APPENDIX E

Woods Hole Group Response Letter

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FILE

May 17, 2006

GeoInsight Project 3871-002

Richard F. Packard
Massachusetts Department of Environmental Protection
Southeast Regional Office
Bureau of Waste Site Cleanup
20 Riverside Drive
Lakeville, Massachusetts

Re: Response to June 30, 2005 Woods Hole Group Letter
Barge B120 Spill
Buzzards Bay, Massachusetts
DEP RTN 4-17786

Dear Mr. Packard:

As requested, GeoInsight, Inc. (GeoInsight) prepared this letter on behalf of Bouchard Transportation Company, Inc. (Bouchard) to note and correct several inaccuracies in the June 30, 2005 letter prepared by the Woods Hole Group (WHG) to the Town of Fairhaven. The WHG letter was prepared to identify potential resource damages to areas of the Fairhaven shoreline for consideration as part of the Natural Resource Damage Assessment (NRDA) process that is being conducted for the release of No. 6 fuel oil from Bouchard Barge 120 (B120)

However, several of the shoreline features characterized in the WHG letter were evaluated as part of the response actions conducted under the Massachusetts Contingency Plan (MCP), 310 CMR 40.0000, et seq., and these shoreline features are not associated with B120 oil. The WHG letter contained several inaccuracies, including:

- misidentification of algal mats in marsh areas as B120 oil;
- misidentification of slag at Pope's Beach as "oiled covered sand nodules" (sp.); and
- misidentification of blue-green algae on rocks as remnant oil.

Additional information regarding these issues is presented below.

ALGAL MATS

The WHG letter identified "remnant oil" or "oil mat" in several areas on the surface of the marsh at Pope's Beach and at Hoppy's Landing. Photographs of these features were included in the WHG letter. The black-colored material on the marsh surface shown in the photographs from Pope's Beach and some of the Hoppy's Landing photographs are actually mats composed of algae and cyanobacteria ("bluegreen algae")[1]. The black color of the algal mats may superficially resemble oil to the untrained eye, but there are several important characteristics that can be used to distinguish between oil and algal mats, including:

Residual B120 Oil	Algal Mat
Black color	Black color with occasional greenish tinge (or green color when scraped with fingernail)
Sticky or tacky on unweathered surface, often with small particles (sand or shell fragments) embedded in the oil	Slippery and smooth
Oil odor	Marine odor
Dense, solid or semi-solid	Spongy, saturated with water
Can produce an oil stain when vigorously disturbed or rubbed	Disintegrates when vigorously disturbed or rubbed

These algal mats were observed in other fringing marshes along Buzzards Bay, including in fringing marshes that were not oiled by the release. Because these algal mats are present in unoiled marshes, it is evident that natural processes can cause the formation of the algal mats and not necessarily B120 oil (e.g., natural die-off of marsh vegetation, ice, or wrack build-up). To evaluate these algal mats in marshes, personnel from GeoInsight and ENTRIX, Inc. (ENTRIX) collected samples of the mat material on the marsh surface located in three separate fringing marshes: two marshes that were oiled by the B120 spill (Hoppy's Landing [W2A-10] and Pope's Beach [W2A-03]) and one marsh that was not oiled by the B120 spill (Long Island North [W2A-16]). The samples were submitted to Dr. Jim Sears, Chancellor Professor Emeritus of the University of Massachusetts at Dartmouth, for identification of biological species that comprised the material. Dr. Sears is a former professor of marine biology and an expert in marine algae identification. A copy of Dr. Sears's report is attached. The report indicated that the samples collected from both the oiled and unoiled marshes contained several species of algae and cyanobacteria, and that algal mats of these species are typical along the shorelines of New England.

The WHG letter also states that "Additional remnant contamination from the oil covered sediment will remain toxic to benthic fauna for the forseeable future." However, the WHG letter did not include information or documentation to support such a broad claim. It is important to point out that an ecological risk characterization is currently being conducted and this ecological

[1] There was a small amount of residual B120 oil present at Pope's Beach; however, this residual oil was present as very small, discontinuous patches of pavement that generally were between one to three inches in diameter. Some of these small oil patches are present in the bare/algal mat areas, and others are located in areas that are predominantly grass. This residual oil was removed in April 2006 as part of IRA clean up activities.

risk characterization will be included as part of the forthcoming Phase II Comprehensive Site Assessment (CSA) report. Several sets of data are used in the ecological risk characterization, including visual observations of shoreline flora and sediment samples collected from marsh areas (including samples collected from the algal mats in the fringing marshes at Pope's Beach and Hoppy's Landing). The results of these additional evaluations will be included as part of the ecological risk characterization section of the Phase II CSA report. Initial evaluation of these data indicates that concentrations of polynuclear aromatic hydrocarbons (PAH) and extractable petroleum hydrocarbon (EPH) fractions associated with the B120 release in the marsh sediment do not present a significant risk to the environment.

SLAG AT POPE'S BEACH

The WHG letter identified "oiled covered sand nodules" (sp.) near the high tide line at Pope's Beach and a photograph of these "nodules" was included as Figure 5. These "nodules" are not associated with the B120 spill and are not derived from oil. These "nodules" do not exhibit the characteristics of oil and, as noted in the WHG letter:

> "The nodules were very hard and required considerable effort to break them apart. Once the nodule was broken, the broken face was friable."

The limited amount of residual B120 oil remaining at Buzzards Bay is typically present in the form of "pavement" (i.e., oil mixed with sand or gravel that is soft and pliable to the touch but superficially resembles roadway pavement) or as splatter on rock surfaces. This residual B120 oil is soft when firmly pressed with a fingernail, may have a slight tackiness on the surface (depending upon the degree of weathering), and has a slight oil odor. It is important to reiterate that the fresh B120 oil at the time of the release was sticky, which resulted in small particles (e.g., sand, shell fragments) becoming adhered to the oil.

The "nodules" observed at Pope's Beach are vesicular (i.e., have a "bubbly" or "frothy" texture), hard, and brittle. These "nodules" are suspected to be residual material from coal combustion, commonly termed "slag" or "boiler slag." The American Coal Ash Association defines slag and boiler slag as follows:

> Slag – the nonmetallic product resulting from the interaction of flux and impurities in the smelting and refining of metals. Also the molten or fused ash in the furnace of a coal fired power plant. (*See boiler slag*)
>
> Boiler slag – a molten ash collected at the base of slag tap and cyclone furnaces that is quenched with water and shatters into black, angular particles having a smooth, glassy appearance.

This material is sometimes also colloquially referred to as "clinkers" or "cinders." In *Methods for Evaluating Application of the Coal Ash and Wood Ash Exemption Under the Massachusetts Contingency Plan* published by the LSP Association, the terms slag, clinkers, and cinders are defined as: "Mass of coal ash that is a byproduct of combustion. Usually forms by condensation of molten coal material and ash that, when cooled, forms into a hard porous material." These definitions of slag, clinkers, and cinders match the "nodules" observed at Pope's Beach.

It is important to note that the field reconnaissance teams have found pieces of coal, as well as slag, at Pope's Beach and Harbor View (which is the segment adjacent to Pope's Beach to the southwest). These two segments are located adjacent to the Atlas Tack Superfund Site, which formerly used coal as part of its manufacturing processes. Impacts from the Atlas Tack Superfund Site, including PAH from coal combustion, have been documented in Boys Creek, which is located adjacent to Pope's Beach and Harbor View. In addition, these segments are located near the entrance to New Bedford harbor, where coal-powered vessels formerly operated, and slag would be expected to be present near this area. Vessels from New Bedford Harbor and the Atlas Tack Superfund Site are considered to be the likely sources for the slag observed at Pope's Beach.

BLUE-GREEN ALGAE

The WHG letter included several photographs of "remnant oil" on or between rocks at Wilbur Point Beach. At least some of the WHG photographs showed rocks with black color on the surface that is not residual oil. This black color appears to be black lichens (*Verrucaria* spp.) and blue-green algae (*Calothrix* spp.) that grow on the rock surface. In contrast to the spilled oil, that tends to be tacky and has a petroleum odor, the lichens and algae are slippery on the surface and generally have a marine odor or no odor at all. In addition, the lichens and algae often show a slight greenish tinge when scraped with a fingernail.

Please feel free to call me at (978) 692-1114 if you have any questions or if you would like to discuss this project.

Sincerely,
GEOINSIGHT, INC.

Kevin D. Trainer, P.G., C.P.G., L.S.P.
Senior Project Geologist

Attachment: Report on identification of algae and Cyanobacteria ('bluegreen algae') in saltmarsh mat samples observed

cc: Morton Bouchard III, Bouchard Transportation Company, Inc.
Andrew N. Davis, Ph.D, Esq., LeBoeuf, Lamb, Greene & MacRae LLP
Austin P. Olney, Esq., LeBoeuf, Lamb, Greene & MacRae LLP
Richard J. Wozmak, LSP-of-Record, EnviroSense, Inc.
Wayne Kicklighter, ENTRIX

Report on identification of algae and Cyanobacteria ('bluegreen algae') in saltmarsh mat samples observed

Jim Sears
Chancellor Professor Emeritus
Department of Biology
University of Massachusetts
Dartmouth, Massachusetts

September 21, 2005

Cyanobacteria of the saltmarsh mats

Cyanobacteria are the dominant life forms of the pieces of salt marsh mat in the samples. They are of the oldest oxygenic photosynthetic organisms, (fossil records go back about 3.2 billion years) tolerate relatively adverse conditions such as drying, freshwater rain, elevated salinity and occasional partly anaerobic conditions and are part of most slat marshes throughout the world. Here they form dense leathery mats of a few to several mm thick. The cyanobacterial mats are generally dark blue green or even black color, are subject to drying and cracking and often develop in panne or otherwise barren areas of salt marshes between stands of *Spartina* and other marsh grasses. Because of the difficulty of distinguishing species with each genus, and the lack of a unified widely accepted taxonomic system I have indicated only the genus of each different kind. Drouet combined many species and even genera and I have largely followed his taxonomy as presented in Humm and Wicks, 1980.[1]
Despite the title of Humm and Wicks' book, bluegreen algae are really bacteria, not algae that are eukaryotic. Bluegreens were referred to as bluegreen algae until the 1970 when they became know as Cyanobacteria reflecting their prokaryotic condition and common evolutionary relationship- to true bacteria. As seen in the samples of cyanobacterial and peat mats observed in samples, the Cyanobacteria seen are a normal and are a common part of the saltmarsh vegetation in otherwise barren areas of the marsh.

Observations:
Samples were observed while fresh and alive within a few days of their collection. Several small pieces a 2-3 mm diameter were torn from separate areas of each mat, teased apart with forceps on glass slides and were observed under 200 to 1000X magnification with a light microscope. Observations were made and sketches were rendered for each genus observed. Tallies of genera observed in each mat sample are given in table 1.

Cyanobacteria observed in mat samples:

Rivularia sp.
Thallus colonies as solid nodular or globular patches 1-3 mm diameter on peat and cyanobacterial mat. Dark greenish black. Each distinct but only a few mm apart and varying sizes. Internally each nodule consists of horizontal or hemispherical bands of radiating trichomes with basal rounded heterocysts with tapered end of trichome pointing upward toward the outer part of nodule and heterocyst toward base of colony. Heterocysts are the cells in which nitrogen fixation occurs.

Oscillatoria (including *Lyngbya*)

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[1] Humm, H. J. and S. R. Wicks. 1980. Introduction and guide to marine bluegreen algae. John Wiley and Sons, NY. 194 pp.

Dominant filamentous cyanobacterium in mats. Sheathed to varying degrees, sometimes thick and stained yellow orange like *Calothrix* to barely visible sheath in others. Trichomes not tapered, straight and unbranched and without heterocyst. Cells usually shorter than wide. Deep to light blue-green in color except when with thick yellow-orange sheath. *Lyngbya* has been included with this genus as usually done in the literature. Common member of the cyanobacterial mat.

Calothrix
Not common in the mat samples but a few specimens were found between more common *Oscillatoria* and *Microcoleus*. Terminal heterocyst and the tapered trichome with a terminal hair-like end within a thick sheath characterized this common intertidal cyanobacterium.

Microcoleus
Thin slightly tapered unbranched trichomes lying in a common clear sheath, hundreds in each bundle. No heterocysts. Individual trichomes like thin *Oscillatoria*. Common element of the saltmarsh cyanobacterial mat.

Arthrospira
Very much like a very fine *Oscillatoria* but spiraled like a spring and with cross walls so thin almost invisible.

Eucaryotic green algae of the mats:
While not nearly so common as cyanobacteria, several eukaryotic algae occurred.
Vaucheria
Siphonous (tubular filaments without cross walls) intermixed with cyanobacteria. Common on many marshes but only a few scattered siphons seen in samples. A member of Xanthophyta or yellow green algae.

Rhizoclonium
Unbranched, uniseriate filaments scattered in with cyanobacteria. Not common in samples but often occurs among marsh grasses. Chloropyta or green algae.

Spongomorpha
Only a single branched piece of this normally bushy green alga observed in samples.

Chlorococcum (or other unidentified coccoid green alga). Seen only in one sample, the small spheres of this alga form a loose colony or aggregation among the cyanobacterial filaments.

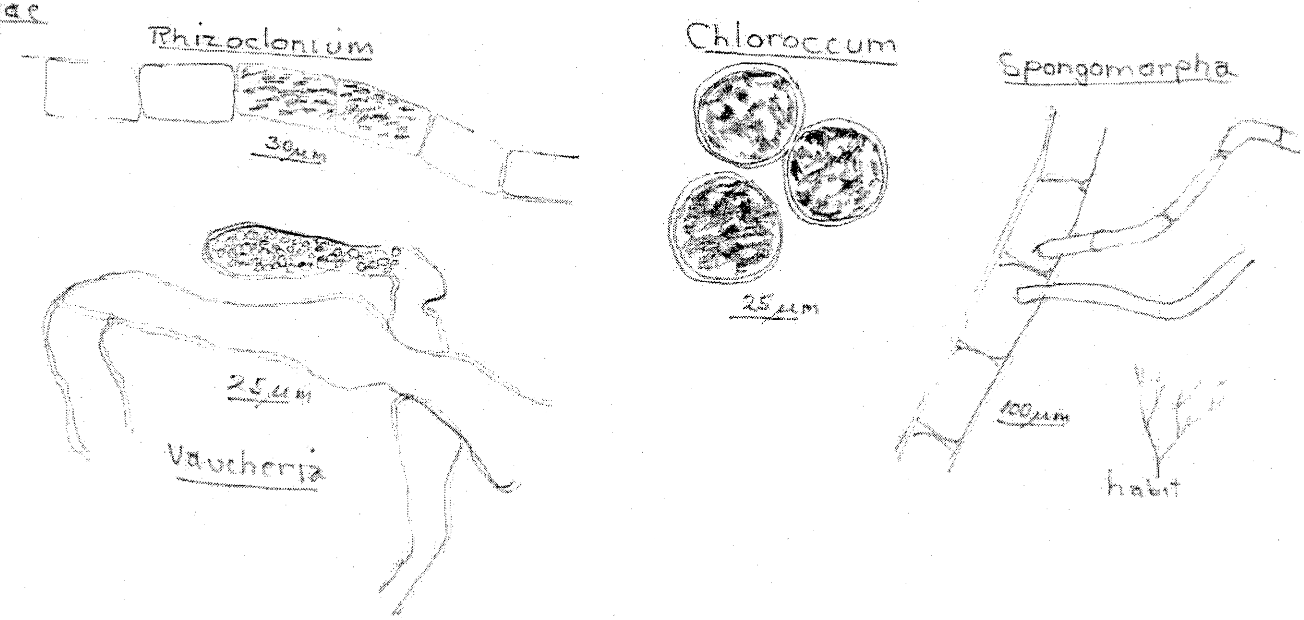
Marsh mat:
I do not know what conditions exist at the marsh in question, but the pieces of marsh mat in the samples sent to me are what one would expect from any New England salt marsh. The mat overlies deposits of underlying peat and sediment. The thickness of mat samples were thin (1-2 mm thick) to moderately thick and

leathery (2-4 (5) mm thick. These mats become dry during neap tides when the marsh is not flooded, or during hot summer months, but come back to life immediately on being rewet. Having survived for billions of years, cyanobacteria are survivors.

Species diversity is what I often see in mats such as those sent. Five species of cyanobacteria and four species of eukaryotic algae were identified. The main components of the mat were *Oscillatoria* and *Microcoleus* with other species as occasional elements except for the mounds of nodule forming *Rivularia*, which dominated one sample (W2A16 #3).

Here I've included here a few sketches of species observed during my microscopic observations of small pieces of mat samples provided.

Green algae



Cyanobacteria

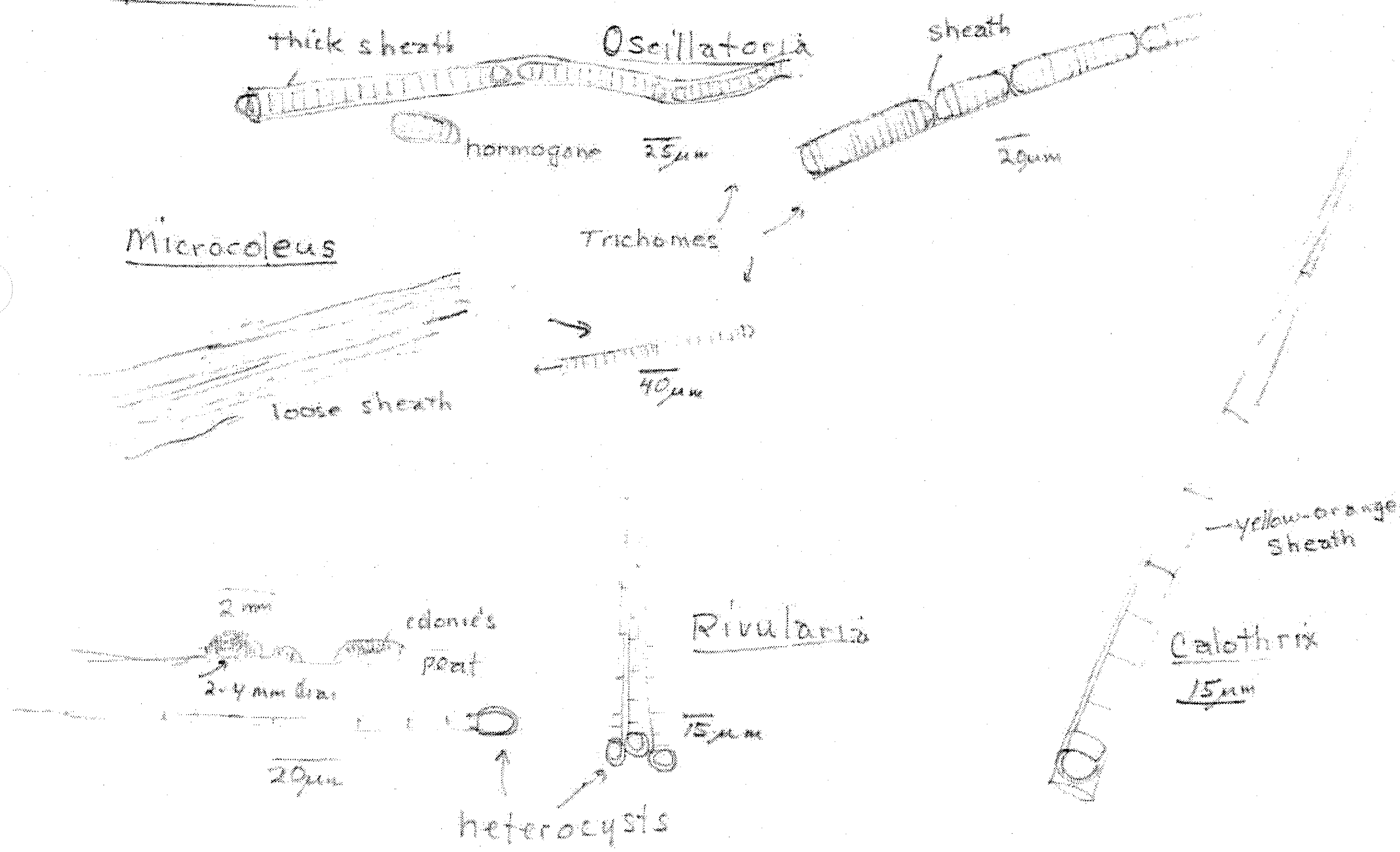


Table 1. Taxa identified in each mat sample as listed by field collecting site.

Station #	*Arthrospira*	*Calothrix*	*Microcoleus*	*Oscillatoria spp./Lyngbya*	*Rivularia sp.*	*Rhizoclonium*	*Vaucheria*	*Chlorococcm (coccoid green)*	*Spongomorpha*
W2A03 #1	X	x	X	X		X			
W2A03 #2		x		x				x	
W2A03 #3	x		X	x					
W2A10 #1	x	x	X	X			x		
W2A10 #2			x						
W2A10 #3			x	x					
W2A10 #4			X	X			x		
W2A10 #5			x	x				x	x
W2A10 #6			x	X					
W2A 16 #1				X			x		
W2A 16 #2									
W2A 16 #3				X	X				
W2A 16 #4			X	X					

X – common or abundant, greater than 10% of sample observed
x – less than about 10% of sample observed