

March 31, 2011

Mr. Andrew Fan
US EPA Region III, 3WC23
1650 Arch Street
Philadelphia, PA 19103-2029

Ms. Barbara Brown
Project Coordinator
Maryland Department of the Environment
1800 Washington Blvd.
Baltimore, Maryland 21230

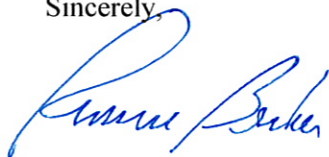
Re: Consent Decree, Civil Action Nos. JFM-97-558, JFM-97-559
Coke Oven Area Interim Measures Cell 4 In-Situ Anaerobic Bio-Treatment System Design

Dear Mr. Fan and Ms. Brown:

Enclosed with this correspondence is the ***Coke Oven Area Interim Measures Cell 4 In-Situ Anaerobic Bio-Treatment System Design*** report completed for the Severstal Sparrows Point Facility. The proposed final design for Cell 4 has been completed and is submitted in accordance with the requirements outlined in US EPA's January 13, 2011 revised approval letter for the Coke Oven Area Interim Measures work associated with the referenced Consent Decree. The report provides design details for the implementation of an in-situ anaerobic bio-treatment system to be constructed in the Cell 4 area at the facility.

Please contact me at (410) 388-6622 should questions arise during your review of the enclosed design report.

Sincerely,



Russell Becker
Division Manager, Environmental Engineering and Affairs

Enclosure

COKE OVEN AREA INTERIM MEASURES

CELL 4: IN-SITU ANAEROBIC BIO-TREATMENT SYSTEM DESIGN

Prepared for

Severstal-Sparrows Point, LLC
Sparrows Point, Maryland



March 31, 2011

URS

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Background

The design of the Cell 4 in-situ anaerobic bio-treatment system was preliminarily outlined in correspondence titled “*Coke Oven Area Interim Measures Work Plan Supplemental Information*” submitted to the agencies for approval on June 18, 2010. This correspondence committed to evaluating baseline bio-chemical conditions to prove the concept of in-situ anaerobic treatment and identifying viable groundwater amendments and recirculation parameters that would encourage/accelerate in-situ biodegradation of Cell 4 groundwater constituents.

Cell 4 baseline groundwater bio-chemical evaluations began in July, 2010 with the deployment of Bio-Trap[®] Samplers (Bio-Traps) and associated supplemental groundwater chemical evaluations. The results of these bio-chemical evaluations confirmed the viability of the Cell 4 treatment concept and were presented to the United States Environmental Protection Agency (US EPA) in the September 2010 “*Coke Oven Area Interim Remedial Measures Progress Report*”.

The US EPA has requested submittal of the proposed final design for Cell 4 by April 1, 2011 and the completion of construction and operational start of Cell 4 by July 3, 2011 (as stated in their revised approval letter dated January 13, 2011). In accordance with that request, this document presents the proposed final design for Cell 4.

Summary of Information Learned from the Cell 4 Baseline Bio-Chemical Evaluation

Table 1 presents the Cell 4 groundwater monitoring results based on baseline sampling conducted during July, 2010 (see **Figure 1** for the well locations). **Table 1** indicates that the primary groundwater contaminant in this area is naphthalene.

A summary of the findings of the Cell 4 baseline bio-chemical evaluation is as follows:

- The vicinities of monitoring wells OBS-6 and OBS-7 are under the influence of iron-reducing and sulfate-reducing conditions, respectively,
- Both benzene and naphthalene were degraded in both observation wells,
- Benzene and naphthalene degraders in both observation wells reported significantly enriched levels of ¹³C in their biomass, confirming the biological breakdown of each contaminant in each observation well,
- Neither benzene nor naphthalene appear to be fully mineralized to carbon dioxide in either observation well,

- The dominant benzene and naphthalene-degrading population in each observation well is composed of Proteobacteria, a group of microbes known for their ability to degrade a wide range of contaminants, survive a wide range of environments, and adjust quickly to changes in their environment,
- None of the target-compound degrading Proteobacteria appear to be experiencing environmental stresses such as an exposure to toxic levels of compounds, and
- In-situ biological degradation of Cell 4 groundwater constituents is viable and can be accelerated by adding nutrients that have become depleted, such as nitrate and phosphorous, using commercially available bionutrients approved by US EPA for such applications (i.e., VB591™ from BioNutraTech).

Cell 4 Design Concept Summary

This Cell 4 design addresses these basic design elements:

- Extraction and mixing of Cell 4 groundwater in an above ground storage tank containing the amendment (VB591™) to produce the nutrient amendment solution to be added into Cell 4 groundwater.
- Introduction and circulation of the amended groundwater within the subsurface at Cell 4 by pumping groundwater from three (3) downgradient extraction wells and recirculating this water into five (5) upgradient recirculation wells. The nutrient amendment solution (from the above ground storage tank) will be metered into the pipeline used to convey extracted groundwater to the recirculation wells.
- Chemical and biological monitoring.
- Periodically repeating the above activities to replenish the nutrient amendment.

Well Network

Figure 1 illustrates the groundwater well network design for Cell 4. The wells fall into three basic categories: (1) extraction, (2) recirculation, and (3) monitoring wells to supplement the monitoring that will also occur at the extraction and recirculation wells. **Table 2** summarizes existing/planned construction details such as diameters, depths, screened intervals, etc. for each well further described as follows:

Well Category	Existing Wells	Planned Wells
Recirculation Wells	EXT-2 and OBS-10	Cell 4-1, Cell 4-2 and Cell 4-3
Extraction Wells	OBS-7	Cell 4-6 and Cell 4-7
Monitoring Wells	OBS-6, OBS-8, OBS-9 and AS-2	Cell 4-4 and Cell 4-5

Nutrient Amendment

Attachment A presents a description of the nutrient amendment to be introduced and circulated into groundwater at Cell 4. Experience indicates that a treated groundwater total Kjeldahl Nitrogen concentration of 10 to 15 milligrams per liter (mg/l) supports the desired microbial activity. Based on the nitrogen properties of the amendment, approximately 8.0×10^{-4} pounds of amendment per gallon of groundwater treated is needed to achieve this concentration range.

Considering the treatment area between the recirculation and extractions wells (about 1,500 ft²), a saturated thickness of about 7 feet, and a porosity of 0.3, an amendment dosing mass of 20 pounds is estimated. Depletion of the amendment due to biological activity and dilution by mixing with groundwater marginal to the treatment area is anticipated, therefore, the dosing estimate is increased by a correction factor of 3 (total of 60 pounds). The amendment (granular solid) will be mixed into 300 gallons of Cell 4 groundwater (0.2 pounds per gallon), creating a thin slurry to be temporarily contained in a surface tank prior to amending into the subsurface. Maintaining the amendment solution in an anaerobic state is not necessary during mixing because the solution will revert to an anaerobic state after application.

Experience also indicates that additionally adding a readily available source of carbon helps to ‘kick start’ desired in-situ biologic activity. Accordingly, eight (8) pounds of sucrose (e.g., table sugar) will also be added to the 300 gallons of amendment solution.

Dosing and Distribution

Figure 2 illustrates the extraction and recirculation system that will be used to dose and circulate groundwater to disperse the nutrient amendment. Groundwater dosing and circulation will not be continuous, but will periodically be repeated (every two months) to maintain groundwater nutrient levels. The goal is to induce amendment dispersal from the line of recirculation wells,

creating a zone of amended groundwater along the line of recirculation wells and extending downgradient toward the extraction wells.

Each of the three extraction wells will be fitted with an appropriate groundwater pump. Groundwater discharge from each pump will be controlled, metered and directed into a pipeline to transport the water to the recirculation wells. A dosing pump will be attached to the groundwater transport pipeline that will feed the nutrient solution into the pipeline so that the solution is evenly and continuously distributed to the recirculation wells. During the feed, the 300 gallon tank of amendment will be continuously mixed to maintain the amendment in suspension.

The duration of recirculation is estimated to be 26 hours that will occur in 8.5 hour increments over three pumping days during which time all of the amendment will have been applied. This time period was estimated by dividing the treatment area saturated zone water volume by the cumulative extraction well pumping rate. Assumptions are:

- Treatment zone saturated thickness of about 7 feet,
- Treatment area of 1,500 ft²,
- Saturated zone porosity of 0.3, and
- Individual extraction well pumping rate of 5 gallons per minute (gpm) (for a cumulative rate of 15 gpm).

During dosing, groundwater samples from monitoring wells located between the extraction and recirculation wells will be sampled and analyzed in the field for nitrate (NO³⁻) and sulfate (SO₄⁻²) to assess amendment and pumping influences on groundwater chemistry during pumping. Pumping durations and amendment dosing concentrations may be adjusted based on these results. Pressure transducers will be installed in monitoring wells OBS-6, AS-2, and OBS-9 to assess hydraulic influences from operation of the extraction and recirculation wells.

The applied amendment will be consumed by the in-situ biologic processes and, therefore, must periodically be replenished. The planned dosing and monitoring schedule for the first six (6) operational months is:

Dosing and Monitoring July, September and November (1st, 3rd, and 5th months)

Monitoring

August, October, December (2nd, 4th, and 6th months)

Monitoring data will be reviewed to assess groundwater conditions and confirm dosing parameters. The above-mentioned schedule may be adjusted depending on the review results.

Monitoring

Table 3 summarizes the planned monthly monitoring for July through December. It may be adjusted based on review of the chemistry data as they become available. The monitoring wells to be sampled will include downgradient, extraction, re-circulation, general treatment area, and upgradient locations.

Three general categories of analyses are planned: (1) fixed laboratory analyses, (2) field probe (Horiba™), and (3) field test kit (HACH™). Analyses to be conducted by each of these techniques are:

Fixed Laboratory:

- Volatile Organic Compounds (VOCs) and semi-VOC naphthalene via US EPA Method 8260B,
- Total Iron via US EPA Method 6010C,
- Ferrous Iron via US EPA Method SM3500-FeD,
- Ferric Iron (calculated value using iron results from US EPA Methods SM3500-FeD and 6010C),
- Nitrogen (total Kjeldahl; TKN) via US EPA Method 351.1,
- Nitrogen (as Nitrite) and combined Nitrite/Nitrate via US EPA Method 353.2,
- Nitrogen (as Nitrate) (calculated value using Nitrogen and Nitrite/Nitrate results from method 353.2),
- Phosphate via US EPA Method 365.5,
- Sulfate via US EPA Method 375.1, and

- Total Heterotrophic Plate Count¹ (HPC) via US EPA Method SM9215B.

Horiba™ Field Probe:

- Conductivity,
- Dissolved Oxygen,
- pH,
- Reduction-Oxidation Potential (REDOX),
- Temperature, and
- Turbidity.

HACH™ Field Test Kit:

- Nitrogen (as nitrate) via methods 10020 or 8039 or 10206 (depending on concentrations).

Table 3 reveals that each of the three months when dosing will occur (July, September, and November) include these three groundwater sampling efforts: (1) ‘pre-dosing’, (2) ‘during dosing’, and (3) ‘post-dosing’.

‘Pre-dosing’ sampling and analysis will define groundwater conditions prior to initiating groundwater pumping and recirculation associated with dosing. ‘Pre-dosing’ analyses will be conducted using a combination of a fixed laboratory and a field probe (Horiba™).

‘During dosing’ sampling and analysis will define groundwater chemistry changes occurring during groundwater pumping and recirculation. One of the analyses (nitrate) will be conducted in ‘real time’ using HACH™ field test kits and will serve as a tracer to assess amendment spreading/dispersal downgradient from the recirculation wells. The duration of groundwater dosing and recirculation may be adjusted depending on these results. Some of the ‘during dosing’ analyses require a fixed laboratory.

¹ Heterotrophic Plate Count (HPC) is a microbial assay method that uses colony formation on culture media to approximate the levels of heterotrophic microbial flora, where ‘heterotrophic’ refers to bacteria that utilize organic carbon sources (rather than carbon dioxide) during metabolism.

'Post-dosing' sampling and analysis will define groundwater conditions immediately after conclusion of groundwater pumping and recirculation associated with dosing. Groundwater chemistry changes are expected to occur during pumping and recirculation and should not be attributed to biological activity (due to the short duration of the pumping and recirculation). The 'post-dosing' groundwater chemistry data will serve as the baseline used to evaluate subsequent groundwater chemistry changes which will be attributable to biological activity.

Table 3 also reveals that the three monitoring months when dosing does not occur: August, October, and December include one groundwater sampling effort intended to collect a single round of samples that will be analyzed using a fixed laboratory and a field probe (Horiba™).

Some water samples will also be collected from the groundwater conveyance pipeline connecting the extraction wells with the recirculation wells. The chemistry of the pipeline water (before nutrient amendment is added into the pipeline) will be a composite of the water pumped from the extraction wells (wells Cell 4-7, OBS-7, and Cell 4-6). The chemistry of the water in the pipeline will change after addition of the nutrient amendment and will influence the chemistry of the recirculation wells (wells Cell 4-1, OBS-10, EXT-2, Cell 4-2, and Cell 4-3) which define the upgradient boundary of the Cell 4 treatment area. During pumping and recirculation the monitoring wells downgradient of the recirculation wells (wells Cell 4-4, AS-2, Cell 4-5, OBS-9 and OBS-8) are expected to exhibit a chemistry shift toward that of the pipeline water chemistry measured after addition of the nutrient amendment.

Effectiveness

The effectiveness of the Cell 4 remediation system will be evaluated by measuring changes in naphthalene groundwater concentrations. This approach will be supplemented by measuring changes in the concentrations of nitrogen, iron, and sulfur anion species that serve as alternative electron acceptors (in the absence of oxygen) and indirectly reveal anaerobic biological activity. Related, mass rates of consumption of these electron acceptors will be evaluated in the context of the stoichiometry of naphthalene anaerobic biodegradation to estimate mass naphthalene removal. Finally, biological activity implied by HPC results will serve as an indicator of effectiveness.

Reporting

Once in operation, monthly progress reports will be submitted to the US EPA and the Maryland Department of the Environment (MDE) summarizing the performance of the Cell 4 system. A reduction in frequency of submission of progress reports may be requested in the future once the Cell 4 operation is underway.

TABLES

Table 1
Baseline Groundwater Monitoring Results.

Analyte	Sample ID: Date: Units	MDE GW Stds ^[1]	OBS-6 7/9/2010	EXT-2 7/9/2010	OBS-7 7/9/2010
Water Quality Parameters					
Temperature	deg C	NA	20.85	17.23	16.40
pH	std units	NA	10.67	11	10.35
ORP	mV	NA	-169	-182	-298
Conductivity	mS/cm	NA	2.800	3.190	1.320
Turbidity	NTU	NA	0.0	0.0	0.0
DO	mg/L	NA	4.90	1.46	0.00
Volatile Organics					
Acetone	µg/L	550	< 50.0 U	< 50.0 U	< 50.0 U
Benzene	µg/L	5	1,510	999	798
Bromoform	µg/L	80	< 5.0 U	< 5.0 U	< 5.0 U
2-Butanone	µg/L	700	< 50.0 U	< 50.0 U	< 50.0 U
Carbon Disulfide	µg/L	100	< 5.0 U	< 5.0 U	< 5.0 U
Carbon Tetrachloride	µg/L	5	< 5.0 U	< 5.0 U	< 5.0 U
Chlorobenzene	µg/L	100	< 5.0 U	< 5.0 U	< 5.0 U
Chloroethane	µg/L	3.6	< 5.0 U	< 5.0 U	< 5.0 U
Chloroform	µg/L	80	< 5.0 U	< 5.0 U	< 5.0 U
1,1-Dichloroethane	µg/L	90	< 5.0 U	< 5.0 U	< 5.0 U
1,2-Dichloroethane	µg/L	5	< 5.0 U	< 5.0 U	< 5.0 U
1,1-Dichloroethene	µg/L	7	< 5.0 U	< 5.0 U	< 5.0 U
trans-1,2-Dichloroethene	µg/L	100	< 5.0 U	< 5.0 U	< 5.0 U
1,2-Dichloropropane	µg/L	5	< 5.0 U	< 5.0 U	< 5.0 U
cis-1,3-Dichloropropene	µg/L	0.44	< 5.0 U	< 5.0 U	< 5.0 U
trans-1,3-Dichloropropene	µg/L	0.44	< 5.0 U	< 5.0 U	< 5.0 U
Ethylbenzene	µg/L	700	< 5.0 U	< 5.0 U	38.3
2-Hexanone	µg/L	NA	< 25.0 U	< 25.0 U	< 25.0 U
4-Methyl-2-Pentanone (MIBK)	µg/L	630	< 25.0 U	< 25.0 U	< 25.0 U
Methylene Chloride	µg/L	5	< 5.0 U	< 5.0 U	< 5.0 U
1,1,1,2-Tetrachloroethane	µg/L	NA	< 5.0 U	< 5.0 U	< 5.0 U
1,1,2,2-Tetrachloroethane	µg/L	0.05	< 5.0 U	< 5.0 U	< 5.0 U
Tetrachloroethene	µg/L	5	< 5.0 U	< 5.0 U	< 5.0 U
Toluene	µg/L	1,000	1,140	874	620
Xylenes, Total	µg/L	10,000	1,130	1,220	751
1,1,1-Trichloroethane	µg/L	200	< 5.0 U	< 5.0 U	< 5.0 U
1,1,2-Trichloroethane	µg/L	5	< 5.0 U	< 5.0 U	< 5.0 U
Trichloroethene	µg/L	5	< 5.0 U	< 5.0 U	< 5.0 U
Vinyl Chloride	µg/L	2	< 5.0 U	< 5.0 U	< 5.0 U
Semi-Volatiles					
Acenaphthene	µg/L	37	11.4	13.2	4.4
Acenaphthylene	µg/L	37	223	335	24.4
Anthracene	µg/L	180	15.7	18.1	2.6
Benzo(a)anthracene	µg/L	0.2	< 1.4 U	< 1.4 U	< 1.4 U
Benzo(a)pyrene	µg/L	0.2	< 1.4 U	< 1.4 U	< 1.4 U
Benzo(b)fluoranthene	µg/L	0.2	< 1.4 U	< 1.4 U	< 1.4 U
Benzo(g,h,i)perylene	µg/L	18	< 1.4 U	< 1.4 U	< 1.4 U
Benzo(k)fluoranthene	µg/L	0.3	< 1.4 U	< 1.4 U	< 1.4 U
4-Bromophenyl-phenylether	µg/L	NA	< 2.8 U	< 2.8 U	< 2.8 U
Butylbenzylphthalate	µg/L	NA	< 2.8 U	< 2.8 U	< 2.8 U

Table 1
Baseline Groundwater Monitoring Results.

Analyte	Sample ID: Date: Units	MDE GW Stds ^[1]	OBS-6 7/9/2010	EXT-2 7/9/2010	OBS-7 7/9/2010
4-Chloro-3-methylphenol	µg/L	NA	< 7.5 U	< 7.5 U	< 7.5 U
Bis(2-Chloroethoxy)methane	µg/L	NA	< 2.8 U	< 2.8 U	< 2.8 U
Bis(2-Chloroethyl)ether	µg/L	0.01	< 2.8 U	< 2.8 U	< 2.8 U
Bis(2-Chloroisopropyl)ether	µg/L	0.26	< 2.8 U	< 2.8 U	< 2.8 U
2-Chloronaphthalene	µg/L	49	< 2.8 U	< 2.8 U	< 2.8 U
2-Chlorophenol	µg/L	3	< 7.5 U	< 7.5 U	< 7.5 U
4-Chlorophenyl-phenylether	µg/L	NA	< 2.8 U	< 2.8 U	< 2.8 U
Chrysene	µg/L	3	< 1.4 U	< 1.4 U	< 1.4 U
m,p-Cresol	µg/L	NA	202	191	192
o-Cresol	µg/L	NA	120	112	138
Di-n-Butylphthalate	µg/L	370	< 2.8 U	< 2.8 U	< 2.8 U
Di-n-Octylphthalate	µg/L	NA	< 7.5 U	< 7.5 U	< 7.5 U
Dibenz(a,h)anthracene	µg/L	0.2	< 1.4 U	< 1.4 U	< 1.4 U
Dibenzofuran	µg/L	3.7	81.0	97.4	16.6
1,2-Dichlorobenzene	µg/L	600	< 2.8 U	< 2.8 U	< 2.8 U
1,3-Dichlorobenzene	µg/L	1.8	< 2.8 U	< 2.8 U	< 2.8 U
1,4-Dichlorobenzene	µg/L	75	< 2.8 U	< 2.8 U	< 2.8 U
3,3-Dichlorobenzidine	µg/L	0.15	< 15.1 U	< 15.1 U	< 15.1 U
2,4-Dichlorophenol	µg/L	11	< 7.5 U	< 7.5 U	< 7.5 U
Diethylphthalate	µg/L	2900	< 7.5 U	< 7.5 U	< 7.5 U
3,3'-Dimethylbenzidine	µg/L	NA	< 7.5 U	< 7.5 U	< 7.5 U
2,4-Dimethylphenol	µg/L	7.3	< 15.1 U	140	90.1
Dimethylphthalate	µg/L	NA	< 7.5 U	< 7.5 U	< 7.5 U
2,4-Dinitrophenol	µg/L	7.3	< 15.1 U	< 15.1 U	< 15.1 U
2,4-Dinitrotoluene	µg/L	7.3	< 2.8 U	< 2.8 U	< 2.8 U
Semi-Volatiles					
2,6-Dinitrotoluene	µg/L	3.7	< 2.8 U	< 2.8 U	< 2.8 U
Bis(2-Ethylhexyl)phthalate	µg/L	6	< 2.8 U	< 2.8 U	< 2.8 U
Fluoranthene	µg/L	150	10.6	12.0	1.5
Fluorene	µg/L	24	74.0	90.4	16.4
Hexachlorobenzene	µg/L	1	< 2.8 U	< 2.8 U	< 2.8 U
Hexachlorobutadiene	µg/L	0.86	< 2.8 U	< 2.8 U	< 2.8 U
Hexachlorocyclopentadiene	µg/L	50	< 7.5 U	< 7.5 U	< 7.5 U
Hexachloroethane	µg/L	4.8	< 2.8 U	< 2.8 U	< 2.8 U
Indeno(1,2,3-cd)pyrene	µg/L	0.2	< 1.4 U	< 1.4 U	< 1.4 U
Isophorone	µg/L	70	< 2.8 U	< 2.8 U	< 2.8 U
2-Methyl-4,6-dinitrophenol	µg/L	NA	< 7.5 U	< 7.5 U	< 7.5 U
2-Methylnaphthalene	µg/L	2.4	327	510	80.0
Naphthalene	µg/L	0.65	8,930	8,120	2,180
Nitrobenzene	µg/L	0.35	< 2.8 U	< 2.8 U	< 2.8 U
2-Nitrophenol	µg/L	NA	< 7.5 U	< 7.5 U	< 7.5 U
4-Nitrophenol	µg/L	NA	< 7.5 U	< 7.5 U	< 7.5 U
Pentachloroethane	µg/L	NA	< 7.5 U	< 7.5 U	< 7.5 U
Pentachlorophenol	µg/L	1	< 15.1 U	< 15.1 U	< 15.1 U
Phenanthrene	µg/L	180	71.0	86.1	16.2
Phenol	µg/L	1100	102	155	126
Pyrene	µg/L	18	5.8	6.5	< 1.4 U
Pyridine	µg/L	NA	237	168	39.5

Table 1
Baseline Groundwater Monitoring Results.

Analyte	Sample ID: Date: Units	MDE GW Stds ^[1]	OBS-6 7/9/2010	EXT-2 7/9/2010	OBS-7 7/9/2010
1,2,4-Trichlorobenzene	µg/L	70	< 2.8 U	< 2.8 U	< 2.8 U
2,4,5-Trichlorophenol	µg/L	370	< 7.5 U	< 7.5 U	< 7.5 U
2,4,6-Trichlorophenol	µg/L	6.1	< 7.5 U	< 7.5 U	< 7.5 U
Wet Chemistry					
Ferrous Iron	mg/L	NA	0.18	0.22	0.19
Nitrate-N	mg/L	NA	< 0.20 U	< 0.20 U	< 0.20 U
Nitrate/Nitrite-N	mg/L	NA	0.44	< 0.20 U	< 0.20 U
Nitrite-N	mg/L	NA	0.44	< 0.20 U	< 0.20 U
Phosphorous, Total	mg/L	NA	< 0.10 U	< 0.10 U	< 0.10 U
Sulfate	mg/L	NA	581	549	335
Metals					
Ferric Iron	mg/L	NA	0.26	0.19	0.29
Aluminum, Total	mg/L	0.05	< 0.11 U	< 0.11 U	< 0.11 U
Antimony, Total	mg/L	0.006	< 0.030 U	< 0.030 U	< 0.030 U
Arsenic, Total	mg/L	0.01	< 0.0090 U	< 0.0090 U	< 0.0090 U
Barium, Total	mg/L	2	0.094	0.079	0.039
Beryllium, Total	mg/L	0.004	< 0.0044 U	< 0.0044 U	< 0.0044 U
Cadmium, Total	mg/L	0.005	< 0.0022 U	< 0.0022 U	< 0.0022 U
Calcium, Total	mg/L	NA	345	333	176
Chromium, Total	mg/L	0.1	< 0.0060 U	< 0.0060 U	< 0.0060 U
Cobalt, Total	mg/L	NA	< 0.0060 U	< 0.0060 U	< 0.0060 U
Copper, Total	mg/L	1.3	< 0.011 U	< 0.011 U	< 0.011 U
Iron, Total	mg/L	0.3	0.44	0.41	0.48
Lead, Total	mg/L	0.015	< 0.0067 U	< 0.0067 U	< 0.0067 U
Magnesium, Total	mg/L	NA	< 0.11 U	< 0.11 U	< 0.11 U
Manganese, Total	mg/L	0.05	0.014	< 0.0060 U	0.015
Nickel, Total	mg/L	0.073	< 0.022 U	< 0.022 U	< 0.022 U
Potassium, Total	mg/L	NA	31.0	26.4	20.8
Selenium, Total	mg/L	0.05	< 0.022 U	< 0.022 U	< 0.022 U
Silver, Total	mg/L	0.1	< 0.0044 U	< 0.0044 U	< 0.0044 U
Sodium, Total	mg/L	NA	126	123	93.9
Thallium, Total	mg/L	0.002	< 0.022 U	< 0.022 U	< 0.022 U
Vanadium, Total	mg/L	0.0037	0.68	0.68	0.91
Zinc, Total	mg/L	5	< 0.022 U	< 0.022 U	< 0.022 U

Notes:

<Blank>	= Not measured
Bold	= Analyte Detected
deg C	= Degree Celcius
mg/L	= milligrams per liter
mS/cm	= Microsiemens per Centimeter
mV	= Millivolts
NA	= Standard not available or not currently established
NTU	= Nephelometric Turbidity Units
ORP	= Oxidation Reduction Potential
std units	= Standard units
</U	= Analyte not detected above corresponding Reporting Limit
µg/L	= micrograms per liter

Table 2
Cell 4 Well Construction Details

Well	Existing/Planned	Well Function (in Addition to Monitoring)	Diameter (inches)	Approximate Depths (feet, bgs)				
				Screen		Water Table	Slag Bottom	Boring Bottom
				Top	Bottom			
AS-2	existing	--	2	17.3	19.3	14	20	19.5
EXT-2	existing	Recirculation	4	5	21	14	21	22
OBS-6	existing	--	4	5	22	14	22	24
OBS-7	existing	Extraction	4	5	22	14	22	23
OBS-8	existing	--	4	5	21	14	21	22
OBS-9	existing	--	4	5	23	14	23	24
OBS-10	existing	Recirculation	4	5	23	14	22	24
Cell 4-1	planned	Recirculation	4	11	21	Est 14	Est 20	21
Cell 4-2	planned	Recirculation	4	11	21	Est 14	Est 20	21
Cell 4-3	planned	Recirculation	4	11	21	Est 14	Est 20	21
Cell 4-4	planned	--	4	11	21	Est 14	Est 20	21
Cell 4-5	planned	--	4	11	21	Est 14	Est 20	21
Cell 4-6	planned	Extraction	4	11	23	Est 14	Est 23	24
Cell 4-7	planned	Extraction	4	11	23	Est 14	Est 23	24

Table 3
Planned Groundwater Sampling and Analysis During Dosing and Monitoring (a).

Analyte	Method			Dosing & Monitoring July & September & November (Months 1,3, and 5)				Monitoring Only August, October & December (Months 2, 4, and 6)
	Fixed Laboratory	Field Probe	Field Test Kit (HACH)	Pre Dosing (fixed lab / Horiba)	During Dosing (Fixed Lab)	During Dosing (HACH)	Post Dosing (fixed lab / Horiba)	Fixed Lab / Horiba
COPI VOCs (Including the semi-VOC naphthalene)	8260B	--	--	X	X	--	X	X
Iron, Ferric (Fe ³⁺)	Calculation (from SM 3500-FeD & 6010C)	--	--	X	--	--	X	X
Iron, Ferrous (Fe ²⁺)	SM 3500-Fe D	--	--	X	--	--	X	X
Iron, Total	6010C	--	--	X	--	--	X	X
Nitrogen, as Total Kjeldahl Nitrogen (TKN)	351.1	--	--	X	X	--	X	X
Nitrogen, as nitrite (NO ₂ ⁻)	353.2	--	--	X	X	--	X	X
Nitrogen, as combined nitrate (NO ₃ ⁻) and nitrite (NO ₂ ⁻)								
Nitrogen, as nitrate (NO ₃ ⁻)	Calculation (from 353.2)	--	10020 / 8039 / 10206	X	X	X	X	X
Phosphate (PO ₄ ³⁻) (synonymous with Orthophosphate)	365.5	--	--	X	X	--	X	X
Sulfate (SO ₄ ²⁻)	375.1	--	--	X	X	--	X	X
Total Heterotrophic Plate Count (HPC)	SM 9215 B	--	--	X	--	--	X	X
Specific Conductivity	--	Horiba	--	X	--	--	X	X
Temperature	--	Horiba	--	X	--	--	X	X
Dissolved Oxygen	--	Horiba	--	X	--	--	X	X
Turbidity	--	Horiba	--	X	--	--	X	X
pH	--	Horiba	--	X	--	--	X	X
Redox	--	Horiba	--	X	--	--	X	X

(a) 'X' indicates the analysis is planned for sample(s) from one or more wells.

FIGURES

Cell 4

In-Situ Anaerobic Bio-System

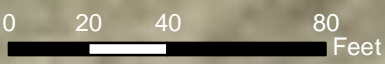


Image source: World Imagery, ESRI, GeoEye, 2009.

Legend

- Extraction Well (Existing)
- Extraction Well (Planned)
- Recirculation Well (Existing)
- Recirculation Well (Planned)
- ⊕ Monitoring Well (Planned)
- ⊕ Monitoring Well (Existing)
- ➔ Groundwater Flow Direction


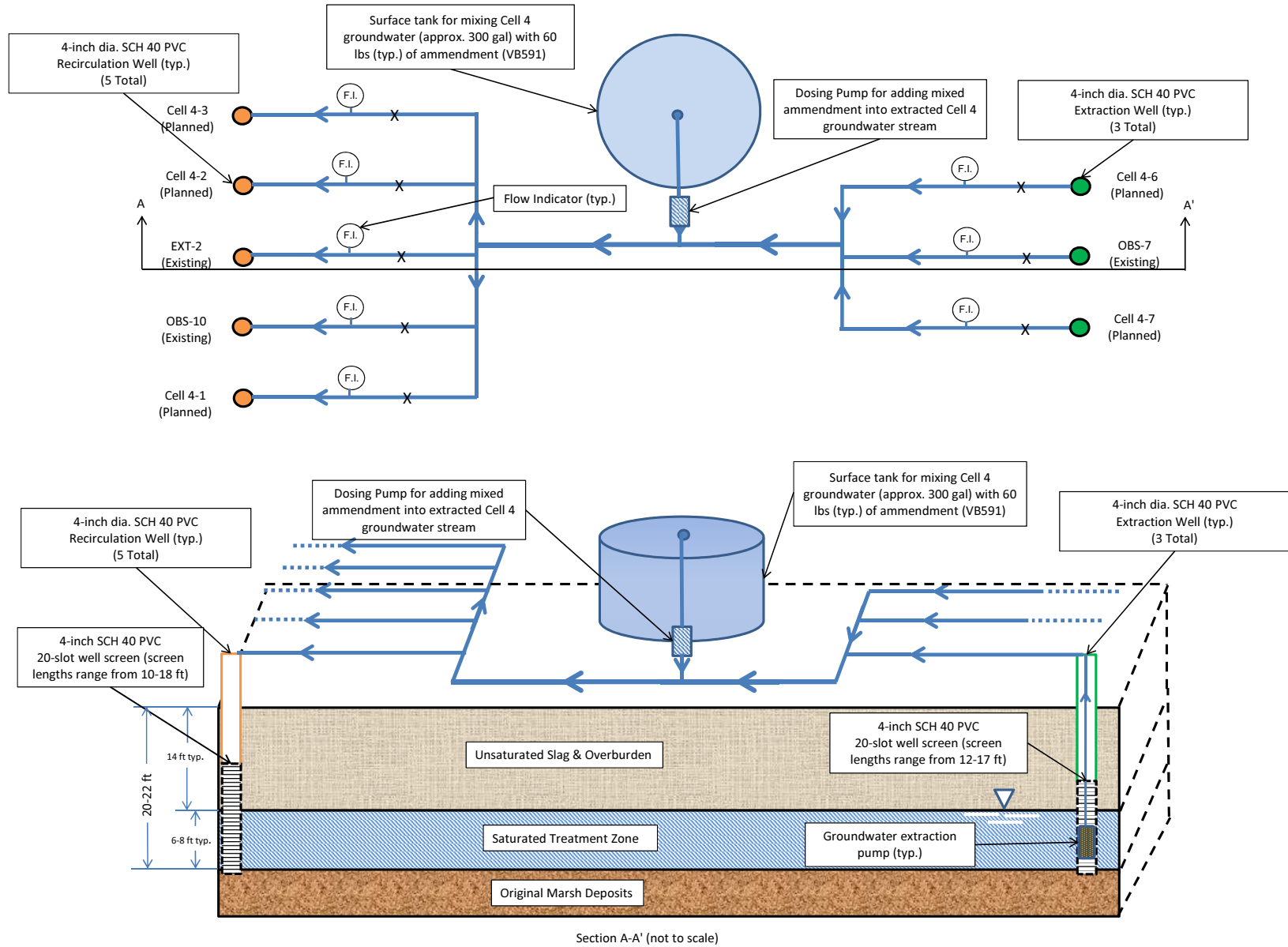
CLIENT	Severstal Sparrows Point, LLC		
LOCATION	Baltimore, MD		
 200 Orchard Ridge Drive Gaithersburg, MD 20878	GIS BY	JK	03/08/2011
	CHK BY	BE	03/08/2011
	PM	BE	03/08/2011



Figure 1
Cell 4 Wells

G:\Projects\SparrowsPoint\Projects\2010\CokeOven-and-CokePoint-Cell4closeup_ExistingandPlanned_Wells.mxd

Figure 2
Schematic Layout and Sections - Cell 4 In-Situ Anaerobic Bio-Treatment System
Severstal Sparrows Point, LLC



ATTACHMENT A
Amendment Description



VB591[®] water

A Totally Green Technology for Water Remediation

- Groundwater Remediation from Hydrocarbon Contamination
- Water Remediation from Oil Spills

VB591[®] Water is a totally green, effective treatment for groundwater remediation from hydrocarbon contamination and also water contaminated from oil spills. Using bioremediation technology, VB591[®] works effectively in groundwater, rivers, coastal waterways, ship channels, harbors, marinas, lake and open seas.



BioNutraTech Products


Organic Waste Bioremediation

- [AgriFresh™ For Horse Stalls](#)
- [Septikos® for Septic Treatment & Maintenance](#)
- [BiNutrix® Gold for Poultry Litter](#)
- [BiNutrix® Wastewater Treatment System](#)
- [BiNutrix® for FOG](#)

Hydrocarbon/Oil Spill Bioremediation

- [VB997® for Soil Remediation](#)
- [VB591® for Groundwater Remediation](#)



Learn more about
our bioremediation
technology... 

Conventional Water Remediation

Many water remediation technologies are available for oil and hydrocarbon contamination: floating barriers and skimmers, dispersants, solvents and/or detergent chemicals, and burning. Regardless of these techniques, the present oil response system in the United States is capable of recovering no more than a maximum of 10-15 percent of the oil, according to the Office of Technology Assessment. Eventually a majority of the oil will end up on beaches, rivers, streams, and sensitive ecological areas where it is left up to Mother Nature to heal man's mishaps.

Impact of Carbon-based Contaminants on Natural Water Remediation

Natural groundwater and water remediation is bioremediation where bacteria and other microorganisms secrete enzymes that break down organic molecules (contaminants) into consumable foods. As part of their metabolic processes, microbes utilize carbon, hydrogen, oxygen, nitrogen and phosphorus. When a spill occurs in a marine environment, nitrogen, phosphorus and other micronutrient levels get thrown out of balance. Microbes gorge on the carbon source, multiply quickly and deplete vital nutrients. When one or more of these key building blocks of life is lacking, the degradation process may be seriously hampered or stopped altogether- natural bioremediation is halted.

Enhanced Water Remediation with VB591

VB591® Water brings balance back to the marine environment by replacing key supplemental nutrients consumed by the accelerated population growth. In addition, an oleophilic coating allows the nutrients to cling tenaciously to contaminants, naturally and without harmful residuals. As a result, life-sustaining nutrients are always present where they are needed, available in time-released concentrations to sustain the populations of degrading microbes.

Because the nutrients stay with the organic contaminants, they remain where they are needed and do not get pulled away by gravity, rain, wind or wave action. Consequently, a lower volume of nutrients can be applied compared to other approaches. This means less waste and there is no risk of over-application of nutrients.

Groundwater Remediation Using VB591® Water for Bioremediation – CASE STUDY

Site: Underground Storage Tanks and Groundwater Remediation, MA

Why Use VB591® Water for Oil Spill Cleanups in Water?

- Does not interfere with, or adversely affect, the action of booms, skimmers, vacuums, or bio-venting methods. When used in open water spills, dispersants are not a problem.
- Remains stable, since it is not affected by pH, salinity, normal temperature fluctuations or alkalinity. Works equally well in fresh, brackish or salt water.
- Allows applications using conventional powder-spraying equipment for land-based personnel or vehicles, ships or barges. Also by aerial delivery methods suited to treat large, widely-dispersed oil along rocky coastlines, beaches, off-shore open water spills, limited access marshlands and remote, inaccessible areas.
- Supports the growth of all non-fastidious natural microbial populations.
- Contains no toxic chemicals, surfactants or hazardous substances.
- Eliminates pre-mixing or special handling precautions.
- Is easy to apply.
- Offers extended shelf life (at least three years if kept dry).

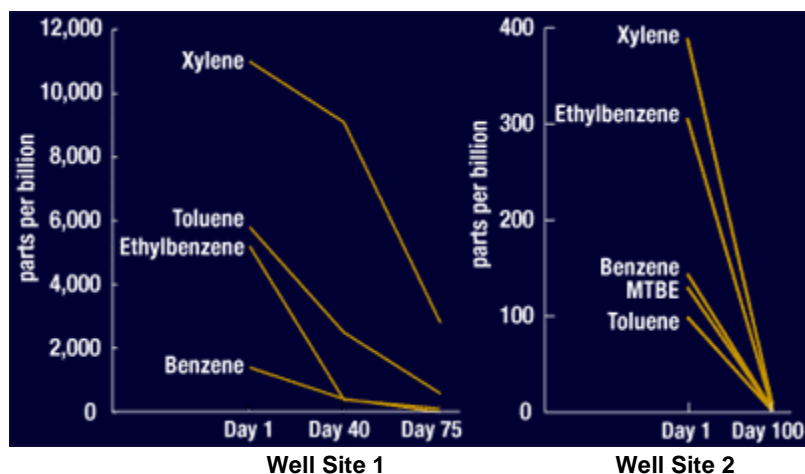
[Here's Why MTBE Isn't as Big a Problem as](#)

Bioremediation Treatment Protocol: In accordance with US EPA regulations, a Massachusetts remediation company commenced work on two wells where gasoline contaminants had polluted the groundwater. The company's use of VB591® made it possible to successfully remediate the wells contaminated with BTEX (benzene, toluene, ethylbenzene and xylene) and MTBE.

The groundwater was treated in-situ without pump-and-treat, bio-venting or air-sparging technologies. A mixture of VB591® and water was inoculated into the wells to remediate the contaminated groundwater.

Results: Treatment of the wells resulted in reaching the EPA minimum standards of BTEX and MTBE contaminants in groundwater in less than three months for Well Site 1 and less than four months for Well Site 2.

The following graphs provide a summary of the bioremediation results. All data are shown in micrograms per liter (parts per billion). While MTBE data were not available for Well Site 1, MTBE was reduced from 130 ppb to 1.8 ppb in Well Site 2.



VB591® Water meets all Environmental Protection Agency (EPA) requirements and is listed on the NCP list pursuant to Title 40 of the CFR section 300.915.

The Texas Natural Resource Conservation Commission (TNRCC) has approved VB591® Water for use. VB591® is licensed for use by the state of California

You Think

MTBE is biodegradable. Microbes can adapt to a hazardous contaminant like MTBE and decompose it the same as any other organic material.

All the microbes need is the right balance of nutrients and a little time to regenerate. A kick start from VB591® is just the thing to get rid of MTBE.

For more information and case studies, download: [Here's Why MTBE Isn't as Big a Problem as You Think.pdf](#).

More Case Studies

VB591® Water Used for Bioremediation of Oil Spills

- [Industrial Plant Florida \(MTBE\)](#)
- [EPA National Contingency Plan](#)
- [Florida Marshlands - Diesel Fuel](#)
- [Freshwater Pond, Northern Texas - Crude Oil](#)

*All BioNutraTech Products
are Safe for Animals,
Plants and People.*





<http://www.epa.gov/oem/content/ncp/products/vb591wat.htm>
 Last updated on Thursday, January 27, 2011

Emergency Management

You are here: [EPA Home](#) [Emergency Management](#) [NCP Subpart J](#) [NCP Product Schedule](#)
 VB591™, VB997™, BINUTRIX®

VB591™, VB997™, BINUTRIX® (formerly MYCOBAC TX-20)

TECHNICAL PRODUCT BULLETIN #B-42
 USEPA, OIL PROGRAM CENTER
 ORIGINAL LISTING DATE: JANUARY 3, 1992
 REVISED LISTING DATE: FEBRUARY 5, 1997
 VB591™, VB997™, BINUTRIX®
 (formerly MYCOBAC TX-20)

EPA HAS CONFIRMED CONTACT INFORMATION FOR THIS PRODUCT

I. NAME, BRAND, OR TRADEMARK

VB591™, VB997™, BINUTRIX® - Patented, partial encapsulated oleophilic (oil-loving) nutrient
 Type of Product: Biological Additive (a nutrient additive that contains no microorganisms)

II. NAME, ADDRESS, AND TELEPHONE NUMBER OF MANUFACTURER/CONTACT

BioNutraTech Inc.
 P.O. Box 2342
 Branson, MO 65615
 Phone: (417) 858-1150
 Fax: (417) 858-1152
 Email: shruza@bionutrtech.com
 Web Site: <http://www.bionutrtech.com>
 Mobile: (713) 301-0254
 (Ms. Sandra Hruza)

III. NAME, ADDRESS, AND TELEPHONE NUMBER OF PRIMARY DISTRIBUTORS

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 P.O. Box 2342
 Branson, MO 65615
 Phone: (417) 858-1150
 Fax: (417) 858-1152
 Email: shruza@bionutrtech.com
 Web Site: <http://www.bionutrtech.com>
 (Ms. Sandra Hruza)

International
 BioGreen Technologies International
 26322 Alpine Rose Lane
 Katy, TX 77494
 Phone: (281) 347-4216

E-mail: ruedajose@hotmail.com
(Mr. Jose Rueda)

SMG Global Partners
526 Kirkwood Drive, Suite 124
Kingwood, TX 77339
Phone: (832) 414-9346
E-mail: joeygee@suddenlink.net
(Mr. Joe Gautier)

IV. SPECIAL HANDLING AND WORKER PRECAUTIONS FOR STORAGE AND FIELD APPLICATION

1. Flammability:
Non-flammable
2. Ventilation:
Normal ventilation is adequate
3. Skin and eye contact; protective clothing; treatment in case of contact:
Normal precautions and protective equipment for handling any type of powder, such as dust protectors and eye shield.
Avoid contact with eyes and do not take internally. Upon contact with eyes, flush with water immediately for a minimum of 15 minutes. If redness or irritation continues, contact a physician. Avoid breathing dust.
- 4.a. Maximum storage temperature: > 140°F
- 4.b. Minimum storage temperature: NA
- 4.c. Optimum storage temperature range: 50°F to 80°F
- 4.d. Temperature phase separations and chemical changes: NA

V. SHELF LIFE

The shelf life is approximately three years if kept dry. Store in dry location and avoid contact with moisture. Prolonged storage may result in the formation of soft clumps which are easily broken by mechanical disruption.

VI. RECOMMENDED APPLICATION PROCEDURE

VB591™, VB997™, and BINUTRIX® is a powder, and can be applied using conventional powder spraying equipment. No pre-mixing or dilution is required. Soft clumps may form after prolonged storage, these clumps are easily broken by mechanical mixing.

1. Application Method:

Application for localized spills can be done using hand-held pressurized dust blowers. For inland waterways, ship channels, marinas or coastal wetlands, large dust blowers mounted on barges or ships can be employed to apply the product. Application by aircraft using conventional dust spraying systems is recommended for treatment of large uncontained spreading spills or spills in open waters or at sea.

2. Concentration/Application Rate:

Recommended initial application rate is 5 to 15 pounds of VB591™, VB997™, and BINUTRIX® per barrel of spilled oil. Follow-up applications at 48-72 hour intervals should be adjusted to allow for reduction in oil due to clean-up activities and natural loss by evaporation, droplet formation and dispersion and microbial activity. Applications should not exceed 250 pounds per acre per application.

3. Conditions for Use:

VB591™, VB997™, and BINUTRIX® should be applied to spilled oil as soon as possible following spillage to stimulate natural oil utilizing microbial populations to maximize biodegradation activity.

Application of VB591™, VB997™, and BINUTRIX® to spilled oil does not significantly alter the physical consistency of the spilled oil, and as such will not adversely affect conventional

cleanup activities, nor will conventional and removal activities adversely affect the activity of VB591™, VB997™, and BINUTRIX®. Dispose of waste in accordance with local, state, and federal regulations.
 Information regarding use of VB591™, VB997™, and BINUTRIX® in conjunction with chemical dispersing agents is at present not available.

VII. TOXICITY AND EFFECTIVENESS

a. Toxicity:
 NA

b. Effectiveness:
 Bioremediation Agent Effectiveness Test (40 CFR 300.900), Federal Register September 15, 1994:

Summary Data Table:

DAYS	PRODUCT 3 REPS/PROD	TOTAL MEAN ALKANES (ppm)	RED% 28 DAYS	TOTAL MEAN AROMATICS (ppm)	RED% 28 DAYS
0	CONTROL	31041.7	0	973.1	0
	NUTRIENT	28251.8	0	976.6	0
	VB591™, VB997™, and BINUTRIX®	28813.8	0	932.8	0
7	CONTROL	31436.33	0	990.5	0
	NUTRIENT	20728.3	26.6	619.1	36.6
	VB591™, VB997™, and BINUTRIX®	14637.4	49.2	733.1	21.4
28	CONTROL	32465.8	0	925.7	0
	NUTRIENT	1787.2	93.7	722.6	26.0
	VB591™, VB997™, and BINUTRIX®	937.97	96.8	290.8	73.1

Results of Gravimetric Analysis:
 Percentage (%) Decrease in Weight of Oil on Day 28
 Control: < 1%
 Nutrient: 17.6%
 Product (VB591™, VB997™, and BINUTRIX®): 18.0%

VIII. MICROBIOLOGICAL ANALYSIS

VB591™, VB997™, and BINUTRIX® is an oleophilic nutrient additive and contains no preserved natural or mutated microorganisms of any type.

1. Listing of all microorganisms by species and percentage in the composition:

None.

2. Optimum pH, temperature, and salinity ranges for use of the additive:

VB591™, VB997™, and BINUTRIX® may be used under any conditions where natural populations of oil-degrading microbes are active.

3. Minimum and maximum pH, temperature, and salinity levels below or above which the effectiveness of the additive is reduced to half its optimum capacity:

pH: NA

Temperature: NA

Salinity: NA

4. Special nutrient requirements.

None.

5. Test results regarding the determination of the presence of the following:

Salmonella: Not applicable

fecal coliform: Not applicable

Shigella: Not applicable

Staphylococcus coagulase positive: Not applicable

Beta hemolytic Streptococci: Not applicable

IX. PHYSICAL PROPERTIES

NA

X. ANALYSIS OF HEAVY METALS, CYANIDE, AND CHLORINATED HYDROCARBONS

NA