Conceptual Alternative Closure Plan
Attleboro Landfill
Attleboro, MA

Prepared By:

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Attachments

1.0 Background and Purpose

Background

The Attleboro Landfill is a 55 acre facility that was used for solid waste disposal since the early 1940's. The City of Attleboro operated an open dump on the property from the 1940's until 1975. From 1975 to 1995, Attleboro Landfill, Inc. operated a sanitary landfill on 32 of the 55 acres (Phase A); that area has been closed and capped. The remaining area (Phase B), which is the remainder of the City's open dump, has about 9.9 acres of waste disposal area that needs to be capped. The Phase B area is referred to herein as the site. Attleboro Landfill, Inc. (ALI) does not have the funds to complete the closure of the site and to ensure the long term post closure care of the entire landfill.

In 2004 ALI entered into an agreement with End Cap Technologies, LLC (End Cap) to close the site by following a policy developed by the DEP to facilitate the proper closure of inactive unlined landfills such as this site. End Cap proposed to accept approximately 650,000 cubic yards of material to grade the site for capping and generate the funding necessary to properly close the site and to provide a fund for post-closure monitoring and maintenance. The End Cap proposal was met with significant community opposition, based mainly on the quantity of material proposed and the associated truck traffic to deliver the material. In early 2013, End Cap terminated its agreement with ALI.

In November of 2013 ALI submitted to the Massachusetts Department of Environmental Protection (MassDEP) a Conceptual Alternative Closure Plan for the site. As a result of discussions with MassDEP ALI is submitting this revised document, which provides additional information about the project.

Purpose

The purpose of this document is to present an alternative proposal for the closure of the site. ALI has entered into discussions with principals of Enviro-Cycle, LLC to complete a capping project utilizing Re-Crete™, a lightweight concrete made with recycled materials for which they hold the patent. Robert Cummings, who is co-inventor of Re-Crete™, is also a principal in Engineering & Management Services, Inc., who consulted on the project before his relocation to California in 2010. As a result, he is very familiar with the requirements and conditions at the site and is confident that the project can be completed with minimal to no impact.

This Revised Conceptual Alternative Closure Plan addresses certain questions and comments made by MassDEP during initial discussions about the project.

2.0 Proposed Closure Method

The following sections provide details of the proposal and describe Re-Crete.

2.1 General Description of Closure Method

The site will be closed by utilizing the Re-Crete™ to regrade the site in support of a cap for the previously placed material. By proceeding in this manner it is possible to minimize the amount of material that needs to be imported to the site to establish the minimum 5% grade required by MassDEP for proper landfill closure. Further, this allows us to bring in essentially the same amount of material that is required just to construct a proper cap for the area of waste deposition. This responds directly to the opponents of the previous closure project by providing the minimum quantity of material necessary to close the site properly.

Since Re-Crete™ is manufactured with a combination of cement and recycled materials, it will be mixed on site using a small pug mill. Water to mix the cement and for dust control will be obtained from the on-site well. Cement will be trucked to the site using a standard tank truck and construction and demolition (C&D) fines (raw material for Re-Crete™) will be trucked using large transfer trailers. While the weight of the trailer is the same as that of trailers hauling dirt, the volume brought in is between two and three times that of a trailer hauling dirt; therefore, there will be fewer truck trips than if soils were brought to reshape the site. It is proposed to bring between 200 and 400 tons per day of raw material; this will represent between five and ten truck trips per day. Since there are far fewer trucks involved than with other closure alternatives, truck routes are being studied that will minimize trucks traveling through the town of Norton.

It is understood that previous proposed closure projects for the site offered a host community fee to both the town of Norton and the city of Attleboro. An impact mitigation fee will be provided to the Town of Norton at a rate of one dollar per ton of material brought to the site. An initial estimate of the volume of material required to achieve the minimum 5% grades and provide suitable base for a solar array and meet all MassDEP requirements is about 201,000 tons.

If the project proceeds at a rate of 200 tons per day, it is expected to take about two years to complete. If 400 tons per day of material is delivered, the project will take about a year. After placing the Re-Crete™, a 6 inch gas vent layer, a 40 mil HDPE liner, a 12 inch thick sand drainage layer, and a 12 inch thick plantable soil layer will be placed and seeded. A perforated pipe grid will be installed in the gas vent layer and appropriate vent pipes brought to the surface in select locations. Upon completion of closure activities, the project will have set aside a fund for the continued monitoring of the landfill (post closure fund).

In order to put this proposal in perspective with a standard landfill closure complying with MassDEP requirements, the following table is a comparison of the truck trips necessary to deliver material to the site for construction. The truck trip ends were calculated based on the weight limitation (40 tons) of a fully loaded truck. Most tractor/semi-trailers weigh about 18 tons empty. The effective load therefore is less than 22 tons. The average unit weight for soil is about 1.6 tons per cubic yard and the weight of the ingredients for Re-Crete™ is about 1 ton per cubic yard; the resulting truck trips are simply the volume times the unit weight divided by 22 tons per truck.

Item	**Standard DEP Closure**		**Re-Crete™ Closure**		**End Cap Closure**	
	Volume (CY)	Truck Trip Ends	Volume (CY)	Truck Trip Ends	Volume (CY)	Truck Trip Ends
Material necessary to bring site to 5% grades	140000	10,200[1]	201000	9136[2]	650000	47272[1]
Sand Layer	24000	1745[1]	24000[1]	1745	24000[1]	1745[1]
Plantable Soil	16000	1163[1]	16000[1]	1163	16000[1]	1163[1]
Cement				482[3]		
Total		13108		12526		50180

Notes:

1. Truck trips =(total volume x 1.6 tons per c.y.)/22 tons per load
2. Truck trips =(total volume x 1.0 tons per c.y.)/22 tons per load
3. Truck trips =(total volume x 1.0 tons per c.y. x 6% cement)/25 tons per load

As can be seen from the above table, the Re-Crete™ closure proposal results in slightly fewer truck trips (4%) to the site compared to a standard closure project and far less than the project previously proposed by End Cap .

The project team expects that a final component of the project will be to construct a solar farm on the newly capped area as well as on other portions of the property where solar construction is feasible. This component is being proposed to compliment the project and to provide a long term means of paying taxes and supplying Attleboro and Norton supplemental income and green power. It is expected that between 3 and 4 MW of electrical power generation capability will be installed. It is proposed to dedicate some of the funds from the lease of the property for solar rights into a fund for payment of property taxes to the city of Attleboro. In addition, some of the payments that would normally go to the landowner would go to the Town of Norton. Finally, both the Town of Norton and the City of Attleboro would have the opportunity to purchase green electricity for their public buildings at a reduced rate.

2.2 Material Delivery

One advantage of using Re-Crete™ for the site closure is that the material delivery to the project site can be strictly controlled. The project will deal with no more than four C&D recyclers; therefore, delivery times can be assigned for each recycler. All of the C&D fines will be delivered using transfer trailers that are capable of carrying 100 cubic yards. As described above, if the project is designed to be completed over a two-year span, between 8 and 10 trailer loads will be delivered daily.

The main delivery route for recyclers bringing material to the site presently under discussion is from Interstate 495. This means that vehicles will travel through the town of Norton in order to get to the Attleboro landfill site. Enviro-Cycle will meet with Norton town officials to develop delivery schedules that will minimize delivery vehicles during busy periods on local roadways. Schedules can be adjusted seasonally to take into account different activities occurring within the town (e.g., school bus pick-up and drop-off). A 20 MPH speed restriction will be imposed on all delivery vehicles utilizing South Worcester Street and Union Road within the town of Norton. This restriction will be contained in a delivery agreement with the C&D recyclers.

It is anticipated that delivery vehicles will utilize the same truck routes that vehicles hauling material to and from the Shpack Site used during the recently completed cleanup activities. It is expected that no more than 1 to 2 deliveries will be made per hour.

2.3 Re-Crete Mixing and Placement

As stated above, the C&D fines will be delivered to the site in transfer trailers. As the trailers are unloaded, site personnel will use a fire hose connected to a water truck to spray a mist on the load. This will minimize any dust from unloading operations and will prevent the material from blowing while it is staged for mixing.

Site personnel will use a bucket loader to load the fines into a mixing device which will be a small pug mill or equivalent. The Portland cement and additional water will be added in a controlled fashion to create the desired mixture. The final mixture will be moved with a bucket loader to the active area, spread in 12 inch thick lifts and back bladed to create a smooth surface. The active area will be moved on a daily basis to allow previously placed material to cure for a day or two prior to placing additional lifts. The material will be brought to subgrade in preparation for capping activities.

The conceptual plan shows in a general fashion stormwater controls. The final system for the site will have two detention basins located along the southerly end of the area. During operations, the perimeter road shown on the plan will act as a berm and direct the stormwater to an interim basin on the westerly side of the area. Discharge from the interim basin will be allowed to slowly discharge after proper settling and filtration. These features will be built by operational staff who will be onsite during mixing and placing. Greater details will be provided on construction drawings.

2.4 Re-Crete Background

Re-Crete™ is trademarked (Trademark Serial Number 77887154) and has a patent issued by the US Patent and Trade Office (US 7,815,729 B2). The patent develops a method for incorporating C&D fines into a concrete mixture that can be used in a variety of applications including limited structural concrete, architectural applications of low strength concrete, and flowable fill.

The term C&D fines refers to the small particles of the debris that fall through crushing equipment and conveyor systems at C&D processing facilities; this term is therefore referred to as "fines". A significant component of the C&D fines is gypsum that originates from wallboard

The Re-Crete™ application eliminates the generation of hydrogen sulfide and the use of gypsum in Re-Crete™ improves the physical characteristics of the final product. The use of this material present an alternative to landfill disposal or reuse of the C&D fines as grading and shaping materials. Many of the landfills currently accepting C&D fines will be closed within two to five years and will no longer be accepting these types of materials.

From an environmental standpoint, Re-Crete™ is essentially a lightweight, low strength concrete and as such has no environmental impacts on the surroundings. For restoration of depressions, it is clearly preferable to the use of contaminated soils, given the public's concern about potential contamination issues. Once the area has been restored using the Re-Crete™ flowable fill, it can provide an exceptional base for future development.

At this time, approval of the use of the material in several other states is underway. For example, the permitting process to utilize the material to restore 700 acres of coal strip mine in Fells Twp., Pennsylvania is about 95% complete. The state of California has already approved the use of the material for surface and subsurface mining applications. Several locations are being evaluated for appropriateness in moving forward.

Finally, Re-Crete™ has an environmental/product liability insurance policy in the amount of $25 million issued by a major insurance carrier as evidence of the market confidence in the product.

2.5 Final Cover Placement

Once the entire site has achieved subgrade, a six-inch thick gas vent layer will be placed over the entire surface. Although the use of Re-Crete™ and the closure of the site are not expected to generate landfill gas, the placement of a gas vent layer complies with MassDEP requirements. A ventilation system will be designed that will consist of a perforated collection line with periodic surface vents.

A 40 mil high density polyethylene liner will be placed over the entire surface of the site. Above that, standard drainage and vegetative support layers will be placed. The final surface will be loamed and seeded.

2.6 Solar Farm Construction

At this time, a solar farm consisting of approximately 3 MW of solar panels is envisioned for the capped area (the site) and the adjacent area within the former site assignment. Enviro-Cycle is in negotiations with two different solar companies to provide that construction.

The normal rent payment from the solar farm would likely be paid to the city of Attleboro for property taxes. Any additional royalty payments could be evenly divided between the city of Attleboro and the town of Norton. In addition, each of the communities would have the opportunity to purchase green power at a discounted rate.

2.8 Post Closure Estimate

The exact monitoring program will be determined upon completion of the CSA for the site. In order to frame an estimate at this time however, the cost for the present program was used for the next 18 years (Landfill was certified as closed in 2002) and then monitoring only the three wells near Phase B for the next 12 years. The estimate is as follows:

TABLE 1 -SUMMARY OF POST CLOSURE COSTS
ATTLEBORO LANDFILL CLOSURE
Total Post-Closure Monitoring/Maintenance Costs

Sequence	Year	Gas/Groundwater Anal. & Collection	Field Work, Inspections	Reporting (310 CMR 19.142(6))	Maintenance	Annual Cost
1	2014	$8,000.00	$550.00	$3,000.00	$2,500.00	$14,050.00
2	2015	$16,000.00	$550.00		$5,000.00	$21,550.00
3	2016	$16,000.00	$550.00	$3,000.00	$2,500.00	$22,050.00
4	2017	$16,000.00	$550.00		$2,500.00	$19,050.00
5	2018	$16,000.00	$550.00	$3,000.00	$2,500.00	$22,050.00
6	2019	$16,000.00	$550.00		$2,500.00	$19,050.00
7	2020	$16,000.00	$550.00	$3,000.00	$5,000.00	$24,550.00
8	2021	$16,000.00	$550.00		$2,500.00	$19,050.00
9	2022	$16,000.00	$550.00	$3,000.00	$2,500.00	$22,050.00
10	2023	$16,000.00	$550.00		$2,500.00	$19,050.00
11	2024	$16,000.00	$550.00	$3,000.00	$2,500.00	$22,050.00
12	2025	$16,000.00	$550.00		$5,000.00	$21,550.00
13	2026	$16,000.00	$550.00	$3,000.00	$2,500.00	$22,050.00
14	2027	$16,000.00	$550.00	$3,000.00	$2,500.00	$22,050.00
15	2028	$16,000.00	$550.00	$0.00	$2,500.00	$19,050.00
16	2029	$16,000.00	$550.00	$3,000.00	$2,500.00	$22,050.00
17	2030	$16,000.00	$550.00	$0.00	$5,000.00	$21,550.00
18	2031	$16,000.00	$550.00	$3,000.00	$5,000.00	$24,550.00
19	2032	$16,000.00	$550.00	$0.00	$2,500.00	$19,050.00
20	2033	$5,000.00	$550.00	$3,000.00	$2,500.00	$11,050.00
21	2034	$5,000.00	$550.00	$0.00	$2,500.00	$8,050.00
22	2035	$5,000.00	$550.00	$3,000.00	$2,500.00	$11,050.00
23	2036	$5,000.00	$550.00	$0.00	$5,000.00	$10,550.00
24	2037	$5,000.00	$550.00	$3,000.00	$2,500.00	$11,050.00
25	2038	$5,000.00	$550.00	$0.00	$2,500.00	$8,050.00
26	2039	$5,000.00	$550.00	$3,000.00	$2,500.00	$11,050.00
27	2040	$5,000.00	$550.00	$0.00	$2,500.00	$8,050.00
28	2041	$5,000.00	$550.00	$3,000.00	$5,000.00	$13,550.00
29	2042	$5,000.00	$550.00	$0.00	$2,500.00	$8,050.00
30	2043	$5,000.00	$550.00	$3,000.00	$2,500.00	$11,050.00
		$351,000.00	$16,500.00	$48,000.00	$92,500.00	$508,000.00

1. The budget is based on 2014 fees and Phase A being certified as closed in 2002
2. Maintenace budget includes lawn care, fence repair/replacement and access to the site, as necessary.

2.7 Financial Analysis

The following table presents an analysis of the financial aspect of the project. Highlights include:

- full coverage of the capping cost of the site (approximately $1.8 million)
- establishment of a post closure fund of approximately $508,000
- establishment of a mitigation fund of about $201,000
- The full cost of reconstruction of Union Road from South Worcester Street to the landfill entrance has been included in the project costs.

Attleboro Landfill Closure Estimate

ESTIMATED REVENUE	
Revenue from C&D Fines	$6,633,000.00
LESS – Cost of mixing and placing Re-Crete™	$3,331,374.00
NET REVENUE	**$3,301,626.00**
ESTIMATED COSTS	
Capping and Closure	$1,745,277.00
Post Closure Fund	$508,000.00
FAM Expense	$200,000.00
Engineering	$125,000.00
Mitigation Fund	$201,000.00
Union Road Reconstruction (100,000 from mitigation)	$125,000.00
TOTAL CAPPING, MONITORING AND MAINTENANCE COSTS	**$2,904,277.00**
TOTAL REVENUE	**$6,633,000.00**
TOTAL EXPENSES	**$6,235,651.00**
PROFIT	**$397,349.00**

Attachment 1 – Conceptual Layout

SCALE:	1" = 100'
DATE:	10/29/2013
DRAWN BY:	RSC
DESIGNED BY:	RSC
CHECKED BY:	RSC
FILE NO:	2213

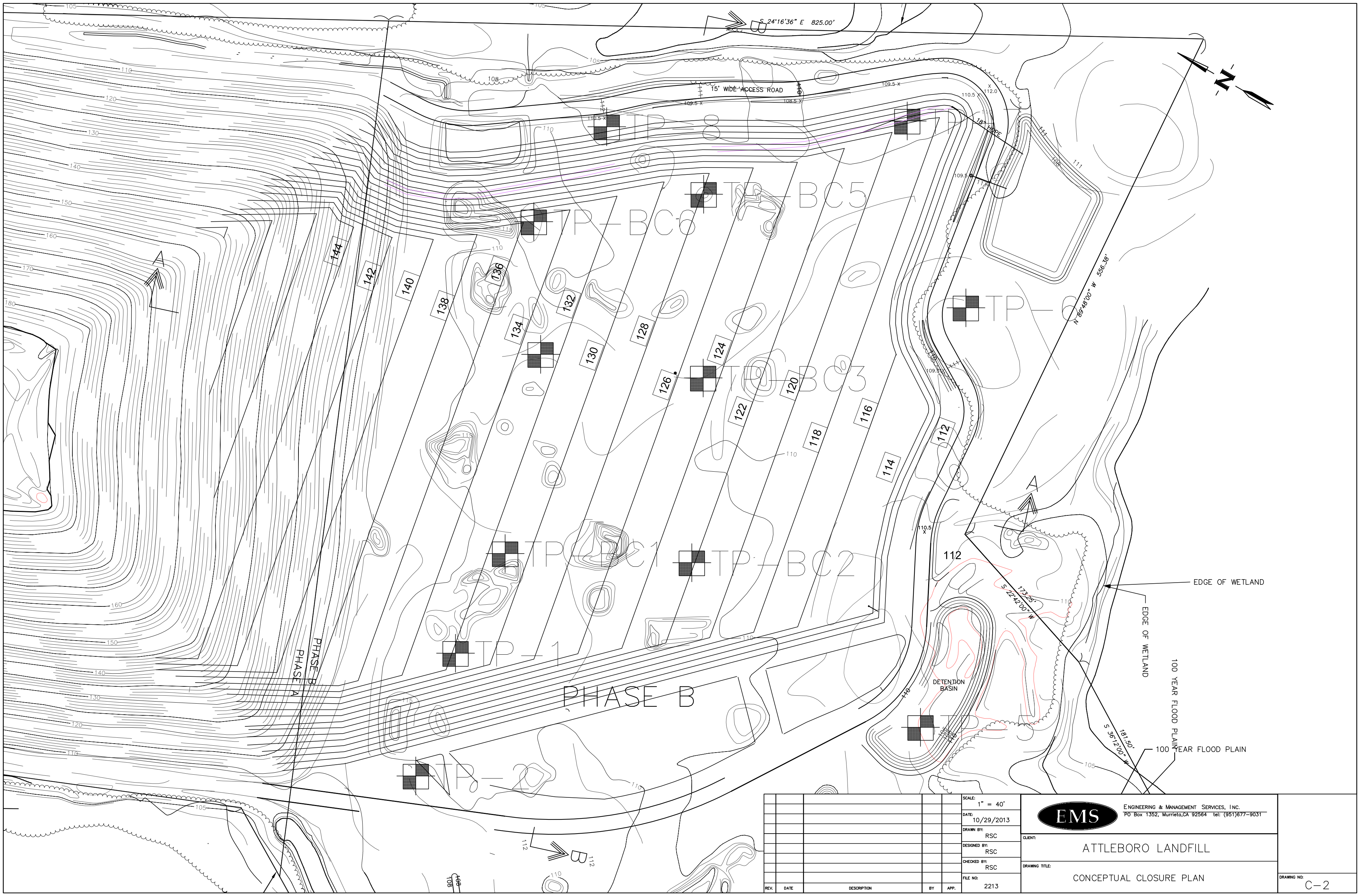
REV.	DATE	DESCRIPTION	BY	APP.

EMS — ENGINEERING & MANAGEMENT SERVICES, INC.
PO Box 1352, Murrieta,CA 92564 tel: (951)677-9031

CLIENT: ATTLEBORO LANDFILL

DRAWING TITLE: CONCEPTUAL CLOSURE PLAN

DRAWING NO: C-1



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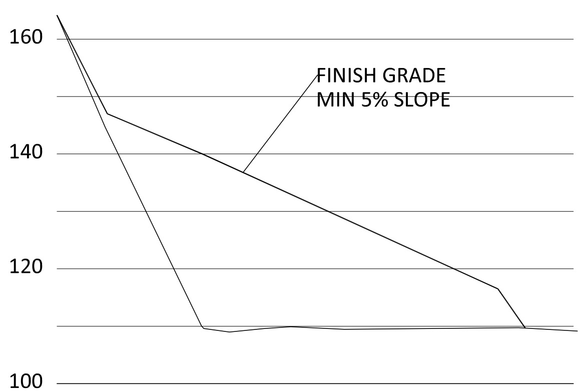
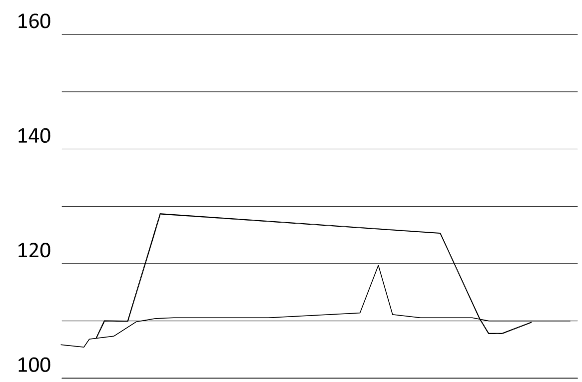
N 89°48'00" W 556.38'
TP-8
TP-BC5
TP-BC6
TP-6
TP-BC3
TP-BC1
TP-BC2
TP-1
TP-2
TP-5
PHASE B
PHASE A
DETENTION BASIN
EDGE OF WETLAND
100 YEAR FLOOD PLAIN
173.25'
S 22°42'00" W
181.50'
S 36°12'00" W
SCALE: 1" = 40'
DATE: 10/29/2013
DRAWN BY: RSC
DESIGNED BY: RSC
CHECKED BY: RSC
FILE NO: 2213
REV. DATE DESCRIPTION BY APP.
EMS
ENGINEERING & MANAGEMENT SERVICES, INC.
PO Box 1352, Murrieta,CA 92564 tel: (951)677-9031
CLIENT: ATTLEBORO LANDFILL
DRAWING TITLE: CONCEPTUAL CLOSURE PLAN
DRAWING NO: C-2



SECTION A-A

SCALES: HORIZ 1"=100'
VERT. 1"=10'



SECTION B-B

SCALES: HORIZ 1"=100'
VERT. 1"=10'

REV.	DATE	DESCRIPTION	BY	APP.			
					SCALE: AS-NOTED DATE: 10/29/2013 DRAWN BY: RSC DESIGNED BY: RSC CHECKED BY: RSC FILE NO: 2213	EMS ENGINEERING & MANAGEMENT SERVICES, INC. PO Box 1352, Murrieta,CA 92564 tel: (951)677-9031 CLIENT: ATTLEBORO LANDFILL DRAWING TITLE: CONCEPTUAL CLOSURE PLAN	DRAWING NO: C-3

Attachment 2 – Re-Crete Patent

US007815729B2

(12) **United States Patent**
Cummings et al.

(10) **Patent No.: US 7,815,729 B2**
(45) **Date of Patent: Oct. 19, 2010**

(54) **METHOD FOR RECYCLING CONSTRUCTION AND DEMOLITION FINES**

(76) Inventors: **Robert S. Cummings**, 7 Allen Rd., Rochester, MA (US) 02770; **Paul G. Chuckran**, 925 Colonial Dr., Bridgewater, MA (US) 02324

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **12/379,962**

(22) Filed: **Mar. 5, 2009**

(65) **Prior Publication Data**

US 2010/0224101 A1 Sep. 9, 2010

(51) **Int. Cl.**
C04B 18/16 (2006.01)

(52) **U.S. Cl.** **106/713**; 106/731; 106/735; 106/737; 106/772

(58) **Field of Classification Search** 106/713, 106/737, 731, 735, 772
See application file for complete search history.

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Primary Examiner—Paul Marcantoni
(74) *Attorney, Agent, or Firm*—Richard C. Litman

(57) **ABSTRACT**

The method for recycling construction and demolition fines involves using mixed fines from construction and demolition debris that would otherwise be disposed of at landfills as an ingredient in cement or concrete. The mixed fines contain a plurality of materials selected from the group consisting of asphalt, plastics, ceramics, fiberglass and batt insulation, soil, dust, drywall, wood, plaster, paper, cardboard, dirt. The fines may also contain particles of recyclable materials, such as concrete, bricks, mortar, metals, glass, and the like. The fines may range in size from microns up to 6 inches in at least one direction. The recycler may incorporate the fines into a concrete mix for bulk sale to commercial enterprises, or may himself form precast, lightweight concrete products, such as decorative columns, pedestals and table bases, trim moldings and cornices, door surrounds, etc.

3 Claims, No Drawings

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METHOD FOR RECYCLING CONSTRUCTION AND DEMOLITION FINES

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to waste disposal and recycling, and particularly to a method for recycling construction and demolition fines, and to a recycled product formed from such fines.

2. Description of the Related Art

In recent years many environmental concerns have been raised concerning the disposal of solid waste material. Landfills that have accumulated sold waste are running out of space. Many landfills have been shown to be the source or site of toxic waste that has spread to the surrounding communities, or have been suspected or feared of harboring and spreading toxins. Moreover, natural resources have been used up and discarded in solid waste facilities, raising concerns that these natural resources are becoming scarce or are in short supply.

As a result, there is growing interest in efforts to recycle solid waste materials. Building and road construction and building demolition produce a considerable amount of waste, known in the trade as construction and demolition (C&D) debris. C&D debris includes a wide variety of materials, including concrete, bricks, mortar, masonry, asphalt, metals, plastics, glass, ceramics, fiberglass and batt insulation, soil, dust, drywall, wood, plaster, paper, cardboard, dirt, and other materials.

In some areas, concrete is being successfully recycled. The larger pieces of concrete are sorted out from the debris and crushed to form recycled concrete aggregate (RCA), which is recycled to form recycled aggregate concrete (RAC). Japanese Patent No. 2002-053362, published Feb. 19, 2002, is representative of this approach (see the Abstract, "reutilization of concrete debris", "steps of: recycling concrete debris", etc.). The smaller RCA fines are sometimes recycled to form mortar or other masonry products. Similarly, larger pieces of glass, metal, paper, and drywall may be sorted from the debris and recycled. However, inevitably there is a residue of finer particles resulting from the crushing, shredding, or grinding of the C&D debris that has a mixed composition, referred to as C&D debris fines, that heretofore could not be economically recycled and is therefore simply dumped at the landfill for disposal.

The only current uses for C&D debris fines are limited to alternative daily cover (ADC) for landfills, soil beds or road beds, earth engineering uses, and the like. Even use for these purposes is sometimes problematical. For example, it has been estimate that C&D debris fines contain about 20% drywall by weight. Drywall contains gypsum (calcium sulfate), which is often converted to hydrogen sulfate when used as ADC in landfills. The resulting odor, similar to rotten eggs, is noxious, and in high enough concentrations, may leach into the soil and underground water, potentially posing a health hazard or damaging nearby crops or vegetation.

Consequently, there is a need for a more economically profitable and environmentally friendly way of recycling C&D fines. Thus, a method for recycling construction and demolition fines solving the aforementioned problems is desired.

SUMMARY OF THE INVENTION

The method for recycling construction and demolition fines involves using mixed fines from construction and demolition debris that would otherwise be disposed of at landfills as an ingredient in cement or concrete. The mixed fines contain a plurality of materials selected from the group consisting of asphalt, plastics, ceramics, fiberglass and batt insulation, soil, dust, drywall, wood, plaster, paper, cardboard, and dirt. The fines may also contain particles of recyclable materials, such as concrete, bricks, mortar, metals, glass, and the like. The fines may range in size from microns up to 6 inches in at least one direction. The recycler may incorporate the fines into a dry cement mix for bulk sale to commercial enterprises, or may himself form precast, lightweight concrete products, such as decorative columns, pedestals and table bases, trim moldings and cornices, door surrounds, etc.

The fines may be suspended in the concrete products to form a mixture of materials, or the fines may be chemically altered and incorporated into the concrete, depending upon the composition of the fines and the composition of the concrete.

These and other features of the present invention will become readily apparent upon further review of the following specification.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The method for recycling construction and demolition fines involves using mixed fines from construction and demolition debris that would otherwise be disposed of at landfills as an ingredient in cement or concrete. The mixed fines contain a plurality of materials selected from the group consisting of asphalt, plastics, ceramics, fiberglass and batt insulation, soil, dust, drywall, wood, plaster, paper, cardboard, and dirt. The fines may also contain particles of recyclable materials, such as concrete, bricks, mortar, metals, glass, and the like. The fines may range in size from microns up to 6 inches, preferably up to 3 inches, in at least one direction. The recycler may incorporate the fines into a dry cement mix for bulk sale to commercial enterprises, or may himself form precast, lightweight concrete products, such as decorative columns, pedestals and table bases, trim moldings and cornices, door surrounds, piers, wall caps, pavers, site furnishings, stair treads, flowerpots, blocks, bricks, and other applications that require low strength, lightweight concrete.

By adding polymer or other strengthening agents, a higher strength concrete can be produced, which may broaden the range of concrete products that may be formed incorporating C&D fines.

The fines may be suspended in the concrete products to form a mixture of materials, or the fines may be chemically altered and incorporated into the concrete, depending upon the composition of the fines and the composition of the concrete.

In order to evaluate the viability of the potential applications of concrete incorporating C&D fines, the inventors prepared various mixtures of cement, stone aggregate, sand, and C&D fines. The resulting concrete was tested for strength using conventional tests. The results are shown in the following Table. It will be noted, for example, that a mixture containing 80% C&D fines and 20% cement by volume can produce concrete that is 30% lighter than standard concrete. It will be understood that as the percentage of C&D fines increases, the cost of producing the resulting concrete goes down, since the unit cost of the remaining ingredients is higher than C&D fines while the proportion of the remaining, ingredients required to produce the same volume of concrete goes down.

TABLE 1

Strength vs. % Fines by Volume							
Sample	1	2	3	4	5	6	7
Cement (unit vol.)	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Cement (% Tot. vol.	20	20	20	20	20	20	20
Sand (unit vol.)	1	0.7	0.5	0.25	0	0	0
Sand (% Tot. vol.)	40	30	20	10	0	0	0
Stone (unit vol.)	1	1	1	1	1	0.5	0
Stone (% Tot. vol.)	40	40	40	40	40	20	0
Fines (unit vol.)	0	0.25	0.50	0.75	1	1.5	2
Fines (% Tot. vol.)	0	10	20	30	40	60	80
Unit weight (lbs/cf	142.7	138.3	132.7	125.8	121.3	104.8	96.3
Strength (P.S.I.)	4290	2650	700	880	880	530	530

It is to be understood that the present invention is not limited to the embodiments described above, but encompasses any and all embodiments within the scope of the following claims.

We claim:

1. A method of recycling construction and demolition fines, comprising the steps of:

a) admixing mixed construction and demolition fines with cement in order to produce a lightweight concrete from recycled material, wherein i) said mixed fines have a size between three microns and six inches and ii) said mixed fines comprise particles made of at least two different materials, one of the two materials being gypsum drywall and the other material selected from the group consisting of asphalt, plastics, ceramics, fiberglass and batt insulation, soil, dust, wood, plaster, paper, cardboard, and dirt; and

b) forming concrete from the admixture of cement with the mixed construction and demolition fines, the cement comprising approximately 20% and the mixed fines comprising between about 10% to 80% of ingredients used to form the concrete.

2. The method of recycling construction and demolition fines according to claim **1**, further comprising the step of forming a precast concrete article from the admixture of cement with the mixed construction and demolition fines.

3. The method of recycling construction and demolition fines according to claim **2**, wherein the precast concrete article is selected from the group consisting of decorative columns, pedestals and table bases, trim moldings and cornices, door surrounds, piers, and wall caps.

* * * * *

Attachment 3 – Re-Crete Informational Document

Re-Crete™ Informational Document

May 2011

Table of Contents

Contents

1.0 Introduction and Background

1.1 Introduction

This document presents a description of the use of Re-Crete™ as flowable fill. The document contains a description of Re-Crete™; details of the physical and chemical properties as well as the laboratory testing conducted on Re-Crete.

1.2 Re-Crete™ Background Information

Re-Crete™ is trademarked and has a patent issued by the US Patent and Trade Office (US 7,815,729 B2). From an environmental standpoint, the product is essentially a lightweight, low strength concrete and as such has no environmental impacts on the surroundings. It can be used to reclaim areas where excavation for sand, gravel and/or rock has created significant depressions in the ground surface. Once the area has been restored using the Re-Crete flowable fill, it can provide an exceptional base for future development

The patent develops a method for incorporating Construction & Demolition (C&D) fines into a concrete mixture that can be used in a variety of applications including limited structural concrete, architectural applications of low strength concrete, and flowable fill. The term C&D fines refers to the small particles of the debris that fall through crushing equipment and conveyor systems at C&D processing facilities; this term is therefore referred to as "fines". A significant component of the C&D fines is gypsum that originates from wallboard. The C&D processors spend significant effort to remove wallboard from the incoming waste stream due to the negative environmental effects that gypsum from the drywall materials causes (hydrogen sulfide gas generation) when reused or disposed in landfills.

The Re-Crete application eliminates the generation of hydrogen sulfide and the use of gypsum in Re-Crete improves the physical characteristics of the final product. The use of this material will ease the processor's recycling efforts and will present an alternative to landfill disposal or reuse of the C&D fines as grading and shaping materials.

2.0 Physical and Chemical Properties of Re-Crete™

As part of the patent development process, various mixtures were experimented with to determine the physical characteristics of the resulting material. In the development of the protocol for the testing, the two primary criterion that were used as focal points are:

- The physical properties of the material as they relate to the ability to be useful as fill material (i.e., compressive strength and permeability) and;
- The properties of the material as they relate to potential effects on the environment (leaching potential of contents and gas generation potential).

2.1.1 Laboratory Testing

On December 16, 2008, seven cylinders of Re-Crete were transported to Tibbetts Engineering Corp., a materials testing laboratory for concrete compression testing in accordance with ASTM C39. The results of the testing are summarized in Table 1, the test data is included in Appendix A.

Table 1
Results of December 2008 Concrete Testing

Sample Number	1	2	3	4	5	6	7
Cement (unit vol)	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Cement (% of Total vol)	20.00%	20.00%	20.00%	20.00%	20.00%	20.00%	20.00%
Sand (unit vol)	1	0.75	0.5	0.25	0	0	0
Sand (% of Total vol)	40.00%	30.00%	20.00%	10.00%	0.00%	0.00%	0.00%
Stone (unit vol)	1	1	1	1	1	0.5	0
Stone (% of Total vol)	40.00%	40.00%	40.00%	40.00%	40.00%	20.00%	0.00%
C&D Fines (unit vol)	0	0.25	0.5	0.75	1	1.5	2
C&D Fines (% of Total vol)	0.00%	10.00%	20.00%	30.00%	40.00%	60.00%	80.00%
Unit weight (lbs/cf)	142.7	138.3	132.7	125.8	121.3	104.8	96.3
Strength (P.S.I.)	4290	2650	700	880	880	530	530

As shown in the above table, the strength of the material decreases as the amount of C&D fines increases. That is, the sample containing 80% by volume of C&D fines at 530 p.s.i. (Sample 7) has significantly less strength than the sample containing 0% C&D fines (Sample1). However, it is noted that once the percentage of C&D fines reaches 20% by volume (Sample 3), the strength of the material does not vary significantly between 20% and 80% of C&D fines by volume. At that level (80% C&D fines by volume), the resulting material is similar to a lightweight low strength concrete that can be used for a myriad of nonstructural applications. At 80% C&D fines by volume, the weight of the concrete matrix is reduced to 96.3 pounds per cubic foot, representing approximately 33% reduction in weight from the concrete only sample (Sample 1).

Visually, sample 7 has the same characteristics as typical concrete. Figure 1 is a picture of cylinder number seven.

Figure 1 - 80% C&D Fines Cylinder

Subsequent to submittal of the patent application, and in anticipation of approval as flowable fill, additional concrete cylinders were produced for testing. In December 2009, six cylinders were prepared with much lower proportions of cement than previously tested and at mixtures consistent with flowable fill. Again, the cylinders were transported to Tibbetts Engineering

Corp. materials testing laboratory for concrete compression testing in accordance with ASTM C39. Table 2 summarizes the testing data; the laboratory results are included in Appendix A.

Table 2
January 2010 Compressive Strength Test Data

Sample Number	**1**	**2**	**3**	**4**	**5**	**6**
Cement (oz.)	15.1	15.1	18.8	18.8	22.6	26.3
C&D Fines (oz.)	168	168	168	168	168	168
Total Wt. (oz.)	183.10	183.10	186.80	186.80	190.60	194.30
Cement (% of Total wt.)	8%	8%	10%	10%	12%	14%
Unit Weight (PCF)	84.9	84.2	83.5	84.7	82.2	81.3
Strength (p.s.i.)	25	29	34	39	37	42
Strength (p.s.f.)	3600	4176	4896	5616	5328	6048

As shown in the above table, the strength of the material is significantly less than the December 2008 samples (Table 1), however, all of the samples (Table 2) show bearing strength greater than ordinary compacted sand or gravel (2500 psf). These data demonstrate that the use of C&D fines co-mixed with concrete is suitable for use as foundation material. Visually, the material looks similar to typical concrete, however the color is slightly more earthtone and the surface not as smooth. With time, the material continues to harden and becomes closer to the appearance of typical concrete (i.e. grayish in color). Figure 2 is a picture of cylinder number 1.

Figure 2 - 8% Cement Cylinder

To assess the potential of leachability of contaminants from the material and its impact on the environment, portions of cylinder number 2 were delivered to GeoLabs, Inc. in Braintree, Massachusetts for laboratory analysis. These tests were performed on January 18, 2010 and consisted of:

TCLP Silver –SW6010B
TCLP Mercury -- E245.1
TCLP RCRA 8 Metals -- SW6010B
TCLP Semi volatile Organics – SW8270C
TCLP Volatile Organics - SW8260B

Of the above analysis, the only constituents detected in the leachate was barium at a concentration of 0.150 mg/l , chromium at a concentration of 0.0700 mg/l, and lead at a concentration of 0.840 mg/l. The concentrations of these constituents did not exceed their respective TCLP standards.

Based on these initial results, additional testing was conducted to provide more comprehensive data. For example, the initial testing provided an indication of the strength of the material and the theoretical chemical characteristics of water leaching through the matrix as measured by the TCLP analysis however, the tests did not provide the permeability of the material or the expected concentration of constituents as water is passed through the material. The TCLP analysis was based on pulverizing the concrete matrix and mixing it with a slightly acidic solution over a 24-hour period of time. In this method, the leachate matrix overstates the concentrations of constituents within the concrete matrix. In reality, water flowing over the hardened concrete material will behave quite differently thus resulting in lower concentrations of constituents.

To address these issues, six test cylinders were prepared for permeability testing: two cylinders containing 8% cement by weight (8-1 and 8-2); two cylinders using 10% (10-1 and 10-2) cement by weight; and one sample of each mixture (8% and 10% of cement by weight) using C&D fines where 10% of the weight of the raw fines was supplemented with gypsum from old wallboard (8-G and 10-G). The last two cylinders were prepared to evaluate the difference in behavior of the material when gypsum is not removed from the C&D mix.

Permeability testing was completed by Geotesting Express. At the completion of the test, water used in the permeability test was collected and transported to GeoLabs for chemical analysis. GeoLabs analyzed the water used for permeability tests for each of the 6 samples for total metals and semi-volatile organics (Method 8270). In addition the water from one sample, (Sample 10-1) was analyzed for dissolved metals. The material in the cylinders was analyzed for total metals, TCLP metals and total and TCLP Semi Volatile Organics.

Further, to evaluate gas generation from the material, a portion of one of the cylinders was placed in a container and kept wet. An air sample was collected and analyzed for Total Reduced Sulfur Compounds by ASTM D-5504. Table 3 summarizes the analytical testing that was completed.

Table 3
Testing Completed May 2010

Sample	Total Metals (RCRA 8 metals)	TCLP RCRA 8Metals	Semi Volatile Organics (EPA Method 8270)	TCLP Semi Volatile Organics	Hydrogen Sulfide
Cylinder 8-1	✓	✓	✓	✓	
Cylinder 8-1	✓	✓	✓	✓	
Cylinder 8-1	✓	✓	✓	✓	
Cylinder 8-1	✓	✓	✓	✓	
Cylinder 8-1	✓	✓	✓	✓	
Cylinder 8-1	✓	✓	✓	✓	
Liquid from permeability test	✓		✓		
Gas From Sample					✓

2.2 Test Results

This section presents a discussion of the test results organized by the physical characteristics of the material; the chemical make – up of the material; the chemical characteristics of water passing through the material; and the gas generated by the material. Tables 4 and 5 present a summary of the data.

2.2.1 PHYSICAL CHARACTERISTICS OF THE MATERIAL

The data contained in Tables 1, 2 and 4 clearly show that the strength of the material is a function of the ratio of C&D fines to the entire contents of the mixture as well as the amount of cement used to make the Re-Crete™. The range of the mixtures tested show a compressive strength from 2650 p.s.i. at 10% C&D fines and 20% cement by volume to 25 p.s.i. at 8% cement and 92% C&D fines by weight. All of these mixtures provide a bearing strength greater than typical sand and gravel (17 p.s.i.). The compressive strength of typical concrete varies from 3000 p.s.i. to 5000 p.s.i., depending on the mix.

The permeability of the 8% and 10% mixtures (Table 4) varies from 1×10^{-4} and 2.5×10^{-5} cm/sec. Various sources report the permeability of typical concrete between 1×10^{-5} and 1×10^{-6} cm/sec, so the material behaves similar to typical concrete in terms of its' water conductive characteristics. The data shows that the addition of gypsum increased the degree of imperviousness by a factor of 5 for the 8% mixture and about 2.3 for the 10% mixture.

2.2.2 CHEMICAL CHARACTERISTICS OF THE MATERIAL

As expected, the data showed consistency in the types of constituents found in the material. Also as expected, the concentration of those constituents varied however within a range of an order of magnitude less. The chemical data relative to the makeup of the material is contained in Table 4 and 5.

The TCLP testing performed show that the constituents found in the material are, for all practical intents and purposes, immobile. For example, the TCLP standard for lead is 5 mg/L; the observed TCLP lead ranged between non-detect to 0.12 mg/L, slightly above the detection limits for the analytical method. Likewise, TCLP chromium was observed between 0.02 and 0.06 mg/L and the chromium TCLP standard is 5 mg/L. Although low concentrations of metals were identified in the leachate, the concentrations were significantly below the TCLP standards.

Table 4
Re-Crete™ Permeability and Chemical Data

Analysis / Sample Number	**8-1**	**8-2**	**8-G**	**10-1**	**10-2**	**10-G**
Permeability (cm/sec)	1.00E-04	1.00E-04	2.00E-05	3.40E-05	8.50E-05	2.50E-05
TOTAL SILVER -SW6010B (mg/kg)						
Silver	ND	ND	ND	ND	ND	ND
MERCURY -SW7471A (mg/kg)						
Mercury	0.282	0.461	0.319	0.565	1.12	2.17
RCRA METALS *W/O* HG -SW6010B (mg/kg)						
Arsenic	ND	ND	ND	ND	ND	ND
Barium	244	246	227	163	126	186
Cadmium	ND	ND	ND	ND	ND	ND
Chromium	24.1	24.4	20.2	20.2	23.7	21.8
Lead	1690	821	852	667	412	382
Selenium	ND	ND	ND	ND	ND	ND
TCLP SILVER -SW6010B (mg/l)						
Silver	ND	ND	ND	ND	ND	ND
TCLP MERCURY -E24S.1 (mg/l)						
Mercury	ND	ND	0.05	ND	0.02	ND
TCLP RCRA METALS -SW6010B (mg/l)						
Arsenic	ND	ND	ND	ND	ND	ND
Barium	0.13	0.11	0.08	0.1	0.1	0.12
Cadmium	ND	ND	ND	ND	ND	ND
Chromium	0.06	0.06	0.06	0.08	0.06	0.02
Lead	0.12	0.1	ND	ND	0.1	0.1
Selenium	ND	ND	ND	ND	ND	ND

Table 4 (Cont.)
Re-Crete™ Permeability and Chemical Data

Analysis / Sample Number	8-1	8-2	8-G	10-1	10-2	10-G
SEMIVOLATILE ORGANICS - (mg/kg)						
1,1'-Biphenyl	ND	ND	ND	ND	ND	ND
1,2,4-Trichlorobenzene	ND	ND	ND	ND	ND	ND
1,2-Dichlorobenzene	ND	ND	ND	ND	ND	ND
1,2-Dinitrobenzene	ND	ND	ND	ND	ND	ND
1,3-Dichlorobenzene	ND	ND	ND	ND	ND	ND
1,3-Dinitrobenzene	ND	ND	ND	ND	ND	ND
1 A-Dichlorobenzene	ND	ND	ND	ND	ND	ND
1,4-Dinitrobenzene	ND	ND	ND	ND	ND	ND
2,3,4,6~Tetrachloropheno!	ND	ND	ND	ND	ND	ND
2,4,5-Trichlorophenol	ND	ND	ND	ND	ND	ND
2,4,6-Trichlorophenol	ND	ND	ND	ND	ND	ND
2,4-Dichlorophenol	ND	ND	ND	ND	ND	ND
2,4~Dimethyfphenol	ND	ND	ND	ND	ND	ND
2,4-Dinitrophenol	ND	ND	ND	ND	ND	ND
2,4~Dinitrotoluene	ND	ND	ND	ND	ND	ND
2,6-Dinitrotoluene	ND	ND	ND	ND	ND	ND
2-Chloronaphthalene	ND	ND	ND	ND	ND	ND
2-Chlorophenol	ND	ND	ND	ND	ND	ND
2-Methylnaphthalene	ND	ND	ND	ND	ND	ND
2-Methylphenol	ND	ND	ND	ND	ND	ND
2-Nitroaniline	ND	ND	ND	ND	ND	ND
2-Nitrophenol	ND	ND	ND	ND	ND	ND
3,3'-Dichlorobenzidine	ND	ND	ND	ND	ND	ND
3-MethylphenolI4-Methylphenol	ND	ND	ND	ND	ND	ND
3-Nitroaniline	ND	ND	ND	ND	ND	ND
4,6-Dinitro~2~Methy!phenol	ND	ND	ND	ND	ND	ND
4-Bromophenyl Phenyl Ether	ND	ND	ND	ND	ND	ND
4-Chloro-3-Methylphenol	ND	ND	ND	ND	ND	ND
4~Chloroaniline	ND	ND	ND	ND	ND	ND
4~Chlorophenyl Phenyl Ether	ND	ND	ND	ND	ND	ND
4-Nitroanmne	ND	ND	ND	ND	ND	ND
4~Nitrophenol	ND	ND	ND	ND	ND	ND
Acenaphthene	ND	ND	ND	1180	ND	ND
Acenaphthylene	ND	ND	ND	ND	ND	ND

Acetophenone	ND	ND	ND	ND	ND	ND
Aniline	ND	ND	ND	ND	ND	ND
Anthracene	6840	3970	3860	7210	2020	5550
Azobenzene	ND	ND	ND	ND	ND	ND
Benz(a)Anthracene	12000	6370	5400	9650	5530	6660
Benzo(a)Pyrene	5210	2710	2680	4110	2950	2820
Benzo{b)Fluoranthene	10200	5040	4440	8810	5110	2880
Benzo(g,h,i)Perylene	5360	2570	3070	4010	2820	1890
Benzo(k)FIu 0 ranthene	7920	3730	4090	4000	3230	3640
Benzyl Alcohol	ND	ND	ND	ND	ND	ND
Bis(2-Chloroethoxy)Methane	ND	ND	ND	ND	ND	ND
Bis(2-Chloroethyl)Ether	ND	ND	ND	ND	ND	ND
Bis(2-Chloroisopropyl)Ether	ND	ND	ND	ND	ND	ND
Bis(2-Ethylhexyl)Phthalate	ND	ND	ND	ND	ND	ND
Butyl Benzyl Phthalate	*4970*	1280	ND	2740	4760	ND
Carbazole	*3450*	1080	1260	ND	ND	ND
Chrysene	*11100*	6210	6020	9290	5280	5390
Dibenz(a, h)Anth race ne	ND	ND	ND	ND	ND	ND
Dibenzofuran	ND	ND	ND	ND	ND	ND
Oiethyl Phthalate	ND	ND	ND	ND	ND	ND
Dimethyl Phthalate	ND	ND	ND	ND	ND	ND
Di~n-Buty! Phthalate	ND	ND	ND	ND	8710	ND
Di·n-Octyl Phthalate	ND	ND	ND	ND	ND	ND
Fluoranthene	*27900*	14500	14200	18200	10800	15900
Fluorene	ND	ND	ND	ND	ND	ND
Hexachlorobenzene	ND	ND	ND	ND	ND	ND
Hexachlorobutadiene	ND	ND	ND	ND	ND	ND
Hexachlorocyclopentadiene	ND	ND	ND	ND	ND	ND
Hexachloroethane	ND	ND	ND	ND	ND	ND
Indeno(1,2,3-cd)pyrene	*4310*	2130	2710	2880	2570	1430
Isophorone	ND	ND	ND	ND	ND	ND
Naphthalene	ND	ND	ND	ND	ND	ND
Nitrobenzene	ND	ND	ND	ND	ND	ND
N-Nitrosodimethylamine	ND	ND	ND	ND	ND	ND
N-Nitrosodi-n-Propylamine	ND	ND	ND	ND	ND	ND
N-Nitrosodiphenylamine	ND	ND	ND	ND	ND	ND
Pentachlorophenol	ND	ND	ND	ND	ND	ND
Phenanthrene	*22900*	11300	11300	27100	6650	12200
Phenol	ND	ND	ND	ND	ND	ND

Pyrene	*22700*	10100	12200	26200	6590	12500
Pyridine	ND	ND	ND	ND	ND	ND
TCLP SEMIVOLATILE ORGANICS -SW8270C (mg/l)						
1,4 Trichlorobenzene	ND	ND	ND	ND	ND	ND
2,4,5 Trichlorophenol	ND	ND	ND	ND	ND	ND
2,4t 6 Trichlorophenol	ND	ND	ND	ND	ND	ND
2,4-Dinitrotoluene	ND	ND	ND	ND	ND	ND
2-Methylphenol	ND	ND	ND	ND	ND	ND
3-Methylphenol/4-Methylphenol	ND	ND	ND	ND	ND	ND
Hexachlorobenzene	ND	ND	ND	ND	ND	ND
Hexachlorobutadiene	ND	ND	ND	ND	ND	ND
Hexachloroethane	ND	ND	ND	ND	ND	ND
Nitrobenzene	ND	ND	ND	ND	ND	ND
Pentachlorophenol	ND	ND	ND	ND	ND	ND
Pyridine	ND	ND	ND	ND	ND	ND

2.2.3 CHEMICAL CHARACTERISTICS OF WATER PASSING THROUGH THE MATERIAL

In order to simulate more realistic conditions in the field, the water which was passed over the cylinders during the permeability tests was analyzed for metals and semi-volatile organic compounds. Unfortunately, there was only a sufficient quantity of water, sample 10-1, to measure dissolved metals; the laboratory used most of the water on all the samples for analysis of total metals and total semi volatile organics. As shown by the test data contained in Table 4 and 5, the suspended metal content in the unfiltered test water is present at concentrations above the TCLP values however, based on the results from sample 10-1, the dissolved fraction is almost an order of magnitude less (0.06 compared to 0.496) than the total fraction.

Table 5
Re-Crete™ Permeameter Water Chemical Data

Analysis / Sample Number	8-1	8-2	8-G	10-1	10-2	10-G
TOTAL METALS BY GFAA -E200.9 (mg/l)						
Arsenic	0.015	0.03	0.083	0.067	0.0654	0.0703
TOTAL METALS BY ICP· (mg/l)						
Barium	0.076	0.287	0.329	0.314	0.286	0.348
Cadmium	ND	ND	ND	ND	ND	ND
Chromium	ND	ND	ND	ND	ND	ND
Lead	0.011	0.257	0.067	0.497	0.361	0.104
Selenium	ND	ND	0.079	0.069	0.061	ND
TOTAL SILVER -E200.7 (mg/l)						
Silver	ND	ND	ND	ND	ND	ND
TOTAL MERCURY -E24S.1 (mg/l)						
Mercury	ND	ND	ND	0.0002	ND	ND
DISSOLVED METALS BY ICP - SW6010B (mg/l)						
Arsenic				ND		
Barium				ND		
Cadmium				ND		
Chromium				ND		
Lead				0.06		
Selenium				ND		
DISSOLVED SILVER - E200.7 (mg/l)						
Silver				ND		
DISSOLVED MERCURY - E245.1 (mg/l)						
Mercury				ND		
SEMIVOLATILE ORGANICS -SW8270C (mg/l)						
1,2,4~Trichlorobenzene	ND	ND	ND	ND	ND	ND
1,2-Dichlorobenzene	ND	ND	ND	ND	ND	ND
1,2-Dinitrobenzene	ND	ND	ND	ND	ND	ND
1,3~Dichlorobenzene	ND	ND	ND	ND	ND	ND
1,3-Dinitrobenzene	ND	ND	ND	ND	ND	ND
1,4-Dichlorobenzene	ND	ND	ND	ND	ND	ND
1 ,4-Dinitrobenzene	ND	ND	ND	ND	ND	ND
2,3,4,6~Tetrachlorophenol	ND	ND	ND	ND	ND	ND
2,4,5~Trichlorophenol	ND	ND	ND	ND	ND	ND
2,4,6· Trichlorophenol	ND	ND	ND	ND	ND	ND
2,4-Dichlorophenol	ND	ND	ND	ND	ND	ND
2,4~Dimethylphenol	ND	ND	ND	ND	ND	ND
2,4·Dinitrophenol	ND	ND	ND	ND	ND	ND

2,4-Dinitrotoluene	ND	ND	ND	ND	ND	ND
2,6~Dinitrotoluene	ND	ND	ND	ND	ND	ND
2-Chloronaphthalene	ND	ND	ND	ND	ND	ND
2-Chlorophenol	ND	ND	ND	ND	ND	ND
2-Methylnaphthalene	ND	ND	ND	ND	ND	ND
2-Methylphenol	ND	ND	ND	ND	ND	ND
2-Nitroaniline	ND	ND	ND	ND	ND	ND
2-Nitrophenol	ND	ND	ND	ND	ND	ND
3,3'-Oichlorobenzidine	ND	ND	ND	ND	ND	ND
3-MethylphenoI/4-Methylphenol	ND	ND	ND	ND	ND	ND
3-Nitroanillne	ND	ND	ND	ND	ND	ND
4,6-Dinitro-2-Methylphenol	ND	ND	ND	ND	ND	ND
4-Bromophenyl Phenyl Ether	ND	ND	ND	ND	ND	ND
4-Chloro-3-Methylphenol	ND	ND	ND	ND	ND	ND
4-Chloroaniline	ND	ND	ND	ND	ND	ND
4-Chlorophenyl Phenyl Ether	ND	ND	ND	ND	ND	ND
4-NitroanHine	ND	ND	ND	ND	ND	ND
4-Nitrophenol	ND	ND	ND	ND	ND	ND
Acenaphthene	ND	ND	ND	ND	ND	ND
Acenaphthylene	ND	ND	ND	ND	ND	ND
Acetophenone	ND	ND	ND	ND	ND	ND
Aniline	ND	ND	ND	ND	ND	ND
Anthracene	ND	ND	ND	ND	ND	ND
Azobenzene	ND	ND	ND	ND	ND	ND
Benz(a)Anthracene	ND	ND	ND	ND	ND	ND
Benzidine	ND	ND	ND	ND	ND	ND
Senzo(a)Pyrene	ND	ND	ND	ND	ND	ND
Benzo(b)Fluoranthene	ND	ND	ND	ND	ND	ND
Benzo(g,h,i)Perylene	ND	ND	ND	ND	ND	ND
Benzo(k)Fluoranthene	ND	ND	ND	ND	ND	ND
Benzyl Alcohol	ND	ND	ND	ND	ND	ND
Bis(2-Chloroethoxy)Methane	ND	ND	ND	ND	ND	ND
Bis(2-Chloroethyl)Ether	ND	ND	ND	ND	ND	ND
Bis(2-Chloroisopropyl)Ether	ND	ND	ND	ND	ND	ND
Bis(2-Ethylhexyl)Phthalate	ND	ND	ND	ND	ND	ND
Butyl Benzyl Phthalate	ND	ND	ND	ND	ND	ND
Carbazole	ND	ND	ND	ND	ND	ND
Chrysene	ND	ND	ND	ND	ND	ND
Dibenz(a,h)Anthracene	ND	ND	ND	ND	ND	ND
Dibenzofuran	ND	ND	ND	ND	ND	ND
Diethyl Phthalate	ND	ND	ND	ND	ND	ND
Dimethyl Phthalate	ND	ND	ND	ND	ND	ND
Di-n-Butyl Phthalate	ND	ND	ND	ND	ND	ND
Di-n-Octyl Phthalate	ND	ND	ND	ND	ND	ND
Fluoranthene	ND	ND	ND	ND	ND	ND

Fluorene	ND	ND	ND	ND	ND	ND
Hexachlorobenzene	ND	ND	ND	ND	ND	ND
Hexachlorobutadiene	ND	ND	ND	ND	ND	ND
Hexachlorocyclopentadiene	ND	ND	ND	ND	ND	ND
Hexachloroethane	ND	ND	ND	ND	ND	ND
Indeno(1,2,3-cd)Pyrene	ND	ND	ND	ND	ND	ND
Isophorone	ND	ND	ND	ND	ND	ND
Naphthalene	ND	ND	ND	ND	ND	ND
Nitrobenzene	ND	ND	ND	ND	ND	ND
N-Nitrosodimethylamine	ND	ND	ND	ND	ND	ND
N-Nitrosodi-n-Propylamine	ND	ND	ND	ND	ND	ND
N-Nitrosodiphenylamine	ND	ND	ND	ND	ND	ND
Pentachlorophenol	ND	ND	ND	ND	ND	ND
Phenanthrene	ND	ND	ND	ND	ND	ND
Phenol	ND	ND	ND	ND	ND	ND
Pyrene	ND	ND	ND	ND	ND	ND
Pyridine	ND	ND	ND	ND	ND	ND

2.2.4 GAS GENERATION BY THE MATERIAL

A portion of cylinder 10-g was partially submerged in water in a closed container and a sample of the air was extracted after a week and analyzed for Total Reduced Sulfur Compounds by ASTM D-5504. The test data showed the presence of only two sulfur compounds, hydrogen sulfide at 0.000152 ppm and carbon disulfide at 0.000274 ppm. The recognition threshold (the concentration at which 50% of humans can detect the smell for hydrogen sulfide) is 0.00047 ppm; almost 3 times higher than the observed results. Likewise, the recognition threshold for carbon disulfide is 0.2 ppm, almost 3 orders of magnitude greater than observed.

2.2.5 SUMMARY

The testing conducted support the conclusion that Re-Crete™ can be safely used for the application of flowable fill. First, the physical properties of the material show that it can be made strong enough to support loads for construction applications by appropriately adding sufficient quantities of cement depending on the application. For uses of Re-Crete as flowable fill, a mixture of 8% cement by weight, with added gypsum, provides more than enough support for typical construction activities. The material is similar to typical concrete with respect to its degree of imperviousness therefore, water flow through the material will be minimal.

The results of the environmental testing conducted on this material with regards to potential leaching, and quantity of gas generated, shows that the material is stable in the environment and is not expected to create any nuisance or environmental impacts. The carbon disulfide and hydrogen sulfide gas levels that were detected from the matrix containing old gypsum materials is well below the olfactory detection limit.

3.0 Conclusion

The material can be used as an aggregate in flowable fill for various restoration activities. The testing described in previous sections clearly demonstrates that there will be no adverse environmental impacts associated with the use. Further, the data indicates that when used as flowable fill, the final product will provide a structure suitable to support conventional foundations to support building construction.