232					
Color	Visual	Clein	Cer					
Odor	Olfactory	chio	CINIC					
Comments: Samy * Three consecutive readings wit		@(`	4:13	narameter				

Monitoring Well Number: Samplers: Sample Number: Purging / Sampling Method:		BIVI-1 Mark Howa	5		002	79080.3		
Sample Number:		Mark How	1	Date	11/2	1/12		
1		mark 110Wa	and Sam	Rowe		/		
Purging / Sampling Method:		BIW-1	5112712	QA/Q	C Collected?	No		
		Peristaltic F	ump with D	edicated Tul	oing/Low-Flo	w		
 L = Total Well Depth: D = Riser Diameter (I.D.): W = Static Depth to Water (T C = Column of Water in Casi V = Volume of Water in Wel D2 = Pump Setting Depth (ft) C2 = Column of water in Pun Tubing Volume = C2(0.0057) 	ing: 1 = C(3.1415): np/Tubing (fi		8)	15.70 0.17 3.76 14.70	feet feet feet gal feet feet gal	D (inches) 1-inch 2-inch 3-inch 4-inch 6-inch	D (feet) 0.08 0.17 0.25 0.33 0.50	
			Conversion	factors to d	etermine V g	iven C		
		D (inches) V (gal / ft)	1-inch 0.041	/ 2-inch 0.163	3-inch 0.37	4-inch 0.65	6-inch 1.5	
Parameter	Units				Readings			
Time	24 hr	10:23	10:28	10 33	10.35	10:43	10:48	10:53
Water Level (0.33)	feet	3,89	384	3.84	3.84	3.8-1	3.84	3.84
Volume Purged	gal		0.25	0.4	0.5	0.75	@1.C	1.25
Flow Rate	mL/min	200	200	200	200	200	200	200
Furbidity (+/- 10%) Dissolved Oxygen (+/- 10%)	NTU %	999.9	600	600	60	600	600	568
	and the second se	238 17	36.0	26	25.2	24.5	23,0	
	mg/L		3.84	2.81	2.72	262	2.48	1.87
	May		21.0		23.3	29.5	24.6	21.0
Eh / ORP (+/- 10)	MeV	18.0	anal					
Eh / ORP (+/- 10) Specific Conductivity	mS/cm ^c	0.728	0.726	0.727	827.0	0.728	0.718	0.729
Eh / ORP (+/- 10) Specific Conductivity Conductivity (+/- 3%)	mS/cm ^c mS/cm	0.728	0.539	C.544	0.545	0.544	0.544	0.542
Eh / ORP (+/- 10) Specific Conductivity Conductivity (+/- 3%) bH (+/- 0.1)	mS/cm ^c mS/cm pH unit	0.728	0.5)9	C.544	2.50	0.544	7.46	0.542
Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10) Specific Conductivity Conductivity (+/- 3%) bH (+/- 0.1) Temp (+/- 0.5) Color	mS/cm ^c mS/cm	0.728	0.539		0.545	0.544	0.544	0.542
Eh / ORP (+/- 10) pecific Conductivity Conductivity (+/- 3%)	mS/cm ^c mS/cm	0.728	0.539	C.544	0.545	0.544	0.544	0.542

Project Name and Number:		Former Dus	o Chemical	Company	6027	9080.3	
Monitoring Well Number:		BIW-1	5	_ Date:	11/2	-11-2	
Samplers:		Mark Howa	rd and Sam	Rowe			
		OTHER	112017	10 200	Sec	16	
Sample Number:		BTM-13	5112712	QA/Q	C Collected?	16	
Purging / Sampling Method:		Peristaltic F	ump with De	edicated Tub	oing/Low-Flov	w	
 L = Total Well Depth: D = Riser Diameter (I.D.): W = Static Depth to Water (' C = Column of Water in Cas 	sing:				feet feet feet feet	D (inches) 1-inch 2-inch 3-inch	D (feet) 0.08 0.17 0.25
5. $V = Volume of Water in We$		9)(0.5D) ² (7.4	8)	-	_gal	4-inch	0.33
6. $D2 = Pump$ Setting Depth (f				1	feet	6-inch	0.50
7. C2 = Column of water in Pu 8. Tubing Volume = C2(0.0057		:):			_feet		
3.140 mg volume = 0.2(0.005)	(3/086)				_gal		
			Conversion	factors to de	etermine V gi	iven C	
		D (inches)	1-inch	2-inch	3-inch	4-inch	6-inch
		V (gal / ft)	0.041	0.163	0.37	0.65	1.5
Water Quality Readings Collec	ted Using		YSI-556 an	d LaMotte 2	020		
Parameter	Units			d LaMotte 2	Readings	-	
Parameter Time	Units 24 hr	10:52	11:03	d LaMotte 2	Readings	-	
Parameter Time Water Level (0.33)	Units 24 hr feet	10:58 3.24	11:03	d LaMotte 2	Readings	-	
Parameter Time Water Level (0.33) Volume Purged	Units 24 hr feet gal	10:52 3.24 1.5	11:03	d LaMotte 2	Readings (11-13 9-8-4 2-25		
Parameter Fime Water Level (0.33) Volume Purged Flow Rate	Units 24 hr feet gal mL / min	10:58 3,84 1.5 200	11:03 3-24 1-75 200	d LaMotte 2	Readings		
Parameter Fime Water Level (0.33) Volume Purged Flow Rate Furbidity (+/- 10%)	Units 24 hr feet gal mL / min NTU	10:58 3.24 1.5 200 200	11:03 3:24 1.75 200 73.6	d LaMotte 2 11:08 3:24 2:0 2:0 2:0 45:6	Readings (1-13 9-25 203		
Parameter Time Water Level (0.33) Volume Purged Flow Rate Furbidity (+/- 10%) Dissolved Oxygen (+/- 10%)	Units 24 hr feet gal mL / min NTU %	10:52 3.24 1.5 200 14.0	11:03 3-24 1-75 200	d LaMotte 2 11:08 3:24 2:0 2:0 2:0 45:6	Readings (1-13 9.24 2-25 203 11.1		
Parameter Time Water Level (0.33) Volume Purged Flow Rate Furbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%)	Units 24 hr feet gal mL / min NTU % mg/L	10:52 3.24 1.5 200 14.0 1.51	11:03 3:24 1.75 200 73.6	d LaMotte 2 11:08 3:24 2:0 2:0 2:0 45:6 11.2 1.30	Readings (1-13 9-25 203		
Parameter Time Water Level (0.33) Volume Purged Flow Rate Furbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10)	Units 24 hr feet gal mL / min NTU % mg/L MeV	10:52 3:24 1.5 200 14.0 1.51 100 0	11:03 3.24 1.75 200 73.6 12:1 1.52	d LaMotte 2 11:08 3:24 2:0 2:0 2:0 10:0 45:6 11:2 1:30 17:5	Readings (1-13 9.24 2-25 203 11.1		
Parameter Time Water Level (0.33) Volume Purged Flow Rate Furbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10) Specific Conductivity	Units 24 hr feet gal mL / min NTU % mg/L MeV mS/cm ^c	10:52 3.24 1.5 200 200 14.0 1.51 10 0 730	11:03 3.24 1.75 200 73.0 12:1 1.52 1.52 1.52 1.52	d LaMotte 2 11:08 3:24 2:0 2:0 2:0 2:0 12:0 15:0 17:5 0:728	Readings (1-73 9.24 2.25 203 [1.1 1-28 (3-1) 0.55 0.55 0.55 0.55 0.55 0.55		
Parameter Time Water Level (0.33) Volume Purged Flow Rate Furbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10) Specific Conductivity Conductivity (+/- 3%)	Units 24 hr feet gal mL / min NTU % mg/L MeV mS/cm ^c mS/cm	10:52 3:24 1.5 200 14.0 1.51 100 0	11:03 3.84 1.75 200 73.6 13:1 1.52 1:52 1:52 0.540	d LaMotte 2 11:08 3:24 2:0 2:0 2:0 2:0 12:0 12:0 17:5 0:720 0:720 0:530	Readings (1-73 9.24 2.25 203 [1.1 1-28 (3-1) 0.55 0.55 0.55 0.55 0.55 0.55		
Parameter Time Water Level (0.33) Volume Purged Flow Rate Furbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10) Specific Conductivity Conductivity (+/- 3%) DH (+/- 0.1)	Units 24 hr feet gal mL / min NTU % mg/L MeV mS/cm ^c mS/cm pH unit	10:52 3.24 1.5 200 200 14.0 1.51 10 0 730	11:03 3.24 1.75 200 73.6 13:1 1.52 1:52 1:52 1:52 0.540 7.40	d LaMotte 2 11:08 3.24 2.0 2.0 45.6 11.2 17.5 0.720 0.720 0.539	Readings (1-13 9.24 2.25 20 11.1 1.28 1.1 1.28 0.539 7.39		
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10) Specific Conductivity Conductivity (+/- 3%) DH (+/- 0.1) Temp (+/- 0.5)	Units 24 hr feet gal mL / min NTU % mg/L MeV mS/cm ^c mS/cm pH unit C	10:52 3.24 1.5 200 14.0 1.51 100 0.542 7.43 1.52	11:03 3.24 1.75 200 73.6 12:1 1.52 17:0 0.540 7.40 11:38	d LaMotte 2 11:08 3.24 2.0 2.0 45.6 11:2 17:5 0.726 0.39 11:36	Readings (1-13 9.24 2-25 20 11.1 1-28 0-539 7-39 11.37		
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10) Specific Conductivity Conductivity (+/- 3%) DH (+/- 0.1) Temp (+/- 0.5) Color	Units 24 hr feet gal mL / min NTU % mg/L MeV mS/cm ^c mS/cm pH unît C Visual	10:52 3.24 1.5 200 14.0 1.51 10:0 0.542 7.43 1:52 7.43 1:52 1:52 1:52	11:03 3.24 1.75 200 73.6 12:1 1.32 17:6 0.540 7.40 11:38 (Joney	d LaMotte 2 11:08 3.24 2.0 2.0 45.6 11:2 17:5 0.728 0.39 11:34 (120)	Readings (1-13 9.24 2.25 20 11.1 1.28 0.539 7.39 11.37 (1ey		
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10) Specific Conductivity Conductivity (+/- 3%) oH (+/- 0.1) Femp (+/- 0.5) Color Ddor	Units 24 hr feet gal mL / min NTU % mg/L MeV mS/cm ^c mS/cm pH unit C Visual Olfactory	10:52 3.24 1.5 200 14.0 1.51 10.0 0.542 7.43 1.542 7.43 1.542 7.43 1.542 7.43	11:03 3:24 1.75 200 73.6 12:1 1.52 1:52 1:52 0:540 7.40 11:38 Cloudy Cho	d LaMotte 2 11:08 3.24 2.0 2.0 45.6 11:2 17:5 0.726 0.39 11:36	Readings (1-13 9.24 2-25 20 11.1 1-28 0-539 7-39 11.37		
Water Quality Readings Collec Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10) Specific Conductivity Conductivity (+/- 3%) DH (+/- 0.1) Temp (+/- 0.5) Color Odor Comments: Suger (0)	Units 24 hr feet gal mL / min NTU % mg/L MeV mS/cm ^c mS/cm pH unit C Visual Olfactory	10:52 3.24 1.5 200 14.0 1.51 10.0 0.542 7.43 1.542 7.43 1.542 7.43 1.542 7.43	11:03 3:24 1.75 200 73.6 12:1 1.52 1:52 1:52 0:540 7.40 11:38 Cloudy Cho	d LaMotte 2 11:08 3.24 2.0 2.0 45.6 11:2 17:5 0.728 0.39 11:34 (120)	Readings (1-13 9.24 2.25 20 11.1 1.28 0.539 7.39 11.37 (1ey		

		onitoring V	Vell Purgi	ing/Sampl	ing Form			
Project Name and Number:		Former Du	so Chemical			79080.3		
Monitoring Well Number:		BFW-1	D weathold	Date	11/27/	12		
Samplers:		Mark Howa	ard and Sam	Rowe				
Sample Number:		BFW-1	2112712	QA/Q	C Collected?	NO		
Purging / Sampling Method:		Peristaltic I	ump with D	edicated Tul	bing/Low-Flo	ow		
L L - Tatal Well David				nre	1			-
1. $L = Total Well Depth:$				02.20	feet	D (inches)		-
2. $D = Riser Diameter (I.D.)$:	TOC			0.17	feet	1-inch	0.08	
 W = Static Depth to Water (' C = Column of Water in Cas 				3.26		2-inch	0.17	2
		0.00		-	feet	3-inch	0.25	
5. $V = V$ olume of Water in We		9)(0.5D) ⁻ (7.4	18)	- 11-1	_gal	4-inch	0.33	1
6. $D2 = Pump$ Setting Depth (f				24.51	_feet	6-inch	0.50	1
7. $C2 = Column of water in Put8. Tubing Volume = C2(0.0057)$		():		-	feet			
c. rubing volume = C2(0,005)	13/088)			-	_gal			
			Conversion	factors to d	etermine V g	iven C		
			Conversion	actors to d	cicinnile v g	iven C		
		D (inches)	1-inch	2-inch	3-inch	4-inch	6-inch	1
		V (gal / ft)	0.041 /	0.163	0.37	0.65	1.5	-
		(0.4., 1.)	1 11011		0.01	0.000	1.0	1
Water Quality Readings Collec	ted Using		YSI-556 at	rd LaMotte 2	2020			
	ted comp	-		ia bainoue .		-		
	Units							
Parameter Time		13.04	13:09	13:14	Readings	13.24	13:29	13:39
Parameter Time Water Level (0.33)	Units	13.04	13:09 5.43	13:14	Readings	6.94	13:29	13:39
Parameter Time Water Level (0.33) Volume Purged	Units 24 hr feet gal	4.71	13:09 5.43 0-25	13:14 6.90 0.5	Readings		8.24	1.25
Parameter Time Water Level (0.33) Volume Purged Flow Rate	Units 24 hr feet gal mL / min	200	13:09 5.43 0-25 150	13:14 6.90 0.5 100	Readings 3:19 6:46 0:5 100	6.94	824 0.75 400	1.25
Parameter Time Water Level (0.33) Volume Purged Flow Rate Furbidity (+/- 10%)	Units 24 hr feet gal mL / min NTU	4.71	13:09 5.43 0.25 150 1800	13:14 6.90 0.5 100 1800	Readings 3:19 6:46 0:5 100	6.94	8.24 C.75 400 359	1.25
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%)	Units 24 hr feet gal mL / min NTU %	4.71 200 911 65.7	13:09 5:43 0:25 150 18:00 207	13:14 6.90 0.5 100 18:0 12:7	Readings 3:19 6-46 0-5 100 852 18.0	6.94	8-24 C.75 400 359 14.6	1.25
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%)	Units 24 hr feet gal mL / min NTU % mg/L	4.71 200 911 65.7 7.35	13:09 5:43 0:25 150 18:00 207 2.26	13.14 6.90 0.5 100 100 12.7 2.06	Readings 3:19 6-46 0-5 100 852 18.0 2.01	6.94 0.6 100 621 17.0 1.90	8-24 C.75 400 359 14.6	1.25
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10)	Units 24 hr feet gal mL / min NTU % mg/L MeV	4.71 200 911 65-7 7.35 547	13:09 5:43 0:25 150 1800 207 2.26 40.8	13:14 6.90 05 160 18:7 2:06 36:2	Readings 3.[9 6.46 0.5 100 852 16.0 2.01 36.2	6.94 0.6 100 621 17.0 1.90 1.90	8 24 C.75 400 359 14.6 1.55 2 (44936	1.25
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10) Specific Conductivity	Units 24 hr feet gal mL / min NTU % mg/L MeV mS/cm ^c	4.71 200 911 65-7 7.35 5477 0.459	13:09 5:43 0:25 150 1800 207 2.26 40.8 0:490	13:14 6.90 05 160 18:7 2.06 36:2 0.491	Readings 3:19 6-46 0-5 100 852 18.0	6.94 0.6 100 621 17.0 1.90 1.90 0.492	8 24 C.75 400 359 14.6 1.55 2144936 0 493	1.25
Parameter Time Water Level (0.33) Volume Purged Flow Rate Furbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10) Specific Conductivity Conductivity (+/- 3%)	Units 24 hr feet gal mL / min NTU % mg/L MeV	4.71 200 911 65-7 7.35 5477 0.459	13:09 5:43 0:25 150 1800 207 2:26 40:8 6:490 0:362	13:14 6.90 05 100 18:7 2:06 36:2 0.491 0.357	Readings 13:19 6:46 0:5 100 852 18:0 2:01 36:2 0:491	6.94 0.6 100 621 17.0 1.90 1.90 1.90 1.90 0.49) 0.354	8 24 C.75 4 00 359 14.6 1.55 2 14096 0 493 0 377	1.25 100 184 37-5 4.27 33-4 0.499 0.399
Parameter Time Water Level (0.33) Volume Purged Flow Rate Furbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10) Specific Conductivity Conductivity (+/- 3%) DH (+/- 0.1)	Units 24 hr feet gal mL / min NTU % mg/L MeV mS/cm ^c mS/cm pH unit	4.71 200 911 5.7 7.35 547 0.469 0.357 7.96	13.09 5.43 0.25 150 1800 207 2.26 40.8 0.490 0.362 7.90	13.14 6.90 0.5 100 18.7 2.06 36.2 0.491 0.357 7.89	Readings 3.[9 6.46 0.5 100 852 16.0 2.01 36.2	6.94 0.6 100 621 17.0 1.90 1.90 0.492	8 24 C.75 4 00 359 14.6 1.55 214036 0 493 0 493 0.377 7.81	1.25 100. 1284 37.5 4.27 2 33.4 0.497 0.377 7.84
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10) Specific Conductivity Conductivity (+/- 3%) oH (+/- 0.1) Femp (+/- 0.5)	Units 24 hr feet gal mL / min NTU % mg/L MeV mS/cm ^c mS/cm pH unit C	4.71 200 911 - 7 7.35 5477 0.357 0.357 0.357 7.957	13:09 5:43 0:25 150 1800 207 2:26 40:8 0:490 0:362 7:90 11:22	13.14 6.90 0.5 100 18.7 2.06 36.2 0.491 0.357 7.89 10.72	Readings 13:19 6:46 0:5 100 852 18:0 2:01 36:2 0:491 0:354 7:87 10:39	6.94 0.6 100 621 17.0 1.90 1.90 1.90 1.90 1.90 0.354 7.85 10.30	8 24 C.75 400 359 14.6 1.55 2144936 0 493	1.25 100. 1284 37.5 4.27 2 33.4 0.499 0.399 7.84 12.35
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10) Specific Conductivity Conductivity (+/- 3%) DH (+/- 0.1) Temp (+/- 0.5) Color	Units 24 hr feet gal mL / min NTU % mg/L MeV mS/cm ^c mS/cm pH unit C Visual	4.71 200 911 65-7 7.35 547 0.469 0.359 7.96 10.77 0.469	13:09 5.43 0.25 150 1800 207 2.26 40.8 0.362 7.90 11.27 Cloudy	13.14 6.90 0.5 100 18.7 2.06 36.2 0.491 0.357 7.89 10.72 Claudy	Readings 13:19 6:46 C-5 100 852 18:0 2:01 36:2 0:491 C:354 7:87 10:39 0:405	6.94 0.6 100 621 17.0 1.90 1.90 1.90 1.90 1.90 0.354 7.85 10.30	8 24 C.75 4 00 359 14.6 1.55 214036 0 493 0 493 0.377 7.81	1.25 100 1224 39:5 4.27 33.4 0.377 7.84 12.35 Class
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10) Specific Conductivity Conductivity (+/- 3%) oH (+/- 0.1) Femp (+/- 0.5)	Units 24 hr feet gal mL / min NTU % mg/L MeV mS/cm ^c mS/cm pH unit C	4.71 200 911 - 7 7.35 5477 0.357 0.357 0.357 0.357 0.357	13:09 5:43 0:25 150 1800 207 2:26 40:8 0:490 0:362 7:90 11:22	13.14 6.90 0.5 100 18.7 2.06 36.2 0.491 0.357 7.89 10.72	Readings 13:19 6:46 0:5 100 852 18:0 2:01 36:2 0:491 0:354 7:87 10:39	6.94 0.6 100 621 17.0 1.90 1.90 1.90 1.90 1.90 0.354 7.85	8 24 C.75 4 00 359 14.6 1.55 2144936 0 493 0.377 7.81 1258	1.25 100. 1284 37.5 4.27 2 33.4 0.499 0.399 7.84 12.35
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10) Specific Conductivity Conductivity (+/- 3%) OH (+/- 0.1) Temp (+/- 0.5) Color Odor Comments:	Units 24 hr feet gal mL / min NTU % mg/L MeV mS/cm ^c mS/cm pH unit C Visual Olfactory	4.71 200 911 65.7 7.35 547 0.457 7.95 10.357 7.96 10.777 Class	13:09 5:43 0:25 150 1800 207 2:26 40:8 0:490 0:362 7:90 11:27 Cloudy 0:5-09	13:14 6.90 05 100 12:7 2.06 36:2 0.357 7.89 10:72 Claudy Chle	$\begin{array}{c} \text{Readings} \\ \hline 13.19 \\ \hline 6.46 \\ \hline 0.5 \\ \hline 100 \\ \hline 252 \\ \hline 16.0 \\ \hline 2.01 \\ \hline 36.2 \\ \hline 2.01 \\ \hline $	6.94 0.6 100 621 17.0 1.90 0.49 7.25 10.30 Claudy Chlo	8 24 C.75 400 359 14.6 1.55 2144936 0 493 0.377 7.61 12.58 Chilo Chilo	1.25 100. 124 39.3 4.27 33.4 0.499 0.377 7.84 12.35 Claus chb
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10) Specific Conductivity Conductivity (+/- 3%) DH (+/- 0.1) Temp (+/- 0.5) Color Ddor	Units 24 hr feet gal mL / min NTU % mg/L MeV mS/cm ^c mS/cm pH unit C Visual Olfactory	4.71 200 911 65.7 7.35 547 0.457 7.95 10.357 7.96 10.777 Class	13:09 5:43 0:25 150 1800 207 2:26 40:8 0:490 0:362 7:90 11:27 Cloudy 0:5-09	13:14 6.90 05 100 12:7 2.06 36:2 0.357 7.89 10:72 Claudy Chle	$\begin{array}{c} \text{Readings} \\ \hline 13.19 \\ \hline 6.46 \\ \hline 0.5 \\ \hline 100 \\ \hline 252 \\ \hline 16.0 \\ \hline 2.01 \\ \hline 36.2 \\ \hline 2.01 \\ \hline $	6.94 0.6 100 621 17.0 1.90 0.49 7.25 10.30 Claudy Chlo	8 24 C.75 400 359 14.6 1.55 2144936 0 493 0.377 7.61 12.58 Chilo Chilo	1.25 100. 124 39.3 4.27 33.4 0.499 0.377 7.84 12.35 Claus chb

Project Name and Number:		Former Dus	o Chemical (Company	602	79080.3		
Monitoring Well Number:		BIW-	D	Date	:	REE	11/27/1.	2
Samplers:		Mark Howa	rd and Sam F	Rowe	1.			
Sample Number:		BIW-	10112712	QA/Q	C Collected	? No		
Purging / Sampling Method:		Peristaltic P	ump with De	dicated Tub	oing/Low-Flo	ow		
1. L = Total Well Depth:					Gast	D Gashas	D (free)	-
					feet	D (inches		-
2. $D = Riser Diameter (I.D.)$:	TOCH			-	_feet	1-inch	0.08	
 W = Static Depth to Water (4. C = Column of Water in Cas 					feet	2-inch	0.17	1
	-	0.00 00.200	0.1		feet	3-inch	0.25	
5. $V = Volume of Water in We$		9)(0.5D) ⁻ (7.4	8)		_gal	4-inch	0.33	
6. $D2 = Pump$ Setting Depth (f					_feet	6-inch	0.50	1
7. $C2 = Column of water in Put8. Tubing Volume = C2(0.0057)$.):			_feet			
8. Tubing volume – $C2(0.005)$	(37088)				_gal			
			Conversion	factors to d	etermine V g	given C		
		D (inches)	1-inch	2-inch	3-inch	4-inch	6-inch	1
		V (gal / ft)	0.041	0.163	0.37	0.65	1.5	
Water Quality Readings Collec	ted Using		YSI-556 and	d LaMotte 2	2020	<u></u>		
Parameter	Units				Readings		L.Coll	1.777.7
Parameter Time	Units 24 hr	13:39	13:44	13:49	Readings	13:59	14:04	
Parameter Time Water Level (0.33)	Units 24 hr feet	9.84	13.44	13:49	Readings	13:59	11.81	115
Parameter Time Water Level (0.33) Volume Purged	Units 24 hr feet gal	9.84	13:44 9.90 1.5	13:49 11-49 1.90	Readings	13:59 11:81 2:45	11.81	1).5
Parameter Time Water Level (0.33) Volume Purged Flow Rate	Units 24 hr feet gal mL / min	9.84 1.4 100	13:44 9,90 1.5 100	13:49 11-44 1.90 400	Readings 13-64 11-80 2-0 100	13.59	11.81 2.25 100	1) 5 2.3 10
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%)	Units 24 hr feet gal mL / min NTU	9.84 1-4 100 138	13.44 9.90 1.5 100 129	13:49 11-49 1.90 400 390	Readings 13-64 11-80 2-0 100	13.59 11.81 2.42 100 2.38	11.81 2.25 100 201	115
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%)	Units 24 hr feet gal mL / min NTU %	9.84 1-4 100 138 408	13-44 9.90 1.5 100 129 363	13:49 11-49 1.90 400 390	Readings 13-44 1180 2-0 00 3752 208	13.59 11.81 2.42 100 2.38	11.81 2.25 100 201 255	1) 5 23
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%)	Units 24 hr feet gal mL / min NTU % mg/L	9.84 1.4 100 138 408 454	13.44 9.90 1.5 100 129 36.3 4.08 8420 5	13:49 11-49 1.90 400 390	Readings 13-44 1180 2-0 00 3752 208	13:59 11:81 2-12 100 238 242 2.73	11.81 2.25 100 201 255	1) 5 2 3 4 10 2 2 4
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10)	Units 24 hr feet gal mL / min NTU % mg/L MeV	9.84 1.4 100 138 408 454 33.6	13.44 9.90 1.5 100 129 36.3 4.08 8420 5	13:49 11:44 1.90 400 30:0 17:6 1.00 35:7	Readings 13-64 1120 2-0 100 3722 208 2-31 34-5	13:59 11.81 2.42 238 242 2.73 37.4	11.81 2.25 100 201 25.5 2.86 39.4 9.4	13 104 40
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10) Specific Conductivity	Units 24 hr feet gal mL / min NTU % mg/L MeV mS/cm ^c	9.84 1.4 100 138 408 454 33.6 0.50	13:44 9.90 1.5 100 129 36.3 4.08 8403325 0.497	13:49 11:44 1.90 400 30:0 17:6 1.00 17:6 1.00 35:7 0:40	Readings 13.44 11.20 20 100 372 2.5 2.5 2.5 2.5 2.5 2.5 2.5 2.5 2.5 2.	13-59 11.81 2-15 100 238 242 2.73 37.4 0.492	11.81 2.25 100 201 25.5 2.86 39.4 9.4	13 104 20 20 20 20 20 20 20 20 20 20 20 20 20
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10) Specific Conductivity Conductivity (+/- 3%)	Units 24 hr feet gal mL / min NTU % mg/L MeV mS/cm ^c mS/cm	9.84 1.4 100 138 408 454 33.6 0.50	13.44 9.90 1.5 100 129 36.3 4.08 8403 825 0.493 0.35	13:49 11:44 1.90 400 30:0 17:6 1.00 35:7	Readings 13-44 1120 2-0 100 372 228 2-51 34-5 0-493 0-364	13-59 11.81 2-12 238 242 2.73 37.4 0.492 0.492	11.81 2.25 100 281 25.5 2.86 39.4 0.489 0.348	115 1044 24 24 24 24 24 24 24 24 24 24 24 24 2
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10) Specific Conductivity Conductivity (+/- 3%) pH (+/- 0.1)	Units 24 hr feet gal mL / min NTU % mg/L MeV mS/cm ^c	9.84 1.4 100 138 408 454 33.50 0.363 7.83	13.44 9.90 1.5 100 129 36.3 4.08 8403 57.5 0.493 0.351 7.79	13:49 11:44 1.90 400 30:0 17:6 1.00 17:6 1.00 35:7 0:40	Readings 13.44 11.20 2.0 100 37.2 2.36 2.37 34.5 0.364 7.80	13-59 11.81 2-12 238 242 2.73 37.4 0.492 0.492	11.81 2.25 100 201 255 2.86 39.4 0.489 0.348 7.76	115
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10) Specific Conductivity Conductivity (+/- 3%)	Units 24 hr feet gal mL / min NTU % mg/L MeV mS/cm ^c mS/cm pH unit	9.84 1.4 100 138 408 454 33.6 0.50 0.50 0.363 1071	13.44 9.90 1.5 1000 129 36.3 4.08 8.0335 5.39 0.351 7.79 9.96	13:49 11-49 1.90 400 39:0 17-6 1.554 35.7 0.490 0.376 7.78	Readings 13.44 11.20 2.0 00 3.12 2.5 2.5 2.5 2.5 2.5 2.5 2.5 2.	13-59 11.81 2-12 100 238 242 2.73 37.4 0.492 0.492 0.492 0.492 0.492 0.492 0.492 0.492 0.534	11.81 2.25 100 201 255 2.86 39.4 0.489 0.348 7.76 9.93	1) 5
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10) Specific Conductivity Conductivity (+/- 3%) pH (+/- 0.1) Temp (+/- 0.5)	Units 24 hr feet gal mL / min NTU % mg/L MeV mS/cm ^c mS/cm pH unit C	9.84 1.4 100 138 408 454 33.50 0.363 7.83	13.44 9.90 1.5 100 129 36.3 4.08 8403 57.5 0.493 0.351 7.79	13:49 11:44 1.90 400 30:0 17:6 1.00 17:6 1.00 35:7 0:40	Readings 13.44 11.20 2.0 100 37.2 2.36 2.37 34.5 0.364 7.80	13-59 11.81 2-12 238 242 2.73 37.4 0.492 0.492	11.81 2.25 100 201 255 2.86 39.4 0.489 0.348 7.76	1) 9 1) 9 10 24 24 24 24 24 24 24 24 24 24
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10) Specific Conductivity Conductivity (+/- 3%) pH (+/- 0.1) Temp (+/- 0.5) Color	Units 24 hr feet gal mL / min NTU % mg/L MeV mS/cm ^c mS/cm pH unit C Visual Olfactory	9.84 1.4 100 138 408 454 33.6 0.50 0.50 0.50 0.50 0.50 0.50 0.50 0.	13.44 9.90 1.5 100 129 36.3 4.08 8403325 0.493 0.351 7.79 9.96 Cleor- chio	13:49 11.44 1.90 400 30:00 17.6 1.004 35.7 0.400 0.376 7.76 7.78 0.400 0.376 7.78 0.000 7.76	Readings 13-44 1120 2-0 00 352 2-5 00 34-5 0-364 7-80 11-59 Claudy	13.59 11.81 2.12 238 242 2.73 37.4 0.492 0.492 0.492 0.492 0.254 10.33 (landy 0.410 - Well	11.81 2.25 100 201 255 2.86 39.4 0.489 0.348 7.76 9.93 Clouds	14:19 104242 2240.4 2240.4 2240.4 20079.6 Clau Clau Clau

	Mo	nitoring V	Vell Purgi	ng/Sampli	ng Form			
Project Name and Number:		Former Dus	so Chemical	Company	6027	79080.3		
Monitoring Well Number:		BIW -	ID	Date:	11/2	27/12		
Samplers:		Mark Howa	ard and Sam	Rowe				
Sample Number:		BIW-	11271	2 QA/Q	C Collected?	NC		_
Purging / Sampling Method:		Peristaltic I	ump with D	edicated Tub	ing/Low-Flo	w		
1. L = Total Well Depth: 2. D = Riser Diameter (I.D.): 3. W = Static Depth to Water (4. C = Column of Water in Cas 5. V = Volume of Water in We 6. D2 = Pump Setting Depth (f 7. C2 = Column of water in Pui 8. Tubing Volume = C2(0.0057)	sing: tll = C(3.1415 t): mp/Tubing (fi		8)		feet feet gal feet gal feet gal	D (inches) 1-inch 2-inch 3-inch 4-inch 6-inch	D (feet) 0.08 0.17 0.25 0.33 0.50	
		D (inches) V (gal / ft)	Conversion	2-inch	3-inch 0.37	iven C 4-inch 0.65	6-inch	
Water Quality Readings Collec	ted Using			nd LaMotte 2		-	1,5	
	ted Using Units				020	-	1.5	
Parameter Time				nd LaMotte 2		-	1.3	
Parameter Time Water Level (0.33)	Units	14:14	YSI-556 an	nd LaMotte 2	020	-	1.5	
Parameter Time Water Level (0.33) Volume Purged	Units 24 hr	14:14 11.81 2.40	YSI-556 ar	14:24 11:21 2:00	020	_	1.5	
Parameter Time Water Level (0.33) Volume Purged Flow Rate	Units 24 hr feet gal mL / min	14:14 11:00 2:40 100	YSI-556 an 14'19 11.61 2.5°	14:24 11:21 11:21 2:00 100	020	-	1,3	
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%)	Units 24 hr feet gal mL / min NTU	14:14 11:81 2:40 2:00 2:00	YSI-556 an 14'19 11.81 2.5° 100 222	14:24 11:21 2:00 16:5	020	-	1,3	
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%)	Units 24 hr feet gal mL / min NTU %	14:14 11:81 2:40 100 200 24-9	YSI-556 an 14'19 11.81 2.5° 100 222 24.6	ad LaMotte 2 14:24 1.61 2.60 165 24.1	020	-	1.3	
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%)	Units 24 hr feet gal mL / min NTU % mg/L	14:14 11:81 2:40 100 200 24-9 2:84	YSI-556 at 14'19 11.81 2.50 200 222 24.6 2.80	ad LaMotte 2 14:24 1.61 2.60 165 24.1	020	-	1.3	
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10)	Units 24 hr feet gal mL / min NTU % mg/L MeV	14:14 11:81 2:40 100 24-9 2:84 40:6	YSI-556 ar 14'19 11.81 2.50 222 24.6 2.80 40.4	14:29 14:29 11:21 2:00 165 24.1 2:76	020		1.3	
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10) Specific Conductivity	Units 24 hr feet gal mL / min NTU % mg/L MeV mS/cm ^c	14:14 11.81 2.40 100 200 24-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-0 2.4-0 2.4-0 2.4-0 100 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-9 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.0-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.4-0 2.	YSI-556 an 14'19 11.61 2.5° 100 222 24.6 2.8° 40.4 0.486	14:24 11:21 2:00 16:5 2:76 16:5 2:76 2:76 2:76 2:76 2:76 2:76 2:76	020		1.3	
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10) Specific Conductivity Conductivity (+/- 3%)	Units 24 hr feet gal mL / min NTU % mg/L MeV mS/cm ^c mS/cm	14:14 11.81 2.40 100 200 24-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9 2.4-9	YSI-556 ar 14'19 11.61 2.5° 100 2.22 2.4.6 2.8° 40.4 C.486 C.342	14:24 11:21 2:00 165 2:10 2:76 409 0:486 0:340	020		1.3	
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10) Specific Conductivity Conductivity (+/- 3%) pH (+/- 0.1)	Units 24 hr feet gal mL / min NTU % mg/L MeV mS/cm ^c mS/cm pH unit	14:14 11.81 2.40 100 200 2.4-9 2.84 40.6 0.486 0.343 7.75	YSI-556 an 14'19 11.61 2.5° 100 222 24.6 2.8° 40.4 0.486	14:24 11:21 2:20 16:5 24:1 2:76 40.9 0:486 0:342 7:73	020			
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10) Specific Conductivity Conductivity (+/- 3%) pH (+/- 0.1) Temp (+/- 0.5)	Units 24 hr feet gal mL / min NTU % mg/L MeV mS/cm ^c mS/cm pH unit C	14:14 11:21 2:40 2:40 2:20 2:40 2:24 2:24 2:24 2:24	YSI-556 ar 14'19 11.61 2.50 222 24.6 2.22 2.4.6 2.22 2.4.6 2.22 2.4.6 2.4.6 2.4.6 0.342 7.74 9.55	14:24 11:21 2:00 10:5 2:1 2:70 2:70 2:70 2:70 2:70 2:70 2:70 2:70	020			
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10) Specific Conductivity Conductivity (+/- 3%) pH (+/- 0.1) Temp (+/- 0.5) Color	Units 24 hr feet gal mL / min NTU % mg/L MeV mS/cm ^c mS/cm pH unit C Visual	14:14 11.81 2.40 100 200 2.4-9 2.84 40.6 0.486 0.343 7.75	YSI-556 an 14'19 11.61 2.5° 100 222 24.6 2.20 2.46 2.8° 40.4 0.342	14:24 11:21 2:00 10:5 2:1 2:70 2:70 2:70 2:70 2:70 2:70 2:70 2:70	020			
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10) Specific Conductivity Conductivity (+/- 3%) pH (+/- 0.1) Temp (+/- 0.5) Color	Units 24 hr feet gal mL / min NTU % mg/L MeV mS/cm ^c mS/cm pH unit C	14:14 11:21 2:40 2:40 2:20 2:40 2:24 2:24 2:24 2:24	YSI-556 ar 14'19 11.61 2.50 222 24.6 2.22 2.4.6 2.22 2.4.6 2.22 2.4.6 2.4.6 2.4.6 0.342 7.74 9.55	14:24 11:21 2:20 16:5 24:1 2:76 40.9 0:486 0:342 7:73	020			
Water Quality Readings Collec Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10) Specific Conductivity Conductivity (+/- 3%) pH (+/- 0.1) Temp (+/- 0.5) Color Odor Comments:	Units 24 hr feet gal mL / min NTU % mg/L MeV mS/cm ^c mS/cm pH unit C Visual	14:14 11:21 2:40 2:40 2:20 2:40 2:24 2:24 2:24 2:24	YSI-556 ar 14'19 11.61 2.50 222 24.6 2.22 2.4.6 2.22 2.4.6 2.22 2.4.6 2.4.6 2.4.6 0.342 7.74 9.55	14:24 11:21 2:00 10:5 2:1 2:70 2:70 2:70 2:70 2:70 2:70 2:70 2:70	020			

	BIW - 2 Mark Howa	ard and Sam	Date	1	79080.3 /1ス					
	Mark Howa	ard and Sam	Rowe	: <u>11/3</u> c	/12					
				_						
	BTW-2	1CUL - N	BTW-25113C12 QA/QC Collected?							
		22113012	QA/Q	C Collected?	No					
			edicated Tub							
DC): ig:		3	8-62 0-17 44 842	feet feet	D (inches) 1-inch 2=inch	D (feet) 0.08 0.17				
= C(3.14159		18)	7.62	gal feet	4-inch 6-inch	0.23				
5/Tubing (ft): 7088)				_feet _gal						
		Conversion	factors to de	etermine V g	iven C					
5	D (inches))						
	V (gal / ft)	0.041	0.163	0.37	4-inch 0.65	6-inch 1.5				
d Using _		YSI-556 an	nd LaMotte 2	020						
Units				Readings						
24 hr	10:32	10:37	10:42		10:52	10:52	11:02			
feet	3.55	3-55	3.55				3.55			
gal		0.25	0.50				1.4C			
mL/min		100	100			100	and the second s			
		623	35.9	32.9	125	10.2	100			
		137	12.2	10.8	9.1	78	9-1.			
	4.33	1.49	1.3.2	1.18	0.99	085	077			
	-12-5	-19:7	-20.4	-23.0		- 27.5	- 33 C			
mS/cm ^c	1.376	1.373	1.370	1.375	1.321	1,291	1274			
mS/cm		1.020	1.017		0.977	0.975	0.94)			
pH unit	775	7.65		7.55	7.50	7.45	743			
	10.94	11.50	11.53	11.42	11.37	11.48	11.55			
Visual	landy	Cloudy	Clear	Clear	Clean		Clar			
Olfactory	chic	Chilo	anto	chio	Clear	Clea	chie			
	g: = C(3.14159) /Tubing (ft): /088) /088) //Units 24 hr feet gal mL / min NTU % mg/L MeV mS/cm pH unit C Visual 0Ifactory	g: = $C(3.14159)(0.5D)^2(7.4)^{(7.4)}$ /Tubing (ft): (088) D (inches) V (gal / ft) Using Units 24 hr 10-32 feet 3.55 gal mL / min 100 NTU 131 % 329 mg/L 4.33 MeV -12-5 mS/cm ^c 1.376 mS/cm 1.007 pH unit 7.75 C 10-544 Visual Cloudy	g: = $C(3.14159)(0.5D)^2(7.48)$ /Tubing (ft): '088) Conversion D (inches) 1-inch V (gal / ft) 0.041 Using YSI-556 an Units 24 hr 10.32 10.37 feet 3.55 3.55 gal - 0.25 mL / min 100 100 NTU 131 62.3 % 32.9 13.7 mg/L 4.33 1.49 MeV - 12-5 - 19.7 mS/cm ⁶ 1.376 1.373 mS/cm 1.007 1.000 pH unit 7.75 7.65 C 10.494 11.50 Visual Cloudy Cloudy Difactory Chilc Chilc	DC): $3-44 \times 8242$ g: $-C(3.14159)(0.5D)^2(7.48)$ /Tubing (ft): 088) Conversion factors to de D (inches) 1-inch 2-inch 0.163 Using YSI-556 and LaMotte 2 Units 24 hr 10.32 10.37 10.42 feet 3.55 3.55 gal 0.25 0.50 mL / min 10C 10C 10C 100 NTU 131 62.3 35.9 % 32 9 13 7 12.2 mg/L 4.33 1.49 132 MeV -12-5 -19.7 -20.4 mS/cm 1.007 7.60 C 10.614 11.50 11.53 Visual Cleady Cleady Clear Difactory Chilc Chilc Chilo	DC): $3 - 44$ $3 - 44$ $3 - 44$ $5 - 44$ $5 - 44$ $5 - 44$ $5 - 44$ $5 - 44$ $5 - 44$ $5 - 44$ $5 - 44$ $5 - 44$ $5 - 44$ $5 - 44$ $5 - 44$ $5 - 44$ $5 - 44$ $5 - 44$ $5 - 44$ $5 - 44$ $5 - 44$ $5 - 44$ $5 - 44$ $5 - 44$ $5 - 44$ $5 - 44$ $5 - 44$ $5 - 44$ $5 - 44$ $5 - 44$ $5 - 44$ $5 - 44$ $5 - 44$ $5 - 44$ $5 - 44$ $5 - 44$ $5 - 44$ $5 - 44$ $5 - 44$ $5 - 44$ $5 - 44$ $5 - 44$ $5 - 44$ $5 - 44$ $5 - 44$ $5 - 44$ $5 - 44$ $5 - 44$ $5 - 44$ $5 - 44$ $5 - 44$ $5 - 44$ $5 - 44$ $5 - 44$ $5 - 44$ $5 - 44$ $5 - 44$ $5 - 44$ $5 - 44$ $5 - 44$ $5 - 44$ $5 - 44$ $5 - 44$ $5 - 44$ $5 - 44$ $5 - 44$ $5 - 44$ $5 - 44$ $5 - 44$ $5 - 44$ $5 - 44$ $5 - 44$ $5 - 44$ $5 - 44$ $5 - 44$ $5 - 44$ $5 - 44$ $5 - 44$ $5 - 44$ $5 - 44$ $5 - 44$ $5 - 44$ $5 - 44$ 5	$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	$\begin{array}{c ccccccccccccccccccccccccccccccccccc$			

Project Name and Number: Monitoring Well Number: Samplers: Sample Number: Purging / Sampling Method:		BIW	so Chemica	I Company	6027	9080.3	
Samplers: Sample Number: Purging / Sampling Method:			5 1			1 1	
Sample Number: Purging / Sampling Method:			5	Date	: <u> </u>	30/12	
Purging / Sampling Method:			ard and Sam				
		BIN	-25/130	1,2 QA/Q	C Collected?	Va	C
		Peristaltic I	Pump with E	Dedicated Tul	bing/Low-Flow	v	
1. L = Total Well Depth:					feet	D (inches)	D (feet)
2. $D = Riser Diameter (I.D.);$				-		D (inches)	D (feet)
3. $W = $ Static Depth to Water (TOCI				feet feet	1-inch	0.08
4. $C = Column of Water in Cas$				-	_feet	2-inch	0.17
5. $V = Volume of Water in We$		01/0 502/7	10)		-	3-inch	0.25
6. $D2 = Pump$ Setting Depth (fi	コー C(3.1413 ት)・	9)(0.5D)*(7.4	to)	2	_gal	4-inch	0.33
7. $C2 = Column of water in Put$	un.			-	feet	6-inch	0.50
8. Tubing Volume = $C2(0.0057)$	737088)	<i>(</i>):		-	_feet		
o. ruonig volume - C2(0.0057	151000)				_gal		
			Conversion	n factors to d	etermine V gi	ven C	
						. sin e	
		PT-PT-PT-PT-PT-PT-PT-PT-PT-PT-PT-PT-PT-P					
		D (inches)	1-inch	2-inch	3-inch	4-inch	6-inch
		D (inches) V (gal / ft)	0.041	2-inch 0.163 nd LaMotte 2	0.37	4-inch 0.65	6-inch 1.5
Parameter	Units	V (gal / ft)	0.041 YSI-556 at	0.163 nd LaMotte 2	0.37 2020 Readings		and the second se
Time	Units 24 hr	V (gal / ft)	0.041 YSI-556 at	0.163 nd LaMotte 2	0.37 2020 Readings		and the second se
Parameter Time Water Level (0.33)	Units 24 hr feet	V (gal / ft)	0.041 YSI-556 at	0.163 nd LaMotte 2	0.37 2020 Readings 11: 2.2 3-55		and the second se
Parameter Time Water Level (0.33) Volume Purged	Units 24 hr feet gal	V (gal / ft)	0.041 YSI-556 an	0.163 nd LaMotte 2	0.37 020 Readings 11:22 3-55 2-25		and the second se
Parameter Time Water Level (0.33) Volume Purged Flow Rate	Units 24 hr feet gal mL / min	V (gal / ft)	0.041 YSI-556 an	0.163 nd LaMotte 2	0.37 Readings 11:22 3-55 2-25 1 C c		and the second se
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%)	Units 24 hr feet gal mL / min NTU	V (gal / ft) 3.55 1.40 1.00 4.2	0.041 YSI-556 an	0.163 nd LaMotte 2 11:17 3-55 2-0 1 cc 24-0	0.37 Readings 11:22 3-55 2-25 1 C c		and the second se
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%)	Units 24 hr feet gal mL / min NTU %	V (gal / ft) 3.55 1.40 1.00 4.2 6-3	0.041 YSI-556 an	0.163 nd LaMotte 2 11:17 3-55 2-0 1 cc 24-0	0.37 Readings 11: 2.2 3-55 2-25 1 C c 24.0 5-0		and the second se
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%)	Units 24 hr feet gal mL / min NTU % mg/L	V (gal / ft) 3.55 1.40 1.00 4.2 6.3 0.65	0.041 YSI-556 an	0.163 nd LaMotte 2 $11:17$ 3.55 2.0 1.0 2.4-0 5.2 0.60	0.37 Readings 11: 2.2 3-55 2-25 1 C c 24.0 5.0 0.59		and the second se
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10)	Units 24 hr feet gal mL / min NTU % mg/L MeV	V (gal / ft) 11.07 3.55 1.00 1.00 4.2 6.3 0.05 -34.2	0.041 YSI-556 au (1. (2 3.55 1.75 1.00 4.1 5.6 0.63 - 39.2	0.163 nd LaMotte 2 11:17 3-55 2-0 1-cc 2-4-0 5-2 0.00 - 32 8	0.37 Readings 11:22 3-55 2-25 1 Cc 24.0 5.0 0.59 -41.8		and the second se
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10) Specific Conductivity	Units 24 hr feet gal mL / min NTU % mg/L MeV mS/cm ^c	V (gal / ft) 11:07 3:55 1:40 1:00 4:2 6:3 0:42 6:3 0:42 1:237	0.041 YSI-556 au YSI-556 au 1.75 1.00 4.1 5.6 0.63 - 39.2 1.215	0.163 nd LaMotte 2 11:17 3-55 2-0 1-0 5-2 0-60 -32-8 1-216	0.37 Readings 11:22 3-55 2-25 1 Cc 24.0 5.0 0.59 -41.8 1.207		and the second se
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10) Specific Conductivity Conductivity (+/- 3%)	Units 24 hr feet gal mL / min NTU % mg/L MeV mS/cm ^c mS/cm	V (gal / ft) 11.07 3.55 1.40 100 4.2 6.3 0.42 1.237 0.915	0.041 YSI-556 au (1. (2 3.55 1.75 1.00 4.1 5.6 0.63 - 39.2	0.163 nd LaMotte 2 11:17 3-55 2-0 1-cc 2-4-0 5-2 0.00 - 32 8	0.37 Readings 11:22 3-55 2-25 1 Cc 24.0 5.0 0.59 -41.8 1.207 0.295		and the second se
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10) Specific Conductivity Conductivity (+/- 3%) pH (+/- 0.1)	Units 24 hr feet gal mL / min NTU % mg/L MeV mS/cm ^c mS/cm pH unit	V (gal / ft) 11.07 3.55 1.40 100 4.2 6.3 0.65 7.39	0.041 YSI-556 an ISI-556 an ISI-75 ICC 4.1 5.6 0.63 -39.2 I.216 0.898 7.37	0.163 nd LaMotte 2 11:17 3-55 2-0 1-cc 24-0 5-2 0.60 - 32 8 1-216 0.288 7-35	$\begin{array}{c} 0.37 \\ \hline 0.020 \\ \hline \\ $		and the second se
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10) Specific Conductivity Conductivity (+/- 3%)	Units 24 hr feet gal mL / min NTU % mg/L MeV mS/cm ^c mS/cm	V (gal / ft) 11.07 3.55 1.40 100 4.2 6.3 0.42 1.237 0.915	0.041 YSI-556 au YSI-556 au 1.75 1.00 4.1 5.6 0.63 - 39.2 1.215	0.163 nd LaMotte 2 11:17 3-55 2-0 1-0 5-2 0-60 -32-8 1-216	0.37 Readings 11:22 3-55 2-25 1 Cc 24.0 5.0 0.59 -41.8 1.207 0.295		and the second se

1.0

	IVIO	onitoring V	Vell Purgi	ing/Sampl	ing Form			
Project Name and Number:		Former Du	so Chemical	Company	602	79080.3		
Monitoring Well Number:		BIW-:	21)	Date	1430/	12		
Samplers:		Mark Howa	ard and Sam	Rowe	- 14	_		
Sample Number:		BIW-	21/1301	2 QA/Q	C Collected	No		
Purging / Sampling Method:		Peristaltic F	oump with D	edicated Tul	bing/Low-Flo)W		1 A
1. L = Total Well Depth:				23.47	feet	D (inches) D (feet)	7
2. $D = Riser Diameter (1.D.)$:				0.17	- feet	1-inch	0.08	-
3. W = Static Depth to Water (TOC):			2.40	feet	2-inch	0.03	D
4. C = Column of Water in Ca				Q!	feet	3-inch	0.25	1
5. $V = Volume of Water in We$		$(0.5D)^2(7.4)$	(8)	-	gal	4-inch	0.33	
6. $D2 = Pump$ Setting Depth (f	ft):	///(/+)	-/	22.47	- feet	6-inch	0.50	
7. C2 = Column of water in Pu		t):		energi (feet	L	1 0.00	-
8. Tubing Volume = C2(0.005		1		-	- gal			
					_ 5			
			Conversion	n factors to d	etermine V g	iven C		
		D. /. 1. 1	1	1/21	1	1		-
		D (inches)	1-inch	2-inch	3-inch	4-inch	6-inch	
		V (gal / ft)	0.041	0.163	0.37	0.65	1.5	
								and the second se
Water Quality Peoplings Calles	tod Haina		Velecc		0000			-
Water Quality Readings Collec	cted Using		YSI-556 at	nd LaMotte 2	2020	-		-
Parameter	eted Using Units		YSI-556 at		Readings	-		-
Parameter Time		8.35	18:40	18:45	Readings	8.55	9:00	9:05
Parameter Time Water Level (0.33)	Units 24 hr feet	8.35 338	YSI-556 at	18:45		8.55	9:00	
Parameter Fime Water Level (0.33) Volume Purged	Units 24 hr feet gal	3.38	8-40 3.46 4.2	8.45	Readings	5.61		91. 15 5-60 150
Parameter Fime Water Level (0.33) Volume Purged Flow Rate	Units 24 hr feet gal mL / min	3.38	8:40 3.46 4.2 40	8.45 3.80 0.25 40	Readings 5.61 0.75 80	8.55 5.61 0.90	5-61	5-60 150 80
Parameter Fime Water Level (0.33) Volume Purged Flow Rate Furbidity (+/- 10%)	Units 24 hr feet gal mL / min NTU	3.38 20 105.7	8 40 3.46 40 331	8.45 3.00 0.25 40 245	Readings 2:50 5.41 0.75 80 158	8.55 5-61 0.90 80 108-5	5-61	5-60 150 80
Parameter Fime Water Level (0.33) Volume Purged Flow Rate Furbidity (+/- 10%) Dissolved Oxygen (+/- 10%)	Units 24 hr feet gal mL/min NTU %	3.38 20 105.7 38.0	8:40 3.46 4.2 40 331 18:4	8.45 3.80 0.25 40 245 11 3	Readings 2:50 5.61 0.75 20 158 9.5	5.55 5.61 0.90 108.5 9.9	5.61 1.20 80 71.3 9.1	5-60 1.50 80 43.7 8.1
Parameter Time Water Level (0.33) Volume Purged Flow Rate Furbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%)	Units 24 hr feet gal mL / min NTU % mg/L	3.38 20 105.7 38.0 7.16	8:40 3.46 4.2 40 331 18:4 2.0	8.45 3.80 0.25 40 245 11 3	Readings 2:50 5.61 0.75 80 158 9.5 1.00	5.61 5.61 0.90 108.5 97.8 1.06	5.61 1.20 80 71.3 9.1 0.99	5.60 150 80 43.7 8.1 0.87
Parameter Fime Water Level (0.33) Volume Purged Flow Rate Furbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10)	Units 24 hr feet gal mL / min NTU % mg/L MeV	3.38 80 105.7 38.0 7.16 63.7	22 3.46 40 331 18.4 2.6 17.6	8:45 3:00 0.25 40_ 265 163 1.79 11.7	Readings 2:50 5.61 0.75 90 158 9.5 1.09 -1.5	6.55 5.61 0.90 108.5 7.86 1.06 -57	5-6(1.20 80 71.3 9-1 0.99 -6.0	5-60 150 80 43.7 8.1 0.87 -55
Parameter Time Water Level (0.33) Volume Purged Flow Rate Furbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10) Specific Conductivity	Units 24 hr feet gal mL / min NTU % mg/L MeV mS/cm ^c	3.38 20 105.7 38.0 7.16	8:40 3.46 4.2 40 331 18.4 2.01 14.8 1.342	8.45 3.00 0.25 40_ 265 16.3 1.79 11.7 1.34.2	Readings 2:50 5.61 0.75 20 158 9.5 1.00 -1.5 1.283	5.61 5.61 0.90 108.5 97.8 1.06	5-6(1.20 80 71.3 9-1 0.99 -6.0	5-60 150 80 43.7 8.1 0.87 -55
Parameter Time Water Level (0.33) Volume Purged Flow Rate Furbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10) Specific Conductivity Conductivity (+/- 3%)	Units 24 hr feet gal mL / min NTU % mg/L MeV mS/cm ^c mS/cm	3.38 EC 105.7 38.0 4.16 63.7 1.200 0.877	8:40 3.46 4.2 40 331 18.4 2.01 14.8 1.342	8.45 3.00 0.25 40_ 245 16.3 1.79 11.7 1.34.2 0.980	Readings 2:50 5.61 0.75 80 158 9.5 1.00 -1.5 1.283 0.999	5.55 5.61 0.90 200 108.5 7.8 1.06 -5.2 1.273 0.963	5.6(1.20 80 71.3 9.1 0.99 -6.0 1.276 0.956	5-60 150 80 43.7 8.1 0.87 -55 1.273
Parameter Time Water Level (0.33) Volume Purged Flow Rate Furbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10) Specific Conductivity Conductivity (+/- 3%) DH (+/- 0.1)	Units 24 hr fcet gal mL / min NTU % mg/L MeV mS/cm ^c mS/cm pH unit	3.38 80 105.7 38.0 7.16 63.7 1.200 0.877 7.27	8:40 3.46 40 331 18.4 14.8 1.342 1.342 1.342 1.342 1.342 1.342 1.342 1.342 1.342 1.342 1.342	8:45 3:80 0.25 40 245 163 1.79 1.79 1.79 1.342 0.980 7.93	Readings 2:50 5.61 0.75 80 158 9.5 1.09 -1.5 1.283 0.999 7.77	5.55 5.61 0.90 108.5 7.8 1.06 -52 1.273 0.963 7.95	5.61 1.20 80 71.3 9.1 0.99 -6.0 1.276	5-60 150 80 43.7 8.1 0.87 -55 1.273
Parameter Time Water Level (0.33) Volume Purged Flow Rate Furbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10) Specific Conductivity Conductivity (+/- 3%) OH (+/- 0.1) Femp (+/- 0.5)	Units 24 hr feet gal mL / min NTU % mg/L MeV mS/cm ^c mS/cm pH unit C	3.38 80 105.7 38.0 4.16 63.7 1.200 0.877 7.27 11.34	2:46 3:46 3:40 331 18:4 14:8 1-342 14:8 1-342 5:20 11:06	8.45 3.80 0.25 40 265 16.3 1.79 1.34.2 0.980 7.93 10.92	Readings 2:50 5.61 0.75 80 158 9.5 1.09 -1.5 1.283 0.499 7.77 13.42	5.55 5.61 9.90 108.5 7.8 1.06 -52 1.273 0.963 7.95 1.2.22	5.6(1.20 80 71.3 9.1 0.99 -6.0 1.276 0.956	5-60 150 80 43.7 81 0.87 -55 1.273 0.957 7.88 12.09
Parameter Time Water Level (0.33) Volume Purged Flow Rate Furbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10) Specific Conductivity Conductivity (+/- 3%) DH (+/- 0.1) Temp (+/- 0.5) Color	Units 24 hr feet gal mL / min NTU % mg/L MeV mS/cm ^c mS/cm pH unit C Visual	3.38 EO 105.7 32.0 4.16 63.7 1.200 0.277 7.27 1.34 Clegr	8:40 3.46 40 331 18.4 14.8 1.342 1.342 1.342 1.342 1.342 1.342 1.342 1.342 1.342 1.342 1.342	8:45 3:80 0.25 40 265 163 1.79 1.342 0.980 7.93 10.92 Cloudy	Readings 2:50 5.61 0.75 20 158 9.5 1.00 -1.5 1.283 0.999 7.7 13.42 Claudy	5.55 5.61 9.90 108.5 7.8 1.06 -5.2 1.273 0.963 7.95 1.2.22 (Jauly	5.61 1.20 80 71.3 9.1 0.99 -6.0 1.276 0.956 7.93 11.26 Claudy	5-60 150 80 43.7 8.1 0.87 -55 1.273 0.957 7.88
Water Quality Readings Collect Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10) Specific Conductivity Conductivity (+/- 3%) bH (+/- 0.1) Temp (+/- 0.5) Color Odor	Units 24 hr feet gal mL / min NTU % mg/L MeV mS/cm ^c mS/cm pH unit C	3.38 80 105.7 38.0 4.16 63.7 1.200 0.877 7.27 11.34	2:46 3:46 3:40 331 18:4 14:8 1-342 14:8 1-342 5:20 11:06	8.45 3.80 0.25 40 265 16.3 1.79 1.34.2 0.980 7.93 10.92	Readings 2:50 5.61 0.75 80 158 9.5 1.09 -1.5 1.283 0.499 7.77 13.42	5.55 5.61 9.90 108.5 7.8 1.06 -52 1.273 0.963 7.95 1.2.22	5.6(1.20 80 71.3 9.1 0.99 -6.0 1.276 0.956 7.93 11.26	5-60 150 80 43.7 81 0.87 -55 1.273 0.957 7.88 12.09
ParameterTimeWater Level (0.33)Volume PurgedFlow RateTurbidity (+/- 10%)Dissolved Oxygen (+/- 10%)Dissolved Oxygen (+/- 10%)Eh / ORP (+/- 10)Specific ConductivityConductivity (+/- 3%)DH (+/- 0.1)Temp (+/- 0.5)ColorOdorComments:	Units 24 hr feet gal mL / min NTU % mg/L MeV mS/cm ^c mS/cm pH unit C Visual Olfactory	3.38 80 105.7 38.0 7.16 63.7 1.200 0.877 7.27 1.34 Clear Clear Clear	2:40 3:46 40 331 18:4 2:01 14:8 1.342 5:27 11:06 C. 10 C. 10	8:45 3:60 0.25 40 265 163 1.79 1.342 0.980 7.93 10.92 Cloudy Cho	Readings 2:50 5.61 0.75 20 158 9.5 1.00 -1.5 1.283 0.999 1.3.42 Cloudy Chile	6.55 5.61 9.90 108.5 7.8 1.06 -52 1.273 0.963 7.95 12.22 Clauty Churty	5.61 1.20 80 71.3 9.1 0.99 -6.0 1.276 0.956 7.93 11.26 Claudy	5-60 150 80 43.7 8.1 0.87 -55 1.273 0.957 7.88 12.00 Clourly
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10) Specific Conductivity Conductivity (+/- 3%) DH (+/- 0.1) Temp (+/- 0.5) Color	Units 24 hr feet gal mL / min NTU % mg/L MeV mS/cm ^c mS/cm pH unit C Visual Olfactory	3.38 80 105.7 38.0 7.16 63.7 1.200 0.877 7.27 1.34 Clear Clear Clear	2:40 3:46 40 331 18:4 2:01 14:8 1.342 5:27 11:06 C. 10 C. 10	8:45 3:60 0.25 40 265 163 1.79 1.342 0.980 7.93 10.92 Cloudy Cho	Readings 2:50 5.61 0.75 20 158 9.5 1.00 -1.5 1.283 0.999 1.3.42 Cloudy Chile	6.55 5.61 9.90 108.5 7.8 1.06 -52 1.273 0.963 7.95 12.22 Clauty Churty	5.61 1.20 80 71.3 9.1 0.99 -6.0 1.276 0.956 7.93 11.26 Claudy	5-60 150 80 43.7 8.1 0.87 -55 1.273 0.957 7.88 12.00 Clourly

and the second		onitoring W						
Project Name and Number:		Former Dus	o Chemical	Company	6027	9080.3		_
Monitoring Well Number:		BIN.	201	_ Date:	11/30	112		
Samplers:			rd and Sam		_			
Sample Number:		BIW-	201130	LIL QA/Q	C Collected?	No		_
Purging / Sampling Method:		Peristaltic P	ump with De	edicated Tub	ing/Low-Flo	W		
1. L = Total Well Depth:					feet	D (inches)	D (feet)	
2. D = Riser Diameter (I.D.):					feet	1-inch	0.08	
3. W = Static Depth to Water (feet	2-inch	0.17	
4. C = Column of Water in Cas	-			-	feet	3-inch	0.25	
5. $V = Volume of Water in We$		59)(0.5D) ² (7.4	8)		gal	4-inch	0.33	
6. $D2 = Pump$ Setting Depth (f					feet	6-inch	0.50	
7. $C2 = Column of water in Put$		t):		_	feet			
8. Tubing Volume = $C2(0.0057)$	737088)			-	gal			
			Conversion	factors to de	etermine V gi	ven C		
		D (inches)	1-inch	2-inch	3-inch	4-inch	6-inch	
		V (gal / ft)	0.041	0.163	0.37	0.65	1.5	
Water Quality Readings Collec	ted Using		YSI-556 an	d LaMotte 2				
Parameter	Units		YSI-556 an			•		
Parameter Time	Units 24 hr	910	9:15	9:20	020			
Parameter Time Water Level (0.33)	Units 24 hr feet	9:10	9:15	9:20	020			
Parameter Time Water Level (0.33) Volume Purged	Units 24 hr feet gal	5.53	9:15	9:20	020			
Parameter Time Water Level (0.33) Volume Purged Flow Rate	Units 24 hr feet gal mL / min	5.53 1.5 20	9-15 5-60 1-75 80	9:20	020			
Parameter Fime Water Level (0.33) Volume Purged Flow Rate Furbidity (+/- 10%)	Units 24 hr feet gal mL / min NTU	5.53 1.5 20 34.9	9:15 5:60 1.75 80 23.0	9:20	020			
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%)	Units 24 hr feet gal mL / min NTU %	5.53 1.5 20 34.9 7.6	9:15 5:60 1.75 80 23.0	9:20	020			
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%)	Units 24 hr feet gal mL / min NTU % mg/L	5.53 1.5 20 34.9 7.6 0.81	9.15 5.60 1.75 80 23.0 2.20 2.20	9-5-00 1000	020			
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10)	Units 24 hr feet gal mL / min NTU % mg/L MeV	5.53 1.5 20 34.9 7.6 0.81 -6.3	9.15 5.60 1.75 80 23.0 2.2 0.22 7.6	9-3-00 MW - 5-0-5-4	020			
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10) Specific Conductivity	Units 24 hr feet gal mL / min NTU % mg/L MeV mS/cm ^c	5.53 1.5 20 34.9 7.6 0.81 -6.8 1.275	9:15 5:60 1.75 23.0 23.0 2.2 0.22 .7.4 1.275	9-3-00 MW - 5-0-5-4	020			
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10) Specific Conductivity Conductivity (+/- 3%)	Units 24 hr feet gal mL / min NTU % mg/L MeV	5.53 1.5 20 34.9 7.6 0.8 -6.8 1.275 0.954	9.15 5.60 1.75 80 23.0 2.2 0.22 7.6	9-3-00 100 100 100 -5-4 -5-4 -5-4 -5-4 -5-4 -5-4 -5-4 -5	020			
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10) Specific Conductivity Conductivity (+/- 3%) bH (+/- 0.1)	Units 24 hr feet gal mL / min NTU % mg/L MeV mS/cm ^c mS/cm	5.53 1.5 20 34.9 7.6 0.81 -6.8 1.275	9:15 5:60 1.75 23.0 23.0 2.2 0.22 .7.4 1.275	9:20 5:60 5:60 15:00 15:00 -5:4 1:267 0:358 7:80 1:267	020			
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10) Specific Conductivity Conductivity (+/- 3%) OH (+/- 0.1) Femp (+/- 0.5) Color	Units 24 hr feet gal mL / min NTU % mg/L MeV mS/cm° mS/cm° pH unit C Visual	5.53 1.5 2.0 34.9 7.6 0.8] -6.8 1.275 0.959 7.25 12.01 Cleve	9.15 5.60 1.75 80 23.0 2.2 2.2 0.22 7.6 1.275 0.957 7.23 12.03	9:20 5:60 5:60 15:00 15:00 -5:4 1:267 0:358 7:80 1:267	020			
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10) Specific Conductivity Conductivity (+/- 3%) OH (+/- 0.1) Femp (+/- 0.5) Color	Units 24 hr feet gal mL / min NTU % mg/L MeV mS/cm° mS/cm° pH unit C	5.53 1.5 20 34.9 7.6 0.81 -6.8 1.275 0.959 7.85 1.2.01	9.15 5.60 1.75 80 23.0 8.2 0.22 7.4 1.275 0.951 7.83	9-3-00 100 100 100 -5-4 -5-4 -5-4 -5-4 -5-4 -5-4 -5-4 -5	020			
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10) Specific Conductivity Conductivity (+/- 3%) DH (+/- 0.1) Temp (+/- 0.5) Color Odor	Units 24 hr feet gal mL / min NTU % mg/L MeV mS/cm° mS/cm° pH unit C Visual Olfactory	5.53 1.5 20 34.9 7.6 0.81 -6.3 1.275 0.959 7.85 1.2.01 Cleor Chic	9.15 5.60 1.75 80 23.0 8.2 0.22 7.6 1.275 0.957 7.23 12.03 clear cho	9:20 5:60 15:00 15:00 15:00 1:207 0:758 7:20 1:207 0:758 7:20 1:207 0:758 7:20 1:207 0:758 7:20 1:207 0:758 7:20 1:207 0:75 0:75 0:75 0:75 0:75 0:75 0:75 0:	020 Readings			
Water Quality Readings Collec Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10) Specific Conductivity Conductivity (+/- 3%) oH (+/- 0.1) Temp (+/- 0.5) Color Odor Comments: Sauft	Units 24 hr feet gal mL / min NTU % mg/L MeV mS/cm° mS/cm° pH unit C Visual Olfactory	5.53 1.5 20 34.9 7.6 0.81 -6.8 1.275 0.959 7.85 1.2.01 Cleor Chic	9.15 5.60 1.75 80 23.0 8.2 0.22 7.6 1.275 0.957 7.23 12.03 clear cho	9:20 5:60 15:00 15:00 15:00 1:207 0:758 7:20 1:207 0:758 7:20 1:207 0:758 7:20 1:207 0:758 7:20 1:207 0:758 7:20 1:207 0:75 0:75 0:75 0:75 0:75 0:75 0:75 0:	020 Readings			

	BIW-3 Mark Howa			6027	9080.3		
	Mark Howa		Deter	1.1			
		ard and Som	- Date:	11/28	12		_
	RIN-3	and and Sam	Rowe				
	Dian an	5112812	QA/Q	C Collected?	NO		
	Peristaltic I	oump with D	edicated Tub	oing/Low-Flo	w		
			6.68	C	DC 1	I D/C A	1
			whee	_feet	D (inches)		1
FOC):			0.00	- feet	1-inch	0.08	-
			2.01	-		and the second s	1
-	010 50217	103		-			
II = C(3.1415)	9)(0.5D) ⁻ (7.4	18)	_				
			-	-	6-inch	0.50	1
110/1 ubing (11	.).			-			
57000)				-gai			
		Conversion	factors to de	etermine V a	iven C		
		Jen reision		comme v g	i i ci c		
	D (inches)	Linch	2-inch	3-inch	4-inch	6-inch	1
		1 mon					
ted Using	V (gal / ft)	0,041	0.163 d LaMotte 2	0.37	0.65	1.5	
Units	V (gal / ft)	0,041 YSI-556 an	0.163 ad LaMotte 2	020 Readings			
Units 24 hr	V (gal / ft)	0,041 YSI-556 an	0.163 d LaMotte 2	020 Readings	15.26	15 31	15
Units 24 hr feet	V (gal / ft)	0,041 YSI-556 an	0.163 d LaMotte 2	020 Readings 15: コー えっこそ	15:26	15:31	251
Units 24 hr feet gal	V (gal / ft)	0,041 YSI-556 an	0.163 d LaMotte 2 0.58 0.75	Readings	15:24 2.50 1.25	15:31 258 15	251
Units 24 hr feet gal mL/min	V (gal / ft)	0,041 YSI-556 an	0.163 d LaMotte 2 0.58 0.75 2.00	020 Readings 15: 21 2.58 1 G 1 2.00	15:26 2.58 1.25 2.00	15:31 258 15	251
Units 24 hr feet gal mL/min NTU	V (gal / ft)	0,041 YSI-556 an	0.163 d LaMotte 2 a.58 a.75 a.co 505	020 Readings 15' 21 2.5E 1 G_1 2.00 443	15:24 2.58 1.25 2.00 391	15:31	251
Units 24 hr feet gal mL / min NTU %	V (gal / ft)	0,041 YSI-556 an 15:11 2.58 0.5 2.00 5/600 24.6	0.163 d LaMotte 2 0.58 0.75 200 505	020 Readings 15: 21 2.58 7 G1 2.00 443 2.65	15:26 2.58 1.25 2.00 391 2.6.5	15:31 258 15 200 372 264	2517
Units 24 hr feet gal mL / min NTU % mg/L	V (gal / ft)	0,041 YSI-556 an 15:11 2.58 0.5 2.00 7/000 24.6	0.163 d LaMotte 2 0.58 0.75 200 505	020 Readings 15: 31 2.58 1 G_1 2.60 443 2.65 2.94	15:24 2.58 1.25 391 26.5 294	15:31 258 1.5 205 372 26.4 2.93	222022
Units 24 hr feet gal mL / min NTU % mg/L MeV	V (gal / ft) 15.04 2.46 200 >1000 >1000 32.1 3.40 87.5	0,041 YSI-556 an 15:11 2.58 0.5 2.00 24.6 2.70 43.3	0.163 d LaMotte 2 a.58 a.75 a.co 505 25.4 2.81 35.8	020 Readings 15: 21 2.58 1.61 2.65 443 2.65 2.94 31.4	15:24 2:50 1:25 391 2:65 294 30.4	15:31 258 15 200 312 26.4 2.93 26.4 2.93 26.8	252 20 200
Units 24 hr feet gal mL / min NTU % mg/L MeV mS/cm ^c	V (gal / ft) 15.04 2.46 200 >1000 32.1 3.46 87.5 0.965	0,041 YSI-556 an 15:11 2.58 0.5 2.00 71000 2.4.6 2.70 4133 0.9,23	0.163 d LaMotte 2 2.58 0.75 2.55 2.55 2.55 2.54 2.81 3.58 0.927	020 Readings 15: 21 2.58 1 G.1 2.65 1 G.1 2.65 2.94 31.4 0.927	15:26 2:58 1:25 2:65 391 2:65 2:94 3:0,4 6:928	15:31 258 1.5 205 258 2.5 2.5 2.6 4 2.93 2.6 5 2.6 5 2.6 5 2.6 5 2.5 7 2.6 5 7 2.6 7 2.5 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7	25,80 330 22
Units 24 hr feet gal mL / min NTU % mg/L MeV mS/cm ^c mS/cm	V (gal / ft) 15 0 4 200 200 200 200 200 200 200 20	0,041 YSI-556 an 15:11 2.58 0.5 2.00 51000 2.4.6 2.70 43.3 0.9,23 0.9,23 0.676	0.163 d LaMotte 2 2.58 0.75 2.55 2.5.4 2.61 3.5.8 C 9.27 0.65	020 Readings 15: 21 2.58 1 G.1 2.00 443 2.65 2.94 31.4 0.927 0.074	15:26 2:58 1:25 2:65 391 26:5 294 30:4 6:928 0.673	15:31 258 12 200 372 200 372 200 372 200 203 200 20 20 20 20 20 20 20 20 20 20 20 20	252 20 200
Units 24 hr feet gal mL / min NTU % mg/L MeV mS/cm ^c mS/cm pH unit	V (gal / ft) 15 0 (2 4 6 2 00 2 0 2	0,041 YSI-556 an 15:11 2.58 0.5 2.00 51000 2.4.6 2.70 43.3 0.9,23 0.9,23 0.9,23 0.676 R.56	0.163 d LaMotte 2 2.58 0.75 2.58 0.75 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2	020 Readings 15! 21 2.58 7 G.1 2.00 443 2.65 2.94 31.4 0.927 0.674 9.72	15:26 2:58 1:25 2:65 391 2:6.5 2:94 30.4 6:928 0.673 7:69	15:31 258 15 200 312 200 312 200 312 200 203 200 203 200 203 200 203 200 203 200 203 200 203 200 203 200 203 200 203 200 200	25,80 200 200
Units 24 hr feet gal mL / min NTU % mg/L MeV mS/cm ^c mS/cm	V (gal / ft) 15 0 4 200 200 200 200 200 200 200 20	0,041 YSI-556 an 15:11 2.58 0.5 2.00 51000 2.4.6 2.70 43.3 0.9,23 0.9,23 0.676	0.163 d LaMotte 2 2.58 0.75 2.55 2.5.4 2.61 3.5.8 C 9.27 0.65	020 Readings 15: 21 2.58 1 G.1 2.00 443 2.65 2.94 31.4 0.927 0.074	15:26 2:58 1:25 2:65 391 26:5 294 30:4 6:928 0.673	15:31 258 12 200 372 200 372 200 372 200 203 200 20 20 20 20 20 20 20 20 20 20 20 20	25,80 330 22
i) 11 11):	ng: I = C(3.14159)(0.5D) ² (7.4); p/Tubing (ft): 37088)	ng: I = C(3.14159)(0.5D) ² (7.48)): np/Tubing (ft): 37088) Conversion	ng: I = C(3.14159)(0.5D) ² (7.48) p; pp/Tubing (ft): 37088) Conversion factors to de	DCC): $Q \cdot O \gamma$ feetng:feetfeet $I = C(3.14159)(0.5D)^2(7.48)$ galp:feetnp/Tubing (ft):feet37088)galConversion factors to determine V g	DCC): $Q_{-0} q_{-1}$ feet2-inchng:feetfeet3-inch $I = C(3.14159)(0.5D)^2(7.48)$ gal4-inch0:feetgal6-inchmp/Tubing (ft):galgal37088)galConversion factors to determine V given C	DOC): $Q.O.7$ feet 2-inch 0.17 $ng:$ feet 3-inch 0.25 $I = C(3.14159)(0.5D)^2(7.48)$ gal 4-inch 0.33 $p:$ feet 6-inch 0.50 $np/Tubing (ft)$: gal 6-inch 0.50 gal gal 0.50 0.50 $Goversion factors to determine V given C 0.50 0.50 $

Monitoring Well Number: Samplers: Sample Number: Purging / Sampling Method: 1. L = Total Well Depth:		BIW- 3	35		60279	0080.3	
Sample Number: Purging / Sampling Method: 1. L = Total Well Depth:		Mark Howa		Date	11/280	112	
Purging / Sampling Method: 1. L = Total Well Depth:		a contra a contra	rd and Sam I	Rowe			
1. L = Total Well Depth:		PIW-:	35112812	QA/Q	C Collected?	iva	
No. We want to be a set of the se					oing/Low-Flov		
2. D = Riser Diameter (I.D.): 3. W = Static Depth to Water (T 4. C = Column of Water in Casi 5. V = Volume of Water in Wel 6. D2 = Pump Setting Depth (ft 7. C2 = Column of water in Pum 8. Tubing Volume = C2(0.0057)	ing: 11 = C(3.14159 t): mp/Tubing (ft		8)		feet feet feet gal feet feet gal	D (inches) 1-inch 2-inch 3-inch 4-inch 6-inch	D (feet) 0.08 0.17 0.25 0.33 0.50
			Conversion	factors to d	etermine V giv	ven C	
		D (inches)	1-inch	2-inch	3-inch	4-inch	6-inch
Water Quality Readings Collect	ted Using	V (gal / ft)	0.041 YSI-556 an	0.163 d LaMotte 2	0.37	0.65	1.5
Parameter	ted Using Units			d LaMotte 2	2020 Readings	0.03	1.0
Parameter Time	Units 24 hr	15:41	YSI-556 an	d LaMotte 2	2020 Readings	0.03	1.0
Parameter Time Vater Level (0.33)	Units 24 hr feet	15:41	YSI-556 an	d LaMotte 2	Readings	0.05	1.0
Parameter Time Vater Level (0.33) Volume Purged	Units 24 hr feet gal	15:41 2.58 1.90	YSI-556 an	d LaMotte 2	Readings	0.05	1
Parameter Time Vater Level (0.33) Volume Purged Tlow Rate	Units 24 hr feet gal mL / min	15:41 2:58 1.90	YSI-556 an 15 4 C 2.58 2.25	d LaMotte 2 15:51 2.58 2.50 2.00	Readings 15:56 2:58 2:75 2:00	0.05	
Parameter Fime Water Level (0.33) Volume Purged Flow Rate Furbidity (+/- 10%)	Units 24 hr feet gal mL / min NTU	15:41 2:58 1.90	YSI-556 an 15 4 C 2.58 2.25	d LaMotte 2 15:51 2.58 2.50 2.50 2.51	Readings 15:56 2:58 2:75 2:00 2/6	0.03	
Parameter Time Vater Level (0.33) /olume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%)	Units 24 hr feet gal mL / min NTU %	15:41 2:58 1.90	YSI-556 an 15 4 C 2.58 2.25	d LaMotte 2 15:51 2.58 2.50 2.50 2.51	Readings 15:56 2:58 2:75 2:00 2/6	0.05	
Parameter Fime Water Level (0.33) Volume Purged Flow Rate Furbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%)	Units 24 hr feet gal mL / min NTU % mg/L	15:41 2:58 2.90 374 262 2.90	YSI-556 an 15 4 C 2.58 2.25 2.25 2.00 2.58 2.25 2.00 2.58 2.25 2.00 2.58 2.00 2.58 2.00 2.58 2.00 2.58 2.00	d LaMotte 2 15:51 2 58 2 50 25 25 25 25 3 07	Readings 15:56 2:58 2:75 2:00 2/6 2:6.1 3:11	0.03	
Parameter Fime Water Level (0.33) Volume Purged Flow Rate Furbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%)	Units 24 hr feet gal mL / min NTU %	15:41 2:58 2:90 2:00 374 2:62 2:90 2:40 2:40 2:40	YSI-556 an	d LaMotte 2 15:51 2 58 250 251 27.6 3 07 20.9	Readings 15:56 2:58 2:58 2:58 2:58 2:58 2:58 2:58 2:58 2:58 2:58 2:58 2:58 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2:56 2	0.03	
Parameter Fime Vater Level (0.33) Volume Purged Flow Rate Furbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10)	Units 24 hr feet gal mL / min NTU % mg/L	15:41 2:58 2:90 2:00 374 2:62 2:90 2:40 2:40 2:40	YSI-556 an 15 4 C 2.58 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.35 2.35 2.35 2.35 2.35 2.35 2.35 2.35 2.35 2.35 2.35 2.35 2.35 2.35 2.35 2.35 2.35 2.35 2.35 2.35 2.35 2.35 2.35 2.35 2.35 2.35 2.35 2.35 2.35 2.35 2.35 2.35 2.35 2.35 2.35 2.35 2.35 2.35 2.35 2.35 2.35 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55	d LaMotte 2 15:51 2:58 2:50 2:51 2:7-6 3:07 2:0.9 0.930	Readings 15:50 2-58 2-58 2-55 200 2 6 -28-1 3-11 21-4 0-930	0.05	
Parameter Fime Vater Level (0.33) Volume Purged Flow Rate Furbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10) Specific Conductivity Conductivity (+/- 3%)	Units 24 hr feet gal mL / min NTU % mg/L MeV	15:41 2.58 1.90 374 26.2 2.90 24.6 0.929 0.675	YSI-556 an 15 4 C 2.58 2.25 2.25 2.25 2.00 2.61 7 3.00 2.31 0.929 6.67	d LaMotte 2 15:51 2.58 2.50 2.50 2.51 2.7.6 3.07 2.0.9 0.930 0.671	Readings 15:50 2-58 2-58 2-58 2-55 200 2 6 -28-1 3-11 21-4 0-930	0.03	
Parameter Fime Vater Level (0.33) Volume Purged Flow Rate Furbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10) Specific Conductivity Conductivity (+/- 3%) H (+/- 0.1)	Units 24 hr feet gal mL / min NTU % mg/L MeV mS/cm ^c mS/cm pH unit	15:41 2,58 1.90 374 26.90 374 2.90 24.9 0.929	YSI-556 an 15 4 C 2.58 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.35 2.35 2.35 2.35 2.35 2.35 2.35 2.35 2.35 2.35 2.35 2.35 2.35 2.35 2.35 2.35 2.35 2.35 2.35 2.35 2.35 2.35 2.35 2.35 2.35 2.35 2.35 2.35 2.35 2.35 2.35 2.35 2.35 2.35 2.35 2.35 2.35 2.35 2.35 2.35 2.35 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55 2.55	d LaMotte 2 15:51 2.58 2.50 25 25 2.50 25 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.57 2.57 2.09 0.930 0.930 0.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.	Readings 15:56 2.58 2.75 2.00 2.6 2.6 3.11 3.1.4 0.930 0.672 7.71	0.03	
Parameter Fime Water Level (0.33) Volume Purged Flow Rate Furbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10) Specific Conductivity Conductivity (+/- 3%) SH (+/- 0.1) Femp (+/- 0.5)	Units 24 hr feet gal mL / min NTU % mg/L MeV mS/cm ^c mS/cm	15:41 2.58 1.90 374 26.2 2.90 24.6 0.929 0.675	YSI-556 an 15 4 C 2.58 2.25 2.25 2.25 2.00 2.61 7 3.00 2.31 0.929 6.67	d LaMotte 2 15:51 2.58 2.50 2.50 2.51 2.7.6 3.07 2.0.9 0.930 0.671	Readings 15:50 2-58 2-58 2-58 2-55 200 2 6 -28-1 3-11 21-4 0-930	0.03	
Parameter Fime Water Level (0.33) Volume Purged Flow Rate Furbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10) Specific Conductivity Conductivity (+/- 3%) DH (+/- 0.1)	Units 24 hr feet gal mL / min NTU % mg/L MeV mS/cm ^c mS/cm pH unit	15:41 2.58 1.90 2.00 374 26.2 2.90 24.0 0.929 0.675 7.72	YSI-556 an 15 4C 2.58 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.25 2.31 0.0129 2.673 7.72	d LaMotte 2 15:51 2.58 2.50 25 25 2.50 25 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.57 2.57 2.09 0.930 0.930 0.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.57 2.	Readings 15:56 2.58 2.75 2.00 2.6 2.6 3.11 3.1.4 0.930 0.672 7.71	0.03	

Project Name and Number:		Former Dus	o Chemical	Company	6027	9080.3		
Monitoring Well Number:		BIW-	35	Date	1/29	12		
Samplers:		Mark Howa	rd and Sam	Rowe				
Sample Number:		BFW-3	0112912	QA/Q	C Collected?	No		
Purging / Sampling Method:		Peristaltic P	ump with D	edicated Tul	oing/Low-Flo	w		
 L = Total Well Depth: D = Riser Diameter (I.D.): W = Static Depth to Water (7) C = Column of Water in Cas V = Volume of Water in We D2 = Pump Setting Depth (fit C2 = Column of water in Put Tubing Volume = C2(0.0057) 	ing: = C(3.1415): np/Tubing (ft		8)	23.49	feet feet feet gal feet feet gal	D (inches 1-inch 2-inch 3-inch 4-inch 6-inch) D (feet) 0.08 0.19 0.25 0.33 0.50	
		D (inches)	1-inch	2-inch	etermine V g	4-inch	6-inch	1
		V (gal / ft)	0.041	0.163	0.37	0.65	1.5	1
				~				
Water Quality Readings Collec	ted Ilsing		VS1.556 au	ad LaMotte	0000			
Water Quality Readings Collec	ted Using		YSI-556 at	nd LaMotte 2	2020	-)		
Parameter	Units				Readings	-		
Parameter Time	Units 24 hr	13:17	13:22	13:27	Readings	13.37	15:42	
Parameter Time Water Level (0.33)	Units 24 hr feet	13:17 4:35	322	13:27	Readings	4.36	4.36	4.3
Parameter Time Water Level (0.33) Volume Purged	Units 24 hr feet gal		322 436 05	13:27 4.36 0.75	Readings	4.36	4.36	4.3
Parameter Time Water Level (0.33) Volume Purged Flow Rate	Units 24 hr feet gal mL / min	120	320	13:27 4.36 0.75 120	Readings 13-32 4-36 1.0 120	436	4.36	4.3
Water Quality Readings Collec Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dia Level (0.4 10%)	Units 24 hr feet gal mL / min NTU	120	320	13:27 4.36 0.75 120 50.5	Readings 13.32 4.36 1.0 120 31.6	436	4.36	3.3.5
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%)	Units 24 hr feet gal mL / min NTU %	120 258 297	3405	13:27 4.36 0.75 120 50.5 8.0	Readings 13.32 4.36 1.0 120 31.6 6.3	436 1.20 120 238 6.7	4.30	4.3.5
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%)	Units 24 hr feet gal mL / min NTU % mg/L	120 258 297	3 28 4 0.5 1205 175 11.0 1.14	13:27 4.36 0.75 120 50.5 8.0 0.81	Readings 13.32 4.36 1.0 120 31.6 6.3 0.64	4.36 1.20 120 238 6.7 0.68	4.36	4.5.5
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10)	Units 24 hr feet gal mL / min NTU % mg/L MeV	120	3405050	13:27 4.36 0.75 120 50.5 8.0 0.81 14.4	Readings 13.32 4.36 1.0 120 31.6 6.3 0.64 12.9	4.36 1.20 120 23.8 4.5 0.68 12.0	4.36	4.3.5
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10) Specific Conductivity	Units 24 hr feet gal mL / min NTU % mg/L MeV mS/cm ^c	120 2587 3.15 3.15 5 0.996	328 4050 1750 1750 1.14 19.3 1.027	13:27 4.36 0.75 120 50.5 8.0 0.81 14.4 1.041	Readings 13.32 4.36 1.0 120 31.6 6.3 0.64 12.9 1.062	4.36 1.20 120 23.8 6.68 12.0 1.088 1.088	4.30	4.3.5
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10) Specific Conductivity Conductivity (+/- 3%)	Units 24 hr feet gal mL / min NTU % mg/L MeV mS/cm ^c mS/cm	120 258 297 3.15 44.5 0.996 0.773	322 436 120 175 1.14 19.3 1.027 0.207	13:27 4.36 0.75 120 50.5 8.0 0.81 14.4 1.041 0.824	Readings 13.32 4.36 1.0 120 31.6 6.3 0.64 12.9 1.062 0.823	4.36 1.20 120 23.8 6.68 12.0 1.088 0.862	4.36 1400 19.41 6.66 9.66 1.166 1.166 0.875	4.3.5.125.125.125.125.125.125.125.125.125.1
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10) Specific Conductivity Conductivity (+/- 3%) pH (+/- 0.1)	Units 24 hr feet gal mL / min NTU % mg/L MeV mS/cm ^c mS/cm pH unit	120 258 258 258 255 3.15 5 0.996 0.773 245	322 436 120 175 110 1.14 19.3 1.027 0.807 8.95	13:27 4.36 0.75 120 50.5 8.0 0.81 14.4 1.041 0.824 8.92	Readings 13.32 4.36 1.0 120 31.6 6.3 0.64 12.9 1.062 0.62 0.62 8.78	4.36 1.20 1.20 1.20 2.3 & 6.68 1.08 1.088 1.088 0.862 8.65	4.36 1400 19.41 0.66 9.66 1.66 1.66 1.66 0.875 0.56	4.1.5
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10) Specific Conductivity Conductivity (+/- 3%) pH (+/- 0.1) Temp (+/- 0.5)	Units 24 hr feet gal mL / min NTU % mg/L MeV mS/cm ^c mS/cm pH unit C	120 2587 3.15 44.5 0.996 0.773 2.45 0.773 2.45 0.773 2.45 0.773 2.45	322 436 05 120 175 110 1.14 19.3 1.027 0.807 8.95 13.77	13:27 4.36 0.75 120 50.5 8.0 0.81 14.4 1.041 0.824 8.92 14.12	Readings 13.32 4.36 1.0 120 31.6 6.3 0.64 12.9 1.062 0.823 8.76 14.25	4.36 1.20 1.20 2.3 & 4.7 0.68 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00	4.36 140 19.9 6.7 6.8 9.66 9.66 1.186 1.186 1.186 1.186 1.186 1.186 1.186 1.186 1.186 1.107	4.1.2 15 5. 5. 7. 1.1000 4
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10) Specific Conductivity Conductivity (+/- 3%) pH (+/- 0.1) Temp (+/- 0.5) Color	Units 24 hr feet gal mL / min NTU % mg/L MeV mS/cm ^c mS/cm pH unit C Visual	120 2587 3.15 44.5 0.773 2.3.20 0.773 2.3.20 Clary	322 405 1205 1205 11.0 1.14 10.27 0.207 8.95 13.75 Cley	13:27 4.36 0.75 120 50.5 8.0 0.81 14.4 1.041 0.824 8.92	Readings 13.32 4.36 1.0 120 31.6 6.3 0.64 12.9 1.062 0.823 8.76 14.25 Clear	4.36 1.20 120 238 4.7 0.68 12.0 1.088 0.862 8.65 8.65 14.14 Clear	4.36 140 190 19.9 6.7 0.66 9.66 9.66 1.166 0.875 8.56 14.07 Clear	4.1.5 15.5.5 7.1.1 0.02 4 0
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10) Specific Conductivity	Units 24 hr feet gal mL / min NTU % mg/L MeV mS/cm ^c mS/cm pH unit C	120 2587 3.15 44.5 0.996 0.773 2.45 0.773 2.45 0.773 2.45 0.773 2.45	322 436 05 120 175 110 1.14 19.3 1.027 0.807 8.95 13.77	13:27 4.36 0.75 120 50.5 8.0 0.81 14.4 1.041 0.824 8.92 14.12	Readings 13.32 4.36 1.0 120 31.6 6.3 0.64 12.9 1.062 0.823 8.76 14.25	4.36 1.20 1.20 2.3 & 4.7 0.68 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00	4.36 140 19.9 6.7 6.8 9.66 9.66 1.186 1.186 1.186 1.186 1.186 1.186 1.186 1.186 1.186 1.107	4.1.5 15.5.5 7.1.1 0.02 4 0
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10) Specific Conductivity Conductivity (+/- 3%) pH (+/- 0.1) Temp (+/- 0.5) Color	Units 24 hr feet gal mL / min NTU % mg/L MeV mS/cm ^c mS/cm pH unit C Visual Olfactory	120 258 3.15 44.5 0.996 0.773 2.45 0.773 2.45 13.20 Clarky Chlo	322 405 1205 1205 11.0 1.14 10.27 0.207 8.95 13.75 Cley	13:27 4.36 0.75 120 50.5 8.0 0.81 14.4 1.041 0.824 8.92 14.12	Readings 13.32 4.36 1.0 120 31.6 6.3 0.64 12.9 1.062 0.823 8.76 14.25 Clear	4.36 1.20 120 238 4.7 0.68 12.0 1.088 0.862 8.65 8.65 14.14 Clear	4.36 140 190 19.9 6.7 0.66 9.66 9.66 1.166 0.875 8.56 14.07 Clear	4.3.5

Project Name and Number:		Former Dus	o Chemical	Company	6027	9080.3		
Monitoring Well Number:		BIW-	30	Date	11/2	9/12		
Samplers:		Mark Howa	and Sam	Rowe	/			
Sample Number:		BEW-	30112912	QA/Q	C Collected?	Klo		
Purging / Sampling Method:		Peristaltic I	ump with D	edicated Tul	oing/Low-Flo	w		
1. L = Total Well Depth:					feet	D (inches)	D (feet)	1
2. $D = Riser Diameter (I.D.)$:				1	feet	1-inch	0.08	
3. $W = $ Static Depth to Water (TOC):			3	feet	2-inch	0.17	
4. $C = Column of Water in Cas$				-	feet	3-inch	0.25	
5. $V = Volume of Water in We$		$(9)(0.5D)^2(7.4)$	(8)		gal	4-inch	0.33	
6. $D2 = Pump$ Setting Depth (f)		(0.0D) (1.4			-gai feet	6-inch	0.50	
7. $C2 = Column of water in Put$	A CONTRACTOR OF A CONTRACTOR O	t):			feet	L	0.00	1
8. Tubing Volume = $C2(0.0057)$					- gal			
	- inter				- 8			
			Conversion	factors to d	etermine V g	iven C		
		D.C. L.				1		1
		D (inches)	1-inch 0.041	2-inch	3-inch	4-inch	6-inch	
		V (gal / ft)	0.041	0.163	0.37	0.65	1.5	1
Water Quality Readings Collec Parameter	Units	-		nd LaMotte 2	Readings	-		
Гime	24 hr	13:52	13-57 4.36	14:02	14:07			
Water Level (0.33)	feet	1.36		4.36	4.36			
Volume Purged	gal	1:70	20	2.25	2.50			
Flow Rate	mL/min	120	120	120	120			
Turbidity (+/- 10%)	NTU	14.7	13.5	13.0	8.67			100
Dissolved Oxygen (+/- 10%)	%		4.1	3.7 C 38	3.6			
Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10)	mg/L	0.46	8-2	0.58	0.36			
enterstand	MeV	29	5-2	7.8	1.1.			
Specific Conductivity	mS/cm ^c	1.119	1124	1.130	1.132			
Conductivity (+/- 3%)	mS/cm	0,683	0.829	0.895	0.295			
oH (+/- 0.1)	pH unit	8.41	8.36	8.31	8.51			
Гетр (+/- 0.5)	C	13.92	and the second se	14.07	14.11 Clea			
Color Odor	Visual	Clear	Clear	Clear	Chlo			
540I	Olfactory	chic	CAG	chlo	chia			
Comments: Scarp	hed c	2) 14	:c7					

Project Name and Number:		Former Dus	o Chemical	Company	6027	9080.3		
Monitoring Well Number:		BIW-4		Date:	11/29	/12		
Samplers:		Mark Howa	rd and Sam	Rowe	_			_
Sample Number:		BIW-	4112912	QA/Q0	C Collected?	No		
Purging / Sampling Method:		Peristaltic P	ump with De	edicated Tub	ing/Low-Flo	w		
 L = Total Well Depth: D = Riser Diameter (I.D.): W = Static Depth to Water (C C = Column of Water in Cas V = Volume of Water in We D2 = Pump Setting Depth (ft C2 = Column of water in Put Tubing Volume = C2(0.0057) 	ing: I = C(3.1415 t): mp/Tubing (fi			10.96 <u>C 17</u> <u>3.91</u> <u>9.96</u> factors-to-de	feet feet gal feet gal feet gal	D (inches) 1-inch 2-inch 3-inch 4-inch 6-inch	D (feet) 0.08 0.17 0.25 0.33 0.50	
		D (inches) V (gal / ft)	1-inch 0.041	2-inch 0.163	3-inch 0.37	4-inch 0.65	6-inch	1
Water Quality Readings Collec Parameter	ted Using Units			d LaMotte 2	020 Readings	-		
Parameter Time		10:47	10:52	10.57	Readings	11:07	11.12	11:
Parameter Time Water Level (0.33)	Units 24 hr feet			10.57	Readings	4.50	4.5	11.
Parameter Time Water Level (0.33) Volume Purged	Units 24 hr	4.50	10:52 4.50 0.25	10.57 4.50 0.50	Readings	4.50	4.5	1.
Parameter Time Water Level (0.33) Volume Purged Flow Rate	Units 24 hr feet gal mL / min	4.50	10:52 4.50 0.25 100	10.57 4.50 0.50 100	Readings 11°C 2 4.50 0.70 100	4.50 0.80 100	4.5 1.0 100	1.2
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%)	Units 24 hr feet gal mL / min NTU	4.50 100 71000	10:52 4.50 0.25 100 490	10.57 4.50 0.50 100 474	Readings 11°C 2 4.50 0.70 100 535	4.50 0.80 100 564	4.5 1.0 100 611	10
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%)	Units 24 hr feet gal mL / min NTU %	4.50 100 71000 100.6	10:52 4.50 0.25 100 490 -11.7	10.57 4.50 0.50 100 474 37.6	Readings 11°C 2 4.50 0.70 100 535	4.50 0.80 100 564 34.5	4.5 1.0 100 611 34.2	1-4-10-152
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%)	Units 24 hr feet gal mL / min NTU % mg/L	4.50 100 71000 1000 1000	10:52 4.50 0.25 100 490 490 41.7 41.76	10.57 4.50 0.50 100 474 37.6 4.25	Readings 11°C 2 4.50 0.70 100 536 34,5 34,5 3,87	4.50 0.80 100 564 34.5 3.88	4.5 1.0 100 611 34.2 3.80	10523
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%)	Units 24 hr feet gal mL / min NTU % mg/L MeV	450	10:52 4.50 0.25 100 490 490 41.7 41.76 41.76	10.57 4.50 0.50 100 474 37.6 4.25 15.6	Readings 11.0 2 4.50 0.70 100 535 34.5 3.87 14.9	4.50 0.80 100 564 34.5 3.80 13.8	4.5 1.0 100 611 34.2 3.80 15.9	10 52315
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%)	Units 24 hr feet gal mL / min NTU % mg/L	4.50 100 71000 1000 1000	10:52 4.50 0.25 100 490 490 41.7 41.76	10.57 4.50 0.50 100 474 37.6 4.25	Readings 11°C 2 4.50 0.70 100 536 34,5 34,5 3,87	4.50 0.80 100 564 34.5 3.88	4.5 1.0 100 611 34.2 3.80 15.9 0.995	105235
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10) Specific Conductivity Conductivity (+/- 3%)	Units 24 hr feet gal mL / min NTU % mg/L MeV	450 100 1000 1000 1000 24.0 0.487 0.487	10:52 4.50 0.25 100 490 4.70 4.76 4.76 4.76 4.76 0.694 0.699	10.57 4.50 0.50 100 474 37.6 474 37.6 4.25 15.6 0.992 0.703	Readings 11°C°2 4.50 0.70 100 535 34.5 3.87 14.9 0.994 0.994 0.707	4.50 100 564 34.5 3.88 13.8 0.996 0.713	4.5 1.0 100 611 34.2 3.80 15.9 0.995 0.995 0.920	10 632 315 00
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10) Specific Conductivity Conductivity (+/- 3%) pH (+/- 0.1)	Units 24 hr feet gal mL / min NTU % mg/L MeV mS/cm ^c mS/cm pH unit	4.50 100 7000 1000 1000 1000 1000 1000 100	10:52 4.50 100 490 490 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 4	10.57 4.50 0.50 100 474 37.6 474 37.6 4.25 15.6 0.992 0.703 7.69	Readings 11°C 2 4.50 0.70 100 535 34.5 34.5 3.87 14.9 0.994 0.994 0.707 7.71	4.50 0.80 100 564 34.5 3.88 13.8 0.996	4.5 1.0 100 611 34.2 3.80 15.9 0.995	10 632 315 00
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10) Specific Conductivity Conductivity (+/- 3%)	Units 24 hr feet gal mL / min NTU % mg/L MeV mS/cm ^c mS/cm pH unit C	450 100 1000 1000 1000 24.0 0.487 0.487	10:52 4.50 0.25 100 490 41.7 4.76 4.76 4.76 0.694 0.699 7.69 7.69 9.39	10.57 4.50 0.50 100 474 37.6 474 37.6 4.25 15.6 0.997 0.703 7.69 9.74	Readings 11°C 2 4.50 0.70 100 536 34.5 3,87 149 0.994 0.994 0.994 0.707 7-71 9.91	4.50 0.80 100 564 34.5 3.88 0.996 0.713 7.69 10.0	4.5 1.0 100 611 34.2 3.80 15.9 0.995 0.995 0.920	100000000000000000000000000000000000000
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10) Specific Conductivity Conductivity (+/- 3%) pH (+/- 0.1)	Units 24 hr feet gal mL / min NTU % mg/L MeV mS/cm ^c mS/cm pH unit C Visual	4.50 100 71000 1000 1000 24.0 0.487 0.487 7.66 870 0.487 7.66	10:52 4.50 0.25 100 490 41.7 4.76 4.76 4.76 0.694 0.699 7.69 7.69 9.39	10.57 4.50 0.50 100 474 37.6 474 37.6 4.25 15.6 0.992 0.703 7.69	Readings 11°C 2 4.50 0.70 100 535 34.5 3.87 14.9 0.994 0.994 0.994 0.994 0.994 0.994 0.907 7.71 9.91 0.91	4.50 0.80 100 564 34.5 3.80 13.8 0.996 0.713 7.69 10.11 Clauby	4.5 1.0 100 611 34.2 3.80 15.9 0.995 0.720 7.64 10.56	100523150071
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10) Specific Conductivity Conductivity (+/- 3%) pH (+/- 0.1) Temp (+/- 0.5)	Units 24 hr feet gal mL / min NTU % mg/L MeV mS/cm ^c mS/cm pH unit C	4.50 100 100 100 100 100 100 100 100 100 1	10:52 4.50 100 490 490 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 41.70 4	10.57 4.50 0.50 100 474 37.6 474 37.6 4.25 15.6 0.997 0.703 7.69 9.74	Readings 11°C 2 4.50 0.70 100 536 34.5 3,87 149 0.994 0.994 0.994 0.707 7-71 9.91	4.50 0.80 100 564 34.5 3.88 0.996 0.713 7.69 10.0	4.5 1.0 100 611 34.2 3.80 15.9 0.995 0.720 7.64	1.052315 00710
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10) Specific Conductivity Conductivity (+/- 3%) pH (+/- 0.1) Temp (+/- 0.5) Color	Units 24 hr feet gal mL / min NTU % mg/L MeV mS/cm ^c mS/cm pH unit C Visual	4.50 100 7000 1000 1000 1000 700 24.0 0.087 0.087 7.66 870 0.084 7.66 870 0.084 7.66	10:52 4.50 0.25 100 490 41.7 4.76 41.76 41.76 41.76 41.76 41.76 7.69 7.69 9.39 Cloud	10.57 4.50 0.50 100 474 376 474 376 4.25 15.6 0.703 7.69 7.69 9.74 0.74	Readings 11°C 2 4.50 0.70 100 535 34.5 3.87 14.9 0.994 0.994 0.994 0.994 0.994 0.994 0.907 7.71 9.91 0.91	4.50 0.80 100 564 34.5 3.80 13.8 0.996 0.713 7.69 10.11 Clauby	4.5 1.0 100 611 34.2 3.80 15.9 0.720 7.64 10.56 Clauby	10

Project Name and Number:		Former Dusc	o Chemical	Company	60279	0080.3	
Monitoring Well Number:		BIW-	4	Date	11/29/	12	4
Samplers:		Mark Howar	d and Sam	Rowe			
Sample Number:		BIW-41	12912	QA/Q	C Collected?	IVO	
Purging / Sampling Method:		Peristaltic Pu	ump with De	edicated Tub	oing/Low-Flow	V	
1. L = Total Well Depth:					feet	D (inches)	D (feet)
2. $D = Riser Diameter (I.D.)$:				-	feet	1-inch	0.08
3. $W = $ Static Depth to Water (7)	FOC)			-	feet	2-inch	0.17
4. $C = Column of Water in Cast$				-	feet	3-inch	0.25
5. $V = Volume of Water in Wel$	-	$9)(0.5D)^{2}(7.45)$	8)		gal	4-inch	0.33
6. $D2 = Pump$ Setting Depth (ft		2)(0.22) (1.40	<i>.</i> ,	-	- gai feet	6-inch	0.50
7. $C2 = Column of water in Pur$		t):			feet	omen	0.00
8. Tubing Volume = $C2(0.0057)$.,.		-	- gal		
or theory of the contract of t							
			Conversion	factors to de	etermine V giv	ven C	
		D (inches)	1-inch	2-inch	3-inch	4-inch	6-inch
		V (gal / ft)	0.041	0.163	0.37	0.65	1.5
Water Quality Readings Collect	ted Using			d LaMotte 2	:020		
Parameter	Units		YSI-556 an	d LaMotte 2	Readings		
Parameter Time	Units 24 hr	11:22	YSI-556 an	d LaMotte 2	Readings		
Parameter Time Water Level (0.33)	Units 24 hr feet	11:22	YSI-556 an	d LaMotte 2	Readings		
Parameter Time Water Level (0.33) Volume Purged	Units 24 hr feet gal	11:22	YSI-556 an	d LaMotte 2	Readings		
Parameter Time Water Level (0.33) Volume Purged Flow Rate	Units 24 hr feet gal mL / min	1:22	YSI-556 an 4.37 1-4 0 100	d LaMotte 2	Readings 11:317 4-5 2-10 100		
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%)	Units 24 hr feet gal mL / min NTU	1:22 4.50 1.50 1.50 1.50	YSI-556 an 4.37 1-4 0 100	d LaMotte 2	Readings 11:37 4.5 2.10 100 573		
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%)	Units 24 hr feet gal mL / min NTU %	1:22 4.50 1.50 1.00 570 31-4	YSI-556 an H: 27 H.5 I-4 C I-6 C I-6 C I-6 C I-6 C I-6 C I-6 C I-6 C	d LaMotte 2 11:32 4.5 1.66 1.66 1.66 1.66 1.66 1.66 1.66 1.66 1.66	Readings		
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%)	Units 24 hr feet gal mL / min NTU % mg/L	11:22 4.50 1.50 1.00 51.7 31.7 31.7 31.7	YSI-556 an H: 27 H: 5 I-4 C I-4 C I-6 C I-7 C I-6 C I-7 C	d LaMotte 2 11:32 4.5 1.80 1.80 1.60 641 31.3 3.45	Readings 4.5 7.10 100 573 309 8.37		
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10)	Units 24 hr feet gal mL / min NTU % mg/L MeV	1:22 4:50 1:50 1:00 3:1-4 3:5-4 3:5-4 1:5-2	YSI-556 an H: 27 H.5 I-4 0 I 0 0 0 0 0 1-4 0 1-6 0 1-6 0 1-6 0 1-6 0 1-6 0 1-6 0 1-6 0 1-6 0 1-6 0 1-6 0 1-6 0 1-6 0 1-6 0 1-6 0 1-6 0 1-6 0 1-6 0 1-6 0 1-6 0 1-6 0 1-6 0 1-6 0 1-6 0 1-6 0 1-6 0 1-6 0 1-6 0 1-6 0 1-6 0 1-6 0 1-6 0 1-6 0 1-6 0 1-6 0 1-6 0 1-6 0 1-6 0 1-6 0 1-6 0 1-6 0 1-6 0 1-6 0 1-6 0 1-6 1-6 1-6 1-6 1-6 1-6 1-6 1-6	d LaMotte 2 11:32 4.5 1.80 100 641 31.3 3.45 17.3	Readings		
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10) Specific Conductivity	Units 24 hr feet gal mL / min NTU % mg/L MeV mS/cm ^c	11:22 4.50 1.50 1.50 1.00 51.7 3.17 3.17 1.52 0.997	YSI-556 an 1.27 4.5 1.40 100 667 31.9 3.50 15.6 0.997	d LaMotte 2 11:32 4.5 1.8c 1.6c 641 31.3 3.45 17.3 0.997	Readings 11:37 4.5 2.10 100 573 309 3.37 18.4 0.996		
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10) Specific Conductivity Conductivity (+/- 3%)	Units 24 hr feet gal mL / min NTU % mg/L MeV mS/cm ^c mS/cm	11:22 4.50 1.50 1.50 1.50 1.50 3.1.4 3.1.4 1.5.2 0.997 0.732	YSI-556 an 1.27 4.5 1-4 0 100 667 31.9 3.50 15-6 0.997 0.733	d LaMotte 2 11:32 4.5 1.8c 1cc 641 31.3 3.45 17.3 0.997 0.734	Readings 11:37 4.5 2.10 100 573 30.9 3.37 12.4 0.996 0.737		
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10) Specific Conductivity Conductivity (+/- 3%) pH (+/- 0.1)	Units 24 hr feet gal mL / min NTU % mg/L MeV mS/cm° mS/cm PH unit	11:22 4.50 1.50 1.50 1.60 670 31.4 3.14 1.5.2 0.997 0.732 7.45	YSI-556 an H: 27 H.5 I-4 C I C C C C C I C C C C C I C C C C C C C I C C C C C C C C I C C C C C C C C C C C C C C C C C C C	d LaMotte 2 11:32 4.5 1.8c 1.6c 641 31.3 3.45 17.3 0.997	Readings 11:37 4.5 2.10 100 573 3.07 3.37 18:4 0.996 0.737 7.63		
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10) Specific Conductivity Conductivity (+/- 3%) pH (+/- 0.1) Temp (+/- 0.5)	Units 24 hr feet gal mL / min NTU % mg/L MeV mS/cm ^c mS/cm pH unit C	1:22 4.50 1.50 1.60 31.7 3.57 0.732 7.45 1.08	YSI-556 an H: 27 H.5 I-4 C I C C I C C G G 7 31.9 3.5 C I5.6 C.997 0.733 7.64 II.15	d LaMotte 2 4.5 1.80 100 641 31.3 3.45 17.3 0.997 0.734 7.63 11.19	Readings 11:37 4:5 2:10 1:00 573 3:37 1:2.4 0:996 0:737 7:63 11:39		
Water Quality Readings Collect Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10) Specific Conductivity Conductivity (+/- 3%) pH (+/- 0.1) Temp (+/- 0.5) Color Odor	Units 24 hr feet gal mL / min NTU % mg/L MeV mS/cm° mS/cm PH unit	11:22 4.50 1.50 1.50 1.60 670 31.4 3.14 1.5.2 0.997 0.732 7.45	YSI-556 an H: 27 H.5 I-4 C I C C C C C I C C C C C I C C C C C C C I C C C C C C C C I C C C C C C C C C C C C C C C C C C C	d LaMotte 2 11:32 4.5 1.8c 1cc 641 31.3 3.45 17.3 0.997 0.734	Readings 11:37 4.5 2.10 100 573 3.07 3.37 18:4 0.996 0.737 7.63		
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10) Specific Conductivity Conductivity (+/- 3%) pH (+/- 0.1) Temp (+/- 0.5) Color Odor	Units 24 hr feet gal mL / min NTU % mg/L MeV mS/cm ^c mS/cm pH unit C Visual Olfactory	1:22 4.50 1.50 1.60 31.7 3.57 0.732 7.45 1.08	YSI-556 an H: 27 H.5 I-4 C I C C C I C C C I C C I C C I C C C C I C C C C I C C C C I C C C C I C C C I C C C C I C C C C I C C C C C C C I C C C C C C C C I C C C C C C C C C C C C C C C C C C C	d LaMotte 2 4.5 1.80 100 641 31.3 3.45 17.3 0.997 0.734 7.63 11.19	Readings 11:37 4.5 2.10 100 573 3.97 12.4 0.996 0.737 7.63 11.39 Claudy		
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10) Specific Conductivity Conductivity (+/- 3%) pH (+/- 0.1) Temp (+/- 0.5) Color Odor	Units 24 hr feet gal mL / min NTU % mg/L MeV mS/cm ^c mS/cm pH unit C Visual Olfactory	11:22 4.5 1.50 1.60 670 31-4 3.44 15.2 0.997 0.732 7.45 11.08 Clauby chio	YSI-556 an H: 27 H.5 I-4 C I C C C I C C C I C C I C C I C C C C I C C C C I C C C C I C C C C I C C C I C C C C I C C C C I C C C C C C C I C C C C C C C C I C C C C C C C C C C C C C C C C C C C	d LaMotte 2 4.5 1.80 100 641 31.3 3.45 17.3 0.997 0.734 7.63 11.19	Readings 11:37 4.5 2.10 100 573 3.97 12.4 0.996 0.737 7.63 11.39 Claudy		
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10) Specific Conductivity Conductivity (+/- 3%) pH (+/- 0.1) Temp (+/- 0.5) Color Odor	Units 24 hr feet gal mL / min NTU % mg/L MeV mS/cm ^c mS/cm pH unit C Visual Olfactory	11:22 4.5 1.50 1.60 670 31-4 3.44 15.2 0.997 0.732 7.45 11.08 Clauby chio	YSI-556 an H: 27 H.5 I-4 C I C C C I C C C I C C I C C I C C C C I C C C C I C C C C I C C C C I C C C I C C C C I C C C C I C C C C C C C I C C C C C C C C I C C C C C C C C C C C C C C C C C C C	d LaMotte 2 4.5 1.80 100 641 31.3 3.45 17.3 0.997 0.734 7.63 11.19	Readings 11:37 4.5 2.10 100 573 3.97 12.4 0.996 0.737 7.63 11.39 Claudy		

'): C(3.1415'	BIW-5 Mark Howa	rd and Sam I デラルユマルス	Date: Rowe QA/QQ edicated Tub	C Collected?	WQ w (inches)	D (feet)	
	Mark Howa	rd and Sam I ディルユマルス	QA/QO edicated Tub	C Collected? ing/Low-Flo	WQ w (inches)	D (feet)	
	BIW-5	5112712	QA/QQ edicated Tub (1.0 (0.(7	ing/Low-Flo _feet	w D (inches)	D (feet)	
			11-66 (ing/Low-Flo _feet	w D (inches)	D (feet)	
	Peristaltic P	ump with De	11.06	feet	D (inches)	D (feet)	
			0.17	-	the second se	D (feet)	
Fubing (ft 88)	9)(0.5D) ² (7.4 i):		3.64 10-41	feet gal feet feet gal	1-inch 2-inch 3-inch 4-inch 6-inch	0.08 0.17 0.25 0.33 0.50	
	D (inches) V (gal / ft)	1-inch 0.041	2-inch 0.163	3-inch 0.37	4-inch 0.65	6-inch 1.5]
Jsing		YS1-556 and	d LaMotte 2	020	-		
Units	4	1000		Readings			
	15:1)	15:17	15:22		15:37	15:37	15:42
	374		3.74	3.74	374	3:74	374
	-	0.25	05		1.0		2.0
the second se	250		250				300
NTU	520	265	89	47.5		44.5	221
			1 S	1.1.2			23.1
		5.4	3.4	2.7	4.2	53	5.0
%	17-0	265	3.4 0.37	2.7	57.0	5.3	5-0
% mg/L	17.0	0.40	0.37	0.29	0.45	5.3	0.54
% mg/L MeV	17.0	0.40	-32.3	0.29	0.45	5.3 0.57 -27.9	5.0
% mg/L MeV nS/cm ^c	17.0	0.40	0.37 -32.3 0.733	0.29 -,28.6 0.593	0.45	5.3 0.57 -27.9 0 545	5.0
% mg/L MeV mS/cm ^c mS/cm	17-0 1.73 14.6 1.729 1.252	0.40	0.37 -32.3 0.733 0.555	0.29 28.6 0.593 0.448	0.45 -29.6 0.573 0.432	5.3 0.57 - 27.9 0 545 0.410	5.0 0.54 -26.8 0.518 0.390
% mg/L MeV nS/cm ^c mS/cm ' oH unit	17-0 1.73 14.6 1.729 1.252 6.70	0.40	0.37 -32.3 0.733 0.555 7.63	0.29 28.6 0.593 0.448 7.58	0.45 -29.6 0.573 0.432 7.53	5.3 0.57 - 27.9 0 545 0 410 7.52	5.0 0.54 0.518 0.390 761
% mg/L MeV mS/cm ^c mS/cm	17-0 1.73 14.6 1.729 1.252	0.40	0.37 -32.3 0.733 0.555	0.29 28.6 0.593 0.448	0.45 -29.6 0.573 0.432	5.3 0.57 - 27.9 0 545 0.410	5.0 0.54 -26.8 0.518 0.390
	Units 24 hr feet gal L / min	V (gal / ft) Units 24 hr 15° 1.2 feet $3,74^{\circ}$ gal L / min 250°	$\begin{array}{c c c c c c c c c c c c c c c c c c c $	$\begin{array}{c c c c c c c c c c c c c c c c c c c $	$\begin{array}{c c c c c c c c c c c c c c c c c c c $	$\begin{array}{c c c c c c c c c c c c c c c c c c c $	$\begin{array}{c c c c c c c c c c c c c c c c c c c $

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Project Name and Number:		Former Dus	o Chemical C	Company	6027	9080.3		
Monitoring Well Number:		BIW-	55	Date:	11/27	/12		
Samplers:		Mark Howa	rd and Sam R	Rowe				
Sample Number:		BIW-	5711271	2 QA/QC	Collected?	No		
Purging / Sampling Method:		Peristaltic P	ump with De	dicated Tubi	ng/Low-Flo	w		
 L = Total Well Depth: D = Riser Diameter (I.D.): W = Static Depth to Water (' C = Column of Water in Cas V = Volume of Water in We D2 = Pump Setting Depth (fi C2 = Column of water in Pun Tubing Volume = C2(0.0057) 	sing: II = C(3.1415) t): mp/Tubing (ft		8) Conversion	factors to de	feet feet feet gal feet gal termine V g	D (inches) 1-inch 2-inch 3-inch 4-inch 6-inch	D (feet) 0.08 0.17 0.25 0.33 0.50	
				1				
		D (inches) V (gal / ft)	1-inch 0.041	2-inch 0.163	3-inch 0.37	4-inch 0.65	6-inch 1.5	
Water Quality Readings Collec	ted Using		YSI-556 and	LaMotte 20	020	- -		
Parameter	Units	10.47	YSI-556 and		020 Readings	-		
Parameter Time	Units 24 hr	15:47	YSI-556 and	15.57		-		
Parameter Time Water Level (0.33)	Units 24 hr feet		15:52	15:57		-		
Parameter Time Water Level (0.33) Volume Purged	Units 24 hr feet gal	3.74	15:52	15°57 3.74 2.75		-	~	
Parameter Time Water Level (0.33) Volume Purged Flow Rate	Units 24 hr feet gal mL / min	3:74 2:85 300	15:52	15°57 3.74 2.75		-	~~	
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%)	Units 24 hr feet gal mL / min NTU	3:74 2:85 300 20:8	15:52	15:57 3:74 2:75 275 14.0		-		
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%)	Units 24 hr feet gal mL / min NTU %	3:74 2:85 300 20:8 4.4	15:52	15:57 3:74 2:75 275 14:0 3:5		-	~~~	
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%)	Units 24 hr feet gal mL / min NTU % mg/L	3:74 2.85 300 20.8 4.4	15:52 3:74 2:50 275 17:7 3.4 30 00.28	15:57 3:74 2:75 275 14:0 3:5 0:36		-		
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10)	Units 24 hr feet gal mL / min NTU % mg/L MeV	7.74 2.85 300 20.8 4.4 -24.6	15:52 3:74 2:55 17:7 3:4 9000.30 724.9	15:57 3:74 2:75 275 14:0 3:5 0:36 -26:9				
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10) Specific Conductivity	Units 24 hr feet gal mL / min NTU % mg/L MeV mS/cm ^c	3.74 2.85 300 20.8 4.4 •.4 •.4 •.4 •.4 •.4 •.4 •.6 0.502	15:52 3:74 2:50 2:75 17:7 3:4 900 0:38 -24-9 0:494	15.57 3.74 2.75 2.75 14.0 3.5 0.36 -26.9 0.492				
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10) Specific Conductivity Conductivity (+/- 3%)	Units 24 hr feet gal mL / min NTU % mg/L MeV mS/cm ^c mS/cm	3.74 2.85 300 20.8 4.4 •24.6 0.502 0.378	15:52 3:74 2:50 275 17:7 3:4 900 0.38 -24-9 0.494 0.494 0.494	15.57 3.74 2.75 2.75 14.0 3.5 0.36 -26.9 0.492 0.370				
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10) Specific Conductivity Conductivity (+/- 3%) pH (+/- 0.1)	Units 24 hr feet gal mL / min NTU % mg/L MeV mS/cm ^c mS/cm pH unit	3.74 2.85 300 20.8 4.4 •24.6 0.502 0.378 7.49	15:52 3:74 2:50 275 17:7 3.4 9000.0.88 724.9 0.494 0.494 0.494 0.494 0.494 0.494	15:57 3.74 2.75 275 14.0 3.5 0.36 -26.9 0.482 0.370 7.482				
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10) Specific Conductivity Conductivity (+/- 3%) pH (+/- 0.1) Temp (+/- 0.5)	Units 24 hr feet gal mL / min NTU % mg/L MeV mS/cm ^c mS/cm pH unit C	3.74 2.85 300 20.8 4.4 7.44.6 0.502 0.378 7.49 (2.03	15:52 3:75 2:55 17:50 2:55 17:40 2:37 2:494 0:371 7:48 12:03	15:57 3:74 2:75 275 14:0 3:5 0:36 -26:9 0:492 0:370 7:46 0:370 7:46 0:370				
Parameter Time Water Level (0.33) /olume Purged Tow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Ch / ORP (+/- 10) pecific Conductivity Conductivity (+/- 3%) H (+/- 0.1) Temp (+/- 0.5)	Units 24 hr feet gal mL / min NTU % mg/L MeV mS/cm ^c mS/cm pH unit C	3.74 2.85 300 20.8 4.4 7.44.6 0.502 0.378 7.49 (2.03	15:52 3:75 2:55 17:50 2:55 17:40 2:37 2:494 0:371 7:48 12:03	15:57 3:74 2:75 275 14:0 3:5 0:36 -26:9 0:492 0:370 7:46 0:370 7:46 0:370				
Water Quality Readings Collec Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10) Specific Conductivity Conductivity (+/- 3%) pH (+/- 0.1) Temp (+/- 0.5) Color Odor	Units 24 hr feet gal mL / min NTU % mg/L MeV mS/cm ^c mS/cm pH unit	3.74 2.85 300 20.8 4.4 •24.6 0.502 0.378 7.49	15:52 3:55 2:55 2:55 2:55 2:55 3:55 3:55	15:57 3.74 2.75 275 14.0 3.5 0.36 -26.9 0.482 0.370 7.482				

	Rowe	C Collected? ing/Low-Flow feet	No	
5011221 Pump with D	2 QA/Q	ing/Low-Flow_feet		
Pump with D		ing/Low-Flow_feet		
	edicated Tub	feet		
48)		-	D (inches)	
48)		-	Dunchest	D (feet)
48)		1001	1-inch	0.08
48)		feet	2-inch	0.08
48)		feet	3-inch	0.17
10)		-		
	-	_gal feet	4-inch 6-inch	0.33 0.50
			0-men	0.50
	-	_feet		
		- ^{gai}		
Conversion	factors to de	etermine V giv	en C	
	2-inch	3-inch	4-inch	6-inch
0.041	0.163	0.37	0.65	1.5
10.0.	10.1.	Readings		
	1.95	671		······
110	in the second	1.75		
1.40	1.US			
100	100	(pineter manager at a second part of		
100	100	100		
	132	100		· · · · · · · · · · · · · · · · · · ·
15.3	132	100		
15.3	132	100 11.2 9.1 0.55		
15.3 62 0.66 -52.1	13 2 5-6 0.60 -57-1	100 11.2 9.1 0.55		
15.3 62 0.66 -51.9 2.179	13 2 5-6 0.60 -57-1 2.170	100 11.2 5.1 0.55 -57.6 2.103		
15.3 62 0.66 -52.1	13 2 5.6 0.60 -57-1 2.100 1.629	100 11.2 9.1 0.55 -57.6 2.183 1.630		
15.3 62 0.66 -51.9 2.179	13 2 5.6 0.60 -57-1 2.120 1.629 7.30	100 11.2 9.1 0.55 -57.6 2.183 1.630 7.28		
15.3 62 0.66 -51.9 2.179	13 2 5.6 0.60 -57-1 2.100 1.629	100 11.2 9.1 0.55 -57.6 2.183 1.630		
	1-inch 0.041	1-inch 2-inch 0.041 0.163 YSI-556 and LaMotte 2 9:21 9:24 6:74 6:74	1-inch 2-inch 3-inch 0.041 0.163 0.37 YSI-556 and LaMotte 2020 Readings 9:21 9:21 9:31 6.74 6.74 6.74	Conversion factors to determine V given C1-inch2-inch3-inch4-inch0.0410.1630.370.65YSI-556 and LaMotte 2020Readings9:219:299:31

Project Name and Number:		Former Dus	so Chemical	Company	602	79080.3			
Monitoring Well Number:		BIW-			11/28	112			
Samplers:		Mark Howa	ard and Sam	1 Rowe					
6 I.N. I		REW-5D	112012		Sec. 2	N			
Sample Number:		pro 50	nacia	QA/Q	C Collected	? <u>NO</u>			
Purging / Sampling Method:		Peristaltic F	Pump with D	edicated Tub	oing/Low-Flo	ow			
1. L = Total Well Depth:				19-68	feet	D (inches) D (feet)	7	
2. D = Riser Diameter (I.D.):				0.17	feet	1-inch	0.08	-	
3. W = Static Depth to Water (7				3-60	feet	<2-inch	0.17	2	
4. $C = Column of Water in Cas$					feet	3-inch	0.25		
5. V = Volume of Water in Wel	l = C(3.1415)	59)(0.5D) ² (7.4	(8)		gal	4-inch	0.33		
6. D2 = Pump Setting Depth (ft				12.68	feet	6-inch	0.50		
7. C2 = Column of water in Pur		t):		197	feet				
8. Tubing Volume = $C2(0.0057)$	37088)			-	gal				
						1.12			
			Conversion	factors to de	etermine V g	given C			
		D (inches)	1-inch	2-inch	3-inch	4-inch	6-inch	1	
		V (gal / ft)	0.041	0.163/	0.37	0.65	1.5	-	
		(gai / It)	0.041	0.105/	0.57	0.05	1.5		
		(gai / it)	0.041	0.103	0.57	0.05	1.5	1	
Water Quality Readings Collect	ed Using	v (gai / it)		d LaMotte 2		0.03	1.5	1	
	~			1	020	-	1.5	-	
Parameter	Units		YSI-556 ar	d LaMotte 2	020 Readings	-			
Parameter Time	Units 24 hr	8:41	YSI-556 an	a LaMotte 2	020 Readings	9:0	9:06	911	
Parameter Time Water Level (0.33)	Units 24 hr feet		YSI-556 an 2:46 5.10	a LaMotte 2	020 Readings 5.31	9:01	9:06	6.73	
Parameter Time Water Level (0.33) Volume Purged	Units 24 hr feet gal	8:41 4.70	YSI-556 an 2:46 5.10	8:51 5-29 0-30	020 Readings 5.31 0.40	9:01 6.73 0.75	9:06 6-73 0.90	6.73	
Parameter Time Water Level (0.33) Volume Purged Flow Rate	Units 24 hr feet gal mL / min	8:41 4.70	YSI-556 an 2:46 5.10	8:51 5-29 0-30 100	020 Readings 5-31 0-40 1 C 0	9:01 6.73 0.75 100	9:06 6.73 0.90 1.00	6.73	
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%)	Units 24 hr feet gal mL / min NTU	8:41 4.70	YSI-556 an 2:46 5.10 0.20 160 3.57	3:51 5-23 5-30 100 50-4	020 Readings 5-31 0-40 100 33-1	9:01 6.73 0.75 100 41.9	9:06 6-73 0.90 100 30.4	6.73 1.0 100 19.6	
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%)	Units 24 hr feet gal mL / min NTU %	8:41 4.70 150 68-2 33.6	YSI-556 an 2:46 5.10 0.20 160 3.17 18-4	8:51 5.29 3.30 100 50.4 16.5	020 Readings 5.31 0.40 100 33.1 16.3	9:01 6.73 0.75 100 41.9 7-0	9:06 6-73 0.90 100 30.4 6.7	6.73 1.0 100 126 6.0	
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%)	Units 24 hr feet gal mL / min NTU % mg/L	8-41 	YSI-556 an 2:46 5.10 0:20 160 160 18-4 2.04	8:51 5:29 5:30 100 50.4 16.5	020 Readings 5.31 0.40 100 33.1 16.3 1.20	9:01 6.73 0.75 100 41.9 7-0 0.74	9:06 6.73 0.90 1.00 30:4 6.7 0.72	6.73 1.0 100 126 6.0	
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10)	Units 24 hr feet gal mL / min NTU % mg/L MeV	6:41 4.70 190 68.2 33.6 3.89 -56.8	YSI-556 ar 8:46 5.10 0:20 160 180 180 18-4 2.04 - 65.4	8:51 5.29 5.30 100 50.4 16.5 1.82 -60.5	020 Readings 5.31 0.40 1.00 33.1 1.6.3 1.6.2 -55.2	9:01 6.73 0.75 100 41.9 7-0 0.74 -61.4	9:06 6.73 0.90 100 30:4 6.7 0.72 -59:8	6.73 1.0 100 196 6.0 0.6 -57.0	
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10) Specific Conductivity	Units 24 hr feet gal mL / min NTU % mg/L MeV mS/cm ^c	6:41 4.70 	YSI-556 ar 2:46 5.10 0:20 160 18-4 2.04 - 65.4 2.160	8:51 5:23 5:30 100 50.4 16.5 1.82 -60.5 2.164	020 Readings 5.31 0.40 100 33.1 1.22 -55.2 2.175	9:01 6.73 0.75 100 41.9 7-0 0.74 -61.9 2.181	9:06 6.73 0.90 100 30:-(6.7 0.72 -59:8 2.192	6.73	
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10) Specific Conductivity Conductivity (+/- 3%)	Units 24 hr feet gal mL / min NTU % mg/L MeV mS/cm ^c mS/cm	8:41 4.70 	YSI-556 ar 2:46 5.10 0:20 160 18-4 2.04 - 65.4 2.160	8:51 5.23 0.30 100 50.4 16.5 1.82 -60.5 2.164 1.568	020 Readings 5.31 0.40 1.00 33.1 1.62 -55.2 2.175 1.564	9:01 6.73 0.75 100 41.9 72-0 0.74 -61.9 2.181 1.688	9:06 6.73 0.90 100 30.4 6.7 0.73 -59.8 2.192 1.641	6.73 1.0 120 120 120 120 120 120 120 12	
Parameter	Units 24 hr feet gal mL / min NTU % mg/L MeV mS/cm ^c	6:41 4.70 	YSI-556 an 8:46 5.10 0:20 180 18-4 2.04 -65.4 2.160 1.563 7:73	8:51 5:23 5:30 100 50.4 16.5 1.82 -60.5 2.164	020 Readings 5.31 0.40 100 33.1 1.62 -55.2 2.175 1.564 7.61	9:01 6.73 0.75 100 41.9 7-0 0.74 -61.4 2.12 1.622 7.49	9:06 6.73 0.90 100 30:4 6.7 0.73 -59:8 2.192 1.641 7.45	6.73 1.0 120 120 120 120 120 120 120 1.0 2.0 1.0 2.0 1.0 2.0 1.0 2.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1	
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10) Specific Conductivity Conductivity (+/- 3%) pH (+/- 0.1) Temp (+/- 0.5) Color	Units 24 hr feet gal mL / min NTU % mg/L MeV mS/cm ^c mS/cm pH unit	8:41 4.70 150 68:2 33:0 3:29 -56:8 2:131 1:429 7:43 7:21	YSI-556 an 2:46 5.10 0.20 160 31.7 18-4 2.04 - 45.4 2.160 1.563 7:73 10.52	8:51 5-23 5-30 100 50.4 16.5 1.825 2.164 1.568 7.69 10.59	020 Readings 5.31 0.40 100 33.1 16.3 1.82 2.175 1.564 7.61 10.30	9:01 6.73 0.75 100 41.9 7.0 0.74 -61.4 2.181 1.688 7.49 13.04	9:06 6-73 0.90 100 30:4 6.7 0.72 -59:8 2.192 1.641 7.45 11.90	6.73 1.0 120 120 120 120 120 120 120 12	
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10) Specific Conductivity Conductivity (+/- 3%) pH (+/- 0.1) Temp (+/- 0.5)	Units 24 hr feet gal mL / min NTU % mg/L MeV mS/cm ^c mS/cm pH unit C	8:41 4.70 150 68:2 33:6 3:89 -56.8 2.131 1.489 7:43 7:43 7:43 7:43 7:43	YSI-556 an 8:46 5.10 0:20 180 18-4 2.04 -65.4 2.160 1.563 7:73	8:51 5.23 0.30 100 50.4 16.5 1.82 -60.5 2.164 1.568 7.61	020 Readings 5.31 0.40 100 33.1 1.62 -55.2 2.175 1.564 7.61	9:01 6.73 0.75 100 41.9 7.0 6.74 -61.4 2.181 1.688 7.49 13.04 13.04	9:06 6.73 0.90 100 30:4 6.7 0.73 -59:8 2.192 1.641 7.45	6.73 1.0 120 120 120 120 2.0 2.0 2.0 2.0 2.0 2.0 2.0 2	
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10) Specific Conductivity Conductivity (+/- 3%) pH (+/- 0.1) Temp (+/- 0.5) Color Odor	Units 24 hr feet gal mL / min NTU % mg/L MeV mS/cm ^c mS/cm pH unit C Visual Olfactory	8:41 4.70 68:2 33.6 3.89 -56.8 2.131 1.489 7.43 7.21 Clear Chio	YSI-556 an 2:46 5.10 0.20 160 31,7 18-4 2.04 -65.4 2.160 1.563 7:73 10.52 Cleor Chio	8:51 5:29 5:30 100 50.4 16.5 1.82 -60.5 2.164 1.568 7.69 10.59 0.69 0.69	020 Readings 5.31 0.40 100 33.1 16.3 1.82 -55.2 2.175 1.564 7.61 10.30 Clear Chla	9:01 6.73 0.75 100 41.9 7.0 6.74 -61.4 2.18 1.688 7.49 13.04 13.04 Cleor Chia	9:06 6-73 0.90 100 30.4 6.7 0.72 -59.8 2.192 1.641 7.45 11.90 Clear Chio	6.73 1.0 120 120 120 120 2.0 2.0 2.0 2.0 2.0 2.0 2.0 2	
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10) Specific Conductivity Conductivity (+/- 3%) pH (+/- 0.1) Temp (+/- 0.5) Color Odor	Units 24 hr feet gal mL / min NTU % mg/L MeV mS/cm ^c mS/cm pH unit C Visual Olfactory	8:41 4.70 68:2 33.6 3.89 -56.8 2.131 1.489 7.43 7.21 Clear Chio	YSI-556 an 2:46 5.10 0.20 160 31,7 18-4 2.04 -65.4 2.160 1.563 7:73 10.52 Cleor Chio	8:51 5:29 5:30 100 50.4 16.5 1.82 -60.5 2.164 1.568 7.69 10.59 0.69 0.69	020 Readings 5.31 0.40 100 33.1 16.3 1.82 -55.2 2.175 1.564 7.61 10.30 Clear Chla	9:01 6.73 0.75 100 41.9 7.0 6.74 -61.4 2.18 1.688 7.49 13.04 13.04 Cleor Chia	9:06 6-73 0.90 100 30.4 6.7 0.72 -59.8 2.192 1.641 7.45 11.90 Clear Chio	6.73 1.0 120 120 120 120 2.0 2.0 2.0 2.0 2.0 2.0 2.0 2	
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10) Specific Conductivity Conductivity (+/- 3%) pH (+/- 0.1) Temp (+/- 0.5) Color Odor	Units 24 hr feet gal mL / min NTU % mg/L MeV mS/cm ^c mS/cm pH unit C Visual Olfactory	8:41 4.70 68:2 33.6 3.89 -56.8 2.131 1.489 7.43 7.21 Clear Chio	YSI-556 an 2:46 5.10 0.20 160 31,7 18-4 2.04 -65.4 2.160 1.563 7:73 10.52 Cleor Chio	8:51 5:29 5:30 100 50.4 16.5 1.82 -60.5 2.164 1.568 7.69 10.59 0.69 0.69	020 Readings 5.31 0.40 100 33.1 16.3 1.82 -55.2 2.175 1.564 7.61 10.30 Clear Chla	9:01 6.73 0.75 100 41.9 7.0 6.74 -61.4 2.18 1.688 7.49 13.04 13.04 Cleor Chia	9:06 6-73 0.90 100 30.4 6.7 0.72 -59.8 2.192 1.641 7.45 11.90 Clear Chio	6.73 1.0 120 120 120 120 120 120 120 12	

Monitoring Well Number:	Project Name and Number:				Former Duso Chemical Company 60279080.3							
Monitoring Well Number:					-							
		BIW-	20	Date:	1/2	8/13						
Samplers:		Mark Howar	Aark Howard and Sam Rowe									
Sample Number:		BTW-6512812 QA/QC Collected? NO										
Purging / Sampling Method:		Peristaltic P	ump with De	dicated Tub	ing/Low-Flo	w						
1. L = Total Well Depth:				9.40	feet	D (inches)	D (feet)]				
2. D = Riser Diameter (I.D.):					feet	1-inch	0.08					
3. $W = $ Static Depth to Water (3.20	feet	2-inch	0.17					
4. C = Column of Water in Cas				-	feet	3-inch	0.25					
5. $V = Volume of Water in We$		9)(0.5D) ² (7.4)	8)		_gal	4-inch	0.33					
6. $D2 = Pump$ Setting Depth (f		×			feet	6-inch	0.50	1				
7. $C2 = Column of water in Pu$):			feet							
8. Tubing Volume = $C2(0.005)$	13/088)				_gal							
			Conversion	factors to de	etermine V g	iven C						
				1								
		D (inches)	1-inch	2-inch	3-inch	4-inch	6-inch					
Water Quality Readings Collec	ted Using	D (inches) V (gal / ft)	0.041	0.163	0.37	4-inch 0.65	6-inch 1.5					
Water Quality Readings Collec Parameter	tted Using Units	V (gal / ft)	0.041 (YSI-556 an	and the second second	0.37	0.65	1.5	1				
Parameter Time	Units 24 hr	V (gal / ft)	0.041 (YSI-556 an	0.163 d LaMotte 2	0.37 020 Readings	0.65	1.5					
Parameter Time Water Level (0.33)	Units 24 hr feet	V (gal / ft)	0.041 (YSI-556 an 13:23 3,28	0.163 d LaMotte 2	0.37 020 Readings 13 3 3 3 28	0.65	1.5	3.2				
Parameter Time Water Level (0.33) Volume Purged	Units 24 hr feet gal	V (gal / ft)	0.041 (YSI-556 and 13:23 3,28 0,20	0.163 d LaMotte 2	0.37 020 Readings 13 3 3 3 28 0 40 C	0.65	1.5 13403 328 0.90	32				
Parameter Time Water Level (0.33) Volume Purged Flow Rate	Units 24 hr feet gal mL / min	V (gal / ft)	0.041 (YSI-556 an 13:23 3,28 0.20 200 120	0.163 d LaMotte 2	0.37 020 Readings 13_33 3_28 0.40 C 120	0.65	1.5 1.5 3.28 0.90 (20	32				
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%)	Units 24 hr feet gal mL / min NTU	V (gal / ft)	0.041 (YSI-556 an 3,28 0,20 200 120 328	0.163 d LaMotte 2 3.28 0.40 120 120	0.37 020 Readings 13_33 3_28 0.40 C 120	0.65 3 2 0 . 75 8 0 0 15 8 0 0 15 8 0 0 0 15 8 0 0 0 15 8 0 0 0 15 8 0 0 0 15	1.5 3 28 0,90 (20 80.0	321				
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%)	Units 24 hr feet gal mL/min NTU %	V (gal / ft)	0.041 (YSI-556 an 3,28 0.20 200 120 328 19-1	0.163 d LaMotte 2 3.28 0.40 120 120	0.37 020 Readings 13_33 3_28 0.40 C 120 120 120 120 120	0.65	1.5 13403 3 28 0,90 (20 80.0 11.5	71.120.4				
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%)	Units 24 hr feet gal mL / min NTU % mg/L	V (gal / ft) 15:18 3.28 0000 120 411 26:7 Ø 3.00	0.041 (YSI-556 an 3,28 0.20 200 120 328 19.1 2.09	0.163 d LaMotte 2 3. 28 0. 40 120 120 120 120 120 2. 0,2	0.37 020 Readings 13 33 3 28 0 40 C 120 120 120 120 120 120 125	0.65 3 2 0 3 2 0 5 75 8 4 2 12 5 4 2 12 5 4 2 1 2 5 1 3 7	1.5 13403 328 0.90 120 80.0 11.5 1.27	120.				
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10)	Units 24 hr feet gal mL / min NTU % mg/L MeV	V (gal / ft) 15:18 3.28 900 120 411 26:7 50.7	0.041 (YSI-556 an 3,28 0.20 200 120 328 19-1 2.09 20 0	0.163 d LaMotte 2 3.200 0.40 1200 1200 1200 1200 1200 1200 1200 12	0.37 Readings 13_33 3_28 0.40 C 120 120 120 14_0 1.75 8_4	0.65 3 2 0 3 2 0 0.75 8 0 2 15 6 4. 2 1 2 5 1 3 7 5 1	1.5 13483 328 0.90 120 80.0 11.5 1.27 7.2	71.10.7				
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10) Specific Conductivity	Units 24 hr feet gal mL / min NTU % mg/L MeV mS/cm ^e	V (gal / ft) 15:18 3.28 9000 120 411 24:7 0 3.00 50.7 0.497	0.041 (YSI-556 an 13:23 3,28 0.20 200 120 328 19-1 2.09 20.0 0.69.2	0.163 d LaMotte 2 3.28 0.40 120 120 120 120 120 120 120 120 120 12	0.37 020 Readings 13 33 3 28 0 40 c 12 0 12 0 12 0 12 0 12 0 12 0 12 0 12 0 12 0 13 5 2 4 0 40 c 13 5 2 4 0 40 c 14 5 15 5	0.65 3.20 3.20 3.20 3.20 3.20 5.10 5.1 C.681	1.5 13483 328 0.90 120 80.0 11.5 1.27 7.2	7.10.7.5.				
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10) Specific Conductivity Conductivity (+/- 3%)	Units 24 hr feet gal mL / min NTU % mg/L MeV mS/cm ^c mS/cm	V (gal / ft) 15:18 3.28 9000 120 411 24:7 9 3.00 50.7 0.504 0.514	0.041 (YSI-556 an 13:23 3,28 0.20 200120 328 19:1 2:09 20:0 0.692 0.692 0.5/4	0.163 d LaMotte 2 3.28 0.40 120 188 188 188 188 188 188 188 188 188 18	0.37 020 Readings 13.33 3.28 0.40 120 120 120 120 120 120 120 12	0.65 13 50 3 2 0 5 2 0 5 2 0 5 1 5 1 C. 68 1 C. 499	1.5 1.5 1.5 3.28 0.90 1.5 1.27 7.2 0.497	7.1 1.1 1.20 5.9 1.09 1.09 1.09 1.09 0.49				
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10) Specific Conductivity Conductivity (+/- 3%) pH (+/- 0.1)	Units 24 hr feet gal mL / min NTU % mg/L MeV mS/cm ^c mS/cm pH unit	V (gal / ft) 15:18 3.28 9000 120 411 24:7 0 3.00 5C.7 C.497 C.497 C.514 LE9	0.041 (YSI-556 and 3.28 0.20 200120 328 19.1 20.0 0.69.2 0.69.2 0.514 7.44	0.163 d LaMotte 2 3.20 0.40 120 120 120 120 120 120 120 120 120 12	0.37 020 Readings 13 33 3.28 0.40 120 120 120 120 120 120 120 12	0.65 3.20 3.20 3.20 3.20 3.20 5.10 5.1 C.681	1.5 13483 328 0.90 120 80.0 11.5 1.27 7.2	7.1 1.1 1.20 1.20 1.20 1.20 1.20 1.20 1.2				
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10) Specific Conductivity Conductivity (+/- 3%)	Units 24 hr feet gal mL / min NTU % mg/L MeV mS/cm ^c mS/cm	V (gal / ft) 15:18 3.28 9000 120 411 24:7 9 3.00 50.7 0.504 0.514	0.041 (YSI-556 an 13:23 3,28 0.20 200120 328 19:1 2:09 20:0 0.692 0.692 0.5/4	0.163 d LaMotte 2 3.28 0.40 120 120 120 120 120 120 120 120 120 12	0.37 020 Readings 13.33 3.28 0.40 120 120 120 120 120 120 120 12	0.65 3.50 3.50 3.50 3.50 5.1 5.1 C.681 0.499 7.52	1.5 1.5 1.5 3.28 0.90 1.5 1.27 7.2 0.497 7.2 0.497 7.51	71.10.59.19.5				

Project Name and Number:		Former Dus	so Chemical	Company	6027	79080.3			
Monitoring Well Number:			BIW-651 Date: 11/28/12						
Samplers:		Mark Howa	ard and Sam	Rowe					
Sample Number:		BIW-	6211281.	2 QA/QO	C Collected?	No			
Purging / Sampling Method:		Peristaltic I	ump with De	edicated Tub	ing/Low-Flo	w			
 L = Total Well Depth: D = Riser Diameter (I.D.): W = Static Depth to Water (' C = Column of Water in Cas V = Volume of Water in We D2 = Pump Setting Depth (ff C2 = Column of water in Put Tubing Volume = C2(0.0057) 	sing: II = C(3.1415 t): mp/Tubing (fi		18)		feet feet feet gal feet feet gal	D (inches) 1-inch 2-inch 3-inch 4-inch 6-inch	D (feet) 0.08 0.17 0.25 0.33 0.50	>	
		D (inches) V (gal / ft)	1-inch 0.041	factors to de 2-inch 0.163	3-inch 0.37	4-inch 0.65	6-inch 1.5		
Water Ouality Readings Collec	ted Using		YSI-556 an		020				
			YSI-556 an	d LaMotte 20	ana la	-			
Parameter	Units	13.53		d LaMotte 20	Readings	-			
Parameter Time		13:53	YSI-556 an	d LaMotte 20	Readings	14:13			
Parameter Time Water Level (0.33)	Units 24 hr		13:58	d LaMotte 20	Readings	14:13 3 2 R 2 0			
Parameter Time Water Level (0.33) Volume Purged	Units 24 hr feet	3.28	13:58 3:28 1.40 120	d LaMotte 20	Readings 14:08 3-26 1-75	358			
Parameter Time Water Level (0.33) Volume Purged Flow Rate	Units 24 hr feet gal	3.28 1.25 1.20	13:58 3:28 1:40 1:20 277	d LaMotte 21 3 - 26 1 - 160 1 - 20	Readings 14:08 3-28 1-75 1-20	358			
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%)	Units 24 hr feet gal mL / min	3.28	13:58 3:28 1:40 1:20 277	d LaMotte 21 3 - 26 1 - 160 1 - 20	Readings 14:08 3-28 1-75 1-20	328 2.0 120 6.5			
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%)	Units 24 hr feet gal mL / min NTU	3 26 1.25 120 37.4 9.6 1.05	13:58 3:28 1:40 120 277 8:5	d LaMotte 21 3 3 28 1 1 60 1 2 0 2 0 2 7 - 8 0 . 8 6	Readings 14:02 3.28 1-75 1.20 2.1.1 7.4	328 2.0 120 6.5 0.76			
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%)	Units 24 hr feet gal mL / min NTU %	3 26 1.25 120 37.4 9.6 1.05	13:58 3:28 1:40 1:20 277	d LaMotte 21 3 - 26 1 - 160 1 - 20	Readings 14:02 3.28 1-75 1.20 2.1.1 7.4	2.0 120 6.5 0.76 10.0			
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10)	Units 24 hr feet gal mL / min NTU % mg/L	3 28 1.25 120 37.4 9.6	13:58 3:28 1:40 120 277 8:5 0:93	d LaMotte 21 3 3 28 1 1 60 1 2 0 2 0 2 7 - 8 0 . 8 6	Readings 14:02 328 1-75 120 21.1 7.4 0.81 10.8 0.668	328 2.0 120 6.5 100 6.5 6 100 6.6 66			
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10) Specific Conductivity	Units 24 hr feet gal mL / min NTU % mg/L MeV	3.28 1.25 1.25 1.25 1.25 1.05 8.00 0.674	13:58 3 28 1.40 120 277 8:5 0.93 10.1 0.073	d LaMotte 20 141:03 3 28 11:60 120 202 7.8 0.86 10.8 0.67 0.493	Readings 14:02 328 1-75 120 21.1 7.4 0.81 10.8 0.668	328 2.0 120 6.5 100 6.5 6 100 6.6 66			
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10) Specific Conductivity Conductivity (+/- 3%)	Units 24 hr feet gal mL / min NTU % mg/L MeV mS/cm ^c mS/cm	3.28 1.25 1.25 1.25 1.25 1.05 8.8 0.674 0.474	13:58 3 28 1.40 120 277 85 0.93 10.1 0.673 0.494	d LaMotte 20 141.03 3.28 1160 120 20.2 7.8 0.86 10.8 0.670	Readings 14:02 328 1-75 120 21.1 7.4 0.81 10.8	2.0 120 6.5 0.76 10.0			
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10) Specific Conductivity Conductivity (+/- 3%) pH (+/- 0.1)	Units 24 hr feet gal mL / min NTU % mg/L MeV mS/cm ^c	3.28 1.25 1.25 1.25 1.25 1.05 8.00 0.674	13:58 3 28 1.40 120 277 8:5 0.93 10.1 0.073	d LaMotte 21 3 38 1 160 1 2 0 2 2 7 6 0 86 1 0.8 0 .67 0 .493 7 .41	Readings 14:02 3:28 1-75 120 21.1 7.4 0.81 10.8 0.492 7.40	328 2.0 120 6.5 10.0 6.5 10.0 6.6 6 0.4 92			
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10) Specific Conductivity Conductivity (+/- 3%) pH (+/- 0.1) Temp (+/- 0.5)	Units 24 hr feet gal mL / min NTU % mg/L MeV mS/cm ^c mS/cm pH unit	3.28 1.25 1.25 1.25 1.25 1.25 1.25 1.05 0.674 0.474 0.494 7.45 11.00	13:58 3 28 1.40 120 277 85 0.93 10.1 0.673 0.494 7.43 1.05	d LaMotte 21 14':03 3.38 1:60 120 202 7.6 0.60 0.493 7.41 11-16	Readings 14:02 3:28 1-75 120 21.1 7.4 0.81 10.8 0.492 7.40	328 2.0 120 6.5 0.76 10.066 0.492 7.40 11.37 0.1ed			
Water Quality Readings Collec Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10) Specific Conductivity Conductivity (+/- 3%) pH (+/- 0.1) Temp (+/- 0.5) Color Odor	Units 24 hr feet gal mL / min NTU % mg/L MeV mS/cm ^c mS/cm pH unit C	3.28 1.25 1.25 1.25 1.25 1.05 8.8 0.474 0.45	13:58 3 28 1.40 120 277 85 0.93 10.1 0.673 0.494	d LaMotte 21 3 38 1 160 1 2 0 2 2 7 6 0 86 1 0.8 0 .67 0 .493 7 .41	Readings 14:02 3:28 1-75 120 21.1 7.4 0.81 10.8 0.668 0.492	328 2.0 120 6.5 0.00 6.5 0.00 6.66 0.492 7.40			

a second second second	WIO	nitoring W			ng rorm			
Project Name and Number:		Former Dus	o Chemical	Company	6027	9080.3		
Monitoring Well Number:	D	_ Date:	11/28	112				
Samplers:		Mark Howa	rd and Sam I	Rowe		1		
Sample Number:		BIW-61	213211	QA/Q	C Collected?	No		
Purging / Sampling Method:		Peristaltic P	ump with De	edicated Tub	ing/Low-Flo	w		
1. L = Total Well Depth:				19.61	feet	D (inches)	D (feet)	1
2. D = Riser Diameter (I.D.):				BID	feet	1-inch	0.08	1
3. W = Static Depth to Water (7				2.64	feet	2-inch	0.17	>
4. C = Column of Water in Cas					feet	3-inch	0.25	
5. $V = Volume of Water in We$		$(0.5D)^{2}(7.4)$	8)		gal	4-inch	0.33	
6. $D2 = Pump$ Setting Depth (fi					feet	6-inch	0.50	
7. $C2 = Column of water in Pun$):			feet			
8. Tubing Volume = $C2(0.0057)$	37088)			-	gal			
			-	e An the stands				
			Conversion	factors to de	etermine V g	iven C		
		D (inches)	1-inch	2-inch	3-inch	4-inch	6 in als	Т
		V (gal / ft)	0.041	in the second seco	a second s	a house and the second second second	6-inch	
				1 1104	1 11 57			
		v (gai / it)	0.041	0.163	0.37	0.65	1.5	1
Water Quality Readings Collec	ted Using	v (gai / it)		1		0.65	1.5	1
Water Quality Readings Collec	ted Using	· (gal / it)		d LaMotte 2		- 0.05	1.5	1
Parameter	Units		YSI-556 an	d LaMotte 2	020 Readings	-		1
Parameter Time	Units 24 hr	10:30	YSI-556 an	d LaMotte 2	020 Readings	10.50	10:55	11:00
Parameter Time Water Level (0.33)	Units 24 hr feet		YSI-556 an	d LaMotte 2	020 Readings (0:45 4.90	10 50	10:55 5.15	745
Parameter Time Water Level (0.33) Volume Purged	Units 24 hr feet gal	10:30	YSI-556 an	10:40 3-66 0-25	020 Readings 10:45 4.90 0.5	10 50 5.0 C.75	10:55 5.15 0.80	125
Parameter Time Water Level (0.33) Volume Purged Flow Rate	Units 24 hr feet gal mL / min	10:30	YSI-556 an 10: 35 3.60 0.20 100	10:40 3-66 0.25	020 Readings 10:45 4.90 0.5	10 50 3.0 C.75 10 0	6:55 5.15 100 100	1.25
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%)	Units 24 hr feet gal mL / min NTU	10:30 3.23 150	YSI-556 an 10:35 3.60 0.20 100 153	10:40 3-66 0.25	$\begin{array}{c} \hline 020 \\ \hline Readings \\ \hline 10.45 \\ \hline 4.90 \\ \hline 0.5 \\ \hline 100 \\ \hline 37.8 \\ \hline \end{array}$	10 50 5.0 C 75 100 22.7	10:55 5.15 0.80 190 190	745
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%)	Units 24 hr feet gal mL / min NTU %	10:30 3.23 150 1999.9	YSI-556 an 10:35 3.60 0.20 100 153 71.8	10:40 3.46 0.25 100 112 21.4	$\begin{array}{c} 020 \\ \hline Readings \\ \hline (0:45) \\ \hline 4.90 \\ \hline 0.5 \\ \hline 1.00 \\ \hline 3.7.8 \\ \hline 15.1 \\ \hline \end{array}$	10 50 5.0 C 75 100 22.7	10:55 5.15 0 8 0 190 190 21.1	745
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%)	Units 24 hr feet gal mL / min NTU % mg/L	10:30 3.23 150 110 999.9 273 50	YSI-556 an 10:35 3.60 0.20 100 153 71.8 7.13	10:40 3.66 0.25 100 112 21.4 2.23	$\begin{array}{c} 020 \\ \hline Readings \\ 10.45 \\ 4.90 \\ C.5 \\ 100 \\ 37.8 \\ 15.1 \\ 1.56 \end{array}$	10 50 5.0 C 75 10 e 22.7 18.3 1.93	6:55 5:50 190 21. 22. 2	1217 269 189
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10)	Units 24 hr feet gal mL / min NTU % mg/L MeV	10:30 3.23 150 150 100 999.9 27350 -33.6	YSI-556 an 10:35 3.60 0.20 100 153 71.8 7.13 - 28-1	10:40 3.66 0.25 100 112 21.4 2.23 -26.5	020 Readings (C: 45 4.90 C.5 1.00 3.7.8 1.5.1 1.56 - 27.8	10 50 5.0 0 75 10 e 22.7 18.3 1.93 -22-1	6:55 5:50 190 21	745
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10) Specific Conductivity	Units 24 hr feet gal mL / min NTU % mg/L MeV mS/cm ^c	10:30 3.23 150 110 991.9 273 50 - 33.6 6 973	YSI-556 an 10:35 3.60 0.20 100 153 71.8 7.13 -28-1 0.972	10:40 3.66 0.25 100 112 21.4 2.23	$\begin{array}{c} 020 \\ \hline Readings \\ \hline (0:45 \\ 4.90 \\ 0.5 \\ 1.60 \\ 37.8 \\ 15.1 \\ 1.56 \\ -27.8 \\ 0.966 \\ \end{array}$	10 50 3.0 C.75 100 22.7 18.3 1.93 -22.1 0962	10:55 5.150 10:55 10:00 10:5 22.7 2.7 4 2.7 4 0.957	1217 269 189
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10) Specific Conductivity Conductivity (+/- 3%)	Units 24 hr feet gal mL / min NTU % mg/L MeV mS/cm ^c mS/cm	10:30 3.23 150 110 991.9 273 50 - 33.6 6 973	YSI-556 an 10:35 3.60 0.20 100 153 71.8 7.13 -28-1 0.972 0.733	10:40 3.66 0.25 100 112 21.4 2.23 -26.5	$\begin{array}{c} 020 \\ \hline Readings \\ \hline 10.45 \\ \hline 4.90 \\ \hline 0.5 \\ \hline 100 \\ \hline 39.8 \\ \hline 15.1 \\ \hline 1.50 \\ \hline -27.8 \\ \hline 0.966 \\ \hline 0.760 \\ \hline \end{array}$	10 50 5.0 C.75 100 22.7 18.3 1.93 -22.1 0.757	10:55 5.15 0.80 100 19.5 21. 22. 4.5 2.24 -17.4 0.957 0.726	745 125 269 199.6 199.6 0.763
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10) Specific Conductivity Conductivity (+/- 3%) pH (+/- 0.1)	Units 24 hr feet gal mL / min NTU % mg/L MeV mS/cm ^c mS/cm pH unit	10:30 3.23 150 110 991.9 273 50 - 33.6 6 973	YSI-556 an 10:35 3.60 0.20 100 153 71.8 7.13 -28-1 0.972 0.733 7.86	10:40 3.66 0.25 100 112 21.4 2.23 -26.5 0.964 0.731 7.62	$\begin{array}{c} 020 \\ \hline Readings \\ \hline 10.45 \\ \hline 4.90 \\ \hline 0.5 \\ \hline 100 \\ \hline 37.8 \\ \hline 15.1 \\ \hline 1.50 \\ \hline -27.8 \\ \hline 0.966 \\ \hline 0.760 \\ \hline 7.83 \end{array}$	10 50 5.0 C.75 100 22.7 18.3 1.93 -22.1 0.757	6:55 5:5 0 80 100 100 100 10,5 21.1 22.4 -17.4 0.957 0.726 7.84	12/7 2/2 2/2 2/2 2/2 2/2 2/2 2/2 2/2 2/2
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10) Specific Conductivity Conductivity (+/- 3%) pH (+/- 0.1) Temp (+/- 0.5)	Units 24 hr feet gal mL / min NTU % mg/L MeV mS/cm ^c mS/cm pH unit C	10:30 3.23 150 1997.7 27350 - 33.6 0973 0973 0973 0973	YSI-556 an 10:35 3.60 0.20 100 153 71.8 7.13 -28-1 0.972 0.733 7.86 12.18	10:40 3.66 0.25 100 112 21.4 2.23 -26.5 0.964 0.731 7.82 10.57	$\begin{array}{c} 020 \\ \hline Readings \\ 10.45 \\ 4.90 \\ 0.5 \\ 100 \\ 37.8 \\ 15.1 \\ 1.50 \\ -27.8 \\ 0.966 \\ 0.760 \\ 7.83 \\ 13.87 \end{array}$	10 50 5.0 C 75 10 e 22.7 18.3 1.93 -22.1 C.962 0.737 7.87 12.80	10:55 5.15 0.80 190 190 21. 190 21. 190 21. 190 24 -17.4 0.957 0.726 7.84 12.35	745 125 125 1299 199.000 7.25 19.00 7.25 14.42
Parameter Time Water Level (0.33) Volume Purged	Units 24 hr feet gal mL / min NTU % mg/L MeV mS/cm ^c mS/cm pH unit	10:30 3.23 150 110 991.9 273 50 - 33.6 6 973	YSI-556 an 10:35 3.60 0.20 100 153 71.8 7.13 -28-1 0.972 0.733 7.86	10:40 3.66 0.25 100 112 21.4 2.23 -26.5 0.964 0.731 7.82 10.53 0.964 0.731 7.82 10.53 0.964	$\begin{array}{c} 020\\ \hline Readings\\ 10:45\\ 4.90\\ C.5\\ 100\\ 37.8\\ 15.1\\ 1.50\\ -27.8\\ 0.966\\ 0.966\\ 0.760\\ 7.83\\ 13.87\\ Cleon\\ \end{array}$	10 50 5.0 C.75 100 22.7 18.3 1.93 -22.1 0.757	10:55 5.15 0.80 190 190 21. 1 224 -17.4 0.957 0.726 7.84 12.35 Clear	12/7 2/2 2/2 2/2 2/2 2/2 2/2 2/2 2/2 2/2
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10) Specific Conductivity Conductivity (+/- 3%) pH (+/- 0.1) Temp (+/- 0.5) Color Odor	Units 24 hr feet gal mL / min NTU % mg/L MeV mS/cm ^c mS/cm pH unit C Visual Olfactory	10:30 3.23 150 150 10 999.9 27350 999.9 27350 0973 0973 0973 0973 0973 0973 0973 097	YSI-556 an 10:35 3.60 0.20 100 153 71.8 7.13 -28-1 0.972 0.733 7.86 12.18	10:40 3.66 0.25 100 112 21.4 2.23 -26.5 0.964 0.731 7.82 10.57	$\begin{array}{c} 020 \\ \hline Readings \\ 10.45 \\ 4.90 \\ 0.5 \\ 100 \\ 37.8 \\ 15.1 \\ 1.50 \\ -27.8 \\ 0.966 \\ 0.760 \\ 7.83 \\ 13.87 \end{array}$	10 50 5.0 C 75 10 e 22.7 18.3 1.93 -22.1 C.962 0.737 7.87 12.80 C e	10:55 5.15 0.80 190 190 21. 190 21. 190 21. 190 24 -17.4 0.957 0.726 7.84 12.35	745 125 269 19.60 19.60 7.85 19.60 7.85 14.42 19.00 7.44 19.00
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10) Specific Conductivity Conductivity (+/- 3%) pH (+/- 0.1) Temp (+/- 0.5) Color Odor	Units 24 hr feet gal mL / min NTU % mg/L MeV mS/cm ^c mS/cm pH unit C Visual Olfactory	10:30 3.23 150 150 10.9 999.9 27350 - 33.6 0973 0973 0973 0973 0973 0973 0973 0973	YSI-556 an 10:35 3.60 0.20 100 153 71.8 7.13 -28-1 0.972 0.733 7.86 12.18 Cleo- Cluo 0:30	10:40 3.66 0.25 100 112 21.4 2.23 -26.5 0.964 0.731 7.82 10.53 0.964 0.731 7.82 10.53 0.964 0.731 7.82 10.53 0.964	$\begin{array}{c} 020\\ \hline Readings\\ 10:45\\ 4.90\\ C.5\\ 100\\ 37.8\\ 15.1\\ 1.50\\ -27.8\\ 0.966\\ 0.966\\ 0.760\\ 7.83\\ 13.87\\ Cleon\\ \end{array}$	10 50 5.0 C 75 10 e 22.7 18.3 1.93 -22.1 C.962 0.737 7.87 12.80 C e	10:55 5.15 0.80 190 190 21. 1 224 -17.4 0.957 0.726 7.84 12.35 Clear	745 125 269 19.60 19.60 7.85 19.60 7.85 14.42 19.60 7.85 14.42
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10) Specific Conductivity Conductivity (+/- 3%) pH (+/- 0.1) Temp (+/- 0.5) Color Odor	Units 24 hr feet gal mL / min NTU % mg/L MeV mS/cm ^c mS/cm pH unit C Visual Olfactory	10:30 3.23 150 150 10.9 999.9 27350 - 33.6 0973 0973 0973 0973 0973 0973 0973 0973	YSI-556 an 10:35 3.60 0.20 100 153 71.8 7.13 -28-1 0.972 0.733 7.86 12.18 Cleo- Cluo 0:30	10:40 3.66 0.25 100 112 21.4 2.23 -26.5 0.964 0.731 7.82 10.53 0.964 0.731 7.82 10.53 0.964 0.731 7.82 10.53 0.964	$\begin{array}{c} 020\\ \hline Readings\\ 10:45\\ 4.90\\ C.5\\ 100\\ 37.8\\ 15.1\\ 1.50\\ -27.8\\ 0.966\\ 0.966\\ 0.760\\ 7.83\\ 13.87\\ Cleon\\ \end{array}$	10 50 5.0 C 75 10 e 22.7 18.3 1.93 -22.1 C.962 0.737 7.87 12.80 C e	10:55 5.15 0.80 190 190 21. 1 224 -17.4 0.957 0.726 7.84 12.35 Clear	745 125 269 19.60 19.60 7.85 19.60 7.85 14.42 19.60 7.85 14.42
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10) Specific Conductivity Conductivity (+/- 3%) pH (+/- 0.1) Temp (+/- 0.5) Color Odor	Units 24 hr feet gal mL / min NTU % mg/L MeV mS/cm ^c mS/cm pH unit C Visual Olfactory	10:30 3.23 150 150 10.9 999.9 27350 - 33.6 0973 0973 0973 0973 0973 0973 0973 0973	YSI-556 an 10:35 3.60 0.20 100 153 71.8 7.13 -28-1 0.972 0.733 7.86 12.18 Cleo- Cluo 0:30	10:40 3.66 0.25 100 112 21.4 2.23 -26.5 0.964 0.731 7.82 10.53 0.964 0.731 7.82 10.53 0.964 0.731 7.82 10.53 0.964	$\begin{array}{c} 020\\ \hline Readings\\ 10:45\\ 4.90\\ C.5\\ 100\\ 37.8\\ 15.1\\ 1.50\\ -27.8\\ 0.966\\ 0.966\\ 0.760\\ 7.83\\ 13.87\\ Cleon\\ \end{array}$	10 50 5.0 C 75 10 e 22.7 18.3 1.93 -22.1 C.962 0.737 7.87 12.80 C e	10:55 5.15 0.80 190 190 21. 1 224 -17.4 0.957 0.726 7.84 12.35 Clear	745 125 269 19.60 19.60 7.85 19.60 7.85 14.42 19.60 7.85 14.42
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10) Specific Conductivity Conductivity (+/- 3%) pH (+/- 0.1) Temp (+/- 0.5) Color Odor	Units 24 hr feet gal mL / min NTU % mg/L MeV mS/cm ^c mS/cm pH unit C Visual Olfactory	10:30 3.23 150 150 10.9 999.9 27350 - 33.6 0973 0973 0973 0973 0973 0973 0973 0973	YSI-556 an 10:35 3.60 0.20 100 153 71.8 7.13 -28-1 0.972 0.733 7.86 12.18 Cleo- Cluo 0:30	10:40 3.66 0.25 100 112 21.4 2.23 -26.5 0.964 0.731 7.82 10.53 0.964 0.731 7.82 10.53 0.964 0.731 7.82 10.53 0.964	$\begin{array}{c} 020\\ \hline Readings\\ 10:45\\ 4.90\\ C.5\\ 100\\ 37.8\\ 15.1\\ 1.50\\ -27.8\\ 0.966\\ 0.966\\ 0.760\\ 7.83\\ 13.87\\ Cleon\\ \end{array}$	10 50 5.0 C 75 10 e 22.7 18.3 1.93 -22.1 C.962 0.737 7.87 12.80 C e	10:55 5.15 0.80 190 190 21. 1 224 -17.4 0.957 0.726 7.84 12.35 Clear	745 125 269 19.60 19.60 7.85 19.60 7.85 14.42 19.60 7.85 14.42
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10) Specific Conductivity Conductivity (+/- 3%) pH (+/- 0.1) Temp (+/- 0.5) Color Odor	Units 24 hr feet gal mL / min NTU % mg/L MeV mS/cm ^c mS/cm pH unit C Visual Olfactory	10:30 3.23 150 150 10.9 999.9 27350 - 33.6 0973 0973 0973 0973 0973 0973 0973 0973	YSI-556 an 10:35 3.60 0.20 100 153 71.8 7.13 -28-1 0.972 0.733 7.86 12.18 Cleo- Cluo 0:30	10:40 3.66 0.25 100 112 21.4 2.23 -26.5 0.964 0.731 7.82 10.53 0.964 0.731 7.82 10.53 0.964 0.731 7.82 10.53 0.964	$\begin{array}{c} 020\\ \hline Readings\\ 10:45\\ 4.90\\ C.5\\ 100\\ 37.8\\ 15.1\\ 1.50\\ -27.8\\ 0.966\\ 0.966\\ 0.760\\ 7.83\\ 13.87\\ Cleon\\ \end{array}$	10 50 5.0 C 75 10 e 22.7 18.3 1.93 -22.1 C.962 0.737 7.87 12.80 C e	10:55 5.15 0.80 190 190 21. 1 224 -17.4 0.957 0.726 7.84 12.35 Clear	145 267 193 -19.6 0.763 7.85 14.42 14.42

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Oa the o TOD We get Monitoring Well Purging/Sampling Form Project Name and Number: Former Duso Chemical Company 60279080.3 (DBAGM? 27/12 Monitoring Well Number: Date: BFW-7 Samplers: Mark Howard and Sam Rowe BIN AW-7112712 NO Sample Number: QA/QC Collected? Purging / Sampling Method: Peristaltic Pump with Dedicated Tubing/Low-Flow 13.65 1. L = Total Well Depth: feet D (inches) D (feet) 2. D = Riser Diameter (I.D.): 0.17 feet 1-inch 0.08 3. W = Static Depth to Water (TOC): 2.34 feet 2-inch 0.17 4. C = Column of Water in Casing: feet 3-inch 0.25 5. V = Volume of Water in Well = $C(3.14159)(0.5D)^{2}(7.48)$ 4-inch 0.33 gal 6. D2 = Pump Setting Depth (ft): 1265 0.50 feet 6-inch 7. C2 = Column of water in Pump/Tubing (ft): feet 8. Tubing Volume = C2(0.005737088) gal Conversion factors to determine V given C D (inches) 2-inch 1-inch 3-inch 4-inch 6-inch V (gal / ft) 0.041 0.163 0.37 0.65 1.5 Water Quality Readings Collected Using YSI-556 and LaMotte 2020 Parameter Units Readings 2:56 :46 Time 24 hr :31 36 8 8 8 9:0 8:5 020 49 200 2.49 Water Level (0.33) feet 2.47 2.49 2.4 5 1.25 Volume Purged 1.5 gal 1 S 200 200 Flow Rate 200 200 mL/min 200 200 00 238 13 34 2 7 55.3 Turbidity (+/- 10%) 4 NTU 44.0 0 1º 3 Dissolved Oxygen (+/- 10%) 9 % 3 191 1.09 C.98 0.99 Dissolved Oxygen (+/- 10%) 2 091 mg/L 0.95 -147.2 Eh / ORP (+/- 10) -117.9 MeV -109.9 -131. - 112.4 - 110.7 -110.4 C 768 C 578 8.02 A.03 0829 Specific Conductivity 0.77 0.77 0.770 mS/cm^c 0.767 265 C.575 Conductivity (+/- 3%) 0.578 0.576 0.578 mS/cm 5 76 8.15 8.07 8.10 7.78 17.93 pH (+/- 0.1) pH unit 5.2 12.16 Temp (+/- 0.5) 10.60 90 С 11-61 19.10 11 Iron Floc Cloudy Cloudy Color Visual Claudi Chu. Clardy and Odor Chlo Chlo hla Olfactory Chlo-Chla hlo **Comments:** wite lor * Three consecutive readings within range indicates stabilization of that parameter.

Sample Number: Purging / Sampling Method: 1. L = Total Well Depth: 2. D = Riser Diameter (1.D.):		<u>BIU -</u> Mark Howa	קו		1	9080.3				
Samplers: Sample Number: Purging / Sampling Method: 1. L = Total Well Depth: 2. D = Riser Diameter (1.D.):		Mark Howa		Deter						
Sample Number: Purging / Sampling Method: 1. L = Total Well Depth: 2. D = Riser Diameter (1.D.):		10.00	rd and Sam I	- Date:	11/20	e/12				
Purging / Sampling Method: 1. L = Total Well Depth: 2. D = Riser Diameter (1.D.):		RTUS		Rowe						
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2. D = Riser Diameter (I.D.):		Peristaltic P	ump with De	edicated Tubi	ing/Low-Flow	N		_		
2. D = Riser Diameter (I.D.):				1315	Fast	D (in share)	D (feet)			
				010	feet	D (inches)	D (feet)	10		
3 W = Static Donth to Water /T	000			121	feet	1-inch	0.08			
 W = Static Depth to Water (Te C = Column of Water in Casin 				-d.54	feet	2-inch	0.17			
	•	ovo coulta a	03		feet	3-inch	0.25			
5. $V = Volume of Water in Well$	= C(3.1415)	9)(0.5D)*(7.4	8)	10	gal	4-inch	0.33			
6. $D2 = Pump$ Setting Depth (ft)				12-65	feet	6-inch	0.50			
7. C2 = Column of water in Pum		t):			feet					
8. Tubing Volume = C2(0.00573	37088)				gal					
			Conversion	factors to de	termine V gi	ven C				
		ID Carlos	1 1 2 1	1 2: 14						
		D (inches)	1-inch	2-inch	3-inch	4-inch	6-inch			
6		V (gal / ft)	0.041 /	0.163	0.37	0.65	1.5			
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Parameter Time Water Level (0.33)	Units 24 hr feet	2.49	YSI-556 an	9:16	020					
Parameter Time Water Level (0.33) Volume Purged	Units 24 hr feet gal	2.49	YSI-556 an 2.49 2.25	9:16	020					
Parameter Time Water Level (0.33) Volume Purged Flow Rate	Units 24 hr feet gal mL / min	2.49 2.0 200	YSI-556 an 9 11 2 49 2 25 2 0 c	9:16 2:49 2:5 2:00	020					
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%)	Units 24 hr feet gal mL / min NTU	2.49 2.0 200 32.4	YSI-556 an 2.49 2.25 200 31.8	9:16 2:49 2:5 2:00	020			7		
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%)	Units 24 hr feet gal mL / min NTU %	2.49 2.0 200 32.4 7.7	YSI-556 an 9:11 2:49 2:25 200 31.8 9:0	9:16 2:49 2:5 2:00 38:0 9:8	020					
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%)	Units 24 hr feet gal mL / min NTU % mg/L	2.49 2.0 32.7 7.7 0.23	YSI-556 an 9:11 2:49 2:25 2:00 31:8 9:0 6:90 6:90	9:16 2:49 2:5 2:00 38:0 9:8 1.07	020					
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10)	Units 24 hr feet gal mL / min NTU % mg/L MeV	2.49 2.0 32.4 7.7 0.23 -102.8	YSI-556 an 9:11 2:49 2:25 200 31:8 9:0 6:96 -111,6	9-16 2.49 2.5 2.5 2.5 2.5 2.5 2.5 2.5 2.5 2.5 2.5	020					
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10) Specific Conductivity	Units 24 hr feet gal mL / min NTU % mg/L MeV mS/cm ^c	2.49 2.0 32.7 7.7 0.23 -102.8 C.763	YSI-556 an 9:11 2:49 2:25 200 31.8 9.0 0.96 -111.6 0-764	9:16 2.49 2.5 2.00 38.6 9:8 1.07 -112.5 0.763	020					
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10) Specific Conductivity Conductivity (+/- 3%)	Units 24 hr feet gal mL / min NTU % mg/L MeV mS/cm ^c mS/cm	2.49 2.0 32.4 7.7 0.23 -102.8 C.763 C.763 C.574	YSI-556 an 9:11 2:49 2:25 200 31.8 9:0 6:96 -111.6 0:764 0:574	9-16 2.49 2.5 2.5 2.5 2.5 2.5 2.5 2.5 2.5 2.5 2.5	020					
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10) Specific Conductivity Conductivity (+/- 3%) pH (+/- 0.1)	Units 24 hr feet gal mL / min NTU % mg/L MeV mS/cm ^c mS/cm pH unit	2.49 2.0 32.7 7.7 0.23 -102.8 C.763 C.763 C.579 7.87	YSI-556 an 9:11 2:49 2:25 200 31.8 9:0 6:96 -111.6 0:764 0:574	9-16 2.49 2.5 2.5 2.5 2.5 2.5 2.5 2.5 2.5 2.5 2.5	020					
Parameter Time Water Level (0.33) Volume Purged Flow Rate Turbidity (+/- 10%) Dissolved Oxygen (+/- 10%) Dissolved Oxygen (+/- 10%) Eh / ORP (+/- 10) Specific Conductivity Conductivity (+/- 3%) pH (+/- 0.1) Temp (+/- 0.5)	Units 24 hr feet gal mL / min NTU % mg/L MeV mS/cm ^c mS/cm pH unit C	2.49 2.0 200 32.4 7.7 0.23 -102.8 C.743 C.514 7.87 2.15	YSI-556 an 9:11 2:49 2:25 200 31.8 9:0 6:96 -111.6 0:764 0:764 0:574 7:65 12:01	9:16 2:49 2:5 2:00 38:6 9:8 1.07 -112:5 0:57 0:57 0:57 7:00 11:99	020					
Parameter Time Water Level (0.33) Volume Purged Flow Rate	Units 24 hr feet gal mL / min NTU % mg/L MeV mS/cm ^c mS/cm pH unit	2.49 2.0 200 32.4 7.7 0.23 -102.8 C.763 C.574 7.87 2.15 Clauda	YSI-556 an 9:11 2:49 2:25 200 31.8 9:0 6:96 -111.6 0:764 0:574	9-16 2.49 2.5 2.5 2.5 2.5 2.5 2.5 2.5 2.5 2.5 2.5	020					

Appendix A-11

Monitoring Well Details and Depth-to-Groundwater Measurements -Star Gas Property

Appendix A-11 Monitoring Well Details and Depth-to-Groundwater Measurements -Star Gas Property Former Duso Chemical Company Poughkeepsie, New York NYSDEC Site No. 3-14-103

Well Identification	Screened Material	Top of Casing Elevation (feet amsl)	Top of Screen (feet bgs)	Bottom of Screen (feet bgs)	Depth-to- Groundwater (feet bgs)	Total Well Depth (feet bgs)	Groundwater Elevation (feet amsl)
BIW-1D	Silty Sand and Silty Clay Interface	111.68	19	26	3.66	25.41	108.02
BIW-1S	Silty Sand	111.99	6	16	3.57	15.69	108.42
BIW-2D	Silty Sand and Silty Clay Interface	111.03	14	24	2.65	23.47	108.38
BIW-2S	Silty Sand	111.01	4	9	2.31	8.61	108.70
BIW-3D	Gravel and Sand	111.93	19	24	4.07	23.50	107.86
BIW-3S	Silty Sand	111.95	2	7	1.87	6.68	110.08
BIW-4	Silty Clay and Glacial Till Interface	112.54	2	11.5	4.01	11.05	108.53
BIW-5D	Silty Sand and Silty Clay Interface	110.93	15	20	3.78	19.68	107.15
BIW-5S	Silty Sand	111.19	5	12	3.59	11.60	107.60
BIW-6D	Silty Sand	111.92	15	20	2.59	19.60	109.33
BIW-6S	Silty Sand	111.93	2	10	3.07	9.39	108.86
BIW-7	Silty Sand	111.21	4	14	2.09	13.65	109.12
MHC-22	Silty Sand	113.03	3.5	13.5	4.14	12.46	108.89
MHC-23	Silty Sand	NA	3	13	3.94	11.59	NA
MHC-24	Silty Sand	111.58	3	13	5.47	12.38	106.11
MHC-25D	Bedrock	NA	36	41	6.18	40.64	NA
MHC-25I	Silty Clay	NA	22	27	1.30	26.40	NA
MHC-25S	Silty Sand	NA	4	14	1.95	13.21	NA
MHC-26	Silty Sand	113.23	3	13	4.58	12.01	108.65
OBG-2S	Silty Sand and Silty Clay Interface	123.19	9.1	19.1	NM	NM	NA
OBG-3S	Silty Clay	123.83	5.9	17.9	NM	NM	NA
OBG-4S	Silty Sand and Silty Clay Interface	122.17	4.3	14.3	NM	NM	NA

Notes:

Measurements collected on December 11, 2012

Top of casing and groundwater elevations based on USGS NAVD 1927

bgs - below ground surface

amsl - above mean sea level

NM - Not measured

NA - Not available

* - Screened material inferred, soil samples not recovered



Appendix A-12

Monitoring Well Details and Depth-to-Groundwater Measurements -Mid Hudson Business Park

Appendix A-12 Monitoring Well Details and Depth-to-Groundwater Measurements -Mid Hudson Business Park Former Duso Chemical Company Poughkeepsie, New York NYSDEC Site No. 3-14-103

Well Identification	Screened Material	Top of Casing Elevation	Top of Screen (feet bgs)	Bottom of Screen	Depth-to- Groundwater	Total Well Depth (feet bgs)	Groundwater Elevation
		(feet amsl)		(feet bgs)	(feet bgs)	、 、	(feet amsl)
MHBP-8	Silty Sand	110.57	5	15	3.41	12.70	107.16
MHBP-10	Silty Sand	111.50	5	15	4.33	11.79	107.17
MHBP-11	Silty Sand	112.06	10	20	NM	NM	NA
MHBP-12	Silty Sand	111.63	10	20	4.47	18.49	107.16
MHBP-13D	Bedrock	110.58	38.5	43.5	4.09	43.44	106.49
MHBP-13S	Silty Sand	110.29	10	20	3.95	16.00	106.34
MHBP-15 MHBP-19D	Silty Sand Bedrock	112.74 111.57	4.5 43	14.5 48	NM** 4.00	24.88 47.59	NA 107.57
MHBP-19D MHBP-19S	Silty Sand	111.57	43	40 12	4.00	47.59	107.63
MHBP-195 MHBP-21	Silty Sand	NA	3	12	5.10	13.82	NA
MHC-29	Silty Sand	112.51	10	20	4.46	18.93	108.05
MHC-29 MHC-30	Silty Sand	112.51	9	19	4.46	16.45	108.05
OBG-1B	Bedrock	114.56	30.5	35.5	4.55 NM	10.45 NM	NA
OBG-15	Silty Sand	115.39	8.9	18.9	NM	NM	NA
OBG-6S	Silty Sand	112.89	5	10	5.14	9.12	107.75
OBG-00 OBG-7D	Silty Clay	112.82	52	61.5	5.49	61.50	107.33
OBG-7I	Silty Sand and Silty Clay Interface	112.88	19.4	29.4	5.69	29.31	107.19
OBG-7S	Silty Sand	112.82	4.8	9.8	5.28	9.33	107.54
OBG-8S	Silty Sand	109.93	6.1	10.1	2.85	9.18	107.08
OGB-14B	Bedrock	112.61	15.1	24.6	NM	NM	NA
OBG-70B	Glacial Till	112.81	69.2	78.8	5.82	78.43	106.99
TW-1D	Glacial Till	110.63	55	60	3.50	60.10	107.13
TW-1I	Silty Clay	110.35	25	35	3.39	35.00	106.96
TW-1S	Silty Sand	110.70	15	20	3.75	19.97	106.95
TW-2D	Silty Clay and Glacial Till Interface	112.71	60	65	5.52	64.94	107.19
TW-2I	Silty Clay	112.31	30	35	5.24	34.32	107.07
TW-2S	Silty Sand	112.30	15	20	5.14	19.79	107.16
TW-3D	Silty Clay and Glacial Till Interface	109.69	44	49	2.84	47.42	106.85
TW-3I	Silty Clay	109.35	25	35	2.81	33.55	106.54
TW-3S	Silty Sand	109.43	15	20	3.13	19.99	106.30
TW-4D	Glacial Till	110.27	35	40	2.89	38.13	107.38
TW-4I	Silty Clay	110.39	15	25	3.96	23.89	106.43
TW-4S	Silty Sand	110.57	5	10	4.13	10.00	106.44
TW-5D	Silty Clay and Glacial Till Interface	112.14	25	35	4.11	35.08	108.03
TW-5S	Silty Sand	111.99	15	20	4.23	19.69	107.76
TW-6D	Silty Clay	108.27	50	55	1.32	53.24	106.95
TW-6I	Silty Clay	108.17	30	35	1.37	32.89	106.80
TW-6S	Silty Sand	108.03	15	20	1.20	19.69	106.83
TW-7D	Glacial Till	112.58	52	57	5.23	56.35	107.35
TW-7I	Silty Clay	112.57	30	35	5.04	33.45	107.53
TW-7S	Silty Sand	112.44	15	20	4.98	17.89	107.46
X-PROP-MW-D	Silty Clay*	112.35	37.5	42.5	5.12	38.27	107.23
X-PROP-MW-I	Silty Clay*	112.35	25	30	5.26	29.21	107.09
X-PROP-MW-S	Silty Sand*	112.35	15	20	5.01	19.89	107.34
Y-PROP-MW-D	Silty Clay*	112.56	52.5	57.5	5.39	56.24	107.17
Y-PROP-MW-I	Silty Clay*	112.56	35	40	7.88	38.10	104.68
Y-PROP-MW-S	Silty Sand*	112.56	15	20	6.11	17.53	106.45
Z-PROP-MW-D	Silty Clay*	112.01	55	60	4.62	58.51	107.39
Z-PROP-MW-I	Silty Clay*	112.01	35	40	4.68	37.38	107.33
Z-PROP-MW-S	Silty Sand*	112.01	15	20	5.20	19.55	106.81

Notes:

Measurements collected on December 11, 2012

Top of casing and groundwater elevations based on USGS NAVD 1927

bgs - below ground surface

amsl - above mean sea level

NM - Not measured

NA - Not available

* - Screened material inferred, soil samples not recovered

** - Water level probe malfunctioned at time of measurement



Appendix A-13

Groundwater Analytical Results - Star Gas Property

Appendix A-13 Groundwater Analytical Results - Star Gas Property Former Duso Chemical Company . Poughkeepsie, New York NYSDEC Site No. 3-14-103

	Sample ID		BIW-1S 112712	BIW-1D 112712	BIW-2S 113012	BIW-2D 113012	BIW-3S 112812	BIW-3D 112912	BIW-4 112912	BIW-5S 112712	BIW-5D 112812	BIW-6S 112812	BIW-6D 112812	BIW-7 112712	MHC-23-112612	MHC-25S 112912	DUP1129121	MHC-26 121112
	Date	AWQS/GV	11/27/2012	11/27/2012	11/30/2012	11/30/2012	11/28/2012	11/29/2012	11/29/2012	11/27/2012	11/28/2012	11/28/2012	11/28/2012	11/27/2012	11/26/2012	11/29/2012	11/29/2012	12/11/2012
CAS No.	Matrix VOC (μg/L)		Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water
71-55-6	1,1,1-Trichloroethane	5	9.4	3,600 D	5,200 D	3.3	1 U	1 U	1 U	560 D	33,000 D	42	0.82 J	1 U	3,900 D	1 U	1 U	1,500 D
79-34-5	1,1,2,2-Tetrachloroethane	5	1 U	50 U	1 U	1 U	1 U	1 U	1 U	10 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	25 U
79-00-5 76-13-1	1,1,2-Trichloroethane 1.1.2-Trichloro-1.2.2-trifluroethane	1	10	50 U 50 U	1 U 1 U	1 U 1 U	1 U 1 U	1 U 1 U	10	10 U 42 D	1.0 1 U	1 U 1 U	1 U 1 U	1 U 1 U	1 U 77	1 U 1 U	10	25 U 25 U
75-34-3	1,1-Dichloroethane	5	3.5	2,400 D	8,500 D	21	1 U	1 U	1 U	810 D	80,000 D	120 D	34	1 U	590 D	3.6	3.5	1,100 D
75-35-4	1,1-Dichloroethene	5	1 U	73 D	420 D	1 U	1 U	1 U	1 U	10 U	1,900 D	10	1 U	1 U	530 D	1 U	1 U	280 D
120-82-1 96-12-8	1,2,4-Trichlorobenzene 1,2-Dibromo-3-chloropropane	5 0.04	10	50 U 50 U	1 U 1 U	1 U 1 U	1 U 1 U	1 U 1 U	1 U 1 U	10 U 10 U	1 U 1 U	1 U 1 U	1 U 1 U	1 U 1 U	0.80 J 1 U	1 U 1 U	1 U 1 U	25 U 25 U
106-93-4	1,2-Dibromoethane	0.0006	1 U	50 U	1 U	1 U	1 U	1 U	1 U	10 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	25 U
95-50-1	1,2-Dichlorobenzene 1.2-Dichloroethane	3	1 U	50 U	1 U	1 U	1 U	1 U	1 U	10 U	1 U	1 U	1 U	1 U	260 D	1 U	1 U	30 D
107-06-2 78-87-5	1,2-Dichloropropane	0.6	0.3 J 1 U	160 D 50 U	170 D 1 U	1 U 1 U	1 U 1 U	1 U 1 U	1 U	77 D 10 U	6,800 D 5.0	53 1 U	2.8 1 U	1 U 1 U	35 1 U	2.8 1 U	2.7 1 U	27 D 25 U
541-73-1	1,3-Dichlorobenzene	3	1 U	50 U	1 U	1 U	1 U	1 U	1 U	10 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	25 U
106-46-7	1,4-Dichlorobenzene	3	1 U 5 U	50 U	1 U 5 U	1 U	1 U 5 U	1 U	1 U	10 U	1 U 5 U	1 U	1 U	1 U 5 U	26	1 U	1 U	25 U 130 U
594-20-7 78-93-3	2-Hexanone 2-Butanone (Methyl ethyl ketone)	5 50(GV)	10 U	250 U 500 U	2.8 J	5 U 10 U	10 U	5 U 10 U	5 U 10 U	50 U 100 U	280	5 U 10 U	5 U 10 U	10 U	5 U 10 U	5 U 10 U	10 U	250 U
108-10-1	4-Methyl-2-pentanone	NA	5 U	250 U	5 U	5 U	5 U	5 U	5 U	50 U	34	5.0 U	5 U	5 U	5 U	5 U	5 U	130 U
67-64-1	Acetone	50 (GV)	10 U	500 U	3.6 J	4.7 J	6.3 J	7.7 J	8.1 J	100 U	740 E	8.2 J	9.2 J	10 U	7.2 J	8.4 J	9.3 J	250 U
71-43-2 75-27-4	Benzene Bromodichloromethane	1 50(GV)	1 U 1 U	50 U 50 U	1.1 1 U	1 U 1 U	1 U 1 U	1 U 1 U	1 U 1 I I	10 U 10 U	3.0 1 U	0.76 J 1 U	1 U 1 U	1 U 1 U	1.4 1 U	1 U 1 U	1 U 1 U	25 U 25 U
75-25-2	Bromoform	50(GV)	10	50 U	1 U	1 U	1 U	1 U	1 U	10 U	1 U	1 U	1 U	1 U	1 U	1 U	10	25 U
74-83-9	Bromomethane	5	1 U	50 U	1 U	1 U	1 U	1 U	1 U	10 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	25 U
75-15-0 56-23-5	Carbon disulfide Carbon tetrachloride	60(GV) 5	1 U 1 U	50 U 50 U	1 U 1 U	1 U 1 U	1 U 1 U	1 U 1 U	1 U 1 U	10 U 10 U	1 U 1 U	1 U 1 U	1 U 1 U	1 U 1 U	0.46 J	1 U	1 U	25 U 25 U
108-90-7	Chlorobenzene	5	10	50 U	1 U	1 U	1 U	1 U	1 U	10 U	1 U	1 U	1 U	1 U	10	1 U	10	25 U
75-00-3	Chloroethane	5	1 U	50 U	1,000 D	1 U	1 U*	1 U	1 U	150 D	490 DJ	1 U	1 U*	1 U	220 D	1 U	1 U	860 D
67-66-3 74-87-3	Chloroform Chloromethane	7	1 U	50 U 50 U	0.52 J	0.99 J 1 U	1 U 1 U	1 U 1 U	1 U	10 U 10 U	22 1 U	0.76 J 1 U	1 U 1 U	1 U 1 U*	2.1	1 U 1 U	1 U	25 U 25 U
156-59-2	cis-1,2-Dichloroethene	5	0.91 J	50 U	910 D	2.0	1 U	10	10	81 D	3.9	4.4	10	10	1 U 490 D	1 U	10	190 D
10061-01-5	cis-1,3-Dichloropropene	0.4	1 U	50 U	1 U	1 U	1 U	1 U	1 U	10 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	25 U
110-82-7	Cyclohexane	50	1 U	50 U	1 U	1 U	1 U	1 U	1 U	10 U	1 U	1 U	1 U	1 U	81	1 U	1 U	25 U
124-48-1 75-71-8	Dibromochloromethane Dichlorodifluoromethane	50(GV)	10	50 U 50 U	1 U 1 U	1 U 1 U	1 U 1 U	1 U 1 U	1 U 1 U	10 U 10 U	1 U 1 U	1 U 1 U	1 U 1 U	1 U 1 U*	1 U 1 U	1 U 1 U	10	25 U 25 U
100-41-4	Ethylbenzene	5	1 U	50 U	1.2	1 U	1 U	1 U	1 U	10 U	1 U	1 U	1 U	1 U	4.7	1 U	1 U	25 U
98-82-8	Isopropylbenzene	5	1 U	50 U	1 U	1 U	1 U	1 U	1 U	10 U	1 U	1 U	1 U	1 U	3.7	1 U	1 U	25 U
79-20-9 1634-04-4	Methyl acetate Methyl tert-butyl ether	5 10(GV)	1 U 1.8	50 U 50 U	1 U 6.2	1 U 1 U	1 U 1 U	1 U 4.3	1 U 1 U	10 U 10 U	0.90 J 73	1 U 8.2	1 U 1 U	1 U 2.4	1 U 1 U	1 U 1.6	1 U 1.8	25 U 23 DJ
108-87-2	Methylcyclohexane	50	1 U	50 U	0.76 J	1 U	1 U	2.6	1 U	65 D	0.47 J	1 U	1 U	1 U	250 D	1 U	1 U	26
75-09-2	Methylene chloride	5	1 U	50 U	1.2	1 U	1 U	1 U	1 U	10 U	25	1 U	1 U	1 U	1 U	1 U	1 U	12 DJ
100-42-5 127-18-4	Styrene Tetrachloroethene	5	1 U 0.54 J	50 U 50 U	1 U 1.5	1 U 2.4	1 U 6.2	1 U 0.86 J	1 U 3.7	10 U 13 D	1 U 56	1 U 5.9	1 U 1 U	1 U 1 U	1 U 23	1 U 1 U	10	25 U 25 U
108-88-3	Toluene	5	1 U	50 U	25	1 U	1 U	1 U	1 U	10 U	1 U	1 U	1 U	1 U	4.1	1 U	1 U	25 U
156-60-5	trans-1,2-Dichloroethene	5	1 U	50 U	10	1 U	1 U	1 U	1 U	10 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	25 U 25 U
10061-02-6 79-01-6	trans-1,3-Dichloropropene Trichloroethene	0.4 5	1 U 2.5	50 U 50 U	1 U 11	1 U 16	1 U 6.1	1 U 0.90 J	1 U 2.7	10 U 46 D	1 U 49	1 U 35	1 U 1 U	1 U 1 U	1 U 340 D	1 U 1 U	1 U 1 U	25 U 28 D
75-69-4	Trichlorofluoromethane	5	1 U	50 U	1 U	1 U	1 U	1 U	1 U	10 U	1 U	1 U	1 U	1 U	2.1	1 U	1 U	25 U
75-01-4	Vinyl chloride	2	1 U	50 U	150 D	1 U	1 U	1 U	1 U	16 D	210 E	2.2	1 U	1 U	20	1 U	1 U	190 D
1330-20-7	Xylenes, Total Total CVOCs	100 NA	2 U 17	100 U 6,233	4.7 16,374	2 U 46	2 U 12	2 U 2	2 U 6	20 U 1,795	2 U 122,562	2 U 273	2 U 38	2 U ND	7.8 6,516	2 U 6	2 U 6	20 U 4,217
	Total VOCs	NA	19	6,233	16,420	50	19	16	15	1,860	123,693	290	47	2.4	6,876	16	17	4,266
74.94.0	Dissolved Gases (µg/L)	NIA	U	L L		U	~ -!!!	7 - 11		000111	bu	2 4 1 1			000	7.612	U	
74-84-0 74-85-1	Ethane Ethene	NA NA	7.5 U 7.0 U	7.5 U 7.0 U	22 13	7.5 U 7.0 U	7.5 U 7.0 U	7.5 U 7.0 U	7.5 U 7.0 U	380 U 350 U	7.5 U 24	7.5 U 7.0 U	7.5 U 7.0 U	7.5 U 7.0 U	380 U 350 U	7.5 U 7.0 U	7.5 U 7.0 U	NS NS
74-82-8	Methane	NA	100	2.4 J	340	35	98	22	5.6	390 D	41	90	29	680	400	13	10	NS
NA	General Chemistry (µg/L) Bromide	2,000	200 U	200 U	200 U	99 J	200 U	200 U	370	200 U	1.000 UD	20011	130 J	200 U	200 U	200 U	330	NS
16887-00-6	Chloride	250,000	84,200	52,700	200,000 D	302,000 D	129,000 D	194,000 D	141,000 D	34,000	531,000 D	43,200	151,000 D	71,100	31,600	200 D	213,000 D	NS
14808-79-8	Sulfate	250,000	18,100	35,200	4,600	42,800	27,300	46,600	32,000	4,000	64,200 D	23,100	36,000	5,500	3,400	17,200	17,200	NS
14797-55-8 14797-65-0	Nitrate Nitrite	10,000	50 U 50 U	50 U 50 U	NS NS	NS NS	130 24 J	50 U 50 U	130 50 U	49 J 50 U	49 J 50 U	50 U 50 U	50 U 50 U	50 U 50 U	50 U 50 U	50 U 50 U	50 U 50 U	NS NS
NA	Total Organic Carbon	NA	1,500	1,000 U	4,100	1,000 U	710 J	1,200	430 J	2,800	21,000	960 J	1,000 U	2,800	3,800	470 J	1,000 U	6,400
14265-44-2	Phosphate	NA	13	69	10 U	10 U	64	10 U	260	40	23	35	11	660	160	10 U	10 U	NS
	Biological Analyses (cells)	NIA	1			1									1			
NA	Dehalococcoides (Dhc)	NA NA	3,000 U	2,000 U	2,000,000	1,000 U	2,000 J	1,000 U	30,000 U	3,000,000	2,000	9,000	1,000 U	2,000	700,000	50,000	NS	NS
NA	Dehalobacter (Dhb)	NA	4,000 U	60,000	6,000,000	2,000 U	200,000	10,000	10,000 J	2,000,000	700,000	2,000 U	1,000 J	200,000	4,000,000	10,000 U	NS	NS
NA	Volatile Fatty Acids (mg/L) Lactate	NA	0.39 U	0.39 U	0.39 U	0.39 U	0.39 U	0.39 U	0.39 U	0.39 U	0.39 U	0.64	0.39 U	0.39 U	0.39 U	0.39 U	NS	NS
NA	Acetate	NA	0.87	0.95	3.0	1.40	1.30	1.30	1.30	1.50	51	1.50	1.10	0.81	0.88	1.40	NS	NS
NA	Propionate	NA	0.31 U	0.31 U	0.31 U	0.31 U	0.31 U	0.31 U	0.31 U	0.31 U	0.31 U	0.31 U	0.31 U	0.31 U	0.31 U	0.31 U	NS	NS
NA NA	Formate Butyrate	NA NA	0.22 U 0.41 U	0.22 U 0.41 U	1.30 0.41 U	0.22 U 0.41 U	13 0.41 U	0.22 U 0.41 U	0.22 U 0.41 U	0.22 U 0.41 U	0.22 U 0.41 U	NS NS	NS NS					
NA	Pyruvate	NA	0.41 U	0.41 U	0.69 U	0.41 U	0.69 U	0.69 U	0.41 U	0.69 U	0.41 U	0.41 U	0.69 U	0.41 U	0.69 U	0.69 U	NS	NS
Notes:						•	•	•							-	· · ·		

Notes: BOLD - The compound was detected at a concentration greater than or equal to the method detection limit (MDL). BOLD/SHADED IN BLUE - The compound was detected at a concentration greater than New York State Ambient Water Quality Standards (AWQS) or Guidance Values (GV). µg/L - milligrams per liter NA - Not Applicable NS - Not Sampled U/ND - The compound was not detected at a concentration greater than or equal to the MDL. J - The concentration given is an approximate value. The concentration is less than the reporting limit (RL) and greater than or equal to the MDL. D - The reported value is from a secondary dilution analysis factor. E - The compound concentration exceeded the calibration range. - Toucilicate sample of MHC-25S 112912

¹ - Duplicate sample of MHC-25S 112912
 * Laboratory control sample (LCS) or LCS Duplicate (LCSD) exceeds the control limits.



Appendix B

Enhanced Reductive Dechlorination Amendment Product Information and Material Safety Data Sheets

Material Safety Data Sheet EHC®

MSDS #: EHC-C Revision Date: 2012-04-30 Version 1



This MSDS has been prepared to meet U.S. OSHA Hazard Communication Standard 29 CFR 1910.1200 and Canada's Workplace Hazardous Materials Information System (WHMIS) requirements.

1. PRODUCT AND COMPANY IDENTIFICATION

Product name

EHC®

Recommended use

Bioremediation product for the remediation of contaminated soil and groundwater only. Not for use in potable drinking water.

FMC CORPORATION FMC Peroxygens 1735 Market Street Philadelphia, PA 19103 Phone: +1 215/ 299-6000 (General Information) E-Mail: msdsinfo@fmc.com

2. Hazards identification Emergency Overview

CONTAINMENT HAZARD:

Any vessel that contains wet EHC must be vented due to potential pressure build up from fermentation gases

Emergency telephone number

+1 703-527-3887 (CHEMTREC)

For leak, fire, spill or accident emergencies, call:

+1 303 / 595 9048 (Medical - Call Collect)

Potential health effects

Acute Toxicity Eves	No significant health effects anticipated Product dust may cause mechanical eye irritation.
Skin	None known .
Inhalation	Inhalation of dust in high concentration may cause irritation of respiratory system.
Ingestion	Ingestion may cause gastrointestinal irritation, nausea, vomiting and diarrhea.
Chronic Toxicity	No known chronic effects of components present at greater than 1%.

3. Composition/information on ingredients

Ingredients

Chemical Name	CAS-No	Weight %
Iron	7439-89-6	18-48
Organic Amendment	Proprietary	52-82

4. First aid measures

Eye contact	In case of contact, immediately flush skin with plenty of water. Get medical attention if irritation develops and persists.
Skin contact	Wash off with soap and water.
Inhalation	Remove person to fresh air. If signs/symptoms continue, get medical attention.
Ingestion	Rinse mouth with water and afterwards drink plenty of water or milk. Call a poison control center or doctor immediately for treatment advice.

5. Fire-fighting measures Combustible material. Flammable properties Suitable extinguishing media Dry chemical, CO₂, sand, earth, water spray or regular foam. **Explosion Data** Sensitivity to Mechanical Impact not applicable Sensitivity to Static Discharge not applicable Specific hazards arising from the Dry or powdered ingredients are combustible. Dispersal of finely divided dust from products into chemical air may form mixtures that are ignitable and explosive. Minimize airborne dust generation and eliminate sources of ignition. NFPA Health Hazard Flammability 1 Stability 0 Special Hazards -**NFPA/HMIS Ratings Legend** Severe = 4; Serious = 3; Moderate = 2; Slight = 1; Minimal = 0 6. Accidental release measures **Personal precautions** Avoid dust formation. For personal protection see section 8. Methods for containment Cover powder spill with plastic sheet or tarp to minimize spreading and keep powder dry. Methods for cleaning up Sweep or vacuum up spillage and return to container. 7. Handling and storage Handling Minimize dust generation and accumulation. Keep away from open flames, hot surfaces and sources of ignition. Refer to Section 8. Storage Keep tightly closed in a dry and cool place. Keep away from open flames, hot surfaces and sources

8. Exposure controls/personal protection

fermentation gases.

of ignition. Any vessel that contains .? must be vented due to potential pressure build up from

Engineering measures	None under normal use conditions. Provide appropriate exhaust ventilation at places where dust is formed.
Personal Protective Equipment	
General Information	If the product is used in mixtures, it is recommended that you contact the appropriate protective equipment suppliers, These recommendations apply to the product as supplied
Respiratory protection	Whenever dust in the worker's breathing zone cannot be controlled with ventilation or other engineering means, workers should wear respirators or dust masks approved by NIOSH/MSHA, EU CEN or comparable organization to protect against airborne dust.
Eye/face protection	Safety glasses with side-shields
Skin and body protection	No special precautions required.
Hand protection	No special precautions required
Hygiene measures	Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks

and immediately after handling the product.

9. Physical and chemical properties

Appearance	Light-tan powder
Physical state	solid
Odor	odorless
рН	5.6 (as aqueous solution)
Melting Point/Range	No information available.
Freezing point	No information available
Boiling Point/Range	not applicable
Flash Point	not applicable
Evaporation rate	not applicable
Autoignition Temperature	No information available.
Flammable properties	Combustible material
Vapor pressure	No information available
Vapor density	No information available
Density	0.80 g/mL
Water solubility	practically insoluble
Percent volatile	No information available
Partition coefficient:	not applicable
Viscosity	No information available
Oxidizing properties	not applicable

10. Stability and reactivity

Stability	Stable.
Conditions to avoid	Heat, flames and sparks
Materials to avoid	Oxidizing agents Strong acids
Hazardous decomposition products	None known
Hazardous polymerization	Hazardous polymerization does not occur

11. Toxicological information

Acute effects Remarks	The product has not been tested. Data is based on component.
Eye irritation Skin irritation	No data available for the formulation. Non-irritating (rabbit) (based on components) No data available for the formulation. Non-irritating (rabbit) (based on components)
LD50 Oral LD50 Dermal LC50 Inhalation:	Iron: 98.6 g/kg (rat) No information available Iron: > 100 mg/m ³ 6 hr (rat)
Chronic Toxicity	
Chronic Toxicity	No known chronic effects of components present at greater than 1%.
Carcinogenicity	Contains no ingredient listed as a carcinogen.

12. Ecological information

Ecotoxicity

The environmental impact of this product has not been fully investigated

Chemical Name	Toxicity to algae	Toxicity to fish	Toxicity to microorganisms	Toxicity to daphnia and other aquatic invertebrates
Iron		LC50= 13.6 mg/L Morone		
		saxatilis 96 h LC50= 0.56 mg/L		
		Cyprinus carpio 96 h		

13. Disposal considerations

Waste disposal methods	This material, as supplied, is not a hazardous waste according to Federal regulations (40 CFR 261). This material could become a hazardous waste if it is mixed with or otherwise comes in contact with a hazardous waste, if chemical additions are made to this material, or if the material is processed or otherwise altered. Consult 40 CFR 261 to determine whether the altered material is a hazardous waste. Consult the appropriate state, regional, or local regulations for additional requirements
Contaminated packaging	Dispose of in accordance with local regulations

14. Transport information

DOT	not regulated
TDG	not regulated
ICAO/IATA	not regulated
IMDG/IMO	not regulated

15. Regulatory information

International Inventories	
TSCA Inventory (United States of America)	-
DSL (Canada)	Complies
NDSL (Canada)	Complies
EINECS/ELINCS (Europe)	Complies
ENCS (Japan)	-
IECSC (China)	Complies
KECL (Korea)	-
PICCS (Philippines)	Complies
AICS (Australia)	Complies
NZIoC (New Zealand)	Complies

U.S. Federal Regulations

SARA 313

Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 (SARA). This product does not contain any chemicals which are subject to the reporting requirements of the Act and Title 40 of the Code of Federal Regulations, Part 372.

SARA 311/312 Hazard Categories	
Acute Health Hazard	no
Chronic Health Hazard	no
Fire Hazard	no
Sudden Release of Pressure Hazard	no
Reactive Hazard	no

CERCLA

This material, as supplied, does not contain any substances regulated as hazardous substances under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) (40 CFR 302) or the Superfund Amendments and Reauthorization Act (SARA) (40 CFR 355). There may be specific reporting requirements at the local, regional, or state level pertaining to releases of this material.

International Regulations Mexico - Grade

No information available

Canada

This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all the information required by the CPR. WHMIS Hazard Class not determined

16. Other information

HMIS	Health Hazard 1	Flammability 1	Stability 0	Special precautions -	
NEDA /IIMIC Detterry Lagon	d Carran 4, Ca	niana 2. Madamata 2. Silia	ht 1. Minimal 0		
NFPA/HMIS Ratings Legen	a Severe = 4; se	Severe = 4; Serious = 3; Moderate = 2; Slight = 1; Minimal = 0			
Revision Date:	2012-04-30				
Reason for revision:	No information	n available.			

Disclaimer

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Prepared By

FMC Corporation FMC Logo and EHC - Trademarks of FMC Corporation

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End of Material Safety Data Sheet



EOS pro		PRODUCT INFORMATION SHEET Emulsified Oils Family		
	designed t anaerobic drainage, used to re	ormerly 598B42) is a nutrient-enriched, DoD-validated, food-grade oil/water emulsion to quickly stimulate microbial activity while providing long-term nourishment to enhance bioremediation of chlorinated solvents, nitrates, perchlorate, energetics, acid mine and other recalcitrant chemicals in contaminated groundwater. EOS pro can also be educe redox sensitive metals and radionuclides. The negative surface charges on the ombined with small droplet size promote effective transport in the subsurface. enefits: ncludes biostimulating vitamins and nutrients apidly-biodegradable substrates to "jump start" bacterial growth low release biodegradable substrates to promote long-term biological activity mall oil droplet size egative surface charge leutral pH xtensive third party validation icorporates the proven patented EOS [®] technologies that clients have trusted for more		
Description	 R SI SI N N E 			
		ecade. Made in the USA with US farmed soybean oil.		
Chemical & Physical Properties	Refined an Rapidly Bi Other Org Specific G pH (Stand Median Oi Organic C	nd Bleached US Soybean Oil (% by wt.) odegradable Soluble Substrate (% by wt.) anics (emulsifiers, food additives, etc.) (% by wt.) ravity	59.8 4 10 0.96 - 0.98 6.0 - 7.0 1.0 74 0.25	
Packaging	Shipped ir	l in 55-gallon drums, 275-gallon IBC totes or bulk tankers (40,000 lbs.)		
Handling & Storage	field to pre be distribu Dosatron [™] depending to maximiz For best p			
	For best performance, use EOS pro within 60 days of delivery and store at a temperature between 40°F (4°C) to 100°F (38°C).			

EHC[®] Original ISCR Reagent Demand Calculations

Customer:	AECOM	
Contact:	Paul M. Dombrowski, P.E.	
Site Location:	Poughkeepsie, NY	
Proposal Number:	FMC-OPP-000435	

PRODUCT OVERVIEW

EHC is composed of controlled-release carbon, zero valent iron (ZVI) particles and nutrients used for stimulating in situ chemical reduction (ISCR) of otherwise persistent organic compounds in groundwater. Following placement of EHC into the subsurface environment, a number of physical, chemical and microbiological processes combine to create very strong reducing conditions that stimulate rapid and complete dechlorination of organic solvents and other recalcitrant compounds (e.g., explosives and organochlorine pesticides).

EHC is delivered as a dry powder in 50-lb / 25-kg bags or super-sacs. EHC can be placed into the saturated zones in a variety of ways including direct push injections, hydraulic and pneumatic fracturing, and direct soil mixing. EHC is completely non-hazardous and safe to handle. EHC is manufactured in the USA, EU and Brazil.

SITE INFORMATION / ASSUMPTIONS

	Value	<u>Unit</u>	Comment
Treatment Area Dimensions:			
Width of targeted zone (perpendicular to gw flow)	25	ft	customer supplied
Length of targeted zone (parallel to gw flow)	50	ft	customer supplied
Depth to top of treatment zone	4	ft bgs	customer supplied
Treatment zone thickness	20	ft	customer supplied
Treatment volume	25,000	ft3	calculated value
Total Porosity	30	%	default value
Groundwater volume	7,500	ft3	calculated value
Soil bulk density	105	lbs/ft3	default value
Soil mass	1,313	ton	calculated value
Transport characteristics:			
Treatment time / design life for one application	3	years	default value
Linear groundwater flow velocity	193	ft/year	calculated value
Distance of inflowing gw over design life	578	ft	calculated value
Effective porosity for groundwater flow	25	%	default value
Volume of water passing region over design life	72270	ft3	calculated value
Soil type	medium		customer supplied
Fraction organic carbon in soil, foc	0.005		estimated value



ENVIRONMENTAL SOLUTIONS

-FMC

17-Jan-2013

CONTAMINANTS OF CONCERN (COCs)				
	GW	Soil*	Total COI Mass**	
Constituent	<u>(mg/L)</u>	<u>(mg/kg)</u>	(lb)	
ТСА	33	30.195	243.6	
1,1-DCA	80	7.6	418.4	
DCE	2	0.6	11.5	
1,2-DCA	7	6.44	51.8	
СА	0.5	0.2	3.0	
PCE	0.1	0.1315	0.8	
TCE	0.1	0.0535	0.6	

*Unless provided, sorbed concentrations were roughly estimated based on expected groundwater concentrations, foc and Koc values. For a more refined estimate, it is recommended that actual values be verified via direct sampling of the targeted treatment interval. **The total COI mass was estimated based on concentrations in soil and groundwater within the targeted area plus expected contributions from inflowing groundwater over the projected design life.

	GW	Soil*	
Competing Electron Acceptors	<u>(mg/L)</u>	<u>(mg/kg)</u>	
Dissolved oxygen	1	2.87	
Nitrate (as N)	0.05	0	
Manganese (dissolved)	0	0	
Iron (III)	0	0	
Sulfate	50	0	
Carbonate Alkalinity (as CaCO3)	0	0	
*Unless provided, soil concentrations were roughly estima more refined estimate, it is recommended that actual value	1 0	-	
ORP (mV)	-20		
рН	7.2		

STOICHIOMETRIC DEMAND CALCULATIONS			
	GW	Soil	
	<u>(mg/L)</u>	<u>(mg/kg)</u>	
H2 Demand from COIs	5.1	2.0	
H2 Demand from Competing Electron Acceptors	4.1	0.4	
Total H2 Demand	9.2	2.3	
H2 Demand from Soil within Targeted Area	6.1	lb	
H2 Demand from GW within Targeted Area	4.3	lb	
H2 Demand from Influx over Design Life	41.6	lb	
Total Estimated H2 Demand	52.1	lb	

EHC DEMAND CALCULATIONS

The Stoichiometric demand for the targeted area was calculated using available data presented above, noting that the Stoichiometric demand represents minimum requirements and require a complete geochemical data set to be calculated accurately. Therefore, the resulting EHC dosing required to meet the estimated Stoichiometric demand was compared to our minimum guidelines for the selected type of application, selecting the higher

Application type: Source Area / Hot-Spot Treatment

	Value	<u>Unit</u>
Minimum EHC application rate to meet H2 demand	0.04	% by soil mass
Minimum recommended appl. rate for source area*	0.35	% by soil mass
Recommended EHC application rate	0.35	% by soil mass
Mass of EHC required	9,188	lbs
Mass of EHC per bag	50	lbs
Number of bags required	184	bags
Mass EHC (rounded up based on bag size)	9,200	lbs

*Our general recommended minimum guideline for the proposed application exceeds the dose rate required based on hydrogen demand calculations and was therefore used for the purpose of this dosing calculation.

OPTIONAL DHC INOCULANT

Although not typically required for ISCR, DHC inoculants have shown to improve removal kinetics, in particular for potential daughter products such as cis-DCE and VC. The DHC will be added after EHC application, once favorable redox conditions (ORP < -75 mV, DO <0.2 mg/L, pH between 6 and 8.5) have been attained. The DHC inoculant will contain at least 5 x10E10 cfu/ml of live bacteria including high numbers of dehalococcoides species with known abilities to biodegrade DCE. The target density of DHC cells in the treated aquifer is 1x10E6 cfu/ml.

	<u>Value</u>	<u>Unit</u>
Dechlorinating consortium concentration in inoculant	5.00E+10	DHC/L
Design final concentration after dilution in aquifer	2.50E+06	DHC/L
Volume of Inoculant Required	11	L

*Note: The minimum shipping volume of 13 L (one small keg) exceeds the caluclated requirement, and was therefore used in the quotation below.

COST ESTIMATE Item Quantity Unit Price Cost EHC 1, 2 9,200 lbs \$24,380 \$2.65 Shipping Estimate ³ 1 lump sum \$1,900 \$1,900 Sub Total Cost \$26,280 **Optional items: DHC** Inoculum 13 L \$1,105 \$85 DHC Shipping Estimate ⁴ \$190 1 per canister \$190 TOTAL COST 5 \$27,575

1) Price valid for 90 days from date at top of document. Terms: net 30 days.

2) Any applicable taxes not included. Please provide a copy of your tax exempt certificate or resale tax number when placing your order.

3) Shipping rate provided is an estimate. Standard delivery time can vary from 1-3 weeks from time of order, depending upon volume. Expedited transport can be arranged at extra cost. Unless requested otherwise, costs assume standard ground transport via truck, with no need for a lift gate or pallet jack.

4) Shipping rate via FedEx. For larger volumes, upon request the culture may be concentrated into a smaller volume to reduce shipping charges.

5) All sales are per FMC's Terms and Conditions.

Disclaimer:

The estimated dosage and recommended application methodology described in this document are based on the site information provided to us, but are not meant to constitute a guaranty of performance or a predictor of the speed at which a given site is remediated. The calculations in the Cost Estimate regarding the amount of product to be used in your project are based on stoichiometry or default minimum guideline values, and do not take into account the kinetics, or speed of the reaction. Note that the Stoichiometric mass represents the minimum anticipated amount needed to address the constituents of concern (COCs). As a result, these calculations should be used as a general approximation for purposes of an initial economic assessment. FMC recommends that you or your consultants complete a comprehensive remedial design that takes into consideration the precise nature of the COC impact and actual site conditions.

INSTALLATION

EHC is supplied as a dry powder which can be mixed with soil or slurried in water. Installation techniques vary widely depending on the application. For example, the powder can be directly mixed into the soil using deep soil mixing equipment or placed into an open excavation where prior soil removal has been conducted. A slurry can be made and the mixture can be injected into the subsurface using techniques such as direct injection through Geoprobe rods or hydraulic fracturing. Injection through fixed wells is not recommended given that the product does not dissolve in water. If application via wells or injection networks were to be the preferred installation method at your site, we instead recommend our soluble ISCR substrate EHC-L.

EHC Slurry Preparation:

The EHC slurry can been prepared in a variety of ways, including using paddle mixers, recirculation and manual mixing using a hand-held drill with a mixing attachment. However, particularly for larger projects, FMC recommends having a mechanical mixing system available on site. In general we recommend continuous mixing in smaller batches (<100 USG / 400 L) to avoid settling of solids at the bottom. For example Chem Grout's high pressure mixing and injection units are ideal for continuous preparation and injection of EHC. However, particularly for larger projects, FMC recommends having a mechanical mixing system available on site. In general we recommend continuous mixing in smaller batches (<100 USG / 400 L) to avoid settling of solids at the bottom. For example Chem Grout's high pressure mixing and injection units are ideal for continuous preparation and injection of EHC. However, particularly for larger projects, FMC recommends having a mechanical mixing system available on site. In general we recommend continuous mixing in smaller batches (<100 USG / 400 L) to avoid settling of solids at the bottom.

The amount of water to prepare the EHC slurry could be varied depending on the desired injection volume and slurry properties. When applied via direct injection, normally a concentration of between 25 and 35% is targeted. The below table shows the amount of water needed per 50-lb / 25-kg bag depending on the targeted concentration and the resulting total injection volumes and percent pore fill (injection volume to total pore volume). Note that a thinner slurry will promote permeation into more permeable formations, whereas a more concentrated/more viscous slurry will promote fracturing and horizontal propagation into more fine-grained formations.

Target concentration			
(% solids):	<u>25%</u>	<u>30%</u>	<u>35%</u>
Mass EHC per bag (lbs)	50	50	50
Volume water per bag (USG)	18.0	14.0	11.1
Volume slurry per bag (lbs)	22.2	18.2	15.4
Total mass EHC (lbs)	9,200	9,200	9,200
Total volume water (USG)	3308	2573	2048
Total injection volume (USG)	4088	3358	2837
Injection volume to <u>total</u> pore volume	7.3%	6.0%	5.1%



INSTALLATION (continued)

Injection recommendations (can be altered):

The EHC slurry can be injected into the ground in a variety of ways including direct injection and hydraulic/pneumatic fracturing. The injection spacing will be determined based on the radius of influence and soil acceptance for the given application method, lithology and depth. Assuming installation via direct push injections and a radius of influence (ROI) of 5 to 8 ft (1.7 to 2.5 m), an injection spacing of 10 to 15 ft (3 to 5 m) is normally applied. For injection PRB applications, a closer spacing is normally recommended to create some overlap or the PRB may be made up of multiple off-set injection lines to improve contact.

Unless specified by the consultant, the below recommendations was based on our experience from other similar lithologies and considers both the estimated ROI and the estimated soil acceptance (maximum injection volume per vertical foot for lithology and depth) using direct injection. However, please note that actual ROI and soil acceptance can vary widely and are also highly influenced by the injection method employed (slurry viscosity, injection pressures and flow rates). Therefore, PLEASE NOTE that the construction estimates presented below can be readily modified in the field as required (for example, the density of the slurry can be changed to modify the total injection volume or the injections spacing could be altered based in installation technology).

	Value	<u>Unit</u>	Comment
Total EHC mass	9,200	lbs	calculated value
Concentration of EHC slurry to inject	25%	by weight	can be altered
Total volume of water required	3,307	U.S. gallons	calculated value
Approximate volume of slurry to inject	4,039	U.S. gallons	calculated value
Injection spacing (grid)	10	ft	customer provided
Number of injection points	13	locations	calculated value
Mass EHC per injection point	708	lbs	calculated value
Mass EHC per vertical foot	35	lbs	calculated value
Injection volume to total pore space volume	7.2%	by volume	calculated value

SOLUTIONS In Situ Chemical Reduction Reagent

Reductive Remediation of Groundwater and Saturated Soil Contamination using Integrated Carbon and Zero Valent Iron Technology

EHC[®] in situ chemical reduction (ISCR) technology describes a family of remediation products used for the treatment of groundwater and saturated soil impacted by persistent organic compounds, including chlorinated solvents, pesticides and organic explosives. The EHC product is a modification of our Daramend[®] reductive bioremediation reagent which has been used since 1991 to treat > 10,000,000 tons of soil, sediment, and other solid materials. The synergistic mixture of zero valent iron (ZVI) and a carbon source, used in EHC[®] products, is FMC-patented technology.

EHC® applications generate very strong reducing conditions, with

attainment of redox potentials (Eh) as low as -500 mV. This is significantly lower than the Eh achieved when using either organic materials (lactate, molasses, and sugars) or reduced metal alone. Eh potentials in this range facilitate the timely and effective removal of recalcitrant chlorinated organic compounds (e.g., carbon tetrachloride, 1,2-DCA) and other persistent compounds (e.g., perchlorate) with less formation of potentially problematic intermediates, such as cis-DCE and VC from the anaerobic degradation of PCE and TCE. Similarly, generation of chloroform and dichloromethane from anaerobic degradation of carbon tetrachloride can be reduced or eliminated.

Benefits include:

Patented, synergistic mix of ZVI and a carbon source

- Direct chemical reduction of contaminants through β–elimination pathway for abiotic reductive dehalogenation, minimizing DCE & VC production
- Indirect chemical reduction by dissolved iron and secondary iron corrosion products
- Stimulation of biological reduction of halogenated compounds through the fermentation of a complex carbon/nutrient source under strong reducing conditions
- Enhanced thermodynamic conditions for the decomposition of chlorinated solvents under very strong reducing conditions

Longevity

Demonstrated effectiveness of over 5 years under field conditions

pH Neutral

Does not result in aquifer acidification (supports activity of dehalogenators)

Potential Applications for use in the saturated zone:

Direct push injections

Hydraulic and pneumatic fracturing

- Permeable reactive barriers
- Direct application in an excavation

For more information and detailed case studies, please visit our website.



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Examples of Contaminants of Concern

CHLORINATED VOCs

PCE, TCE, DCE, VC, TCA, DCA, Methylene Chloride, Carbon Tetrachloride

ORGANIC EXPLOSIVES

Perchlorate, TNT, DNT, RDX, HMX, tetryl, and others

CHLORINATED PESTICIDES

Toxaphene, DDT, Lindane, and others







MATERIAL SAFETY DATA SHEET

EOS pro, EOS ls, EOS 450, EOS xr

1. MANUFACTUER AND EMERGENCY CONTACT

Manufacturer:

EOS Remediation, LLC 1101 Nowell Road Raleigh, NC 27607 www.EOSRemediation.com Phone: 919-873-2204 Fax: 919-873-1074

24-Hour Emergency Contact:

ChemTel Inc. Phone: 1-800-255-3924 International Phone: 813-248-0585

Date of Preparation: January 9, 2013

banaary 0, 201

2. HAZARDOUS INGREDIENTS / IDENTITY INFORMATION

	% by	EXPOSURE LIMITS		EXPOSURE LIMITS			
COMPONENT(S)	WEIGHT	CAS NO.	OSHA PEL-TWA	ACGIH TLV-TWA	NIOSH REL-TWA		
Soybean Oil	45 - 60*	8001-22-7	Mist: 15 mg/m ³ (total) 5 mg/m ³ (respirable)	NE	Mist: 10 mg/m ³ (total) 5 mg/m ³ (respirable)		
Emulsifiers Trade Secret ^{1,2}	1 - 10	Proprietary	NE	NE	NE		
Soluble Substrates Trade Secret ^{1,2}	4 - 8	Proprietary	Mist: 15 mg/m ³ (total) 5 mg/m ³ (respirable)	Mist: 10 mg/m ³	NE		
Organic Substrate Trade Secret ¹	0 - 10	Proprietary	NE	Mist: 10 mg/m ³	NE		
Food Additives / Preservatives Trade Secret ¹	0.1 - 1	Proprietary	NE	NE	NE		
Nutrients / Extracts Trade Secret ^{1,2}	0 - 1	Proprietary	NE	NE	NE		
Water	Balance	7732-18-5	NE	NE	NE		

NE - Not established

1 - The precise composition of this product is proprietary information. A more complete disclosure will be provided to a physician in the event of a medical emergency.

2 - The soluble substrates and emulsifiers are generally recognized as safe for food contact.

* - Percentage of soybean oil varies by product.

3. PHYSICAL / CHEMICAL CHARACTERISTICS

pH:	Neutral
Boiling Point:	212°F
Specific Gravity:	0.96-0.98; 0.92 (pure oil phase)
Vapor Pressure:	Not established
Melting Point:	Liquid at room temperature
Percent Volatile by Volume (%):	25 - 48 (as water)
Vapor Density:	Heavier than air
Evaporation Rate:	Not established
Solubility in Water:	Dispersible
Appearance and Odor:	White liquid with vegetable oil odor

4. FIRE AND EXPLOSION HAZARD DATA

Flash Point:	>300°F
Flammable Limits:	Not established
Extinguishing Media:	CO ₂ , foam, dry chemical Note: Water, fog and foam may cause frothing and spattering.
Special Fire Fighting Procedures:	Wear self-contained breathing apparatus and chemical resistant clothing. Use water spray to cool fire exposed containers.
Unusual Fire Hazards:	Burning will cause oxides of carbon.
Unusual Explosion Hazards:	None

5. REACTIVITY DATA

Stability:
Incompatibility:
Hazardous Decomposition Products:
Hazardous Polymerization:
Conditions to Avoid:

Stable Strong acids and oxidizers Thermal decomposition may produce oxides of carbon. Will not occur None known

6. HEALTH HAZARD DATA

Routes of Entry:	Ingestion, dermal
Health Hazards:	
Acute:	Potential eye and skin irritant
Chronic:	None known
Carcinogenicity:	
N.T.P:	No
IARC:	No
OSHA:	No
Signs and Symptoms of Exposure:	None known
Medical Conditions Aggravated by Exposure:	None known

EOS pro, EOS 15, EOS 450, EOS xr

Emergency First Aid Procedures:

Inhalation:	
Eyes:	

Skin: Ingestion: Remove to fresh air. Flush with water for 15 minutes; if irritation persists see a physician. Wash with mild soap and water. Product is non-toxic. If nausea occurs, induce vomiting and seek medical attention.

7. PRECAUTIONS FOR SAFE HANDLING AND USE

Handling and Storage: Other Precautions: Spill Response: Do not store near excessive heat or oxidizers. None

None

Soak up with dry absorbent and flush area with large amounts of water.

Waste Disposal Methods:

Dispose of according to Federal and local regulations for non-hazardous waste.

8. CONTROL MEASURES

Respiratory Protection:	Not normally required.
Ventilation:	Local exhaust
Protective Gloves:	Recommended
Eye Protection:	Recommended
Other Protective Clothing or Equipment:	None

The information contained herein is based on available data and is believed to be correct. However, EOS Remediation, LLC makes no warranty, expressed or implied, regarding the accuracy of this data or the results to be obtained thereof. This information and product are furnished on the condition that the person receiving them shall make his/her own determination as to the suitability of the product for his/her particular purpose. Appendix C

Enhanced Reductive Dechlorination Amendment Calculations

AECOM

Enhanced In-Situ Bioremediation Pilot Study Volume and Dosage Calculation Table Former Duso Chemical Site - Poughkeepsie, NY

This calculation focuses on determining the appropriate injection volume. Emulsified vegetable oil quantities based on ESTCP calculations provided in Appendix C.

	Area	Thickness	Soil Volume	Pore Volume	Injection Points	Pore Volume Target	Injection Volume	Volume per vertical foot	Volume Per Point	EISB Emulsified Vegetable Oil	Volumetric Dilution (v/v)
Area Name	ft ²	ft	ft ³	ft ³	-	%	gallons	gallons	gallons	gallons	-
Emulsified Vegetable Oil											
East Area (MHC-22 to BIW-2)	2,035	12	24,420	7,326	17	18.5%	10138	50	596	1060	10.5%
Northeast (BIW-6S)	1,855	8	14,840	4,452	14	14.0%	4662	42	333	460	9.9%
Center Area (MHC-26)	1,170	14	16,380	4,914	8	16.0%	5881	53	735	605	10.3%
Northwest Area (BIW-1)	2,485	20	49,700	14,910	18	14.0%	15615	43	867	1570	10.1%
West Center Area (BIW-5S)	1,525	6	9,150	2,745	9	14.0%	2875	64	381	275	9.6%
Southwest Area (MHC-23)	1,120	20	22,400	6,720	9	14.0%	7038	39	782	685	9.7%
EVO Total	10,190		136,890	41,067	75		46,210			4655	
EVO Average		12				15.0%		48	616		10.0%
			Soil	Pore	Injection	Volume	Injection	Volume per	Volume Per		
	Area	Thickness	Volume	Volume	Points	Target	Volume	vertical foot	Point	EHC Mass	EHC Dosage
Area Name	ft ²	ft	ft ³	ft ³	-	%	gallons	gallons	gallons	pounds	% Soil Mass
EHC (Carbon + ZVI)											
West Center Area (BIW-5D)	1,525	14	21,350	6,405	9	8.0%	3,833	30	426	7850	0.35%
SITE TOTAL	10,190		158,240	47,472	75		50,043				
Average		14.1									

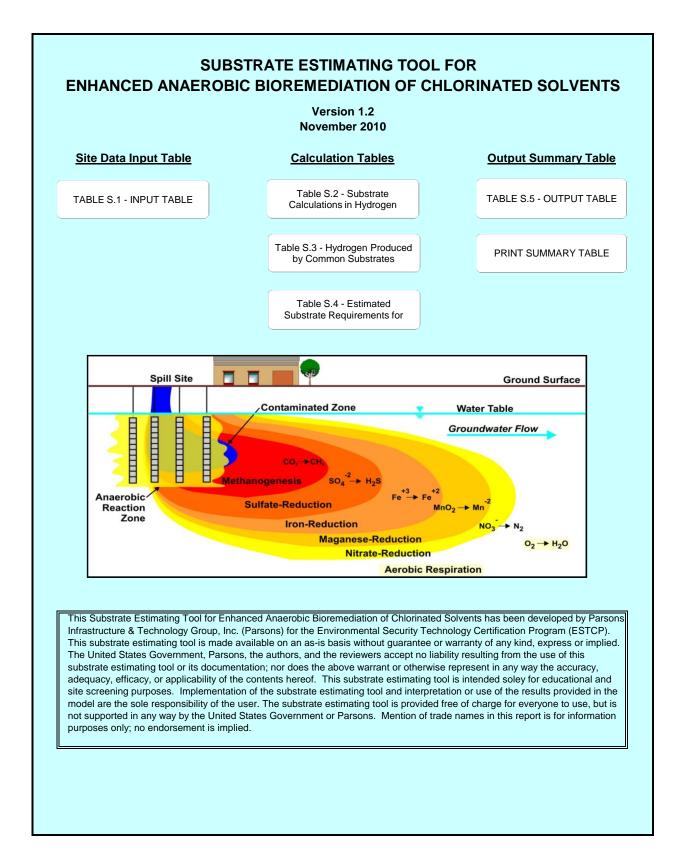
Notes:	
Assumed Porosity	

Assumed Forosity	
Assumed Soil Bulk Density	

lb/ft³

30%

105



Site Name: Former Dusc	Chemical (Cer	ter . MHC-26	\	RETURN TO COVER PAGE
Site Marie. Former Dusc	NOTE: Unshaded			
. Treatment Zone Physical Dimensions	Values	Range	Units	User Notes
Width (Perpendicular to predominant groundwater flow direction)	45	1-10,000	feet	Former Duso Chemical (Center - MHC-26)
Length (Parallel to predominant groundwater flow)	26	1-1,000	feet	
Saturated Thickness	14	1-100	feet	treatment thickness (4-18)
Treatment Zone Cross Sectional Area	630		ft ²	
Treatment Zone Volume	16,380		ft ³	
Treatment Zone Total Pore Volume (total volume x total porosity)	39,218		gallons	
Treatment Zone Effective Pore Volume (total volume x effective porosity)	34,315		gallons	
Design Period of Performance	4.0	.5 to 5	year	
Design Factor (times the electron acceptor hydrogen demand)	5.0	2 to 20	unitless	AECOM recommendation to use a design factor of 2 to 5
. Treatment Zone Hydrogeologic Properties				
Total Porosity	32%	.05-50	percent	Assumed for silty sand
Effective Porosity	28%	.05-50	percent	Assumed for silty sand (conservative high for higher PV)
Average Aquifer Hydraulic Conductivity	4	.01-1000	ft/day	average from MHBP RI
Average Hydraulic Gradient	0.033	0.0001-0.1	ft/ft	average from 2 values in RI
Average Groundwater Seepage Velocity through the Treatment Zone	0.47		ft/day	
Average Groundwater Seepage Velocity through the Treatment Zone	172.1		ft/yr	
Average Groundwater Discharge through the Treatment Zone	227,104		gallons/year	
Soil Bulk Density	1.65	1.4-2.0	gm/cm ³	Assumed
Soil Fraction Organic Carbon (foc)	3.00%	0.01-10	percent	Assumed
Nativa Electron Accentors				
Native Electron Acceptors				
A. Aqueous-Phase Native Electron Acceptors		0.01 1- 10		
Oxygen	0.6	0.01 to 10	mg/L	ant detected in DI
Nitrate Sulfate	0.10 35	0.1 to- 20	mg/L	not detected in RI
Carbon Dioxide (estimated as the amount of Methane produced)	10.0	10 to 5,000	mg/L	RI readings 2, 11, 43, 79 in MHC-23 and MHC-26
Carbon Dioxide (estimated as the amount of Methane produced)	10.0	0.1 to 20	mg/L	
B. Solid-Phase Native Electron Acceptors				
Manganese (IV) (estimated as the amount of Mn (II) produced)	10	0.1 to 20	mg/L	RI Mn 4-8 mg/L in slightly reducing GW, assume some produ
Iron (III) (estimated as the amount of Fe (II) produced)	12	0.1 to 20	mg/L	RI ~10 mg/L in slightly reducing GW, assume some production
		0.1 10 20		
. Contaminant Electron Acceptors				
Tetrachloroethene (PCE)	0.000		mg/L	max conc from MHC-26 (2012)
Trichloroethene (TCE)	0.028		mg/L	
Dichloroethene (cis-DCE, trans-DCE, and 1,1-DCE)	0.280		mg/L	
Vinyl Chloride (VC)	0.190		mg/L	
Carbon Tetrachloride (CT)	0.000		mg/L	
Trichloromethane (or chloroform) (CF)	0.000		mg/L	
Dichloromethane (or methylene chloride) (MC)	0.012		mg/L	
Chloromethane	0.000		mg/L	
Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA)	0.000		mg/L	
Trichloroethane (1,1,1-TCA and 1,1,2-TCA)	1.500		mg/L	
Dichloroethane (1,1-DCA and 1,2-DCA)	1.100		mg/L	
Chloroethane	0.860		mg/L	
Perchlorate	0.000		mg/L	
. Aquifer Geochemistry (Optional Screening Parameters)				
A. Aqueous Geochemistry				
Oxidation-Reduction Potential (ORP)	-25	-400 to +500	mV	2012 Field Sheets (avg BIW-2S, MHC-23, BIW-5S)
Temperature	13	5.0 to 30	°C	2012 Field Sheets
<u>pH</u>	7.1	4.0 to 10.0	su	2012 Field Sheets (7.06-7.4)
Alkalinity	300	10 to 1,000	mg/L	
Total Dissolved Solids (TDS, or salinity)		10 to 1,000	mg/L	
Specific Conductivity	2000	100 to 10,000	μs/cm	2012 Field Sheets Approximate Average
Chloride		10 to 10,000	mg/L	
Sulfide - Pre injection	0.0	0.1 to 100	mg/L	
Sulfide - Post injection	0.0	0.1 to 100	mg/L	
B. Aquifer Matrix				
Total Iron	10000	200 to 20,000		Assumed
Cation Exchange Capacity	NA	1.0 to 10	meq/100 g	
Neutralization Potential	10.0%	1.0 to 100	Percent as CaCO ₃	Assumed
NOTES:				

Substrate Estimating Tool (Version 1.2)

Table 5.2	Substrate Ca	alculations in	Hydrogen	Equivalents		
Site Name:	Former Dusc	Chemical (Cer	nter - MHC-26)	RETURN TO	COVER PAGE
				NOTE: Open cells		
1. Treatment Zone Physical Dimensions				Values	Range	Units
Width (Perpendicular to predominant groundwater f	low direction)			45	1-10,000	feet
Length (Parallel to predominant groundwater flow)				26	1-1,000	feet
Saturated Thickness				14	1-100	feet
Treatment Zone Cross Sectional Area				630		ft ²
Treatment Zone Volume				16,380		ft ³
Treatment Zone Effective Pore Volume (total volum	e x effective porosit	ty)		34,315		gallons
Design Period of Performance				4.0	.5 to 5	year
2. Treatment Zone Hydrogeologic Propert	ies					
Total Porosity				0.32	.05-50	
Effective Porosity				0.28	.05-50	
Average Aquifer Hydraulic Conductivity				4	.01-1000	ft/day
Average Hydraulic Gradient				0.033	0.1-0.0001	ft/ft
Average Groundwater Seepage Velocity through the	e Treatment Zone			0.47		ft/day
Average Groundwater Seepage Velocity through the				172.1		ft/yr
Average Groundwater Flux through the Treatment Z	lon	0		227,104		gallons/year
Soil Bulk Density				1.65	1.4-2.0	gm/cm ³
Soil Fraction Organic Carbon (foc)				0.03	0.0001-0.1	
3. Initial Treatment Cell Electron-Acceptor	Demand (one	total pore volu	me)			
				Stoichiometric	Hydrogen	Electron
A. Aqueous-Phase Native Electron Acceptors		Concentration	Mass	demand	Demand	Equivalents pe
		(mg/L)	(lb)	(wt/wt h ₂)	(lb)	Mole
Oxygen		0.6	0.17	7.94	0.02	4
Nitrate (denitrification)		0.0	0.03	12.30	0.00	5
Sulfate		35	10.02	11.91	0.84	8
Carbon Dioxide (estimated as the amount of metha	ne produced)	10.0	2.86	1.99	1.44	8
	io produced)			eptor Demand (lb.)	2.30	
				Stoichiometric	Hydrogen	Electron
B. Solid-Phase Native Electron Acceptors		Concentration	Mass	demand	Demand	Equivalents pe
(Based on manganese and iron produced)		(mg/L)	(lb)	(wt/wt h ₂)	(lb)	Mole
Manganese (IV) (estimated as the amount of Mn (II)	produced)	10.0	78.67	27.25	2.89	2
Iron (III) (estimated as the amount of Fe (II) produce	• •	12.0	94.40	55.41	1.70	1
non (iii) (estimated as the amount of r e (ii) produce				ceptor Demand (lb.)	4.59	· ·
				Stoichiometric		
C. Caluble Conteminant Electron Accontene		Concentration	Maaa		Hydrogen	Electron
C. Soluble Contaminant Electron Acceptors		Concentration	Mass	demand	Demand	Equivalents pe
		(mg/L)	(lb)	(wt/wt h ₂)	(lb)	Mole
Tetrachloroethene (PCE)		0.000	0.00	20.57	0.00	8
Trichloroethene (TCE)		0.028	0.01	21.73	0.00	6
Dichloroethene (cis-DCE, trans-DCE, and 1,1-DCE)	1	0.280	0.08	24.05	0.00	4
Vinyl Chloride (VC)		0.190	0.05	31.00	0.00	2
Carbon Tetrachloride (CT)		0.000	0.00	19.08	0.00	8
Trichloromethane (or chloroform) (CF)		0.000	0.00	19.74	0.00	6
Dichloromethane (or methylene chloride) (MC)		0.012	0.00	21.06 25.04	0.00	4
Chloromethane				25.04	0.00	2
		0.000			0.00	0
Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA)		0.000	0.00	20.82	0.00	8
Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1,1-TCA and 1,1,2-TCA)		0.000 1.500	0.00 0.43	20.82 22.06	0.02	6
Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1,1-TCA and 1,1,2-TCA) Dichloroethane (1,1-DCA and 1,2-DCA)		0.000 1.500 1.100	0.00 0.43 0.31	20.82 22.06 24.55	0.02 0.01	6 4
Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1,1-TCA and 1,1,2-TCA) Dichloroethane (1,1-DCA and 1,2-DCA) Chloroethane		0.000 1.500 1.100 0.860	0.00 0.43 0.31 0.25	20.82 22.06 24.55 32.00	0.02 0.01 0.01	6 4 2
Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1,1-TCA and 1,1,2-TCA) Dichloroethane (1,1-DCA and 1,2-DCA)	Total	0.000 1.500 1.100 0.860 0.000	0.00 0.43 0.31 0.25 0.00	20.82 22.06 24.55	0.02 0.01	6 4
Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1,1-TCA and 1,1,2-TCA) Dichloroethane (1,1-DCA and 1,2-DCA) Chloroethane	Total	0.000 1.500 1.100 0.860 0.000	0.00 0.43 0.31 0.25 0.00	20.82 22.06 24.55 32.00 12.33	0.02 0.01 0.01 0.00	6 4 2 6
Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1,1-TCA and 1,1,2-TCA) Dichloroethane (1,1-DCA and 1,2-DCA) Chloroethane	Total Koc	0.000 1.500 1.100 0.860 0.000	0.00 0.43 0.31 0.25 0.00	20.82 22.06 24.55 32.00 12.33 ceptor Demand (lb.)	0.02 0.01 0.01 0.00 0.05	6 4 2 6 Electron
Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1,1-TCA and 1,1,2-TCA) Dichloroethane (1,1-DCA and 1,2-DCA) Chloroethane Perchlorate D. Sorbed Contaminant Electron Acceptors	Кос	0.000 1.500 1.100 0.860 0.000 Soluble Contamin Soil Conc.	0.00 0.43 0.31 0.25 0.00 ant Electron Acc	20.82 22.06 24.55 32.00 12.33 :eptor Demand (lb.) Stoichiometric demand	0.02 0.01 0.01 0.00 0.05 Hydrogen Demand	6 4 2 6 Electron
Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1,1-TCA and 1,1,2-TCA) Dichloroethane (1,1-DCA and 1,2-DCA) Chloroethane Perchlorate D. Sorbed Contaminant Electron Acceptors (Soil Concentration = Koc x foc x Cgw)	Koc (mL/g)	0.000 1.500 1.100 0.860 0.000 Soluble Contamin Soil Conc. (mg/kg)	0.00 0.43 0.31 0.25 0.00 ant Electron Acc Mass (lb)	20.82 22.06 24.55 32.00 12.33 :eptor Demand (lb.) Stoichiometric demand (wt/wt h ₂)	0.02 0.01 0.00 0.05 Hydrogen Demand (lb)	6 4 2 6 Electron Equivalents pe Mole
Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1,1-TCA and 1,1,2-TCA) Dichloroethane (1,1-DCA and 1,2-DCA) Chloroethane Perchlorate D. Sorbed Contaminant Electron Acceptors (Soil Concentration = Koc x foc x Cgw) Tetrachloroethene (PCE)	Koc (mL/g) 263	0.000 1.500 1.100 0.860 0.000 Soluble Contamin Soil Conc. (mg/kg) 0.00	0.00 0.43 0.31 0.25 0.00 ant Electron Acco Mass (lb) 0.00	20.82 22.06 24.55 32.00 12.33 :eptor Demand (lb.) Stoichiometric demand (wt/wt h ₂) 20.57	0.02 0.01 0.00 0.05 Hydrogen Demand (lb) 0.00	6 4 2 6 Electron Equivalents pe Mole 8
Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1,1-TCA and 1,1,2-TCA) Dichloroethane (1,1-DCA and 1,2-DCA) Chloroethane Perchlorate D. Sorbed Contaminant Electron Acceptors (Soil Concentration = Koc x foc x Cgw) Tetrachloroethene (PCE) Trichloroethene (TCE)	Koc (mL/g) 263 107	0.000 1.500 1.100 0.860 0.000 Soluble Contamin Soil Conc. (mg/kg) 0.00 0.09	0.00 0.43 0.31 0.25 0.00 ant Electron Acc Mass (lb) 0.00 0.15	20.82 22.06 24.55 32.00 12.33 :eptor Demand (lb.) Stoichiometric demand (wt/wt h ₂) 20.57 21.73	0.02 0.01 0.00 0.05 Hydrogen Demand (lb) 0.00 0.01	6 4 2 6 Electron Equivalents pe Mole
Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1,1-TCA and 1,1,2-TCA) Dichloroethane (1,1-DCA and 1,2-DCA) Chloroethane Perchlorate D. Sorbed Contaminant Electron Acceptors (Soil Concentration = Koc x foc x Cgw) Tetrachloroethene (PCE) Trichloroethene (TCE) Dichloroethene (Cis-DCE, trans-DCE, and 1,1-DCE)	Koc (mL/g) 263 107 45	0.000 1.500 1.100 0.860 0.000 Soluble Contamin Soil Conc. (mg/kg) 0.00 0.09 0.38	0.00 0.43 0.31 0.25 0.00 ant Electron Acco Mass (lb) 0.00 0.15 0.64	20.82 22.06 24.55 32.00 12.33 :eptor Demand (lb.) Stoichiometric demand (wt/wt h ₂) 20.57 21.73 24.05	0.02 0.01 0.00 0.05 Hydrogen Demand (lb) 0.00 0.01 0.03	6 4 2 6 Electron Equivalents pe Mole 8 6 4
Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1,1-TCA and 1,1,2-TCA) Dichloroethane (1,1-DCA and 1,2-DCA) Chloroethane Perchlorate D. Sorbed Contaminant Electron Acceptors (Soil Concentration = Koc x foc x Cgw) Tetrachloroethene (PCE) Trichloroethene (TCE) Dichloroethene (CS) Vinyl Chloride (VC)	Koc (mL/g) 263 107 45 3.0	0.000 1.500 1.100 0.860 0.000 Soluble Contamin Soil Conc. (mg/kg) 0.00 0.09 0.38 0.02	0.00 0.43 0.25 0.00 ant Electron Acc (b) 0.00 0.15 0.64 0.03	20.82 22.06 24.55 32.00 12.33 ceptor Demand (lb.) Stoichiometric demand (wt/wt h ₂) 20.57 21.73 24.05 31.00	0.02 0.01 0.00 0.05 Hydrogen Demand (lb) 0.00 0.01 0.03 0.00	6 4 2 6 J Electron Equivalents pe Mole 8 6 4 2
Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1,1-TCA and 1,1,2-TCA) Dichloroethane (1,1-DCA and 1,2-DCA) Chloroethane Perchlorate D. Sorbed Contaminant Electron Acceptors (Soil Concentration = Koc x foc x Cgw) Tetrachloroethene (PCE) Trichloroethene (TCE) Dichloroethene (CS-DCE, trans-DCE, and 1,1-DCE) Vinyl Chloride (VC) Carbon Tetrachloride (CT)	Koc (mL/g) 263 107 45 3.0 224	0.000 1.500 1.100 0.860 0.000 Soluble Contamin Soil Conc. (mg/kg) 0.00 0.09 0.38 0.02 0.00	0.00 0.43 0.31 0.25 0.00 ant Electron Acc (lb) 0.00 0.15 0.64 0.03 0.00	20.82 22.06 24.55 32.00 12.33 Exptor Demand (lb.) Stoichiometric demand (wt/wt h ₂) 20.57 21.73 24.05 31.00 19.08	0.02 0.01 0.00 0.05 Hydrogen Demand (lb) 0.00 0.01 0.03 0.00 0.00	6 4 2 6 Electron Equivalents per Mole 8 6 4 2 8
Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1,1-TCA and 1,1,2-TCA) Dichloroethane (1,1-DCA and 1,2-DCA) Chloroethane Perchlorate D. Sorbed Contaminant Electron Acceptors (Soil Concentration = Koc x foc x Cgw) Tetrachloroethene (PCE) Trichloroethene (TCE) Dichloroethene (cis-DCE, trans-DCE, and 1,1-DCE) Vinyl Chloride (VC) Carbon Tetrachloride (CT) Trichloromethane (or chloroform) (CF)	Koc (mL/g) 263 107 45 3.0 224 63	0.000 1.500 1.100 0.860 0.000 Soluble Contamin Soil Conc. (mg/kg) 0.00 0.09 0.38 0.02 0.00 0.00	0.00 0.43 0.31 0.25 0.00 ant Electron Acc Mass (lb) 0.00 0.15 0.64 0.03 0.00 0.00 0.00	20.82 22.06 24.55 32.00 12.33 Septor Demand (lb.) Stoichiometric demand (wt/wt h ₂) 20.57 21.73 24.05 31.00 19.08 19.74	0.02 0.01 0.00 0.05 Hydrogen Demand (lb) 0.00 0.01 0.03 0.00 0.00 0.00	6 4 2 6 Electron Equivalents pe Mole 8 6 4 2 8 6
Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1,1-TCA and 1,1,2-TCA) Dichloroethane (1,1-DCA and 1,2-DCA) Chloroethane Perchlorate D. Sorbed Contaminant Electron Acceptors (Soil Concentration = Koc x foc x Cgw) Tetrachloroethene (PCE) Trichloroethene (CE) Dichloroethene (cis-DCE, trans-DCE, and 1,1-DCE) Vinyl Chloride (VC) Carbon Tetrachloride (CT) Trichloromethane (or chloroform) (CF) Dichloromethane (or methylene chloride) (MC)	Koc (mL/g) 263 107 45 3.0 224 63 28	0.000 1.500 1.100 0.860 0.000 Soluble Contamin Soil Conc. (mg/kg) 0.00 0.09 0.38 0.02 0.00 0.00 0.00 0.00 0.00	0.00 0.43 0.31 0.25 0.00 ant Electron Acco Mass (lb) 0.00 0.15 0.64 0.03 0.00 0.00 0.00 0.00	20.82 22.06 24.55 32.00 12.33 ceptor Demand (lb.) Stoichiometric demand (wt/wt h ₂) 20.57 21.73 24.05 31.00 19.08 19.74 21.06	0.02 0.01 0.00 0.05 Hydrogen Demand (Ib) 0.00 0.01 0.03 0.00 0.00 0.00 0.00	6 4 2 6 Electron Equivalents pe Mole 8 6 4 2 8 6 4
Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1,1-TCA and 1,1,2-TCA) Dichloroethane (1,1-DCA and 1,2-DCA) Chloroethane Perchlorate D. Sorbed Contaminant Electron Acceptors (Soil Concentration = Koc x foc x Cgw) Tetrachloroethene (PCE) Trichloroethene (TCE) Dichloroethene (TCE) Dichloroethene (TCE) Dichloroethene (CC) Carbon Tetrachloride (CT) Trichloromethane (or chloroform) (CF) Dichloromethane (or methylene chloride) (MC) Chloromethane	Koc (mL/g) 263 107 45 3.0 224 63 28 28 25	0.000 1.500 1.100 0.860 0.000 Soluble Contamin Soil Conc. (mg/kg) 0.00 0.09 0.38 0.02 0.00 0.00 0.00 0.01 0.00	0.00 0.43 0.25 0.00 ant Electron Acc Mass (b) 0.00 0.15 0.64 0.03 0.00 0.00 0.00 0.02 0.00	20.82 22.06 24.55 32.00 12.33 Exptor Demand (lb.) Stoichiometric demand (wt/wt h ₂) 20.57 21.73 24.05 31.00 19.08 19.74 21.06 25.04	0.02 0.01 0.00 0.05 Hydrogen Demand (lb) 0.00 0.01 0.03 0.00 0.00 0.00 0.00 0.00	6 4 2 6 Electron Equivalents pe Mole 8 6 4 2 8 6 4 2 8 6 4 2
Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1-TCA and 1,1,2-TCA) Dichloroethane (1,1-DCA and 1,2-DCA) Chloroethane Perchlorate D. Sorbed Contaminant Electron Acceptors (Soil Concentration = Koc x foc x Cgw) Tetrachloroethene (PCE) Trichloroethene (TCE) Dichloroethene (CE) Dichloroethene (CC) Carbon Tetrachloride (CT) Trichloromethane (or chloroform) (CF) Dichloromethane (or methylene chloride) (MC) Chloromethane Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA)	Koc (mL/g) 263 107 45 3.0 224 63 28 28 25 117	0.000 1.500 1.100 0.860 0.000 Soluble Contamin Soil Conc. (mg/kg) 0.00 0.09 0.38 0.02 0.00 0.00 0.00 0.00 0.00 0.00	0.00 0.43 0.25 0.00 ant Electron Acc (b) 0.00 0.15 0.64 0.03 0.00 0.00 0.00 0.02 0.00 0.00	20.82 22.06 24.55 32.00 12.33 ceptor Demand (lb.) Stoichiometric demand (wt/wt h ₂) 20.57 21.73 24.05 31.00 19.08 19.74 21.06 25.04 20.82	0.02 0.01 0.00 0.05 Hydrogen Demand (lb) 0.00 0.01 0.03 0.00 0.00 0.00 0.00 0.00	6 4 2 6 5 5 5 6 4 6 4 2 8 6 4 2 8 6 4 2 8 8 6 4 2 8 8 6 4 2 8 8
Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1,1-TCA and 1,1,2-TCA) Dichloroethane (1,1-DCA and 1,2-DCA) Chloroethane Perchlorate D. Sorbed Contaminant Electron Acceptors (Soil Concentration = Koc x foc x Cgw) Tetrachloroethene (PCE) Trichloroethene (TCE) Dichloroethene (CCE) Trichloroethene (CC) Carbon Tetrachloride (CT) Trichloromethane (or chloroform) (CF) Dichloromethane (or chloroform) (CF) Dichloromethane (T,1,1,2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1,1-TCA and 1,1,2-TCA)	Koc (mL/g) 263 107 45 3.0 224 63 28 25 117 105	0.000 1.500 1.100 0.860 0.000 Soluble Contamin Soil Conc. (mg/kg) 0.00 0.09 0.38 0.02 0.00 0.00 0.00 0.01 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00	0.00 0.43 0.31 0.25 0.00 ant Electron Acc Mass (lb) 0.00 0.15 0.64 0.03 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.15 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00	20.82 22.06 24.55 32.00 12.33 ceptor Demand (lb.) Stoichiometric demand (wt/wt h ₂) 20.57 21.73 24.05 31.00 19.08 19.74 21.06 25.04 20.82 22.06	0.02 0.01 0.00 0.05 Hydrogen Demand (lb) 0.00 0.01 0.03 0.00 0.00 0.00 0.00 0.00	6 4 2 6 5 Electron Equivalents pe Mole 8 6 4 2 8 6 4 2 8 6 4 2 8 6 6
Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1,1-TCA and 1,1,2-TCA) Dichloroethane (1,1-DCA and 1,2-DCA) Chloroethane Perchlorate D. Sorbed Contaminant Electron Acceptors (Soil Concentration = Koc x foc x Cgw) Tetrachloroethene (PCE) Trichloroethene (TCE) Dichloroethene (CS-DCE, trans-DCE, and 1,1-DCE) Vinyl Chloride (VC) Carbon Tetrachloride (CT) Trichloromethane (or chloroform) (CF) Dichloromethane (or methylene chloride) (MC) Chloromethane (1,1,1,2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1,1-TCA and 1,1,2-TCA) Dichloroethane (1,1-DCA and 1,2-DCA)	Koc (mL/g) 263 107 45 3.0 224 63 28 25 25 117 105 30	0.000 1.500 1.100 0.860 0.000 Soluble Contamin Soil Conc. (mg/kg) 0.00 0.09 0.38 0.02 0.00 0.00 0.00 0.00 0.00 0.00 4.73 0.99	0.00 0.43 0.31 0.25 0.00 ant Electron Acc (lb) 0.00 0.15 0.64 0.03 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00	20.82 22.06 24.55 32.00 12.33 Septor Demand (lb.) Stoichiometric demand (wt/wt h ₂) 20.57 21.73 24.05 31.00 19.08 19.74 21.06 25.04 20.82 22.06 24.55	0.02 0.01 0.00 0.05 Hydrogen Demand (lb) 0.00 0.01 0.03 0.00 0.00 0.00 0.00 0.00	6 4 2 6 Electron Equivalents pe Mole 8 6 4 2 8 6 4 2 8 6 4 2 8 6 4 4
Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1-TCA and 1,1,2-TCA) Dichloroethane (1,1-DCA and 1,2-DCA) Chloroethane Perchlorate D. Sorbed Contaminant Electron Acceptors (Soil Concentration = Koc x foc x Cgw) Tetrachloroethene (PCE) Trichloroethene (TCE) Dichloroethene (TCE) Dichloroethene (CT) Trichloromethane (or chloroform) (CF) Dichloromethane (or methylene chloride) (MC) Chloromethane (1,1,1,2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1,1-TCA and 1,1,2-TCA) Dichloroethane (1,1-DCA and 1,2-DCA) Chloroethane (1,1-DCA and 1,2-DCA)	Koc (mL/g) 263 107 45 3.0 224 63 28 25 117 105 30 3 3	0.000 1.500 1.100 0.860 0.000 Soluble Contamin Soil Conc. (mg/kg) 0.00 0.09 0.38 0.02 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00	0.00 0.43 0.25 0.00 ant Electron Acc Mass (lb) 0.00 0.15 0.64 0.03 0.00 0.02 0.00 0.02 0.00 0.00 7.97 1.67 0.14	20.82 22.06 24.55 32.00 12.33 :eptor Demand (lb.) Stoichiometric demand (wt/wt h ₂) 20.57 21.73 24.05 31.00 19.08 19.74 21.06 25.04 20.82 22.06 24.55 32.00	0.02 0.01 0.00 0.05 Hydrogen Demand (lb) 0.00 0.01 0.03 0.00 0.00 0.00 0.00 0.00	6 4 2 6 Electron Equivalents pe Mole 8 6 4 2 8 6 4 2 8 6 4 2 8 6 4 2 2 8 6 4 2 2
Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1,1-TCA and 1,1,2-TCA) Dichloroethane (1,1-DCA and 1,2-DCA) Chloroethane Perchlorate D. Sorbed Contaminant Electron Acceptors (Soil Concentration = Koc x foc x Cgw) Tetrachloroethene (PCE) Trichloroethene (TCE) Dichloroethene (CS-DCE, trans-DCE, and 1,1-DCE) Vinyl Chloride (VC) Carbon Tetrachloride (CT) Trichloromethane (or chloroform) (CF) Dichloromethane (or methylene chloride) (MC) Chloromethane (1,1,1,2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1,1-TCA and 1,1,2-TCA) Dichloroethane (1,1-DCA and 1,2-DCA)	Koc (mL/g) 263 107 45 3.0 224 63 28 25 117 105 30 3 0.0	0.000 1.500 1.100 0.860 0.000 Soluble Contamin Soil Conc. (mg/kg) 0.00 0.09 0.38 0.02 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00	0.00 0.43 0.25 0.00 ant Electron Acc Mass (b) 0.00 0.15 0.64 0.03 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.15 0.64 0.00 0.00 0.00 0.15 0.64 0.00 0.00 0.00 0.15 0.64 0.00 0.00 0.00 0.15 0.64 0.00 0.00 0.00 0.15 0.64 0.00 0.00 0.00 0.00 0.15 0.64 0.00 0.00 0.00 0.00 0.15 0.64 0.00 0.00 0.00 0.00 0.15 0.64 0.00 0.00 0.00 0.00 0.00 0.15 0.64 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.15 0.64 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.14 0.00	20.82 22.06 24.55 32.00 12.33 Septor Demand (lb.) Stoichiometric demand (wt/wt h ₂) 20.57 21.73 24.05 31.00 19.08 19.74 21.06 25.04 20.82 22.06 24.55	0.02 0.01 0.00 0.05 Hydrogen Demand (lb) 0.00 0.01 0.03 0.00 0.00 0.00 0.00 0.00	6 4 2 6 Electron Equivalents pe Mole 8 6 4 2 8 6 4 2 8 6 4 2 8 6 4 4 2 8 6 4

4. Treatment Cell Electron-Acceptor Flux (per year)	
4. Treatment Cell Electron-Acceptor Flux (per year)	
Stoichiometric Hydrogen	Electron
A. Soluble Native Electron Acceptors Concentration Mass demand Demand	Equivalents per
(mg/L) (lb) (wt/wt h ₂) (lb)	Mole
Oxygen 0.6 1.14 7.94 0.14	4
Nitrate (denitrification) 0.1 0.19 10.25 0.02	5
Sulfate 35 66.33 11.91 5.57	8
Carbon Dioxide (estimated as the amount of Methane produced) 10 18.95 1.99 9.52	8
Total Competing Electron Acceptor Demand Flux (lb/yr) 15.3	
Stoichiometric Hydrogen	Electron
B. Soluble Contaminant Electron Acceptors Concentration Mass demand Demand	Equivalents per
(mg/L) (lb) (wt/wt h ₂) (lb)	Mole
Tetrachloroethene (PCE) 0.00 0.00 20.57 0.00	8
Trichloroethene (TCE) 0.028 0.05 21.73 0.00	6
Dichloroethene (cis-DCE, trans-DCE, and 1,1-DCE) 0.280 0.53 24.05 0.02	4
Vinyl Chloride (VC) 0.190 0.36 31.00 0.01	2
Carbon Tetrachloride (CT) 0.000 0.00 19.08 0.00	8
Trichloromethane (or chloroform) (CF) 0.000 0.00 19.74 0.00	6
Dichloromethane (or methylene chloride) (MC) 0.012 0.02 21.06 0.00	4
Chloromethane 0.000 0.00 25.04 0.00	2
Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA) 0.000 0.00 20.82 0.00	8
Trichloroethane (1,1,1-TCA and 1,1,2-TCA) 1.500 2.84 22.06 0.13	6
Dichloroethane (1,1-DCA and 1,2-DCA) 1.100 2.08 24.55 0.08	4
Chloroethane 0.860 1.63 32.00 0.05	2
Perchlorate 0.000 0.00 12.33 0.00	6
Total Soluble Contaminant Electron Acceptor Demand Flux (lb/yr) 0.30	
Initial Hydrogen Requirement First Year (lb) 23.0	
Total Life-Cycle Hydrogen Requirement (lb) 69.6	
5. Design Factors	
Microbial Efficiency Uncertainty Factor 2X - 4X	
Methane and Solid-Phase Electron Acceptor Uncertainty 2X - 4X	
Remedial Design Factor (e.g., Substrate Leaving Reaction Zone) 1X - 3X	
Design Factor 5.0	
Total Life-Cycle Hydrogen Requirement with Design Factor (Ib) 348.2	
6. Acronyns and Abbreviations	
°C =degrees celsius meg/100 g = milliequivalents per 100 grams	
µs/cm = microsiemens per centimeter mg/kg = milligrams per kilogram	
cm/day = centimeters per day mg/L = milligrams per liter	
cm/sec = centimeters per second m/m = meters per meters	
ft ² = square feet mV = millivolts	
ft/day = feet per day m/yr = meters per year	
ft/ft = foot per foot su = standard pH units	
ft/yr = feet per year wt/wt H2 = concetration molecular hydrogen, weight per weight	
gm/cm ³ = grams per cubic centimeter	
gni/on = grams per cubic centimeter	
gm/cm = grams per cubic centimeter kg of CaCO3 per mg = kilograms of calcium carbonate per milligram lb = pounds	
kg of CaCO3 per mg = kilograms of calcium carbonate per milligram	

	Table S.3				
Hydrogen Produced by Fern	RETURN TO COVER PAGE				
Substrate	Molecular Formula	Substrate Molecular Weight (gm/mole)	Moles of Hydrogen Produced per Mole of Substrate	Ratio of Hydrogen Produced to Substrate (gm/gm)	Range of Moles H₂/Mole Substrate
Lactic Acid	C ₃ H ₆ O ₃	90.1	2	0.0448	2 to 3
Molasses (assuming 100% sucrose)	C ₁₂ H ₂₂ O ₁₁	342	8	0.0471	8 to 11
High Fructose Corn Syrup (assuming 50% fructose and 50% glucose)	C ₆ H ₁₂ O ₆	180	4	0.0448	4 to 6
Ethanol	C ₂ H ₆ O	46.1	2	0.0875	2 to 6
Whey (assuming 100% lactose)	C ₁₂ H ₂₂ O ₁₁	342	11	0.0648	11
HRC [®] (assumes 40% lactic acid and 40% glycerol by weight)	C ₃₉ H ₅₆ O ₃₉	956	28	0.0590	28
Linoleic Acid (Soybean Oil, Corn Oil, Cotton Oil)	C ₁₈ H ₃₂ O ₂	281	16	0.1150	16

Table S.4 Estimated Substrate Requirements for Hydrogen Demand in Table S.3

Design Life (years): 4

Substrate	Design Factor	Pure Substrate Mass Required to Fulfill Hydrogen Demand (pounds)	Substrate Product Required to Fulfill Hydrogen Demand (pounds)	Substrate Mass Required to Fulfill Hydrogen Demand (milligrams)	Effective Substrate Concentration (mg/L)
Lactic Acid	5.0	7,778	7,778	3.53E+09	989
Sodium Lactate Product (60 percent solution)	5.0	7,778	16,138	3.53E+09	989
Molasses (assuming 6 0	5.0	7,389	12,316	3.35E+09	939
HFCS (assuming 40% fructose and 40% glucose by weight)	5.0	7,780	9,725	3.53E+09	989
Ethanol Product (assuming 80% ethanol by weight)	5.0	3,978	4,973	1.80E+09	506
Whey (assuming 100% lactose)	5.0	5,369	7,671	2.44E+09	683
HRC [®] (assumes 40% lactic acid and 40% glycerol by weight)	5.0	5,896	5,896	2.67E+09	600
Linoleic Acid (Soybean Oil, Corn Oil, Cotton Oil)	5.0	3,028	3,028	1.37E+09	385
Commercial Vegetable Oil Emulsion Product (60% oil by weight)	5.0	3,028	5,046	1.37E+09	385

NOTES: Sodium Lactate Product

1. Assumes sodium lactate product is 60 percent sodium lactate by weight.

2. Molecular weight of sodium lactate (CH₃-CHOH-COONa) = 112.06.

3. Molecular weight of lactic Acid $(C_6H_6O_3) = 90.08$.

4. Therefore, sodium lactate product yields 48.4 (0.60 x (90.08/112.06)) percent by weight lactic acid.

5. Weight of sodium lactate product = 11.0 pounds per gallon.

6. Pounds per gallon of lactic acid in product = 1.323 x 8.33 lb/gal H2O x 0.60 x (90.08/112.06) = 5.31 lb/gal.

NOTES: Standard HRC Product

1. Assumes HRC product is 40 percent lactic acid and 40 percent glycerol by weight.

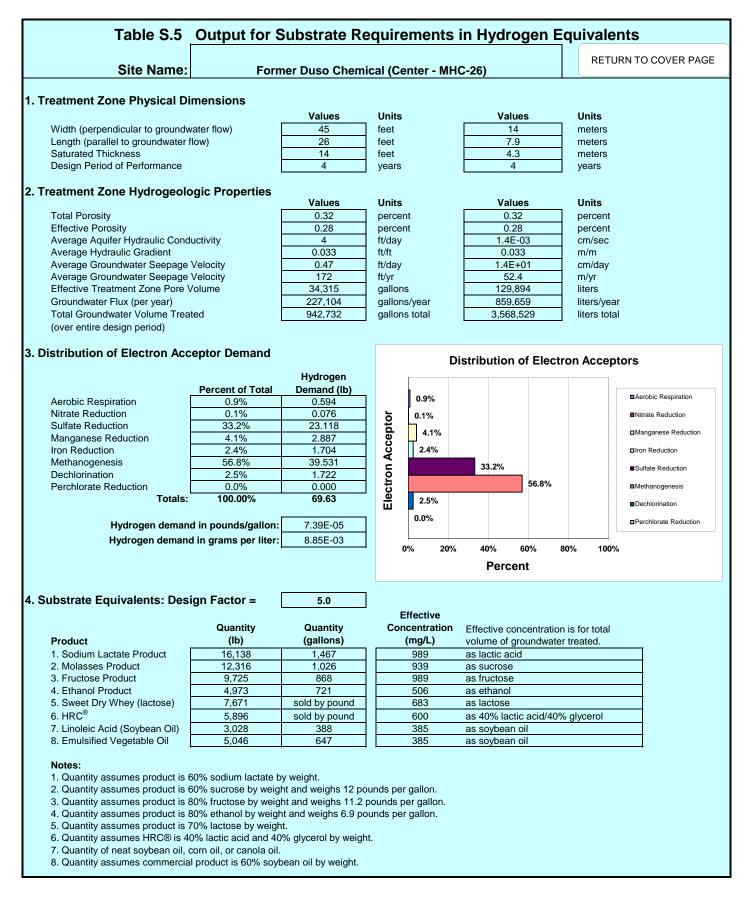
2. HRC[®] weighs approximately 9.18 pounds per gallon.

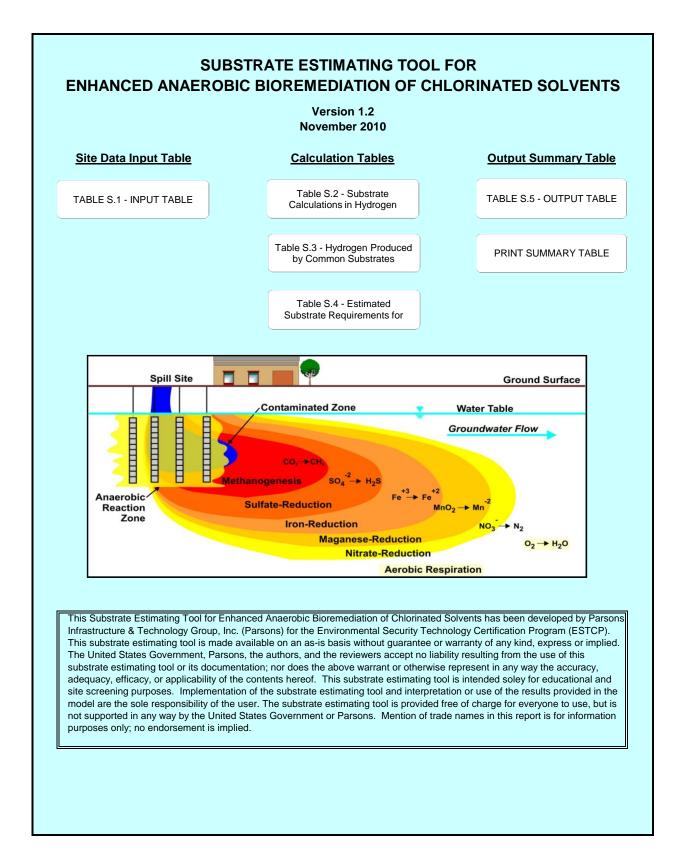
NOTES: Vegetable Oil Emulsion Product

1. Assumes emulsion product is 60 percent soybean oil by weight.

2. Soybean oil is 7.8 pounds per gallon.

3. Assumes specific gravity of emulsion product is 0.96.





Site Name: Former Duso Ch	emical (east - F	BIW-2 to MHC-2	22)	RETURN TO COVER PAGE
	NOTE: Unshaded			-
Treatment Zone Physical Dimensions	Values		Units	User Notes
Width (Perpendicular to predominant groundwater flow direction)	101.5	1-10,000 f	feet	Former Duso Chemical (east - BIW-2 to MHC-22)
Length (Parallel to predominant groundwater flow)	20		feet	
Saturated Thickness	12		feet	treatment thickness (4-16)
Treatment Zone Cross Sectional Area	1218		it ²	
Freatment Zone Volume	24,360		it ³	
Treatment Zone Total Pore Volume (total volume x total porosity)	58,324		gallons	
Treatment Zone Effective Pore Volume (total volume x effective porosity)	51,033		gallons	
Design Period of Performance Design Factor (times the electron acceptor hydrogen demand)	4.0 4.0		year	AECOM recommendation to use a design factor of 2 to E
	4.0	21020	unitless	AECOM recommendation to use a design factor of 2 to 5
Treatment Zone Hydrogeologic Properties				
otal Porosity	32%	.05-50 p	percent	Assumed for silty sand
Effective Porosity	28%		percent	Assumed for silty sand (conservative high for higher PV)
Average Aquifer Hydraulic Conductivity	4	.01-1000 f	it/day	average from MHBP RI
Average Hydraulic Gradient	0.033	0.0001-0.1 f	it/ft	average from 2 values in RI
Average Groundwater Seepage Velocity through the Treatment Zone	0.47	f	it/day	
Average Groundwater Seepage Velocity through the Treatment Zone	172.1	f	it/yr	
Average Groundwater Discharge through the Treatment Zone	439,068	(gallons/year	
Soil Bulk Density	1.65	1.4-2.0	gm/cm ³	Assumed
Soil Fraction Organic Carbon (foc)	3.00%	0.01-10 p	percent	Assumed
Native Electron Acceptors A. Aqueous-Phase Native Electron Acceptors				
•	0.6	0.01 to 10 r	mg/L	
Oxygen Nitrate	0.10		mg/L	not detected in RI
Sulfate	35		mg/L	RI readings 2, 11, 43, 79 in MHC-23 and MHC-26
Carbon Dioxide (estimated as the amount of Methane produced)	10.0		mg/L	14 readings 2, 11, 43, 73 in Wind-23 and Wind-20
B. Solid-Phase Native Electron Acceptors	10.0	0.110 20 1	11g/L	
Manganese (IV) (estimated as the amount of Mn (II) produced)	10	0.1 to 20 r	mg/L	RI Mn 4-8 mg/L in slightly reducing GW, assume some prod
ron (III) (estimated as the amount of Fe (II) produced)	10		mg/L	RI ~10 mg/L in slightly reducing GW, assume some product
			0	
Contaminant Electron Acceptors				
Tetrachloroethene (PCE)	0.100	r	mg/L	max conc from BIW-2S (2012) or MHC-22 (2011)
Trichloroethene (TCE)	0.050	r	mg/L	
Dichloroethene (cis-DCE, trans-DCE, and 1,1-DCE)	0.990	r	mg/L	
/inyl Chloride (VC)	0.190		mg/L	
Carbon Tetrachloride (CT)	0.000		mg/L	
Trichloromethane (or chloroform) (CF)	0.001		mg/L	
Dichloromethane (or methylene chloride) (MC)	0.001		mg/L	
	0.000		mg/L	
Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA)	0.000		mg/L	
Trichloroethane (1,1,1-TCA and 1,1,2-TCA)	5.200		mg/L	
Dichloroethane (1,1-DCA and 1,2-DCA)	8.500		mg/L	
Chloroethane Perchlorate	1.100 0.000		mg/L	
Aquifer Geochemistry (Optional Screening Parameters)	0.000	1	mg/L	
A. Aqueous Geochemistry				
Dxidation-Reduction Potential (ORP)	-25	-400 to +500 r		2012 Field Sheets (avg BIW-2S, MHC-23, BIW-5S)
Temperature	13		УC	2012 Field Sheets
H	7.1		su	2012 Field Sheets (7.06-7.4)
Alkalinity	300		mg/L	
Total Dissolved Solids (TDS, or salinity)			mg/L	
Specific Conductivity	2000	100 to 10,000 µ		2012 Field Sheets Approximate Average
Chloride			mg/L	
Sulfide - Pre injection	0.0		mg/L	
Sulfide - Post injection	0.0	0.1 to 100 r	mg/L	
B. Aquifer Matrix	40000	000 1- 00 005		Assumed
Total Iron	10000	200 to 20,000 r		Assumed
Cation Exchange Capacity Veutralization Potential	NA 10.0%		meq/100 g Percent as CaCO ₃	Assumed
NOTES:		-		

Substrate Estimating Tool (Version 1.2)

	Substrate Ca	alculations in	Hydrogen	Equivalents	v	
Site Name: For	rmer Duso Ch	nemical (east - E	BIW-2 to MHC	-22)	RETURN TO	COVER PAGE
				NOTE: Open cells	are user input.	
1. Treatment Zone Physical Dimensions				Values	Range	Units
Width (Perpendicular to predominant groundwater flow	w direction)			101.5	1-10,000	feet
Length (Parallel to predominant groundwater flow)	an extension,			20	1-1,000	feet
Saturated Thickness				12	1-100	feet
Treatment Zone Cross Sectional Area				1218		ft ²
Treatment Zone Volume				24,360		ft ³
Treatment Zone Effective Pore Volume (total volume >	v effective porosi	h/)		51,033		
Design Period of Performance	k ellective porosi	(y)		4.0	.5 to 5	gallons year
2. Treatment Zone Hydrogeologic Propertie	s					
Total Porosity				0.32	.05-50	
Effective Porosity				0.28	.05-50	
Average Aquifer Hydraulic Conductivity				4	.01-1000	ft/day
Average Hydraulic Gradient				0.033	0.1-0.0001	ft/ft
Average Groundwater Seepage Velocity through the T				0.47		ft/day
Average Groundwater Seepage Velocity through the T				172.1		ft/yr
Average Groundwater Flux through the Treatment Zor	1	0		439,068		gallons/year
Soil Bulk Density				1.65	1.4-2.0	gm/cm ³
Soil Fraction Organic Carbon (foc)				0.03	0.0001-0.1	ginoin
3. Initial Treatment Cell Electron-Acceptor	Demand (one	total pore volu	ne)	0.00	0.0001 0.1	
				Stoichiometric	Hydrogen	Electron
A Aqueous Phase Native Electron Accordance		Concentration	Maaa		, ,	
A. Aqueous-Phase Native Electron Acceptors		Concentration	Mass	demand	Demand	Equivalents pe
		(mg/L)	(lb)	(wt/wt h ₂)	(lb)	Mole
Oxygen		0.6	0.26	7.94	0.03	4
Nitrate (denitrification)		0.0	0.04	12.30	0.00	5
		-				
Sulfate		35	14.90	11.91	1.25	8
Carbon Dioxide (estimated as the amount of methane	produced)	10.0	4.26	1.99	2.14	8
		Soluble Competi	ing Electron Acc	eptor Demand (lb.)	3.43	
				Stoichiometric	Hydrogen	Electron
B. Solid-Phase Native Electron Acceptors		Concentration	Mass	demand	Demand	Equivalents pe
(Based on manganese and iron produced)		(mg/L)	(lb)	(wt/wt h ₂)	(lb)	Mole
			()			-
Manganese (IV) (estimated as the amount of Mn (II) p		10.0	150.81	27.25	5.53	2
Iron (III) (estimated as the amount of Fe (II) produced)		12.0	180.97	55.41	3.27	1
	So	lid-Phase Competi	ng Electron Acc	eptor Demand (lb.)	8.80	
				Stoichiometric	Hydrogen	Electron
C. Soluble Contaminant Electron Acceptors		Concentration	Mass	demand	Demand	Equivalents pe
o. boluble containinant Electron Acceptors						
		(mg/L)	(lb)	(wt/wt h ₂)	(lb)	Mole
Tetrachloroethene (PCE)		0.100	0.04	20.57	0.00	8
Trichloroethene (TCE)		0.050	0.02	21.73	0.00	6
Dichloroethene (cis-DCE, trans-DCE, and 1,1-DCE)		0.990	0.42	24.05	0.02	4
Vinyl Chloride (VC)		0.190	0.08	31.00	0.02	2
			0.00	31.00	0.00	2
Carbon Tetrachloride (CT)				40.00	0.00	-
		0.000	0.00	19.08	0.00	8
Trichloromethane (or chloroform) (CF)		0.000 0.001	0.00 0.00	19.74	0.00	6
Trichloromethane (or chloroform) (CF) Dichloromethane (or methylene chloride) (MC)		0.000	0.00			
Dichloromethane (or methylene chloride) (MC)		0.000 0.001 0.001	0.00 0.00 0.00	19.74 21.06	0.00 0.00	6 4
Dichloromethane (or methylene chloride) (MC) Chloromethane		0.000 0.001 0.001 0.000	0.00 0.00 0.00 0.00	19.74 21.06 25.04	0.00 0.00 0.00	6 4 2
Dichloromethane (or methylene chloride) (MC) Chloromethane Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA)		0.000 0.001 0.001 0.000 0.000	0.00 0.00 0.00 0.00 0.00	19.74 21.06 25.04 20.82	0.00 0.00 0.00 0.00	6 4 2 8
Dichloromethane (or methylene chloride) (MC) Chloromethane Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1,1-TCA and 1,1,2-TCA)		0.000 0.001 0.001 0.000 0.000 5.200	0.00 0.00 0.00 0.00 0.00 2.21	19.74 21.06 25.04 20.82 22.06	0.00 0.00 0.00 0.00 0.10	6 4 2 8 6
Dichloromethane (or methylene chloride) (MC) Chloromethane Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1,1-TCA and 1,1,2-TCA) Dichloroethane (1,1-DCA and 1,2-DCA)		0.000 0.001 0.001 0.000 0.000 5.200 8.500	0.00 0.00 0.00 0.00 0.00 2.21 3.62	19.74 21.06 25.04 20.82 22.06 24.55	0.00 0.00 0.00 0.00 0.10 0.15	6 4 2 8 6 4
Dichloromethane (or methylene chloride) (MC) Chloromethane Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1,1-TCA and 1,1,2-TCA)		0.000 0.001 0.001 0.000 0.000 5.200	0.00 0.00 0.00 0.00 0.00 2.21	19.74 21.06 25.04 20.82 22.06	0.00 0.00 0.00 0.00 0.10	6 4 2 8 6
Dichloromethane (or methylene chloride) (MC) Chloromethane Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1,1-TCA and 1,1,2-TCA) Dichloroethane (1,1-DCA and 1,2-DCA)		0.000 0.001 0.001 0.000 0.000 5.200 8.500	0.00 0.00 0.00 0.00 0.00 2.21 3.62	19.74 21.06 25.04 20.82 22.06 24.55	0.00 0.00 0.00 0.00 0.10 0.15	6 4 2 8 6 4
Dichloromethane (or methylene chloride) (MC) Chloromethane Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1,1-TCA and 1,1,2-TCA) Dichloroethane (1,1-DCA and 1,2-DCA) Chloroethane	Total	0.000 0.001 0.000 0.000 5.200 8.500 1.100 0.000	0.00 0.00 0.00 0.00 2.21 3.62 0.47 0.00	19.74 21.06 25.04 20.82 22.06 24.55 32.00	0.00 0.00 0.00 0.10 0.15 0.01 0.00	6 4 2 8 6 4 2
Dichloromethane (or methylene chloride) (MC) Chloromethane Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1,1-TCA and 1,1,2-TCA) Dichloroethane (1,1-DCA and 1,2-DCA) Chloroethane	Total	0.000 0.001 0.000 0.000 5.200 8.500 1.100 0.000	0.00 0.00 0.00 0.00 2.21 3.62 0.47 0.00	19.74 21.06 25.04 20.82 22.06 24.55 32.00 12.33	0.00 0.00 0.00 0.10 0.15 0.01 0.00 0.29	6 4 2 8 6 4 2 2 6
Dichloromethane (or methylene chloride) (MC) Chloromethane Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1,1-TCA and 1,1,2-TCA) Dichloroethane (1,1-DCA and 1,2-DCA) Chloroethane Perchlorate		0.000 0.001 0.001 0.000 5.200 8.500 1.100 0.000 Soluble Contamina	0.00 0.00 0.00 0.00 2.21 3.62 0.47 0.00 ant Electron Acc	19.74 21.06 25.04 20.82 22.06 24.55 32.00 12.33 eptor Demand (lb.) Stoichiometric	0.00 0.00 0.00 0.10 0.15 0.01 0.00 0.29 Hydrogen	6 4 2 8 6 4 2 6 5 5 5 5 5 6
Dichloromethane (or methylene chloride) (MC) Chloromethane Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1,1-TCA and 1,1,2-TCA) Dichloroethane (1,1-DCA and 1,2-DCA) Chloroethane Perchlorate D. Sorbed Contaminant Electron Acceptors	Кос	0.000 0.001 0.000 0.000 5.200 8.500 1.100 0.000 Soluble Contamina	0.00 0.00 0.00 0.00 2.21 3.62 0.47 0.00 ant Electron Acc Mass	19.74 21.06 25.04 20.82 22.06 24.55 32.00 12.33 eptor Demand (lb.) Stoichiometric demand	0.00 0.00 0.00 0.10 0.15 0.01 0.00 0.29 Hydrogen Demand	6 4 2 8 6 4 2 6 5 Electron Equivalents pe
Dichloromethane (or methylene chloride) (MC) Chloromethane Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1,1-TCA and 1,1,2-TCA) Dichloroethane (1,1-DCA and 1,2-DCA) Chloroethane Perchlorate D. Sorbed Contaminant Electron Acceptors (Soil Concentration = Koc x foc x Cgw)	Koc (mL/g)	0.000 0.001 0.000 0.000 5.200 8.500 1.100 0.000 Soluble Contamina Soil Conc. (mg/kg)	0.00 0.00 0.00 0.00 2.21 3.62 0.47 0.00 ant Electron Acco Mass (Ib)	19.74 21.06 25.04 20.82 22.06 24.55 32.00 12.33 eptor Demand (lb.) Stoichiometric demand (wt/wt h ₂)	0.00 0.00 0.00 0.10 0.15 0.01 0.00 0.29 Hydrogen Demand (lb)	6 4 2 8 6 4 2 6 5 6 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
Dichloromethane (or methylene chloride) (MC) Chloromethane Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1,1-TCA and 1,1,2-TCA) Dichloroethane (1,1-DCA and 1,2-DCA) Chloroethane Perchlorate D. Sorbed Contaminant Electron Acceptors	Кос	0.000 0.001 0.000 0.000 5.200 8.500 1.100 0.000 Soluble Contamina	0.00 0.00 0.00 0.00 2.21 3.62 0.47 0.00 ant Electron Acc Mass	19.74 21.06 25.04 20.82 22.06 24.55 32.00 12.33 eptor Demand (lb.) Stoichiometric demand	0.00 0.00 0.00 0.10 0.15 0.01 0.00 0.29 Hydrogen Demand	6 4 2 8 6 4 2 6 5 Electron Equivalents pe
Dichloromethane (or methylene chloride) (MC) Chloromethane Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1,1-TCA and 1,1,2-TCA) Dichloroethane (1,1-DCA and 1,2-DCA) Chloroethane Perchlorate D. Sorbed Contaminant Electron Acceptors (Soil Concentration = Koc x foc x Cgw)	Koc (mL/g)	0.000 0.001 0.000 0.000 5.200 8.500 1.100 0.000 Soluble Contamina Soil Conc. (mg/kg)	0.00 0.00 0.00 0.00 2.21 3.62 0.47 0.00 ant Electron Acco Mass (Ib)	19.74 21.06 25.04 20.82 22.06 24.55 32.00 12.33 eptor Demand (lb.) Stoichiometric demand (wt/wt h ₂)	0.00 0.00 0.00 0.10 0.15 0.01 0.00 0.29 Hydrogen Demand (lb)	6 4 2 8 6 4 2 6 5 6 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
Dichloromethane (or methylene chloride) (MC) Chloromethane Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1-TCA and 1,1,2-TCA) Dichloroethane (1,1-DCA and 1,2-DCA) Chloroethane Perchlorate D. Sorbed Contaminant Electron Acceptors (Soil Concentration = Koc x foc x Cgw) Tetrachloroethene (PCE) Trichloroethene (TCE)	Koc (mL/g) 263 107	0.000 0.001 0.001 0.000 5.200 8.500 1.100 0.000 Soluble Contamina Soil Conc. (mg/kg) 0.79 0.16	0.00 0.00 0.00 0.00 2.21 3.62 0.47 0.00 ant Electron Acce Mass (lb) 1.98 0.40	19.74 21.06 25.04 20.82 22.06 24.55 32.00 12.33 eptor Demand (lb.) Stoichiometric demand (wt/wt h ₂) 20.57 21.73	0.00 0.00 0.00 0.10 0.15 0.01 0.00 0.29 Hydrogen Demand (lb) 0.10 0.02	6 4 2 8 6 4 2 6 4 2 6 5 5 6 8 6
Dichloromethane (or methylene chloride) (MC) Chloromethane Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1,1-TCA and 1,1,2-TCA) Dichloroethane (1,1-DCA and 1,2-DCA) Chloroethane Perchlorate D. Sorbed Contaminant Electron Acceptors (Soil Concentration = Koc x foc x Cgw) Tetrachloroethene (PCE) Trichloroethene (TCE) Dichloroethene (cis-DCE, trans-DCE, and 1,1-DCE)	Koc (mL/g) 263 107 45	0.000 0.001 0.001 0.000 5.200 8.500 1.100 0.000 Soluble Contamina Soil Conc. (mg/kg) 0.79 0.16 1.34	0.00 0.00 0.00 0.00 2.21 3.62 0.47 0.00 ant Electron Acc Mass (lb) 1.98 0.40 3.35	19.74 21.06 25.04 20.82 22.06 24.55 32.00 12.33 eptor Demand (lb.) Stoichiometric demand (wt/wt h ₂) 20.57 21.73 24.05	0.00 0.00 0.00 0.10 0.15 0.01 0.00 0.29 Hydrogen Demand (lb) 0.10 0.02 0.14	6 4 2 8 6 4 2 6 4 2 6 5 5 6 8 6 4
Dichloromethane (or methylene chloride) (MC) Chloromethane Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1,1-TCA and 1,1,2-TCA) Dichloroethane (1,1-DCA and 1,2-DCA) Chloroethane Perchlorate D. Sorbed Contaminant Electron Acceptors (Soil Concentration = Koc x foc x Cgw) Tetrachloroethene (PCE) Trichloroethene (TCE) Dichloroethene (Cis-DCE, trans-DCE, and 1,1-DCE) Vinyl Chloride (VC)	Koc (mL/g) 263 107 45 3.0	0.000 0.001 0.001 0.000 5.200 8.500 1.100 0.000 Soluble Contamina Soil Conc. (mg/kg) 0.79 0.16 1.34 0.02	0.00 0.00 0.00 0.00 2.21 3.62 0.47 0.00 ant Electron Acco Mass (lb) 1.98 0.40 3.35 0.04	19.74 21.06 25.04 20.82 22.06 24.55 32.00 12.33 eptor Demand (lb.) Stoichiometric demand (wt/wt h ₂) 20.57 21.73 24.05 31.00	0.00 0.00 0.00 0.10 0.15 0.01 0.00 0.29 Hydrogen Demand (lb) 0.10 0.02 0.14 0.00	6 4 2 8 6 4 2 6 5 5 5 6 8 6 8 6 6 4 2
Dichloromethane (or methylene chloride) (MC) Chloromethane Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1,1-TCA and 1,1,2-TCA) Dichloroethane (1,1-DCA and 1,2-DCA) Chloroethane Perchlorate D. Sorbed Contaminant Electron Acceptors (Soil Concentration = Koc x foc x Cgw) Tetrachloroethene (PCE) Trichloroethene (TCE) Dichloroethene (CE) Dichloroethene (CC) Vinyl Chloride (VC) Carbon Tetrachloride (CT)	Koc (mL/g) 263 107 45 3.0 224	0.000 0.001 0.001 0.000 5.200 8.500 1.100 0.000 Soluble Contamina Soil Conc. (mg/kg) 0.79 0.16 1.34 0.02 0.00	0.00 0.00 0.00 0.00 2.21 3.62 0.47 0.00 ant Electron Acc Mass (Ib) 1.98 0.40 3.35 0.04 0.00	19.74 21.06 25.04 20.82 22.06 24.55 32.00 12.33 eptor Demand (lb.) Stoichiometric demand (wt/wt h₂) 20.57 21.73 24.05 31.00 19.08	0.00 0.00 0.00 0.10 0.15 0.01 0.29 Hydrogen Demand (lb) 0.10 0.02 0.14 0.00 0.00	6 4 2 8 6 4 2 6 5 5 5 5 5 5 6 5 6 6 4 2 8 8
Dichloromethane (or methylene chloride) (MC) Chloromethane Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1,1-TCA and 1,1,2-TCA) Dichloroethane (1,1-DCA and 1,2-DCA) Chloroethane Perchlorate D. Sorbed Contaminant Electron Acceptors (Soil Concentration = Koc x foc x Cgw) Tetrachloroethene (PCE) Trichloroethene (TCE) Dichloroethene (Cis-DCE, trans-DCE, and 1,1-DCE) Vinyl Chloride (VC)	Koc (mL/g) 263 107 45 3.0	0.000 0.001 0.001 0.000 5.200 8.500 1.100 0.000 Soluble Contamina Soil Conc. (mg/kg) 0.79 0.16 1.34 0.02	0.00 0.00 0.00 0.00 2.21 3.62 0.47 0.00 ant Electron Acco Mass (lb) 1.98 0.40 3.35 0.04	19.74 21.06 25.04 20.82 22.06 24.55 32.00 12.33 eptor Demand (lb.) Stoichiometric demand (wt/wt h ₂) 20.57 21.73 24.05 31.00	0.00 0.00 0.00 0.10 0.15 0.01 0.00 0.29 Hydrogen Demand (lb) 0.10 0.02 0.14 0.00	6 4 2 8 6 4 2 6 5 5 5 6 8 6 8 6 4 2
Dichloromethane (or methylene chloride) (MC) Chloromethane Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1,1-TCA and 1,1,2-TCA) Dichloroethane (1,1-DCA and 1,2-DCA) Chloroethane Perchlorate D. Sorbed Contaminant Electron Acceptors (Soil Concentration = Koc x foc x Cgw) Tetrachloroethene (PCE) Trichloroethene (TCE) Dichloroethene (CE) Dichloroethene (CC) Vinyl Chloride (VC) Carbon Tetrachloride (CT)	Koc (mL/g) 263 107 45 3.0 224	0.000 0.001 0.001 0.000 5.200 8.500 1.100 0.000 Soluble Contamina Soil Conc. (mg/kg) 0.79 0.16 1.34 0.02 0.00	0.00 0.00 0.00 0.00 2.21 3.62 0.47 0.00 ant Electron Acc Mass (Ib) 1.98 0.40 3.35 0.04 0.00	19.74 21.06 25.04 20.82 22.06 24.55 32.00 12.33 eptor Demand (lb.) Stoichiometric demand (wt/wt h₂) 20.57 21.73 24.05 31.00 19.08	0.00 0.00 0.00 0.10 0.15 0.01 0.29 Hydrogen Demand (lb) 0.10 0.02 0.14 0.00 0.00	6 4 2 8 6 4 2 6 5 5 5 5 5 5 6 5 6 6 4 2 8 8
Dichloromethane (or methylene chloride) (MC) Chloromethane Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1,1-TCA and 1,1,2-TCA) Dichloroethane (1,1-DCA and 1,2-DCA) Chloroethane Perchlorate D. Sorbed Contaminant Electron Acceptors (Soil Concentration = Koc x foc x Cgw) Tetrachloroethene (PCE) Trichloroethene (CE) Dichloroethene (cis-DCE, trans-DCE, and 1,1-DCE) Vinyl Chloride (VC) Carbon Tetrachloride (CT) Trichloromethane (or chloroform) (CF) Dichloromethane (or methylene chloride) (MC)	Koc (mL/g) 263 107 45 3.0 224 63 28	0.000 0.001 0.001 0.000 5.200 8.500 1.100 0.000 Soluble Contamina Soil Conc. (mg/kg) 0.79 0.16 1.34 0.02 0.00 0.00 0.00	0.00 0.00 0.00 0.00 2.21 3.62 0.47 0.00 ant Electron Acc Mass (b) 1.98 0.40 3.35 0.04 0.00 0.00 0.00	19.74 21.06 25.04 20.82 22.06 24.55 32.00 12.33 eptor Demand (lb.) Stoichiometric demand (wt/wt h2) 20.57 21.73 24.05 31.00 19.74 21.06	0.00 0.00 0.00 0.10 0.15 0.01 0.29 Hydrogen Demand (lb) 0.10 0.02 0.14 0.00 0.00 0.00 0.00	6 4 2 8 6 4 2 6 4 2 6 5 5 6 8 6 6 4 2 8 6 6 4
Dichloromethane (or methylene chloride) (MC) Chloromethane Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1-TCA and 1,1,2-TCA) Dichloroethane (1,1-DCA and 1,2-DCA) Chloroethane Perchlorate D. Sorbed Contaminant Electron Acceptors (Soil Concentration = Koc x foc x Cgw) Tetrachloroethene (PCE) Trichloroethene (TCE) Dichloroethene (cis-DCE, trans-DCE, and 1,1-DCE) Vinyl Chloride (VC) Carbon Tetrachloride (CT) Trichloromethane (or chloroform) (CF) Dichloromethane (or methylene chloride) (MC) Chloromethane	Koc (mL/g) 263 107 45 3.0 224 63 28 25	0.000 0.001 0.001 0.000 5.200 8.500 1.100 0.000 Soluble Contamina Soli Conc. (mg/kg) 0.79 0.16 1.34 0.02 0.00 0.00 0.00 0.00 0.00	0.00 0.00 0.00 0.00 2.21 3.62 0.47 0.00 ant Electron Acc Mass (lb) 1.98 0.40 3.35 0.04 0.00 0.00 0.00 0.00 0.00	19.74 21.06 25.04 20.82 22.06 24.55 32.00 12.33 eptor Demand (lb.) Stoichiometric demand (wt/wt h2) 20.57 21.73 24.05 31.00 19.74 21.76 25.04	0.00 0.00 0.00 0.10 0.15 0.01 0.00 0.29 Hydrogen Demand (lb) 0.10 0.02 0.14 0.00 0.00 0.00 0.00 0.00	6 4 2 8 6 4 2 6 4 2 6 Mole 8 6 4 2 8 6 4 2 8 6 4 2 8 6 4 2
Dichloromethane (or methylene chloride) (MC) Chloromethane Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1,1-TCA and 1,1,2-TCA) Dichloroethane (1,1-DCA and 1,2-DCA) Chloroethane Perchlorate D. Sorbed Contaminant Electron Acceptors (Soil Concentration = Koc x foc x Cgw) Tetrachloroethene (PCE) Trichloroethene (TCE) Dichloroethene (TCE) Dichloroethene (CC) Carbon Tetrachloride (CT) Trichloromethane (or chloroform) (CF) Dichloromethane (or methylene chloride) (MC) Chloromethane	Koc (mL/g) 263 107 45 3.0 224 63 28 28 25 117	0.000 0.001 0.001 0.000 5.200 8.500 1.100 0.000 Soluble Contamina Soil Conc. (mg/kg) 0.79 0.16 1.34 0.02 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00	0.00 0.00 0.00 2.21 3.62 0.47 0.00 ant Electron Acco Mass (lb) 1.98 0.40 3.35 0.04 0.00 0.00 0.00 0.00 0.00 0.00	19.74 21.06 25.04 20.82 22.06 24.55 32.00 12.33 eptor Demand (lb.) Stoichiometric demand (wt/wt h ₂) 20.57 21.73 24.05 31.00 19.08 19.74 21.06 25.04 20.82	0.00 0.00 0.00 0.10 0.15 0.01 0.00 0.29 Hydrogen Demand (lb) 0.10 0.02 0.14 0.00 0.00 0.00 0.00 0.00 0.00	6 4 2 8 6 4 2 6 5 5 5 5 5 5 6 6 4 2 8 6 4 2 8 6 4 2 8 8 6 4 2 8 8 6 4 2 8 8 6 6 7 7 7 8 8 7 7 7 8 7 7 7 8 7 8 7
Dichloromethane (or methylene chloride) (MC) Chloromethane Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1-TCA and 1,1,2-TCA) Dichloroethane (1,1-DCA and 1,2-DCA) Chloroethane Perchlorate D. Sorbed Contaminant Electron Acceptors (Soil Concentration = Koc x foc x Cgw) Tetrachloroethene (PCE) Trichloroethene (CE) Dichloroethene (cis-DCE, trans-DCE, and 1,1-DCE) Vinyl Chloride (VC) Carbon Tetrachloride (CT) Trichloromethane (or chloroform) (CF) Dichloromethane (romethylene chloride) (MC) Chloromethane (1,1,1,2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1,1-TCA and 1,1,2-TCA)	Koc (mL/g) 263 107 45 3.0 224 63 28 25 117 105	0.000 0.001 0.001 0.000 5.200 8.500 1.100 0.000 Soluble Contamina Soil Conc. (mg/kg) 0.79 0.16 1.34 0.02 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.16 0.00 0.00 0.00 0.00 0.16 0.00 0.00 0.00 0.00 0.00 0.16 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00	0.00 0.00 0.00 0.00 2.21 3.62 0.47 0.00 ant Electron Acco Mass (Ib) 1.98 0.40 3.35 0.04 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00	$\begin{array}{c} 19.74\\ 19.74\\ 21.06\\ 25.04\\ 20.82\\ 22.06\\ 24.55\\ 32.00\\ 12.33\\ eptor Demand (lb.)\\ Stoichiometric demand (wt/wt h_2)\\ 20.57\\ 21.73\\ 24.05\\ 31.00\\ 19.08\\ 19.74\\ 21.06\\ 25.04\\ 20.82\\ 22.06\\ \end{array}$	0.00 0.00 0.00 0.10 0.15 0.01 0.29 Hydrogen Demand (lb) 0.10 0.22 0.14 0.00 0.00 0.00 0.00 0.00 0.00 0.00	6 4 2 8 6 4 2 6 5 5 5 5 5 5 6 6 4 2 2 8 6 6 4 2 8 6 6 5 6 5 6 5 6 5 6 5 6 5 6 5 6 5 6 5
Dichloromethane (or methylene chloride) (MC) Chloromethane Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1,1-TCA and 1,1,2-TCA) Dichloroethane (1,1-DCA and 1,2-DCA) Chloroethane Perchlorate D. Sorbed Contaminant Electron Acceptors (Soil Concentration = Koc x foc x Cgw) Tetrachloroethene (PCE) Trichloroethene (TCE) Dichloroethene (TCE) Dichloroethene (CC) Carbon Tetrachloride (CT) Trichloromethane (or chloroform) (CF) Dichloromethane (or methylene chloride) (MC) Chloromethane	Koc (mL/g) 263 107 45 3.0 224 63 28 28 25 117	0.000 0.001 0.001 0.000 5.200 8.500 1.100 0.000 Soluble Contamina Soil Conc. (mg/kg) 0.79 0.16 1.34 0.02 0.00 0.00 0.00 0.00 0.00 0.00 0.00	0.00 0.00 0.00 2.21 3.62 0.47 0.00 ant Electron Acco Mass (lb) 1.98 0.40 3.35 0.04 0.00 0.00 0.00 0.00 0.00 0.00	19.74 21.06 25.04 20.82 22.06 24.55 32.00 12.33 eptor Demand (lb.) Stoichiometric demand (wt/wt h ₂) 20.57 21.73 24.05 31.00 19.08 19.74 21.06 25.04 20.82	0.00 0.00 0.00 0.10 0.15 0.01 0.00 0.29 Hydrogen Demand (lb) 0.10 0.02 0.14 0.00 0.00 0.00 0.00 0.00 0.00	6 4 2 8 6 4 2 6 5 5 5 5 5 5 6 6 4 2 8 8 6 4 2 8 8 6 4 2 8 8 8 6 4 2 8 8 8 8 8 6 8 8 8 8 8 8 8 8 8 8 8 8 8
Dichloromethane (or methylene chloride) (MC) Chloromethane Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1-TCA and 1,1,2-TCA) Dichloroethane (1,1-DCA and 1,2-DCA) Chloroethane Perchlorate D. Sorbed Contaminant Electron Acceptors (Soil Concentration = Koc x foc x Cgw) Tetrachloroethene (PCE) Trichloroethene (CE) Dichloroethene (cis-DCE, trans-DCE, and 1,1-DCE) Vinyl Chloride (VC) Carbon Tetrachloride (CT) Trichloromethane (or chloroform) (CF) Dichloromethane (romethylene chloride) (MC) Chloromethane (1,1,1,2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1,1-TCA and 1,1,2-TCA)	Koc (mL/g) 263 107 45 3.0 224 63 28 25 117 105 30	0.000 0.001 0.001 0.000 5.200 8.500 1.100 0.000 Soluble Contamina Soil Conc. (mg/kg) 0.79 0.16 1.34 0.02 0.00 0.00 0.00 0.00 0.00 0.00 16.38 7.65	0.00 0.00 0.00 0.00 2.21 3.62 0.47 0.00 ant Electron Acc Mass (lb) 1.98 0.40 3.35 0.04 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00	19.74 21.06 25.04 20.82 22.06 24.55 32.00 12.33 eptor Demand (lb.) Stoichiometric demand (wt/wt h2) 20.57 21.73 24.05 31.00 19.74 21.06 25.04 20.57 21.73 24.05 31.00 19.08 20.82 22.06 24.55	0.00 0.00 0.00 0.10 0.15 0.01 0.29 Hydrogen Demand (lb) 0.10 0.02 0.14 0.00 0.00 0.00 0.00 0.00 0.00 0.00	6 4 2 8 6 4 2 6 5 6 6 8 6 6 4 2 8 8 6 4 2 8 8 6 4 4 2 8 8 6 4 4
Dichloromethane (or methylene chloride) (MC) Chloromethane Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1,1-TCA and 1,1,2-TCA) Dichloroethane (1,1-DCA and 1,2-DCA) Chloroethane (1,1-DCA and 1,2-DCA) Chloroethane Perchlorate D. Sorbed Contaminant Electron Acceptors (Soil Concentration = Koc x foc x Cgw) Tetrachloroethene (PCE) Trichloroethene (CE) Dichloroethene (cis-DCE, trans-DCE, and 1,1-DCE) Vinyl Chloride (VC) Carbon Tetrachloride (CT) Trichloromethane (or chloroform) (CF) Dichloromethane (1,1,1,2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1,1-TCA and 1,1,2-TCA) Dichloroethane (1,1-DCA and 1,2-DCA) Chloroethane (1,1-DCA and 1,2-DCA)	Koc (mL/g) 263 107 45 3.0 224 63 28 25 117 105 30 3	0.000 0.001 0.001 0.000 5.200 8.500 1.100 0.000 Soluble Contamina Soluble Contamina Soluble Contamina 0.79 0.16 1.34 0.02 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.01 0.00 0.00 0.00 0.00 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.011 0.11	0.00 0.00 0.00 0.00 2.21 3.62 0.47 0.00 ant Electron Acce Mass (b) 1.98 0.40 3.35 0.04 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00	19.74 21.06 25.04 20.82 22.06 24.55 32.00 12.33 eptor Demand (lb.) Stoichiometric demand (wt/wt h2) 20.57 21.73 24.05 31.00 19.74 21.06 25.04 20.57	0.00 0.00 0.00 0.10 0.15 0.01 0.29 Hydrogen Demand (lb) 0.10 0.02 0.14 0.00 0.00 0.00 0.00 0.00 0.00 0.00	6 4 2 8 6 4 2 6 4 2 6 Mole Equivalents pa Mole 8 6 4 2 8 6 6 4 2 8 6 6 4 2 2 8 6 6 4 2 2
Dichloromethane (or methylene chloride) (MC) Chloromethane Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1-TCA and 1,1,2-TCA) Dichloroethane (1,1-DCA and 1,2-DCA) Chloroethane (1,1-DCA and 1,2-DCA) Chloroethane Perchlorate D. Sorbed Contaminant Electron Acceptors (Soil Concentration = Koc x foc x Cgw) Tetrachloroethene (PCE) Trichloroethene (CE) Dichloroethene (CE) Dichloroethene (cis-DCE, trans-DCE, and 1,1-DCE) Vinyl Chloride (VC) Carbon Tetrachloride (CT) Trichloromethane (or chloroform) (CF) Dichloromethane (or methylene chloride) (MC) Chloromethane Tetrachloroethane (1,1,1-TCA and 1,1,2-PCA) Trichloroethane (1,1,1-TCA and 1,1,2-TCA) Dichloroethane (1,1-DCA and 1,2-DCA)	Koc (mL/g) 263 107 45 3.0 224 63 28 25 117 105 30 3 3 0.0	0.000 0.001 0.001 0.000 5.200 8.500 1.100 0.000 Soluble Contamina Soil Conc. (mg/kg) 0.79 0.16 1.34 0.02 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.00000 0.00000 0.00000 0.00000 0.0000000 0.00000000	0.00 0.00 0.00 0.00 2.21 3.62 0.47 0.00 ant Electron Acc Mass (lb) 1.98 0.40 3.35 0.04 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.27 0.00	19.74 21.06 25.04 20.82 22.06 24.55 32.00 12.33 eptor Demand (lb.) Stoichiometric demand (wt/wt h2) 20.57 21.73 24.05 31.00 19.74 21.06 25.04 20.57 21.73 24.05 31.00 19.08 20.82 22.06 24.55	0.00 0.00 0.00 0.10 0.15 0.01 0.29 Hydrogen Demand (lb) 0.10 0.02 0.14 0.00 0.00 0.00 0.00 0.00 0.00 0.00	6 4 2 8 6 4 2 6 4 2 6 Mole 8 6 4 2 8 6 4 2 8 6 4 2 8 6 4 2 8 6 4

Table S.2 Sub	strate Calculations in	Hydrogen	Equivalents		
4. Treatment Cell Electron-Acceptor Flux (per y					
	·		Stoichiometric	Hydrogen	Electron
A. Soluble Native Electron Acceptors	Concentration	Mass	demand	Demand	Equivalents pe
	(mg/L)	(lb)	(wt/wt h ₂)	(lb)	Mole
Oxygen	0.6	2.20	7.94	0.28	4
Nitrate (denitrification)	0.1	0.37	10.25	0.04	5
Sulfate	35	128.23	11.91	10.77	8
Carbon Dioxide (estimated as the amount of Methane prod	uced) 10	36.64	1.99	18.41	8
· · · ·	Total Competing Ele	ctron Acceptor [Demand Flux (lb/yr)	29.5	
			Stoichiometric	Hydrogen	Electron
B. Soluble Contaminant Electron Acceptors	Concentration	Mass	demand	Demand	Equivalents pe
•	(mg/L)	(lb)	(wt/wt h ₂)	(lb)	Mole
Tetrachloroethene (PCE)	0.100	0.37	20.57	0.02	8
Trichloroethene (TCE)	0.050	0.18	21.73	0.01	6
Dichloroethene (cis-DCE, trans-DCE, and 1,1-DCE)	0.990	3.63	24.05	0.01	4
Vinyl Chloride (VC)	0.190	0.70	31.00	0.02	2
Carbon Tetrachloride (CT)	0.000	0.00	19.08	0.00	8
Trichloromethane (or chloroform) (CF)	0.001	0.00	19.74	0.00	6
Dichloromethane (or methylene chloride) (MC)	0.001	0.00	21.06	0.00	4
Chloromethane	0.000	0.00	25.04	0.00	2
Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA)	0.000	0.00	20.82	0.00	8
Trichloroethane (1,1,1-TCA and 1,1,2-TCA)	5.200	19.05	22.06	0.86	6
Dichloroethane (1,1-DCA and 1,2-DCA)	8.500	31.14	24.55	1.27	4
Chloroethane	1.100	4.03	32.00	0.13	2
Perchlorate	0.000	0.00	12.33	0.00	6
Т	otal Soluble Contaminant Ele	ctron Acceptor I	Demand Flux (lb/yr)	2.46	
	Initial Hydroge	n Requireme	nt First Year (Ib)	47.4	1
	Total Life-Cycl	e Hydrogen R	Requirement (Ib)	143.2	
5. Design Factors					-
Microbial Efficiency Uncertainty Factor				2X - 4X	
Methane and Solid-Phase Electron Acceptor Uncertainty				2X - 4X	
Remedial Design Factor (e.g., Substrate Leaving Reaction Zo	one)			1X - 3X	
			Design Factor	4.0	7
Total Life-	Cycle Hydrogen Require	ement with De	•	572.9	
6. Acronyns and Abbreviations			J		
	/100 g = milliequivalents per 10	00 grams			
	kg = milligrams per kilogram				
	_ = milligrams per liter				
	= meters per meters				
	= millivolts				
	= meters per year				
	standard pH units	and the second			
	t H2 = concetration molecular h	iyarogen, weight	per weight		
$gm/cm^3 = grams$ per cubic centimeter					
	milligram				
kg of CaCO3 per mg = kilograms of calcium carbonate per	g.a				
kg of CaCO3 per mg = kilograms of calcium carbonate per lb = pounds	g.a				

	Table S.3				
Hydrogen Produced by Fern	RETURN TO COVER PAGE				
Substrate	Molecular Formula	Substrate Molecular Weight (gm/mole)	Moles of Hydrogen Produced per Mole of Substrate	Ratio of Hydrogen Produced to Substrate (gm/gm)	Range of Moles H₂/Mole Substrate
Lactic Acid	C ₃ H ₆ O ₃	90.1	2	0.0448	2 to 3
Molasses (assuming 100% sucrose)	C ₁₂ H ₂₂ O ₁₁	342	8	0.0471	8 to 11
High Fructose Corn Syrup (assuming 50% fructose and 50% glucose)	C ₆ H ₁₂ O ₆	180	4	0.0448	4 to 6
Ethanol	C ₂ H ₆ O	46.1	2	0.0875	2 to 6
Whey (assuming 100% lactose)	C ₁₂ H ₂₂ O ₁₁	342	11	0.0648	11
HRC [®] (assumes 40% lactic acid and 40% glycerol by weight)	C ₃₉ H ₅₆ O ₃₉	956	28	0.0590	28
Linoleic Acid (Soybean Oil, Corn Oil, Cotton Oil)	C ₁₈ H ₃₂ O ₂	281	16	0.1150	16

Table S.4 Estimated Substrate Requirements for Hydrogen Demand in Table S.3

Design Life (years): 4

Substrate	Design Factor	Pure Substrate Mass Required to Fulfill Hydrogen Demand (pounds)	Substrate Product Required to Fulfill Hydrogen Demand (pounds)	Substrate Mass Required to Fulfill Hydrogen Demand (milligrams)	Effective Substrate Concentration (mg/L)
Lactic Acid	4.0	12,799	12,799	5.81E+09	849
Sodium Lactate Product (60 percent solution)	4.0	12,799	26,553	5.81E+09	849
Molasses (assuming 6 0	4.0	12,159	20,264	5.52E+09	806
HFCS (assuming 40% fructose and 40% glucose by weight)	4.0	12,802	16,002	5.81E+09	849
Ethanol Product (assuming 80% ethanol by weight)	4.0	6,546	8,182	2.97E+09	434
Whey (assuming 100% lactose)	4.0	8,835	12,621	4.01E+09	586
HRC [®] (assumes 40% lactic acid and 40% glycerol by weight)	4.0	9,702	9,702	4.40E+09	515
Linoleic Acid (Soybean Oil, Corn Oil, Cotton Oil)	4.0	4,982	4,982	2.26E+09	330
Commercial Vegetable Oil Emulsion Product (60% oil by weight)	4.0	4,982	8,303	2.26E+09	330

NOTES: Sodium Lactate Product

1. Assumes sodium lactate product is 60 percent sodium lactate by weight.

2. Molecular weight of sodium lactate (CH₃-CHOH-COONa) = 112.06.

3. Molecular weight of lactic Acid $(C_6H_6O_3) = 90.08$.

4. Therefore, sodium lactate product yields 48.4 (0.60 x (90.08/112.06)) percent by weight lactic acid.

5. Weight of sodium lactate product = 11.0 pounds per gallon.

6. Pounds per gallon of lactic acid in product = 1.323 x 8.33 lb/gal H2O x 0.60 x (90.08/112.06) = 5.31 lb/gal.

NOTES: Standard HRC Product

1. Assumes HRC product is 40 percent lactic acid and 40 percent glycerol by weight.

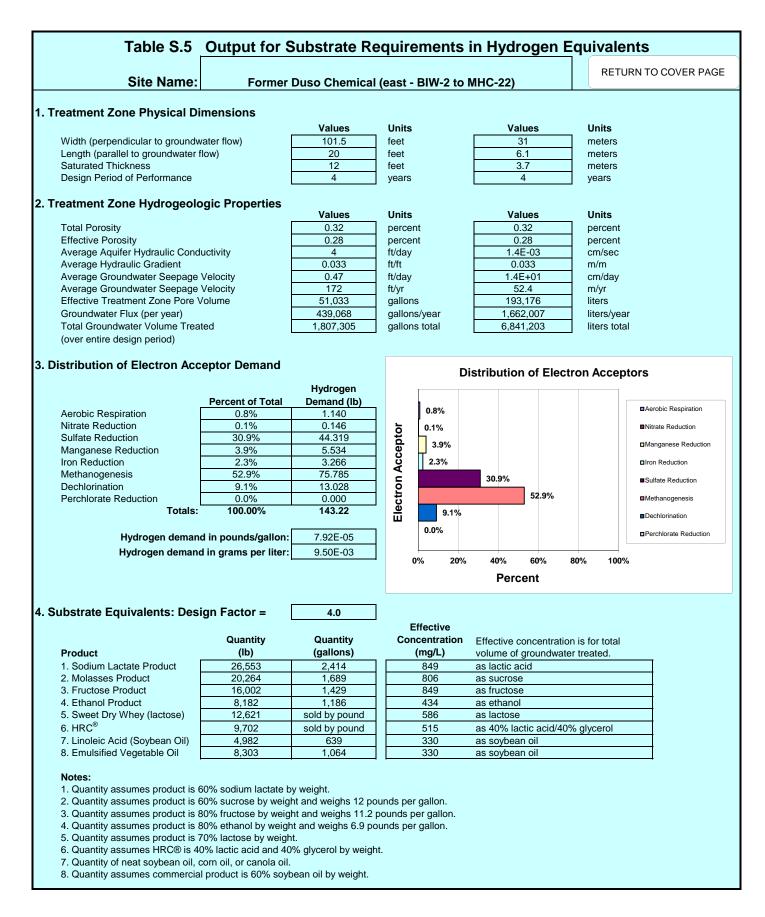
2. HRC[®] weighs approximately 9.18 pounds per gallon.

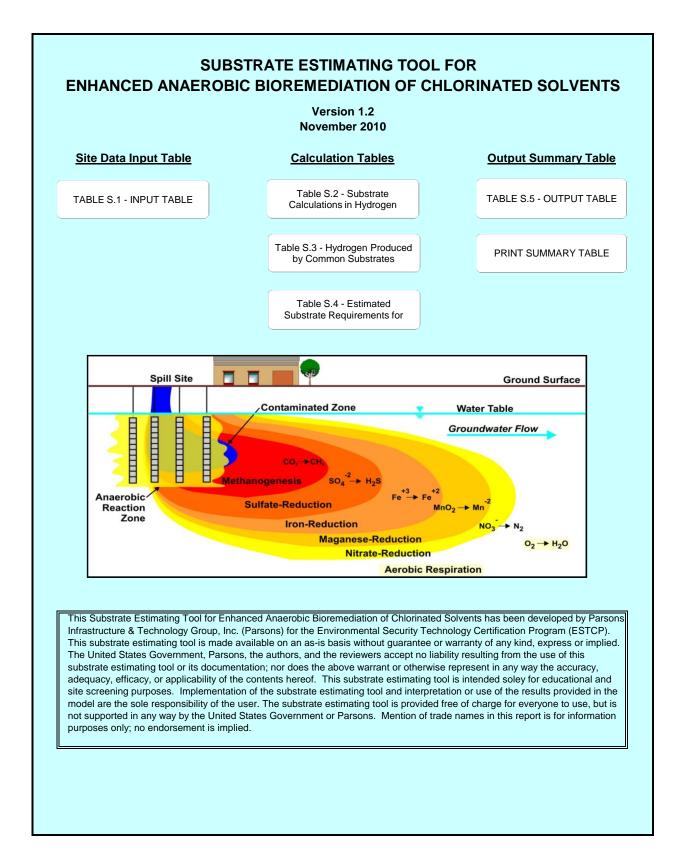
NOTES: Vegetable Oil Emulsion Product

1. Assumes emulsion product is 60 percent soybean oil by weight.

2. Soybean oil is 7.8 pounds per gallon.

3. Assumes specific gravity of emulsion product is 0.96.





Site Name: Former Duso Ct Image: Stream S	UTE: Unshaded Values 92 20 8 736 14,720 35,243 30,838 4.0 3.0 32% 28% 4 0.033 0.47 172.1 265,315 1.65 3.00% 0.6 0.10			User Notes Former Duso Chemical (east - BIW-6S) treatment thickness (4-12) AECOM recommendation to use a design factor of 2 to 5 Assumed for silty sand Assumed for silty sand (conservative high for higher PV) average from MHBP RI average from 2 values in RI Assumed Assumed Assumed
Freatment Zone Physical Dimensions fidth (Perpendicular to predominant groundwater flow direction) angth (Parallel to predominant groundwater flow) aturated Thickness reatment Zone Cross Sectional Area reatment Zone Volume reatment Zone Total Pore Volume (total volume x total porosity) reatment Zone Effective Pore Volume (total volume x effective porosity) reatment Zone Effective Pore Volume (total volume x effective porosity) esign Pactor (times the electron acceptor hydrogen demand) Treatment Zone Hydrogeologic Properties otal Porosity verage Aquifer Hydraulic Conductivity verage Groundwater Seepage Velocity through the Treatment Zone verage Groundwater Seepage Velocity through the Treatment Zone verage Groundwater Discharge through the Treatment Zone verage Hydraulic Carbon (foc)	Values 92 20 8 736 14,720 35,243 30,838 4.0 3.0 32% 28% 4 0.033 0.47 172.1 265,315 1.65 3.00% 0.6 0.10	Range 1-10,000 1-1,000 1-1,000	Units feet feet fft ² ft ³ gallons gallons year unitless percent percent ft/day ft/ft ft/day ft/yr gallons/year gm/cm ³	Former Duso Chemical (east - BIW-6S) treatment thickness (4-12) AECOM recommendation to use a design factor of 2 to 5 Assumed for silty sand Assumed for silty sand (conservative high for higher PV) average from MHBP RI average from 2 values in RI Assumed
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esign Period of Performance esign Factor (times the electron acceptor hydrogen demand)	4.0 3.0 32% 28% 4 0.033 0.47 172.1 265,315 1.65 3.00% 0.6 0.10	2 to 20 .05-50 .01-1000 0.0001-0.1 1.4-2.0 0.01-10	year unitless percent ft/day ft/tr ft/day ft/yr gallons/year gm/cm ³	Assumed for silty sand Assumed for silty sand (conservative high for higher PV) average from MHBP RI average from 2 values in RI Assumed
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verage Groundwater Seepage Velocity through the Treatment Zone verage Groundwater Discharge through the Treatment Zone oil Bulk Density oil Fraction Organic Carbon (foc) Vative Electron Acceptors . Aqueous-Phase Native Electron Acceptors xygen	172.1 265,315 1.65 3.00% 0.6 0.10	 1.4-2.0 0.01-10	ft/yr gallons/year gm/cm ³	
verage Groundwater Discharge through the Treatment Zone bil Bulk Density bil Fraction Organic Carbon (foc) Native Electron Acceptors Aqueous-Phase Native Electron Acceptors xygen	265,315 1.65 3.00% 0.6 0.10	 1.4-2.0 0.01-10	gallons/year gm/cm ³	
bil Bulk Density bil Fraction Organic Carbon (foc) Vative Electron Acceptors Aqueous-Phase Native Electron Acceptors xygen	1.65 3.00% 0.6 0.10	1.4-2.0 0.01-10	gm/cm ³	
oil Fraction Organic Carbon (foc) Vative Electron Acceptors Aqueous-Phase Native Electron Acceptors xygen	3.00% 0.6 0.10	0.01-10	•	
Native Electron Acceptors Aqueous-Phase Native Electron Acceptors xygen	0.6 0.10	-	percent	Assumed
Aqueous-Phase Native Electron Acceptors xygen	0.10	0.01 to 10		
Aqueous-Phase Native Electron Acceptors xygen	0.10	0.01 to 10		
xygen	0.10	0.01 to 10		
	0.10	0.01 to 10		
itrate			mg/L	
		0.1 to- 20	mg/L	not detected in RI
ulfate	35	10 to 5,000	mg/L	RI readings 2, 11, 43, 79 in MHC-23 and MHC-26
arbon Dioxide (estimated as the amount of Methane produced)	10.0	0.1 to 20	mg/L	
Solid-Phase Native Electron Acceptors	4.0			
anganese (IV) (estimated as the amount of Mn (II) produced)	10	0.1 to 20	mg/L	RI Mn 4-8 mg/L in slightly reducing GW, assume some prod
on (III) (estimated as the amount of Fe (II) produced)	12	0.1 to 20	mg/L	RI ~10 mg/L in slightly reducing GW, assume some production
Contominant Floatron Accontors				
Contaminant Electron Acceptors	0.040	1		
etrachloroethene (PCE)	0.010		mg/L	avg conc from BIW-6S + BIW-2S (2012)
ichloroethene (TCE)	0.035		mg/L	
ichloroethene (cis-DCE, trans-DCE, and 1,1-DCE)	0.465		mg/L	
inyl Chloride (VC)	0.010		mg/L	
arbon Tetrachloride (CT)	0.000		mg/L	
ichloromethane (or chloroform) (CF)	0.001		mg/L	
ichloromethane (or methylene chloride) (MC)	0.001		mg/L	
hloromethane	0.000		mg/L	
etrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA)	0.000		mg/L	
richloroethane (1,1,1-TCA and 1,1,2-TCA)	2.600		mg/L	
ichloroethane (1,1-DCA and 1,2-DCA)	4.300		mg/L	
hloroethane	0.500		mg/L	
erchlorate	0.000		mg/L	
Aquifer Geochemistry (Optional Screening Parameters)				
Aqueous Geochemistry	25	400 to +500	m\/	2012 Field Shoote (avg BIW 25 MHC 22 BIW 50)
xidation-Reduction Potential (ORP)	-25 13	-400 to +500	mV ⁰C	2012 Field Sheets (avg BIW-2S, MHC-23, BIW-5S)
emperature		5.0 to 30		2012 Field Sheets
	7.1	4.0 to 10.0	su ma/l	2012 Field Sheets (7.06-7.4)
kalinity tal Dissolved Solids (TDS, or salinity)	300	10 to 1,000	mg/L	SB55147 - SE-MW07, Collected on 8-23-12
	2000	10 to 1,000	mg/L	2010 Field Chapter Approximate According
pecific Conductivity hloride	2000	100 to 10,000	•	2012 Field Sheets Approximate Average
	0.0	10 to 10,000	•	
ulfide - Pre injection	0.0	0.1 to 100	mg/L	
ulfide - Post injection	0.0	0.1 to 100	mg/L	
Aquifor Matrix				
Aquifer Matrix	10000	200 to 20.000	ma/ka	Assumed
otal Iron	10000 NA	200 to 20,000		Assumed
ation Exchange Capacity eutralization Potential	NA 10.0%	1.0 to 10 1.0 to 100	meq/100 g Percent as CaCO ₃	Assumed
	10.070	1.0 10 100		Abound
OTES:				

Substrate Estimating Tool (Version 1.2)

	Substrate Ca	alculations in	Hydrogen I	Equivalents	r	
Site Name:	Former Duso	Chemical (nort	heast - BIW-6	5)	RETURN TO	COVER PAGE
				NOTE: Open cells	are user input.	
1. Treatment Zone Physical Dimensions				Values	Range	Units
Width (Perpendicular to predominant groundwater flo	w direction)			92	1-10,000	feet
Length (Parallel to predominant groundwater flow)				20	1-1,000	feet
Saturated Thickness				8	1-100	feet
Treatment Zone Cross Sectional Area				736		ft ²
Treatment Zone Volume				14,720		ft ³
Treatment Zone Effective Pore Volume (total volume	x effective porosit	v)		30,838		gallons
Design Period of Performance	x encentre percen			4.0	.5 to 5	year
2. Treatment Zone Hydrogeologic Propertie	es					
Total Porosity				0.32	.05-50	
Effective Porosity				0.28	.05-50	
Average Aquifer Hydraulic Conductivity				4	.01-1000	ft/day
Average Hydraulic Gradient				0.033	0.1-0.0001	ft/ft
Average Groundwater Seepage Velocity through the	Treatment Zone			0.47		ft/day
Average Groundwater Seepage Velocity through the	Treatment Zone			172.1		ft/yr
Average Groundwater Flux through the Treatment Zo		0		265,315		gallons/year
Soil Bulk Density				1.65	1.4-2.0	gm/cm ³
Soil Fraction Organic Carbon (foc)				0.03	0.0001-0.1	g
3. Initial Treatment Cell Electron-Acceptor	Demand (one	total pore volu	me)			
				Stoichiometric	Hydrogen	Electron
A. Aqueous-Phase Native Electron Acceptors		Concentration	Mass	demand	Demand	Equivalents per
•		(mg/L)	(lb)	(wt/wt h ₂)	(lb)	Mole
Oxygen		0.6	0.15	7.94	0.02	4
Nitrate (denitrification)		0.1	0.03	12.30	0.00	5
Sulfate		35	9.01	11.91	0.76	8
Carbon Dioxide (estimated as the amount of methane	e produced)	10.0	2.57	1.99	1.29	8
		Soluble Compet	ing Electron Acc	eptor Demand (lb.) Stoichiometric	2.07 Hydrogen	Electron
B. Solid-Phase Native Electron Acceptors		Concentration	Mass	demand	Demand	
-						Equivalents per
(Based on manganese and iron produced)		(mg/L)	(lb)	(wt/wt h ₂)	(lb)	Mole
Manganese (IV) (estimated as the amount of Mn (II)	· · · · · · · · · · · · · · · · · · ·	10.0	91.13	27.25	3.34	2
Iron (III) (estimated as the amount of Fe (II) produced		12.0	109.36	55.41	1.97	1
	So	lid-Phase Compet	ing Electron Acc	eptor Demand (lb.)	5.32	
				Stoichiometric	Hydrogen	Electron
C. Soluble Contaminant Electron Acceptors		Concentration	Mass	demand	Demand	Equivalents per
			iviado			
					(lb)	Mole
Tetrachloroethene (PCE)		(mg/L)	(lb)	(wt/wt h ₂)	(lb)	Mole
Tetrachloroethene (PCE)		(mg/L) 0.010	(lb) 0.00	(wt/wt h ₂) 20.57	0.00	Mole 8
Trichloroethene (TCE)		(mg/L) 0.010 0.035	(lb) 0.00 0.01	(wt/wt h ₂) 20.57 21.73	0.00	Mole 8 6
Trichloroethene (TCE) Dichloroethene (cis-DCE, trans-DCE, and 1,1-DCE)		(mg/L) 0.010 0.035 0.465	(lb) 0.00 0.01 0.12	(wt/wt h ₂) 20.57 21.73 24.05	0.00 0.00 0.00	Mole 8 6 4
Trichloroethene (TCE) Dichloroethene (cis-DCE, trans-DCE, and 1,1-DCE) Vinyl Chloride (VC)		(mg/L) 0.010 0.035 0.465 0.010	(lb) 0.00 0.01 0.12 0.00	(wt/wt h ₂) 20.57 21.73 24.05 31.00	0.00 0.00 0.00 0.00	Mole 8 6 4 2
Trichloroethene (TCE) Dichloroethene (cis-DCE, trans-DCE, and 1,1-DCE) Vinyl Chloride (VC) Carbon Tetrachloride (CT)		(mg/L) 0.010 0.035 0.465 0.010 0.000	(lb) 0.00 0.01 0.12 0.00 0.00	(wt/wt h ₂) 20.57 21.73 24.05 31.00 19.08	0.00 0.00 0.00 0.00 0.00	Mole 8 6 4 2 8 8
Trichloroethene (TCE) Dichloroethene (cis-DCE, trans-DCE, and 1,1-DCE) Vinyl Chloride (VC) Carbon Tetrachloride (CT) Trichloromethane (or chloroform) (CF)		(mg/L) 0.010 0.035 0.465 0.010 0.000 0.001	(lb) 0.00 0.01 0.12 0.00 0.00 0.00	(wt/wt h ₂) 20.57 21.73 24.05 31.00 19.08 19.74	0.00 0.00 0.00 0.00 0.00 0.00	Mole 8 6 4 2 8 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6
Trichloroethene (TCE) Dichloroethene (cis-DCE, trans-DCE, and 1,1-DCE) Vinyl Chloride (VC) Carbon Tetrachloride (CT) Trichloromethane (or chloroform) (CF) Dichloromethane (or methylene chloride) (MC)		(mg/L) 0.010 0.035 0.465 0.010 0.000 0.001 0.001	(lb) 0.00 0.01 0.12 0.00 0.00 0.00 0.00	(wt/wt h ₂) 20.57 21.73 24.05 31.00 19.08 19.74 21.06	0.00 0.00 0.00 0.00 0.00 0.00 0.00	Mole 8 6 4 2 8 6 4 4
Trichloroethene (TCE) Dichloroethene (cis-DCE, trans-DCE, and 1,1-DCE) Vinyl Chloride (VC) Carbon Tetrachloride (CT) Trichloromethane (or chloroform) (CF) Dichloromethane (or methylene chloride) (MC) Chloromethane		(mg/L) 0.010 0.035 0.465 0.010 0.000 0.001 0.001 0.000	(lb) 0.00 0.01 0.12 0.00 0.00 0.00 0.00 0.00	(wt/wt h ₂) 20.57 21.73 24.05 31.00 19.08 19.74 21.06 25.04	0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.0	Mole 8 6 4 2 8 6 4 2 2 4 2 2 4 2 2 2
Trichloroethene (TCE) Dichloroethene (cis-DCE, trans-DCE, and 1,1-DCE) Vinyl Chloride (VC) Carbon Tetrachloride (CT) Trichloromethane (or chloroform) (CF) Dichloromethane (or methylene chloride) (MC) Chloromethane Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA)		(mg/L) 0.010 0.035 0.465 0.010 0.000 0.001 0.001 0.000 0.000	(lb) 0.00 0.01 0.12 0.00 0.00 0.00 0.00 0.00 0.00	(wt/wt h ₂) 20.57 21.73 24.05 31.00 19.08 19.74 21.06 25.04 20.82	0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.0	Mole 8 6 4 2 8 6 4 2 8 6 4 2 8 6 4 2 8
Trichloroethene (TCE) Dichloroethene (cis-DCE, trans-DCE, and 1,1-DCE) Vinyl Chloride (VC) Carbon Tetrachloride (CT) Trichloromethane (or chloroform) (CF) Dichloromethane (or methylene chloride) (MC) Chloromethane Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1,1-TCA and 1,1,2-TCA)		(mg/L) 0.010 0.035 0.465 0.010 0.000 0.001 0.001 0.000 0.000 2.600	(lb) 0.00 0.01 0.12 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.67	(wt/wt h ₂) 20.57 21.73 24.05 31.00 19.08 19.74 21.06 25.04 20.82 22.06	0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.0	Mole 8 6 4 2 8 6 4 2 8 6 4 2 8 6 6 6
Trichloroethene (TČE) Dichloroethene (cis-DCE, trans-DCE, and 1,1-DCE) Vinyl Chloride (VC) Carbon Tetrachloride (CT) Trichloromethane (or chloroform) (CF) Dichloromethane (or methylene chloride) (MC) Chloromethane Tetrachloroethane (1,1,1-Z-PCA and 1,1,2,2-PCA) Trichloroethane (1,1,1-TCA and 1,1,2-TCA) Dichloroethane (1,1-DCA and 1,2-DCA)		(mg/L) 0.010 0.035 0.465 0.010 0.000 0.001 0.001 0.000 0.000 2.600 4.300	(lb) 0.00 0.01 0.12 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.67 1.11	(wt/wt h ₂) 20.57 21.73 24.05 31.00 19.08 19.74 21.06 25.04 20.82 22.06 24.55	0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.03 0.05	Mole 8 6 4 2 8 6 4 2 8 6 4 2 8 6 4 2 8 6 4
Trichloroethene (TČE) Dichloroethene (cis-DCE, trans-DCE, and 1,1-DCE) Vinyl Chloride (VC) Carbon Tetrachloride (CT) Trichloromethane (or chloroform) (CF) Dichloromethane (or methylene chloride) (MC) Chloromethane Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1,1-TCA and 1,1,2-TCA) Dichloroethane (1,1-DCA and 1,2-DCA) Chloroethane		(mg/L) 0.010 0.035 0.465 0.010 0.000 0.001 0.001 0.000 2.600 4.300 0.500	(lb) 0.00 0.01 0.12 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.67 1.11 0.13	(wt/wt h ₂) 20.57 21.73 24.05 31.00 19.08 19.74 21.06 25.04 20.82 22.06 24.55 32.00	0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.03 0.05 0.00	Mole 8 6 4 2 8 6 4 2 8 6 4 2 8 6 4 2 8 6 4 2
Trichloroethene (TČE) Dichloroethene (cis-DCE, trans-DCE, and 1,1-DCE) Vinyl Chloride (VC) Carbon Tetrachloride (CT) Trichloromethane (or chloroform) (CF) Dichloromethane (or methylene chloride) (MC) Chloromethane Tetrachloroethane (1,1,1-Z-PCA and 1,1,2,2-PCA) Trichloroethane (1,1,1-TCA and 1,1,2-TCA) Dichloroethane (1,1-DCA and 1,2-DCA)		(mg/L) 0.010 0.035 0.465 0.010 0.000 0.001 0.000 0.000 2.600 4.300 0.500 0.000	(lb) 0.00 0.01 0.12 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.67 1.11 0.13 0.00	(wt/wt h ₂) 20.57 21.73 24.05 31.00 19.08 19.74 21.06 25.04 20.82 22.06 24.55 32.00 12.33	0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.03 0.05 0.00 0.00	Mole 8 6 4 2 8 6 4 2 8 6 4 2 8 6 4 2 8 6 4
Trichloroethene (TČE) Dichloroethene (cis-DCE, trans-DCE, and 1,1-DCE) Vinyl Chloride (VC) Carbon Tetrachloride (CT) Trichloromethane (or chloroform) (CF) Dichloromethane (or methylene chloride) (MC) Chloromethane Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1,1-TCA and 1,1,2-TCA) Dichloroethane (1,1-DCA and 1,2-DCA) Chloroethane	Total	(mg/L) 0.010 0.035 0.465 0.010 0.000 0.001 0.000 0.000 2.600 4.300 0.500 0.000	(lb) 0.00 0.01 0.12 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.67 1.11 0.13 0.00	(wt/wt h ₂) 20.57 21.73 24.05 31.00 19.08 19.74 21.06 25.04 20.82 22.06 24.55 32.00 12.33 eptor Demand (lb.)	0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.03 0.05 0.00 0.00 0.00 0.00 0.00 0.00	Mole 8 6 2 8 6 4 2 8 6 4 2 8 6 4 2 6 4 2 6 4 2 6
Trichloroethene (TCE) Dichloroethene (cis-DCE, trans-DCE, and 1,1-DCE) Vinyl Chloride (VC) Carbon Tetrachloride (CT) Trichloromethane (or chloroform) (CF) Dichloromethane (or methylene chloride) (MC) Chloromethane Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1,1-TCA and 1,1,2-TCA) Dichloroethane (1,1-DCA and 1,2-DCA) Chloroethane Perchlorate		(mg/L) 0.010 0.035 0.465 0.010 0.000 0.001 0.000 0.000 2.600 4.300 0.500 0.500 0.000 Soluble Contamin	(lb) 0.00 0.01 0.12 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.67 1.11 0.13 0.00 ant Electron Acc	(wt/wt h ₂) 20.57 21.73 24.05 31.00 19.08 19.74 21.06 25.04 20.82 22.06 24.55 32.00 12.33 eptor Demand (lb.) Stoichiometric	0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.03 0.05 0.00 0.00 0.00 Hydrogen	Mole 8 6 4 2 8 6 4 2 8 6 4 2 8 6 4 2 8 6 4 2 6 4 2 6 4 2 6 Electron
Trichloroethene (TCE) Dichloroethene (cis-DCE, trans-DCE, and 1,1-DCE) Vinyl Chloride (VC) Carbon Tetrachloride (CT) Trichloromethane (or chloroform) (CF) Dichloromethane (or methylene chloride) (MC) Chloromethane (1,1,1,2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1,1-TCA and 1,1,2-TCA) Dichloroethane (1,1-DCA and 1,2-DCA) Chloroethane Perchlorate D. Sorbed Contaminant Electron Acceptors	Кос	(mg/L) 0.010 0.035 0.465 0.010 0.000 0.001 0.000 2.600 4.300 0.500 0.000 Soluble Contamin	(lb) 0.00 0.01 0.12 0.00 0.00 0.00 0.00 0.00 0.00 0.67 1.11 0.13 0.00 ant Electron Acc Mass	(wt/wt h ₂) 20.57 21.73 24.05 31.00 19.08 19.74 21.06 25.04 20.82 22.06 24.55 32.00 12.33 eptor Demand (lb.) Stoichiometric demand	0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.03 0.05 0.00 0.00 0.00 Hydrogen Demand	Mole 8 6 2 8 6 4 2 8 6 4 2 8 6 4 2 6 6 Electron Equivalents per
Trichloroethene (TČE) Dichloroethene (cis-DCE, trans-DCE, and 1,1-DCE) Vinyl Chloride (VC) Carbon Tetrachloride (CT) Trichloromethane (or chloroform) (CF) Dichloromethane (or methylene chloride) (MC) Chloromethane Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1,1-TCA and 1,1,2-TCA) Dichloroethane (1,1-DCA and 1,2-DCA) Chloroethane Perchlorate D. Sorbed Contaminant Electron Acceptors (Soil Concentration = Koc x foc x Cgw)	Koc (mL/g)	(mg/L) 0.010 0.035 0.465 0.010 0.000 0.001 0.000 0.000 2.600 4.300 0.500 0.000 Soluble Contamin Soil Conc. (mg/kg)	(lb) 0.00 0.01 0.12 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.67 1.11 0.13 0.00 ant Electron Acc Mass (lb)	(wt/wt h ₂) 20.57 21.73 24.05 31.00 19.08 19.74 21.06 25.04 20.82 22.06 24.55 32.00 12.33 eptor Demand (lb.) Stoichiometric demand (wt/wt h ₂)	0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.03 0.05 0.00 0.00 0.00 0.00 Hydrogen Demand (lb)	Mole 8 6 2 8 6 4 2 8 6 4 2 8 6 4 2 8 6 4 2 8 6 2 8 6 2 8 6 9 9 8 6 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9
Trichloroethene (TČE) Dichloroethene (cis-DCE, trans-DCE, and 1,1-DCE) Vinyl Chloride (VC) Carbon Tetrachloride (CT) Trichloromethane (or chloroform) (CF) Dichloromethane (or methylene chloride) (MC) Chloromethane (1,1,1,2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1,1-TCA and 1,1,2-TCA) Dichloroethane (1,1-DCA and 1,2-DCA) Chloroethane Perchlorate D. Sorbed Contaminant Electron Acceptors (Soil Concentration = Koc x foc x Cgw) Tetrachloroethene (PCE)	Koc (mL/g) 263	(mg/L) 0.010 0.035 0.465 0.010 0.000 0.001 0.001 0.000 2.600 4.300 0.500 0.500 0.000 Soluble Contamin Soil Conc. (mg/kg) 0.08	(lb) 0.00 0.01 0.12 0.00 0.00 0.00 0.00 0.00 0.00 0.67 1.11 0.13 0.00 ant Electron Acc Mass (lb) 0.12	(wt/wt h ₂) 20.57 21.73 24.05 31.00 19.08 19.74 21.06 25.04 20.82 22.06 24.55 32.00 12.33 eptor Demand (lb.) Stoichiometric demand (wt/wt h ₂) 20.57	0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.03 0.05 0.00 0.00 0.00 Hydrogen Demand (lb) 0.01	Mole 8 6 4 2 8 6 4 2 8 6 4 2 8 6 4 2 8 6 4 2 8 6 4 2 6 4 2 6 0 Electron Equivalents per Mole 8
Trichloroethene (TČE) Dichloroethene (cis-DCE, trans-DCE, and 1,1-DCE) Vinyl Chloride (VC) Carbon Tetrachloride (CT) Trichloromethane (or chloroform) (CF) Dichloromethane (or methylene chloride) (MC) Chloromethane (1,1,1,2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1,1-TCA and 1,1,2-TCA) Dichloroethane (1,1-DCA and 1,2-DCA) Chloroethane Perchlorate D. Sorbed Contaminant Electron Acceptors (Soil Concentration = Koc x foc x Cgw) Tetrachloroethene (PCE) Trichloroethene (TCE)	Koc (mL/g) 263 107	(mg/L) 0.010 0.035 0.465 0.010 0.000 0.001 0.001 0.000 2.600 4.300 0.500 0.000 Soluble Contamin Soil Conc. (mg/kg) 0.08 0.11	(lb) 0.00 0.01 0.12 0.00 0.00 0.00 0.00 0.00 0.00 0.67 1.11 0.13 0.00 ant Electron Acc Mass (lb) 0.12 0.17	(wt/wt h ₂) 20.57 21.73 24.05 31.00 19.08 19.74 21.06 25.04 20.82 22.06 24.55 32.00 12.33 eptor Demand (lb.) Stoichiometric demand (wt/wt h ₂) 20.57 21.73	0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.03 0.05 0.00 0.00 0.00 0.09 Hydrogen Demand (lb) 0.01 0.01	Mole 8 6 4 2 8 6 4 2 8 6 4 2 8 6 4 2 8 6 4 2 6 4 2 6 4 2 6 8 6 8 6
Trichloroethene (TČE) Dichloroethene (cis-DCE, trans-DCE, and 1,1-DCE) Vinyl Chloride (VC) Carbon Tetrachloride (CT) Trichloromethane (or chloroform) (CF) Dichloromethane (or methylene chloride) (MC) Chloromethane (1,1,1,2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1,1-TCA and 1,1,2-TCA) Dichloroethane (1,1-DCA and 1,2-DCA) Chloroethane Perchlorate D. Sorbed Contaminant Electron Acceptors (Soil Concentration = Koc x foc x Cgw) Tetrachloroethene (PCE) Trichloroethene (TCE) Dichloroethene (cis-DCE, trans-DCE, and 1,1-DCE)	Koc (mL/g) 263	(mg/L) 0.010 0.035 0.465 0.010 0.000 0.001 0.001 0.000 2.600 4.300 0.500 0.500 0.000 Soluble Contamin Soil Conc. (mg/kg) 0.08	(lb) 0.00 0.01 0.12 0.00 0.00 0.00 0.00 0.00 0.00 0.67 1.11 0.13 0.00 ant Electron Acc Mass (lb) 0.12	(wt/wt h ₂) 20.57 21.73 24.05 31.00 19.08 19.74 21.06 25.04 20.82 22.06 24.55 32.00 12.33 eptor Demand (lb.) Stoichiometric demand (wt/wt h ₂) 20.57	0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.03 0.05 0.00 0.00 0.00 Hydrogen Demand (lb) 0.01	Mole 8 6 4 2 8 6 4 2 8 6 4 2 8 6 4 2 8 6 4 2 8 6 4 2 6 4 2 6 0 Electron Equivalents per Mole 8
Trichloroethene (TČE) Dichloroethene (cis-DCE, trans-DCE, and 1,1-DCE) Vinyl Chloride (VC) Carbon Tetrachloride (CT) Trichloromethane (or chloroform) (CF) Dichloromethane (or methylene chloride) (MC) Chloromethane (1,1,1,2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1,1-TCA and 1,1,2-TCA) Dichloroethane (1,1-DCA and 1,2-DCA) Chloroethane Perchloraet D. Sorbed Contaminant Electron Acceptors (Soil Concentration = Koc x foc x Cgw) Tetrachloroethene (PCE) Trichloroethene (TCE) Dichloroethene (CE) Dichloroethene (CE) Vinyl Chloride (VC)	Koc (mL/g) 263 107	(mg/L) 0.010 0.035 0.465 0.010 0.000 0.001 0.001 0.000 2.600 4.300 0.500 0.000 Soluble Contamin Soil Conc. (mg/kg) 0.08 0.11	(lb) 0.00 0.01 0.12 0.00 0.00 0.00 0.00 0.00 0.00 0.67 1.11 0.13 0.00 ant Electron Acc Mass (lb) 0.12 0.17	(wt/wt h ₂) 20.57 21.73 24.05 31.00 19.08 19.74 21.06 25.04 20.82 22.06 24.55 32.00 12.33 eptor Demand (lb.) Stoichiometric demand (wt/wt h ₂) 20.57 21.73	0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.03 0.05 0.00 0.00 0.00 0.09 Hydrogen Demand (lb) 0.01 0.01	Mole 8 6 4 2 8 6 4 2 8 6 4 2 8 6 4 2 8 6 4 2 6 4 2 6 4 2 6 8 6 8 6
Trichloroethene (TČE) Dichloroethene (cis-DCE, trans-DCE, and 1,1-DCE) Vinyl Chloride (VC) Carbon Tetrachloride (CT) Trichloromethane (or chloroform) (CF) Dichloromethane (or methylene chloride) (MC) Chloromethane (1,1,1,2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1,1-TCA and 1,1,2-TCA) Dichloroethane (1,1-DCA and 1,1,2-TCA) Dichloroethane (1,1-DCA and 1,2-DCA) Chloroethane Perchlorate D. Sorbed Contaminant Electron Acceptors (Soil Concentration = Koc x foc x Cgw) Tetrachloroethene (PCE) Trichloroethene (TCE) Dichloroethene (cis-DCE, trans-DCE, and 1,1-DCE)	Koc (mL/g) 263 107 45	(mg/L) 0.010 0.035 0.465 0.010 0.000 0.001 0.000 2.600 4.300 0.500 0.500 0.000 Soluble Contamin Soil Conc. (mg/kg) 0.08 0.11 0.63	(lb) 0.00 0.01 0.12 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.67 1.11 0.13 0.00 ant Electron Acc Mass (lb) 0.12 0.17 0.95	(wt/wt h ₂) 20.57 21.73 24.05 31.00 19.08 19.74 21.06 25.04 20.82 22.06 24.55 32.00 12.33 eptor Demand (lb.) Stoichiometric demand (wt/wt h ₂) 20.57 21.73 24.05	0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.03 0.05 0.00 0.00 0.09 Hydrogen Demand (lb) 0.01 0.01 0.04	Mole 8 6 4 2 8 6 4 2 8 6 4 2 8 6 4 2 8 6 Hetting 8 6 8 6 4
Trichloroethene (TČE) Dichloroethene (cis-DCE, trans-DCE, and 1,1-DCE) Vinyl Chloride (VC) Carbon Tetrachloride (CT) Trichloromethane (or chloroform) (CF) Dichloromethane (or methylene chloride) (MC) Chloromethane (1,1,1,2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1,1-TCA and 1,1,2-TCA) Dichloroethane (1,1-DCA and 1,2-DCA) Chloroethane Perchloraet D. Sorbed Contaminant Electron Acceptors (Soil Concentration = Koc x foc x Cgw) Tetrachloroethene (PCE) Trichloroethene (TCE) Dichloroethene (CE) Dichloroethene (CE) Vinyl Chloride (VC)	Koc (mL/g) 263 107 45 3.0	(mg/L) 0.010 0.035 0.465 0.010 0.000 0.001 0.000 2.600 4.300 0.500 0.000 Soluble Contamin Soil Conc. (mg/kg) 0.08 0.11 0.63 0.00	(lb) 0.00 0.01 0.12 0.00 0.00 0.00 0.00 0.00 0.00 0.67 1.11 0.13 0.00 ant Electron Acc Mass (lb) 0.12 0.17 0.95 0.00	(wt/wt h ₂) 20.57 21.73 24.05 31.00 19.08 19.74 21.06 25.04 20.82 22.06 24.55 32.00 12.33 eptor Demand (lb.) Stoichiometric demand (wt/wt h ₂) 20.57 21.73 24.05 31.00	0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.03 0.05 0.00 0.00 Hydrogen Demand (lb) 0.01 0.01 0.04 0.00	Mole 8 6 2 8 6 4 2 8 6 4 2 8 6 Wole 8 6 4 2 8 6 4 2
Trichloroethene (TČE) Dichloroethene (cis-DCE, trans-DCE, and 1,1-DCE) Vinyl Chloride (VC) Carbon Tetrachloride (CT) Trichloromethane (or chloroform) (CF) Dichloromethane (or methylene chloride) (MC) Chloromethane (1,1,1,2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1,1-TCA and 1,1,2-TCA) Dichloroethane (1,1-DCA and 1,2-DCA) Chloroethane Perchlorate D. Sorbed Contaminant Electron Acceptors (Soil Concentration = Koc x foc x Cgw) Tetrachloroethene (PCE) Trichloroethene (CE) Dichloroethene (cis-DCE, trans-DCE, and 1,1-DCE) Vinyl Chloride (VC) Carbon Tetrachloride (CT) Trichloromethane (or chloroform) (CF)	Koc (mL/g) 263 107 45 3.0 224 63	(mg/L) 0.010 0.035 0.465 0.010 0.000 0.001 0.000 0.000 2.600 4.300 0.500 0.000 Soluble Contamin Soil Conc. (mg/kg) 0.08 0.11 0.63 0.00 0.00 0.00	(lb) 0.00 0.01 0.12 0.00 0.00 0.00 0.00 0.00 0.00 0.67 1.11 0.13 0.00 ant Electron Acc Mass (lb) 0.12 0.17 0.95 0.00 0.00	(wt/wt h ₂) 20.57 21.73 24.05 31.00 19.08 19.74 21.06 25.04 20.82 22.06 24.55 32.00 12.33 eptor Demand (lb.) Stoichiometric demand (wt/wt h ₂) 20.57 21.73 24.05 31.00 19.08 19.74	0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.03 0.05 0.00 0.00 Hydrogen Demand (lb) 0.01 0.01 0.04 0.00	Mole 8 6 4 2 8 6 4 2 8 6 4 2 8 6 4 2 8 6 4 2 8 6 4 2 8 6 4 2 8 6 4 2 8 6 4 2 8 6
Trichloroethene (TČE) Dichloroethene (cis-DCE, trans-DCE, and 1,1-DCE) Vinyl Chloride (VC) Carbon Tetrachloride (CT) Trichloromethane (or chloroform) (CF) Dichloromethane (or methylene chloride) (MC) Chloromethane (1,1,1,2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1,1-TCA and 1,1,2-TCA) Dichloroethane (1,1-DCA and 1,2-DCA) Chloroethane (1,1-DCA and 1,2-DCA) Chloroethane Perchlorate D. Sorbed Contaminant Electron Acceptors (Soil Concentration = Koc x foc x Cgw) Tetrachloroethene (PCE) Trichloroethene (CE) Dichloroethene (cis-DCE, trans-DCE, and 1,1-DCE) Vinyl Chloride (VC) Carbon Tetrachloride (CT) Trichloromethane (or chloroform) (CF) Dichloromethane (or methylene chloride) (MC)	Koc (mL/g) 263 107 45 3.0 224 63 28	(mg/L) 0.010 0.035 0.465 0.010 0.000 0.001 0.001 0.000 2.600 4.300 0.500 0.000 Soluble Contamin Soil Conc. (mg/kg) 0.08 0.11 0.63 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0	(lb) 0.00 0.01 0.12 0.00 0.00 0.00 0.00 0.00 0.67 1.11 0.13 0.00 ant Electron Acc Mass (lb) 0.12 0.17 0.95 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00	(wt/wt h ₂) 20.57 21.73 24.05 31.00 19.08 19.74 21.06 25.04 20.82 22.06 24.55 32.00 12.33 eptor Demand (lb.) Stoichiometric demand (wt/wt h ₂) 20.57 21.73 24.05 31.00 19.08 19.74 21.06	0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.03 0.05 0.00 0.00 0.09 Hydrogen Demand (lb) 0.01 0.01 0.04 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.01 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00	Mole 8 6 4 2 8 6 4 2 8 6 4 2 8 6 4 2 8 6 4 2 6 4 2 6 4 2 8 6 4 2 8 6 4 2 8 6 4 2 8 6 4
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Trichloroethene (TČE) Dichloroethene (cis-DCE, trans-DCE, and 1,1-DCE) Vinyl Chloride (VC) Carbon Tetrachloride (CT) Trichloromethane (or chloroform) (CF) Dichloromethane (or methylene chloride) (MC) Chloromethane (1,1,1-2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1,1-TCA and 1,1,2-TCA) Dichloroethane (1,1-TCA and 1,1,2-TCA) Dichloroethane (1,1-DCA and 1,2-DCA) Chloroethane Perchlorate D. Sorbed Contaminant Electron Acceptors (Soil Concentration = Koc x foc x Cgw) Tetrachloroethene (PCE) Trichloroethene (TCE) Dichloroethene (CE) Trichloroethene (CC) Carbon Tetrachloride (CT) Trichloromethane (or chloroform) (CF) Dichloromethane (1,1,1,2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1,1-TCA and 1,1,2-TCA)	Koc (mL/g) 263 107 45 3.0 224 63 28 25 117 105	(mg/L) 0.010 0.035 0.465 0.010 0.000 0.001 0.000 0.000 2.600 4.300 0.000 2.600 4.300 0.000 Soluble Contamin Soil Conc. 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Stoichiometric demand (wt/wt h ₂) 20.57 21.73 24.05 31.00 19.08 19.74 21.06 22.06	0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.03 0.05 0.00 0.00 0.09 Hydrogen Demand (lb) 0.01 0.01 0.04 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00	Mole 8 6 4 2 8 6 4 2 8 6 4 2 8 6 4 2 8 6 4 2 8 6 4 2 8 6 4 2 8 6 4 2 8 6 4 2 8 6 2 8 6
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Trichloroethene (TČE) Dichloroethene (cis-DCE, trans-DCE, and 1,1-DCE) Vinyl Chloride (VC) Carbon Tetrachloride (CT) Trichloromethane (or chloroform) (CF) Dichloromethane (or methylene chloride) (MC) Chloromethane (1,1,1,2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1,1-TCA and 1,1,2-TCA) Dichloroethane (1,1-DCA and 1,2-DCA) Chloroethane (1,1-DCA and 1,2-DCA) Chloroethane Perchlorate D. Sorbed Contaminant Electron Acceptors (Soil Concentration = Koc x foc x Cgw) Tetrachloroethene (PCE) Trichloroethene (TCE) Dichloroethene (cis-DCE, trans-DCE, and 1,1-DCE) Vinyl Chloride (VC) Carbon Tetrachloride (CT) Trichloromethane (or chloroform) (CF) Dichloroethane (1,1,1,2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1,1-TCA and 1,1,2-TCA) Dichloroethane (1,1,1-DCA and 1,2-DCA)	Koc (mL/g) 263 107 45 3.0 224 63 28 25 117 105 30 3 3 0.0	(mg/L) 0.010 0.035 0.465 0.010 0.000 0.001 0.000 2.600 4.300 0.000 Soluble Contamin Soil Conc. (mg/kg) 0.08 0.11 0.63 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.00000 0.00000 0.00000 0.00000000	(lb) 0.00 0.01 0.12 0.00 0.00 0.00 0.00 0.00 0.00 0.67 1.11 0.13 0.00 ant Electron Acc Mass (lb) 0.12 0.17 0.95 0.00 0.00 0.00 0.00 0.00 0.12 0.17 0.95 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00	(wt/wt h ₂) 20.57 21.73 24.05 31.00 19.08 19.74 21.06 25.04 20.82 22.06 24.55 32.00 12.33 eptor Demand (lb.) Stoichiometric demand (wt/wt h ₂) 20.57 21.73 24.05 31.00 19.08 19.74 21.06 22.06 24.55 31.00 19.08 22.05 24.05 24.05 24.05 24.05 24.05 24.05 24.05 24.05 24.05 24.05 24.05 24.05 24.05 24.05 24.05 24.05 24.05 24.05 24.05 24.05 24.05 24.05 24.05 24.05 24.05 24.05 24.05 24.05 24.05 24.05 24.05 24.05 24.05 24.05 24.05 24.05 24.05 24.05 24.05 24.05 24.05 24.05 24.05 24.05 24.05 24.05 24.05 24.05 24.05 24.05 24.05 24.05 24.05 24.05 24.05 24.05 24.05 24.05 24.05 24.05 24.05 24.05 24.05 24.05 24.05 24.05 24.05 24.05 24.05 24.05 24.05 24.05 24.05 24.05 24.05 24.05 24.05 24.05 24.05 24.05 24.05 24.05 24.05 24.05 24.05 24.05 24.05 24.05 24.05 24.05 24.05 24.05 24.05 24.05 24.05 24.05 24.05 24.05 24.05 24.05 24.05 24.05 24.05 24.05 24.05 24.05 24.05 24.05 24.05 24.05 24.05 24.05 25.04 20.67 25.04 20.67 24.05 25.04 20.67 24.05 24.05 25.04 20.67 25.04 22.06 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55 24.55	0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.03 0.05 0.00 0.00 0.00 0.00 0.00 0.00 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00	Mole 8 6 4 2 8 6 4 2 8 6 4 2 8 6 4 2 8 6 4 2 8 6 4 2 8 6 4 2 8 6 4 2 8 6 4 2 8 6 4 2 8 6 4

Table S.2 Substrat	te Calculations in	Hydrogen	Equivalents		
4. Treatment Cell Electron-Acceptor Flux (per year)		· · ·			
1 u 3 ,			Stoichiometric	Hydrogen	Electron
A. Soluble Native Electron Acceptors	Concentration	Mass	demand	Demand	Equivalents per
	(mg/L)	(lb)	(wt/wt h ₂)	(lb)	Mole
Oxygen	0.6	1.33	7.94	0.17	4
Nitrate (denitrification)	0.1	0.22	10.25	0.02	5
Sulfate	35	77.49	11.91	6.51	8
Carbon Dioxide (estimated as the amount of Methane produced)	10	22.14	1.99	11.13	8
	Total Competing Elec			17.8	
			Stoichiometric	Hydrogen	Electron
B. Soluble Contaminant Electron Acceptors	Concentration	Mass	demand	Demand	Equivalents per
	(mg/L)	(lb)	(wt/wt h ₂)	(lb)	Mole
Tetrachloroethene (PCE)	0.010	0.02	20.57	0.00	8
Trichloroethene (TCE)	0.035	0.02	21.73	0.00	6
Dichloroethene (cis-DCE, trans-DCE, and 1,1-DCE)	0.465	1.03	24.05	0.00	4
Vinyl Chloride (VC)	0.405	0.02	31.00	0.04	2
Carbon Tetrachloride (CT)	0.000	0.02	19.08	0.00	8
Trichloromethane (or chloroform) (CF)	0.000	0.00	19.08	0.00	6
Dichloromethane (or methylene chloride) (MC)	0.001	0.00	21.06	0.00	4
Chloromethane	0.000	0.00	25.04	0.00	2
Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA)	0.000	0.00	20.82	0.00	8
Trichloroethane (1,1,1-TCA and 1,1,2-TCA)	2.600	5.76	22.06	0.26	6
Dichloroethane (1,1-DCA and 1,2-DCA)	4.300	9.52	22.06	0.28	4
Chloroethane	0.500	1.11	32.00	0.03	2
Perchlorate	0.000	0.00	12.33	0.03	6
	oluble Contaminant Elec			0.00	0
	Initial Hydroge	n Requireme	nt First Year (Ib)	26.9	1
			equirement (lb)		
5. Design Factors					-
Microbial Efficiency Uncertainty Factor				2X - 4X	
Methane and Solid-Phase Electron Acceptor Uncertainty				2X - 4X	
Remedial Design Factor (e.g., Substrate Leaving Reaction Zone)				1X - 3X	
······································			Design Factor		7
Total Life-Cvcl	le Hydrogen Require	ment with De	•		
6. Acronyns and Abbreviations			,		_
¹ 0 to 100 to 1		0			
	g = milliequivalents per 10	o grams			
	nilligrams per kilogram				
	lligrams per liter				
	ters per meters				
ft ² = square feet mV = milli					
	ters per year				
	lard pH units	udrogonist t	o or woight		
	= concetration molecular h	yarogen, weight	per weight		
$gm/cm^3 = grams per cubic centimeter$					
kg of CaCO3 per mg = kilograms of calcium carbonate per millig	ram				
lb = pounds					

Table S.3										
Hydrogen Produced by Ferr	RETURN TO COVER PAGE									
Substrate	Molecular Formula	Substrate Molecular Weight (gm/mole)	Moles of Hydrogen Produced per Mole of Substrate	Ratio of Hydrogen Produced to Substrate (gm/gm)	Range of Moles H₂/Mole Substrate					
Lactic Acid	C ₃ H ₆ O ₃	90.1	2	0.0448	2 to 3					
Molasses (assuming 100% sucrose)	C ₁₂ H ₂₂ O ₁₁	342	8	0.0471	8 to 11					
High Fructose Corn Syrup (assuming 50% fructose and 50% glucose)	C ₆ H ₁₂ O ₆	180	4	0.0448	4 to 6					
Ethanol	C ₂ H ₆ O	46.1	2	0.0875	2 to 6					
Whey (assuming 100% lactose)	C ₁₂ H ₂₂ O ₁₁	342	11	0.0648	11					
HRC [®] (assumes 40% lactic acid and 40% glycerol by weight)	C ₃₉ H ₅₆ O ₃₉	956	28	0.0590	28					
Linoleic Acid (Soybean Oil, Corn Oil, Cotton Oil)	C ₁₈ H ₃₂ O ₂	281	16	0.1150	16					

Design Life (years): 4

Substrate	Design Factor	Pure Substrate Mass Required to Fulfill Hydrogen Demand (pounds)	Substrate Product Required to Fulfill Hydrogen Demand (pounds)	Substrate Mass Required to Fulfill Hydrogen Demand (milligrams)	Effective Substrate Concentration (mg/L)
Lactic Acid	3.0	5,532	5,532	2.51E+09	607
Sodium Lactate Product (60 percent solution)	3.0	5,532	11,477	2.51E+09	607
Molasses (assuming 6 0	3.0	5,255	8,759	2.38E+09	577
HFCS (assuming 40% fructose and 40% glucose by weight)	3.0	5,533	6,917	2.51E+09	607
Ethanol Product (assuming 80% ethanol by weight)	3.0	2,829	3,537	1.28E+09	310
Whey (assuming 100% lactose)	3.0	3,819	5,455	1.73E+09	419
HRC [®] (assumes 40% lactic acid and 40% glycerol by weight)	3.0	4,194	4,194	1.90E+09	368
Linoleic Acid (Soybean Oil, Corn Oil, Cotton Oil)	3.0	2,153	2,153	9.77E+08	236
Commercial Vegetable Oil Emulsion Product (60% oil by weight)	3.0	2,153	3,589	9.77E+08	236

NOTES: Sodium Lactate Product

1. Assumes sodium lactate product is 60 percent sodium lactate by weight.

2. Molecular weight of sodium lactate (CH₃-CHOH-COONa) = 112.06.

3. Molecular weight of lactic Acid $(C_6H_6O_3) = 90.08$.

4. Therefore, sodium lactate product yields 48.4 (0.60 x (90.08/112.06)) percent by weight lactic acid.

5. Weight of sodium lactate product = 11.0 pounds per gallon.

6. Pounds per gallon of lactic acid in product = 1.323×8.33 lb/gal H2O x 0.60 x (90.08/112.06) = 5.31 lb/gal.

NOTES: Standard HRC Product

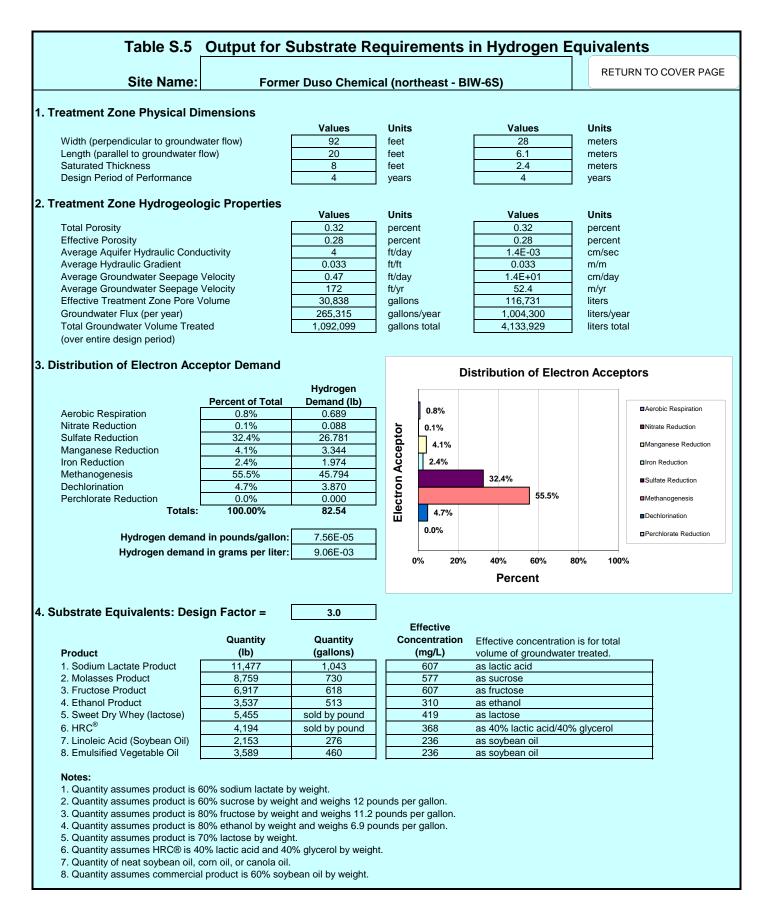
1. Assumes HRC product is 40 percent lactic acid and 40 percent glycerol by weight.

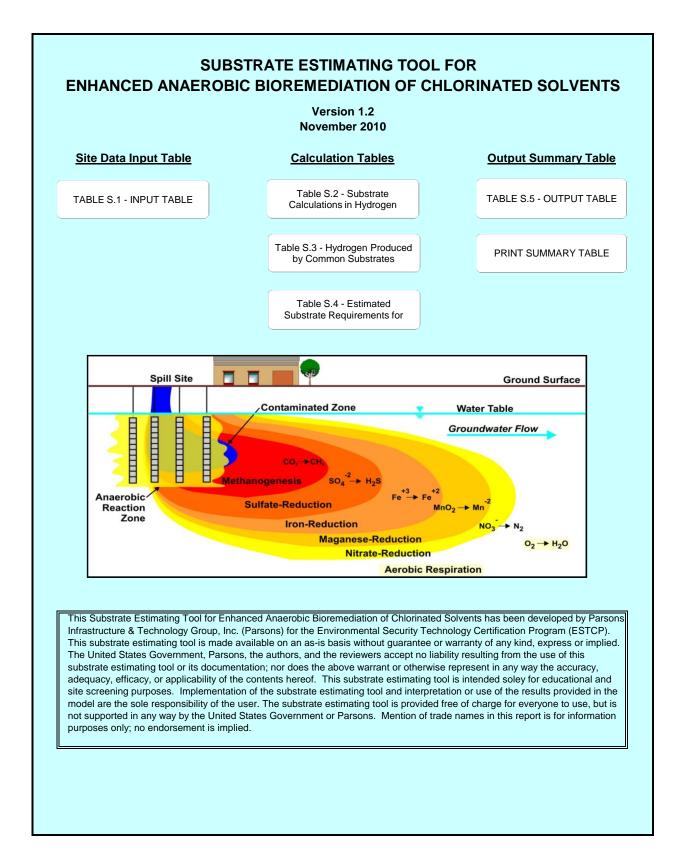
2. HRC[®] weighs approximately 9.18 pounds per gallon.

NOTES: Vegetable Oil Emulsion Product

1. Assumes emulsion product is 60 percent soybean oil by weight.

2. Soybean oil is 7.8 pounds per gallon.





	so Chemical (North					
Frostmant Zona Physical Dimonsions		d boxes are use	r input	RETURN TO COVER PAGE		
Treatment Zone Physical Dimensions	Values	Range	Units	User Notes		
Vidth (Perpendicular to predominant groundwater flow direction)	71	1-10,000	feet	Former Duso Chemical (Northwest - BIW-1D)		
ength (Parallel to predominant groundwater flow)	35	1-1,000	feet	, , , , , , , , , , , , , , , , , , ,		
Saturated Thickness	20	1-100	feet	treatment thickness (6-26)		
reatment Zone Cross Sectional Area	1420		ft ²			
reatment Zone Volume	49,700		ft ³			
reatment Zone Total Pore Volume (total volume x total porosity)	118,994		gallons			
reatment Zone Effective Pore Volume (total volume x effective poros	sity) 104,120		gallons			
Design Period of Performance	4.0	.5 to 5	year			
Design Factor (times the electron acceptor hydrogen demand)	5.0	2 to 20	unitless	AECOM recommendation to use a design factor of 2 to 5		
Tractment Zene Undreggelegie Dreparties						
Treatment Zone Hydrogeologic Properties	200/	05 E0	norcont	Assumed for allty and		
otal Porosity	32%	.05-50	percent	Assumed for silty sand		
iffective Porosity	28%	.05-50	percent tt/dov	Assumed for silty sand (conservative high for higher PV)		
verage Aquifer Hydraulic Conductivity	0.033	.01-1000 0.0001-0.1	ft/day ft/ft	average from MHBP RI		
werage Groundwater Seepage Velocity through the Treatment Zone		0.0001-0.1	ft/day	average from 2 values in RI		
verage Groundwater Seepage Velocity through the Treatment Zone			ft/yr			
werage Groundwater Discharge through the Treatment Zone	511,886		gallons/year			
coil Bulk Density	1.65	1.4-2.0	gm/cm ³	Assumed		
Soll Fraction Organic Carbon (foc)	3.00%	0.01-10	percent	Assumed		
	0.0070	0.01-10	poroon			
Native Electron Acceptors						
A Aqueous-Phase Native Electron Acceptors						
Dxygen	0.6	0.01 to 10	mg/L			
litrate	0.10	0.1 to- 20	mg/L	not detected in RI		
Sulfate	35	10 to 5,000	mg/L	RI readings 2, 11, 43, 79 in MHC-23 and MHC-26		
Carbon Dioxide (estimated as the amount of Methane produced)	10.0	0.1 to 20	mg/L			
8. Solid-Phase Native Electron Acceptors						
Aanganese (IV) (estimated as the amount of Mn (II) produced)	10	0.1 to 20	mg/L	RI Mn 4-8 mg/L in slightly reducing GW, assume some prod		
ron (III) (estimated as the amount of Fe (II) produced)	12	0.1 to 20	mg/L	RI ~10 mg/L in slightly reducing GW, assume some product		
Contaminant Electron Acceptors		-				
etrachloroethene (PCE)	0.001		mg/L	max conc from BIW-1D		
richloroethene (TCE)	0.003		mg/L			
Dichloroethene (cis-DCE, trans-DCE, and 1,1-DCE)	2.400		mg/L			
(inyl Chloride (VC)	0.000		mg/L			
Carbon Tetrachloride (CT)	0.000		mg/L			
richloromethane (or chloroform) (CF)	0.000		mg/L			
Dichloromethane (or methylene chloride) (MC)	0.000		mg/L			
Chloromethane	0.000		mg/L			
etrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA)	0.000		mg/L			
richloroethane (1,1,1-TCA and 1,1,2-TCA)	3.600		mg/L			
Dichloroethane (1,1-DCA and 1,2-DCA)	2.400		mg/L			
Chloroethane	0.000		mg/L			
Perchlorate	0.000		mg/L			
Aquifer Geochemistry (Optional Screening Paramete	re)					
	13)					
A. Aqueous Geochemistry Dividation-Reduction Potential (ORP)	-25	-400 to +500	m\/	2012 Field Sheets (avg BIW-2S, MHC-23, BIW-5S)		
emperature	-25	-400 to +500 5.0 to 30	mV ⁰C	2012 Field Sheets (avg Briv-25, MHC-23, Briv-55) 2012 Field Sheets		
H	7.1	4.0 to 10.0	su	2012 Field Sheets (7.06-7.4)		
n Ikalinity	300	4.0 to 10.0	mg/L			
otal Dissolved Solids (TDS, or salinity)	300	10 to 1,000	mg/L			
Specific Conductivity	2000	100 to 10,000		2012 Field Sheets Approximate Average		
Chloride	2000	10 to 10,000	mg/L			
Sulfide - Pre injection	0.0	0.1 to 100	mg/L			
Sulfide - Post injection	0.0	0.1 to 100	mg/L			
	0.0	0.1.10 100				
8. Aquifer Matrix						
iotal Iron	10000	200 to 20,000	mg/kg	Assumed		
Cation Exchange Capacity	NA	1.0 to 10	meq/100 g			
leutralization Potential	10.0%	1.0 to 100	Percent as CaCO	3 Assumed		
IOTES:						
0120.						

	Substrate Ca	alculations in	Hydrogen I	Equivalents		
Site Name:	Former Duso (Chemical (North	nwest - BIW-1	D)	RETURN TO	COVER PAGE
				NOTE: Open cells	are user input.	
I. Treatment Zone Physical Dimensions				Values	Range	Units
Width (Perpendicular to predominant groundwater fle	ow direction)			71	1-10,000	feet
Length (Parallel to predominant groundwater flow)				35	1-1,000	feet
Saturated Thickness				20	1-100	feet
Treatment Zone Cross Sectional Area	1420		ft ²			
Treatment Zone Volume	49,700 104,120		ft ³			
Treatment Zone Effective Pore Volume (total volume Design Period of Performance	 .5 to 5	gallons year				
2. Treatment Zone Hydrogeologic Properti	ies					
Total Porosity				0.32	.05-50	
Effective Porosity				0.28	.05-50	
Average Aquifer Hydraulic Conductivity				4	.01-1000	ft/day
Average Hydraulic Gradient				0.033	0.1-0.0001	ft/ft
Average Groundwater Seepage Velocity through the	Treatment Zone			0.47		ft/day
Average Groundwater Seepage Velocity through the				172.1		
		0				ft/yr
Average Groundwater Flux through the Treatment Zo	on	0		511,886		gallons/year
Soil Bulk Density				1.65	1.4-2.0	gm/cm ³
Soil Fraction Organic Carbon (foc)				0.03	0.0001-0.1	
3. Initial Treatment Cell Electron-Acceptor	Demand (one	total pore volu	me)			
				Stoichiometric	Hydrogen	Electron
A. Aqueous-Phase Native Electron Acceptors		Concentration	Mass	demand	Demand	Equivalents per
		(mg/L)	(lb)	(wt/wt h ₂)	(lb)	Mole
Oxygen		0.6	0.52	7.94	0.07	4
Nitrate (denitrification)		0.1	0.09	12.30	0.01	5
Sulfate	e e e e e e	35	30.41	11.91	2.55	8
Carbon Dioxide (estimated as the amount of methan	e produced)	10.0	8.69	1.99	4.37	8
		Soluble Compet	ing Electron Acc	eptor Demand (lb.)	6.99	
				Stoichiometric	Hydrogen	Electron
B. Solid-Phase Native Electron Acceptors		Concentration	Mass	demand	Demand	Equivalents per
(Based on manganese and iron produced)		(mg/L)	(lb)	(wt/wt h ₂)	(lb)	Mole
			()		. ,	
Manganese (IV) (estimated as the amount of Mn (II)	• •	10.0	179.55	27.25	6.59	2
Iron (III) (estimated as the amount of Fe (II) produce		12.0	215.46	55.41	3.89	1
	50	lid-Phase Competi	ing Electron Acc	eptor Demand (lb.)	10.48	
				Stoichiometric	Hydrogen	Electron
C. Soluble Contaminant Electron Acceptors		Concentration	Mass	demand	Demand	Equivalents per
		(mg/L)	(lb)	(wt/wt h ₂)	(lb)	Mole
			.,		()	
Tetrachloroethene (PCE)		0.001	0.00	20.57	0.00	8
Trichloroethene (TCE)		0.003	0.00	21.73	0.00	6
Dichloroethene (cis-DCE, trans-DCE, and 1,1-DCE)		2.400	2.09	24.05	0.09	4
Vinyl Chloride (VC)		0.000	0.00	31.00	0.00	2
Carbon Tetrachloride (CT)		0.000	0.00	19.08	0.00	
Trichloromethane (or chloroform) (CF)			0.00	10.00	0.00	8
		0.000	0.00	19.74	0.00	6
		0.000 0.000				
Dichloromethane (or methylene chloride) (MC)		0.000	0.00 0.00	19.74 21.06	0.00 0.00	6 4
Dichloromethane (or methylene chloride) (MC) Chloromethane		0.000 0.000	0.00 0.00 0.00	19.74 21.06 25.04	0.00 0.00 0.00	6 4 2
Dichloromethane (or methylene chloride) (MC) Chloromethane Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA)		0.000 0.000 0.000	0.00 0.00 0.00 0.00	19.74 21.06 25.04 20.82	0.00 0.00 0.00 0.00	6 4 2 8
Dichloromethane (or methylene chloride) (MC) Chloromethane Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1,1-TCA and 1,1,2-TCA)		0.000 0.000 0.000 3.600	0.00 0.00 0.00 0.00 3.13	19.74 21.06 25.04 20.82 22.06	0.00 0.00 0.00 0.00 0.14	6 4 2 8 6
Dichloromethane (or methylene chloride) (MC) Chloromethane Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1,1-TCA and 1,1,2-TCA) Dichloroethane (1,1-DCA and 1,2-DCA)		0.000 0.000 0.000 3.600 2.400	0.00 0.00 0.00 0.00 3.13 2.09	19.74 21.06 25.04 20.82 22.06 24.55	0.00 0.00 0.00 0.00 0.14 0.08	6 4 2 8 6 4
Dichloromethane (or methylene chloride) (MC) Chloromethane Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1-TCA and 1,1,2-TCA) Dichloroethane (1,1-DCA and 1,2-DCA) Chloroethane		0.000 0.000 0.000 3.600 2.400 0.000	0.00 0.00 0.00 3.13 2.09 0.00	19.74 21.06 25.04 20.82 22.06 24.55 32.00	0.00 0.00 0.00 0.14 0.08 0.00	6 4 2 8 6 4 2
Dichloromethane (or methylene chloride) (MC) Chloromethane Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1,1-TCA and 1,1,2-TCA) Dichloroethane (1,1-DCA and 1,2-DCA)	Total	0.000 0.000 3.600 2.400 0.000 0.000	0.00 0.00 0.00 3.13 2.09 0.00 0.00	19.74 21.06 25.04 20.82 22.06 24.55 32.00 12.33	0.00 0.00 0.00 0.14 0.08 0.00 0.00	6 4 2 8 6 4
Dichloromethane (or methylene chloride) (MC) Chloromethane Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1-TCA and 1,1,2-TCA) Dichloroethane (1,1-DCA and 1,2-DCA) Chloroethane	Total	0.000 0.000 3.600 2.400 0.000 0.000	0.00 0.00 0.00 3.13 2.09 0.00 0.00	19.74 21.06 25.04 20.82 22.06 24.55 32.00 12.33 eptor Demand (lb.)	0.00 0.00 0.00 0.14 0.08 0.00 0.00 0.00 0.31	6 4 2 8 6 4 2 6
Dichloromethane (or methylene chloride) (MC) Chloromethane Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1,1-TCA and 1,1,2-TCA) Dichloroethane (1,1-DCA and 1,2-DCA) Chloroethane Perchlorate		0.000 0.000 3.600 2.400 0.000 Soluble Contamina	0.00 0.00 0.00 3.13 2.09 0.00 0.00 0.00 ant Electron Acc	19.74 21.06 25.04 20.82 22.06 24.55 32.00 12.33 eptor Demand (lb.) Stoichiometric	0.00 0.00 0.00 0.14 0.08 0.00 0.00 0.00 0.31 Hydrogen	6 4 2 8 6 4 2 6 5 Electron
Dichloromethane (or methylene chloride) (MC) Chloromethane Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1-TCA and 1,1,2-TCA) Dichloroethane (1,1-DCA and 1,2-DCA) Chloroethane	Total -	0.000 0.000 3.600 2.400 0.000 0.000	0.00 0.00 0.00 3.13 2.09 0.00 0.00	19.74 21.06 25.04 20.82 22.06 24.55 32.00 12.33 eptor Demand (lb.)	0.00 0.00 0.00 0.14 0.08 0.00 0.00 0.00 0.31	6 4 2 8 6 4 2 6 5 5 6 5 6 5 6 5 6 5 6 5 6 5 6 5 6 5
Dichloromethane (or methylene chloride) (MC) Chloromethane Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1,1-TCA and 1,1,2-TCA) Dichloroethane (1,1-DCA and 1,2-DCA) Chloroethane Perchlorate		0.000 0.000 3.600 2.400 0.000 Soluble Contamina	0.00 0.00 0.00 3.13 2.09 0.00 0.00 0.00 ant Electron Acc	19.74 21.06 25.04 20.82 22.06 24.55 32.00 12.33 eptor Demand (lb.) Stoichiometric	0.00 0.00 0.00 0.14 0.08 0.00 0.00 0.00 0.31 Hydrogen	6 4 2 8 6 4 2 6 5 5 6 5 6 5 6 5 6 5 6 5 6 5 6 5 6 5
Dichloromethane (or methylene chloride) (MC) Chloromethane Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1,1-TCA and 1,1,2-TCA) Dichloroethane (1,1-DCA and 1,2-DCA) Chloroethane Perchlorate D. Sorbed Contaminant Electron Acceptors (Soil Concentration = Koc x foc x Cgw)	Koc (mL/g)	0.000 0.000 3.600 2.400 0.000 Soluble Contamin Soil Conc. (mg/kg)	0.00 0.00 0.00 3.13 2.09 0.00 0.00 ant Electron Acc Mass (Ib)	19.74 21.06 25.04 20.82 22.06 24.55 32.00 12.33 eptor Demand (lb.) Stoichiometric demand (wt/wt h ₂)	0.00 0.00 0.00 0.14 0.08 0.00 0.00 0.31 Hydrogen Demand (lb)	6 4 2 8 6 4 2 6 5 6 5 5 6 5 6 5 6 5 6 5 6 6 5 6 6 5 6 6 7 6 6 7 7 6 7 6
Dichloromethane (or methylene chloride) (MC) Chloromethane Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1-TCA and 1,1,2-TCA) Dichloroethane (1,1-DCA and 1,2-DCA) Chloroethane Perchlorate D. Sorbed Contaminant Electron Acceptors (Soil Concentration = Koc x foc x Cgw) Tetrachloroethene (PCE)	Koc (mL/g) 263	0.000 0.000 3.600 2.400 0.000 Soluble Contamin Soil Conc. (mg/kg) 0.00	0.00 0.00 0.00 3.13 2.09 0.00 0.00 ant Electron Acc Mass (lb) 0.02	19.74 21.06 25.04 20.82 22.06 24.55 32.00 12.33 eptor Demand (lb.) Stoichiometric demand (wt/wt h ₂) 20.57	0.00 0.00 0.00 0.14 0.08 0.00 0.00 0.31 Hydrogen Demand (lb) 0.00	6 4 2 8 6 4 2 6 5 5 5 5 6 5 6 5 6 6 5 6 6 6 6 6 6 6
Dichloromethane (or methylene chloride) (MC) Chloromethane Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1-TCA and 1,1,2-TCA) Dichloroethane (1,1-DCA and 1,2-DCA) Chloroethane Perchlorate D. Sorbed Contaminant Electron Acceptors (Soil Concentration = Koc x foc x Cgw) Tetrachloroethene (PCE) Trichloroethene (TCE)	Koc (mL/g) 263 107	0.000 0.000 3.600 2.400 0.000 Soluble Contamin Soil Conc. (mg/kg) 0.00 0.01	0.00 0.00 0.00 3.13 2.09 0.00 0.00 ant Electron Acc Mass (lb) 0.02 0.04	19.74 21.06 25.04 20.82 22.06 24.55 32.00 12.33 eptor Demand (lb.) Stoichiometric demand (wt/wt h2) 20.57 21.73	0.00 0.00 0.00 0.14 0.08 0.00 0.00 0.31 Hydrogen Demand (lb) 0.00 0.00	6 4 2 8 6 4 2 2 6 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
Dichloromethane (or methylene chloride) (MC) Chloromethane Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1-TCA and 1,1,2-TCA) Dichloroethane (1,1-DCA and 1,2-DCA) Chloroethane Perchlorate D. Sorbed Contaminant Electron Acceptors (Soil Concentration = Koc x foc x Cgw) Tetrachloroethene (PCE) Trichloroethene (TCE) Dichloroethene (cis-DCE, trans-DCE, and 1,1-DCE)	Koc (mL/g) 263 107 45	0.000 0.000 3.600 2.400 0.000 Soluble Contamin Soil Conc. (mg/kg) 0.00 0.01 3.24	0.00 0.00 0.00 0.00 3.13 2.09 0.00 0.00 ant Electron Acc Mass (lb) 0.02 0.04 16.59	19.74 21.06 25.04 20.82 22.06 24.55 32.00 12.33 eptor Demand (lb.) Stoichiometric demand (wt/wt h ₂) 20.57 21.73 24.05	0.00 0.00 0.00 0.14 0.08 0.00 0.00 0.31 Hydrogen Demand (lb) 0.00 0.00 0.00 0.00	6 4 2 8 6 4 2 2 6 5 5 5 5 6 6 4
Dichloromethane (or methylene chloride) (MC) Chloromethane Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1-TCA and 1,1,2-TCA) Dichloroethane (1,1-DCA and 1,2-DCA) Chloroethane Perchloraethane Perchlorate D. Sorbed Contaminant Electron Acceptors (Soil Concentration = Koc x foc x Cgw) Tetrachloroethene (PCE) Trichloroethene (TCE) Dichloroethene (is-DCE, trans-DCE, and 1,1-DCE) Vinyl Chloride (VC)	Koc (mL/g) 263 107 45 3.0	0.000 0.000 3.600 2.400 0.000 Soluble Contamina Soil Conc. (mg/kg) 0.00 0.01 3.24 0.00	0.00 0.00 0.00 0.00 3.13 2.09 0.00 0.00 ant Electron Acc Mass (lb) 0.02 0.04 16.59 0.00	19.74 21.06 25.04 20.82 22.06 24.55 32.00 12.33 eptor Demand (lb.) Stoichiometric demand (wt/wt h ₂) 20.57 21.73 24.05 31.00	0.00 0.00 0.00 0.14 0.08 0.00 0.00 0.31 Hydrogen Demand (lb) 0.00 0.69 0.00	6 4 2 8 6 4 2 6 4 2 6 4 2 6 4 2 6 8 6 6 4 2
Dichloromethane (or methylene chloride) (MC) Chloromethane Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1-TCA and 1,1,2-TCA) Dichloroethane (1,1-DCA and 1,2-DCA) Chloroethane Perchlorate D. Sorbed Contaminant Electron Acceptors (Soil Concentration = Koc x foc x Cgw) Tetrachloroethene (PCE) Trichloroethene (PCE) Dichloroethene (CTC) Dichloroethene (CC) Carbon Tetrachloride (VC)	Koc (mL/g) 263 107 45 3.0 224	0.000 0.000 3.600 2.400 0.000 Soluble Contamina Soil Conc. (mg/kg) 0.00 0.01 3.24 0.00 0.00	0.00 0.00 0.00 3.13 2.09 0.00 0.00 0.00 0.00 Mass (lb) 0.02 0.04 16.59 0.00 0.00	19.74 21.06 25.04 20.82 22.06 24.55 32.00 12.33 eptor Demand (lb.) Stoichiometric demand (wt/wt h₂) 20.57 21.73 24.05 31.00 19.08	0.00 0.00 0.00 0.14 0.08 0.00 0.00 0.31 Hydrogen Demand (lb) 0.00 0.00 0.69 0.00 0.00	6 4 2 8 6 4 2 5 6 5 5 5 5 6 5 6 6 4 2 2 8
Dichloromethane (or methylene chloride) (MC) Chloromethane Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1-TCA and 1,1,2-TCA) Dichloroethane (1,1-DCA and 1,2-DCA) Chloroethane Perchlorate D. Sorbed Contaminant Electron Acceptors (Soil Concentration = Koc x foc x Cgw) Tetrachloroethene (PCE) Trichloroethene (TCE) Dichloroethene (cis-DCE, trans-DCE, and 1,1-DCE) Vinyl Chloride (VC) Carbon Tetrachloride (CT) Trichloromethane (or chloroform) (CF)	Koc (mL/g) 263 107 45 3.0 224 63	0.000 0.000 0.000 3.600 2.400 0.000 Soluble Contamin Soil Conc. (mg/kg) 0.00 0.01 3.24 0.00 0.00 0.00	0.00 0.00 0.00 3.13 2.09 0.00 0.00 ant Electron Acc Mass (b) 0.02 0.04 16.59 0.00 0.00 0.00	19.74 21.06 25.04 20.82 22.06 24.55 32.00 12.33 eptor Demand (lb.) Stoichiometric demand (wt/wt h₂) 20.57 21.73 24.05 31.00 19.08 19.74	0.00 0.00 0.00 0.14 0.08 0.00 0.00 0.31 Hydrogen Demand (lb) 0.00 0.69 0.00 0.00 0.00	6 4 2 8 6 4 2 6 5 5 5 6 8 6 6 6
Dichloromethane (or methylene chloride) (MC) Chloromethane Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1-TCA and 1,1,2-TCA) Dichloroethane (1,1-DCA and 1,2-DCA) Chloroethane Perchlorate D. Sorbed Contaminant Electron Acceptors (Soil Concentration = Koc x foc x Cgw) Tetrachloroethene (PCE) Trichloroethene (TCE) Dichloroethene (CE) Dichloroethene (CC) Carbon Tetrachloride (CT) Trichloromethane (or chloroform) (CF) Dichloromethane (or methylene chloride) (MC)	Koc (mL/g) 263 107 45 3.0 224 63 28	0.000 0.000 3.600 2.400 0.000 Soluble Contamin Soil Conc. (mg/kg) 0.00 0.01 3.24 0.00 0.01 0.01 0.00 0.00 0.00 0.00 0.00	0.00 0.00 0.00 3.13 2.09 0.00 0.00 ant Electron Acc Mass (lb) 0.02 0.04 16.59 0.00 0.00 0.00 0.00 0.00	19.74 21.06 25.04 20.82 22.06 24.55 32.00 12.33 eptor Demand (lb.) Stoichiometric demand (wt/wt h2) 20.57 21.73 24.05 31.00 19.74 21.06	0.00 0.00 0.00 0.14 0.08 0.00 0.00 0.31 Hydrogen Demand (lb) 0.00 0.00 0.69 0.00 0.00 0.00 0.00 0.00 0.00	6 4 2 8 6 4 2 6 4 2 6 4 2 6 Mole 8 6 4 2 8 6 4 2 8 6 4
Dichloromethane (or methylene chloride) (MC) Chloromethane Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1-TCA and 1,1,2-TCA) Dichloroethane (1,1-DCA and 1,2-DCA) Chloroethane Perchlorate D. Sorbed Contaminant Electron Acceptors (Soil Concentration = Koc x foc x Cgw) Tetrachloroethene (PCE) Trichloroethene (TCE) Dichloroethene (cis-DCE, trans-DCE, and 1,1-DCE) Vinyl Chloride (VC) Carbon Tetrachloride (CT) Trichloromethane (or chloroform) (CF)	Koc (mL/g) 263 107 45 3.0 224 63	0.000 0.000 0.000 3.600 2.400 0.000 Soluble Contamin Soil Conc. (mg/kg) 0.00 0.01 3.24 0.00 0.00 0.00	0.00 0.00 0.00 3.13 2.09 0.00 0.00 ant Electron Acc Mass (b) 0.02 0.04 16.59 0.00 0.00 0.00	19.74 21.06 25.04 20.82 22.06 24.55 32.00 12.33 eptor Demand (lb.) Stoichiometric demand (wt/wt h₂) 20.57 21.73 24.05 31.00 19.08 19.74	0.00 0.00 0.00 0.14 0.08 0.00 0.00 0.31 Hydrogen Demand (lb) 0.00 0.69 0.00 0.00 0.00	6 4 2 8 6 4 2 6 4 2 6 5 5 5 6 8 6 6
Dichloromethane (or methylene chloride) (MC) Chloromethane Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1-TCA and 1,1,2-TCA) Dichloroethane (1,1-DCA and 1,2-DCA) Chloroethane Perchlorate D. Sorbed Contaminant Electron Acceptors (Soil Concentration = Koc x foc x Cgw) Tetrachloroethene (PCE) Trichloroethene (TCE) Dichloroethene (CE) Dichloroethene (CC) Carbon Tetrachloride (CT) Trichloromethane (or chloroform) (CF) Dichloromethane (or methylene chloride) (MC)	Koc (mL/g) 263 107 45 3.0 224 63 28	0.000 0.000 3.600 2.400 0.000 Soluble Contamin Soil Conc. (mg/kg) 0.00 0.01 3.24 0.00 0.01 0.01 0.00 0.00 0.00 0.00 0.00	0.00 0.00 0.00 3.13 2.09 0.00 0.00 ant Electron Acc Mass (lb) 0.02 0.04 16.59 0.00 0.00 0.00 0.00 0.00	19.74 21.06 25.04 20.82 22.06 24.55 32.00 12.33 eptor Demand (lb.) Stoichiometric demand (wt/wt h2) 20.57 21.73 24.05 31.00 19.74 21.06	0.00 0.00 0.00 0.14 0.08 0.00 0.00 0.31 Hydrogen Demand (lb) 0.00 0.00 0.69 0.00 0.00 0.00 0.00 0.00 0.00	6 4 2 8 6 4 2 6 4 2 6 Mole 8 6 4 2 8 6 4 2 8 6 4 2 8 6 4
Dichloromethane (or methylene chloride) (MC) Chloromethane Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1-TCA and 1,1,2-TCA) Dichloroethane (1,1-DCA and 1,2-DCA) Chloroethane Perchlorate D. Sorbed Contaminant Electron Acceptors (Soil Concentration = Koc x foc x Cgw) Tetrachloroethene (PCE) Trichloroethene (TCE) Dichloroethene (CE) Dichloroethene (CC) Carbon Tetrachloride (CT) Trichloromethane (or chloroform) (CF) Dichloromethane (or methylene chloride) (MC) Chloromethane Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA)	Koc (mL/g) 263 107 45 3.0 224 63 28 25 117	0.000 0.000 3.600 2.400 0.000 Soluble Contamin Soil Conc. (mg/kg) 0.00 0.01 3.24 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00	0.00 0.00 0.00 3.13 2.09 0.00 ant Electron Acc Mass (Ib) 0.02 0.04 16.59 0.00 0.00 0.00 0.00 0.00 0.00 0.00	19.74 21.06 25.04 20.82 22.06 24.55 32.00 12.33 eptor Demand (lb.) Stoichiometric demand (wt/wt h ₂) 20.57 21.73 24.05 31.00 19.08 19.74 21.06 25.04 20.82	0.00 0.00 0.00 0.14 0.08 0.00 0.00 0.31 Hydrogen Demand (lb) 0.00 0.69 0.00 0.69 0.00 0.00 0.00 0.00	6 4 2 8 6 4 2 6 4 2 6 9 8 6 4 2 8 6 4 2 8 6 4 2 8 6 4 2 8 6 4 2 8
Dichloromethane (or methylene chloride) (MC) Chloromethane Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1-TCA and 1,1,2-TCA) Dichloroethane (1,1-DCA and 1,2-DCA) Chloroethane Perchlorate D. Sorbed Contaminant Electron Acceptors (Soil Concentration = Koc x foc x Cgw) Tetrachloroethene (PCE) Trichloroethene (TCE) Dichloroethene (CE) Trichloroethene (CE) Vinyl Chloride (VC) Carbon Tetrachloride (CT) Trichloromethane (or chloroform) (CF) Dichloromethane (1,1,1,2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1,1-TCA and 1,1,2-TCA)	Koc (mL/g) 263 107 45 3.0 224 63 28 25 117 105	0.000 0.000 0.000 3.600 2.400 0.000 Soluble Contamina Soil Conc. (mg/kg) 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.	0.00 0.00 0.00 3.13 2.09 0.00 0.00 0.00 0.00 0.02 0.04 16.59 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00	19.74 21.06 25.04 20.82 22.06 24.55 32.00 12.33 eptor Demand (lb.) Stoichiometric demand (wt/wt h₂) 20.57 21.73 24.05 31.00 19.74 21.06 25.04 20.82 22.06	0.00 0.00 0.00 0.14 0.08 0.00 0.00 0.31 Hydrogen Demand (lb) 0.00 0.69 0.00 0.00 0.00 0.00 0.00 0.00	6 4 2 8 6 4 2 6 Electron Equivalents pe Mole 8 6 4 2 8 6 4 2 8 6 4 2 8 6 4 2 8 6
Dichloromethane (or methylene chloride) (MC) Chloromethane Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1-TCA and 1,1,2-TCA) Dichloroethane (1,1-DCA and 1,2-DCA) Chloroethane Perchlorate D. Sorbed Contaminant Electron Acceptors (Soil Concentration = Koc x foc x Cgw) Tetrachloroethene (PCE) Trichloroethene (TCE) Dichloroethene (CE) Vinyl Chloride (VC) Carbon Tetrachloride (CT) Trichloromethane (or chloroform) (CF) Dichloromethane (1,1,1-2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1,1-TCA and 1,1,2-TCA) Dichloroethane (1,1-DCA and 1,2-DCA)	Koc (mL/g) 263 107 45 3.0 224 63 28 25 117 105 30	0.000 0.000 0.000 3.600 2.400 0.000 Soluble Contamin Soil Conc. (mg/kg) 0.00 0.00 0.01 3.24 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.0	0.00 0.00 0.00 3.13 2.09 0.00 0.00 ant Electron Acc Mass (b) 0.02 0.04 16.59 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00	19.74 21.06 25.04 20.82 22.06 24.55 32.00 12.33 eptor Demand (lb.) Stoichiometric demand (wt/wt h₂) 20.57 21.73 24.05 31.00 19.74 21.06 25.04 20.57	0.00 0.00 0.00 0.14 0.08 0.00 0.00 0.31 Hydrogen Demand (lb) 0.00 0.69 0.00 0.69 0.00 0.00 0.00 0.00	6 4 2 8 6 4 2 6 4 2 6 6 8 6 4 2 8 6 4 2 8 6 4 2 8 6 4 2
Dichloromethane (or methylene chloride) (MC) Chloromethane Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1,1-TCA and 1,1,2-TCA) Dichloroethane (1,1-DCA and 1,2-DCA) Chloroethane Perchlorate D. Sorbed Contaminant Electron Acceptors (Soil Concentration = Koc x foc x Cgw) Tetrachloroethene (PCE) Trichloroethene (TCE) Dichloroethene (CC) Trichloromethane (or chloroform) (CF) Dichloromethane (or chloroform) (CF) Dichloromethane (1,1,1,2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1,1-TCA and 1,1,2-TCA) Dichloroethane (1,1-DCA and 1,2-DCA) Chloroethane	Koc (mL/g) 263 107 45 3.0 224 63 63 28 25 117 105 30 3	0.000 0.000 0.000 3.600 2.400 0.000 Soluble Contamin Soil Conc. (mg/kg) 0.00 0.01 3.24 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.0	0.00 0.00 0.00 0.00 0.00 0.00 0.00 ant Electron Acc Mass (lb) 0.02 0.04 16.59 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00	19.74 21.06 25.04 20.82 22.06 24.55 32.00 12.33 eptor Demand (lb.) Stoichiometric demand (wt/wt h2) 20.57 21.73 24.05 31.00 19.74 21.06 25.04 20.57	0.00 0.00 0.00 0.14 0.08 0.00 0.00 0.31 Hydrogen Demand (lb) 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00	6 4 2 8 6 4 2 6 4 2 6 4 2 6 8 6 4 2 8 6 4 2 8 6 4 2 8 6 4 2 8 6 4 2 8 6 4 2
Dichloromethane (or methylene chloride) (MC) Chloromethane Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1-TCA and 1,1,2-TCA) Dichloroethane (1,1-DCA and 1,2-DCA) Chloroethane Perchlorate D. Sorbed Contaminant Electron Acceptors (Soil Concentration = Koc x foc x Cgw) Tetrachloroethene (PCE) Trichloroethene (TCE) Dichloroethene (CE) Vinyl Chloride (VC) Carbon Tetrachloride (CT) Trichloromethane (or chloroform) (CF) Dichloromethane (1,1,1-2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1,1-TCA and 1,1,2-TCA) Dichloroethane (1,1-DCA and 1,2-DCA)	Koc (mL/g) 263 107 45 3.0 224 63 28 25 117 105 30 30 3 0.0	0.000 0.000 0.000 3.600 2.400 0.000 Soluble Contamin Soil Conc. (mg/kg) 0.00 0.01 3.24 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.0	0.00 0.00 0.00 0.00 3.13 2.09 0.00 ant Electron Acc Mass (lb) 0.02 0.04 16.59 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00	19.74 21.06 25.04 20.82 22.06 24.55 32.00 12.33 eptor Demand (lb.) Stoichiometric demand (wt/wt h₂) 20.57 21.73 24.05 31.00 19.74 21.06 25.04 20.57	0.00 0.00 0.00 0.14 0.08 0.00 0.00 0.31 Hydrogen Demand (lb) 0.00 0.69 0.00 0.69 0.00 0.00 0.00 0.00	6 4 2 8 6 4 2 6 4 2 6 6 8 6 4 2 8 6 4 2 8 6 4 2 8 6 4 2

Table S.2 Substi	rate Calculations in	Hydrogen	Equivalents		
4. Treatment Cell Electron-Acceptor Flux (per yea	r)				
			Stoichiometric	Hydrogen	Electron
A. Soluble Native Electron Acceptors	Concentration	Mass	demand	Demand	Equivalents per
	(mg/L)	(lb)	(wt/wt h ₂)	(lb)	Mole
Oxygen	0.6	2.56	7.94	0.32	4
Nitrate (denitrification)	0.1	0.43	10.25	0.04	5
Sulfate	35	149.50	11.91	12.55	8
Carbon Dioxide (estimated as the amount of Methane produce	ed) 10	42.71	1.99	21.46	8
, , , , , , , , , , , , , , , , , , ,	Total Competing Ele	ctron Acceptor [Demand Flux (lb/yr)	34.4	
			Stoichiometric	Hydrogen	Electron
B. Soluble Contaminant Electron Acceptors	Concentration	Mass	demand	Demand	Equivalents per
	(mg/L)	(lb)	(wt/wt h ₂)	(lb)	Mole
Tetrachloroethene (PCE)	0.001	0.00	20.57	0.00	8
Trichloroethene (TCE)	0.003	0.01	21.73	0.00	6
Dichloroethene (cis-DCE, trans-DCE, and 1,1-DCE)	2.400	10.25	24.05	0.43	4
Vinyl Chloride (VC)	0.000	0.00	31.00	0.00	2
Carbon Tetrachloride (CT)	0.000	0.00	19.08	0.00	8
Trichloromethane (or chloroform) (CF)	0.000	0.00	19.74	0.00	6
Dichloromethane (or methylene chloride) (MC)	0.000	0.00	21.06	0.00	4
Chloromethane	0.000	0.00	25.04	0.00	2
Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA)	0.000	0.00	20.82	0.00	8
Trichloroethane (1,1,1-TCA and 1,1,2-TCA)	3.600	15.38	22.06	0.70	6
Dichloroethane (1,1-DCA and 1,2-DCA)	2.400	10.25	24.55	0.42	4
Chloroethane	0.000	0.00	32.00	0.00	2
Perchlorate	0.000	0.00	12.33	0.00	6
Tota	I Soluble Contaminant Ele	ctron Acceptor [Demand Flux (lb/yr)	1.54	
	Initial Hydroge	n Requiremer	nt First Year (lb)	57.5	7
	Total Life-Cycl	e Hydrogen R	equirement (lb)	165.3	
5. Design Factors					
Microbial Efficiency Uncertainty Factor				2X - 4X	
Methane and Solid-Phase Electron Acceptor Uncertainty				2X - 4X	
Remedial Design Factor (e.g., Substrate Leaving Reaction Zone	e)			1X - 3X	
			Design Factor	5.0	
Total Life-C	ycle Hydrogen Require	ement with De	-		
6. Acronyns and Abbreviations	joio njulogon noquin			02010	_
	00 g = milliequivalents per 10	00 grams			
	= milligrams per kilogram				
	milligrams per liter				
	meters per meters				
	nillivolts				
	meters per year				
	andard pH units		orweight		
	12 = concetration molecular h	iyarogen, weight j	berweight		
gm/cm ³ = grams per cubic centimeter					
kg of CaCO3 per mg = kilograms of calcium carbonate per mil	lligram				
lb = pounds					

Table S.3										
Hydrogen Produced by Fern	RETURN TO COVER PAGE									
Substrate	Molecular Formula	Substrate Molecular Weight (gm/mole)	Moles of Hydrogen Produced per Mole of Substrate	Ratio of Hydrogen Produced to Substrate (gm/gm)	Range of Moles H₂/Mole Substrate					
Lactic Acid	C ₃ H ₆ O ₃	90.1	2	0.0448	2 to 3					
Molasses (assuming 100% sucrose)	C ₁₂ H ₂₂ O ₁₁	342	8	0.0471	8 to 11					
High Fructose Corn Syrup (assuming 50% fructose and 50% glucose)	C ₆ H ₁₂ O ₆	180	4	0.0448	4 to 6					
Ethanol	C ₂ H ₆ O	46.1	2	0.0875	2 to 6					
Whey (assuming 100% lactose)	C ₁₂ H ₂₂ O ₁₁	342	11	0.0648	11					
HRC [®] (assumes 40% lactic acid and 40% glycerol by weight)	C ₃₉ H ₅₆ O ₃₉	956	28	0.0590	28					
Linoleic Acid (Soybean Oil, Corn Oil, Cotton Oil)	C ₁₈ H ₃₂ O ₂	281	16	0.1150	16					

Design Life (years): 4

Substrate	Design Factor	Pure Substrate Mass Required to Fulfill Hydrogen Demand (pounds)	Substrate Product Required to Fulfill Hydrogen Demand (pounds)	Substrate Mass Required to Fulfill Hydrogen Demand (milligrams)	Effective Substrate Concentration (mg/L)
Lactic Acid	5.0	18,460	18,460	8.37E+09	1,028
Sodium Lactate Product (60 percent solution)	5.0	18,460	38,298	8.37E+09	1,028
Molasses (assuming 6 0	5.0	17,536	29,227	7.95E+09	977
HFCS (assuming 40% fructose and 40% glucose by weight)	5.0	18,464	23,080	8.38E+09	1,028
Ethanol Product (assuming 80% ethanol by weight)	5.0	9,441	11,801	4.28E+09	526
Whey (assuming 100% lactose)	5.0	12,743	18,204	5.78E+09	710
HRC [®] (assumes 40% lactic acid and 40% glycerol by weight)	5.0	13,993	13,993	6.35E+09	623
Linoleic Acid (Soybean Oil, Corn Oil, Cotton Oil)	5.0	7,185	7,185	3.26E+09	400
Commercial Vegetable Oil Emulsion Product (60% oil by weight)	5.0	7,185	11,975	3.26E+09	400

NOTES: Sodium Lactate Product

1. Assumes sodium lactate product is 60 percent sodium lactate by weight.

2. Molecular weight of sodium lactate (CH₃-CHOH-COONa) = 112.06.

3. Molecular weight of lactic Acid $(C_6H_6O_3) = 90.08$.

4. Therefore, sodium lactate product yields 48.4 (0.60 x (90.08/112.06)) percent by weight lactic acid.

5. Weight of sodium lactate product = 11.0 pounds per gallon.

6. Pounds per gallon of lactic acid in product = 1.323×8.33 lb/gal H2O x 0.60 x (90.08/112.06) = 5.31 lb/gal.

NOTES: Standard HRC Product

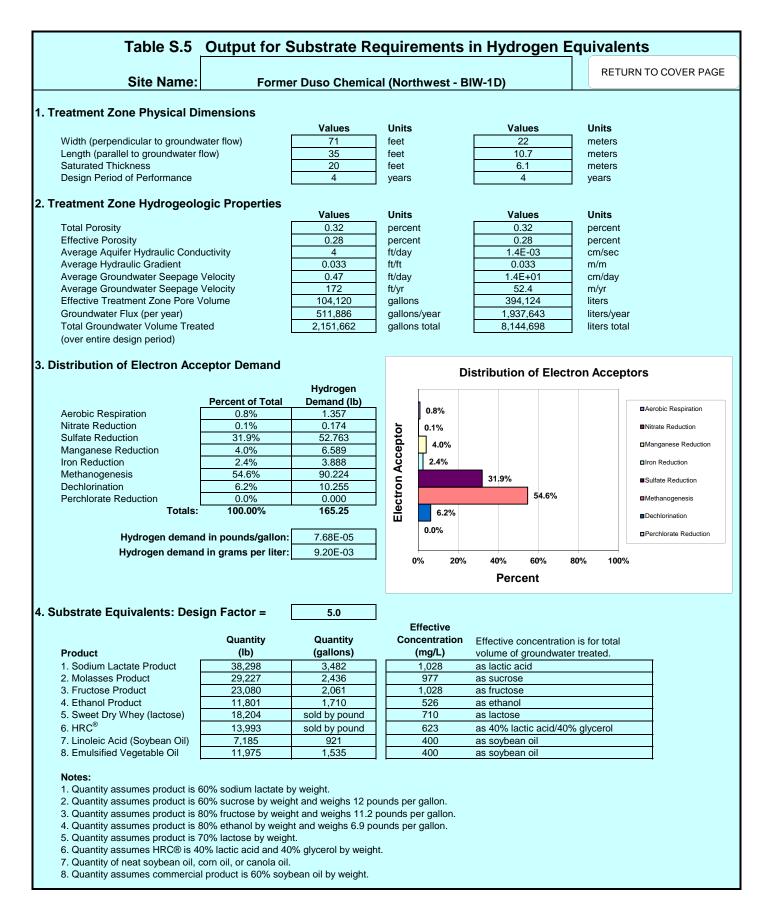
1. Assumes HRC product is 40 percent lactic acid and 40 percent glycerol by weight.

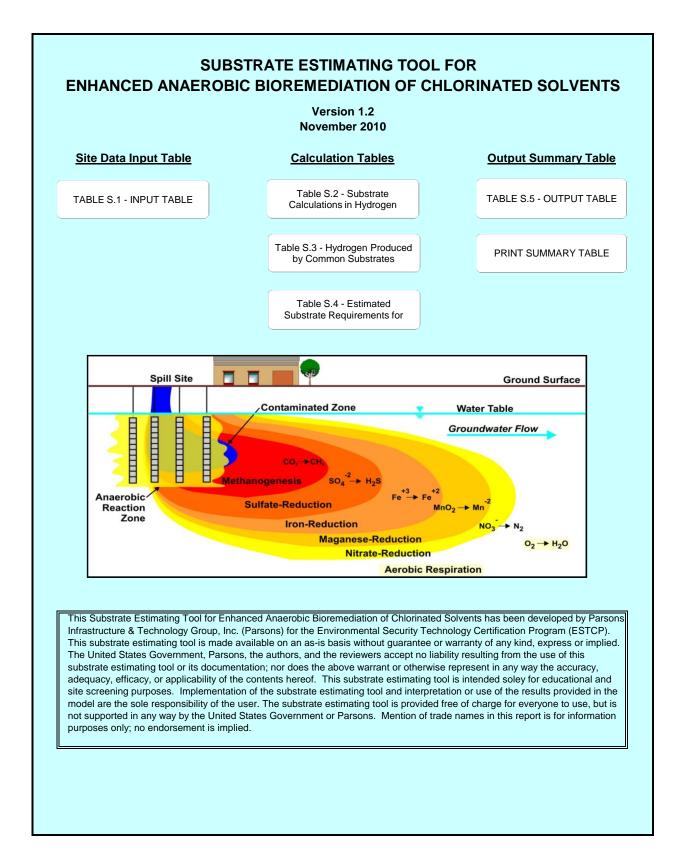
2. HRC[®] weighs approximately 9.18 pounds per gallon.

NOTES: Vegetable Oil Emulsion Product

1. Assumes emulsion product is 60 percent soybean oil by weight.

2. Soybean oil is 7.8 pounds per gallon.





Site Name: Former Duso C	hemical (South	west - MHC-2	23)	RETURN TO COVER PAGE
	NOTE: Unshaded			
Treatment Zone Physical Dimensions	Values	Range	Units	User Notes
Vidth (Perpendicular to predominant groundwater flow direction)	32	1-10,000	feet	Former Duso Chemical (Southwest - MHC-23)
ength (Parallel to predominant groundwater flow)	35	1-1,000	feet	
aturated Thickness	20	1-100	feet	treatment thickness (6-26)
reatment Zone Cross Sectional Area	640		ft ²	
reatment Zone Volume	22,400		ft ³	
Treatment Zone Total Pore Volume (total volume x total porosity)	53,631		gallons	
Treatment Zone Effective Pore Volume (total volume x effective porosity) Design Period of Performance	46,927 4.0	 .5 to 5	gallons year	
Design Factor (times the electron acceptor hydrogen demand)	5.0	2 to 20	unitless	AECOM recommendation to use a design factor of 2 to 5
Treatment Zone Hydrogeologic Properties				
Total Porosity	32%	.05-50	percent	Assumed for silty sand
Effective Porosity	28%	.05-50	percent	Assumed for silty sand (conservative high for higher PV)
verage Aquifer Hydraulic Conductivity	4	.01-1000	ft/day	average from MHBP RI
Average Hydraulic Gradient	0.033	0.0001-0.1	ft/ft	average from 2 values in RI
Average Groundwater Seepage Velocity through the Treatment Zone	0.47		ft/day	
Verage Groundwater Seepage Velocity through the Treatment Zone	172.1		ft/yr	
Average Groundwater Discharge through the Treatment Zone	230,709		gallons/year	
Soil Bulk Density	1.65	1.4-2.0	gm/cm ³	Assumed
Soil Fraction Organic Carbon (foc)	3.00%	0.01-10	percent	Assumed
Native Electron Acceptors				
A. Aqueous-Phase Native Electron Acceptors		_		
Dxygen	0.6	0.01 to 10	mg/L	
Vitrate	0.10	0.1 to- 20	mg/L	not detected in RI
Sulfate	35	10 to 5,000	mg/L	RI readings 2, 11, 43, 79 in MHC-23 and MHC-26
Carbon Dioxide (estimated as the amount of Methane produced)	10.0	0.1 to 20	mg/L	
3. Solid-Phase Native Electron Acceptors				
Manganese (IV) (estimated as the amount of Mn (II) produced)	10	0.1 to 20	mg/L	RI Mn 4-8 mg/L in slightly reducing GW, assume some produ
ron (III) (estimated as the amount of Fe (II) produced)	12	0.1 to 20	mg/L	RI ~10 mg/L in slightly reducing GW, assume some production
Contaminant Electron Acceptors				
Tetrachloroethene (PCE)	0.023		mg/L	max conc from MHC-23
richloroethene (TCE)	0.340		mg/L	
Dichloroethene (cis-DCE, trans-DCE, and 1,1-DCE)	0.530		mg/L	
/inyl Chloride (VC)	0.020		mg/L	
Carbon Tetrachloride (CT) richloromethane (or chloroform) (CF)	0.000		mg/L mg/L	
Dichloromethane (or methylene chloride) (MC)	0.002		mg/L	
Chloromethane	0.000		mg/L	
Fetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA)	0.000		mg/L	
richloroethane (1,1,1-TCA and 1,1,2-TCA)	3.900		mg/L	
Dichloroethane (1,1-DCA and 1,2-DCA)	0.590		mg/L	
Chloroethane	0.220		mg/L	need to add Chloroethane
Perchlorate	0.000		mg/L	
Aquifer Geochemistry (Optional Screening Parameters)				
A. Aqueous Geochemistry		-		
Dxidation-Reduction Potential (ORP)	-25		mV	2012 Field Sheets (avg BIW-2S, MHC-23, BIW-5S)
emperature	13	5.0 to 30	°C	2012 Field Sheets
	7.1	4.0 to 10.0	su	2012 Field Sheets (7.06-7.4)
Alkalinity	300	10 to 1,000	mg/L	
otal Dissolved Solids (TDS, or salinity) Specific Conductivity	2000	10 to 1,000	mg/L	2012 Field Shoots Approximate Average
Chloride	2000	100 to 10,000 10 to 10,000	μs/cm mg/L	2012 Field Sheets Approximate Average
Sulfide - Pre injection	0.0	0.1 to 100	mg/L	
ulfide - Post injection	0.0	0.1 to 100	mg/L	
3. Aquifer Matrix				
otal Iron	10000	200 to 20,000		Assumed
Cation Exchange Capacity	NA	1.0 to 10	meq/100 g	Assessed
leutralization Potential	10.0%	1.0 to 100	Percent as CaCO ₃	Assumed
IOTES:				
101L3.				

S-1

Table S.2	Substrate C	alculations in	Hydrogen	Equivalents			
Site Name:	Former Duso C	Chemical (South	nwest - MHC-2	23)	RETURN TO	COVER PAGE	
				NOTE: Open cells	are user input.		
1. Treatment Zone Physical Dimensions				Values	Range	Units	
Width (Perpendicular to predominant groundwater flo	ow direction)			32	1-10,000	feet	
Length (Parallel to predominant groundwater flow)	,			35	1-1,000	feet	
Saturated Thickness				20	1-100	feet	
Treatment Zone Cross Sectional Area				640		ft ²	
Treatment Zone Volume				22,400		ft ³	
Treatment Zone Effective Pore Volume (total volume	x effective porosi	ty)		46,927		gallons	
Design Period of Performance				4.0	.5 to 5	year	
2. Treatment Zone Hydrogeologic Properti	es						
Total Porosity				0.32	.05-50		
Effective Porosity				0.28	.05-50		
Average Aquifer Hydraulic Conductivity				4	.01-1000	ft/day	
				0.033	0.1-0.0001	ft/ft	
Average Hydraulic Gradient	T						
Average Groundwater Seepage Velocity through the				0.47		ft/day	
Average Groundwater Seepage Velocity through the				172.1		ft/yr	
Average Groundwater Flux through the Treatment Zo	on	0		230,709		gallons/year	
Soil Bulk Density				1.65	1.4-2.0	gm/cm ³	
Soil Fraction Organic Carbon (foc)				0.03	0.0001-0.1	5	
3. Initial Treatment Cell Electron-Acceptor	Demand (one	total pore volu	me)				
	•			Stoichiometric	Hydrogen	Electron	
A. Aqueous-Phase Native Electron Acceptors		Concentration	Mass	demand	Demand	Equivalents pe	
				(wt/wt h ₂)			
		(mg/L)	(lb)	(2)	(lb)	Mole	
Oxygen		0.6	0.23	7.94	0.03	4	
Nitrate (denitrification)		0.1	0.04	12.30	0.00	5	
Sulfate		35	13.71	11.91	1.15	8	
Carbon Dioxide (estimated as the amount of methan	e produced)	10.0	3.92	1.99	1.97	8	
	o produced)			eptor Demand (lb.)	3.15		
				Stoichiometric	Hydrogen	Electron	
B. Solid-Phase Native Electron Acceptors		Concentration	Mass	demand	Demand	Equivalents pe	
						Mole	
(Based on manganese and iron produced)		(mg/L)	(lb)	(wt/wt h ₂)	(lb)		
Manganese (IV) (estimated as the amount of Mn (II)	produced)	10.0	80.92	27.25	2.97	2	
Iron (III) (estimated as the amount of Fe (II) produced	d)	12.0	97.11	55.41	1.75	1	
	So	lid-Phase Compet	ing Electron Acc	eptor Demand (lb.)	4.72		
				Stoichiometric	Hydrogen	Electron	
C. Soluble Contaminant Electron Acceptors		Concentration	Mass	demand	Demand	Equivalents pe	
		(mg/L)	(lb)	(wt/wt h ₂)	(lb)	Mole	
			. ,		. ,	-	
Tetrachloroethene (PCE)		0.023	0.01	20.57	0.00	8	
Trichloroethene (TCE)		0.340	0.13	21.73	0.01	6	
Dichloroethene (cis-DCE, trans-DCE, and 1,1-DCE)		0.530	0.21	24.05	0.01	4	
Vinyl Chloride (VC)		0.020	0.01	31.00	0.00	2	
Carbon Tetrachloride (CT)		0.000	0.00	19.08	0.00	8	
Trichloromethane (or chloroform) (CF)		0.000	0.00	19.74	0.00	6	
Dichloromethane (or methylene chloride) (MC)		0.002	0.00	21.06	0.00	4	
Chloromethane		0.000	0.00	25.04	0.00	2	
Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA)		0.000	0.00	20.82	0.00	8	
Trichloroethane (1,1,1-TCA and 1,1,2-TCA)		3.900	1.53	22.06	0.07	6	
Dichloroethane (1,1-DCA and 1,2-DCA)		0.590	0.23	24.55	0.01	4	
Chloroethane		0.220	0.09	32.00	0.00	2	
Perchlorate		0.000	0.00	12.33	0.00	6	
	Total			eptor Demand (lb.)	0.10		
				Stoichiometric	Hydrogen	Electron	
D. Sorbed Contaminant Electron Acceptors	Koc	Soil Conc.	Mass	demand	Demand	Equivalents pe	
(Soil Concentration = Koc x foc x Cgw)	(mL/g)	(mg/kg)	(lb)	(wt/wt h ₂)	(lb)	Mole	
· · · · · · · · · · · · · · · · · · ·					,		
Tetrachloroethene (PCE)	263	0.18	0.42	20.57	0.02	8	
Trichloroethene (TCE)	107	1.09	2.52	21.73	0.12	6	
Dichloroethene (cis-DCE, trans-DCE, and 1,1-DCE)	45	0.72	1.65	24.05	0.07	4	
Vinyl Chloride (VC)	3.0	0.00	0.00	31.00	0.00	2	
Carbon Tetrachloride (CT)	224	0.00	0.00	19.08	0.00	8	
Trichloromethane (or chloroform) (CF)	63	0.00	0.01	19.74	0.00	6	
Dichloromethane (or methylene chloride) (MC)	28	0.00	0.00	21.06	0.00	4	
Chloromethane	25	0.00	0.00	25.04	0.00	2	
Totrophlaraothana (4.4.4.0 DOA	117	0.00	0.00	20.82	0.00	8	
Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA)	105	12.29	28.35	22.06	1.29	6	
Trichloroethane (1,1,1-TCA and 1,1,2-TCA)		0.50	1.23	24.55	0.05	4	
	30	0.53	1.23	2 1100			
Trichloroethane (1,1,1-TCA and 1,1,2-TCA)	<u>30</u> 3	0.53	0.05	32.00	0.00	2	
Trichloroethane (1,1,1-TCA and 1,1,2-TCA) Dichloroethane (1,1-DCA and 1,2-DCA)					0.00		
Trichloroethane (1,1,1-TCA and 1,1,2-TCA) Dichloroethane (1,1-DCA and 1,2-DCA) Chloroethane	3 0.0	0.02 0.00	0.05 0.00	32.00		2 6	

Table S.2 Substrate	Calculations in	Hydrogen	Equivalents		
4. Treatment Cell Electron-Acceptor Flux (per year)					
			Stoichiometric	Hydrogen	Electron
A. Soluble Native Electron Acceptors	Concentration	Mass	demand	Demand	Equivalents per
	(mg/L)	(lb)	(wt/wt h ₂)	(lb)	Mole
Oxygen	0.6	1.16	7.94	0.15	4
Nitrate (denitrification)	0.1	0.19	10.25	0.02	5
Sulfate	35	67.38	11.91	5.66	8
Carbon Dioxide (estimated as the amount of Methane produced)	10	19.25	1.99	9.67	8
	Total Competing Elec	ctron Acceptor [Demand Flux (lb/yr)	15.5	
			Stoichiometric	Hydrogen	Electron
B. Soluble Contaminant Electron Acceptors	Concentration	Mass	demand	Demand	Equivalents per
	(mg/L)	(lb)	(wt/wt h ₂)	(lb)	Mole
Tetrachloroethene (PCE)	0.023	0.04	20.57	0.00	8
Trichloroethene (TCE)	0.340	0.65	21.73	0.03	6
Dichloroethene (cis-DCE, trans-DCE, and 1,1-DCE)	0.530	1.02	24.05	0.04	4
Vinyl Chloride (VC)	0.020	0.04	31.00	0.00	2
Carbon Tetrachloride (CT)	0.000	0.00	19.08	0.00	8
Trichloromethane (or chloroform) (CF)	0.002	0.00	19.74	0.00	6
Dichloromethane (or methylene chloride) (MC)	0.000	0.00	21.06	0.00	4
Chloromethane	0.000	0.00	25.04	0.00	2
Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA)	0.000	0.00	20.82	0.00	8
Trichloroethane (1,1,1-TCA and 1,1,2-TCA)	3.900	7.51	22.06	0.34	6
Dichloroethane (1,1-DCA and 1,2-DCA)	0.590	1.14	24.55	0.05	4
Chloroethane	0.220	0.42	32.00	0.01	2
Perchlorate	0.000	0.00	12.33	0.00	6
Total Solu	ble Contaminant Elec	ctron Acceptor I	Demand Flux (lb/yr)	0.48	
	Initial Hydroge	n Reguiremer	nt First Year (Ib)	25.5	1
	Total Life-Cycle	e Hydrogen R	equirement (lb)	73.4	
5. Design Factors	-				_
Microbial Efficiency Uncertainty Factor				2X - 4X	
Methane and Solid-Phase Electron Acceptor Uncertainty				2X - 4X	
Remedial Design Factor (e.g., Substrate Leaving Reaction Zone)				1X - 3X	
o (o)			Design Factor	5.0	
Total Life-Cycle H	lydrogen Require	ment with De	•	367.0	
6. Acronyns and Abbreviations	iyarogen kequire	inent with De	Sign actor (ib)	507.0	_
°C =degrees celsius meq/100 g = i	milliequivalents per 10	0 grams			
µs/cm = microsiemens per centimeter mg/kg = millig	grams per kilogram				
cm/day = centimeters per day mg/L = milligr					
cm/sec = centimeters per second m/m = meters					
ft ² = square feet mV = millivolt					
ft/day = feet per day m/yr = meters					
ft/ft = foot per foot su = standard	·				
	ncetration molecular h	ydrogen, weight	per weight		
gm/cm ³ = grams per cubic centimeter					
kg of CaCO3 per mg = kilograms of calcium carbonate per milligram					
lb = pounds					

Table S.3										
Hydrogen Produced by Fern	RETURN TO COVER PAGE									
Substrate	Molecular Formula	Substrate Molecular Weight (gm/mole)	Moles of Hydrogen Produced per Mole of Substrate	Ratio of Hydrogen Produced to Substrate (gm/gm)	Range of Moles H₂/Mole Substrate					
Lactic Acid	C ₃ H ₆ O ₃	90.1	2	0.0448	2 to 3					
Molasses (assuming 100% sucrose)	C ₁₂ H ₂₂ O ₁₁	342	8	0.0471	8 to 11					
High Fructose Corn Syrup (assuming 50% fructose and 50% glucose)	C ₆ H ₁₂ O ₆	180	4	0.0448	4 to 6					
Ethanol	C ₂ H ₆ O	46.1	2	0.0875	2 to 6					
Whey (assuming 100% lactose)	C ₁₂ H ₂₂ O ₁₁	342	11	0.0648	11					
HRC [®] (assumes 40% lactic acid and 40% glycerol by weight)	C ₃₉ H ₅₆ O ₃₉	956	28	0.0590	28					
Linoleic Acid (Soybean Oil, Corn Oil, Cotton Oil)	C ₁₈ H ₃₂ O ₂	281	16	0.1150	16					

Design Life (years): 4

Substrate	Design Factor	Pure Substrate Mass Required to Fulfill Hydrogen Demand (pounds)	Substrate Product Required to Fulfill Hydrogen Demand (pounds)	Substrate Mass Required to Fulfill Hydrogen Demand (milligrams)	Effective Substrate Concentration (mg/L)
Lactic Acid	5.0	8,199	8,199	3.72E+09	1,013
Sodium Lactate Product (60 percent solution)	5.0	8,199	17,011	3.72E+09	1,013
Molasses (assuming 6 0	5.0	7,789	12,982	3.53E+09	962
HFCS (assuming 40% fructose and 40% glucose by weight)	5.0	8,201	10,251	3.72E+09	1,013
Ethanol Product (assuming 80% ethanol by weight)	5.0	4,193	5,242	1.90E+09	518
Whey (assuming 100% lactose)	5.0	5,660	8,086	2.57E+09	699
HRC [®] (assumes 40% lactic acid and 40% glycerol by weight)	5.0	6,215	6,215	2.82E+09	614
Linoleic Acid (Soybean Oil, Corn Oil, Cotton Oil)	5.0	3,191	3,191	1.45E+09	394
Commercial Vegetable Oil Emulsion Product (60% oil by weight)	5.0	3,191	5,319	1.45E+09	394

NOTES: Sodium Lactate Product

1. Assumes sodium lactate product is 60 percent sodium lactate by weight.

2. Molecular weight of sodium lactate (CH₃-CHOH-COONa) = 112.06.

3. Molecular weight of lactic Acid $(C_6H_6O_3) = 90.08$.

4. Therefore, sodium lactate product yields 48.4 (0.60 x (90.08/112.06)) percent by weight lactic acid.

5. Weight of sodium lactate product = 11.0 pounds per gallon.

6. Pounds per gallon of lactic acid in product = 1.323×8.33 lb/gal H2O x 0.60 x (90.08/112.06) = 5.31 lb/gal.

NOTES: Standard HRC Product

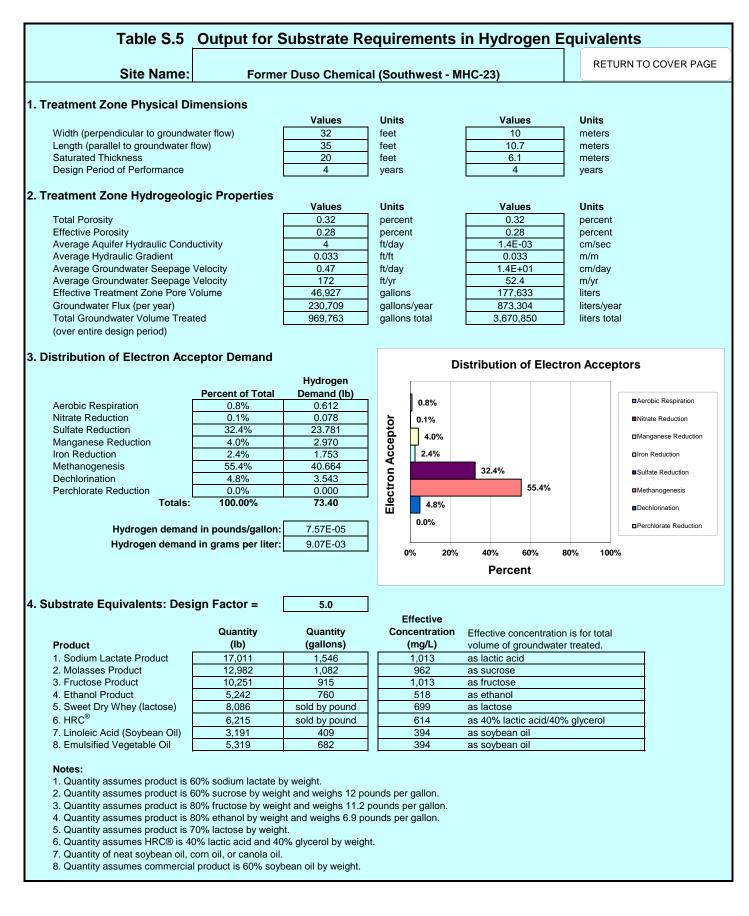
1. Assumes HRC product is 40 percent lactic acid and 40 percent glycerol by weight.

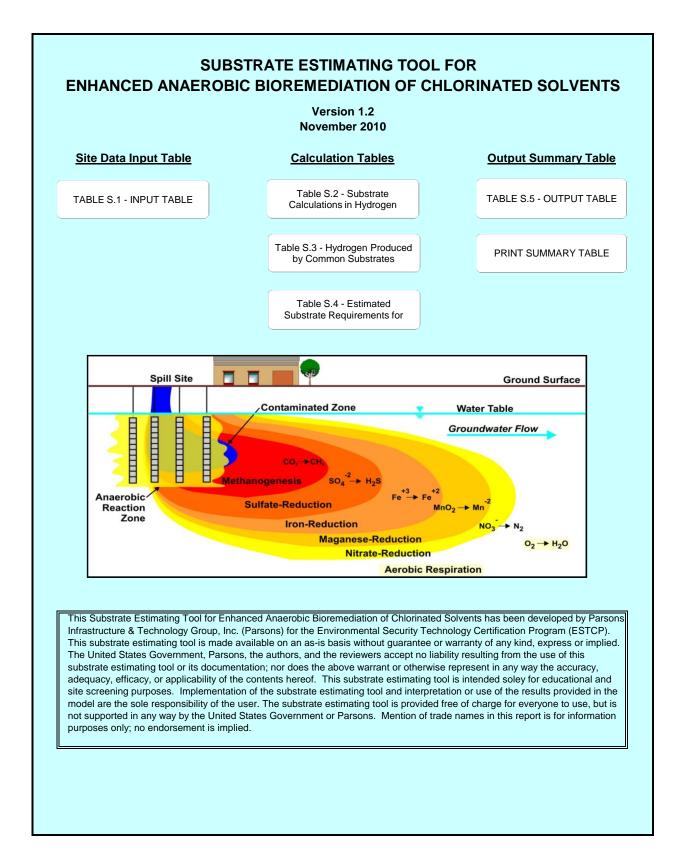
2. HRC[®] weighs approximately 9.18 pounds per gallon.

NOTES: Vegetable Oil Emulsion Product

1. Assumes emulsion product is 60 percent soybean oil by weight.

2. Soybean oil is 7.8 pounds per gallon.





Object Space OF 100 Space Description Description Treatment Zone Physical Dimension Values Range Units User Notes Interpretability of physical Dimension 40 1-1000 Res Reserve Notes Interpretability of physical Dimension 40 1-1000 Res Reserve Notes Interpretability of physical Dimension 40 1-1000 Res Reserve Notes Interpretability of physical Dimension 40 5.00 Res Reserve Notes Interpretability of physical Dimension 72.020 - R ¹ Reserve Notes Interpretability of physical Dimension 72.020 - Res Reserve Notes Interpretability of physical Dimension 72.020 - Res Reserve Notes Interpretability of physical Dimension 72.02 - Res Res Res Interpretability of physical Dimension 72.02 - Res Res Res Interpretability of physical Dimension 72.02 - Res Res Res <t< th=""><th>hemical (West</th><th>Center - BIW-</th><th>·5D)</th><th>RETURN TO COVER PAGE</th></t<>	hemical (West	Center - BIW-	·5D)	RETURN TO COVER PAGE
Provide production to productional groundwater flow direction) 40 1-10.00 feet Porme Data Dimensional Wess Center - BIV-SD) assisted Theoremain groundwater flow) 38 1-10.00 feet measures The Creating Class. assisted Theoremain groundwater flow 74 1-10.00 feet measures The Creating Class. assisted Theoremain groundwater flow devices 74.00 - rf assisted Theoremain Class. assisted Theoremain Groundwater flow devices 74.00 - rf assisted Theoremain Class. assisted Theoremain Groundwater flow device assisted assis	,			<u> </u>
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instance Stop				
instance 12.202 - n* instance Solar by Uniter (build volume (build volume x etal pound)) 45.84 - galaxies instance Solar by Uniter (build volume x etal pound)) 45.84 - galaxies instance Solar by watch Solar by watch Account of all you watch Account of all you watch instance Solar by watch Solar by watch Account of all you watch Account of all you watch instance Solar by watch Solar by watch Account of all you watch Account of all you watch instance Solar by watch Account of all you watch Account of all you watch Account of all you watch instance Solar by watch Colar by watch Account of all you watch Account of all you watch instance Solar by watch Colar by you Account of all you watch Account of all you watch instance Solar by you Colar by you Account of all you watch Account of all you watch instance Solar by you Colar by you Account of all you watch Account of all you you watch ina				
Instrument One Status Output of the second				assume EHC treatment for this interval
Instance Zinze Effective Four Volume (bits volume a effective pools) 44.951 - gather Beegin Petiod Ordenmano. 40.9 50.5 year Seegin Petiod Ordenmano. 40.9 50.5 year Seegin Petiod Ordenmano. 50.5 2 10.30 unlifeste Accounted for ally sand Seegin Petiod Petioding. 52% .05550 perioding intermination to use a design factor of 2 10.5 Treatment Zone Hydrogeologic Properties .053 .05560 perioding intermination to use a design factor of 2 10.5 Versign Andref Hydraid. Gradenti 0.03 .0001-1.1 http://weinite. .0637 .0001-1.1 perioding intermination for all interminations Seegin Petiod Properties .0.03 .0.011.0 mpdin .0.01 .0.011.0 perioding interminations .0.01 .0.011.0 mpdin .0.01 .0.011.0 mpdin .0.01 .0.011.0 mpdin .0.01 .0.01 .0.01 .0.01 .0.01 .0.01 .0.01 .0.01 .0.01 .0.01 .0.01 .0.01 .0.01 .0.01 .0.01 .0.01 .0.01 <td></td> <td></td> <td></td> <td></td>				
segn Part of Performance 4.0 4.0 5.0 year segn Part of Meen Reaction accord projecting decard of 0 2.0.0 2.0.0 Meen Reaction Reaction Control on the Reaction Reacti			•	
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0ail Procesy 32% 05-50 percent Assumed to risk sand verage Applic Produce Conductivity 24 0.11000 friday average for this sand verage Applic Produce Conductivity 4 0.11000 friday average for on this sand verage Applic Produce Conductivity 4 0.11000 friday average for on 2velues in RI verage Conductivity 24.8 - friday average for on 2velues in RI verage Conductivity 16.8 1.4.2.0 galinnini Assumed all Fraction Organic Castion flop) 3.50% 0.6110 mgl. not detected in RI Native Electron Acceptors . Assumed Assumed Assumed Solid-Phase Native Electron Acceptors . . 0.110.0 mgl. not detected in RI Solid-Phase Native Electron Acceptors Infractor Organic Castion flop 0.10 0.10 to 20 mgl. 				
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uvarga Goundmater Stepage Velocity through the Treatment Zoon 0.47				
unrage Graunwater Seepage Valority through the Treatment Zone 172.1 tfy/r oil Buik Density 1.65 1.42.0 gricm ² Assumed oil Buik Density 1.65 1.42.0 gricm ² Assumed oil Buik Density 0.010 9000000000000000000000000000000000000	0.033	0.0001-0.1	ft/ft	average from 2 values in RI
verage Groundwater Discharge through the Treatment Zone 201,870	0.47		ft/day	
16 Buk Density 1.65 1.4-2.0 gwr/om ² Assumed oil Fraction Organic Carbon (foc) 3.00% 0.01-10 percent Assumed Native Electron Acceptors	172.1		ft/yr	
Bit Praction Organic Carbon (foc) 3.00% 0.01-10 percent Assumed Native Electron Acceptors			· ·	
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extrachloroethene (PCE) 0.056				
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leutralization Potential 10.0% 1.0 to 100 Percent as CaCO ₃ Assumed				
IOTES:				Assumed
IOIES:	10.0%	1.0 to 100	Percent as CaCO ₃	Assumed
	10.0%	1.0 to 100	Percent as CaCO ₃	Assumed
leutralization Potential		NOTE: Unshade Values 40 38 14 560 21,280 50,949 44,581 4.0 5.0 32% 28% 4 4 0.033 0.47 172,1 201,870 1.65 3.00% 0.47 172,1 201,870 1.65 3.00% 0.10 1.65 3.00% 0.10 10.0 10 10 12 0.056 0.049 2.000 0.210 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.0000 0.0000 0.0000 0.000000	NOTE: Unshaded boxes are use Values Range 40 1-10,000 38 1-1,000 14 1-100 560 21,280 50,949 44,581 4.0 .5 to 5 5.0 2 to 20 32% .05-50 28% .05-50 28% .05-50 4 .01-1000 0.033 0.0001-0.1 0.47 172.1 201,870 1.65 1.4-2.0 3.00% 0.01+10 0.10 0.1 to 20 35 10 to 5,000 10 0.1 to 20 12 0.1 to 20 12 0.1 to 20 10 0.1 to 20 110 0.1 to 20 12 0.1 to 20 10 0.1 to 20 12 0.1 to 20	Values Range Units 40 1-10,000 feet 38 1-1,000 feet 14 1-100 feet 560 ft ² 21,280 ft ³ 50,949 gallons 44,581 gallons 4.0 .5 to 5 year 5.0 2 to 20 unitless 32% .05-50 percent 28% .05-50 percent 4 .01-1000 ft/day 0.033 0.0001-0.1 ft/ft 0.47 ft/day 172.1 ft/day 172.1 ft/day 172.1 ft/day 1870 gallons/year 1.65 1.4-2.0 gm/cm ³ 3.00% 0.01 to 10 mg/L 0.10 0.1 to 20 mg/L 10.0 0.1 to 20 mg/L

10016-0.2	Substrate Ca	alculations in	Hydrogen	Equivalents		
Site Name:	Former Duso C	hemical (West	Center - BIW-	5D)	RETURN TO	COVER PAGE
				NOTE: Open cells	are user input.	
1. Treatment Zone Physical Dimensions				Values	Range	Units
Width (Perpendicular to predominant groundwater	flow direction)			40	1-10,000	feet
Length (Parallel to predominant groundwater flow)	,			38	1-1,000	feet
Saturated Thickness				14	1-100	feet
Treatment Zone Cross Sectional Area				560		ft ²
Treatment Zone Volume				21,280		ft ³
Treatment Zone Effective Pore Volume (total volum Design Period of Performance	ne x effective porosit	ty)		44,581 4.0	 .5 to 5	gallons year
2. Treatment Zone Hydrogeologic Proper	ties					,
Total Porosity				0.32	.05-50	
Effective Porosity				0.28	.05-50	
Average Aquifer Hydraulic Conductivity				4	.01-1000	ft/day
Average Hydraulic Gradient				0.033	0.1-0.0001	ft/ft
Average Groundwater Seepage Velocity through th	e Treatment Zone			0.47		ft/day
Average Groundwater Seepage Velocity through th Average Groundwater Seepage Velocity through th				172.1		•
		0				ft/yr
Average Groundwater Flux through the Treatment 2	LUIT	0		201,870		gallons/year
Soil Bulk Density				1.65	1.4-2.0	gm/cm ³
Soil Fraction Organic Carbon (foc)				0.03	0.0001-0.1	
3. Initial Treatment Cell Electron-Accepto	r Demand (one	total pore volu	me)			
				Stoichiometric	Hydrogen	Electron
A. Aqueous-Phase Native Electron Acceptors		Concentration	Mass	demand	Demand	Equivalents pe
		(mg/L)	(lb)	(wt/wt h ₂)	(lb)	Mole
Oxygen		0.6	0.22	7.94	0.03	4
		0.0	0.04		0.00	
Nitrate (denitrification)				12.30		5
Sulfate		35	13.02	11.91	1.09	8
Carbon Dioxide (estimated as the amount of metha	ine produced)	10.0	3.72	1.99	1.87	8
		Soluble Compet	ing Electron Acc	eptor Demand (lb.)	2.99	
				Stoichiometric	Hydrogen	Electron
B. Solid-Phase Native Electron Acceptors		Concentration	Mass	demand	Demand	Equivalents pe
(Based on manganese and iron produced)		(mg/L)	(lb)	(wt/wt h ₂)	(lb)	Mole
Manganese (IV) (estimated as the amount of Mn (II	10.0	71.10	27.25	2.61	2	
• • • • • • • • •	12.0	85.32	55.41	1.54	1	
Iron (III) (estimated as the amount of Fe (II) produce				eptor Demand (lb.)	4.15	1
	50	nu-r nase compet		• • • •		
				Stoichiometric	Hydrogen	Electron
C. Soluble Contaminant Electron Acceptors		Concentration	Mass	demand	Demand	Equivalents pe
		(mg/L)	(lb)	(wt/wt h ₂)	(lb)	Mole
Tetrachloroethene (PCE)		0.056	0.02	20.57	0.00	8
Trichloroethene (TCE)		0.049	0.02	21.73	0.00	6
	\	2.000	0.74		0.03	4
Dichloroethene (cis-DCE, trans-DCE, and 1,1-DCE))			24.05		
Vinyl Chloride (VC)		0.210	0.08	31.00	0.00	2
Carbon Tetrachloride (CT)		0.000	0.00	19.08	0.00	8
Trichloromethane (or chloroform) (CF)		0.000	0.00	19.74	0.00	6
Dichloromethane (or methylene chloride) (MC)						
		0.025	0.01	21.06	0.00	4
Chloromethane		0.000	0.01 0.00	21.06 25.04	0.00	2
Chloromethane Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA)						
		0.000	0.00	25.04	0.00	2
Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1,1-TCA and 1,1,2-TCA)		0.000 0.000	0.00 0.00	25.04 20.82	0.00 0.00	2 8
Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA)		0.000 0.000 33.000 87.000	0.00 0.00 12.28 32.36	25.04 20.82 22.06 24.55	0.00 0.00 0.56 1.32	2 8 6
Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1,1-TCA and 1,1,2-TCA) Dichloroethane (1,1-DCA and 1,2-DCA)		0.000 0.000 33.000 87.000 0.400	0.00 0.00 12.28	25.04 20.82 22.06	0.00 0.00 0.56 1.32 0.00	2 8 6 4 2
Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1,1-TCA and 1,1,2-TCA) Dichloroethane (1,1-DCA and 1,2-DCA) Chloroethane	Total	0.000 0.000 33.000 87.000 0.400 0.000	0.00 0.00 12.28 32.36 0.15 0.00	25.04 20.82 22.06 24.55 32.00	0.00 0.00 0.56 1.32	2 8 6 4
Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1,1-TCA and 1,1,2-TCA) Dichloroethane (1,1-DCA and 1,2-DCA) Chloroethane	Total	0.000 0.000 33.000 87.000 0.400 0.000	0.00 0.00 12.28 32.36 0.15 0.00	25.04 20.82 22.06 24.55 32.00 12.33 eptor Demand (lb.)	0.00 0.00 0.56 1.32 0.00 0.00 1.92	2 8 6 4 2 6
Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1,1-TCA and 1,1,2-TCA) Dichloroethane (1,1-DCA and 1,2-DCA) Chloroethane Perchlorate		0.000 0.000 33.000 87.000 0.400 0.000 Soluble Contamin	0.00 0.00 12.28 32.36 0.15 0.00 ant Electron Acc	25.04 20.82 22.06 24.55 32.00 12.33 eptor Demand (lb.) Stoichiometric	0.00 0.00 1.32 0.00 0.00 1.92 Hydrogen	2 8 6 4 2 6 5 Electron
Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1,1-TCA and 1,1,2-TCA) Dichloroethane (1,1-DCA and 1,2-DCA) Chloroethane Perchlorate D. Sorbed Contaminant Electron Acceptors	Кос	0.000 0.000 33.000 87.000 0.400 0.000 Soluble Contamin Soil Conc.	0.00 0.00 12.28 32.36 0.15 0.00 ant Electron Acco Mass	25.04 20.82 22.06 24.55 32.00 12.33 eptor Demand (Ib.) Stoichiometric demand	0.00 0.00 1.32 0.00 0.00 1.92 Hydrogen Demand	2 8 6 4 2 6 S Electron Equivalents pe
Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1,1-TCA and 1,1,2-TCA) Dichloroethane (1,1-DCA and 1,2-DCA) Chloroethane Perchlorate D. Sorbed Contaminant Electron Acceptors (Soil Concentration = Koc x foc x Cgw)	Koc (mL/g)	0.000 0.000 33.000 87.000 0.400 0.000 Soluble Contamin Soil Conc. (mg/kg)	0.00 0.00 12.28 32.36 0.15 0.00 ant Electron Acc Mass (lb)	25.04 20.82 22.06 24.55 32.00 12.33 eptor Demand (lb.) Stoichiometric demand (wt/wt h ₂)	0.00 0.00 0.56 1.32 0.00 0.00 1.92 Hydrogen Demand (lb)	2 8 6 4 2 6 S Electron Equivalents pe Mole
Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1,1-TCA and 1,1,2-TCA) Dichloroethane (1,1-DCA and 1,2-DCA) Chloroethane Perchlorate D. Sorbed Contaminant Electron Acceptors (Soil Concentration = Koc x foc x Cgw) Tetrachloroethene (PCE)	Koc (mL/g) 263	0.000 0.000 33.000 87.000 0.400 0.000 Soluble Contamin Soil Conc. (mg/kg) 0.44	0.00 0.00 12.28 32.36 0.15 0.00 ant Electron Acc Mass (lb) 0.97	25.04 20.82 22.06 24.55 32.00 12.33 eptor Demand (lb.) Stoichiometric demand (wt/wt h ₂) 20.57	0.00 0.00 0.56 1.32 0.00 0.00 1.92 Hydrogen Demand (lb) 0.05	2 8 6 4 2 6 5 Electron Equivalents pe Mole 8
Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1,1-TCA and 1,1,2-TCA) Dichloroethane (1,1-DCA and 1,2-DCA) Chloroethane Perchlorate D. Sorbed Contaminant Electron Acceptors (Soil Concentration = Koc x foc x Cgw) Tetrachloroethene (PCE) Trichloroethene (TCE)	Koc (mL/g) 263 107	0.000 0.000 33.000 87.000 0.400 0.000 Soluble Contamin Soil Conc. (mg/kg) 0.44 0.16	0.00 0.00 12.28 32.36 0.15 0.00 ant Electron Acc Mass (lb)	25.04 20.82 22.06 24.55 32.00 12.33 eptor Demand (lb.) Stoichiometric demand (wt/wt h ₂) 20.57 21.73	0.00 0.00 0.56 1.32 0.00 0.00 1.92 Hydrogen Demand (lb)	2 8 6 4 2 6 S Electron Equivalents pe Mole
Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1,1-TCA and 1,1,2-TCA) Dichloroethane (1,1-DCA and 1,2-DCA) Chloroethane Perchlorate D. Sorbed Contaminant Electron Acceptors (Soil Concentration = Koc x foc x Cgw) Tetrachloroethene (PCE)	Koc (mL/g) 263 107	0.000 0.000 33.000 87.000 0.400 0.000 Soluble Contamin Soil Conc. (mg/kg) 0.44	0.00 0.00 12.28 32.36 0.15 0.00 ant Electron Acc Mass (lb) 0.97	25.04 20.82 22.06 24.55 32.00 12.33 eptor Demand (lb.) Stoichiometric demand (wt/wt h ₂) 20.57	0.00 0.00 0.56 1.32 0.00 0.00 1.92 Hydrogen Demand (lb) 0.05	2 8 6 4 2 6 5 Electron Equivalents pe Mole 8
Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1,1-TCA and 1,1,2-TCA) Dichloroethane (1,1-DCA and 1,2-DCA) Chloroethane Perchlorate D. Sorbed Contaminant Electron Acceptors (Soil Concentration = Koc x foc x Cgw) Tetrachloroethene (PCE) Trichloroethene (TCE)	Koc (mL/g) 263 107	0.000 0.000 33.000 87.000 0.400 0.000 Soluble Contamin Soil Conc. (mg/kg) 0.44 0.16	0.00 0.00 12.28 32.36 0.15 0.00 ant Electron Acc Mass (lb) 0.97 0.34	25.04 20.82 22.06 24.55 32.00 12.33 eptor Demand (lb.) Stoichiometric demand (wt/wt h ₂) 20.57 21.73	0.00 0.00 0.56 1.32 0.00 0.00 1.92 Hydrogen Demand (lb) 0.05 0.02	2 8 6 2 6 S Electron Equivalents per Mole 8 6
Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1,1-TCA and 1,1,2-TCA) Dichloroethane (1,1-DCA and 1,2-DCA) Chloroethane Perchlorate D. Sorbed Contaminant Electron Acceptors (Soil Concentration = Koc x foc x Cgw) Tetrachloroethene (PCE) Trichloroethene (TCE) Dichloroethene (CS-DCE, trans-DCE, and 1,1-DCE	Koc (mL/g) 263 107) 45	0.000 0.000 33.000 87.000 0.400 0.000 Soluble Contamin Soil Conc. (mg/kg) 0.44 0.16 2.70	0.00 0.00 12.28 32.36 0.15 0.00 ant Electron Acc Mass (lb) 0.97 0.34 5.92	25.04 20.82 22.06 24.55 32.00 12.33 eptor Demand (lb.) Stoichiometric demand (wt/wt h ₂) 20.57 21.73 24.05	0.00 0.56 1.32 0.00 0.00 1.92 Hydrogen Demand (lb) 0.05 0.02 0.25	2 8 6 4 2 6 5 5 6 Mole 8 6 4
Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1,1-TCA and 1,1,2-TCA) Dichloroethane (1,1-DCA and 1,2-DCA) Chloroethane Perchlorate D. Sorbed Contaminant Electron Acceptors (Soil Concentration = Koc x foc x Cgw) Tetrachloroethene (PCE) Trichloroethene (TCE) Dichloroethene (CE) Dichloroethene (CE) trichloroethene (CCE) Carbon Tetrachloride (CT)	Koc (mL/g) 263 107) 45 3.0 224	0.000 0.000 33.000 87.000 0.400 0.000 Soluble Contamin Soil Conc. (mg/kg) 0.44 0.16 2.70 0.02 0.00	0.00 0.00 12.28 32.36 0.15 0.00 ant Electron Acc (b) 0.97 0.34 5.92 0.04 0.00	25.04 20.82 22.06 24.55 32.00 12.33 eptor Demand (lb.) Stoichiometric demand (wt/wt h ₂) 20.57 21.73 24.05 31.00 19.08	0.00 0.00 0.56 1.32 0.00 0.00 1.92 Hydrogen Demand (lb) 0.05 0.02 0.25 0.00 0.00	2 8 6 4 2 6 5 5 5 5 6 6 6 6 6 4 2 8
Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1,1-TCA and 1,1,2-TCA) Dichloroethane (1,1-DCA and 1,2-DCA) Chloroethane Perchlorate D. Sorbed Contaminant Electron Acceptors (Soil Concentration = Koc x foc x Cgw) Tetrachloroethene (PCE) Trichloroethene (TCE) Dichloroethene (cis-DCE, trans-DCE, and 1,1-DCE Vinyl Chloride (VC) Carbon Tetrachloride (CT) Trichloromethane (or chloroform) (CF)	Koc (mL/g) 263 107) 45 3.0 224 63	0.000 0.000 33.000 87.000 0.400 0.000 Soluble Contamin Soil Conc. (mg/kg) 0.44 0.16 2.70 0.02 0.00 0.00	0.00 0.00 12.28 32.36 0.15 0.00 ant Electron Acc Mass (lb) 0.97 0.34 5.92 0.04 0.00 0.00	25.04 20.82 22.06 24.55 32.00 12.33 eptor Demand (lb.) Stoichiometric demand (wt/wt h ₂) 20.57 21.73 24.05 31.00 19.08 19.74	0.00 0.00 0.56 1.32 0.00 0.00 1.92 Hydrogen Demand (lb) 0.05 0.02 0.25 0.00 0.00 0.00	2 8 6 4 2 6 5 5 5 5 5 6 6 8 6 4 2 8 6 6
Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1,1-TCA and 1,1,2-TCA) Dichloroethane (1,1-DCA and 1,2-DCA) Chloroethane Perchlorate D. Sorbed Contaminant Electron Acceptors (Soil Concentration = Koc x foc x Cgw) Tetrachloroethene (PCE) Trichloroethene (CE) Dichloroethene (cis-DCE, trans-DCE, and 1,1-DCE Vinyl Chloride (VC) Carbon Tetrachloride (CT) Trichloromethane (or chloroform) (CF) Dichloromethane (or methylene chloride) (MC)	Koc (mL/g) 263 107) 45 3.0 224 63 28	0.000 0.000 33.000 87.000 0.400 0.000 Soluble Contamin Soil Conc. (mg/kg) 0.44 0.16 2.70 0.02 0.00 0.00 0.00	0.00 0.00 12.28 32.36 0.15 0.00 ant Electron Acc (lb) 0.97 0.34 5.92 0.04 0.00 0.00 0.00 0.05	25.04 20.82 22.06 24.55 32.00 12.33 eptor Demand (lb.) Stoichiometric demand (wt/wt h ₂) 20.57 21.73 24.05 31.00 19.08 19.74 21.06	0.00 0.00 0.56 1.32 0.00 0.00 1.92 Hydrogen Demand (lb) 0.05 0.02 0.25 0.00 0.00 0.00 0.00	2 8 6 4 2 6 Electron Equivalents pe Mole 8 6 4 2 8 6 4 4
Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1,1-TCA and 1,1,2-TCA) Dichloroethane (1,1-DCA and 1,2-DCA) Chloroethane Perchlorate D. Sorbed Contaminant Electron Acceptors (Soil Concentration = Koc x foc x Cgw) Tetrachloroethene (PCE) Trichloroethene (TCE) Dichloroethene (TCE) Dichloroethene (CT) Trichloromethane (or chloroform) (CF) Dichloromethane (or methylene chloride) (MC) Chloromethane	Koc (mL/g) 263 107) 45 3.0 224 63 28 25	0.000 0.000 33.000 87.000 0.400 0.000 Soil Conc. (mg/kg) 0.44 0.16 2.70 0.02 0.00 0.00 0.00 0.00	0.00 0.00 12.28 32.36 0.15 0.00 ant Electron Acc Mass (lb) 0.97 0.34 5.92 0.04 0.00 0.00 0.05 0.00	25.04 20.82 22.06 24.55 32.00 12.33 eptor Demand (lb.) Stoichiometric demand (wt/wt h ₂) 20.57 21.73 24.05 31.00 19.08 19.74 21.76 25.04	0.00 0.56 1.32 0.00 1.92 Hydrogen Demand (Ib) 0.05 0.02 0.25 0.00 0.00 0.00 0.00 0.00	2 8 6 4 2 6 5 5 5 5 6 6 4 2 8 6 4 2 2 8 6 4 2
Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1,1-TCA and 1,1,2-TCA) Dichloroethane (1,1-DCA and 1,2-DCA) Chloroethane Perchlorate D. Sorbed Contaminant Electron Acceptors (Soil Concentration = Koc x foc x Cgw) Tetrachloroethene (PCE) Trichloroethene (TCE) Dichloroethene (Cis-DCE, trans-DCE, and 1,1-DCE Vinyl Chloride (VC) Carbon Tetrachloride (CT) Trichloromethane (or chloroform) (CF) Dichloromethane (or methylene chloride) (MC) Chloromethane	Koc (mL/g) 263 107) 45 3.0 224 63 28 28 25 117	0.000 0.000 33.000 87.000 0.400 0.000 Soluble Contamin Soil Conc. (mg/kg) 0.44 0.16 2.70 0.02 0.00 0.00 0.00 0.00	0.00 0.00 12.28 32.36 0.15 0.00 ant Electron Acco Mass (lb) 0.97 0.34 5.92 0.04 0.00 0.00 0.05 0.00 0.00	25.04 20.82 22.06 24.55 32.00 12.33 eptor Demand (lb.) Stoichiometric demand (wt/wt h ₂) 20.57 21.73 24.05 31.00 19.08 19.74 21.06 25.04 20.82	0.00 0.00 0.56 1.32 0.00 1.92 Hydrogen Demand (Ib) 0.05 0.02 0.25 0.00 0.00 0.00 0.00 0.00 0.00	2 8 6 4 2 6 5 5 6 8 6 6 4 2 8 6 4 2 8 6 4 2 8 8 6 4 2 8 8 6 4 2 8 8 6 8 8 6 8 8 8 6 6 8 8 8 6 8 8 8 8
Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1-TCA and 1,1,2-TCA) Dichloroethane (1,1-DCA and 1,2-DCA) Chloroethane Perchlorate D. Sorbed Contaminant Electron Acceptors (Soil Concentration = Koc x foc x Cgw) Tetrachloroethene (PCE) Trichloroethene (TCE) Dichloroethene (CE) Dichloroethene (CC) Carbon Tetrachloride (CT) Trichloromethane (or chloroform) (CF) Dichloromethane (or chloroform) (CF) Dichloromethane (1,1,1,2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1,1-TCA and 1,1,2-TCA)	Koc (mL/g) 263 107) 45 3.0 224 63 28 25 117 105	0.000 0.000 33.000 87.000 0.400 0.000 Soluble Contamin Soil Conc. (mg/kg) 0.44 0.16 2.70 0.02 0.00 0.00 0.00 0.00 0.00 103.95	0.00 0.00 12.28 32.36 0.15 0.00 ant Electron Acc Mass (lb) 0.97 0.34 5.92 0.04 0.00 0.00 0.00 0.00 0.00 0.00 227.90	25.04 20.82 22.06 24.55 32.00 12.33 eptor Demand (lb.) Stoichiometric demand (wt/wt h ₂) 20.57 21.73 24.05 31.00 19.08 19.74 21.06 25.04 20.82 22.06	0.00 0.00 0.56 1.32 0.00 0.00 1.92 Hydrogen Demand (lb) 0.05 0.02 0.25 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00	2 8 6 4 2 6 5 5 5 5 5 5 6 6 4 2 8 6 6 4 2 8 6 6 5 6 6 6 6 6 6 6 7 7 7 7 8 7 7 7 7 7 7 7 7
Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1,1-TCA and 1,1,2-TCA) Dichloroethane (1,1-DCA and 1,2-DCA) Chloroethane Perchlorate D. Sorbed Contaminant Electron Acceptors (Soil Concentration = Koc x foc x Cgw) Tetrachloroethene (PCE) Trichloroethene (TCE) Dichloroethene (TCE) Dichloroethene (TCE) Dichloroethene (TCE) Trichloroethene (or CDCE, trans-DCE, and 1,1-DCE Vinyl Chloride (VC) Carbon Tetrachloride (CT) Trichloromethane (or chloroform) (CF) Dichloromethane (or methylene chloride) (MC) Chloromethane (1,1,1,2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1,1-TCA and 1,1,2-TCA) Dichloroethane (1,1,1-DCA and 1,2-DCA)	Koc (mL/g) 263 107) 45 3.0 224 63 28 25 117 105 30	0.000 0.000 33.000 87.000 0.400 0.000 Soluble Contamin Soil Conc. (mg/kg) 0.44 0.16 2.70 0.02 0.00 0.00 0.00 0.00 103.95 78.30	0.00 0.00 12.28 32.36 0.15 0.00 ant Electron Acc Mass (lb) 0.97 0.34 5.92 0.04 0.00 0.00 0.00 0.00 0.00 0.00 0.00 171.66	25.04 20.82 22.06 24.55 32.00 12.33 eptor Demand (lb.) Stoichiometric demand (wt/wt h ₂) 20.57 21.73 24.05 31.00 19.08 19.74 21.06 25.04 20.82 22.06 24.55	0.00 0.00 0.56 1.32 0.00 1.92 Hydrogen Demand (lb) 0.05 0.02 0.25 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.02 0.25 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.02 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00	2 8 6 4 2 6 5 Electron Equivalents pe Mole 8 6 4 2 8 6 6 4 2 8 6 6 4 4 2 8 6 4
Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1-TCA and 1,1,2-TCA) Dichloroethane (1,1-DCA and 1,2-DCA) Chloroethane Perchlorate D. Sorbed Contaminant Electron Acceptors (Soil Concentration = Koc x foc x Cgw) Tetrachloroethene (PCE) Trichloroethene (TCE) Dichloroethene (Cis-DCE, trans-DCE, and 1,1-DCE Vinyl Chloride (VC) Carbon Tetrachloride (CT) Trichloromethane (or chloroform) (CF) Dichloromethane (or chloroform) (CF) Dichloromethane (1,1,1,2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1,1-TCA and 1,1,2-TCA) Dichloroethane (1,1-DCA and 1,2-DCA) Chloroethane	Koc (mL/g) 263 107) 45 3.0 224 63 28 25 117 105 30 3	0.000 0.000 33.000 87.000 0.400 0.000 Soluble Contamin Soil Conc. (mg/kg) 0.44 0.16 2.70 0.02 0.00 0.00 0.00 0.00 0.00 103.95 78.30 0.04	0.00 0.00 12.28 32.36 0.15 0.00 ant Electron Acc Mass (lb) 0.97 0.34 5.92 0.04 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00	25.04 20.82 22.06 24.55 32.00 12.33 eptor Demand (lb.) Stoichiometric demand (wt/wt h ₂) 20.57 21.73 24.05 31.00 19.08 19.74 21.06 25.04 22.06 24.55 32.00	0.00 0.00 0.56 1.32 0.00 0.00 1.92 Hydrogen Demand (lb) 0.05 0.02 0.25 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.02 0.25 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00	2 8 6 4 2 6 5 5 6 8 6 6 4 2 8 6 6 4 2 8 6 6 4 2 8 6 4 2 2 8 6 4 2 2
Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1,1-TCA and 1,1,2-TCA) Dichloroethane (1,1-DCA and 1,2-DCA) Chloroethane Perchlorate D. Sorbed Contaminant Electron Acceptors (Soil Concentration = Koc x foc x Cgw) Tetrachloroethene (PCE) Trichloroethene (TCE) Dichloroethene (TCE) Dichloroethene (TCE) Dichloroethene (TCE) Trichloroethene (or CDCE, trans-DCE, and 1,1-DCE Vinyl Chloride (VC) Carbon Tetrachloride (CT) Trichloromethane (or chloroform) (CF) Dichloromethane (or methylene chloride) (MC) Chloromethane (1,1,1,2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1,1-TCA and 1,1,2-TCA) Dichloroethane (1,1,1-DCA and 1,2-DCA)	Koc (mL/g) 263 107) 45 3.0 224 63 28 25 117 105 30	0.000 0.000 33.000 87.000 0.400 0.000 Soluble Contamin Soil Conc. (mg/kg) 0.44 0.16 2.70 0.02 0.00 0.00 0.00 0.00 103.95 78.30	0.00 0.00 12.28 32.36 0.15 0.00 ant Electron Acc Mass (lb) 0.97 0.34 5.92 0.04 0.00 0.00 0.00 0.00 0.00 0.00 0.00 171.66	25.04 20.82 22.06 24.55 32.00 12.33 eptor Demand (lb.) Stoichiometric demand (wt/wt h ₂) 20.57 21.73 24.05 31.00 19.08 19.74 21.06 25.04 20.82 22.06 24.55	0.00 0.00 0.56 1.32 0.00 1.92 Hydrogen Demand (lb) 0.05 0.02 0.25 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.02 0.25 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.02 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00	2 8 6 4 2 6 5 Electron Equivalents pe Mole 8 6 4 2 8 6 6 4 2 8 6 6 4 4 2 8 6 4
Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA) Trichloroethane (1,1,1-TCA and 1,1,2-TCA) Dichloroethane (1,1-DCA and 1,2-DCA) Chloroethane Perchlorate D. Sorbed Contaminant Electron Acceptors (Soil Concentration = Koc x foc x Cgw) Tetrachloroethene (PCE) Trichloroethene (TCE) Dichloroethene (CIC) Trichloroethene (CT) Trichloromethane (or chloroform) (CF) Dichloromethane (or chloroform) (CF) Dichloromethane (1,1,1,2-PCA and 1,1,2,2-PCA) Trichloromethane (1,1,1-TCA and 1,1,2-TCA) Dichloroethane (1,1-DCA and 1,2-DCA) Chloroethane (1,1-DCA and 1,2-DCA)	Koc (mL/g) 263 107) 45 3.0 224 63 28 25 117 105 30 3 0.0	0.000 0.000 33.000 87.000 0.400 0.000 Soluble Contamin Soil Conc. (mg/kg) 0.44 0.16 2.70 0.02 0.00 0.00 0.00 0.00 103.95 78.30 0.04 0.00	0.00 0.00 12.28 32.36 0.15 0.00 ant Electron Acc Mass (lb) 0.97 0.34 5.92 0.04 0.00 0.00 0.05 0.00 0.00 0.00 227.90 171.66 0.08 0.00	25.04 20.82 22.06 24.55 32.00 12.33 eptor Demand (lb.) Stoichiometric demand (wt/wt h ₂) 20.57 21.73 24.05 31.00 19.08 19.74 21.06 25.04 22.06 24.55 32.00	0.00 0.00 0.56 1.32 0.00 0.00 1.92 Hydrogen Demand (lb) 0.05 0.02 0.25 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00	2 8 6 4 2 6 Electron Equivalents pe Mole 8 6 4 2 8 6 4 2 8 6 4 2 8 6 4 2 2 8 6 4 2 2 8 6 4 2 2 8 6 4 2 2 6 1 2 1 6 1 2 1 6 1 2 1 6 1 2 1 6 1 2 1 1 1 1

Table S.2 Substra	te Calculations in	Hydrogen	Equivalents		
4. Treatment Cell Electron-Acceptor Flux (per year)					
· · · · · · · · · · · · · · · · · · ·			Stoichiometric	Hydrogen	Electron
A. Soluble Native Electron Acceptors	Concentration	Mass	demand	Demand	Equivalents per
	(mg/L)	(lb)	(wt/wt h ₂)	(lb)	Mole
Oxygen	0.6	1.01	7.94	0.13	4
Nitrate (denitrification)	0.1	0.17	10.25	0.02	5
Sulfate	35	58.96	11.91	4.95	8
Carbon Dioxide (estimated as the amount of Methane produced)		16.85	1.99	8.46	8
	Total Competing Elec			13.6	
			Stoichiometric	Hydrogen	Electron
B. Soluble Contaminant Electron Acceptors	Concentration	Mass	demand	Demand	Equivalents per
	(mg/L)	(lb)	(wt/wt h ₂)	(lb)	Mole
Tetrachloroethene (PCE)	0.056	0.09	20.57	0.00	8
Trichloroethene (TCE)	0.030	0.09	21.73	0.00	6
Dichloroethene (cis-DCE, trans-DCE, and 1,1-DCE)	2.000	3.37	24.05	0.00	4
Vinyl Chloride (VC)	0.210	0.35	31.00	0.14	2
Carbon Tetrachloride (CT)	0.210	0.35	19.08	0.00	8
	0.000	0.00	19.08	0.00	6
Trichloromethane (or chloroform) (CF) Dichloromethane (or methylene chloride) (MC)	0.000	0.00	21.06	0.00	4
Chloromethane	0.025	0.04	25.04	0.00	2
Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA)	0.000	0.00	20.82	0.00	8
Trichloroethane (1,1,1-TCA and 1,1,2-TCA)	33.000	55.59	20.82	2.52	6
Dichloroethane (1,1,1-1CA and 1,1,2-1CA)	87.000	146.55	22.06	2.52	6
Chloroethane	0.400	0.67	32.00	0.02	2
Perchlorate	0.400	0.07	12.33	0.02	6
	Soluble Contaminant Elec			8.67	0
			nt First Year (lb) equirement (lb)	48.9 115.6	-
5. Design Factors	Total Elle-Oyer	e nyarogen n	equirement (ib)	115.0	
				2X - 4X	
Microbial Efficiency Uncertainty Factor					
Methane and Solid-Phase Electron Acceptor Uncertainty				2X - 4X	
Remedial Design Factor (e.g., Substrate Leaving Reaction Zone)				1X - 3X	7
			Design Factor	5.0	
Total Life-Cyc	le Hydrogen Require	ement with De	sign Factor (lb)	578.1	
6. Acronyns and Abbreviations					_
°C =degrees celsius meq/100	g = milliequivalents per 10	10 grams			
	milligrams per kilogram	o grams			
	hilligrams per liter				
	eters per meters				
$ft^2 = square feet$ mV = mill					
	eters per year				
	dard pH units				
	= concetration molecular h	wdrogen weight	oer weight		
$qm/cm^3 = qrams per cubic centimeter$		iyarogen, wergint j			
	21000				
kg of CaCO3 per mg = kilograms of calcium carbonate per millig	gram				
lb = pounds					

	Table S.3				
Hydrogen Produced by Fern	nentation Rea	ctions of Commo	n Substrates	RETURN TO C	OVER PAGE
Substrate	Molecular Formula	Substrate Molecular Weight (gm/mole)	Moles of Hydrogen Produced per Mole of Substrate	Ratio of Hydrogen Produced to Substrate (gm/gm)	Range of Moles H₂/Mole Substrate
Lactic Acid	C ₃ H ₆ O ₃	90.1	2	0.0448	2 to 3
Molasses (assuming 100% sucrose)	C ₁₂ H ₂₂ O ₁₁	342	8	0.0471	8 to 11
High Fructose Corn Syrup (assuming 50% fructose and 50% glucose)	C ₆ H ₁₂ O ₆	180	4	0.0448	4 to 6
Ethanol	C ₂ H ₆ O	46.1	2	0.0875	2 to 6
Whey (assuming 100% lactose)	C ₁₂ H ₂₂ O ₁₁	342	11	0.0648	11
HRC [®] (assumes 40% lactic acid and 40% glycerol by weight)	C ₃₉ H ₅₆ O ₃₉	956	28	0.0590	28
Linoleic Acid (Soybean Oil, Corn Oil, Cotton Oil)	C ₁₈ H ₃₂ O ₂	281	16	0.1150	16

Design Life (years): 4

Substrate	Design Factor	Pure Substrate Mass Required to Fulfill Hydrogen Demand (pounds)	Substrate Product Required to Fulfill Hydrogen Demand (pounds)	Substrate Mass Required to Fulfill Hydrogen Demand (milligrams)	Effective Substrate Concentration (mg/L)
Lactic Acid	5.0	12,916	12,916	5.86E+09	1,816
Sodium Lactate Product (60 percent solution)	5.0	12,916	26,796	5.86E+09	1,816
Molasses (assuming 6 0	5.0	12,270	20,450	5.57E+09	1,726
HFCS (assuming 40% fructose and 40% glucose by weight)	5.0	12,919	16,148	5.86E+09	1,817
Ethanol Product (assuming 80% ethanol by weight)	5.0	6,606	8,257	3.00E+09	929
Whey (assuming 100% lactose)	5.0	8,916	12,737	4.04E+09	1,254
HRC [®] (assumes 40% lactic acid and 40% glycerol by weight)	5.0	9,791	9,791	4.44E+09	1,102
Linoleic Acid (Soybean Oil, Corn Oil, Cotton Oil)	5.0	5,027	5,027	2.28E+09	707
Commercial Vegetable Oil Emulsion Product (60% oil by weight)	5.0	5,027	8,379	2.28E+09	707

NOTES: Sodium Lactate Product

1. Assumes sodium lactate product is 60 percent sodium lactate by weight.

2. Molecular weight of sodium lactate (CH₃-CHOH-COONa) = 112.06.

3. Molecular weight of lactic Acid $(C_6H_6O_3) = 90.08$.

4. Therefore, sodium lactate product yields 48.4 (0.60 x (90.08/112.06)) percent by weight lactic acid.

5. Weight of sodium lactate product = 11.0 pounds per gallon.

6. Pounds per gallon of lactic acid in product = 1.323×8.33 lb/gal H2O x 0.60 x (90.08/112.06) = 5.31 lb/gal.

NOTES: Standard HRC Product

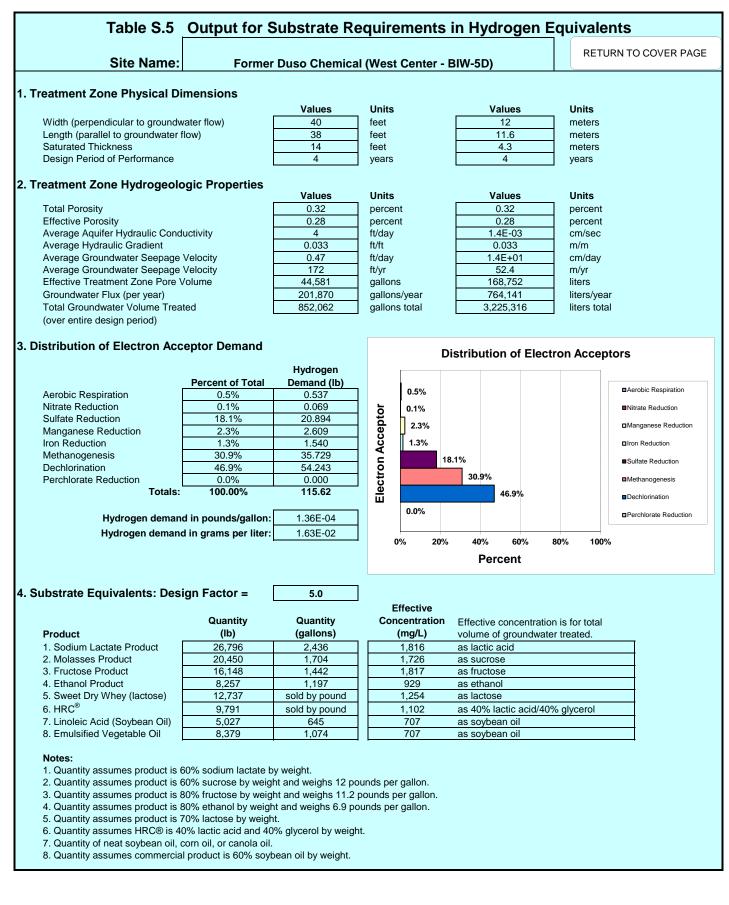
1. Assumes HRC product is 40 percent lactic acid and 40 percent glycerol by weight.

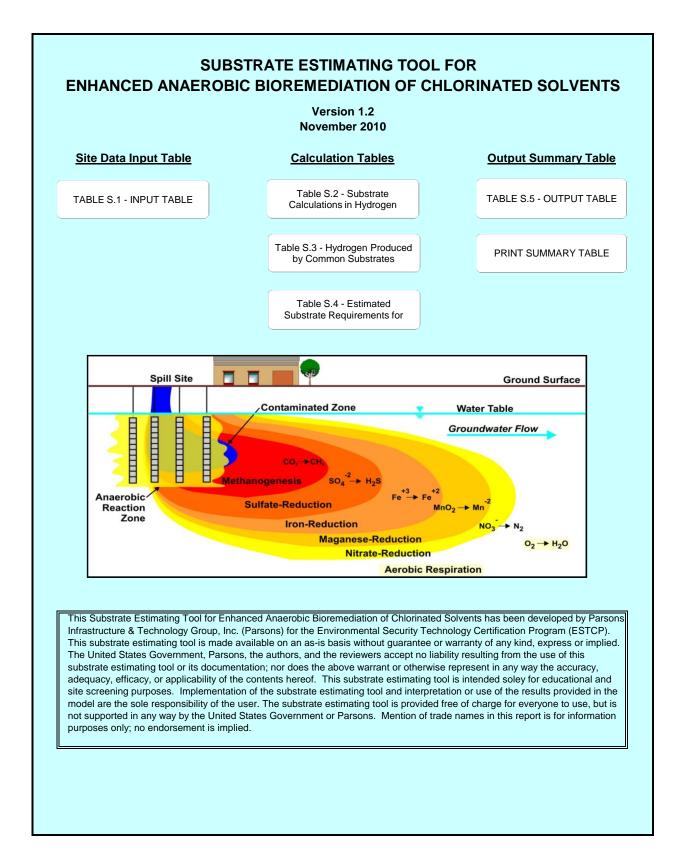
2. HRC[®] weighs approximately 9.18 pounds per gallon.

NOTES: Vegetable Oil Emulsion Product

1. Assumes emulsion product is 60 percent soybean oil by weight.

2. Soybean oil is 7.8 pounds per gallon.





Site Name: prmer Duso Chemi	ical (West Cent	er Shallow - I	BIW-5S)	RETURN TO COVER PAGE
	NOTE: Unshaded			<u>`</u>
Treatment Zone Physical Dimensions	Values	Range	Units	User Notes
Width (Perpendicular to predominant groundwater flow direction)	40	1-10,000	feet	Former Duso Chemical (West Center Shallow - BIW-5S)
Length (Parallel to predominant groundwater flow)	38	1-1,000	feet	
Saturated Thickness	6	1-100	feet	treatment thickness (4-10) for EOS
Treatment Zone Cross Sectional Area	240		ft ² ft ³	assume EHC for 10-24'
Treatment Zone Volume Treatment Zone Total Pore Volume (total volume x total porosity)	9,120 21,835			
Treatment Zone Effective Pore Volume (total volume x total porosity)	19,106		gallons gallons	
Design Period of Performance	4.0	.5 to 5	year	
Design Factor (times the electron acceptor hydrogen demand)	5.0	2 to 20	unitless	AECOM recommendation to use a design factor of 2 to 5
Treatment Zone Hydrogeologic Properties	1	٦		
Total Porosity	32%	.05-50	percent	Assumed for silty sand
Effective Porosity	28%	.05-50	percent	Assumed for silty sand (conservative high for higher PV)
Average Aquifer Hydraulic Conductivity Average Hydraulic Gradient	4 0.033	.01-1000 0.0001-0.1	ft/day ft/ft	average from MHBP RI
Average Groundwater Seepage Velocity through the Treatment Zone	0.47		ft/day	average from 2 values in RI
Average Groundwater Seepage Velocity through the Treatment Zone	172.1		ft/yr	
Average Groundwater Discharge through the Treatment Zone	86,516		gallons/year	
Soil Bulk Density	1.65	1.4-2.0	gm/cm ³	Assumed
Soil Fraction Organic Carbon (foc)	3.00%	0.01-10	percent	Assumed
Native Electron Acceptors				
A. Aqueous-Phase Native Electron Acceptors	· · · · · · · · · · · · · · · · · · ·	1		
Oxygen	0.6	0.01 to 10	mg/L	
Nitrate	0.10	0.1 to- 20	mg/L	not detected in RI
Sulfate Carbon Dioxide (estimated as the amount of Methane produced)	35 10.0	10 to 5,000 0.1 to 20	mg/L mg/L	RI readings 2, 11, 43, 79 in MHC-23 and MHC-26
Carbon Dioxide (estimated as the amount of Methane produced)	10.0	0.1 10 20	ilig/L	
B. Solid-Phase Native Electron Acceptors				
Manganese (IV) (estimated as the amount of Mn (II) produced)	10	0.1 to 20	mg/L	RI Mn 4-8 mg/L in slightly reducing GW, assume some pro
Iron (III) (estimated as the amount of Fe (II) produced)	12	0.1 to 20	mg/L	RI ~10 mg/L in slightly reducing GW, assume some produ
Contaminant Electron Acceptors		7		
Tetrachloroethene (PCE)	0.050		mg/L	max conc from BIW-5S
Trichloroethene (TCE)	0.050		mg/L	
Dichloroethene (cis-DCE, trans-DCE, and 1,1-DCE) Vinyl Chloride (VC)	0.200		mg/L mg/L	
Carbon Tetrachloride (CT)	0.000		mg/L	
Trichloromethane (or chloroform) (CF)	0.000		mg/L	
Dichloromethane (or methylene chloride) (MC)	0.025		mg/L	
Chloromethane	0.000		mg/L	
Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA)	0.000		mg/L	
Trichloroethane (1,1,1-TCA and 1,1,2-TCA)	0.600		mg/L	
Dichloroethane (1,1-DCA and 1,2-DCA)	1.000		mg/L	
Chloroethane	0.200		mg/L	need to add Chloroethane
Perchlorate	0.000		mg/L	
Aquifer Geochemistry (Optional Screening Parameters)				
A. Aqueous Geochemistry				
Oxidation-Reduction Potential (ORP)	-25	-400 to +500	mV	2012 Field Sheets (avg BIW-2S, MHC-23, BIW-5S)
Temperature	13	5.0 to 30	°C	2012 Field Sheets (avg Divi-20, Millo-20, Divi-30)
pH	7.1	4.0 to 10.0	su	2012 Field Sheets (7.06-7.4)
Alkalinity	300	10 to 1,000	mg/L	
Total Dissolved Solids (TDS, or salinity)		10 to 1,000	mg/L	
Specific Conductivity	2000	100 to 10,000	μs/cm	2012 Field Sheets Approximate Average
Chloride		10 to 10,000	mg/L	
Sulfide - Pre injection	0.0	0.1 to 100	mg/L	
Sulfide - Post injection	0.0	0.1 to 100	mg/L	
D. Annifer Matein				
B. Aquifer Matrix	10000	200 to 20.000	ma/ka	Assumed
Total Iron Cation Exchange Capacity	10000 NA	200 to 20,000 1.0 to 10	mg/kg meq/100 g	Assumed
Lation Exchange Capacity	10.0%	1.0 to 10	Percent as CaCO ₃	Assumed
NOTES:				

Table S.2	Substrate Ca	alculations ir	Hydrogen	Equivalents	r	
Site Name: Forme	er Duso Chem	ical (West Cen	ter Shallow - E	BIW-5S)	RETURN TO	COVER PAGE
				NOTE: Open cells	are user input.	
1. Treatment Zone Physical Dimensions				Values	Range	Units
Width (Perpendicular to predominant groundwater flo	w direction)			40	1-10,000	feet
Length (Parallel to predominant groundwater flow)	w direction)			38	1-1,000	feet
Saturated Thickness						
				6	1-100	feet
Treatment Zone Cross Sectional Area				240		ft ²
Treatment Zone Volume				9,120		ft ³
Treatment Zone Effective Pore Volume (total volume	x effective porosit	ty)		19,106		gallons
Design Period of Performance				4.0	.5 to 5	year
2. Treatment Zone Hydrogeologic Propertie	es					
Total Porosity				0.32	.05-50	
Effective Porosity				0.28	.05-50	
Average Aquifer Hydraulic Conductivity				4	.01-1000	ft/day
Average Hydraulic Gradient				0.033	0.1-0.0001	ft/ft
Average Groundwater Seepage Velocity through the	Treatment Zone			0.47		ft/day
Average Groundwater Seepage Velocity through the		•		172.1		ft/yr
Average Groundwater Flux through the Treatment Zo	n	0		86,516		gallons/year
Soil Bulk Density				1.65	1.4-2.0	gm/cm ³
Soil Fraction Organic Carbon (foc)				0.03	0.0001-0.1	
3. Initial Treatment Cell Electron-Acceptor	Demand (one	total pore volu	me)			
				Stoichiometric	Hydrogen	Electron
A. Aqueous-Phase Native Electron Acceptors		Concentration	Mass	demand	Demand	Equivalents pe
		(mg/L)	(lb)	(wt/wt h ₂)	(lb)	Mole
Oxygen		0.6	0.10	7.94	0.01	4
Nitrate (denitrification)		0.1	0.02	12.30	0.00	5
Sulfate		35	5.58	11.91	0.47	8
Carbon Dioxide (estimated as the amount of methane	e produced)	10.0	1.59	1.99	0.80	8
		Soluble Compet	ing Electron Acc	eptor Demand (lb.)	1.28	
				Stoichiometric	Hydrogen	Electron
B. Solid-Phase Native Electron Acceptors		Concentration	Mass	demand	Demand	Equivalents pe
(Based on manganese and iron produced)		(mg/L)	(lb)	(wt/wt h ₂)	(lb)	Mole
Manganese (IV) (estimated as the amount of Mn (II)	10.0	30.47	27.25	1.12	2	
Iron (III) (estimated as the amount of Fe (II) produced	12.0	36.57	55.41	0.66	1	
····· () (···································				eptor Demand (lb.)	1.78	
				Stoichiometric	Hydrogen	Electron
C. Soluble Conteminent Electron Accontors		Concentration	Maga		Demand	
C. Soluble Contaminant Electron Acceptors		Concentration	Mass	demand		Equivalents pe
		(mg/L)	(lb)	(wt/wt h ₂)	(lb)	Mole
Tetrachloroethene (PCE)		0.050	0.01	20.57	0.00	8
Trichloroethene (TCE)		0.050	0.01	21.73	0.00	6
Dichloroethene (cis-DCE, trans-DCE, and 1,1-DCE)		0.200	0.03	24.05	0.00	4
Vinyl Chloride (VC)		0.050	0.01	31.00	0.00	2
Carbon Tetrachloride (CT)		0.000	0.00	19.08	0.00	8
Trichloromethane (or chloroform) (CF)		0.000	0.00	19.74	0.00	6
Dichloromethane (or methylene chloride) (MC)		0.025	0.00	21.06	0.00	4
			0.00		0.00	2
Chloromethane		0.000		25.04		
Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA)		0.000	0.00	20.82	0.00	8
Trichloroethane (1,1,1-TCA and 1,1,2-TCA)		0.600	0.10	22.06	0.00	6
Dichloroethane (1,1-DCA and 1,2-DCA)		1.000	0.16	24.55	0.01	4
Chloroethane		0.200	0.03	32.00	0.00	2
Perchlorate		0.000	0.00	12.33	0.00	6
	Total	Soluble Contamin	ant Electron Acc	eptor Demand (lb.)		
				Stoichiometric	Hydrogen	Electron
D. Sorbed Contaminant Electron Acceptors	Koc	Soil Conc.	Mass	demand	Demand	Equivalents pe
(Soil Concentration = Koc x foc x Cgw)	(mL/g)	(mg/kg)	(lb)	(wt/wt h ₂)	(lb)	Mole
Tetrachloroethene (PCE)	263	0.39	0.37	20.57	0.02	8
Trichloroethene (TCE)	107	0.16	0.15	21.73	0.02	6
Dichloroethene (cis-DCE, trans-DCE, and 1,1-DCE)	45	0.10	0.15	24.05	0.01	4
Vinyl Chloride (VC)	3.0	0.00	0.00	31.00	0.00	2
Carbon Tetrachloride (CT)	224	0.00	0.00	19.08	0.00	8
Trichloromethane (or chloroform) (CF)	63	0.00	0.00	19.74	0.00	6
Dichloromethane (or methylene chloride) (MC)	28	0.02	0.02	21.06	0.00	4
Chloromethane	25	0.00	0.00	25.04	0.00	2
Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA)	117	0.00	0.00	20.82	0.00	8
Trichloroethane (1,1,1-TCA and 1,1,2-TCA)	105	1.89	1.78	22.06	0.08	6
	30	0.90	0.85	24.55	0.03	4
Dichloroethane (1,1-DCA and 1,2-DCA)						2
	3	0.02	0.02	32.00	0.00	
Chloroethane	3 0.0	0.02	0.02	32.00 12.33	0.00	
	0.0	0.00	0.00	12.33 eptor Demand (lb.)	0.00	6

Table S.2 Substrate 0	Calculations in	Hydrogen	Equivalents		
4. Treatment Cell Electron-Acceptor Flux (per year)					
			Stoichiometric	Hydrogen	Electron
A. Soluble Native Electron Acceptors	Concentration	Mass	demand	Demand	Equivalents per
	(mg/L)	(lb)	(wt/wt h ₂)	(lb)	Mole
Oxygen	0.6	0.43	7.94	0.05	4
Nitrate (denitrification)	0.1	0.07	10.25	0.01	5
Sulfate	35	25.27	11.91	2.12	8
Carbon Dioxide (estimated as the amount of Methane produced)	10	7.22	1.99	3.63	8
	Total Competing Ele	ctron Acceptor D	Demand Flux (lb/yr)	5.8	
			Stoichiometric	Hydrogen	Electron
B. Soluble Contaminant Electron Acceptors	Concentration	Mass	demand	Demand	Equivalents per
	(mg/L)	(lb)	(wt/wt h ₂)	(lb)	Mole
Tetrachloroethene (PCE)	0.050	0.04	20.57	0.00	8
Trichloroethene (TCE)	0.050	0.04	21.73	0.00	6
Dichloroethene (cis-DCE, trans-DCE, and 1,1-DCE)	0.200	0.14	24.05	0.01	4
Vinyl Chloride (VC)	0.050	0.04	31.00	0.00	2
Carbon Tetrachloride (CT)	0.000	0.00	19.08	0.00	8
Trichloromethane (or chloroform) (CF)	0.000	0.00	19.74	0.00	6
Dichloromethane (or methylene chloride) (MC)	0.025	0.02	21.06	0.00	4
Chloromethane	0.000	0.00	25.04	0.00	2
Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA)	0.000	0.00	20.82	0.00	8
Trichloroethane (1,1,1-TCA and 1,1,2-TCA)	0.600	0.43	22.06	0.02	6
Dichloroethane (1,1-DCA and 1,2-DCA)	1.000	0.72	24.55	0.03	4
Chloroethane	0.200	0.14	32.00	0.00	2
Perchlorate	0.000	0.00	12.33	0.00	6
Total Solut	ole Contaminant Ele	ctron Acceptor E	Demand Flux (lb/yr)	0.06	
	Initial Hvdroge	n Requiremer	nt First Year (Ib)	9.1	1
	Total Life-Cycl	e Hydrogen R	equirement (lb)	26.7	
5. Design Factors	-				-
Microbial Efficiency Uncertainty Factor				2X - 4X	
Methane and Solid-Phase Electron Acceptor Uncertainty				2X - 4X	
Remedial Design Factor (e.g., Substrate Leaving Reaction Zone)				1X - 3X	
· · · · · · · · · · · · · · · · · · ·			Design Factor	5.0	7
Total Life-Cycle H	lydrogon Roquire	mont with Do	-	133.7	
6. Acronyns and Abbreviations	iyulogen kequile		Sign Factor (ib)	133.7	J
°C =degrees celsius meq/100 g = n	nilliequivalents per 10	0 grams			
μs/cm = microsiemens per centimeter mg/kg = millig	rams per kilogram				
cm/day = centimeters per day mg/L = milligra	ams per liter				
cm/sec = centimeters per second m/m = meters	per meters				
ft ² = square feet mV = millivolts	6				
ft/day = feet per day m/yr = meters					
ft/ft = foot per foot su = standard					
	ncetration molecular h	ydrogen, weight p	per weight		
gm/cm ³ = grams per cubic centimeter					
kg of CaCO3 per mg = kilograms of calcium carbonate per milligram					
lb = pounds					

	Table S.3				
Hydrogen Produced by Ferr	Hydrogen Produced by Fermentation Reactions of Common Substrates				
Substrate	Molecular Formula	Substrate Molecular Weight (gm/mole)	Moles of Hydrogen Produced per Mole of Substrate	Ratio of Hydrogen Produced to Substrate (gm/gm)	Range of Moles H ₂ /Mole Substrate
Lactic Acid	C ₃ H ₆ O ₃	90.1	2	0.0448	2 to 3
Molasses (assuming 100% sucrose)	C ₁₂ H ₂₂ O ₁₁	342	8	0.0471	8 to 11
High Fructose Corn Syrup (assuming 50% fructose and 50% glucose)	C ₆ H ₁₂ O ₆	180	4	0.0448	4 to 6
Ethanol	C ₂ H ₆ O	46.1	2	0.0875	2 to 6
Whey (assuming 100% lactose)	C ₁₂ H ₂₂ O ₁₁	342	11	0.0648	11
HRC [®] (assumes 40% lactic acid and 40% glycerol by weight)	C ₃₉ H ₅₆ O ₃₉	956	28	0.0590	28
Linoleic Acid (Soybean Oil, Corn Oil, Cotton Oil)	C ₁₈ H ₃₂ O ₂	281	16	0.1150	16

Design Life (years): 4

Substrate	Design Factor	Pure Substrate Mass Required to Fulfill Hydrogen Demand (pounds)	Substrate Product Required to Fulfill Hydrogen Demand (pounds)	Substrate Mass Required to Fulfill Hydrogen Demand (milligrams)	Effective Substrate Concentration (mg/L)
Lactic Acid	5.0	2,986	2,986	1.35E+09	980
Sodium Lactate Product (60 percent solution)	5.0	2,986	6,195	1.35E+09	980
Molasses (assuming 6 0	5.0	2,837	4,728	1.29E+09	931
HFCS (assuming 40% fructose and 40% glucose by weight)	5.0	2,987	3,733	1.35E+09	980
Ethanol Product (assuming 80% ethanol by weight)	5.0	1,527	1,909	6.93E+08	501
Whey (assuming 100% lactose)	5.0	2,061	2,945	9.35E+08	676
HRC [®] (assumes 40% lactic acid and 40% glycerol by weight)	5.0	2,264	2,264	1.03E+09	594
Linoleic Acid (Soybean Oil, Corn Oil, Cotton Oil)	5.0	1,162	1,162	5.27E+08	381
Commercial Vegetable Oil Emulsion Product (60% oil by weight)	5.0	1,162	1,937	5.27E+08	381

NOTES: Sodium Lactate Product

1. Assumes sodium lactate product is 60 percent sodium lactate by weight.

2. Molecular weight of sodium lactate (CH₃-CHOH-COONa) = 112.06.

3. Molecular weight of lactic Acid $(C_6H_6O_3) = 90.08$.

4. Therefore, sodium lactate product yields 48.4 (0.60 x (90.08/112.06)) percent by weight lactic acid.

5. Weight of sodium lactate product = 11.0 pounds per gallon.

6. Pounds per gallon of lactic acid in product = 1.323×8.33 lb/gal H2O x 0.60 x (90.08/112.06) = 5.31 lb/gal.

NOTES: Standard HRC Product

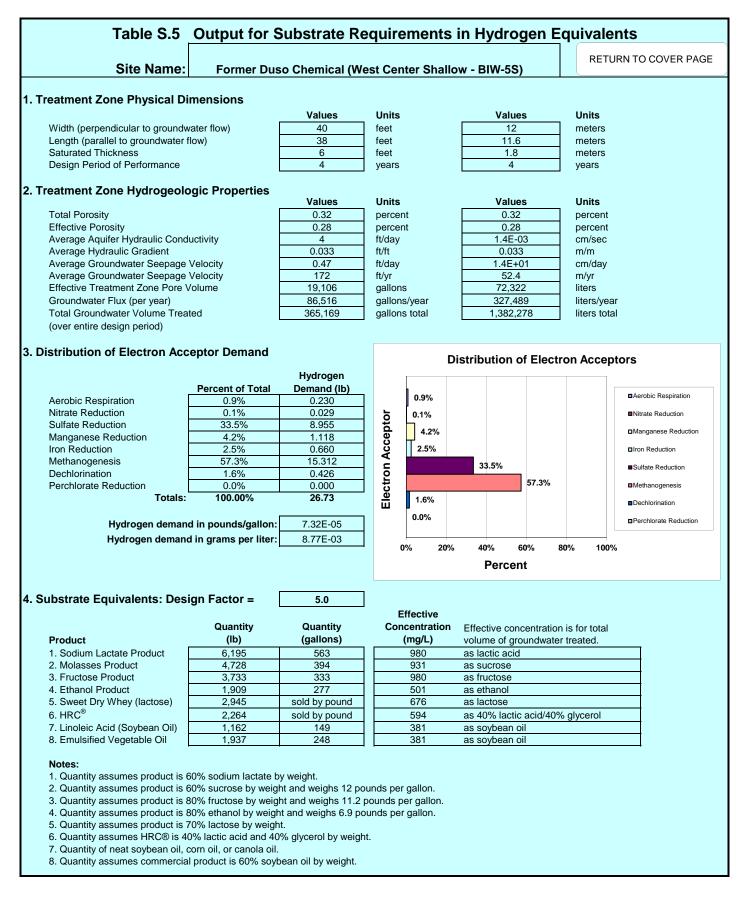
1. Assumes HRC product is 40 percent lactic acid and 40 percent glycerol by weight.

2. HRC[®] weighs approximately 9.18 pounds per gallon.

NOTES: Vegetable Oil Emulsion Product

1. Assumes emulsion product is 60 percent soybean oil by weight.

2. Soybean oil is 7.8 pounds per gallon.



Appendix D

SiREM Laboratories Biotreatability Study Report

Prepared for:

AECOM 40 British American Blvd., Latham, NY 12110

LABORATORY BIOTREATABILITY STUDY TO EVALUATE BIODEGRADATION OF CHLORINATED SOLVENTS IN GROUNDWATER

Former Duso Chemical Site Poughkeepsie New York

Prepared by:



130 Research Lane, Suite 2 Guelph, Ontario N1G 5G3

SiREM Ref: TL0139.19

30 August 2011



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APPENDIX A: Gene-Trac[®] Reports

APPENDIX B: Henry's Law Calculation



LIST OF ABBREVIATIONS

1,1-DCA	1,1-dichloroethane
1,2-DCA	1,2-dichloroethane
1,1-DCE	1,1-dichloroethene
TCA	1,1,1-trichloroethane
cells/liter	cells per liter
cis-1,2-DCE	<i>cis</i> -1,2-dichloroethene
cVOC	chlorinated volatile organic compound
CA	chloroethane
°C	degrees Celsius
°C/min	degrees Celsius per minute
Dhb	Dehalobacter
Dhc	Dehalococcoides
DHG	dissolved hydrocarbon gases
EOS 598B42	emulsified oil substrate 59.8% enriched with vitamin B12
ERD	enhanced reductive dechlorination
GC	gas chromatograph
Geosyntec	Geosyntec Consultants
IC	ion chromatograph
µg/L	micrograms per liter
μL	microliters
min	minutes
mg/L	milligrams per liter
mL	milliliters
mL/min	milliliters per minute
mM	millimolar
mmol/bottle	millimole per bottle
ORP	oxygen reducing potential
%	per cent
QL	quantitation limit
qPCR	quantitative polymerase chain reaction
RPM	revolutions per minute
rRNA	16S ribonucleic acid
SiREM	SiREM Laboratories
PCE	tetrachloroethene
TCE	trichloroethene
VC	vinyl chloride
vcrA	vinyl chloride reductase
VFA	volatile fatty acid



1. INTRODUCTION

AECOM retained SiREM Laboratory (SiREM) to perform a laboratory biotreatability study to assess the potential for in situ bioremediation of chlorinated volatile organic compounds (cVOCs) in groundwater at the Former Duso Chemical Site in Poughkeepsie, NY (the Site). The purpose of the study was to assess anaerobic biodegradation of the Site contaminants. namelv chlorinated ethenes (tetrachloroethene [PCE], trichloroethene [TCE], cis-1,2-dichloroethene [cDCE], 1,1dichloroethene [1,1-DCE] and vinyl chloride [VC]) and chlorinated ethanes (1,1,1trichloroethane [1,1,1-TCA], 1,1-dichloroethane [1,1-DCA], 1,2-dichloroethane [1,2-DCA] and chloroethane [CA]).

Groundwater and soil used in this study were collected from locations SGSB3, MHC-22, MHC-24, MHC-26 (groundwater), and SB-1, SB-2, SB-3 and SB-4 (soil) on 21 March 2011. The material was received by SiREM on 24 March 2011.

The remainder of this report contains a summary of key biodegradation processes (Section 1.1), the experimental materials and methods (Section 2), the results and discussion of the microcosm study (Section 3), conclusions (Section 4) and report references (Section 5).

1.1 Summary of Biodegradation Processes

Biological degradation products of PCE include TCE, *c*DCE, VC and the fully dechlorinated end product ethene. Breakdown products of 1,1,1-TCA include 1,1-DCA, and CA, while 1,1-DCE and acetate can be produced from an abiotic elimination reaction. 1,2-DCA primarily degrades via dihaloelimination to ethene. Figure 1 contains degradation pathways for the chlorinated ethanes and 1,1-DCE and Figure 2 contains degradation pathways for the chlorinated ethenes and 1,2-DCA.

Natural attenuation processes can occur in situ and are often mediated by indigenous microbial populations present at contaminated sites. Enhanced reductive dechlorination (ERD) can, in certain cases, be achieved by stimulating the indigenous microbial populations through the addition of electron donors. Bioaugmentation is the process in which a microbial population known to promote ERD or other biodegradation processes is introduced to groundwater to enhance the rate or extent of biodegradation. *Dehalococcoides* (Dhc) microorganisms are known to be responsible for mediating the complete dechlorination of PCE, TCE, cDCE, 1,1-DCE, VC and 1,2-DCA to ethene (Major et al., 2002; Duhamel et al., 2002). 1,1,1-TCA has been observed to inhibit anaerobic biological processes including methanogenesis and ERD



of chlorinated ethenes that are mediated by the Dhc group of organisms (Grostern and Edwards, 2006). Overcoming this inhibition is important when dealing with chlorinated ethanes and chlorinated ethenes as co-contaminants and this has been demonstrated to be possible when other dehalogenating organisms such as *Dehalobacter* (Dhb) that are known to degrade 1,1,1-TCA are present.

2. MATERIALS AND METHODS

The following sections describe the materials and methods used for microcosm construction and incubation (Section 2.1), and microcosm sampling and analysis (Section 2.2).

2.1 Microcosm Construction and Incubation

A total of 9 microcosms were constructed on 13 April 2011. Site soil and groundwater were placed in a disposable anaerobic glove bag with the materials required to construct the various treatment and control microcosms. Of the four samples of groundwater received three were used in microcosm construction (SGSB-3, MHC-26 and MHC-22). The three types of groundwater were mixed together prior to the microcosm construction. The glove bag was purged with a carbon dioxide/nitrogen (20:80) gas mixture in order to create an anaerobic environment. The soil from the different cores was combined and mixed by hand to improve reproducibility between replicates. Microcosms were constructed by filling sterile 250 milliliter (mL) (nominal volume) screw cap Boston round clear glass bottles (Systems Plus, New Hamburg, ON) with 60 mL of homogenized soil and 200 mL of Site groundwater. The bottles were capped with Mininert[™] closures to allow repetitive sampling of the bottle with minimal VOC loss and to allow amendments, as needed, throughout the incubation period. All controls and treatments were constructed in triplicate. Table 1 summarizes the details of microcosm construction and amendments for the treatment and control microcosms.

Anaerobic sterile control microcosms were constructed to quantify potential abiotic and experimental VOC losses from the microcosms. The sterile controls were constructed by autoclaving the Site soil at 121 degrees Celsius (°C) and 15 pounds per square inch pressure for 45 to 60 minutes (min). After autoclaving, the control microcosms were returned to the anaerobic chamber, filled with 200 mL of Site groundwater and amended with 2.8 mL of 2.7 per cent (%) mercuric chloride (equal to a final liquid concentration of 0.05%) and 0.5 mL of 5% sodium azide (equal to a final liquid concentration of 0.017%) to inhibit microbial activity.



All microcosms were sampled and incubated in an anaerobic chamber (Coy Laboratory Products, Grass Lake, MI) filled with an atmosphere of approximately 80% nitrogen, 10% carbon dioxide, and 10% hydrogen (Linde gases, Guelph, ON). Hydrogen was added to scavenge low levels of oxygen via a palladium catalyst, and anaerobic conditions were verified using resazurin-containing mineral medium, which turns pink if oxygen is present. During quiescent incubation, all microcosms were covered to minimize photodegradation, and stored horizontally to minimize VOC losses via the (submerged) Mininert[™] closure. Microcosms were incubated for a period of up to 203 days at 22°C (room temperature).

AECOM specified that the initial, cDCE, 1,1-DCA, and 1,1,1-TCA concentrations, in the microcosms should be 3 milligrams per liter (mg/L), 10 mg/L, and 2 mg/L, respectively to represent concentrations measured at the Site. The initial concentrations measured in the prepared microcosms were not at these target concentrations; therefore on 19 April 2011 (Day -1), the microcosms were amended with 175 microliters (μ L) of a saturated *c*DCE water stock (3,500 mg/L), 268 μ L of saturated 1,1-DCA water stock (5,060 mg/L), and 244 μ L of a saturated 1,1,1-TCA water stock (1,495mg/L) to reach the target concentrations in the microcosms.

Treatment microcosms were amended with Emulsified Oil Substrate 59.8% enriched with vitamin B12 (EOS[®] 598 B42) (EOS Remediation, Inc., Raleigh, NC) as the electron donor. These microcosms were amended with 334 μ L of EOS[®] 598 B42 corresponding to a target concentration of 0.1% as oil (EOS[®] 598 B42 is 59.8% soybean oil). The amount of EOS[®] 598 B42 electron donor added was based on experience with prior laboratory studies and corresponds to a percentage of what is typically added in the field.

2.2 Microcosm and Reactor Sampling and Analysis

2.2.1 Microcosm Sampling

Aqueous samples were collected from the control and treatment microcosms on a weekly to biweekly (i.e., every two weeks) basis for analysis of cVOCs, dissolved hydrocarbon gases (DHGs) (ethene, ethane, and methane), and anions (sulfate, nitrate, nitrite, chloride, phosphate, bromide). Aqueous samples were also collected periodically for analysis of volatile fatty acids (VFAs) (lactate, acetate, propionate, formate, butyrate, and pyruvate), pH, Dhc and Dhb. Microcosms were sampled using gas-tight 1 mL Hamilton glass syringes. Separate sets of syringes were used for the bioaugmented and non-bioaugmented treatments to minimize the potential for transfer of KB-1[®] microorganisms from bioaugmented to non-bioaugmented treatments.



Syringes were cleaned with acidified water (pH \sim 2) and rinsed 10 times with deionized water between samples, to ensure that VOCs and microorganisms were not transferred between replicates or treatments. The analytical methods employed by SiREM are described below.

2.2.2 Analysis of cVOCs and Dissolved Hydrocarbon Gases

This section describes the methods used to quantify the cVOCs and DHGs. The quantitation limits (QL) for the cVOCs and DHGs were typically 5 to 10 micrograms per liter (μ g/L) in the microcosms based on the lowest concentration standards that were included in the linear calibration trend.

Aqueous cVOC and DHG concentrations in the microcosms were measured using a Hewlett-Packard (Hewlett Packard 7890) gas chromatograph (GC) equipped with an auto sampler (Hewlett Packard G1888) programmed to heat each sample vial to 75°C for 45 min prior to headspace injection into a GSQ Plot column (0.53 mL x 30 meters, J&W) and a flame ionization detector. Sample vials were heated to ensure that all VOCs in the aqueous sample would partition into the headspace. The injector temperature was 200°C, and the detector temperature was 250°C. The oven temperature was programmed as follows: 35°C for 2 min, increased to 100°C at 50 degrees Celsius per minute (°C/min), then increased to 185°C at 25°C/min and held at 185°C for 6.80 min. The carrier gas was helium at a flow rate of 11 milliliters per minute (mL/min).

After withdrawing a 1 mL sample (as described in section 2.2.1), the sample was injected into a 10 mL auto sampler vial containing 5.0 mL of acidified deionized water (pH ~2). The water was acidified to inhibit microbial activity between microcosm sampling and GC analysis. The vial was sealed with an inert Teflon[®]-coated septum and aluminium crimp cap for automated injection of 3 mL of headspace onto the GC. One VOC standard was analyzed with each set of samples to verify the instrument five-point calibration curve using methanolic stock solutions containing known concentrations of the target analytes. Calibration was performed using external standards purchased as standard solutions (Sigma, St Louis, MO), where known volumes of standard solutions were added to acidified water in auto sampler vials and analyzed as described above for microcosm samples. Data were integrated using Chemstation Software (Agilent Technologies, Santa Clara, CA).



2.2.3 Analysis of Anions and Total Volatile Fatty Acids

This section describes the methods used to quantify anions and total VFAs. This analysis was performed on a Dionex DX-600 ion chromatograph (IC) equipped with a Dionex AS-40 auto sampler and an AS18 column, the sample loop volume was 25 µL. An isocratic separation was performed using 33 millimolar (mM) reagent grade sodium hydroxide (Fisher Scientific, Ottawa, ON) eluent for 13 min. One standard was analysed with each set of samples tested in order to verify the seven-point calibration using external standards of known concentrations. External standards were prepared gravimetrically using chemicals of the highest purity available (Sigma St Louis, MO or Bioshop, Burlington, ON). Data were integrated using Peaknet Chromatography software (Dionex, Oakville, ON). The QLs were as follows: 0.25 mg/L total VFA, 0.03 mg/L chloride, 0.12 mg/L nitrite, 0.10 mg/L nitrate, 0.72 mg/L sulfate, 0.57 mg/L phosphate and 0.39 mg/L bromide. The total VFA value includes lactate, formate, acetate, propionate, pyruvate and butyrate (valerate has not been confirmed), as this particular analytical method does not resolve VFAs. The VFA method described below (Section 2.2.4) is used to quantify individual VFAs.

A 0.5 mL sample was withdrawn (as described in section 2.2.1), after which the sample was placed in a 1.5 mL micro-centrifuge tube. Samples were centrifuged for five minutes at 13,000 revolutions per minute (RPM) to remove solids. The supernatant was removed, diluted 10-fold in deionized water and placed in a Dionex auto sampler vial with a cap that filters the sample during automated injection onto the IC.

2.2.4 Analysis of Volatile Fatty Acids

This section describes the methods used to quantify individual VFAs (lactate, acetate, propionate, formate, butyrate and pyruvate). This analysis was performed on a Dionex DX-600 IC equipped with a Dionex AS-40 auto sampler and an AS11-HC column, the sample loop volume was 25 μ L. A gradient separation was performed using the following eluent profile; 1.0 mM sodium hydroxide for 8.0 min to 15 mM at 18.0 min and proceeding to 30 mM at 28.0 min. with a flow rate of 1.5 mL/min. Calibration was performed using external standards of known concentrations. One standard was analysed with each set of samples to verify the instrument's seven-point calibration curve produced using external standards of known concentrations. External standards were prepared gravimetrically using chemicals of the highest purity available (Sigma St. Louis, MO or Bioshop, Burlington, ON). Data were integrated using Peaknet chromatography software (Dionex, Oakville, ON). The QLs were as follows: lactate 0.40 mg/L, acetate 0.54 mg/L, propionate 0.31 mg/L, formate 0.23 mg/L, butyrate 0.41 mg/L, and pyruvate 0.69 mg/L.



A 0.5 mL sample was withdrawn (as described in section 2.2.1), after which the sample was placed in a 1.5 mL micro-centrifuge tube. Samples were centrifuged for five minutes at 13,000 RPM in a micro-centrifuge to remove solids. The supernatant was removed, diluted 50-fold in deionized water and placed in a Dionex auto sampler vial with a cap that filters the sample during automated injection onto the IC.

2.2.5 Analysis of pH

The pH measurements were performed using an Oakton pH spear with combination pH electrode (Oakton, Vernon Hills, IL). A 500 μ L sample was taken (as described in section 2.2.1), the vial was removed from the glove box and the pH was measured on the lab bench. The pH spear was calibrated at each sampling event according to the manufacturer's instructions using pH 4.0, 7.0 and 10 standards.

2.2.6 Analysis of Oxidation-reduction Potential (ORP)

On 14 July 2011 (Day 85) a 2 mL aqueous sample was removed from each of the EOS[®] 598 B42 amended microcosms to measure the oxidation-reduction potential (ORP). The 2 mL sample was placed into a 10 mL glass vial for the ORP measurements which were performed using a Corning 313 meter with double junction ORP electrode (Ag/AgCl reference). A single point calibration of the meter was performed at each sampling event with Zobell ORP calibration solution.

2.2.7 Gene Trac[®] Dehalococcoides and DehalobacterTesting

Gene-Trac[®] quantitative polymerase chain reaction (qPCR) testing was performed in this study to quantify and characterize Dhc microorganisms known to facilitate the dechlorination of PCE to ethene and Dhb microorganisms known to facility the dechlorination of 1,1,1-TCA to CA.The method for the analysis is provided in Appendix A.

The Gene-Trac[®] Dhc and Dhb tests quantify the total Dhc and Dhb population by targeting the16S ribosomal ribonucleic acid (rRNA) gene whereas the Gene-Trac[®] VC test targets the Dhc vinyl chloride reductase (*vcrA*) gene. The *vcrA* gene is present in only a subset of Dhc populations, and is a functional gene responsible for complete dechlorination of cDCE and VC to ethene (Mueller et al., 2004). There is a strong correlation between the presence of vcrA and complete dechlorination of chloroethenes to non-toxic ethene.



As per AECOM request a 100 mL sample from groundwater SGSB3 and MHC-26 were collected for baseline analysis. These samples represented background microbiological conditions, and were tested to identify if indigenous dechlorinating organisms were present in the site materials used to construct the microcosms.

On 29 June 2011 (Day 70) and 17 August 2011 (Day 119), a 10 mL composite sample was collected (3.3 mL from each triplicate) for the mid-point and end point sampling respectively, and submitted for Gene-Trac[®] Dhc, Dhb and *vcrA* testing. (Test Certificates are provided in Appendix A)

3. RESULTS AND DISCUSSION

The following section presents and discusses the results of the biotreatability study. Section 3.1 discusses the results for the anaerobic sterile and active control microcosms, and Section 3.2 discusses the results for the EOS[®] 598 B42 amended microcosms.

Tables 2A, 2B, 2C, and 2D provide cVOC, ethene, ethane, methane, anion, VFA, and pH data from the control and treatment microcosms over the incubation period for the study. All cVOC, ethene, ethane, and methane concentrations are presented in units of mg/L and millimoles per microcosm bottle (mmol/bottle) to demonstrate mass balances on a molar basis. Concentrations were converted from mg/L to mmol/bottle using Henry's Law as demonstrated in Appendix B. Table 3 summarizes the Gene-Trac[®] results, Table 4 presents the cVOC half-lives, and Figures 3 through 5 present trends in the concentrations of cVOCs, ethene, and ethane in the control and treatment microcosms over the incubation period for the study.

3.1 Anaerobic Sterile and Active Control Microcosms

The cVOC concentrations in the sterile control microcosms remained stable over the incubation period and there were no increases in degradation products (Figure 3). Sulfate concentrations also remained stable in all three microcosms. These results confirm that there was no mass loss of cVOCs in the treatment microcosms resulting from abiotic degradation or experimental losses (e.g., sorption or loss through microcosm closures).

The cVOC concentrations also remained stable in the anaerobic active control microcosms over the incubation period, with the exception of slight decreases in the cDCE and 1, 1, 1-TCA concentrations (Figure 4). cDCE and 1,1,1-TCA degradation



products did not increase indicating that the decreases cDCE and 1,1,1-TCA were not due to reductive dechlorination and may have been the result of abiotic degradation. Sulfate reduction was observed throughout the duration of the study. These data suggest that the intrinsic biodegradation activity at the Site may be limited due to a lack of available nutrients (e.g., electron donors or co metabolites) to promote degradation of the cVOCs.

3.2 EOS[®] 598 B42 Amended Microcosms

The addition of EOS[®] 598 B42 alone promoted the complete dechlorination of chlorinated ethenes to ethene, 1,1,1-TCA and 1,1-DCA to CA and partial dechlorination of 1,2-DCA (Figure 5). cDCE decreased rapidly with corresponding increases in VC. cDCE and VC reached non-detect levels by day 70 with corresponding increases in ethene. 1,1 DCE reached non-detect levels by day 119. 1,1,1-TCA and 1,1-DCA also decreased rapidly and reached non-detect levels by days 42 and 85 respectively with a corresponding increase in CA. 1,2-DCA concentrations remained stable to Day 42 (average concentration of 0.66 mg/L) followed by a slow decrease to an average concentration of 0.092 mg/L by Day 119. Sulfate reduction was observed and was essentially complete by Day 28 (Table 2B). Methane concentrations increased throughout the incubation period (Table 2A) indicating that methanogenic microorganisms were present in the site material and consumed a portion of the available electron donor.

Lactate was detected at time zero and decreased to non-detect by day 56 indicating that the lactate component of the EOS[®] 598 B42 was utilized. Acetate, propionate, and butyrate were all detected at day 56 indicating that fermentation of the EOS[®] 598 B42 was occurring (Table 2C). The pH of the sterile and active controls remained stable throughout the duration of the study (Table 2D), while the pH of the treatment microcosms decreased only slightly over the incubation period reaching an average value of 6.60 on Day 119 (Table 2D). This indicates that the acid buffering properties of the Site materials were sufficient to maintain a relatively neutral pH during reductive dechlorination and electron donor fermentation (both acid producing processes). The optimum pH for reductive dechlorination is 6.8 to 7.5 (Middledorp et al., 1999) and complete dechlorination can occur between a pH range of 6.0 and 8.0 (SiREM, unpublished data). These results suggest that application of buffering agents is not likely to be required to support ERD at the Site. On day 85 the ORP of the EOS[®] 598 B42 amended microcosms was measured as requested by AECOM. The results indicated that highly reducing conditions (i.e., <-100 millivolts) required for dechlorination were established in the microcosms.



Table 3 summarizes the Gene-Trac[®] test results for baseline groundwater and aqueous samples collected from the baseline groundwater and microcosms throughout the study.

The baseline analysis performed on the two groundwater types used for this study (SGSB-3 and MHC-26) indicated a low to moderate population of Dhc (determined by vinyl chloride reductase gene [vcrA] found in Dhc) and Dhb. At Day 62 composite samples from both the active control and EOS[®] 598 B42 microcosms were analyzed for vcrA and Dhb. The active control continued to have a low to moderate Dhc and Dhb populations (5E+06 cells per liter (cells/L) and 4E+06 cells/L respectively). However, when treated with EOS[®] 598 B42 the indigenous population of Dhc and Dhb was able to flourish to high levels (6E+09 cells/L and 3E+09 cells/L respectively), which supports the dechlorination data observed. Typically Dhc concentrations above 1 x 10 ⁷cells/L are required for high rates of *in situ* reductive dechlorination (Lu et al., 2006) and ethene production. There is currently no industry standard for Dhb, but 1 x 10 ⁷cells/L is often used. At Day 119 both the active control and EOS[®] 598 B42 amended microcosms were sampled. A slight decrease in Dhc and Dhb populations was observed in the electron donor amended sample, most likely due to the fact that the both the chlorinated ethenes and ethanes in the electron donor amended microcosms were essentially depleted prior to sample collection. A similar decrease was observed for the active control sample, but the populations remained low throughout the duration of the study.

These data suggest that intrinsic microorganisms present at the site may be capable of dechlorinating chlorinated ethenes and ethanes with EOS[®] 598 B42 as the electron donor.

3.3 Degradation Half-Lives for Chlorinated Ethenes and Chlorinated Ethanes

Laboratory half-lives were calculated based on the average dechlorination observed in the individual treatment microcosm replicates as indicated in Table 4. First order reaction kinetics was assumed for all calculations as described in Newell et al, 2002. The half- lives were calculated using the following relationship:

Half life = $\ln(2)/[\ln(C_2/C_1)/(t_2-t_1)]$

where,

 C_1 is the concentration at early time (t₁ days)

 C_2 is the concentration at later time (t_2 days)



Based on the data collected, the calculated dechlorination half-lives for the chlorinated ethenes (TCE, cDCE, VC and 1,1-DCE) were 21 days, 5.8 days, 2.6 days and 8.3 days respectively (Table 4). The calculated dechlorination half-lives for the chlorinated ethanes were in a similar range with 1,1,1-TCA and 1,1-DCA half lives of 5.3 and 3.8 days respectively. The highest half life calculated was 45 days for 1,2-DCA. The dechlorination of 1,2-DCA wasn't observed until dechlorination of the other chlorinated compounds was essentially complete leading to the higher half life for 1,2-DCA.

4. CONCLUSIONS

The laboratory biotreatability study results indicate the following:

- 1. The rate and extent of intrinsic degradation of the chlorinated ethenes and ethanes in Site groundwater is limited by the lack of available nutrients (e.g., electron donors) at the Site.
- 2. EOS[®] 598 B42 amendment promoted the appropriate geochemical conditions (i.e., sulfate reducing conditions) and maintenance of suitable pH for bioremediation of chlorinated ethenes and ethanes.
- 3. EOS[®] 598 B42 supported increases of indigenous Dhc and Dhb populations to levels associated with complete dechlorination.
- 4. Indigenous bacteria present at the Site appear to be capable of completely dechlorinating the chlorinated ethenes to ethene, 1,1,1-TCA and 1,1-DCA to CA and partial dechlorination of 1,2-DCA with the addition of EOS[®] 598 B42 as the electron donor.

Based on the results of this study, EOS[®] 598 B42 as electron donor may be an effective remedial approach to reduce chlorinated ethenes and chlorinated ethanes concentrations in Site groundwater.



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TABLES

TABLE 1: SUMMARY OF MICROCOSM CONTROLS AND TREATMENTS

Former Duso Chemical, Poughkeepsie, New York

Microcosm Name	Control/Treatment	Description
ANSC	Anaerobic Sterile Control	Autoclaved and amended with mercuric chloride and sodium azide.
ANAC	Anaerobic Active Control	No amendments added
EOS [®] 598 B42 Amended	EOS [®] 598 B42 Amended and Bioaugmentation	Initial electron donor target concentration of 0.1% as oil.

Notes:

ANSC – anaerobic sterile control ANAC – anaerobic active control EOS[®] – emulsified oil substrate % - percent

TABLE 2A: Summary of Microcosm Chlorinated VOCs, Ethene, Ethane, and Methane Results Former Duso Chemical, Poughkeepsie, New York

						Cł	nlorinated Et	henes				Chl	orinated Etha	anes	1	Methane	
Treatment	Date	Day	Replicate	PCE	TCE	CDCE		VC	Ethene	Total Ethenes	1,1,1-TCA	1,1-DCA	1,2-DCA	CA	Ethane	Methane	Comment
				mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mmo//bottle	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	
Anaerobic Sterile Control	13-Apr-11	-7															Poisoned with mercuric chloride and sodium azide.
																	Amended the first replicate with resazurin.
	19-Apr-11															1	Spiked with cDCE, 1,1-DCA and 1,1,1-TCA to target concentrations of 3, 10 and 2 ppm respectively.
	20-Apr-11	0	ANSC-1	<0.010	0.029	6.5	<0.010	<0.010	<0.010	-	1.1	7.2	0.22	0.24	<0.010	0.035	
			ANSC-2	<0.010	0.032	5.9	0.011	0.010	<0.010	-	1.2	7.4	0.22	0.27	<0.010	0.077	
			ANSC-3	<0.010	0.032	5.6	0.014	0.014	<0.010		1.1	7.2	0.23	0.28	<0.010 ND	0.029	
			Average Concentration (mg/L)	ND	0.031	6.0	0.0083	0.0079	ND	-	1.1	7.3			0.0E+00	0.047 1.2E-03	
			Standard Deviation (mmoles) Average Total mmoles	0.0E+00 ND	2.9E-06	9.9E-04	1.7E-05	2.5E-05	0.0E+00		5.0E-05	2.8E-04	1.3E-05 0.00045	6.4E-05 0.00084	0.0E+00 ND	1.2E-03 0.0022	
	04-May-11	14	Average Total minoles ANSC-1	<0.010	0.000049	0.013 5.8	0.000019	0.000028 <0.010	ND <0.010	1.3E-02	0.0019	0.015 6.9	0.00045	0.21	<0.010	0.0022	-
	04-May-11	14	ANSC-2	<0.010	0.037	5.8	0.012	<0.010	<0.010	-	0.94	6.9 7.8	0.22	0.21	<0.010	0.028	
			ANSC-2 ANSC-3	0.010	0.030	5.7	0.014	<0.010	<0.010		1.1	7.0	0.23	0.27	<0.010	0.027	
			Average Concentration (mg/L)	0.0041	0.040	5.9	0.013	0.0036	ND	-	1.0	7.3	0.25	0.25	ND	0.027	-
			Standard Deviation (mmoles)	9.4E-06	7.6E-06	4.3E-04	3.1E-06	2.2E-05	0.0E+00		1.6E-04	9.0E-04	1.0E-04	1.0E-04	0.0E+00	1.0E-05	
			Average Total mmoles	0.0000054	0.000057	0.012	0.000030	0.000013	ND	1.2E-02	0.0017	0.015	0.00051	0.00080	ND	0.0013	
	17-May-11	27	ANSC-1	< 0.010	0.000037	5.7	0.000030	< 0.010	<0.010	1.20-02	0.91	6.6	0.22	0.20	<0.010	0.030	
			ANSC-2	<0.010	0.029	5.6	0.016	0.014	<0.010		1.1	7.3	0.22	0.25	<0.010	0.030	
		1	ANSC-3	0.017	0.025	5.4	0.019	<0.014	<0.010	-	0.98	6.7	0.24	0.24	<0.010	0.030	
		1	Average Concentration (mg/L)	0.0058	0.023	5.6	0.013	0.0047	ND	-	0.98	6.9	0.23	0.23	ND	0.030	-
		1	Standard Deviation (mmoles)	1.3E-05	9.4E-06	3.3E-04	5.8E-06	2.8E-05	0.0E+00	-	1.1E-04	8.1E-04	3.0E-05	8.4E-05	0.0E+00	2.1E-05	
		1	Average Total mmoles	0.0000077	0.000037	0.012	0.000038	0.000016	ND	1.2E-02	0.0016	0.014	0.00046	0.00074	ND	0.0014	
	15-Jun-11	56	ANSC-1	0.015	0.042	5.6	0.020	< 0.010	<0.010		0.87	6.8	0.23	0.19	<0.010	0.028	7
		1	ANSC-2	< 0.010	0.043	5.6	< 0.010	0.011	<0.010		1.0	7.3	0.22	0.24	<0.010	0.027	
			ANSC-3	0.023	0.032	5.2	< 0.010	< 0.010	< 0.010		0.92	6.8	0.23	0.23	<0.010	0.027	
			Average Concentration (mg/L)	0.012	0.039	5.5	0.0065	0.0035	ND		0.93	7.0	0.23	0.22	ND	0.027	
			Standard Deviation (mmoles)	1.5E-05	9.1E-06	4.4E-04	2.6E-05	2.1E-05	0.0E+00	-	1.1E-04	5.8E-04	6.5E-06	7.5E-05	0.0E+00	2.3E-05	
			Average Total mmoles	0.000016	0.000062	0.012	0.000015	0.000012	ND	1.2E-02	0.0015	0.014	0.00046	0.00070	ND	0.0013	
	17-Aug-11	119	ANSC-1	0.023	0.032	5.3	0.033	< 0.010	<0.010	-	0.81	6.9	0.21	0.18	<0.010	0.032	
			ANSC-2	< 0.010	0.031	5.5	0.037	0.011	<0.010	-	0.92	7.1	0.22	0.21	<0.010	0.049	
			ANSC-3	0.045	0.032	5.3	0.036	<0.010	<0.010		0.86	6.8	0.23	0.21	<0.010	0.029	
			Average Concentration (mg/L)	0.023	0.032	5.4	0.035	0.0036	ND	-	0.86	6.9	0.22	0.20	ND	0.037	
			Standard Deviation (mmoles)	3.0E-05	7.1E-07	2.4E-04	5.3E-06	2.2E-05	0.0E+00	-	9.3E-05	3.2E-04	1.7E-05	6.4E-05	0.0E+00	5.1E-04	
			Average Total mmoles	0.000030	0.000050	0.011	0.000081	0.000013	ND	1.1E-02	0.0014	0.014	0.00045	0.00064	ND	0.0017	
Anaerobic Active Control	13-Apr-11																Amended the first replicate with resazurin.
	19-Apr-11	-1						r	-		r						Spiked with cDCE, 1,1-DCA and 1,1,1-TCA to target concentrations of 3, 10 and 2 ppm respectively.
	20-Apr-11	0	ANAC-1	0.013	0.081	6.9	0.043	0.030	<0.010	-	1.4	9.3	0.58	0.51	<0.010	0.030	
											1.4	8.3					
			ANAC-2	0.011	0.074	7.2	0.039	0.027	<0.010	-			0.54	0.47	<0.010	0.028	
			ANAC-3	0.042	0.081	6.9	0.042	0.028	0.012	-	1.6	8.7	0.63	0.45	<0.010	0.027	_
			ANAC-3 Average Concentration (mg/L)	0.042	0.081	6.9 7.0	0.042	0.028	0.012	-	1.4	8.7 8.8	0.63 0.58	0.45	<0.010 ND	0.027	-
			ANAC-3 Average Concentration (mg/L) Standard Deviation (mmoles)	0.042 0.022 2.3E-05	0.081 0.079 6.1E-06	6.9 7.0 3.7E-04	0.042 0.042 4.8E-06	0.028 0.028 4.9E-06	0.012 0.0038 8.8E-05		1.4 1.7E-04	8.7 8.8 1.1E-03	0.63 0.58 9.7E-05	0.45 0.48 1.1E-04	<0.010 ND 0.0E+00	0.027 0.028 7.7E-05	-
	01.11		ANAC-3 Average Concentration (mg/L) Standard Deviation (mmoles) Average Total mmoles	0.042 0.022 2.3E-05 0.000029	0.081 0.079 6.1E-06 0.00013	6.9 7.0 3.7E-04 0.015	0.042 0.042 4.8E-06 0.000095	0.028 0.028 4.9E-06 0.000099	0.012 0.0038 8.8E-05 0.000051	-	1.4 1.7E-04 0.0024	8.7 8.8 1.1E-03 0.018	0.63 0.58 9.7E-05 0.0012	0.45 0.48 1.1E-04 0.0015	<0.010 ND 0.0E+00 ND	0.027 0.028 7.7E-05 0.0013	
	04-May-11	14	ANAC-3 Average Concentration (mg/L) Standard Deviation (mmoles) Average Total mmoles ANAC-1	0.042 0.022 2.3E-05 0.000029 0.029	0.081 0.079 6.1E-06 0.00013 0.10	6.9 7.0 3.7E-04 0.015 6.6	0.042 0.042 4.8E-06 0.00095 0.062	0.028 0.028 4.9E-06 0.000099 0.031	0.012 0.0038 8.8E-05 0.000051 <0.010	 1.5E-02 	1.4 1.7E-04 0.0024 1.3	8.7 8.8 1.1E-03 0.018 9.1	0.63 0.58 9.7E-05 0.0012 0.63	0.45 0.48 1.1E-04 0.0015 0.52	<0.010 ND 0.0E+00 ND <0.010	0.027 0.028 7.7E-05 0.0013 0.027	-
	04-May-11	14	ANAC-3 Average Concentration (mg/L) Standard Deviation (mmoles) Average Total mmoles ANAC-1 ANAC-2	0.042 0.022 2.3E-05 0.000029 0.029 <0.010	0.081 0.079 6.1E-06 0.00013 0.10 0.087	6.9 7.0 3.7E-04 0.015 6.6 6.0	0.042 0.042 4.8E-06 0.000095 0.062 0.055	0.028 0.028 4.9E-06 0.000099 0.031 0.029	0.012 0.0038 8.8E-05 0.000051 <0.010 <0.010		1.4 1.7E-04 0.0024 1.3 1.3	8.7 8.8 1.1E-03 0.018 9.1 8.7	0.63 0.58 9.7E-05 0.0012 0.63 0.56	0.45 0.48 1.1E-04 0.0015 0.52 0.48	<0.010 ND 0.0E+00 ND <0.010 <0.010	0.027 0.028 7.7E-05 0.0013 0.027 0.033	-
	04-May-11	14	ANAC-3 Average Concentration (mg/L) Standard Deviation (mmoles) Average Total mmoles ANAC-1 ANAC-2 ANAC-3	0.042 0.022 2.3E-05 0.000029 <0.029 <0.010 0.029	0.081 0.079 6.1E-06 0.00013 0.10 0.087 0.081	6.9 7.0 3.7E-04 0.015 6.6 6.0 6.5	0.042 0.042 4.8E-06 0.00095 0.062 0.055 0.048	0.028 0.028 4.9E-06 0.000099 0.031 0.029 0.027	0.012 0.0038 8.8E-05 0.000051 <0.010 <0.010 <0.010	 - 1.5E-02 	1.4 1.7E-04 0.0024 1.3 1.3 1.3 1.4	8.7 8.8 1.1E-03 0.018 9.1 8.7 8.7	0.63 0.58 9.7E-05 0.0012 0.63 0.56 0.58	0.45 0.48 1.1E-04 0.0015 0.52 0.48 0.42	<0.010 ND 0.0E+00 ND <0.010 <0.010 <0.010	0.027 0.028 7.7E-05 0.0013 0.027 0.033 0.027	-
	04-May-11	14	ANAC-3 Average Concentration (mg/L) Standard Deviation (mmoles) Average Total mmoles ANAC-1 ANAC-3 ANAC-3 AvAC-3 Average Concentration (mg/L)	0.042 0.022 2.3E-05 0.009 <0.029 <0.010 0.029 0.029 0.019	0.081 0.079 6.1E-06 0.00013 0.10 0.087 0.081 0.090	6.9 7.0 3.7E-04 0.015 6.6 6.0 6.5 6.4	0.042 0.042 4.8E-06 0.00095 0.062 0.055 0.048 0.055	0.028 0.028 4.9E-06 0.000099 0.031 0.029 0.027 0.029	0.012 0.0038 8.8E-05 0.000051 <0.010 <0.010 <0.010 ND	 1.5E-02 	1.4 1.7E-04 0.0024 1.3 1.3 1.4 1.3	8.7 8.8 1.1E-03 0.018 9.1 8.7 8.7 8.9	0.63 0.58 9.7E-05 0.0012 0.63 0.56 0.58 0.59	0.45 0.48 1.1E-04 0.52 0.48 0.42 0.47	<0.010 ND 0.0E+00 ND <0.010 <0.010 <0.010 ND	0.027 0.028 7.7E-05 0.0013 0.027 0.033 0.027 0.029	-
	04-May-11	14	ANAC-3 Average Concentration (mg/L) Standard Deviation (mmdles) Average Total mmoles ANAC-1 ANAC-2 ANAC-3 Average Concentration (mg/L) Standard Deviation (mmoles)	0.042 0.022 2.3E-05 0.029 <0.010 0.029 <0.010 0.029 0.019 2.2E-05	0.081 0.079 6.1E-06 0.00013 0.10 0.087 0.081 0.090 1.7E-05	6.9 7.0 3.7E-04 0.015 6.6 6.0 6.5 6.4 6.4 6.4E-04	0.042 0.042 4.8E-06 0.00095 0.062 0.055 0.048 0.055 1.6E-05	0.028 0.028 4.9E-06 0.000099 0.031 0.029 0.027 0.029 7.2E-06	0.012 0.0038 8.8E-05 0.000051 <0.010 <0.010 <0.010 ND 0.0E+00	 1.5E-02 	1.4 1.7E-04 0.0024 1.3 1.3 1.4 1.3 7.4E-05	8.7 8.8 1.1E-03 9.1 8.7 8.7 8.7 8.9 5.2E-04	0.63 0.58 9.7E-05 0.0012 0.63 0.56 0.58 0.59 8.0E-05	0.45 0.48 1.1E-04 0.0015 0.52 0.48 0.42 0.47 1.5E-04	<0.010 ND 0.0E+00 ND <0.010 <0.010 <0.010 ND 0.0E+00	0.027 0.028 7.7E-05 0.0013 0.027 0.033 0.027 0.029 1.7E-04	-
			ANAC-3 Average Concentration (mg/L) Standard Deviation (mmoles) Average Total mmoles ANAC-1 ANAC-2 ANAC-2 ANAC-3 Average Concentration (mg/L) Standard Deviation (mmoles) Average Total mmoles	0.042 0.022 2.3E-05 0.000029 <0.010 0.029 0.019 2.2E-05 0.000025	0.081 0.079 6.1E-06 0.00013 0.10 0.087 0.081 0.090 1.7E-05 0.00014	6.9 7.0 3.7E-04 0.015 6.6 6.0 6.5 6.4 6.4 6.4E-04 0.014	0.042 0.042 4.8E-06 0.00095 0.062 0.055 0.048 0.055 1.6E-05 0.00013	0.028 0.028 4.9E-06 0.000099 0.031 0.029 0.027 0.029 7.2E-06 0.0001	0.012 0.0038 8.8E-05 0.000051 <0.010 <0.010 <0.010 ND 0.0E+00 ND	 	1.4 1.7E-04 0.0024 1.3 1.3 1.4 1.3 7.4E-05 0.0022	8.7 8.8 1.1E-03 9.1 8.7 8.7 8.7 8.9 5.2E-04 0.018	0.63 0.58 9.7E-05 0.0012 0.63 0.56 0.58 0.59 8.0E-05 0.0012	0.45 0.48 1.1E-04 0.0015 0.52 0.48 0.42 0.47 1.5E-04 0.0015	<0.010 ND 0.0E+00 ND <0.010 <0.010 <0.010 ND 0.0E+00 ND	0.027 0.028 7.7E-05 0.0013 0.027 0.033 0.027 0.029 1.7E-04 0.0013	-
	04-May-11 17-May-11		ANAC-3 Average Concentration (mg/L) Standard Deviation (mmoles) Average Total mmoles ANAC-1 ANAC-3 AVAC-3 Average Concentration (mg/L) Standard Deviation (mmoles) Average Total mmoles ANAC-1	0.042 0.022 2.3E-05 0.000029 <0.010 0.029 0.019 2.2E-05 0.000025 <0.010	0.081 0.079 6.1E-06 0.00013 0.10 0.087 0.081 0.090 1.7E-05 0.00014 0.10	6.9 7.0 3.7E-04 0.015 6.6 6.0 6.5 6.4 6.4 6.4E-04 0.014 8.4	0.042 0.042 4.8E-06 0.00095 0.062 0.055 0.048 0.055 1.6E-05 0.00013 0.084	0.028 0.028 4.9E-06 0.000099 0.031 0.029 0.027 0.029 7.2E-06 0.0001 0.029	0.012 0.0038 8.8E-05 0.000051 <0.010 <0.010 <0.010 ND 0.0E+00 ND <0.010	 1.5E-02 	1.4 1.7E-04 0.0024 1.3 1.3 1.4 1.3 7.4E-05 0.0022 1.2	8.7 8.8 1.1E-03 9.1 8.7 8.7 8.7 5.2E-04 0.018 8.8	0.63 0.58 9.7E-05 0.0012 0.63 0.56 0.58 0.59 8.0E-05 0.0012 0.59	0.45 0.48 1.1E-04 0.0015 0.52 0.48 0.42 0.47 1.5E-04 0.0015 0.49	<0.010 ND 0.0E+00 ND <0.010 <0.010 <0.010 0.0E+00 ND <0.010	0.027 0.028 7.7-05 0.0013 0.027 0.027 0.027 0.029 1.7E-04 0.0013 0.030	-
			ANAC-3 Average Concentration (mg/L) Standard Deviation (mm/e) Average Total mmoles ANAC-1 ANAC-2 ANAC-3 Average Concentration (mg/L) Standard Deviation (mm/es) Average Total mmoles ANAC-1 ANAC-2	0.042 0.022 2.3E-05 0.000029 0.029 0.010 0.029 0.019 2.2E-05 0.000025 <0.010 0.079	0.081 0.079 6.1E-06 0.00013 0.10 0.087 0.081 0.090 1.7E-05 0.00014 0.10 0.095	6.9 7.0 3.7E-04 0.015 6.6 6.0 6.5 6.4 6.4E-04 0.014 8.4 5.8	0.042 0.042 4.8E-06 0.000095 0.062 0.055 0.048 0.055 1.6E-05 0.00013 0.084 0.057	0.028 0.028 4.9E-06 0.000099 0.031 0.029 0.027 0.029 7.2E-06 0.0001 0.029 0.028	0.012 0.0038 8.8E-05 0.000051 <0.010 <0.010 <0.010 0.0E+00 ND <0.010 <0.010	 1.4E-02 	1.4 1.7E-04 0.0024 1.3 1.3 1.4 1.3 7.4E-05 0.0022	8.7 8.8 1.1E-03 9.1 8.7 8.7 8.7 8.9 5.2E-04 0.018	0.63 0.58 9.7E-05 0.0012 0.63 0.56 0.58 0.59 8.0E-05 0.0012 0.59 0.58	0.45 0.48 1.1E-04 0.0015 0.52 0.48 0.42 0.47 1.5E-04 0.0015 0.49 0.46	<0.010 ND 0.0E+00 ND <0.010 <0.010 <0.010 ND 0.0E+00 ND <0.010 <0.010	0.027 0.028 7.7E-05 0.0013 0.027 0.033 0.027 0.029 1.7E-04 0.0013 0.030 0.030	-
			ANAC-3 Average Concentration (mg/L) Standard Deviation (mmoles) Average Total mmoles ANAC-1 ANAC-2 ANAC-2 Average Concentration (mg/L) Standard Deviation (mmoles) Average Total mmoles Average Total mmoles ANAC-3 ANAC-3	0.042 0.022 2.3E-05 0.000029 <0.010 0.029 0.019 2.2E-05 0.000025 <0.010 0.079 0.027	0.081 0.079 6.1E-06 0.00013 0.10 0.087 0.081 0.090 1.7E-05 0.00014 0.10 0.095 0.087	6.9 7.0 3.7E-04 0.015 6.6 6.0 6.5 6.4 6.4E-04 0.014 8.4 5.8 6.0	0.042 0.042 4.8E-06 0.000095 0.062 0.055 0.048 0.055 1.6E-05 0.0084 0.057 0.056	0.028 0.028 4.9E-06 0.000099 0.031 0.029 0.027 0.029 7.2E-06 0.0001 0.029 0.028 0.022	0.012 0.0038 8.8E-05 0.000051 <0.010 <0.010 <0.010 0.0E+00 ND <0.010 <0.010 <0.010	 1.4E-02 	1.4 1.7E-04 0.0024 1.3 1.3 1.4 1.3 7.4E-05 0.0022 1.2 1.3 1.3	8.7 8.8 1.1E-03 9.1 8.7 8.7 5.2E-04 0.018 8.8 8.9 8.5	0.63 0.58 9.7E-05 0.0012 0.63 0.56 0.58 0.59 8.0E-05 0.0012 0.59 0.59 0.59	0.45 0.48 1.1E-04 0.0015 0.52 0.48 0.42 0.47 1.5E-04 0.0015 0.49 0.46 0.40	<0.010 ND 0.0E+00 ND <0.010 <0.010 <0.010 ND 0.0E+00 ND <0.010 <0.010 <0.010 <0.010 <0.010 <0.010	0.027 0.028 7.7E-05 0.0013 0.027 0.033 0.027 1.7E-04 0.0013 0.0013 0.031	
			ANGC-3 Average Concentration (mgL) Standard Deviation (mmdles) Average Total mmotes ANGC-1 ANGC-3 Average Concentration (mg/L) Standard Deviation (mmdles) Average Concentration (mg/L) ANGC-1 ANGC-3 AVerage Concentration (mg/L)	0.042 0.022 2.3E-05 0.00029 <0.010 0.029 <0.010 0.029 2.2E-05 0.000025 <0.010 0.079 0.027 0.035	0.081 0.079 6.1E-06 0.00013 0.10 0.087 0.081 0.090 1.7E-05 0.00014 0.10 0.095 0.087 0.095	6.9 7.0 3.7E-04 0.015 6.6 6.0 6.5 6.4 6.4E-04 0.014 6.4 5.8 6.0 6.1	0.042 0.042 4.8E-06 0.00095 0.062 0.055 0.048 0.055 1.6E-05 0.00013 0.064 0.057 0.056 0.059	0.028 0.028 4.9E-06 0.000099 0.031 0.029 0.027 0.029 7.2E-06 0.0001 0.029 0.028 0.022 0.028	0.012 0.0038 8.8E-05 0.000051 <0.010 <0.010 <0.010 ND 0.0E+00 ND <0.010 <0.010 <0.010 <0.010 ND	 1.4E-02 	1.4 1.7E-04 0.0024 1.3 1.3 1.4 1.3 7.4E-05 0.0022 1.2 1.3 1.3 1.3 1.3	8.7 8.8 1.1E-03 9.1 8.7 8.7 8.9 5.2E-04 0.018 8.8 8.8 8.9 8.5 8.7	0.63 0.58 9.7E-05 0.0012 0.63 0.56 0.58 0.59 8.0E-05 0.0012 0.59 0.58 0.59 0.59 0.59	0.45 0.48 1.1E-04 0.0015 0.52 0.48 0.42 0.47 1.5E-04 0.49 0.49 0.46 0.40 0.45	<0.010 ND 0.0E+00 ND <0.010 <0.010 <0.010 0.0E+00 ND 0.0E+00 ND <0.010 <0.010 <0.010 ND	0.027 0.028 7.7E-05 0.0013 0.027 0.023 1.7E-04 0.029 1.7E-04 0.0013 0.030 0.031 0.031 0.031	-
			ANAC-3 Average Concentration (mg/L) Standard Deviation (mmoles) Average Total mmoles ANAC-1 Average Concentration (mg/L) Standard Deviation (mmoles) Average Total mmoles ANAC-3 ANAC-3 ANAC-3 ANAC-3 AVERGE Concentration (mg/L) Standard Deviation (mg/L)	0.042 0.022 2.3E-05 0.00029 <0.010 0.029 <0.010 0.029 2.2E-05 0.000025 <0.010 0.079 0.027 0.035 5.3E-05	0.081 0.079 6.1E-06 0.00013 0.10 0.087 0.081 0.090 1.7E-05 0.00014 0.10 0.095 0.087 0.095 1.2E-05	6.9 7.0 3.7E-04 0.015 6.6 6.0 6.5 6.4 6.4E-04 8.4 5.8 6.0 6.1 6.4E-04	0.042 0.042 4.8E-06 0.000095 0.062 0.055 0.048 0.055 1.6E-05 0.00013 0.084 0.057 0.056 0.059 9.2E-06	0.028 0.028 4.9E-06 0.000099 0.027 0.029 0.027 7.2E-06 0.0001 0.029 0.028 0.022 0.028 1.3E-05	0.012 0.0038 8.8E-05 0.000051 <0.010 <0.010 <0.010 ND 0.0E+00 ND <0.010 <0.010 <0.010 <0.010 <0.010 ND 0.0E+00	 1.5E-02 1.4E-02 	1.4 1.7E-04 0.0024 1.3 1.3 1.4 1.3 7.4E-05 0.0022 1.2 1.3 1.3 1.3 9.1E-05	8.7 8.8 1.1E-03 9.1 8.7 8.7 5.2E-04 0.018 8.8 8.9 8.5 8.5 8.7 3.9E-04	0.63 0.58 9.7E-05 0.0012 0.63 0.56 0.58 0.59 8.0E-05 0.0012 0.59 0.59 0.59 0.59 9.7E-06	0.45 0.48 1.1E-04 0.0015 0.52 0.48 0.42 0.47 1.5E-04 0.0015 0.49 0.46 0.40 0.45 1.4E-04	<0.010 ND 0.0E+00 ND <0.010 <0.010 <0.010 ND 0.0E+00 ND <0.010 <0.010 <0.010 <0.010 <0.010 <0.010	0.027 0.028 7.7E-05 0.0013 0.027 0.029 1.7E-04 0.0013 0.030 0.031 0.031 0.031 0.031 0.033	
	17-May-11	27	ANIC-3 Average Concertation (mpL) Standard Deviator (mmdes) Average Total mmoles ANIC-1 ANIC-2 ANIC-3 Standard Deviator (mmdes) Average Concertation (mpL) Standard Deviator (mmdes) ANIC-1 ANIC-3 AVEG2 Average Concentration (mpL) Standard Deviator (mmdes) Average Concentration (mpL) Standard Deviator (mmdes) Average Concentration (mpL)	0.042 0.022 2.3E-05 0.000029 <0.010 0.029 0.019 2.2E-05 0.000025 <0.010 0.079 0.027 0.035 5.3E-05 0.000047	0.081 0.079 6.1E-06 0.00013 0.087 0.081 0.090 1.7E-05 0.095 0.095 0.095 0.095 0.095 0.095 0.095	6.9 7.0 3.7E-04 0.015 6.6 6.6 6.6 6.5 6.4 6.4 6.4 5.8 6.4 6.4 5.8 6.0 6.1 6.4 6.4 5.8 6.1 6.4 1.0 6.1 6.4 2.04 0.013	0.042 0.042 4.8E-06 0.00095 0.065 0.055 0.048 0.055 1.6E-05 0.00013 0.064 0.057 0.056 0.056 0.056 0.056 0.02013	0.028 0.028 4.9E-06 0.000099 0.031 0.029 0.027 0.029 7.2E-06 0.0001 0.029 0.028 0.022 0.028 0.022 0.022 0.022 0.022	0.012 0.0038 8.8E-05 0.000051 <0.010 <0.010 0.0E+00 ND <0.010 <0.010 <0.010 <0.010 ND ND ND	 1.4E-02 	1.4 1.7E-04 0.0024 1.3 1.3 1.3 1.4 1.3 7.4E-05 0.0022 1.2 1.3 1.3 9.1E-05 0.0021	8.7 8.8 1.1E-03 0.018 8.7 8.7 8.9 5.2E-04 0.018 8.8 8.9 8.5 8.7 3.9E-04 0.018	0.63 0.58 9.7E-05 0.0012 0.63 0.56 0.58 0.59 8.0E-05 0.0012 0.59 0.59 0.58 0.59 0.59 9.7E-06 0.0012	0.45 0.48 1.1E-04 0.0015 0.52 0.48 0.42 0.47 1.5E-04 0.49 0.46 0.49 0.46 0.40 0.45 1.4E-04 0.0015	<0.010 ND 0.0E+00 ND <0.010 <0.010 <0.010 ND 0.0E+00 ND <0.010 <0.010 <0.010 ND 0.0E+00 ND 0.0E+00 ND	0.027 0.028 7.7E-05 0.0013 0.027 0.029 1.7E-04 0.0013 0.030 0.031 0.031 0.031 0.030 0.031 0.030 2.4E-05 0.0014	
		27	ANAC-3 Average Concentration (mg/L) Standard Deviation (mmoles) Average Total mmoles ANAC-1 Average Concentration (mg/L) Standard Deviation (mmoles) Average Total mmoles ANAC-3 ANAC-3 ANAC-3 ANAC-3 AVERGE Concentration (mg/L) Standard Deviation (mg/L)	0.042 0.022 2.3E-05 0.000029 <0.010 0.029 <0.010 0.019 2.2E-05 0.000025 <0.010 0.079 0.027 0.035 5.3E-05 0.000047 0.044	0.081 0.079 6.1E-06 0.00013 0.087 0.087 0.090 1.7E-05 0.09014 0.095 1.2E-05 0.0095 1.2E-05 0.00015 0.025	6.9 7.0 3.7E-04 0.015 6.6 6.0 6.5 6.4 6.4 6.4 6.4 6.4 6.4 6.4 6.4 6.4 6.4	0.042 0.042 4.8E-06 0.000995 0.062 0.055 0.045 0.055 1.8E-05 0.00013 0.056 0.059 9.2E-06 0.00013 0.068	0.028 0.028 4.9E-06 0.000099 0.031 0.029 0.027 7.2E-06 0.0001 0.029 0.028 0.022 0.026 1.3E-05 0.00099	0.012 0.0038 8.8E-05 0.000051 <0.010 <0.010 <0.010 ND 0.0E+00 ND <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.0010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0	 1.5E-02 1.4E-02 	1.4 1.7E-04 0.0024 1.3 1.3 1.4 1.3 7.4E-05 0.0022 1.3 1.3 1.3 1.3 9.1E-05 0.0022 1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3	8.7 8.8 1.1E-03 0.018 9.1 8.7 8.9 5.2E-04 0.018 8.8 9 8.5 8.7 3.9E-04 0.018 8.6	0.63 0.58 9.7E-05 0.0012 0.63 0.56 0.58 8.0E-05 0.0012 0.59 0.59 0.59 0.59 9.7E-06	0.45 0.48 1.1E-04 0.0015 0.52 0.48 0.42 0.47 1.5E-04 0.0015 0.49 0.46 0.40 0.45 1.4E-04	<0.010 ND 0.0E+00 ND <0.010 <0.010 <0.010 0.0E+00 ND <0.010 <0.010 <0.010 ND 0.0E+00 ND	0.027 0.028 7.7E-05 0.0073 0.027 0.027 0.027 0.027 0.029 0.021 0.021 0.021 0.021 0.021 0.021 0.031 0.031 0.031 0.031 0.031 0.031 0.031 0.031 0.031	
	17-May-11	27	ANIC-3 Average Concertation (mpl/L) Standard Deviation (mmles) Average Total mmoles ANIC-1 ANIC-3 Average Concentration (mpl/L) Standard Deviation (mmles) ANIC-2 Average Concentration (mpl/L) Average Concentration (mpl/L) Average Total mmoles ANIC-1	0.042 0.022 2.3E-05 0.00029 0.029 0.019 2.2E-05 0.00025 0.019 2.2E-05 0.00025 5.3E-05 0.000047 0.037	0.081 0.079 6.1E-06 0.00013 0.087 0.081 0.087 0.081 0.095 1.7E-05 0.087 0.095 1.2E-05 0.095 1.2E-05 0.012 0.077	6.9 7.0 3.7E-04 0.015 6.6 6.6 6.6 6.5 6.4 6.4 6.4 5.8 6.4 6.4 5.8 6.0 6.1 6.4 6.4 5.8 6.1 6.4 1.0 6.1 6.4 2.04	0.042 0.042 4.8E-06 0.062 0.055 0.062 0.055 1.6E-05 0.0013 0.056 0.057 0.056 0.057 0.056 0.059 9.2E-06 0.0051 0.058	0.028 0.028 4.9E-06 0.031 0.029 0.027 0.029 7.2E-06 0.0001 0.029 0.028 0.022 0.028 0.022 0.022 1.3E-05 0.00091 0.029	0.012 0.0038 8.8E-05 0.000051 <0.010 <0.010 <0.010 ND <0.010 <0.010 <0.010 <0.010 <0.010 ND 0.0E+00 ND 0.0E+00 ND <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.000 ND <0.010 <0.010 <0.010 <0.010 <0.000 ND <0.010 <0.010 <0.010 <0.010 <0.010 <0.000 ND <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010	 	1.4 1.7E-04 0.0024 1.3 1.3 1.3 1.4 1.3 7.4E-05 0.0022 1.2 1.3 1.3 9.1E-05 0.0021	8.7 8.8 1.1E-03 0.018 8.7 8.7 8.9 5.2E-04 0.018 8.8 8.9 8.5 8.7 3.9E-04 0.018	0.63 0.58 9.7E-05 0.0012 0.63 0.56 0.59 8.0E-05 0.0012 0.59 0.59 0.59 9.7E-06 0.59 0.59 0.59 0.59 0.59	0.45 0.48 1.1E-04 0.0015 0.52 0.48 0.42 0.47 1.5E-04 0.49 0.46 0.49 0.46 0.40 0.45 0.45	<0.010 ND 0.0E+00 ND <0.010 <0.010 <0.010 ND 0.0E+00 ND <0.010 <0.010 <0.010 ND 0.0E+00 ND 0.0E+00 ND 0.0E+00 ND 0.0E+00 ND 0.00E+00 ND 0.0E+00 ND 0.0E+00 ND 0.0E+00 ND 0.0E+00 ND 0.0E+00 ND 0.0E+00 ND 0.0E+00 ND 0.0E+00 ND 0.0E+00 ND 0.0E+00 ND 0.0E+00 ND 0.0E+00 ND 0.0E+00 ND 0.0E+00 ND 0.0E+00 ND 0.0E+00 ND 0.0E+00 ND 0.0E+00 ND 0.0E+00 ND 0.0E+00 ND 0.0E+00 ND 0.0E+00 ND 0.0E+00 ND 0.0E+00 ND 0.0E+00 ND 0.0E+00 ND 0.0E+00 ND 0.0E+00 ND 0.0E+00 ND 0.0E+00 ND 0.0E+00 ND 0.0E+00 ND 0.0E+00 ND 0.0E+00 ND 0.0E+00 ND 0.0E+00 ND 0.0E+00 ND 0.0E+00 ND 0.0E+00 ND 0.0E+00 ND 0.0E+00 ND 0.0E+00 ND 0.0E+00 ND 0.0E+00 ND 0.0E+00 ND 0.0E+00 ND 0.0E+00 ND 0.0E+00 ND 0.0E+00 ND 0.000 0.0E+00 ND 0.000 ND 0.000 ND 0.000 ND 0.000 ND 0.000 ND 0.000 ND 0.000 ND 0.000 ND 0.0000 ND 0.000 ND 0.000 ND 0.000 ND 0.000 ND 0.000 ND 0.000 ND 0.000 ND 0.000 ND 0.000 ND 0.000 ND 0.000 ND 0.000 ND 0.000 ND 0.000 ND 0.000 ND 0.000 ND 0.000 ND	0.027 0.028 7.7E-05 0.0013 0.027 0.029 1.7E-04 0.029 0.029 0.029 0.029 0.031 0.031 0.031 0.031 0.030 2.4E-05 0.0054 0.028	
	17-May-11	27	ANIC-3 Average Concertation (mpl/s) Stindard Deviation (mmles) Average Total mmoles ANIC-1 ANIC-3 Average Concertation (mpl/s) Stindard Deviation (mmles) Average Concertation (mpl/s) Average Concertation (mpl/s) Average Concertation (mpl/s) Average Total mmoles ANIC-2 ANIC-2 ANIC-3 AVERAGE Concertation (mpl/s) Average Total mmoles ANIC-2 ANIC-3	0.042 0.022 2.3E-05 0.000029 <0.010 0.029 <0.010 0.019 2.2E-05 0.000025 <0.010 0.079 0.027 0.035 5.3E-05 0.000047 0.044	0.081 0.079 6.1E-06 0.00013 0.087 0.087 0.090 1.7E-05 0.09014 0.095 1.2E-05 0.0095 1.2E-05 0.00015 0.025	6.9 7.0 3.7E-04 6.6 6.0 6.5 6.4 6.4E-04 0.014 6.4 5.8 6.4 6.4 5.8 6.1 6.4 6.1 6.4 E-04 0.013 6.2	0.042 0.042 4.8E-06 0.000995 0.062 0.055 0.045 0.055 1.8E-05 0.00013 0.056 0.059 9.2E-06 0.00013 0.068	0.028 0.028 4.9E-06 0.000099 0.031 0.029 0.027 7.2E-06 0.0001 0.029 0.028 0.022 0.026 1.3E-05 0.00099	0.012 0.0038 8.8E-05 0.000051 <0.010 <0.010 <0.010 ND 0.0E+00 ND <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.0010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0	 	1.4 1.7E-04 0.0024 1.3 1.3 1.4 1.3 7.4E-05 0.0021 1.2 1.3 1.3 9.1E-05 0.0021 1.1	8.7 8.8 1.1E-04 9.1 8.7 8.7 5.2E-04 0.018 8.8 8.9 5.2E-04 0.018 8.5 8.7 3.9E-04 0.018 8.6 8.6 8.4	0.63 0.58 9.7E-05 0.0012 0.63 0.59 8.0E-05 0.0012 0.59 0.59 0.59 0.59 0.59 0.59 0.59 9.7E-06 0.0012 0.69 0.59	0.45 0.48 1.1E-04 0.6015 0.52 0.42 0.47 1.5E-04 0.49 0.46 0.49 0.46 0.49 0.45 1.4E-04 0.45 1.4E-04 0.45	<0.010 ND 0.0E+00 ND <0.010 <0.010 0.0E+00 ND 0.0E+00 ND 0.0E+00 ND 0.0E+00 ND 0.0E+00 ND	0.027 0.028 7.7E-05 0.0073 0.027 0.027 0.027 0.027 0.029 0.021 0.021 0.021 0.021 0.021 0.021 0.031 0.031 0.031 0.031 0.031 0.031 0.031 0.031 0.031	
	17-May-11	27	ANVC-3 Average Concertation (mpL) Standard Deviation (mmLes) Average Total mmoles ANAC-1 ANAC-2 ANAC-3 Average Concertation (mpL) Standard Deviation (mmLes) AVAC-1 ANAC-3 Average Concentration (mpL) Standard Deviation (mmLes) AVAC-1 AVAC-3 Average Concentration (mpL) ANAC-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVARG-3 AVA	0.042 0.022 2.3E-05 0.000029 0.029 0.019 0.019 0.019 0.019 0.079 0.027 0.035 5.3E-05 0.000047 0.028 0.044 0.028 0.037	0.081 0.079 6.1E-06 0.00013 0.081 0.090 1.7E-05 0.00014 0.090 1.7E-05 0.087 0.095 1.2E-05 0.025 1.2E-05 0.12 0.077 0.081	6.9 7.0 3.7E-04 0.015 6.6 6.0 6.5 6.4 6.4E-04 0.014 6.3 6.2 6.2	0.042 0.042 4.8E-06 0.062 0.055 0.055 0.055 1.8E-05 0.064 0.057 0.056 0.059 9.2E-06 0.059 9.2E-06 0.0059 0.059 0.068 0.071 0.068 0.067	0.028 0.028 4.9E-06 0.00099 0.031 0.029 0.027 0.029 0.028 0.0001 0.029 0.028 0.022 0.026 1.3E-05 0.00001 0.029 0.028 0.022 0.026 1.3E-05 0.00001 0.029 0.029 0.029 0.022 0.027	0.012 0.0038 8.8E-05 0.0010 <0.010 <0.010 ND 0.0E+00 ND <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 ND 0.0E+00 ND 0.0E+00 ND 0.0E+00 ND 0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 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0.59 0.	0.45 0.48 1.1E-04 0.0015 0.52 0.48 0.42 0.47 1.5E-04 0.49 0.46 0.49 0.46 0.40 0.45 1.4E-04 0.0015 0.45 0.45 0.45 0.42	<0.010 ND 0.0E+00 ND 0.0E+00 ND 0.0E+00 ND 0.0E+00 ND 0.0E+00 ND 0.0E+00 ND 0.0E+00 ND 0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 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0.031 0.031 0.031 0.030 2.4E-05 0.0054 0.028 0.028 0.028 0.028	
	17-May-11	27	ANUC-3 Average Concertation (mpl/b) Stindard Deviation (mmdes) Average Total mmoles ANUC-1 ANUC-3 Average Concentration (mpl/b) Stindard Deviation (mmdes) AVEC-1 Average Concentration (mpl/b) Average Concentration (mpl/b) Average Total mmoles ANUC-1 AVEC-2 ANUC-2 AVEC-2 AVEC-3 Average Concentration (mpl/b) Average Concentration (mpl/b) Average Concentration (mpl/b)	0.042 0.022 2.3E-05 0.000029 0.029 0.010 0.029 0.010 2.2E-05 0.000025 0.071 0.027 0.027 0.027 0.027 0.027 0.027 0.027 0.027 0.027 0.027 0.027 0.027 0.027 0.027 0.027 0.027 0.029 0.071 0.029 0.071 0.029 0.071 0.029 0.071 0.029 0.029 0.029 0.029 0.029 0.029 0.029 0.029 0.029 0.029 0.029 0.029 0.029 0.029 0.029 0.029 0.029 0.029 0.029 0.029 0.029 0.029 0.029 0.029 0.029 0.029 0.029 0.029 0.029 0.029 0.029 0.029 0.029 0.029 0.029 0.029 0.029 0.029 0.029 0.029 0.029 0.029 0.029 0.029 0.029 0.029 0.029 0.029 0.029 0.029 0.029 0.029 0.029 0.029 0.029 0.029 0.029 0.029 0.029 0.029 0.029 0.029 0.029 0.029 0.027 0.027 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	17-May-11 15-Jun-11	27	ANVC-3 Average Concertation (mpL) Standard Deviation (mmLes) Average Total mmoles ANAC-1 ANAC-3 Average Concertation (mpL) Standard Deviation (mmLes) Average Concertation (mpL) Average Concentration (mpL) Standard Deviation (mmLes) Average Concentration (mpL)	0.042 0.022 2.3E-05 0.000029 0.029 0.019 2.2E-05 0.000025 0.079 0.079 0.079 0.079 0.035 5.3E-05 0.000025 0.000025 0.000025 0.000025 0.000025 0.000025 0.000025 0.000025 0.000025 0.000025 0.000025 0.000025 0.000025 0.000025 0.000025 0.000025 0.000025 0.000025 0.000025 0.000025 0.000025 0.000025 0.000025 0.000025 0.000025 0.000025 0.000025 0.000025 0.000025 0.000025 0.000025 0.000025 0.000025 0.000025 0.000025 0.000025 0.000025 0.000025 0.000025 0.000025 0.000025 0.000025 0.000025 0.000025 0.000025 0.000025 0.000025 0.000025 0.000025 0.000025 0.000025 0.000025 0.000025 0.000025 0.000025 0.000025 0.000025 0.000025 0.000025 0.000025 0.000025 0.000025 0.000025 0.000025 0.000025 0.000025 0.000025 0.000025 0.000025 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	17-May-11	27	ANUC-3 Average Concertation (mpl/) Stindard Deviation (mm/dea) Average Total mmoles ANUC-1 ANUC-3 ANUC-3 Average Concentration (mpl/) Stindard Deviation (mm/dea) AVEC-1 Average Concentration (mpl/) Average Total mmoles ANUC-1 Average Concentration (mpl/) Average Total mmoles ANUC-2 ANUC-2 ANUC-2 AVEC-3 Average Concentration (mpl/) Average Concentration (mpl/)	0.042 0.022 .3E-05 0.00029 0.019 2.2E-05 0.0019 2.2E-05 0.0019 0.027 0.035 5.3E-05 0.000047 0.035 5.3E-05 0.000047 0.037 1.1E-05 0.00049	0.081 0.079 6.1E-05 0.087 0.081 0.080 0.080 0.080 0.080 0.095 0.095 0.095 0.095 0.095 0.095 0.077 0.077 0.077 0.094 4.2E-05 0.094	6.9 7.0 3.7E-04 0.015 6.6 6.0 6.5 6.4 6.4 6.4 6.4 6.4 6.4 6.4 6.4 6.1 6.1 6.4 6.0 6.1 6.3 6.3 6.2 2.7E-04 0.013	0.042 0.042 4.8E-06 0.055 0.062 0.055 0.048 0.055 1.6E-05 0.00913 0.057 0.056 0.059 9.2E-06 0.059 9.2E-06 0.063 0.071 0.063 0.067 9.8E-06 0.0065	0.028 0.028 4.9E-05 0.000999 0.031 0.029 0.027 0.029 0.028 0.028 0.028 0.022 0.028 0.022 0.028 0.022 0.026 0.027 0.026 0.027 0.026 0.027	0.012 0.0038 8.8E-05 0.00051 <0.010 <0.010 ND 0.0E+00 ND 0.0E+00 ND 0.0E+00 ND 0.0E+00 ND 0.0E+00 ND 0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <		1.4 1.7E-04 0.0024 1.3 1.3 1.4 1.3 1.4 1.3 7.4E-05 0.0022 1.2 1.3 1.3 9.1E-05 0.0021 1.1 1.1 1.1 1.1 1.1 3.7E-05 0.0021	8.7 8.8 9.1 8.7 8.7 5.2E-04 0.018 8.9 8.5 9 5.2E-04 0.018 8.8 9 8.5 8.7 3.9E-04 0.018 8.4 8.4 5.3E-04 0.018 7.8	0.63 0.58 9.7E-05 0.0012 0.63 0.56 0.58 0.58 0.59 0.59 0.59 0.59 0.59 0.59 0.59 0.59	0.45 0.48 1.1E-04 0.62 0.48 0.42 0.47 1.5E-04 0.49 0.46 0.49 0.46 0.40 0.45 0.49 0.46 0.40 0.45 0.40 0.45 0.44 0.0015	<0.010	0.027 0.028 7.7E-05 0.0073 0.027 0.029 1.7E-04 0.0073 0.029 0.029 0.029 0.031 0.031 0.031 0.031 0.031 0.031 0.031 0.031 0.031 0.028 0.028 0.028 0.028 0.028	
	17-May-11 15-Jun-11	27	ANUC-3 Average Concertation (mpl/) Stindard Deviation (mm/dea) Average Total mmoles ANUC-1 ANUC-3 Average Concentration (mpl/) Stindard Deviation (mm/dea) AVEC-2 AVEC-2 AVEC-2 AVEC-2 AVEC-2 AVEC-2 AVEC-2 AVEC-2 AVEC-2 AVEC-2 AVEC-2 AVEC-2 AVEC-2 AVEC-2 AVEC-2 AVEC-2 AVEC-2 AVEC-2 AVEC-2 AVEC-2 AVEC-2 AVEC-2 AVEC-2 AVEC-2 AVEC-2 AVEC-2 AVEC-2 AVEC-2 AVEC-2 AVEC-2 AVEC-2 AVEC-2 AVEC-2 AVEC-2 AVEC-2 AVEC-2 AVEC-2 AVEC-2 AVEC-2 AVEC-2 AVEC-2 AVEC-2 AVEC-2 AVEC-2 AVEC-2 AVEC-2 AVEC-2 AVEC-2 AVEC-2 AVEC-2 AVEC-2 AVEC-2 AVEC-2 AVEC-2 AVEC-2 AVEC-2 AVEC-2 AVEC-2 AVEC-2 AVEC-2 AVEC-2 AVEC-2 AVEC-2 AVEC-2 AVEC-2 AVEC-2 AVEC-2 AVEC-2 AVEC-2 AVEC-2 AVEC-2 AVEC-2 AVEC-2 AVEC-2 AVEC-2 AVEC-2 AVEC-2 AVEC-2 AVEC-2 AVEC-2 AVEC-2 AVEC-2 AVEC-2 AVEC-2 AVEC-2 AVEC-2 AVEC-2 AVEC-2 AVEC-2 AVEC-2 AVEC-2 AVEC-2 AVEC-2 AVEC-2 AVEC-2 AVEC-2 AVEC-2 AVEC-2 AVEC-2 AVEC-2 AVEC-2 AVEC-2 AVEC-2 AVEC-2 AVEC-2 AVEC-2 AVEC-2 AVEC-2 AVEC-2 AVEC-2 AVEC-2 AVEC-2 AVEC-2 AVEC-2 AVEC-2 AVEC-2 AVEC-2 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AVEC-2 AVEC-2 AVEC-2 AVEC-2 AVEC-2 AVEC-2 AVEC-2 AVEC-2 AVEC-2 AVEC-2 A	0.042 0.022 2.3E-05 0.000029 0.029 0.019 2.2E-05 0.000025 0.079 0.079 0.079 0.079 0.035 5.3E-05 0.000025 0.000025 0.000025 0.000025 0.000025 0.000025 0.000025 0.000025 0.000025 0.000025 0.000025 0.000025 0.000025 0.000025 0.000025 0.000025 0.000025 0.000025 0.000025 0.000025 0.000025 0.000025 0.000025 0.000025 0.00025 0.000025 0.00025 0.00025 0.00025 0.00025 0.00025 0.00025 0.00025 0.00025 0.00025 0.00025 0.00025 0.00025 0.00025 0.00025 0.00025 0.00025 0.00025 0.00025 0.00025 0.00025 0.00025 0.00025 0.00025 0.00025 0.00025 0.00025 0.00025 0.00025 0.00025 0.00025 0.00025 0.00025 0.00025 0.00025 0.00025 0.00025 0.00025 0.00025 0.00025 0.00025 0.00025 0.00025 0.00025 0.00025 0.00025 0.00025 0.000025 0.000025 0.00005 0.00005 0.00005 0.00005 0.00005 0.00005 0.00005 0.00005 0.00005 0.00005 0.00005 0.00005 0.00005 0.00005 0.00005 0.00005 0.00005 0.00005 0.00005 0.00005 0.00005 0.00005 0.00005 0.00005 0.00005 0.00005 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0.0005 0.0005 0.0005 0.0005 0.0005 0.0005 0.0005 0.0005 0.0005 0.0005 0.0005 0.0005 0.0005 0.0005 0.0005 0.0005 0.0005 0.0000	0.081 0.079 6.1E-06 0.0807 0.087 0.081 0.090 1.7E-05 0.095 1.2E-05 0.095 1.2E-05 0.00015 0.021 0.021 0.021 0.021 0.021 0.021 0.021	6.9 7.0 37E-04 0.015 6.6 6.6 6.5 6.4 6.4 6.0 14 6.3 6.1 6.4 6.0 14 6.3 6.1 6.4 6.0 13 6.2 6.2 6.2 2.7 E-04 0.013 5.8	0.042 0.042 4.8E-06 0.055 0.055 1.6E-05 0.055 1.6E-05 0.055 1.6E-05 0.055 0.056 0.059 9.2E-06 0.00013 0.068 0.075 0.068 0.068 0.068 0.068 0.068 0.0663 0.0667 9.8E-06 0.00015	0.028 0.028 4.9E-06 0.031 0.029 0.027 0.029 0.027 0.029 0.028 0.022 0.026 0.026 1.3E-05 0.00091 0.029 0.027 0.026 0.027 0.026 0.027 0.026 0.027 0.026 0.027 0.026 0.027 0.026 0.027 0.026 0.027 0.026 0.027 0.026 0.027 0.026 0.027 0.026 0.027 0.026 0.027 0.026 0.026 0.027 0.026 0.026 0.026 0.026 0.026 0.026 0.026 0.026 0.026 0.026 0.026 0.026 0.026 0.026 0.026 0.026 0.026 0.026 0.026 0.026 0.026 0.026 0.026 0.026 0.026 0.026 0.026 0.026 0.026 0.026 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0.029 1.7E-04 0.0073 0.031 0.031 0.031 0.031 0.031 0.031 0.031 0.031 0.031 0.025 0.025 0.025 0.025 0.025 0.025 0.025 0.025	
	17-May-11 15-Jun-11	27	ANUC-3 Average Concentration (mpL/s) Standard Deviation (mm/des) AVAC-1 AVAC-2 AVAC-2 AVAC-2 AVAC-2 AVAC-2 AVAC-2 AVAC-2 AVAC-2 AVAC-2 AVAC-2 AVAC-2 AVAC-2 AVAC-2 AVAC-2 AVAC-2 AVAC-2 AVAC-2 AVAC-2 AVAC-2 AVAC-2 AVAC-2 AVAC-2 AVAC-2 AVAC-2 AVAC-2 AVAC-2 AVAC-2 AVAC-2 AVAC-2 AVAC-2 AVAC-2 AVAC-2 AVAC-2 AVAC-2 AVAC-2 AVAC-2 AVAC-2 AVAC-2 AVAC-2	0.042 0.022 3.3E-05 0.00029 0.029 0.019 2.2E-05 0.019 2.2E-05 0.019 2.2E-05 0.00047 0.035 5.3E-05 0.00047 0.035 0.337 1.1E-05 0.000047 0.037 1.1E-05 0.000047 0.037 1.1E-05 0.000049 0.037	0.081 0.079 6.1E-05 0.00013 0.087 0.081 0.090 1.7E-05 0.095 1.2E-05 0.095 1.2E-05 0.095 1.2E-05 0.094 4.2E-05 0.094 0.098 0.098 0.098	6.9 7.0 3.7E-04 0.015 6.6 6.0 6.5 6.4 6.4 6.4 6.4 6.4 6.4 6.4 6.1 6.1 6.1 6.2 6.2 2.7E-04 0.013 6.2 6.2 2.7E-04 0.5.8 6.1 5.8	0.042 0.042 4.8E-06 0.055 0.062 0.055 0.048 0.055 0.068 0.057 0.066 0.059 9.2E-06 0.059 9.2E-06 0.069 9.2E-06 0.066 0.067 9.8E-06 0.066 0.085 0.085	0.028 0.028 4.9E-05 0.000999 0.031 0.027 0.029 7.2E-06 0.0091 0.028 0.022 0.028 0.022 0.026 1.3E-05 0.00091 0.027 0.027 0.027 0.027 0.027 0.027 0.027 0.027 0.027 0.027 0.027 0.027 0.027 0.027 0.027 0.027 0.027 0.027 0.027 0.027 0.027 0.027 0.027 0.027 0.027 0.027 0.027 0.027 0.027 0.027 0.027 0.027 0.028 0.027 0.028 0.028 0.028 0.028 0.028 0.028 0.028 0.028 0.028 0.028 0.028 0.028 0.028 0.028 0.028 0.028 0.028 0.028 0.028 0.028 0.028 0.028 0.028 0.028 0.028 0.028 0.028 0.028 0.028 0.028 0.028 0.028 0.028 0.028 0.028 0.028 0.028 0.028 0.028 0.028 0.028 0.028 0.028 0.028 0.028 0.028 0.028 0.028 0.028 0.027 0.028 0.028 0.028 0.027 0.028 0.028 0.027 0.028 0.027 0.028 0.027 0.028 0.027 0.028 0.027 0.028 0.027 0.029 0.028 0.027 0.029 0.028 0.027 0.029 0.027 0.029 0.027 0.029 0.027 0.027 0.027 0.027 0.027 0.027 0.027 0.027 0.027 0.027 0.027 0.027 0.027 0.027 0.027 0.027 0.027 0.027 0.027 0.027 0.027 0.027 0.027 0.027 0.027 0.027 0.027 0.027 0.027 0.027 0.027 0.027 0.027 0.027 0.027 0.027 0.027 0.027 0.027 0.027 0.028 0.027 0.027 0.028 0.027 0.028 0.027 0.028 0.027 0.028 0.027 0.028 0.027 0.028 0.027 0.027 0.028 0.027 0.027 0.027 0.028 0.027 0.027 0.028 0.027 0.027 0.028 0.027 0.028 0.027 0.028 0.027 0.028 0.029 0.027 0.028 0.029 0.029 0.029 0.029 0.029 0.029 0.029 0.029 0.029 0.029 0.029 0.029 0.029 0.029 0.029 0.029 0.029 0.029 0.029 0.029	0.012 0.0038 8.8E-05 0.000051 <0.010 <0.010 <0.010 ND <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 ND ND ND ND <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010		1.4 1.7E-04 0.0024 1.3 1.3 1.3 1.4 1.3 1.4 1.3 1.4 1.3 1.4 1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3	8.7 8.8 1.1E-03 0.018 9.1 8.7 8.7 5.2E-04 0.018 8.8 8.9 8.5 8.7 3.9E-04 0.018 8.6 8.4 8.4 5.3E-04 0.018 8.4 5.3E-04 7.8 8.8 4 5.3E-04 7.8 8.8 4 5.3E-04 7.8 7.8 7.8 7.8 7.8 8.8 8.9 8.5 8.7 3.9 8.5 8.7 3.9 8.5 8.7 3.9 8.5 8.7 3.9 8.5 8.7 3.9 8.7 8.7 8.7 8.7 8.7 8.7 8.7 8.7 8.7 8.7	0.63 0.58 9.7E-05 0.0012 0.63 0.56 0.59 8.0E-05 0.0012 0.59 9.7E-05 0.0012 0.68 0.59 9.7E-06 0.0012 0.66 0.57 0.57 0.57 0.57 0.56 0.65	0.45 0.48 1.1E-04 0.52 0.48 0.47 1.SE-04 0.47 1.SE-04 0.49 0.46 0.49 0.46 0.40 0.45 1.4E-04 0.045 0.45 0.45 0.44 0.37 0.42 1.3E-04 0.36 0.41	<0.010 ND 0.0E+00 ND 0	0.027 0.028 7.7E-05 0.027 0.037 0.037 0.037 0.037 0.037 0.030 0.031 0.031 0.031 0.031 0.031 0.031 0.031 0.031 0.031 0.031 0.030 0.031 0.030 0.027 3.3E-05 0.0012 0.032	
	17-May-11 15-Jun-11	27	ANUC-3 Average Concertation (mpl/) Stindard Deviation (mml/es) Average Total mmoles ANUC-1 ANUC-3 Average Concentration (mpl/) Stindard Deviation (mml/es) Average Concentration (mml/es) ANUC-3 Average Total mmoles ANUC-3 Average Concentration (mml/es) Average Concentration (mml/es) Average Concentration (mml/es) Average Total mmoles ANUC-3 Average Concentration (mml/es) Average Total mmoles ANUC-3 ANUC-3 ANUC-3	0.042 0.022 2.3E-05 0.000029 0.029 0.010 2.2E-05 0.000025 0.077 0.035 5.3E-05 0.000027 0.035 5.3E-05 0.000047 0.044 0.039 0.037 1.1E-05 0.000049 0.037	0.081 0.079 6.1E-06 0.087 0.081 0.087 0.081 0.090 1.7E-05 0.0905 1.2E-05 0.0905 0.087 0.095 0.087 0.095 0.087 0.095 0.081 0.077 0.081 0.077 0.081 0.070 0.081 0.070 0.081 0.070 0.081 0.070 0.081 0.095 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.00000 0.00000 0.000000	6.9 7.0 3.7E-04 0.015 6.6 6.0 6.5 6.4 6.4 6.4 6.6 6.7 6.1 6.4 6.1 6.4 6.3 6.2 2.7E-04 0.013 5.8 6.1	0.042 0.042 4.8E-06 0.055 0.055 0.048 0.055 1.6E-05 0.068 0.057 0.056 0.059 9.2E-06 0.059 9.2E-06 0.068 0.068 0.067 9.8E-06 0.066 0.085	0.028 0.028 4.9E-05 0.00099 0.029 0.029 0.029 0.029 0.029 0.028 0.028 0.022 0.026 1.3E-05 0.029 0.022 0.026 0.027 0.029 0.027 0.029 0.027 0.026 0.029 0.027 0.029 0.027 0.029 0.027 0.029 0.027 0.028	0.012 0.0038 8.8E-05 0.000051 <0.010 <0.010 ND 0.0E+00 ND 0.0E+00 ND 0.0E+00 ND 0.0E+00 ND 0.0E+00 ND 0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 <0.010 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1.1 1.1 1.1 1.1 1.1 1.1 1.1 1.1 1	8.7 8.8 1.1E-03 0.018 8.7 8.7 8.7 8.7 8.9 5.2E-04 0.018 8.8 8.9 8.5 8.7 3.3€-04 0.018 8.6 8.6 8.6 8.4 8.1 8.4 5.3E-04 0.017 7.8 8.8	0.63 0.58 9.7E-05 0.0012 0.63 0.58 0.59 0.58 0.59 0.58 0.59 9.7E-06 0.0012 0.66 0.57 0.59 9.7E-06 0.57 0.59 9.7E-06 0.57 0.59 0.59 9.7E-06 0.66 0.57 0.66 0.57 0.0012 0.66 0.65 0.65	0.45 0.48 1.1E-04 0.52 0.48 0.42 0.47 1.5E-04 0.47 0.49 0.46 0.40 0.45 1.4E-04 0.45 0.45 0.45 0.45 0.45 0.45 0.45 0.	<0.010 ND ND 0.0E+00 ND 0.010 0.010 0.010 0.010 0.010 ND <0.010	0.027 0.028 7.7E-05 0.0073 0.027 0.029 1.7E-04 0.0073 0.029 1.7E-04 0.0073 0.031 0.031 0.031 0.031 0.031 0.031 0.031 0.031 0.031 0.025 0.025 0.025 0.025 0.025 0.025 0.025 0.025 0.025 0.025 0.025 0.025 0.025 0.025 0.025 0.025 0.025 0.025 0.025 0.025 0.025 0.025 0.025 0.025 0.025 0.025 0.025 0.025 0.025 0.025 0.025 0.025 0.025 0.025 0.025 0.025 0.025 0.025 0.025 0.025 0.025 0.025 0.025 0.025 0.025 0.025 0.025 0.025 0.025 0.025 0.025 0.025 0.025 0.025 0.025 0.025 0.025 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TABLE 2A: Summary of Microcosm Chlorinated VOCs, Ethene, Ethane, and Methane Results Former Duso Chemical, Poughkeepsie, New York

							hlorinated Et						orinated Etha			Methane	
Treatment	Date	Day	Replicate	PCE	TCE	CDCE	1,1-DCE	VC			1,1,1-TCA		1,2-DCA	CA	Ethane	Methane	Comment
				mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mmol/bottle	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	
nded with EOS® 598B42	13-Apr-11	-7															Amended the first replicate with resazurin.
	19-Apr-11	-1															Spiked with cDCE, 1,1-DCA and 1,1,1-TCA to target concentrations of 3, 10 and 2 ppm respectively.
	20-Apr-11	0	EOS* 598B42-1	0.020	0.056	6.2	0.044	0.034	0.013	-	1.1	8.0	0.62	0.46	<0.010	0.029	Amended with 334 ul of EOS *598 B42 to a target concentration of 0.1% as oil.
			EOS* 598B42-2	< 0.010	0.055	6.3	0.032	0.022	<0.010		1.1	8.0	0.59	0.28	<0.010	0.028	
			EOS* 598B42-3	0.017	0.047	6.4	0.044	0.034	<0.010		1.1	8.5	0.63	0.42	<0.010	0.027	
			Average Concentration (mg/L)	0.012	0.053	6.3	0.040	0.030	0.0043		1.1	8.2	0.61	0.39	ND	0.028	
			Standard Deviation (mmoles)	1.4E-05	8.2E-06	2.2E-04	1.5E-05	2.5E-05	9.9E-05		5.4E-05	5.9E-04	4.4E-05	3.1E-04	0.0E+00	3.4E-05	
			Average Total mmoles	0.000016	0.000084	0.013	0.000091	0.0001	0.000057	1.3E-02	0.0019	0.017	0.0012	0.0013	ND	0.0013	
	04-May-11	14	EOS* 598B42-1	0.023	0.065	6.0	0.053	0.040	<0.010		1.1	8.2	0.58	0.47	<0.010	0.027	
			EOS* 598B42-2	0.025	0.018	5.7	0.058	0.046	<0.010		1.1	8.4	0.68	0.43	<0.010	0.026	
			EOS* 598B42-3	<0.010	0.024	6.0	0.049	0.031	<0.010		1.1	7.9	0.65	0.28	<0.010	0.027	
			Average Concentration (mg/L)	0.016	0.036	5.9	0.054	0.039	ND		1.1	8.2	0.64	0.39	ND	0.027	
			Standard Deviation (mg/L)	1.8E-05	4.1E-05	4.5E-04	1.1E-05	2.7E-05	0.0E+00		5.8E-05	6.2 5.2E-04	1.1E-04	3.2E-04	0.0E+00	3.0E-05	
													0.0013	0.0013	ND	0.0013	
			Average Total mmoles	0.000021	0.000058	0.013	0.00012	0.00014	ND	1.3E-02	0.0018	0.017					
	17-May-11	27	EOS* 598B42-1	0.031	0.039	4.1	0.058	0.11	<0.010		0.17	0.20	0.61	7.7	<0.010	0.030	
			EOS* 598B42-2	0.021	<0.010	5.0	0.049	0.34	<0.010		0.023	5.2	0.70	3.3	<0.010	0.030	
			EOS* 598B42-3	0.027	0.022	4.0	0.062	0.15	<0.010		0.45	0.14	0.70	7.7	<0.010	0.030	
	1	1 1	Average Concentration (mg/L)	0.026	0.020	4.4	0.056	0.20	ND	-	0.21	1.8	0.67	6.2	ND	0.030	
	1	1	Standard Deviation (mmoles)	6.7E-06	3.1E-05	1.1E-03	1.5E-05	4.4E-04	0.0E+00	-	3.6E-04	6.0E-03	1.0E-04	8.2E-03	0.0E+00	2.1E-05	
	1	1 1	Average Total mmoles	0.000034	0.000032	0.0093	0.00013	0.0007	ND	1.0E-02	0.00035	0.0038	0.0014	0.020	ND	0.0014	
	01-Jun-11	42	EOS* 598B42-1	< 0.010	0.048	3.7	0.058	0.39	<0.010		< 0.010	< 0.010	0.66	7.8	<0.010	0.37	
			EOS* 598B42-2	< 0.010	0.017	0.47	0.013	2.6	0.067		< 0.010	0.013	0.66	7.6	<0.010	0.25	
			EOS* 598B42-3	<0.010	0.027	3.4	0.059	0.71	<0.001		<0.010	<0.010	0.00	8.2	<0.010	0.26	
			Average Concentration (mg/L)	ND	0.027	2.5	0.035	1.2	0.022		ND	0.0043	0.69	7.9	ND	0.29	
			Standard Deviation (mmoles)		2.5E-05					-	0.0E+00		1.1E-04	9.8E-04	0.0E+00	3.2E-03	
				0.0E+00		3.8E-03	6.0E-05	4.1E-03	5.1E-04			1.5E-05	0.0014		ND		
			Average Total mmoles	ND	0.000049	0.0054	0.000099	0.0043	0.00030	1.0E-02	ND	0.000088		0.025		0.014	
	08-Jun-11	49	EOS* 598B42-1	< 0.010	0.055	2.8	<0.010	0.97	0.036		< 0.010	<0.010	0.66	7.8	<0.010	0.87	
			EOS* 598B42-2	<0.010	<0.010	0.011	0.012	1.5	0.40	-	< 0.010	0.02	0.55	7.5	<0.010	1.2	
			EOS® 598B42-3	< 0.010	0.022	2.1	0.041	1.5	0.029		< 0.010	0.055	0.73	7.9	<0.010	0.74	
			Average Concentration (mg/L)	ND	0.026	1.7	0.018	1.3	0.15		ND	0.025	0.64	7.7	ND	0.93	
			Standard Deviation (mmoles)	0.0E+00	4.4E-05	3.1E-03	4.8E-05	1.1E-03	2.8E-03	-	0.0E+00	5.8E-05	1.9E-04	5.8E-04	0.0E+00	1.1E-02	
			Average Total mmoles	ND	0.000041	0.0035	0.000040	0.0047	0.002	1.0E-02	ND	0.000052	0.0013	0.025	ND	0.043	
	15-Jun-11	56	EOS* 598B42-1	< 0.010	0.039	0.43	< 0.010	1.0	0.40		< 0.010	0.049	0.59	7.5	<0.010	1.9	
			EOS* 598B42-2	< 0.010	<0.010	<0.010	<0.010	0.050	0.56		< 0.010	0.021	0.44	7.1	<0.010	2.3	
			EOS* 598B 42-3	<0.010	<0.010	0.13	<0.010	1.8	0.30	-	<0.010	0.021	0.61	7.4	<0.010	1.4	
			Average Concentration (mg/L)	ND	0.013	0.13	ND	0.96	0.40	-	ND	0.075	0.55	7.3	ND	1.9	
													1.9E-04	8.3E-04	0.0E+00	2.2E-02	
			Standard Deviation (mmoles)	0.0E+00	3.6E-05	4.8E-04	0.0E+00	3.1E-03	2.0E-03	-	0.0E+00	6.0E-05					
			Average Total mmoles	ND	0.000021	0.00040	ND	0.0034	0.0053	9.1E-03	ND	0.00010	0.0011	0.024	ND	0.086	
	29-Jun-11	70	EOS* 598B 42-1	<0.010	<0.010	<0.010	0.014	<0.010	0.53		<0.010	0.013	0.42	7.2	<0.010	14	
			EOS* 598B 42-2	< 0.010	<0.010	< 0.010	0.012	<0.010	0.47	-	<0.010	0.018	0.37	7.1	<0.010	10	
			EOS* 598B 42-3	< 0.010	<0.010	< 0.010	< 0.010	< 0.010	0.56		< 0.010	0.081	0.40	7.6	<0.010	6.9	
			Average Concentration (mg/L)	ND	ND	ND	0.0088	ND	0.52		ND	0.037	0.40	7.3	ND	10	
			Standard Deviation (mmoles)	0.0E+00	0.0E+00	0.0E+00	1.8E-05	0.0E+00	5.7E-04		0.0E+00	7.8E-05	5.9E-05	8.1E-04	0.0E+00	1.7E-01	
			Average Total mmoles	ND	ND	ND	0.000020	ND	0.0068	6.8E-03	ND	0.000077	0.00080	0.024	ND	0.48	
	14-Jul-11	85	EOS* 598B 42-1	< 0.010	<0.010	< 0.010	< 0.010	< 0.010	0.51		< 0.010	< 0.010	0.19	7.1	<0.010	36	
			EOS* 598B42-2	< 0.010	<0.010	< 0.010	0.014	< 0.010	0.41		< 0.010	< 0.010	0.22	6.5	<0.010	42	
			EOS* 598B42-3	0.010	<0.010	< 0.010	0.012	< 0.010	0.41		<0.010	<0.010	0.17	6.8	<0.010	39	
			Average Concentration (mg/L)	0.0034	ND	ND	0.0086	ND	0.44		ND	ND	0.20	6.8	NĐ	39	
			Standard Deviation (mmoles)	7.8E-06	0.0E+00	0.0E+00	1.7E-05	0.0E+00	7.3E-04	-	0.0E+00	0.0E+00	5.6E-05	9.8E-04	0.0E+00	1.4E-01	
					0.0E+00 ND	0.0E+00		0.0E+00 ND	0.0058	5.8E-03	0.0E+00	0.0E+00			ND	1.8	
			Average Total mmoles	0.0000045			0.000019			5.8E-03			0.00040	0.022			
	03-Aug-11	105	EOS* 598B42-1	<0.010	<0.010	<0.010	0.049	<0.010	0.19	-	<0.010	< 0.010	0.08	5.6	<0.010	48	
			EOS* 598B42-2	0.011	<0.010	<0.010	0.018	< 0.010	0.28		< 0.010	<0.010	0.13	6.2	<0.010	48	
			EOS® 598B42-3	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	0.39		< 0.010	<0.010	0.11	6.7	<0.010	95	
	1	1 1	Average Concentration (mg/L)	0.0038	ND	ND	0.022	ND	0.29	- 1	ND	ND	0.11	6.2	ND	64	
			Standard Deviation (mmoles)	8.6E-06	0.0E+00	0.0E+00	5.6E-05	0.0E+00	1.3E-03	-	0.0E+00	0.0E+00	5.1E-05	1.8E-03	0.0E+00	1.3E+00	
	1	1 1	Average Total mmoles	0.0000050	ND	ND	0.000051	ND	0.0038	3.9E-03	ND	ND	0.00022	0.020	ND	3.0	
	17-Aug-11	119	EOS* 598B42-1	< 0.010	< 0.010	< 0.010	<0.010	< 0.010	0.15		< 0.010	<0.010	0.079	5.4	<0.010	39	1
			EOS* 598B42-2	0.013	<0.010	<0.010	<0.010	< 0.010	0.25		<0.010	<0.010	0.11	5.9	<0.010	41	
			EOS* 598B42-2 EOS* 598B42-3	<0.013	0.013	<0.010	<0.010	<0.010	0.23		<0.010	<0.010	0.089	6.0	<0.010	79	
	1	1 1				<0.010 ND							0.000		<0.010 ND	53	-
	1	1 1	Average Concentration (mg/L)	0.0042	0.0045		ND	ND	0.23	-	ND	ND	0.092	5.7			
	1	1	Standard Deviation (mmoles)	9.7E-06	1.2E-05	0.0E+00	0.0E+00 ND	0.0E+00 ND	9.2E-04 0.0030	- 3.0E-03	0.0E+00 ND	0.0E+00 ND	3.0E-05 0.00019	1.1E-03 0.019	0.0E+00 ND	1.1E+00 2.5	
			Average Total mmoles	0.0000056	0.0000072	ND											

 Notes:
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 - conpound not detected, the associated value is the detected limit 1,1-DCE - 1,1-tichlorosethane

 1,1-DCA - 1,1,1-tichlorosethane
 1,2-DCA - 1,2-doitororethane
 1,2-DCA - 1,2-doitororethane

TABLE 2B: SUMMARY OF MICROCOSM ANION RESULTS

Former Duso Chemical, Poughkeepsie, New York

TREATMENT	DATE	DAY	Treatment Replicate	Chloride	Nitrite	Nitrate	Sulfate	Bromide	Phosphate
IREAIMENT				mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Anaerobic Sterile Control	20-Apr-11	0	ANSC-1	293	<0.12	21	50	<0.39	<0.57
			ANSC-2	289	<0.12	19	51	<0.39	<0.57
			ANSC-3	279	<0.12	20	45	< 0.39	<0.57
			Average Concentration	287	ND	20	49	ND	ND
	18-May-11	28	ANSC-1	320	<0.12	24	46	<0.39	<0.57
			ANSC-2	324	<0.12	23	57	< 0.39	<0.57
			ANSC-3	309	<0.12	22	43	< 0.39	<0.57
			Average Concentration	318	ND	23	49	ND	ND
	15-Jun-11	56	ANSC-1	334	<0.12	21	57	< 0.39	<0.57
			ANSC-2	355	<0.12	23	66	<0.39	<0.57
			ANSC-3	337	<0.12	21	56	< 0.39	<0.57
			Average Concentration	342	ND	22	60	ND	ND
Anaerobic Active Control	20-Apr-11	0	ANAC-1	221	<0.12	1.2	93	<0.39	<0.57
			ANAC -2	207	<0.12	<0.10	40	<0.39	<0.57
			ANAC -3	215	<0.12	<0.10	41	<0.39	<0.57
			Average Concentration	214	ND	0.40	58	ND	ND
	18-May-11	28	ANAC-1	220	<0.12	1.9	43	<0.39	<0.57
			ANAC -2	213	<0.12	0.59	48	<0.39	<0.57
			ANAC -3	214	<0.12	3.4	33	< 0.39	<0.57
			Average Concentration	216	ND	2.0	41	ND	ND
	15-Jun-11	56	ANAC-1	229	<0.12	<0.10	40	<0.39	<0.57
			ANAC -2	229	<0.12	<0.10	60	<0.39	<0.57
			ANAC -3	224	<0.12	<0.10	41	<0.39	<0.57
			Average Concentration	227	ND	ND	47	ND	ND
Amended with EOS [®] 598B42	20-Apr-11	0	EOS [®] 598 B42-2	210	<0.12	<0.10	37	<0.39	<0.57
			EOS [®] 598 B42-2	242	<0.12	<0.10	42	<0.39	<0.57
			EOS [®] 598 B42-3	219	<0.12	<0.10	41	<0.39	<0.57
			Average Concentration	224	ND	ND	40	ND	ND
	18-May-11	28	EOS [®] 598 B42-2	221	<0.12	1.2	0.20	< 0.39	<0.57
			EOS [®] 598 B42-2	230	<0.12	0.32	1.2	< 0.39	<0.57
			EOS [®] 598 B42-3	219	<0.12	0.63	1.3	< 0.39	<0.57
			Average Concentration	223	ND	0.71	0.89	ND	ND
	15-Jun-11	56	EOS [®] 598 B42-2	229	<0.12	<0.10	2.6	<0.39	<0.57
			EOS [®] 598 B42-2	230	<0.12	0.92	2.4	<0.39	<0.57
			EOS [®] 598 B42-3	225	<0.12	<0.10	2.9	<0.39	<0.57
			Average Concentration	228	ND	0.31	2.7	ND	ND

Notes:

ANAC - anaerobic active control

ANSC - anaerobic sterile control

EOS - emulsified oil substrate

mg/L - milligrams per liter

ND - not detected

< - compound not detected, the associated value is the detected limit

TABLE 2C: SUMMARY OF MICROCOSM VFA RESULTS

Former Duso Chemical, Poughkeepsie, New York

TREATMENT	DATE	DAY	Treatment Replicate	Lactate	Acetate	Propionate	Formate	Butyrate	Pyruvate
IREAIMENT	DATE	DAT	Treatment Replicate	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Amended with EOS [®] 598 B42	20-Apr-11	0	EOS*598 B42-1	48	<0.54	<0.31	0.47	<0.41	<0.69
			EOS [®] 598 B42-2	34	<0.54	<0.31	0.66	<0.41	<0.69
			EOS [®] 598 B42-3	63	<0.54	1.9	<0.22	<0.41	<0.69
			Average Concentration	48	ND	1.9	0.57	ND	ND
	15-Jun-11	56	EOS*598 B42-1	<0.39	290	15	0.67	16	<0.69
			EOS [®] 598 B42-2	<0.39	227	1.8	0.88	17	<0.69
			EOS [®] 598 B42-3	<0.39	252	20	0.58	17	<0.69
			Average Concentration	ND	256	12	0.71	16	ND

Notes:

EOS - emulsified oil substrate

mg/L - milligrams per liter ND - not detected

< - compound not detected, the associated value is the detected limit

TABLE 2D: SUMMARY OF MICROCOSM pH RESULTS

Former Duso Chemical, Poughkeepsie, New York

TREATMENT	DATE	DAY	Treatment Replicate	рН	ORP (m)()
Anaerobic Sterile Control	20-Apr-11	0	ANSC-1	6.51	(mV)
	207.0	Ũ	ANSC-2	6.69	
			ANSC-3	6.68	
		-	Average	6.63	n/a
	17-May-11	27	ANSC-1	6.58	
	Th May Th	21	ANSC-2	6.55	
			ANSC-3	6.64	
		-	Average	6.59	n/a
	15-Jun	56	ANSC-1	6.72	
	io ouri	00	ANSC-2	6.75	
			ANSC-3	6.73	
		ŀ	Average	6.73	n/a
	17-Aug	119	ANAC -1	6.74	
			ANAC -2	6.79	
			ANAC -3	6.78	
		ł	Average	6.77	n/a
Anaerobic Active Control	20-Apr-11	0	ANAC -1	6.75	
Anaelobic Active Control	20700111	Ũ	ANAC -2	6.85	
			ANAC -3	6.83	
		-	Average	6.81	n/a
	17-May-11	27	AVerage ANAC -1	6.76	
	17 Way 11	21	ANAC -2	6.64	
			ANAC -3	6.66	
		-	Average	6.69	n/a
	15-Jun	56	AVerage ANAC -1	6.83	
	15-5011	50	ANAC -2	6.85	
			ANAC -3	6.93	
		-	Average	6.87	n/a
	17-Aug	119	AVerage ANAC -1	6.89	
	17-Aug	115	ANAC -2	6.85	
			ANAC -3	6.98	
			Average	6.91	 n/a
Amended with EOS [®] 598B42	20-Apr-11	0	EOS [®] 598 B42-1	6.70	
Amended with EOS 596B42	20-Api-11	0	EOS [®] 598 B42-2	6.75	
			EOS [®] 598 B42-3		
		-		6.80	
	47 14-11 44	07		6.75	n/a
	17-May-11	27	EOS [®] 598 B42-1 EOS [®] 598 B42-2	6.44	
				6.52	
			EOS [®] 598 B42-3	6.46	
			Average	6.47	n/a
	8-Jun	49	EOS [®] 598 B42-1	6.68	
			EOS [®] 598 B42-2	6 75	
			EOS [®] 598 B42-3	6.64	
		ļ	Average	6.69	n/a
	15-Jun	56	EOS [®] 598 B42-1	6.55	
	70 00m		EOS [®] 598 B42-2	6.58	
		Ļ	EOS [®] 598 B42-3	6.60	
	├		Average	6.58	n/a
	13-Jul	84	EOS [®] 598 B42-1	6.60	-120
			EOS [®] 598 B42-2	6.67	-124
			EOS [®] 598 B42-3	6.74	-123
		ł	Average	6.67	-122
	3-Aug	105	EOS [®] 598 B42-1	6.59	
	3-Aug	105	EOS 598 B42-1 EOS [®] 598 B42-2	6.75	
			EOS [®] 598 B42-3	6.65	
		ŀ			
		-	Average	6.66	n/a
	17-Aug	119	Average EOS [®] 598 B42-1		n/a
	17-Aug	119	Average EOS [®] 598 B42-1	6.66 6.57	
	17-Aug	119	Average	6.66	

Notes:

ANAC - anaerobic active control ANSC - anaerobic sterile control EOS - emulsified oil substrate mV - millivolts n/a - not applicable ORP - Oxydation Reduction Potential

TABLE 3: SUMMARY OF GENE-TRAC[®] RESULTS

Former Duso Chemical, Poughkeepsie, New York

Sample ID	Replicate Sample ID	Sample Date	Day	Dehalococcoides Enumeration (Gene-Trac® Dhc)	Vinyl Chloride Reductase Enumeration (Gene-Trac® VC)	<i>Dehalobacter</i> Enumeration (Gene-Trac [®] Dhb)
Baseline Groundwater	SGSB-3	21-Mar-11	NA	6 x 10 ⁶ /liter	7 x 10 ⁶ /liter	3 x 10 ⁶ /liter
Baseline Groundwater	MHC-26	21-Mar-11	NA	8 x 10⁵/liter	5 x 10 ⁵ /liter	3 x 10 ⁴ /liter
Anaerobic Active Control	4,5,6	29-Jun-11	70	7 x 10 ⁶ /liter	5 x 10 ⁶ /liter	4 x 10 ⁶ /liter
	4,5,6	17-Aug-11	119	1 x 10 ⁶ /liter	9 x 10 ⁵ /liter	6 x 10⁵/liter
EOS [®] 598 B42 Amended	7,8,9	29-Jun-11	70	8 x 10 ⁹ /liter	6 x 10 ⁹ /liter	3 x 10 ⁹ /liter
LOG 350 B42 Amenueu	7,8,9	17-Aug-11	119	2 x 10 ⁹ /liter	1 x 10 ⁹ /liter	2 x 10 ⁷ /liter

Notes:

ANAC - anaerobic active control EOS® - emulsified oil substrate NA - not applicable/not analyzed

ND - not detected

TABLE 4: HALF LIVES (DAYS) OF CHLORINATED ETHENES DETECTED IN MICROCOSMS Former Duso Chemical, Poughkeepsiek New York

		TCE			cDCE			VC		1	,1-DCE		1.	,1,1-TCA		1	,1-DCA		1	,2-DCA			CA	
Treatment	Half Life	T ₁	T ₂	Half Life	T ₁	T ₂	Half Life	T ₁	T ₂	Half Life	T ₁	T ₂	Half Life	T ₁	T ₂	Half Life	T ₁	T ₂	Half Life	T ₁	T ₂	Half Life	T ₁	T ₂
	(Days)	(Day)	(Days)																					
Anaerobic Sterile Control	~	NA	NA	494	NA	NA	~	NA	NA	~	NA	NA	270	NA	NA	1195	0	119	~	NA	NA	303	NA	NA
Anaerobic Active Control	~	NA	NA	370	0	119	523	NA	NA	~	NA	NA	175	0	119	700	0	119	~	NA	NA	266	0	119
EOS* 598 B42	21	0	70	5.8	0	56	2.6	49	70	8.3	27	56	5.3	0	42	3.8	0	42	45	0	119	177	42	119

Notes:

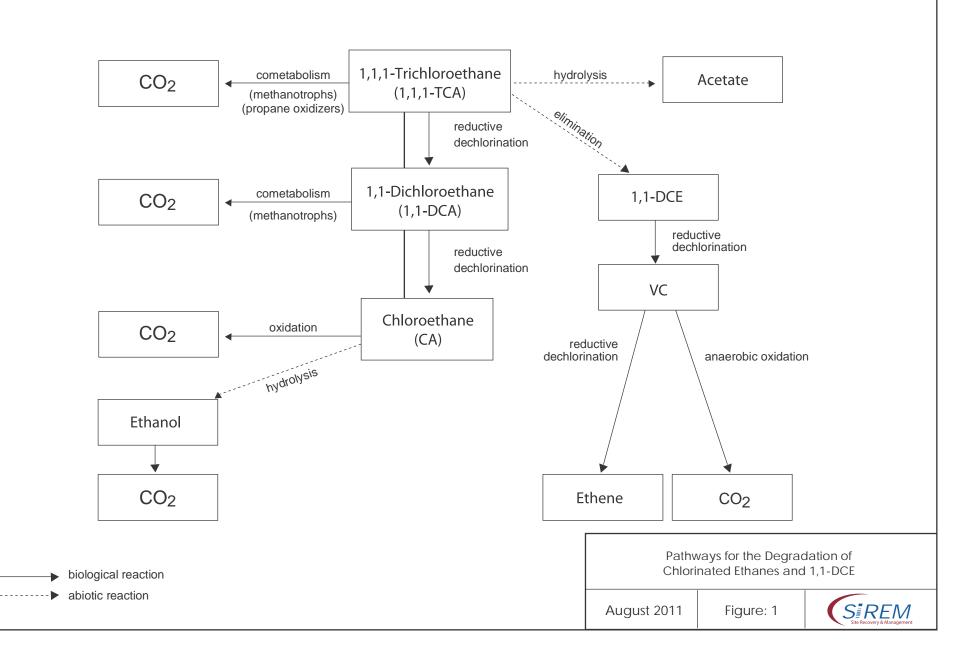
CA - chloroethane cDCE - cis-1,2-dichloroethene 1,2-DCA - 1,2-dichloroethane 1,1-DCA - 1,1-dichloroethane 1,1-DCE- 1,1-dichloroethene

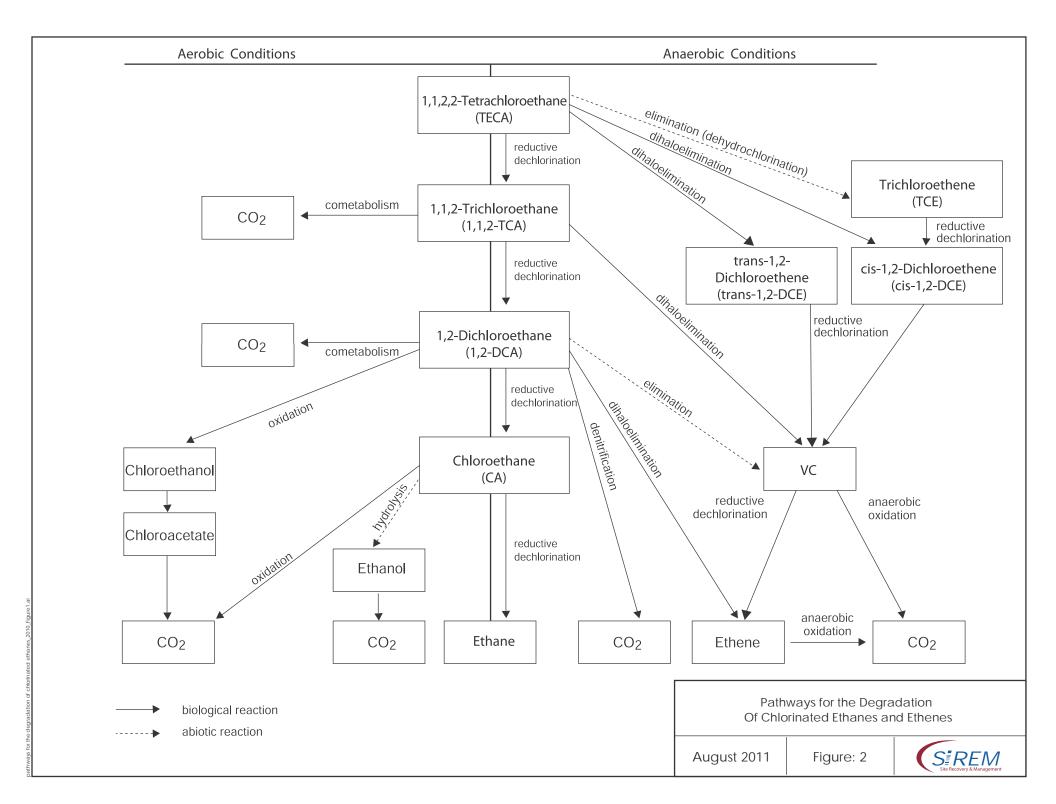
1,11-TCA - 1,1,1-trichloroethane NA - not applicable TCE - trichloroethane PCE - tetrachloroethane VC - ving triloroide - net degradation of compound was not detected over duration of study

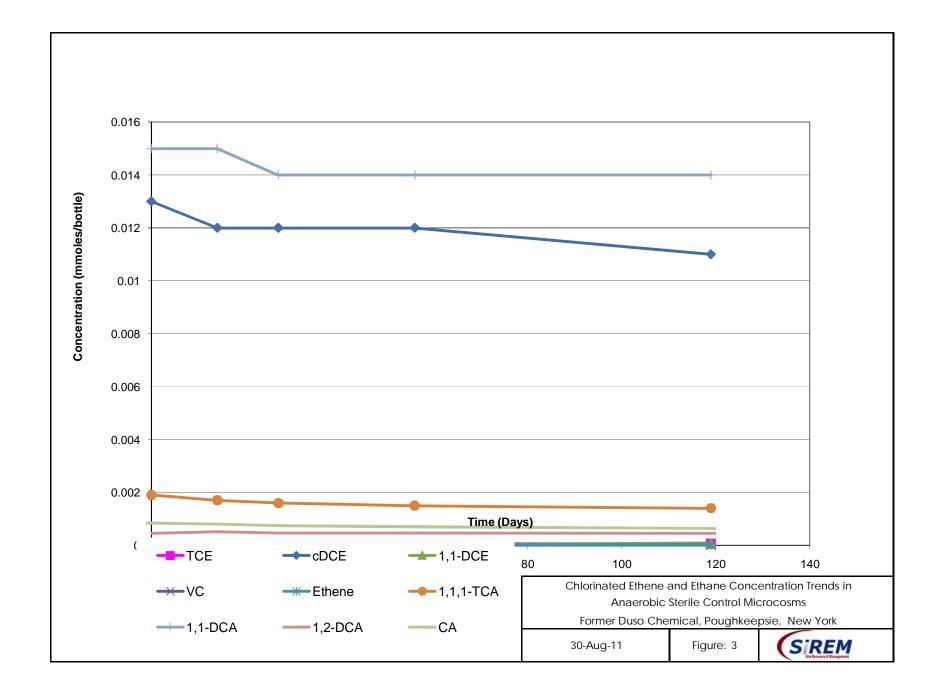


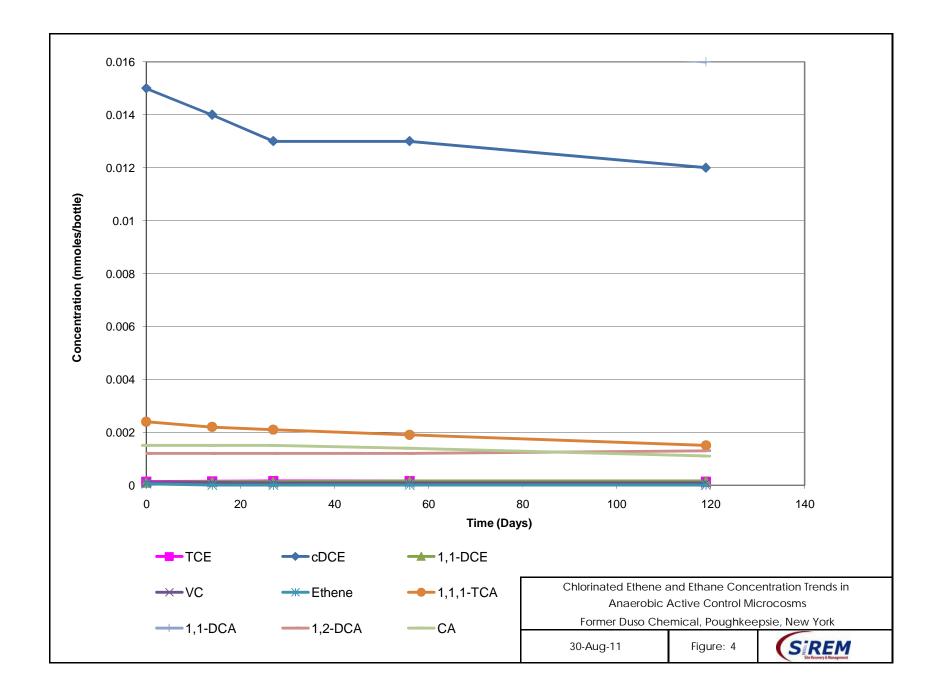
FIGURES

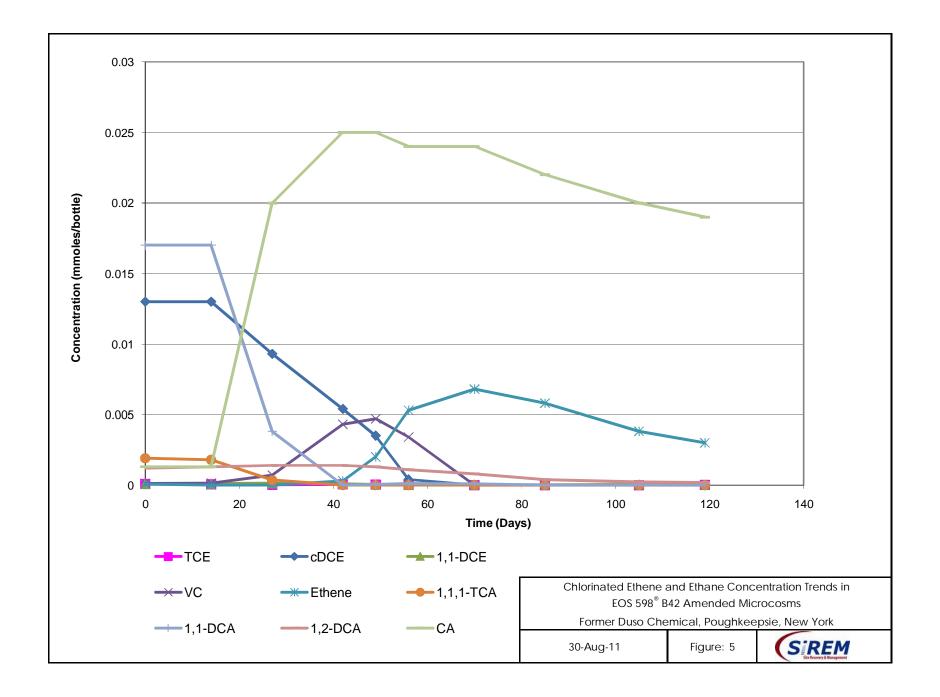
Aerobic Conditions













APPENDIX A: Gene-Trac Reports





Certificate of Analysis: Gene-Trac® Dehalococcoides Assay

Customer: Dan Servatas, AECOM Project: Former Duso Chemical Customer Reference: Not Provided SiREM Reference: S-2200 Report Issued: 18-Apr-11 Data Files: MyiQ-DHC-QPCR-0751 DHC-QPCR-Check-gel-0541 iQ5-DB-DHC-QPCR-0200

Table 1a: Test Results

Customer Sample ID	SiREM Sample ID	Sample Collection Date	Sample Matrix	Percent Dhc [*]	<i>Dehalococcoides</i> Enumeration/Liter
SGSB-3	DHC-7175	21-Mar-11	Groundwater	0.3-0.9%	6 x 10 ⁶
MHC-26	DHC-7176	21-Mar-11	Groundwater	0.04-0.1%	8 x 10 ⁵

Notes:

Percent *Dehalococcoides* (Dhc) in microbial population. This value is calculated by dividing the number of Dhc 16S ribosomal ribonucleic acid (rRNA) gene copies by the total number of bacteria as estimated by the mass of DNA extracted from the sample. Range represents normal variation in Dhc enumeration.

** Based on quantification of Dhc 16S rRNA gene copies. Dhc are generally reported to contain one 16S rRNA gene copy per cell; therefore, this number is often interpreted to represent the number of Dhc cells present in the sample.

J The associated value is an estimated quantity between the method detection limit and quantitation limit.

U Not detected, associated value is the quantification limit.

B Analyte was also detected in the method blank.

NA Not applicable as Dehalococcoides not detected and/or quantifiable DNA not extracted from the sample.

J. Wilkinson

Analyst:

Jen Wilkinson Biotechnology Technologist

Jimena Druar

Approved: ____/ Ximena Druar, B.Sc. Molecular Biology Coordinator



Certificate of Analysis: Gene-Trac[®] VC, Vinyl Chloride Reductase (*vcrA*) Assay

Customer: Dan Servatas, AECOM Project: Former Duso Chemical Customer Reference: Not Provided SiREM Reference: S-2200

Report Issued: 18-Apr-11 Data Files: iQ5-VC-QPCR-0376 VC-QPCR-Check-gel-0398

Table 1b: Test Results

Customer Sample ID	SiREM Sample ID	Sample Collection Date	Sample Matrix	Percent <i>vcrA</i> *	Vinyl Chloride Reductase (<i>vcrA</i>) Gene Copies/Liter
SGSB-3	VCR-2534	21-Mar-11	Groundwater	0.3-1%	7 x 10 ⁶
MHC-26	VCR-2535	21-Mar-11	Groundwater	0.03-0.08%	5 x 10⁵

Notes:

Analyst:

Percentage of bacteria in the microbial population that harbor the *vcrA* gene. This value is calculated by dividing the measured number of cells haboring the vinyl chloride reductase A (*vcrA*) gene by the total number of bacteria in the sample estimated using the mass of DNA extracted from the sample. Range represents normal variation in enumeration of *vcrA*.

J The associated value is an estimated quantity between the method detection limit and quantitation limit.

U Not detected, associated value is the quantification limit.

B Analyte was also detected in the method blank.

NA Not applicable as vcrA not detected and/or quantifiable DNA not extracted from the sample.

J. Wilkinson

Jen Wilkinson Biotechnology Technologist

Jumena Druar Approved:

Ximena Druar, B.Sc. Molecular Biology Coordinator





Certificate of Analysis: Gene-Trac® Dehalobacter Assay

Customer: Dan Servatas, AECOM Project: Former Duso Chemical Customer Reference: Not Provided SiREM Reference: S-2200 Report Issued: 18-Apr-11 Data Files: MyiQ-DHB-QPCR-0151 DHB-QPCR-Check-gel-074

Table 1c: Test Results

Customer Sample ID	SiREM Sample ID	Sample Collection Date	Sample Matrix	Percent Dhb [*]	<i>Dehalobacter</i> 16S rRNA Gene Copies/ Liter
SGSB-3	DHB-0402	21-Mar-11	Groundwater	0.2-0.5%	3 x 10 ⁶
MHC-26	DHB-0403	21-Mar-11	Groundwater	0.001-0.004%	3 x 10 ⁴

Notes:

Percent *Dehalobacter* (Dhb) in microbial population. This value is calculated by dividing the number of Dhb 16S ribosomal ribonucleic acid (rRNA) gene copies by the total number of bacteria as estimated by the mass of DNA extracted from the sample. Range represents normal variation in Dhb enumeration.

J The associated value is an estimated quantity between the method detection limit and quantitation limit.

U Not detected, associated value is the quantification limit.

B Analyte was also detected in the method blank.

NA Not applicable as *Dehalobacter* not detected and/or quantifiable DNA not extracted from the sample.

J. Wilkinson

Analyst:

Jen Wilkinson Biotechnology Technologist

Jumena Druar Approved:

Ximena Druar, B.Sc. Molecular Biology Coordinator



Table 2: Detailed Test Parameters, Test Reference S-2200

Customer Sample ID	SGSB-3	MHC-26
SiREM Sample ID	DHC-7175/VCR-2534/DHB-0402	DHC-7176/VCR-2535/DHB-0403
Date Received	24-Mar-11	24-Mar-11
Sample Temperature	5 °C	5 °C
Volume Used for DNA Extraction	100 mL	100 mL
Filtration Date	1-Apr-11	1-Apr-11
DNA Extraction Date	11-Apr-11	11-Apr-11
DNA Concentration in Sample (extractable)	4013 ng/L	4223 ng/L
PCR Amplifiable DNA	Detected	Detected
Dhc qPCR Date Analyzed	12-Apr-11	12-Apr-11
vcrA qPCR Date Analyzed	15-Apr-11	15-Apr-11
Dhb qPCR Date Analyzed	15-Apr-11	15-Apr-11
Laboratory Controls (see Tables 3, 4 & 5)	Passed	Passed
Comments		

Notes:

Refer to Tables 3, 4 & 5 for detailed results of controls. ng/L = nanograms per liter

mL = milliliters

°C = degrees Celsius PCR = polymerase chain reaction qPCR = quantitative PCR Dhb = *Dehalobacter* Dhc = *Dehalococcoides* DNA = Deoxyribonucleic acid *vcrA* = vinyl chloride reductase



Table 3: Gene-Trac Dhc Control Results, Test Reference S-2200

Laboratory Control	Analysis Date	Control Description	Spiked Dhc 16S rRNA Gene Copies per Liter	Recovered Dhc 16S rRNA Gene Copies per Liter	Comments
Positive Control Low Concentration	12-Apr-11	qPCR with KB-1 genomic DNA (CSLD-0389)	3.6 x 10 ⁵	3.9 x 10 ⁵	
Positive Control High Concentration	12-Apr-11	qPCR with KB-1 genomic DNA (CSHD-0389)	3.0 x 10 ⁷	3.0 x 10 ⁷	
DNA Extraction Blank	12-Apr-11	Tris Reagent Blank (TBD-0349)	0	3.9 x 10 ³ U	
Negative Control	12-Apr-11	DNA extraction sterile water (FB-1410)	0	3.9 x 10 ³ U	

Notes:

Dhc = *Dehalococcoides*

qPCR = quantitative PCR

DNA = Deoxyribonucleic acid

16S rRNA = 16S ribosomal ribonucleic acid



Table 4: Gene-Trac VC Control Results, Test Reference S-2200

Laboratory Control	Analysis Date	Control Description	Spiked <i>vcrA</i> reductase Gene Copies per Liter	Recovered <i>vcrA</i> reductase Gene Copies per Liter	Comments
Positive Control Low Concentration	15-Apr-11	qPCR with KB-1 genomic DNA (CSLV-0244)	4.8 x 10 ⁵	3.7 x 10 ⁵	
Positive Control High Concentration	15-Apr-11	qPCR with KB-1 genomic DNA (CSHV-0244)	3.6 x 10 ⁷	4.1 x 10 ⁷	
Negative Control	15-Apr-11	Tris Reagent Blank (TBV-0215)	0	3.9 x 10 ³ U	
DNA Extraction Blank	15-Apr-11	DNA extraction sterile water (FB-1410)	0	3.9 x 10 ³ U	

Notes:

qPCR = quantitative PCR DNA = Deoxyribonucleic acid

16S rRNA = 16S ribosomal ribonucleic acid

vcrA = vinyl chloride reductase



Table 5: Gene-Trac Dhb Control Results, Test Reference S-2200

Laboratory Control	Analysis Date	Control Description	Spiked Dhb 16S rRNA Gene Copies per Liter	Recovered Dhb 16S rRNA Gene Copies per Liter	Comments
Positive Control Low Concentration	15-Apr-11	qPCR with WBC2 genomic DNA (CSLDB-0112)	8.7 x 10 ⁵	5.4 x 10 ⁵	
DNA Extraction Blank	15-Apr-11	DNA extraction sterile water (FB-1410)	0	3.9 x 10 ³ U	
Negative Control	15-Apr-11	Tris Reagent Blank	0	3.9 x 10 ³ U	

Notes:

qPCR = quantitative PCR

Dhb = Dehalobacter

DNA = Deoxyribonucleic acid

16S rRNA = 16S ribosomal ribonucleic acid

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Certificate of Analysis: Gene-Trac® Dehalococcoides Assay

Customer: Arthur Taddeo, AECOM Project: Former Duso Chemical Customer Reference: not provided SiREM Reference: S-2265 Report Issued: 29-Jun-11 Data Files: iQ5-DHC-QPCR-0780 DHC-QPCR-Check-gel-0563 MyiQ-DB-DHC-QPCR-0217

Table 1a: Test Results

Customer Sample ID	SiREM Sample ID	Sample Collection Date	Sample Matrix	Percent Dhc [*]	<i>Dehalococcoides</i> Enumeration/Liter ^{**}
ANAC composite	DHC-7386	21-Jun-11	Microcosm	0.03-0.08%	7 x 10 ⁶
EOS composite	DHC-7387	21-Jun-11	Microcosm	27-62%	8 x 10 ⁹

Notes:

Percent *Dehalococcoides* (Dhc) in microbial population. This value is calculated by dividing the number of Dhc 16S ribosomal ribonucleic acid (rRNA) gene copies by the total number of bacteria as estimated by the mass of DNA extracted from the sample. Range represents normal variation in Dhc enumeration.

Based on quantification of Dhc 16S rRNA gene copies. Dhc are generally reported to contain one 16S rRNA gene copy per cell; therefore, this number is often interpreted to represent the number of Dhc cells present in the sample.

J The associated value is an estimated quantity between the method detection limit and quantitation limit.

U Not detected, associated value is the quantification limit.

B Analyte was also detected in the method blank.

NA Not applicable as *Dehalococcoides* not detected and/or quantifiable DNA not extracted from the sample.

J. Wilkinson

Analyst:

Jen Wilkinson Biotechnology Technologist

Jumena Druar Approved:

Ximena Druar, B.Sc. Molecular Biology Coordinator



Certificate of Analysis: Gene-Trac[®] VC, Vinyl Chloride Reductase (*vcrA*) Assay

Customer: Arthur Taddeo, AECOM Project: Former Duso Chemical Customer Reference: not provided SiREM Reference: S-2265

Report Issued: 29-Jun-11 Data Files: MyiQ-VC-QPCR-0394 VC-QPCR-Check-gel-0415 MyiQ-DB-VC-QPCR-0151

Table 1b: Test Results

Customer Sample ID	SiREM Sample ID	Sample Collection Date	Sample Matrix	Percent <i>vcrA</i> *	Vinyl Chloride Reductase (<i>vcrA</i>) Gene Copies/Liter
ANAC composite	VCR-2663	21-Jun-11	Microcosm	0.02-0.05%	5 x 10 ⁶
EOS composite	VCR-2664	21-Jun-11	Microcosm	20-49%	6 x 10 ⁹

Notes:

Percentage of bacteria in the microbial population that harbor the *vcrA* gene. This value is calculated by dividing the measured number of cells haboring the vinyl chloride reductase A (*vcrA*) gene by the total number of bacteria in the sample estimated using the mass of DNA extracted from the sample. Range represents normal variation in enumeration of *vcrA*.

J The associated value is an estimated quantity between the method detection limit and quantitation limit.

U Not detected, associated value is the quantification limit.

B Analyte was also detected in the method blank.

NA Not applicable as vcrA not detected and/or quantifiable DNA not extracted from the sample.

1. Wilkinson

Analyst:

Jen Wilkinson Biotechnology Technologist

limena Druar

Approved: <u>/</u> Ximena Druar, B.Sc. Molecular Biology Coordinator



Certificate of Analysis: Gene-Trac® Dehalobacter Assay

Customer: Arthur Taddeo, AECOM Project: Former Duso Chemical Customer Reference: not provided SiREM Reference: S-2265 Report Issued: 29-Jun-11 Data Files: iQ5-DHB-QPCR-0161 DHB-QPCR-Check-gel-0082 iQ5-DB-DHB-QPCR-0001

Table 1c: Test Results

Customer Sample ID	SiREM Sample ID	Sample Collection Date	Sample Matrix	Percent Dhb [*]	<i>Dehalobacter</i> 16S rRNA Gene Copies/ Liter
ANAC composite	DHB-0442	21-Jun-11	Microcosm	0.01-0.04%	4 x 10 ⁶
EOS composite	DHB-0443	21-Jun-11	Microcosm	12-31%	3 x 10 ⁹

Notes:

Percent *Dehalobacter* (Dhb) in microbial population. This value is calculated by dividing the number of Dhb 16S ribosomal ribonucleic acid (rRNA) gene copies by the total number of bacteria as estimated by the mass of DNA extracted from the sample. Range represents normal variation in Dhb enumeration.

J The associated value is an estimated quantity between the method detection limit and quantitation limit.

U Not detected, associated value is the quantification limit.

B Analyte was also detected in the method blank.

NA Not applicable as Dehalobacter not detected and/or quantifiable DNA not extracted from the sample.

1. Wilkinson

Analyst:

Jen Wilkinson Biotechnology Technologist

Jumena Druar Approved:

Ximena Druar, B.Sc. Molecular Biology Coordinator



Table 2: Detailed Test Parameters, Test Reference S-2265

Customer Sample ID	ANAC composite	EOS composite
SiREM Sample ID	DHC-7386/VCR-2663/DHB-0442	DHC-7387/VCR-2664/DHB-0443
Date Received	21-Jun-11	21-Jun-11
Sample Temperature	NA	NA
Volume Used for DNA Extraction	10 mL	10 mL
Filtration Date	22-Jun-11	22-Jun-11
DNA Extraction Date	23-Jun-11	23-Jun-11
DNA Concentration in Sample (extractable)	53775 ng/L	48825 ng/L
PCR Amplifiable DNA	Detected	Detected
Dhc qPCR Date Analyzed	24-Jun-11	24-Jun-11
vcrA qPCR Date Analyzed	27-Jun-11	27-Jun-11
Dhb qPCR Date Analyzed	27-Jun-11	27-Jun-11
Laboratory Controls (see Tables 3, 4 & 5)	Passed	Passed
Comments		

Notes:

Refer to Tables 3 & 4 for detailed results of controls. NA = not applicable

mL = milliliters

ng/L = nanograms per liter

Dhc = *Dehalococcoides vcrA* = vinyl chloride reductase Dhb = *Dehalobacter* °C = degrees Celsius PCR = polymerase chain reaction qPCR = quantitative PCR DNA = Deoxyribonucleic acid



Table 3: Gene-Trac Dhc Control Results, Test Reference S-2265

Laboratory Control	Analysis Date	Control Description	Spiked Dhc 16S rRNA Gene Copies per Liter	Recovered Dhc 16S rRNA Gene Copies per Liter	Comments
Positive Control Low Concentration	24-Jun-11	qPCR with KB-1 genomic DNA (CSLD-0418)	4.2 x 10 ⁵	4.8 x 10 ⁵	
Positive Control High Concentration	24-Jun-11	qPCR with KB-1 genomic DNA (CSHD-0418)	4.0 x 10 ⁷	4.2 x 10 ⁷	
Negative Control	24-Jun-11	Tris Reagent Blank (TBD-0378)	0	3.9 x 10 ³ U	
DNA Extraction Blank	24-Jun-11	DNA extraction sterile water (FB-1464)	0	3.9 x 10 ³ U	

Notes:

Dhc = Dehalococcoides

qPCR = quantitative PCR

DNA = Deoxyribonucleic acid

16S rRNA = 16S ribosomal ribonucleic acid



Table 4: Gene-Trac VC Control Results, Test Reference S-2265

Laboratory Control	Analysis Date	Control Description	Spiked <i>vcrA</i> reductase Gene Copies per Liter	Recovered <i>vcrA</i> reductase Gene Copies per Liter	Comments
Positive Control Low Concentration	27-Jun-11	qPCR with KB-1 genomic DNA (CSLV-0262)	5.8 x 10 ⁵	4.8 x 10 ⁵	
Positive Control High Concentration	27-Jun-11	qPCR with KB-1 genomic DNA (CSHV-0262)	4.6 x 10 ⁷	5.8 x 10 ⁷	
Negative Control	27-Jun-11	Tris Reagent Blank (TBV-0233)	0	3.9 x 10 ³ U	
DNA Extraction Blank	27-Jun-11	DNA extraction sterile water (FB-1464)	0	3.9 x 10 ³ U	

Notes:

qPCR = quantitative PCR

DNA = Deoxyribonucleic acid

16S rRNA = 16S ribosomal ribonucleic acid

vcrA = vinyl chloride reductase

U Not detected, associated value is the quantification limit.



Table 5: Gene-Trac Dhb Control Results, Test Reference S-2265

Laboratory Control	Analysis Date	Control Description	Spiked Dhb 16S rRNA Gene Copies per Liter	Recovered Dhb 16S rRNA Gene Copies per Liter	Comments
Positive Control	27-Jun-11	qPCR with WBC2 genomic DNA (CSLDB-0122)	9.0 x 10 ⁵	1.1 x 10 ⁶	
Negative Control	27-Jun-11	Tris Reagent Blank	0	3.9 x 10 ³ U	
DNA Extraction Blank	28-Jul-11	DNA extraction sterile water (FB-1464)	0	3.9 x 10 ³ U	

Notes:

qPCR = quantitative PCR

Dhb = Dehalobacter

DNA = Deoxyribonucleic acid

16S rRNA = 16S ribosomal ribonucleic acid

U Not detected, associated value is the quantification limit.





130 Research Lane, Suite 2 Guelph, Ontario N1G 5G3 Phone (519) 822-2265 Fax (519) 822-3151

Certificate of Analysis: Gene-Trac® Dehalococcoides Assay

Customer: Dan Servatas, AECOM Project: Former Duso Chemical Customer Reference: Not Provided SiREM Reference: S-2303 Report Issued: 29-Aug-11 Data Files: MyiQ-DHC-QPCR-0803 DHC-QPCR-Check-gel-0580 iQ5-DB-DHC-QPCR-0229

Table 1a: Test Results

Customer Sample ID	SiREM Sample ID	Sample Collection Date	Sample Matrix	Percent Dhc [*]	<i>Dehalococcoides</i> Enumeration/Liter ^{**}
DUSO-ANAC-170811	DHC-7502	17-Aug-11	Microcosm	0.006-0.02%	1 x 10 ⁶
DUSO-EOS-170811	DHC-7503	17-Aug-11	Microcosm	4-12%	2 x 10 ⁹

Notes:

Percent Dehalococcoides (Dhc) in microbial population. This value is calculated by dividing the number of Dhc 16S ribosomal ribonucleic acid (rRNA) gene copies by the total number of bacteria as estimated by the mass of DNA extracted from the sample. Range represents normal variation in Dhc enumeration.

** Based on quantification of Dhc 16S rRNA gene copies. Dhc are generally reported to contain one 16S rRNA gene copy per cell; therefore, this number is often interpreted to represent the number of Dhc cells present in the sample.

J The associated value is an estimated quantity between the method detection limit and quantitation limit.

U Not detected, associated value is the quantification limit.

B Analyte was also detected in the method blank.

NA Not applicable as Dehalococcoides not detected and/or quantifiable DNA not extracted from the sample.

Analyst: __

Kela Bartle, B.Sc. **Biotechnology Technologist**

fimena Druar Approved:

Ximena Druar. B.Sc. **Molecular Biology Coordinator**



130 Research Lane, Suite 2 Guelph, Ontario N1G 5G3 Phone (519) 822-2265 Fax (519) 822-3151

Certificate of Analysis: Gene-Trac[®] VC, Vinyl Chloride Reductase (*vcrA*) Assay

Customer: Dan Servatas, AECOM Project: Former Duso Chemical

Customer Reference: Not Provided

SiREM Reference: S-2303

Report Issued: 29-Aug-11

Data Files: MyiQ-VC-QPCR-0404 VC-QPCR-Check-gel-0424 MyiQ-DB-VC-QPCR-0160

Table 1b: Test Results

Customer Sample ID	SiREM Sample ID	Sample Collection Date	Sample Matrix	Percent <i>vcrA</i> *	Vinyl Chloride Reductase (<i>vcrA</i>) Gene Copies/Liter
DUSO-ANAC-170811	VCR-2738	17-Aug-11	Microcosm	0.004-0.01%	9 x 10⁵B
DUSO-EOS-170811	VCR-2739	17-Aug-11	Microcosm	3-9%	1 x 10 ⁹ B

Notes:

Percentage of bacteria in the microbial population that harbor the *vcrA* gene. This value is calculated by dividing the measured number of cells haboring the vinyl chloride reductase A (*vcrA*) gene by the total number of bacteria in the sample estimated using the mass of DNA extracted from the sample. Range represents normal variation in enumeration of *vcrA*.

J The associated value is an estimated quantity between the method detection limit and quantitation limit.

U Not detected, associated value is the quantification limit.

B Analyte was also detected in the method blank.

NA Not applicable as vcrA not detected and/or quantifiable DNA not extracted from the sample.

LelaBattle

Analyst:

Kela Bartle Biotechnology Technologist

Jumena Druar Approved:

Ximena Druar, B.Sc. Molecular Biology Coordinator





130 Research Lane, Suite 2 Guelph, Ontario N1G 5G3 Phone (519) 822-2265 Fax (519) 822-3151

Certificate of Analysis: Gene-Trac® Dehalobacter Assay

Customer: Dan Servatas, AECOM Project: Former Duso Chemical Customer Reference: Not Provided SiREM Reference: S-2303

Report Issued: 29-Aug-11 Data Files: MyiQ-DHB-QPCR-0171 DHB-QPCR-Check-gel-0089 iQ5-DB-DHB-QPCR-0008

Table 1c: Test Results

Customer Sample ID	SiREM Sample ID	Sample Collection Date	Sample Matrix	Percent Dhb [*]	<i>Dehalobacter</i> 16S rRNA Gene Copies/ Liter
DUSO-ANAC-170811	DHB-0472	17-Aug-11	Microcosm	0.003-0.008%	6 x 10⁵B
DUSO-EOS-170811	DHB-0473	17-Aug-11	Microcosm	0.05-0.1%	2 x 10 ⁷ B

Notes:

Percent *Dehalobacter* (Dhb) in microbial population. This value is calculated by dividing the number of Dhb 16S ribosomal ribonucleic acid (rRNA) gene copies by the total number of bacteria as estimated by the mass of DNA extracted from the sample. Range represents normal variation in Dhb enumeration.

J The associated value is an estimated quantity between the method detection limit and quantitation limit.

U Not detected, associated value is the quantification limit.

B Analyte was also detected in the method blank.

NA Not applicable as *Dehalobacter* not detected and/or quantifiable DNA not extracted from the sample.

Kelabatele

Analyst:

Kela Bartle, B.Sc. Biotechnology Technologist

Jumena Druar Approved:

Ximena Druar, B.Sc. Molecular Biology Coordinator



Table 2: Detailed Test Parameters, Test Reference S-2303

Customer Sample ID	DUSO-ANAC-170811	DUSO-EOS-170811			
SiREM Sample ID	DHC-7502/VCR-2738/DHB-0472	DHC-7503/VCR-2739/DHB-0473			
Date Received	17-Aug-11	17-Aug-11			
Sample Temperature	NA	NA			
Volume Used for DNA Extraction	10 mL	10 mL			
Filtration Date	17-Aug-11	17-Aug-11			
DNA Extraction Date	17-Aug-11	17-Aug-11			
DNA Concentration in Sample (extractable)	44475 ng/L	76425 ng/L			
PCR Amplifiable DNA	Detected	Detected			
Dhc qPCR Date Analyzed	18-Aug-11	18-Aug-11			
vcrA qPCR Date Analyzed	22-Aug-11	22-Aug-11			
Dhb qPCR Date Analyzed	25-Aug-11	25-Aug-11			
Laboratory Controls (see Tables 3, 4 & 5)	Passed	Passed			
Comments					

Notes:

Refer to Tables 3, 4 & 5 for detailed results of controls. NA = not applicable mL = milliliters

ng/L = nanograms per liter

DNA = Deoxyribonucleic acid PCR = polymerase chain reaction qPCR = quantitative PCR °C = degrees Celsius Dhc = *Dehalococcoides* Dhb = *Dehalobacter vcrA* = vinyl chloride reductase



 Table 3: Gene-Trac Dhc Control Results, Test Reference S-2303

Laboratory Control	Analysis Date	Control Description	Spiked Dhc 16S rRNA Gene Copies per Liter	Recovered Dhc 16S rRNA Gene Copies per Liter	Comments
Positive Control Low Concentration	18-Aug-11	qPCR with KB-1 genomic DNA (CSLD-0441)	2.5 x 10 ⁵	3.1 x 10 ⁵	
Positive Control High Concentration	18-Aug-11	qPCR with KB-1 genomic DNA (CSHD-0441)	2.8 x 10 ⁷	3.5 x 10 ⁷	
Negative Control	18-Aug-11	Tris Reagent Blank (TBD-0401)	0	3.9 x 10 ³ U	
DNA Extraction Blank	18-Aug-11	DNA extraction sterile water (FB-1498)	0	3.9 x 10 ³ U	

Notes:

Dhc = Dehalococcoides

qPCR = quantitative PCR

DNA = Deoxyribonucleic acid

16S rRNA = 16S ribosomal ribonucleic acid

U Not detected, associated value is the quantification limit.



Laboratory Control	Analysis Date	Control Description	Spiked <i>vcrA</i> reductase Gene Copies per Liter	Recovered <i>vcrA</i> reductase Gene Copies per Liter	Comments
Positive Control Low Concentration	22-Aug-11	qPCR with KB-1 genomic DNA (CSLV-0272)	2.8 x 10 ⁵	1.5 x 10 ⁵	
Positive Control High Concentration	22-Aug-11	qPCR with KB-1 genomic DNA (CSHV-0272)	3.2 x 10 ⁷	2.3 x 10 ⁷	
Negative Control	22-Aug-11	Tris Reagent Blank (TBV-0243)	0	3.9 x 10 ³ U	
DNA Extraction Blank	19-Aug-11	DNA extraction sterile water (FB-1498)	0	6.4 x 10 ³	See Note 1

Notes:

qPCR = quantitative PCR

DNA = Deoxyribonucleic acid

16S rRNA = 16S ribosomal ribonucleic acid

vcrA = vinyl chloride reductase

U Not detected, associated value is the quantification limit.

¹Acceptable as test results for relevant samples exceeded DNA Extraction Blank test result by at least 10-fold.



Table 5: Gene-Trac Dhb Control Results, Test Reference S-2303

Laboratory Control	Analysis Date	Control Description	Spiked Dhb 16S rRNA Gene Copies per Liter	Recovered Dhb 16S rRNA Gene Copies per Liter	Comments
Positive Control Low Concentration	25-Aug-11	qPCR with WBC2 genomic DNA (CSLDB-0132)	3.0 x 10 ⁵	2.6 x 10 ⁵	
Positive Control High Concentration	25-Aug-11	qPCR with WBC2 genomic DNA (CSHDB-0132)	3.3 x 10 ⁷	3.0 x 10 ⁷	
Negative Control	25-Aug-11	Tris Reagent Blank	0	3.9 x 10 ³ U	
DNA Extraction Blank	19-Aug-11	DNA extraction sterile water (FB-1498)	0	1.9 x 10 ³ J	See Note 1

Notes:

qPCR = quantitative PCR

Dhb = Dehalobacter

DNA = Deoxyribonucleic acid

16S rRNA = 16S ribosomal ribonucleic acid

U Not detected, associated value is the quantification limit.

J The associated value is an estimated quantity between the method detection limit and quantitation limit.

¹Acceptable as test results for relevant samples exceeded DNA Extraction Blank test result by at least 10-fold.



Chain-of-Custody Form

130 Research Lane, Suite 2 C Guelph, Ontario, Canada N1G 5G3 Phone (519) 822-2265 or toll free 1-866-251-1747 Fax (519) 822-3151

www.siremlab.com

Nº

Lab#

of .

Page _

5-2303

3249

Project Name DUSO Chen	ich	,	Project #				Analysis														
Project Manager	mid						Prese	rvative													
Email Address Company	2	1 -						/	/	7	1	7	1	7	1	/	/	/	7	Preservative K 0. None 1. HCl	ey
Address			ade	20				Dhc	140	-ie-Trac Dhb	/ /	/ /	/ /	/ /	/ /	/ /	/ ,	/ ,	/	2. Other 3. Other	
Phone #		Fax #		2 Y - 1				Gence Dhe	Gen.	e-Irac	/	/	/	/	/	/	/	/			
Sampler's Signature		Sampler's P Name	rinted		-		8	/ "		\square				\square			\square		_		
Customer Sample ID			Sam		Matrix	# of Containers														Other Informat	ion
		1.	Date	Time														-			
DUSOMANSE	17081	-/ 12		_	++	1×10m	1		+	1											
DUSO-ANAC-	-17081	1			W	1×10ml	.~	~	~												
DUSO-EOS-1	7081	1			W	1×10ml	r	~	~	1											
				1.00																	
		_																			Loons Systems
	and the second																				
Cooler Condition: Sample Receipt		-	P.O. #		Billing In	formation					aroun	d Time	Reque	ested		For L	ab Us	e Only			
Cooler Temperature:			Bill To:								ush										
Custody Seals: Yes No	ly Seals: Yes No				_																
/											_		_			Prop	osal #				
Relinquished By: Signature				shed By:	Signature			Receiv	ed By:			Sign	ature	Relinquished By: ture				Signature	eived By:		
Printed Name	Printed Name	D. Nespoli' Printed Name			Printed Printed Name Name						Printed					Printed Name					
Firm	Firm Cr	P		Firm				irm						Firm	a substation .					Firm	
Date/Time	Firm SCREM.		Date/Tim	e		Date/Time					Date/Time					Date/Time					

Distribution: White - Return to Originator: Yellow - Lab Copy: Pink - Retained by Client

Site netwery a management	tite 2 © Guelph, Ontari					1-866-251	-1747 Fax (51	19) 822-315	1	Page	of	Lab#	3116		
Project Name Former Duss Chemical	Project #						Analysis								
Project Manager Dan Squatas				Preservative	Preservative							15 et			
Email Address arthw. tadded Caec	an com				11	13/1	xD/	11		11	Preserva 0. None	tive Key	eling: -		
Company	AECOM						2/ /	11	/	/ /	1 HCI	11			
							\times / /	/ /		/	2. Other . 3. Other .	None			
Bhono #		/	1010	Gene-Trac Dhc Gene-Trac Vr	Gene-Trac Dhb	1001	//	11	/	/					
Sampler's Ala Sampler's	78)957 2 Printed M. L	11	1	Gene.	Gene-Tra	Terr	/ /	/ /	/ /	/					
Signature Wark/Haward Name	Sampling	IT OWO	# of		-/ 7	NY		<u> </u>	((
Customer Sample ID	Date Time	Matrix	Containers								Other Inf	ormation			
5658-3	3/21/11 1452	GW	1			X									
MAC-24	7/21/11 1600	GW	1			X			+						
mHC-26	2/21/11 1430		1												
MHC-22	72/11 1510	GW	1		+ +	$\overline{\mathbf{x}}$			+						
The Gas SOT	3/21/11	C	2			X			+			.e			
Star Gas SB-2 Star Gas SB-3	3/21/11		2			Ź									
Star Gas SB-4	3/2///	6	7.			X									
Stat Ous OF 1	4011														
			-									the second s			
Cooler Condition: Sample Receipt	P.O. #	Billing In	formation		Turnar	ound Time	Requested	For	Lab Use C	only					
600p .					Nor	mal X)								
Cooler Temperature:	Bill To: Dan	Serva	tas		Rus	h 🗌									
Custody Seals: Yes No	40 Bit	ich A	Merican	Blud											
/~	Litham		VV	12/16				Proj	oosal #: _						
Relinquished By: / Received E	By:		ished By:		Received	By:		Reli	nquished	By:		Received B	}y:		
Signature Alach Alucan Signature	Signatur	e		Signature			Signa	ature			Signature				
Printed Mart Haward Printed Name O. Nes	001, Printed Name			Printed Name			Printe Name	d		Printed Name					
FIRM AECOM FIRM SIREM	S ·			Firm			Firm			Firm					
Date/Time 327/11 1830 Date/Time Distribution: White - Return to Originator: Yellow - Lab Copy: Pink - Retained by Client	Date/Tim	e		Date/Time	•		Date/	Time			Date/Time	*	Date/Time		



APPENDIX B: Henry's Law Calculation



The following Henry's Law calculation was used to convert aqueous concentrations (Table 2A) to total mmoles of each analyte per microcosm bottle (Figures 3 to 5):

Total mmoles = $\frac{C_{iig} \times (V_{lig} + H \times V_{gas})}{Molecular Weight (mg/mmol)}$

Where

$$\begin{split} &C_{liq} = liquid \ concentration \ (mg/L) \\ &V_{liq} = liquid \ volume \ (0.20 \ L) \ per \ bottle \\ &V_{gas} = headspace \ volume \ (0.02 \ L) \ per \ bottle \\ &H = Henry's \ Law \ constant \ (dimensionless) \end{split}$$

The Henry's Law constants used are summarized in the table below.

Analyte	Henry's Law Constant ^a (dimensionless)
Trichloroethene	0.48
cis-1,2-dichloroethene	0.31
1,1-dichloroethene	1.04
Vinyl chloride	0.95
Ethene	8.76
1,1,1-trichlorolethane	1.13
1,1-dichloroethane	0.23
chloroethane	0.48
Ethane	20.42
Methane	27.2

^a Source: Montgomery, J.H. 2000. *Groundwater Chemicals Desk Reference, Third Edition.* CRC Press LLC, Boca Raton, FL.

Appendix E

Underground Injection Control Inventory Notification

	U.S. ENVIRONMENTAL PROTECTION AGENCY, REGION 2																
	UNDERGROUND INJECTION CONTROL PROGRAM																
		SI	TE REM	EDIATION I	NJECTION \	VELL INVE	NTORY SPF	READSHEET									
		e-Mail	Comple	eted Forms	to Region2_	UIC@epa.g	ov or Fax to	o (212) 637-3953	}								
Facility Name Facility City State Facility Facility																	
Former Duso					No phone at									75 (injection using direct- push	1. Emulsified Vegetable Oil (EOS Pro), 10% v/v (75 pts) 2. Plant Based Carbon Substrate		
Chemical Site					facility (use NYSDEC PM									methods; no injection wells	with Zero Valent Iron (EHC),		
NYSDEC Site # 3-14-103	33 Fulton Street	Poughkeepsie	NY		Phone 518. 402.9814)	41.7003	73.9214	David J. Chiusano (NYSDEC)	625 Broadway, 12th Floor	Albany	NY	12233	Remediation	to be constructed)	0.35% soil volume (9 pts)	1 time	4-8 weeks

From:	Underhill, Scott
Sent:	Wednesday, March 13, 2013 1:35 PM
To:	Region2_UIC@epa.gov
Cc:	David Chiusano
Subject:	UIC Notification for Former Duso Chemical Site NYSDEC Site #3-14-103
Attachments:	DUSO IGP-22 Att1_DEC_Inventory_Spreadsheet 092809.xlsx

On behalf of the New York State Department of Environmental Conservation (NYSDEC) Division of Remediation (DER), AECOM is presenting this notification of remediation injections at the Former Duso Chemical Site (NYSDEC Site #3-14-103) in Poughkeepsie, NY, which is a NYSDEC led site. In accordance with the DER Internal Guidance Policy (IGP-22), notification is being made directly by NYSDEC's consultant using the inventory spreadsheet which was created by EPA Region 2 for exclusive use by DEC (attached). Per the ROD issued by NYSDEC in March 2008, the selected remedy for this site is Enhanced In-Situ Bioremediation via reductive dechlorination as the primary contaminants are chlorinated volatile organic compounds (CVOCs). The proposed injection plan includes injection of an emulsified vegetable oil (EOS Pro) into 75 injection points using direct-push methods; a limited number of injection points located in the area of highest concentrations will also receive zero valent iron and a plant based carbon substrate (EHC). AECOM has successfully and safely implemented these remedial amendments for treatment of CVOCs at nearly 100 sites. Please note a range of four to eight weeks is presented as injection duration, and the actual duration will be determined by subsurface conditions. The NYSDEC project manager is David Chiusano. Please contact Mr. Chiusano (copied to this email) or myself with any questions regarding the notification or the proposed remedial plan.

Thank you, Scott

Scott Underhill, PE

Project Manager Environment D 518.951.2208 M 518.396.7638 scott.underhill@aecom.com

AECOM

40 British American Blvd, Latham, NY 12110 T 518.951.2200 F 518.951.2300 www.aecom.com Appendix F

Enhanced In-Situ Bioremediation Pilot Study Subcontractor Cost Estimate

FORMER DUSO CHEMICAL SITE 33 Fulton Street, Poughkeepsie, NY

Enhanced In-Situ Bioremediation Pilot Study

Engineer's Cost Estimate for Remediation Subcontractor Costs

DESCRIPTION	UNIT QUANTITY RATE		TOTAL COST	ESTIMATE/SOURCE NOTES	
INJECTION SUBCONTRACTOR (assume subcontractor procures	all chemicals	and provides all I	abor, equipm	ent, and supplies t	
Mobilization	1	LS	\$10,000	\$10,000	Conservative Allowance based on AECOM experience 2011- 2013
Mobilization Misc. & Additional	1	LS	\$1,500	\$1,500	Dumpster, connections, etc
Injection Subcontractor (labor, rig, equipment for ZVI points)	7	days	\$4,200	\$29,400	Average cost from AECOM experience 2011-2013 in the northeast with day rate quotes from \$2,500 to \$6200 (n=4)
Injection Subcontractor (labor, rig, equipment for VO points)	20	days	\$3,200	\$64,000	Average cost from AECOM experience 2011-2013 in the northeast with day rate quotes from \$1,500 to \$6200 (n=5)
Subcontractor Per Diem	27	days	\$450	\$12,150	AECOM experience 2011-2013 (assume 2-3 person crew)
Bentonite Chips for Hole Fill	95	bags	\$25	\$2,375	allowance based on field experience
Water Tanker Trailer Rental	5	weeks	\$500	\$2,500	based on quotes received for other projects in CT, NY, and MA
Water Delivery	12	deliveries	\$350	\$4,200	Each delivery 4,000-5,000 gallons to fill tanker (Estimated volume of 48,000 gallons)
Remediation Chemicals					
EHC (FMC)	7850	lbs	\$2.65	\$20,803	FMC quote January 2013
EHC (FMC) Delivery	1	shipment	\$1,900	\$1,900	FMC quote January 2013
Vegetable Oil (EOS Pro)	15	totes	\$4,000	\$60,000	average of EOS quote Jan. 2013 and AECOM EOS invoice Oct 2012
Vegetable Oil (EOS Pro)	4	drums	\$840	\$3,360	EOS invoice October 2012
Vegetable Oil (EOS Pro) Delivery	1	shipment	\$3,500	\$3,700	EOS quote January 2013 + 25%
Subcontractor Markup on Chemical			4%	\$4,423	
INJECTION CONTRACTOR TOTAL				\$220,310	

DESCRIPTION	UNIT	QUANTITY	RATE	TOTAL COST	ESTIMATE/SOURCE NOTES
ROUNDWATER PERFORMANCE MONITORING (inclu	des labor, equipment, a	and supplies to pe	erform ground	dwater performanc	e sampling and analytical laboratory costs)
er the EISB Pilot Test Work Plan, assumes sampling following injectio	n at 1 month (water quality p	parameters only), 3 mo	onths, 6 months	s, 9 months, 12 months	, 18 months, 24 months, and 36 months
ield Sampling Labor					assume 3 wells per person per day
7-9 well events	8	event	\$3,135	\$25,080	assume 8 hours on site plus roundtrip travel
ampling Equipment	8	event	\$1,500	\$12,000	Allowance, including YSI, peristaltic pumps, water levels, Turk Meters, PID, PPE, vehicle rental, misc
aboratory Analyses					
VOCs	63	samples	\$55	\$3,465	Test America, 2012
TOC	66	samples	\$21	\$1,386	Test America, 2012
Sulfate	18	samples	\$10	\$180	Test America, 2012
M/E/E	36	samples	\$90	\$3,240	Test America, 2012
DHC/DHB	27	samples	\$380	\$10,260	SiREM, 2012
Volatile Fatty Acids	18	samples	\$55	\$990	SiREM, 2012
As/Fe/Mn	25	samples	\$40	\$1,000	assumption based on recent AECOM in-situ projects
C Samples (20% of analytical total)	20%			\$4,200	

Appendix G

Property Access Information





Parcel Grid Identification #: 134689-6162-05-005836-0000 Municipality: Poughkeepsie

Parcel Location 3440-3444 North Rd

Owner Name on March 1 Midhudson Center LLC , (P)

Primary (P) Owner Mail Address

PO Box 9273 Oak Brook IL 605229273



Parcel Details

Size (acres):	5.81 Ac (S)	Land Use Class:	(452) Commercial: Retail Services: Area or Neighborhood Shopping Centers
File Map:	10650	Agri. Dist.:	(0)
File Lot #:	3	School District:	(133201) Hyde Park Central School District
Split Town			

Assessment Information (Current)

*** 2013 assessments not yet established ***

Last Sale/Transfer

Sales Price: \$0	Sale Date: 0	Deed Book: 1957	Deed Page: 0612	Sale Condition: ()	No. Parcels: 0
Site Information: Site Number: 1 Water Supply: (3) Comm/public	Sewer Type: (3) Comm/public	Desirabili (3) Super			cal center
Commercial/Industrial/L Site Number: 1	Jtility Building Informat	ion:			
Bldg Sec.: 1 Bldg. Num	ber: 1				
Year Built: 2000	No. Stories: 1	Gross Floor Area: 54700	Boeck Model (0325) Shopping	ctr/strip load sup	Const. Qual.: (2) Average +
Air Cond. %:	Sprinkler %:	Alarm %:	No. Elevator:		Basement sf.:
0	0	0	0		0
Number Identical: 1	Condition Code: 3				

Commercial Rental Information: Site Number: 1

Use Number: 1 Used As: (D03) Local	center			
Unit Code:	Total Rent Area:	Area 1 Bdrms Apts	Area 2 Bdrms Apts	Area 3 Bdrms Apts
(01) Square feet	24700	0	0	0
Total Units:	No. 1 Bdrms Apts	No. 2 Bdrms Apts	No. 3 Bdrms Apts	
1	0	0	0	
Site Number: 1				
Use Number: 2 Used As: (Z98) Non-c	contrib			
Unit Code:	Total Rent Area:	Area 1 Bdrms Apts	Area 2 Bdrms Apts	Area 3 Bdrms Apts
()	31600	0	0	0
Total Units:	No. 1 Bdrms Apts	No. 2 Bdrms Apts	No. 3 Bdrms Apts	
0	0	0	0	
Site Number: 1				
Use Number: 3	unde a cura a			
Used As: (F03) Dstr v Unit Code:	Total Rent Area:	Area 1 Bdrms Apts	Area 2 Bdrms Apts	Area 3 Bdrms Apts
()	6900	0	0	0
Total Units:	No. 1 Bdrms Apts	No. 2 Bdrms Apts	No. 3 Bdrms Apts	
0	0	0	0	
Special District Inform	nation:			
Special District: 999Y				
Primary Units:	Advalorem	Value	Spec. Dist. Name:	
20800	0		Townwide Drain Imp	
•				
Special District: CL05				
Primary Units:	Advalorem V	Value	Spec. Dist. Name:	
0	4450000		Consolidated Light	
•				
Special District: FF02				
Primary Units:	Advalorem	Value	Spec. Dist. Name:	
0	4450000		Fairview Fire Pok	
•				
Special District: GL00		(-h		
Primary Units:	Advalorem	value	Spec. Dist. Name: Pok Lib District	
0	4450000		FOR LID DISUICI	
•				
Special District: TW0				
Primary Units:	Advalorem	value	Spec. Dist. Name: Town Wide Wat Imp	
35900	0		rown while wat mp	
•				
Special District: WS0		/-l	On an Dist M	
Primary Units:	Advalorem	value	Spec. Dist. Name:	
28900	0		4th Ward Swr Imp Cap	
•				

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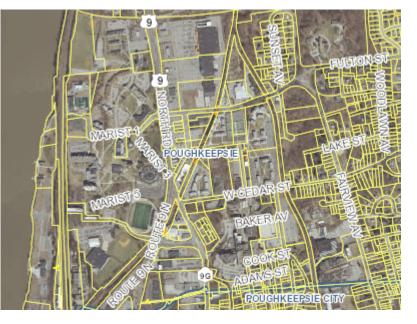


Parcel Grid Identification #: 134689-6162-05-011773-0000 Municipality: Poughkeepsie

Parcel Location Spur N & E Of City

Owner Name on March 1 New York Central Lines LLC , (P)

Primary (P) Owner Mail Address 500 Water St Jacksonville FL 322020000



Parcel Details

Size (acres):	11.5 Ac (C)	Land Use Class:	(340) Vacant Land Located in Industrial Areas
File Map:		Agri. Dist.:	(0)
File Lot #:		School District:	(133201) Hyde Park Central School District

Deed Book:

21999

Split Town

Assessment Information (Current)

** 2013 assessments not yet established ***

Last Sale/Transfer					
Sales Price:	Sale Date:				
\$0	0				
Site Information:					
Site Number: 1					
Water Supply:	Sewer Type:				

(1) None

0

Water Supply: (1) None

Special District Information:

Special District: 999Y2 Primary Units: 9300

Special District: CL057 Primary Units:

0

Special District: FF025 Primary Units:

0

Advalorem Value 466000 Advalorem Value 466000

Advalorem Value

Desirability: (1) Inferior

Deed Page:

05513

Zoning Code: FC

()

Sale Condition:

Used As: ()

No. Parcels:

0

Spec. Dist. Name: Townwide Drain Imp

Spec. Dist. Name: Consolidated Light

Spec. Dist. Name: Fairview Fire Pok

Special District: GL000 Primary Units: 0	Advalorem Value 466000	Spec. Dist. Name: Pok Lib District
Special District: TW0K3 Primary Units:	Advalorem Value	Spec. Dist. Name:
4800	0	Town Wide Wat Imp
•		

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Parcel Grid Identification #: 134689-6162-05-042826-0000 Municipality: Poughkeepsie

Parcel Location 33 Fulton St

Owner Name on March 1 Star Gas Properties Inc , (P)

Primary (P) Owner Mail Address 33 Fulton St Poughkeepsie NY 126010000



Parcel Details

Si	Size (acres):	.7 Ac	Land Use Class:	(441) Commercial: Storage, Warehouse and Distribution Facilities: Gasoline, Fuel, Oil,
		AC		Liquid Petroleum Storage and or Distribution
	File Map:		Agri. Dist.:	(0)
	File Lot #:		School District:	(133201) Hyde Park Central School District
	Split Town			

Assessment Information (Current) *** 2013 assessments not yet established ***

Last Sale/Transfer

Sales Price: \$0	Sale Date: 0	Deed Book: 1984	Deed Pag 0657	ge: S (ale Conditior)	n: No. Parcels: 0
Site Information: Site Number: 1 Water Supply: (3) Comm/public	Sewer Type: (3) Comm/pul	Desira olic (3) Su		Zoning Coo FC	de:	Used As: (F06) Nat gas dstr
Commercial/Industrial	/Utility Building Inforr	nation:				
Bldg Sec.: 1 Bldg. Nur Year Built: 0	mber: 1 No. Stories: 0	Gross Floor Area: 7400	Boeck Moo (0832) 1 st	lel y warehouse	e wood mill	Const. Qual.: (3) Above Average
Air Cond. %: 0	Sprinkler %: 0	Alarm %: 0	No. Elevato 0	or:		Basement sf.: 3200
Number Identical: 1	Condition Code: 3					

Site Number: 1

Bldg Sec.: 1 Bldg. Number: 2

Dutchess County, NY Property Record

Structure Code:

Year Built: 1965	No. Stories: 1	Gross Floor Area: Boeck M 1470 (0312) 1		del ty store load sup	Const. Qual.: (2) Average
Air Cond. %:	Sprinkler %:	Alarm %:	No. Elevat	tor:	Basement sf .:
100	0	0	0		0
Number Identical:	Condition Code:				
1	3				
Site Number: 1					
Bldg Sec.: 1 Bldg. Nu Year Built:	mber: 3 No. Stories:	Gross Floor Area:			
1965	1	3240	Boeck Mo (0832) 1 s	del ty warehouse wood mill	Const. Qual.: (2) Average
Air Cond. %:	Sprinkler %:	Alarm %:	No. Elevat	tor:	Basement sf .:
0	0	0	0		0
Number Identical:	Condition Code:				
1	3				
<u>Commercial Rental Ir</u> Site Number: 1 Use Number: 1 Used As: (F06) Nat g					
Unit Code:	Total Rent Area:	Area 1 Bdrms	Apts	Area 2 Bdrms Apts	Area 3 Bdrms Apts
(01) Square feet	7910	0		0	0
Total Units:	No. 1 Bdrms Apts	No. 2 Bdrms A	Apts	No. 3 Bdrms Apts	
0	0	0		0	
• Site Number: 1 Use Number: 2 Used As: (Z98) Non-o Unit Code:	contrib Total Rent Area:	Area 1 Bdrms	Apts	Area 2 Bdrms Apts	Area 3 Bdrms Apts
(01) Square feet	7400	0		0	0
Total Units:	No. 1 Bdrms Apts	No. 2 Bdrms A	Apts	No. 3 Bdrms Apts	
0	0	0		0	
Improvements: Site Number: 1					
Improvement Number	r: 1				
Structure Code:		Dim 1:	Dim 2	Quantity	Year Built
(RG4) Gar-1.0 det		0	0	1	1950
Condition: (3) Normal		Grade	Sq. Ft.		
		С	150		
• Site Number: 1					
Improvement Numbe	r: 2				
Structure Code:		Dim 1:	Dim 2	Quantity	Year Built
(FC3) Shed-galvnzd		0	0	1	1950
Condition: (3) Normal		Grade C	Sq. Ft. 285		
• Site Number: 1					
Improvement Numbe	r: 3				

Dim 2

Quantity

Dim 1:

Year Built

(FC3) Shed-galvnzd		0	0	1	1950
Condition: (3) Normal		Grade C	Sq. Ft. 240		
Site Number: 1		-			
Improvement Number: 4 Structure Code: (FC3) Shed-galvnzd		Dim 1:	Dim 2	Quantity	Year Built
•		0 Crada	0 Sa Et	1	1950
Condition: (3) Normal		Grade C	Sq. Ft. 144		
Site Number: 1					
Improvement Number: 5 Structure Code: (TK6) Tank-hz bulk		Dim 1: 0	Dim 2 0	Quantity 1	Year Built 1962
Condition: (3) Normal		Grade C	Sq. Ft. 30000		
Site Number: 1					
Improvement Number: 6 Structure Code: (TK6) Tank-hz bulk		Dim 1: 0	Dim 2 0	Quantity 1	Year Built 1950
Condition: (3) Normal		Grade C	Sq. Ft. 15000		
• Site Number: 1					
Improvement Number: 7 Structure Code:		Dim 1:	Dim 2	Quantity	Year Built
(LP4) Pavng-asphlt		0	0	1	1985
Condition: (3) Normal		Grade C	Sq. Ft. 10000		
Special District Information: Special District: 999Y2					
Primary Units: 2300	Advalorem Valu 0			Spec. Dist. Name: Townwide Drain Imp	
• Special District: CL057 Primary Units:	Advalorem Valu	10			
0	451500	16		Spec. Dist. Name: Consolidated Light	
Special District: FF025 Primary Units: 0	Advalorem Value 451500			Spec. Dist. Name: Fairview Fire Pok	
Special District: GL000 Primary Units: 0	Advalorem Valu 451500	ıe		Spec. Dist. Name: Pok Lib District	
• Special District: TW0K3					
Primary Units: 3900	Advalorem Valu 0	ıe		Spec. Dist. Name: Town Wide Wat Imp	

Special District: WS0P4 Primary Units: 3100

.

Advalorem Value 0 Spec. Dist. Name: 4th Ward Swr Imp Cap

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