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May 18, 2011

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CLASS V EXPERIMENTAL UNDERGROUND INJECTION CONTROL (UIC) RENEWAL PERMIT APPLICATION FOR EXISTING TERMINAL ISLAND RENEWABLE ENERGY (TIRE) PROJECT

Dear Mr. Albright:

The City of Los Angles is submitting for your review and approval a Class V UIC permit renewal application for the existing TIRE demonstration project. The existing project has been in operation for approximately 3 years under EPA Permit No CA5060001, which expires on November 6, 2011. We are requesting to continue the TIRE experimental project for an additional five years.

The City and its contractor GeoEnvironmental Technology (GET) who is responsible for operating the TIRE demonstration project has met the regulatory requirements under the existing permit and has successfully placed more than 100 million gallons of bio-slurry material into deep subsurface. The TIRE Project has shown many environmental benefits. Eighty-three thousand tons of carbon dioxide has being sequestered per year through the geothermal biodegradation and there has been a decrease in air emissions by 84 tons of NOx and 13 tons of carbon monoxide per year through reduced transportation of biosolids. Monitoring has indicated that methane gas is being produced in the subsurface and we anticipate that eventually enough methane will be produced that can ultimately be utilized to produce green energy.

We look forward to continuing our working relationship with the U. S. EPA on the existing TIRE project and through the approval of a new permit to continue demonstrating deep well injection for an additional five years. Attached is the renewal permit application for a

Class V UIC experimental permit, and its supporting material. The application includes EPA Form 7520-6.

If you have any questions or require further discussion please contact Mr. H. R. (Omar) Moghaddam, Regulatory Affairs Division Manager at (310) 648-5423.

Sincerely,

ENRIQUE C. ZALDIVAR, Director
Bureau of Sanitation

Attachment

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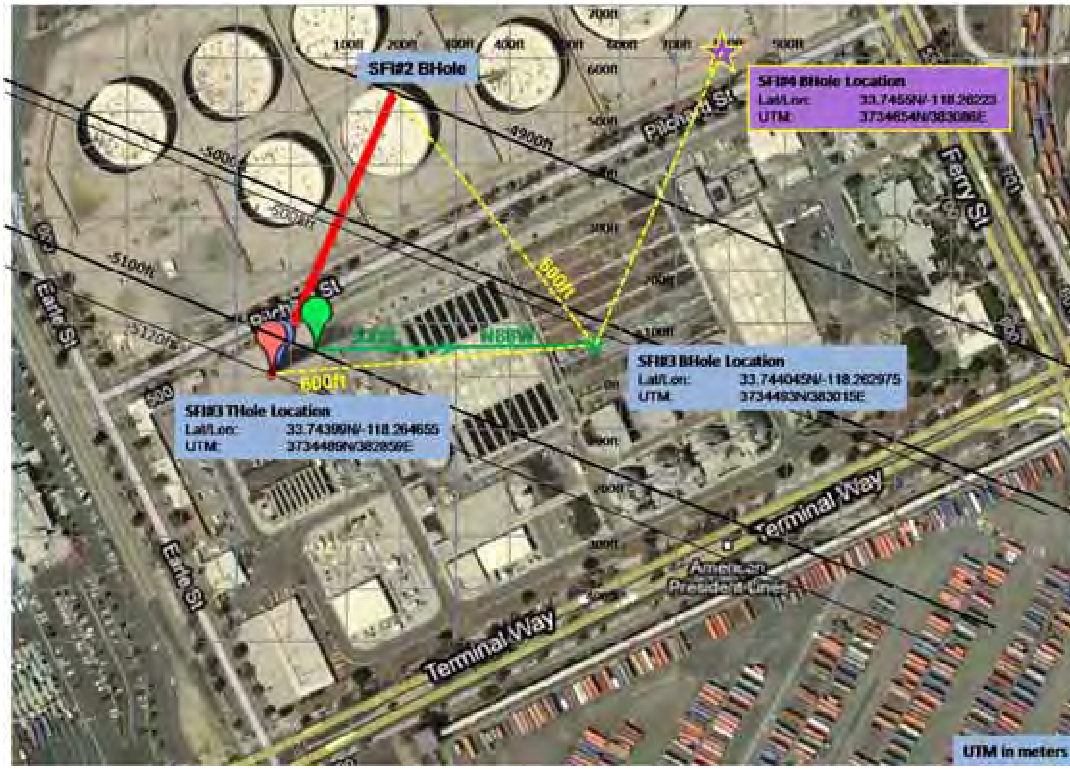
Class V Experimental
Underground Injection Control (UIC)
Permit Renewal Application



Well Names: SFI-1, SFI-2, SFI-3, SFI-4
Terminal Island Water Reclamation Plant, Los Angeles County, California
Terminal Island Renewal Energy (T.I.R.E.) Project

Submitted to the U.S. Environmental Protection Agency, Region 9,
May 16, 2011

By

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And

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TTI

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EXECUTIVE SUMMARY

The City of Los Angeles and GeoEnvironment Technologies have been operating since July 2008, an innovative technology for converting biosolids into clean energy by deep well injection and thermal biodegradation. Slurry mixtures of treated, non-hazardous, municipal sludge, brine, and plant effluent are injected into a high permeability unconsolidated sandstone formation at a depth of 5200 feet beneath the Terminal Island Water Reclamation Plant(TIWRP) operated by City of Los Angeles.

At a depth of 5200 feet the organic mass is undergoing a natural process of high-temperature anaerobic biodegradation, similar to the process of diagenesis naturally deposited organic layers undergo over time after deposition and burial. Retention in the high temperature (about $60^{o}C$) saline environment converts the biosolids into CH_4, CO_2, and non-volatile residual solids. This process holds a number of significant environmental advantages over current biosolids management options, including but not limited to:

- Enhanced treatment and pasteurization of biosolids;
- Greater protection for surface and groundwater;
- Elimination of truck transport and associated emissions and pollution;
- Geologic sequestration of CO_2, significantly reducing greenhouse gas emissions;
- Potential recovery and beneficial use of generated methane as a clean fuel.

The experimental objectives of this Class V demonstration are as follows:

1. Demonstrate successful injection of up to 400 tons per day of biosolids;
2. Apply advanced geophysical monitoring tools and numerical simulation to verify placement of material in the permitted intervals;
3. Sample and quantify CH_4 and CO_2 generation; and,
4. Conduct additional microbiology tests to better understand the subsurface biodegradation process.

Injection operations commenced in July, 2008, and the project is currently injecting approximately 200 tons per day of equivalent wetcake biosolids into a single well (SFI#1), while monitoring and sampling occurs from two other wells (SFI#2 and SFI#3).

The demonstration project is proceeding well. Containment has been demonstrated through advanced pressure analysis, fiber optic temperature monitoring, well logging, and microseismic monitoring. Sampling and measuring have indicated a gradually increasing methane content in the updip monitoring well. Microbiology tests have identified thermophilic methanogenic bacteria in fluid samples also obtained from the updip monitoring well.

Since the injection operations began there have been some challenges. The fibrous nature of the injectate has extended the time required for pressure to relax following shut-in. Furthermore, the current permit requirements for injecting into only a single well has limited the project from injecting a sufficient amount of biomass (the originally proposed 400 tons per day) to generate an appreciable and measurable amount of methane, and to demonstrate the considerable environmental benefits of the technology that can be provided on a practical scale to benefit large urban cities.

The City of Los Angeles requests to continue the existing deep well injection demonstration project under a new Class V permit for an additional five years. The City requests that existing wells SFI#1 and SFI#3 be allowed for alternating or simultaneous injection and for the construction of an additional updip (SFI#4) interchangeable monitoring or injection well. Also, we are requesting the option to construct up to 4 replacement wells to facilitate operational well problems and unforeseen conditions, such as natural disasters. At no time will there be more than 4 active wells. These modifications will provide the following experimental and demonstration benefits to the project.

1. Adding an additional interchangeable monitoring/injection, well to the northeast of the project area will provide more spatial information of pressure and temperature changes throughout the study area;
2. The addition of another well also allows for monitoring and pressure interference testing from 3 wells surrounding any one active injection well, providing additional information on lateral material placement and transmissibility;
3. By allowing two wells for injection, the shut-in time can be extended for each well, subjecting each to less strain and providing for improved pressure relaxation; and,
4. Alternating or simultaneously injecting into two wells will allow the project to achieve its originally proposed target injection volumes, which will increase the methane generation and better demonstrate that this technology is practical for helping to solve the nation's need for more environmentally sound biosolids management techniques.

The project logging and measurement techniques in general have worked very well and provided useful information. Through the demonstration project we have also observed that some logging and measurement techniques have not provided useful information or were not effective for the intended purpose. We therefore also include herein some requested modifications to the measurement plans.

A) Area of Review

The area of review (AOR) per 40 CFR 146.6(b) (2) for this project has included a geologic summary and examination of all wells within 1-mile radius of the SFI wells. There have been no new wells drilled except for the 3 SFI wells associated with this permit. There are no abandoned wells within ½ mile of the injection drill site, eliminating the risk for breakthrough due to poorly cemented offset wells. Table 1 contains a summary of wells within a one-mile radius of the SFI wells. Appendix A shows individual well schematics as well as the three permitted SFI wells.

Table 1: Area of review well summary

	Well Name		Well Status		Cement Status
		TD (ft.)	Abandon year	Status	
1	Superior B-1	6200	1940	abandon	392-1007'
2	Apex Hards-Warnock#1	3448	1957	abandon	1070-1253'
3	SP LA Harbor#301	10,569	1965	abandon	3591-4155'
4	TIRE SFI#1	5550ft		active	Cement turned to surface
5	TIRE SFI#2	5541ft		active	Cement turned to surface
6	TIRE SFI#3	5431ft		active	Cement turned to surface

Table 1 summarizes all the wells within a one-mile radius. SP LA Harbor #301 hit basement at 2706ft (measure depth) or 2294ft subsea depth. It was pulled back and side-tracked, and bottomed in Miocene at 10,568ft (measure depth) or 8910ft subsea depth (SP LA Harbor #301 well file). There is no log available for Apex Hards Warnock #1 well. Superior B-1 well drilled to 6200ft and bottomed in Miocene (Yerkes et al., 1965). We also have drilled 3 SFI wells during 2007 to 2010. All SFI wells are cased and have cement return to surface.

B) Maps of Area of Review

Figure 1 below shows a 1 mile Area of Review.

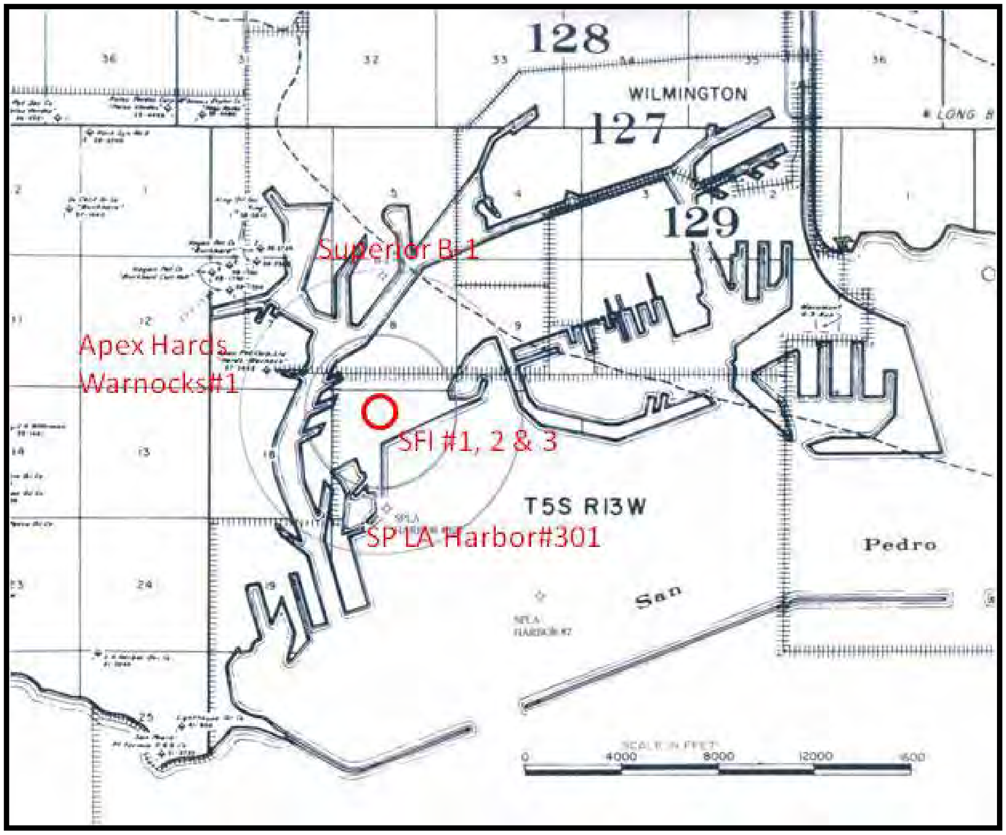

Figure 1: Area of review

Source: DOGGR Map

C) Corrective Action Plan and Well Data

The 3 improperly abandoned wells are all located >1/2 mile away (Figure 1). The numerical gas modeling performed within the past 2 ½ years using SFI wells shows that the pressure did not increase more than a few psi at the monitoring well less than 600ft away. We are currently monitoring the improperly abandoned wells using numerical gas modeling.

The SFI #1, #2 and #3 wells are all cased with cement returning to surface. Cement bond logs were run on all casings verifying the integrity of the cement and were approved by EPA. See Appendix A for well schematics.

D) Description of Underground Sources Drinking Water (USDWs).

(a) Depth to base of fresh water.

The base of fresh water(BFW) is recorded at 2800ft in SP LA Harbor #2 (SP LA Harbor #2 well file), and 2300ft from SFI wells logs (SFI well resistivity curves). According to Henderson (1987), the base of fresh water (3000ppm) is located in the lower part of the Pico Formation (Figure 2). Base of Pico Formation which defines the base of fresh water (10,000ppm) at the TIRE site is located at about 2100ft (from log correlation). The BFW at the TIRE site is therefore located between 2100-2300ft. The top of our requested injection zone is 3800ft, minimum 1500ft above the base of fresh water.

(b) Geologic description of water units.

The principle groundwater aquifers occur within the San Pedro and the Pico Formations. The Newport-Inglewood fault provides a barrier to the groundwater flow within the deeper aquifers (Clarke, 1987). From top, the first hydrologic units are the Gaspur aquifer, the 200 Foot Sand, the 400 Foot Gravel, the Silverado and the Pico hydrologic unit (Henderson, 1987). Pico and Silverado hydrologic units serve as fresh water sources for some areas and have been monitored constantly for salt-water intrusion and contamination.

The Newport-Inglewood fault provides an impermeable barrier to the deep aquifers that resulted in over pressured artesian aquifers (Clarke, 1987). The shallow aquifers, however, show hydrologic continuity as evidenced by extensive salt-water intrusion onshore (Clarke. 1987). The Dominguez Gap and Alamitos Barrier projects have been established to prevent saltwater encroachment into the pressure depleted aquifers (Henderson, 1987). To prevent contamination of the hydrologic units, surface casing is required to be set at the lower-middle break in the San Pedro Formation. All SFI wells are cased with cement returned to surface.

E) Name and Depth of USDWs

Figure 2 below describes the hydrologic units within the Wilmington Basin.

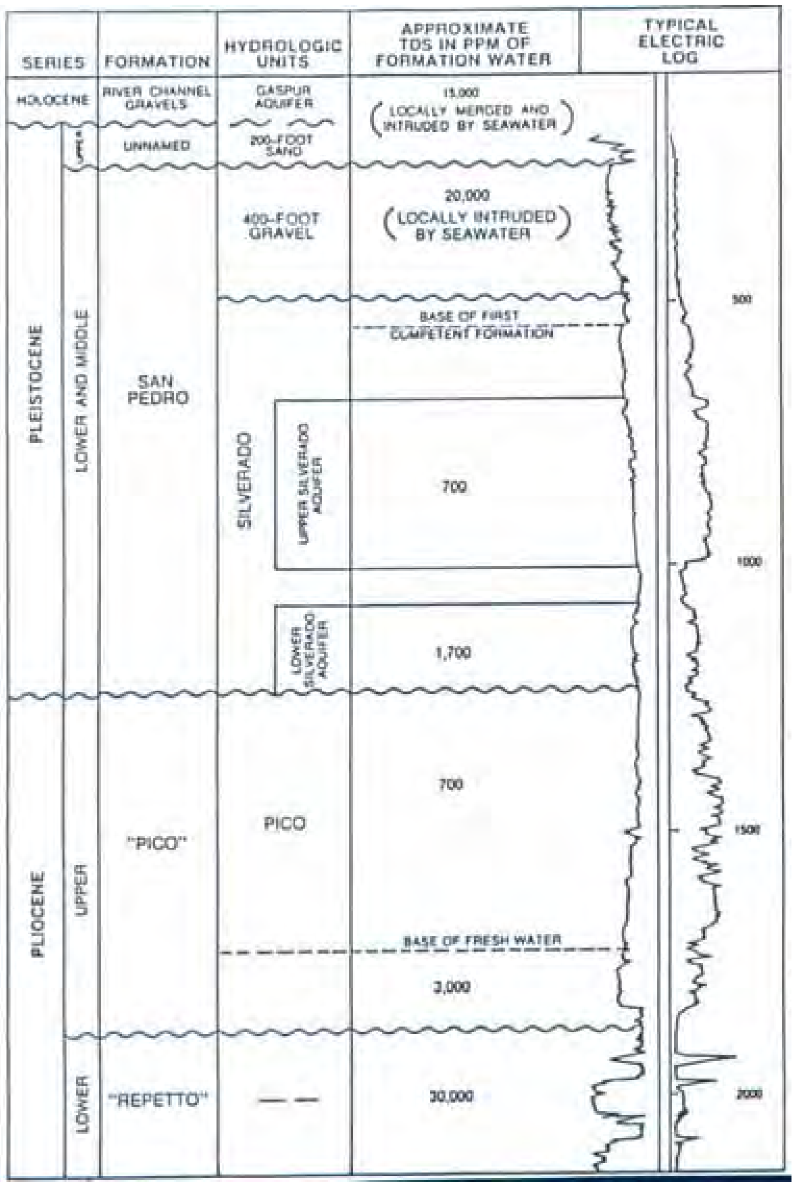

Figure 2: Hydrologic units within the Wilmington field

Source: Henderson, 1987

F) Maps and Cross Sections of Geologic Structure of Area

(a) Local Geology

The City of Los Angeles Terminal Island Water Reclamation Plant is located between the Thums-Huntington Beach and the Palos Verdes faults at the northern end of the Wilmington Graben. The Wilmington oil field, the largest Los Angeles Basin oil field, is located just northeastward of the Thums-Huntington Beach fault. Little is known about the Thums-Huntington Beach fault, the SFI wells have provided some new insight into this fault. The Thums-Huntington Beach fault is poorly defined from existing 2D and 3D seismic lines. Clarke (2008) and Legg (2011) feel this fault extends further west from the Long Beach Harbor and merged with the Palos Verdes fault (Figure 3). The Palos Verdes fault is fairly well defined. It terminates at the Santa Monica fault in the north and runs southeastward about 50 miles to Lasuen Knoll, offshore San Pedro shelf (Fischer et al., 1987). Palos Verdes fault is nearly vertical with a slip rate of about 1/8" (0.3 to 0.4mm) per year (McNeilan et al., 1996). There is no single through going fault, the fault bends or steps left leaving about 300-1000ft wide fault zone (Clarke, 2008). Several surface breaks associated with the Palos Verdes fault have been recorded.

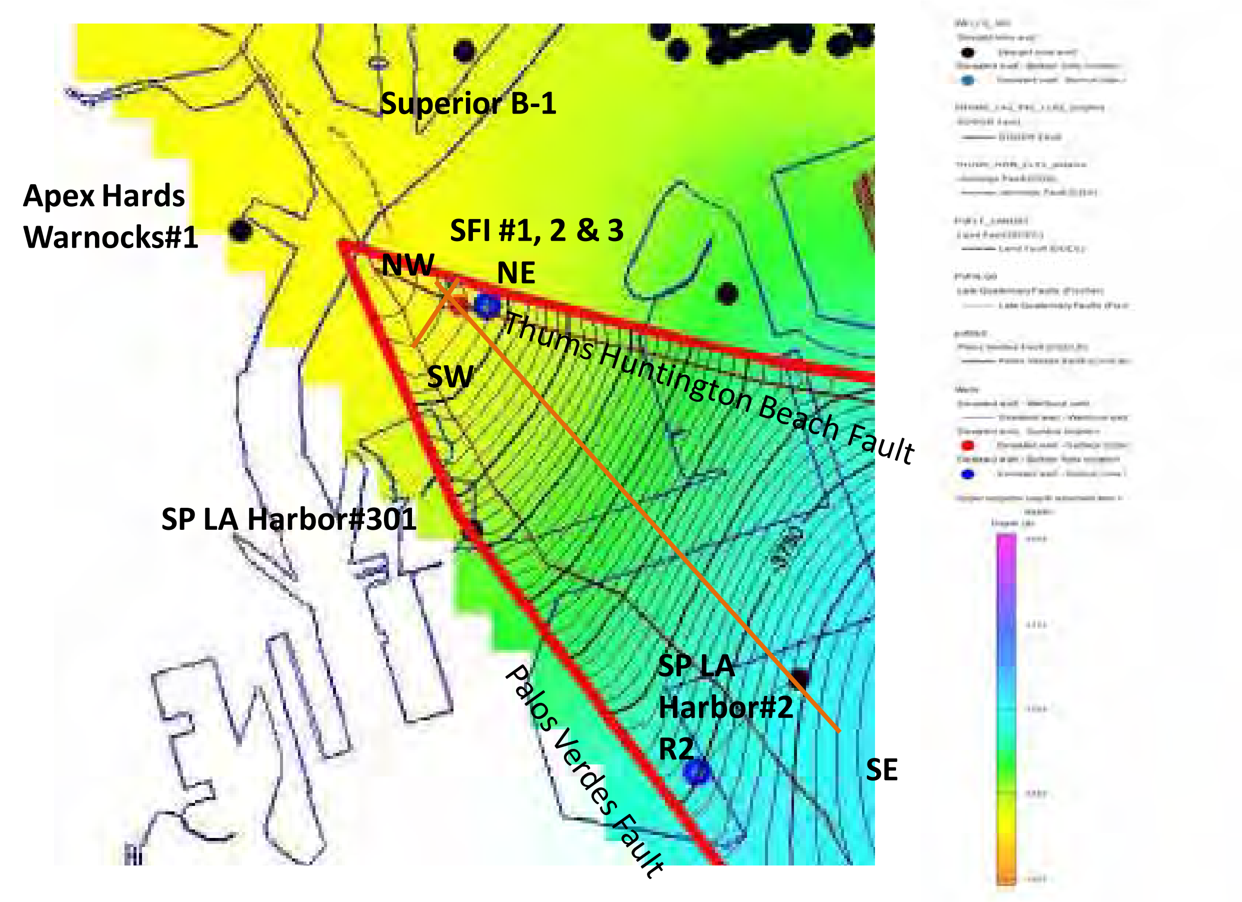

Figure 3: Upper Repetto Unconformity Structure Map with location of cross sections
Source: Legg, 2011

According to Clarke (2010), the geology at the TIRE site can be separated into 3 major domains; the first is separated from the lower two by the THUMS-Huntington Beach Fault and the lower two are divided by a hinge line that defines a chevron fold. See Figure 4. All 3 SFI wells (SFI#1, SFI#2 and SFI#3) cut the Thums Huntington Beach Fault. The enclosed block (dip domains two and three) was formed by compression. The Palos Verdes Peninsula block has pushed against and thrust up the enclosed block along the Palos Verdes Fault. There is no observed sign of lateral movement, but it is suggested that the two faults converge to the west. The Palos Verdes Fault was not penetrated by the three wells, however, there are faults observed in the logged sections of SFI-1, SFI-2 and SFI-3 wells. All SFI wells only penetrated into the Pliocene sediments. The older Miocene foraminifera found in SFI#2 were reworked.

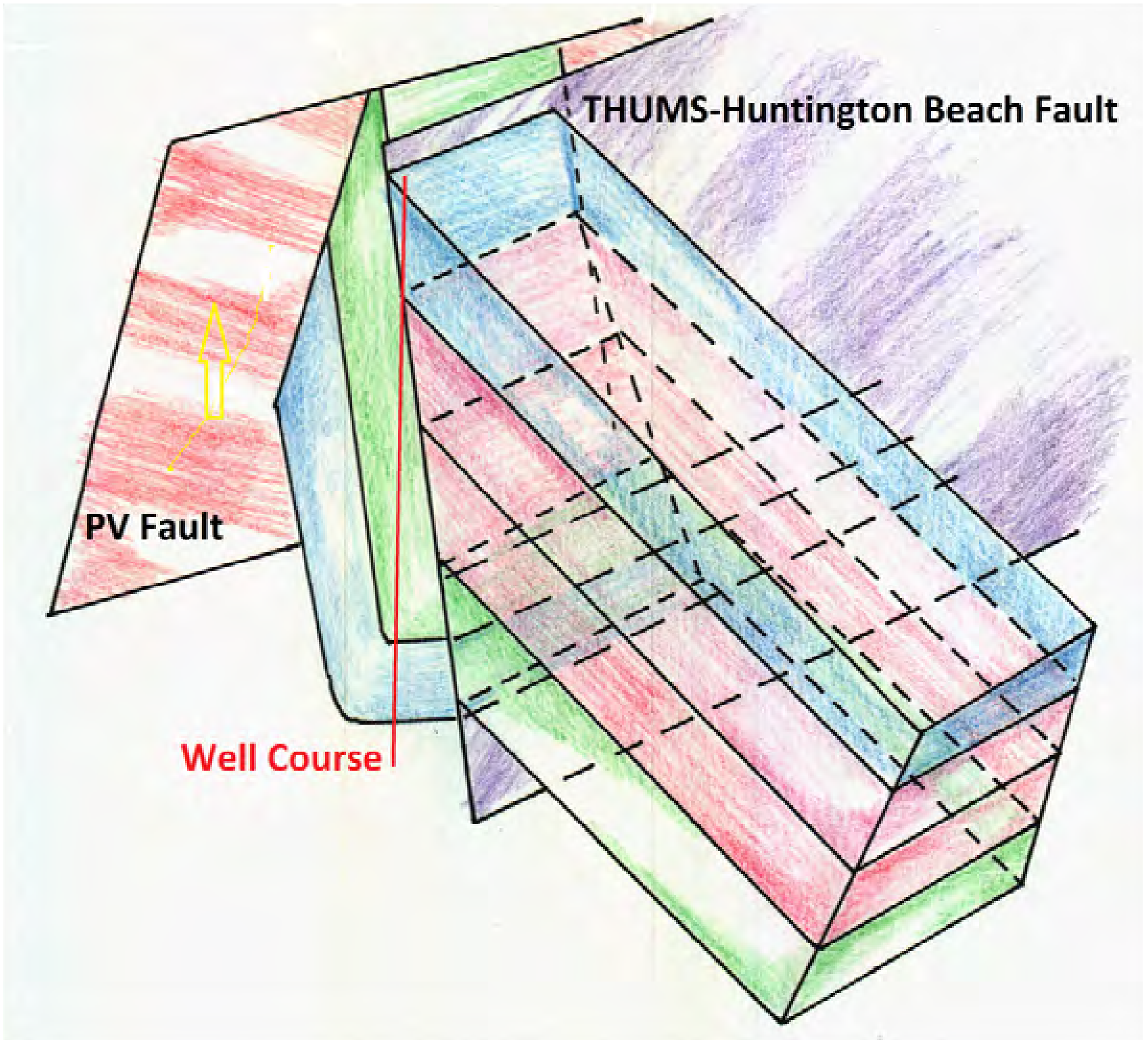

Figure 4: Three dimensional cartoon showing chevron folds at the well location. The yellow arrows indicate direction of movement along the Palos Verdes Fault

Source: Clarke, 2010

Below are 2 computer simulated cross sections through the TIRE site. The Northeast-Southwest section is drawn along the SFI#2 well path (Figure 5), and the NW-SE section is projected 2 miles to the LA SP Harbor #2 well (Figure 6). More data will be needed to verify the accuracy on the lithology and structure in Figure 6.

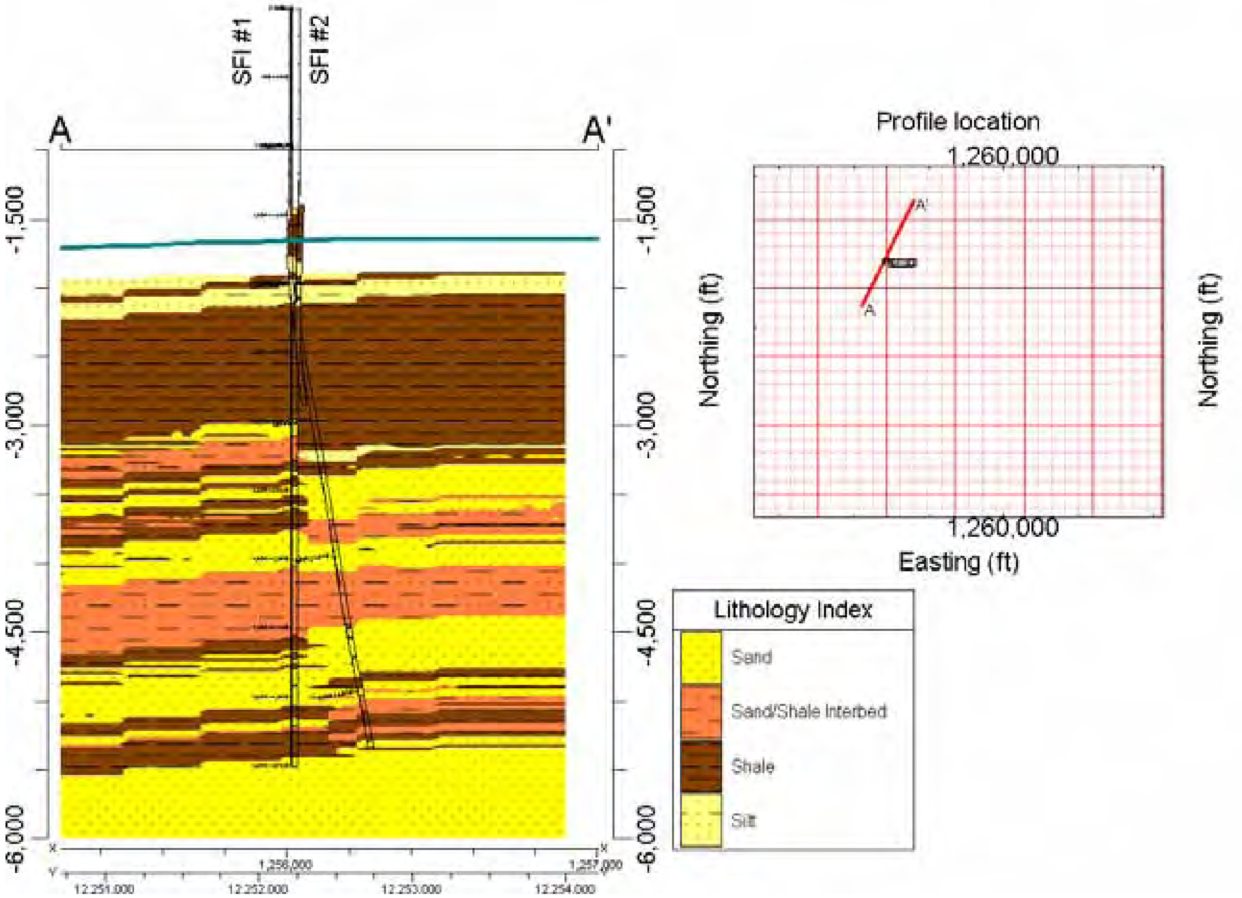

Figure 5: Northeast-Southwest Cross Section along SFI#2 Well Path
For location of cross sections, see Figure 3

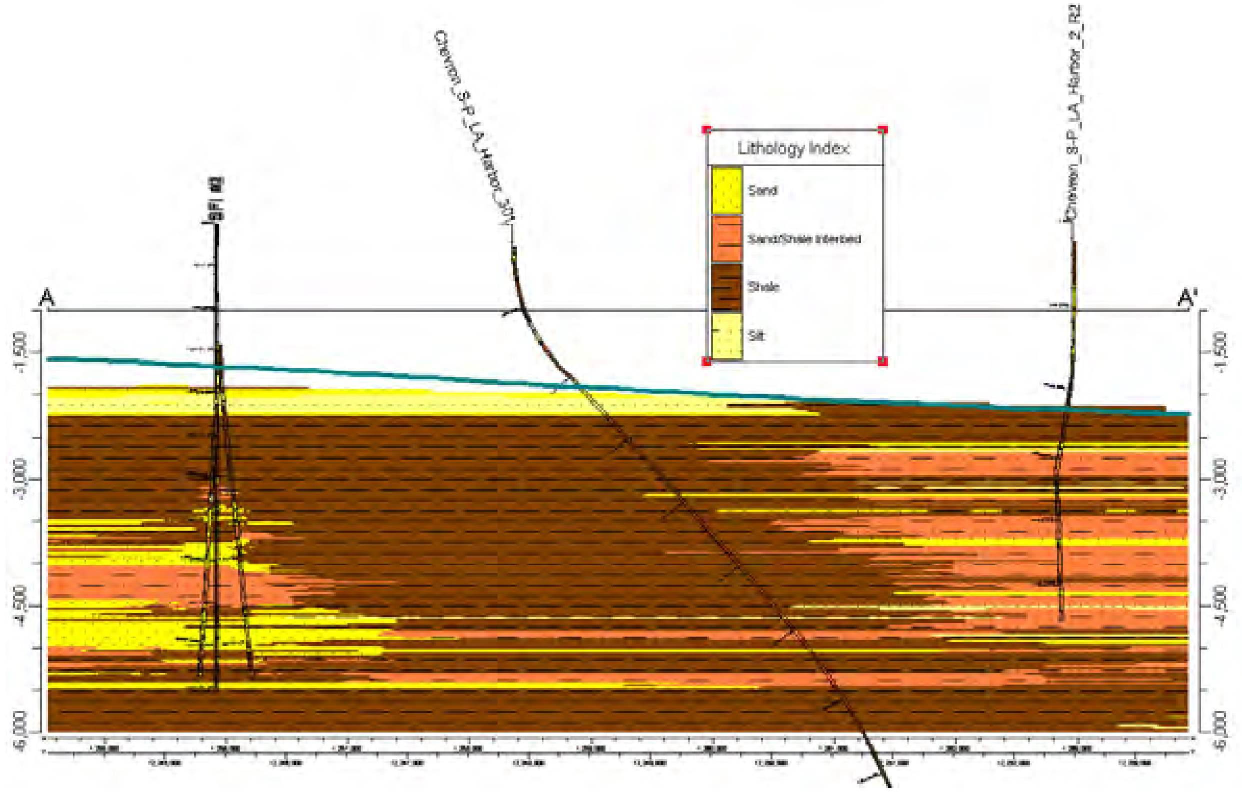

Figure 6: NW-SE Cross Section

For location of cross sections, see Figure 3

G) Lithology and Stratigraphy for SFI4

The lithology for the TIRE site is compiled from the nearby Wilmington oil field and refined by the drilling of the 3 SFI wells.

(a) Geologic description of rocks penetrated

Basement

Basement rocks are locally named the Catalina Schist. It consists of fine-grained, gray-green schist of Jurassic to Cretaceous age (Norton and Otott Jr., 1996). It crops out at 600ft above sea level at the Palos Verdes Peninsula (Norton and Otott Jr., 1996), and dropped to over 16,000ft in the Huntington Beach offshore area (Clarke, 1987). SP LA Habor#301 original hole penetrated basement at 2720ft subsea (SP LA Habor#301 Well File).

Puente Formation

Overlying basement is the turbidite package of Miocene Puente Formation. The Puente Formation ranges from 3500ft-5000ft thick (Clarke, 1987) is an alternating layers of fine to coarse grained, poorly sorted sandstones, siltstones and dark brown-gray shales and clays (Henderson, 1987). This formation can be divided into the middle Miocene 237 Zone, the upper Miocene Ford, Union Pacific, Terminal and lower Ranger Zones. The sand units vary in thickness from a few inches to 60ft with sand/shale ratios averaging 35% within the lower Puente Formation to 60% within the upper Puente Formation (Henderson, 1987). The 3 SFI wells drilled to date have not penetrated the Miocene Puente Formation.

Repetto Formation

The regional diatomaceous shales occur near the Puente and Repetto unconformity contact (Upper Repetto unconformity marker). This contact varies vertically up to 160ft in the Wilmington oil field and the surrounding areas (Henderson, 1987). The Pliocene Repetto Formation consists of poorly to unconsolidated, fine to coarse-grained sands ranges from 1000ft thick at the Wilmington oil field to over 3500ft at the Terminal Island site. Pebbles up to several centimeters in diameter were found in cores (Norton and Otott Jr., 1966). In the offshore Long Beach Unit, 100-200ft thick sand separated by 20-30ft shales was reported on a field wide scale (Norton and Otott Jr., 1966). These sands are lobate and laterally offset, typical of a turbidite sequence.

At TIWRP location, the Repetto top was mapped at about 2000ft from the seismic and well log interpretation. The Repetto comprises of sands and shales and is at least 3500ft thick at the Terminal Island site. The micropaleontology performed on SFI#2 ditch cuttings found the well bottomed in Pliocene. Well log correlation is good at the bottom section for all three SFI wells, thus all three wells bottomed in the Pliocene Repetto Formation. The porosity and permeability taken from core samples ranges from 22 to 34% and 12 to 932 mD for the sands and 27 to 29% and <1 to 4mD for the shales (SFI well files).

Pico Formation

The area re-submerged and the Pico Formation lies unconformably over the Repetto Formation. Pico Formation is a series of semi-consolidated sand, clays, silts and occasional gravels (Henderson, 1987). Base of fresh water was found in SP LA Harbor #2 well at 2800ft (SP LA Harbor #2, Well File) within the Pico Formation. The base of fresh water from existing SFI wells is interpreted to be between 2100-2300ft. Pico Formation is late Pliocene age.

San Pedro Formation

The Pleistocene San Pedro Formation and Holocene sediments are unconsolidated sands, gravels, clays and marls that cover the Pico formation. Up to 1800ft of San Pedro sediments cover the producing intervals of the Wilmington Oil Field (Norton and Otott Jr., 1966).

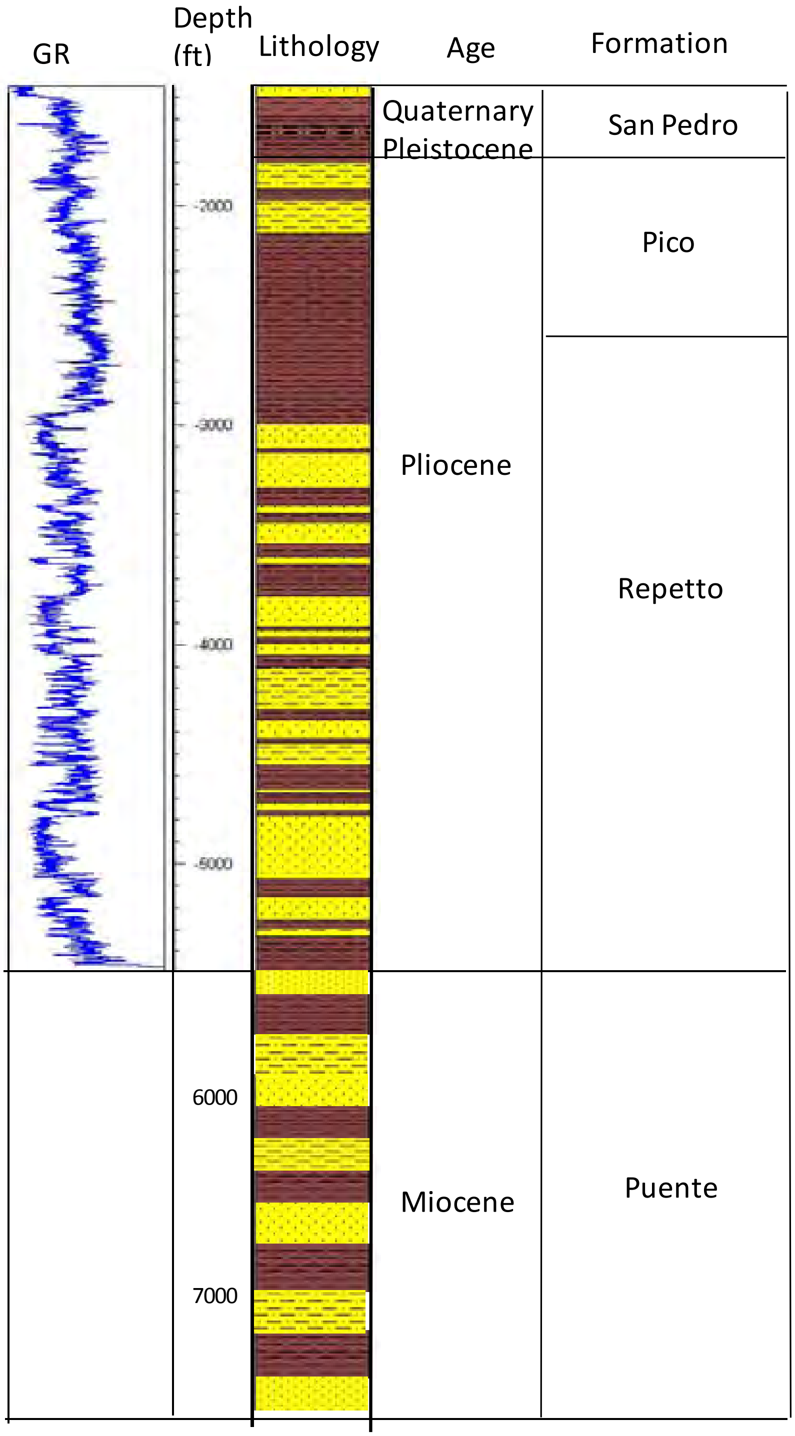

Figure 7: Stratigraphic Column for SFI#1 well

Source: SFI#1 well log and Wilmington Oil Field Composite Log

(b) Description of injection unit.

The City of Los Angeles requests to inject into the Repetto and the Puente sands between 3800-

7500ft (1100-2280m) as the injection zone for SFI#4 well.

The Repetto comprises of sands and shales and is at least 3500ft thick at the Terminal Island site. The porosity and permeability taken from core samples ranges from 22 to 34% and 12 to 932 mD for the sands and 27 to 29% and <1 to 4mD for the shales. The compression test performed on the SFI#2 convention core found the weakly consolidated sandstones has an average in situ yield strength of 4633psi, Young's Modulus ranges from 312,000-446,000psi and the Poisson's ratio at 0.10-0.22.

The Puente comprises of alternating layers of fine to coarse grained, poorly sorted sandstones, siltstones and dark brown-gray shales and clays. Porosity ranges from 20 to 40%, while permeability ranges from 10 to 700md have been recorded from the Wilmington Oil Field.

(c) Description of confinement unit

Approximately 800-1000ft thick shales section found between 2100-3200ft in SFI#1, SFI#2 and SFI#3 wells indicate there is a good confining unit to seal the injectate below. See cross section in Figure 5, this shale section, based on the present information seems to have a fair lateral extend.

(d) Description of containment unit

Between 3200-3800ft are sand shale interbeds which are ideal as containment unit. The 600 ft thick alternating sand and shale sections are additional protection that can absorb and prevent fluid migration from passing above this zone.

H) Operations Data

(a) Injection Plan

During normal operations, the Biosolids slurry mixture is transferred to high pressure pumps and injected through a properly designed well into a deep, high porosity and high permeability sand formation. Material will be injected into the Repetto and Puente Formation. Slurry material passes through steel tubing, positioned inside an outer steel casing surrounded by a cement sheath, to an exit point at a depth beginning from 7500ft (2280m). 3800-7500ft (1100-2280m) is the targeted Biosolids injection interval. The BFW is found at 2300ft at the injection location, therefore the highest permitted injection depth of 3800ft, is 1500ft above the base of fresh water.

Pumping operations are episodic, generally from 8 to 14 hours per day per well, five days per week. Pumping is shut-in nightly and for extended periods over weekends to allow formation pressures to decline to natural conditions (2085 psi; SRT performed prior to injection during June 2008).

When pumping is stopped, the high porosity formation closes in on the solids and allows the fluid pressure to bleed off and return to natural conditions. The injection pressure of the slurry is sufficient to overcome parting pressures in the formation and the unconsolidated sand formation will dilate to allow the slurry to enter into fractures and pore space. The natural pressure in the porous strata is much less than the water pressure in the slurry, providing a strong natural gradient that draws the water away, leaving the solids component behind. Fluid is prevented from migrating upwards by multiple impermeable shale layers overlying the permeable injection formation similar to the various existing oil/water contacts within the Wilmington oil field (Norton and Otott Jr., 1996). Injection rates and downhole pressure response is continuously monitored and displayed in real-time in the computer control and data acquisition room.

The City requests to continue the Class V permit for five years, allowing for alternating or simultaneously injection into wells SFI#1 and SFI#3 and add an additional up-dip interchangeable monitoring and sampling well (SFI#4). These modifications will provide experimental and demonstration benefits to the project. By adding an additional monitoring and sampling well to the northeast of the project area will provide more spatial information of pressure and temperature changes throughout the study area; the additional well also allows for monitoring and pressure interference testing from 3 wells surrounding any one active injection well, providing additional information on lateral material placement and transmissibility. Also by alternating injection between two wells, we can extend the shut-in time for each well, subjecting each to less strain and providing for improved pressure relaxation; and, alternating or simultaneously injecting into two wells will allow the project to achieve its originally proposed target injection volumes of 400 tons of Biosolids per day, which will increase the methane generation and better demonstrate that this technology is practical for helping to solve the nation's need for a new environmentally sound biosolids management techniques.

We further request the flexibility to drill up to 4 more replacement wells in case the injectivity or general functionality of the well is lost. The old well will be properly plugged and abandoned. (See plugging and abandonment section in appendix D At no time will there be more than 4 active wells at the TIRE project.

(b) Injection waste source

Most Biosolids will come from TIWRP and Hyperion sites. However, some Biosolids may also come from Los Angeles and/or Orange County treatment plants. Biosolids material will be loaded at the source waste processing plants into sludge trucks operated by trucking companies or agencies' own trucks that have experience in Biosolids handling. The trucks will be sealed against leakage, and will be operated by experienced drivers.

Biosolids material is anticipated (but may not be limited to) come from four sources:

1) Hyperion Treatment Plant located at 12000 Vista del Mar, Playa del Rey, CA 90293;

2) Terminal Island Water Reclamation Plant located at 455 Ferry Street, San Pedro, CA 90731;

3) Los Angeles County Treatment Plant located off Figueroa Blvd. in the City of Carson, and

4) Orange County Treatment Plant located in the 10,000 block of Ellis Avenue in the City of Fountain Valley.

Biosolids, Digested Sludge, TWAS (Thickening Waste Activated Sludge) and/or other waste fluids from TIWRP will be moved and/or pumped directly from the treatment plant into the sump. No truck hauling is necessary if Biosolids is from TIWRP own site.

Up to 400 wet tons per day of Biosolids will be processed at TIWRP located at 445 Ferry Street, San Pedro, California. The well site is located on the northwest lot of TIWRP, out of sight from any residential property.

(c) Injection Parameters

Injection operations are planned for five days per week, with extended shut-in periods on each weekend. Typical injection parameters are summarized in table below. We will record and report injection volumes, rates, concentration, density, and pressures. These data can be viewed online at http://www.geoenvironment-technologies.com. Project summary reports are prepared and distributed on a weekly basis, in addition to the quarterly EPA report.

Table 2: Injection well proposed injection parameters and operating data (per well)

Average daily rate of injection	10 barrels per minute (bpm)
Average daily volume of injectate	7,000 barrels (bbls)
Maximum daily rate of injection	15 bpm
Maximum daily volume of injectate	9,000 bbls
Average daily biosolids injection	200 – 400 wet tons
Slurry density	1.0 – 1.5 specific gravity
Viscosity	TBD
Average injection pressure	4,000 psi
Maximum injection pressure	6,000 psi
Solids concentrations	Average 5-15% by weight
Nature of annulus fluid	Water

I) Formation Testing Program

Table 3: Injection Fluid Characteristics

Injection fluid characteristics (source/analysis);	
Chemical	See Table 4
Physical	Slurry
Radiological	NA
Biological	Bacteria identified in digested sludge as baseline (See Appendix B)
Density	1 g/cm^3
Corrosiveness	TBD

(a) Chemical characteristics of formation fluid.

Three in situ pressurized samples from SFI#1, SFI#2 and SFI#3 wells have been analyzed for geochemical composition. SFI#1 well was perforated at the injection zone (30ft), and fluid sample was taken prior to any injection and is used as the baseline. A total of 60ft in the same injection zone(5200ft sand) plus the sand above(4900ft sand) was perforated in SFI#2 well. A 20ft interval of the injection zone was perforated for the SFI#3 well. Table 4 shows the chemical composition of the in situ pressurized fluid samples taken from the 3 wells.

Table 4: Chemical Composition of the Fluid Samples

Component	SFI#1	SFI#2	SFI#3	
	BASELINE		Sample 1	Sample 2
Density	1.0206 g/cc	1.021 g/cc	1.025 g/cc	1.025g/cc
Gas Water Ratio @60ºF/1 atm	7 scf/bbl	5.8 scf/bbl	6 scf/bbl	4 scf/bbl
Salinity	29177 ppm	32189 ppm	22000 ppm	20000 ppm
Helium	0.32 Mol%			
Hydrogen	1.6 Mol%			
Carbon Dioxide	0.23 Mol%	0.83 Mol%	0.32 Mol%	0.19 Mol%
Hydrogen Sulfide	<0.01 Mol%	0	0	0
Argon/Oxygen	2.5 Mol%			
Nitrogen	18.53 Mol%	0.13 Mol%	3.31 Mol%	4.98 Mol%
Carbon Monoxide	0.45 Mol%			
Methane	76.03 Mol%	98.89 Mo%	96.11 Mol%	94.57 Mol%
Ethane	0.1 Mol%	0.08 Mol%	0.13 Mol%	0.13 Mol%

J) Stimulation Program

The Biosolids contain fibrous materials that has clumped and clogged the perforation at the wellbore. Periodically we may need to perform a chemical stimulation program to dissolve the fibrous materials. The procedure is included in Appendix C. The cleanout process will be carried out semi-annually or when weekly falloff bottom-hole pressures (BHP) are less than 15% of the previous week's bottom BHP. A sufficient amount of a mixture of caustic sodium hydroxide, sodium hypochlorite and/or other material that will aid in dissolving the clogged solids will be injected at the end of the week after a modified high pressure effluent (HPE) step down. The caustic solution will be allowed to rest in the well casing and near wellbore formation area to help dissolve the fibrous material deposited by the injection process. This treatment will help open up the casing perforations as well as the near wellbore formation pore spaces, allowing the injected slurry to further propagate into the pore spaces. The City would request prior approval from EPA before proceeding with any cleanout operation.

K) Injection Procedure

Upon arrival at TIWRP the Biosolids will be off-loaded into the sump (wetcake and sludge blending pit), mixed and blended with Digested Sludge and high pressure effluent (HPE) from the plant to achieve the desired slurry characteristics (density, solids concentration, viscosity). The slurried material is pumped into the Mix Tank and further slurried before injecting into the well. The whole process are continuously monitored with electronic gauges and displayed in real time in the computer control and data acquisition room. Operational data is available for viewing at http://www.geoenvironment-technologies.com/. Project summary reports are prepared and distributed on a weekly basis. In depth injection and operational analyses are presented in the EPA quarterly reports.

1) Wetcake & Sludge blending pit
2) Screen System
3) Mixing Tank
4) Electric Pumps
5) Injection Well
6) Monitoring Well
7) Office

Figure 8: Panoramic View of the TIRE Project

(a) Description of Surface Equipment

The surface equipment is shown in the Terminal Island injection site panoramic view (Figure 8). Field equipment comprises of the following:

1. Wetcake and sludge blending pit, where the Biosolids trucked from Hyperion, Los Angeles or Orange County Sanitation plants will be blended with the Digested Sludge from Terminal Island Water Reclamation Plant;
2. Screen system, where the Digested Sludge is screened before mixing with the trucked Biosolids;
3. Mix tank, where the slurried material is further blended and readied for injection;
4. Electric pumps and associated Motor Control Center (MCC) that house the variable frequency drive;
5. Injection wells;
6. Monitoring wells;
7. Office, which is the control and monitoring room where data acquisition and remote system control reside.

L) Construction Procedure for SFI#4 and replacement wells

We request the flexibility of modifying the casing program depending on the stocks available during the drilling period. The proposed interchangeable injection and monitoring well general designed is as follows: (see also Figure 9 and Figure 10 for 2 possible configurations) If we find it necessary, this same construction procedure will be used for the replacement wells.

- Conductor pipe: 20” casing in 26” hole, 65#/ft H Conductor piping, cement to surface;
- Surface casing: 13 3/8” casing in 17 ½” hole, 61#/ft K-55 casing; or 10 ¾” casing in 14 ¾” hole, 40.5#/ft J-55 casing, cement to surface;
- Injection casing: 8 5/8” (or 9 5/8”) casing in 12 ¼” (or 13”) hole, 44#/ft (or 47#) L80 casing; or 7” casing in 9 7/8” hole, 29#/ft L80 casing, cement to surface;
- Injection tubing: 3 ½” 9.2#/ft L80 tubing; or 2 3/8” 4.7# J55 tubing;
- Packer: retrievable tension injection packer;
- Injection perforations: to be determined, bottom of injection interval 7500ft;
- Up to a total vertical depth of 7500ft.

M) Construction Details

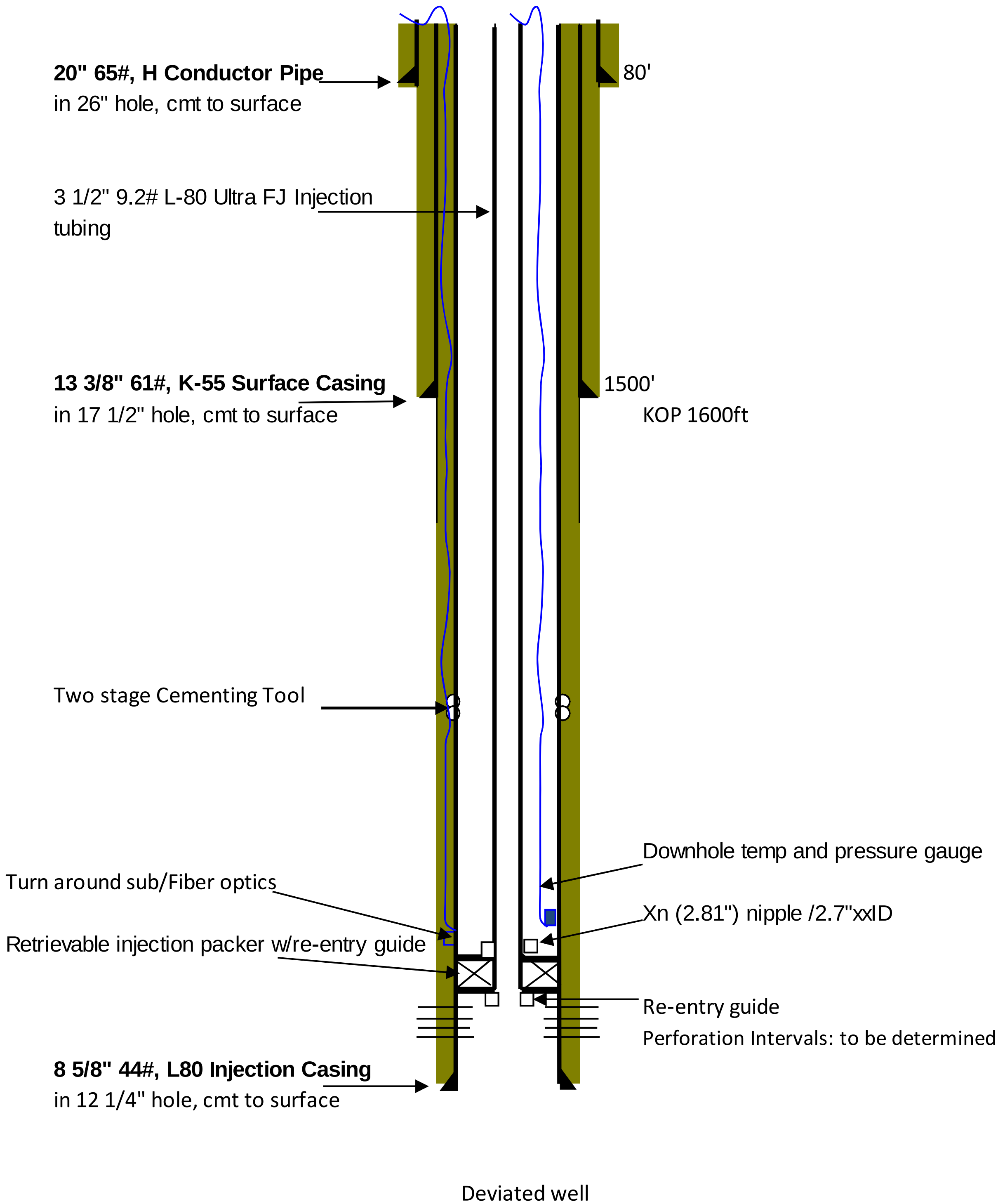

Figure 9: Interchangeable injection and monitoring well schematic 8 5/8” casing

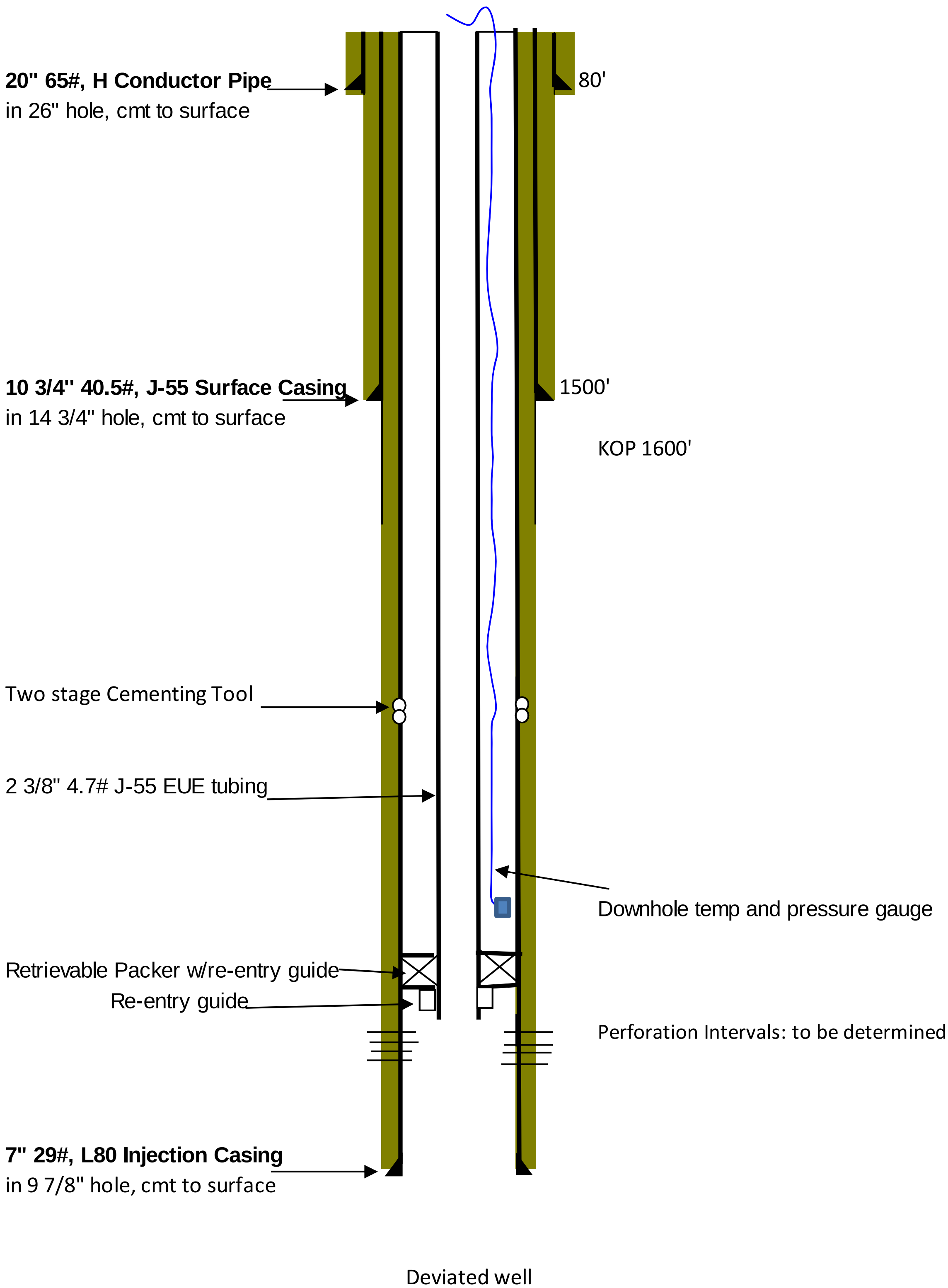

Figure 10: Interchangeable injection and monitoring well schematic 7" casing

N) Changes in Injection Fluid

None expected.

O) Plans for Well Failures

The casing pressure, wellhead pressure, bottom-hole pressure, slurry densities, injection rates, and injection volumes are continuously monitored. Field personnel are trained and experienced with high-pressure injection procedures and operations. Should an Emergency Shutdown (ESD) condition arise, TIRE staff has been trained to maintain control of the plant operation and perform procedures to safely shutdown injection operations and shut-in the well to minimize potential bodily harm and any damage the emergency may cause.

The following circumstances will identify an ESD condition for injection operations in the unlikely event of a well failure created by a natural disaster or operations failure, and will compel an immediate ESD response when:

- BHP and/or WHP show a sustained pressure surge or loss over a 15-minute interval - a surge or drop is defined as a 20% change in pressure;
- A rapid change in casing pressure of 10 to 25% over a 30 minute monitoring period;
- The presence of water or injectate at the surface – observed by on site personnel;
- Breakdown of any of the injection equipment affecting pumping, or breakdown of the injection monitoring system.

The immediate ESD response in the event of a well failure due to natural disaster will be as follows:

- Shut off the injection pumps, close the wellhead valve, and shut down SFI operations securing all incoming sources of digested sludge, water and electrical power.

The immediate response due to an operational failure will be as follows:

- Switch the injection stream immediately to water (if type of failure allows TIRE personnel to do so). Begin an abbreviated step down of the well by injecting HPE (water) at a rate of 6 bpm for 10 minutes, stepping down to 4 bpm for 10 minutes, and again stepping down to 2 bpm for the final 10 minutes (30 minute total HPE (water) injection). If water step down is not possible, immediate shut-in of injection well will proceed.
- Immediately, (concurrently) notify the TIRE Project Manager and the TIRE Operations Manager. State the nature and location of the failure. The Project Manager or Operations Manager will contact the appropriate well support personnel (if needed).
- Shut down the injection pumps, close the wellhead valve (double block) dependent upon the type of failure experienced. There are two wellhead valves located on the wellhead tree. Generally, shut down all SFI operations in total (per shut down SOP). We will de-energize both VFD’s (open breakers).

- Secure all incoming sources of city product streams; this includes digested sludge and water (HPE header). Double block where applicable. Isolate, (shut down) all auxiliary equipment on site (this includes all mix tank and sump agitators and any other pump remaining in operation).
- Inspect all wellhead tree components at each well on site. The site inspection should include the casing annulus outlet valves, all casing head housing assemblies (including studs and bolts), casing head spool and all high pressure piping from well to injection pumps. Complete a general inspection of the entire site's piping system. Inspect the mix tank's integrity and ensure no other major equipment failure or breach exists throughout the site.

P) Monitoring Program

(a) Prior to Commencing Injection

i. Well Logging and Coring Program

A carefully chosen suite of wireline services will allow us to estimate values for hydrocarbon saturation, porosity, lithology, dip direction of the different formations, and rock mechanical properties. We propose to run the following logs in each borehole:

Spontaneous Potential

The Spontaneous Potential (SP) log records the electrical potential voltage produced by the interaction of formation connate water, conductive drilling fluid, and certain ion-selective rocks such as shales. The SP curve opposite shales usually is a more or less straight line on the log, called the shale baseline. Opposite permeable formations, the curve shows deflection from the shale baseline. Thus, the SP curve can easily display shale sand profiles. The SP curve is useful for formation correlation and lithologic identification. This log can only be used in uncased hole.

Gamma Ray

The Gamma Ray (GR) log indicates the natural radioactivity of the formations. Nearly all rocks exhibit some natural radioactivity and the amount depends on the concentration of potassium, thorium and uranium. In sedimentary formations, the GR log normally reflects the shale content of the formations because radioactive elements tend to concentrate in clays and shales. Clean sand formations usually have very low level of radioactivity. The GR log can differentiate potentially porous and permeable rocks such as sandstones, limestones and dolomites from non-permeable clays and shales. The GR is a useful tool for lithologic identification, formation correlation and shaliness of the formation.

Resistivity Log

The Resistivity log is a key parameter in determining the hydrocarbon saturation. Electricity can pass through a formation only because of the conductive water it contains. Subsurface formations have finite, measurable resistivities because of the water in their pores or absorbed in their interstitial clay. The resistivity of the formation water is an important interpretation parameter for the calculation of saturations of water and/or hydrocarbon from basic resistivity logs. This log can only be used in uncased hole.

Sonic Log

Sonic logs will be used to estimate the mechanical properties of the formation. Integrated sonic transit times are also helpful in interpreting seismic records. The sonic log is a recording versus depth of the time required for a sound wave to traverse one foot of the formation. The interval transit time is the reciprocal of the velocity of the sound wave. When combined with neutron log, the presence of free gas in a formation will cause the neutron porosity readings to diverge from the sonic porosity readings.

Density Log

Density logs are primarily used as porosity logs, detection of gas, determination of hydrocarbon density, calculation of overburden pressure and rock mechanical properties. This log can only be used in uncased hole.

Neutron Log

The neutron log is used for the delineation of porous formation and determination of their porosity. Neutron log responds to the amount of hydrogen in the formation. Thus, in clean formations whose pores are filled with water or oil, the neutron log reflects the amount of liquid filled porosity. Neutron log is good tool for gas zone identification when combined with other porosity log and core analysis. This technique is very effective when free gas is present, but is not as successful when gas is only present as bubbles in the fluid.

Dipmeter

Dipmeter can provide data on the pattern of internal structures and dip direction. This data will be useful for locating the position of the monitoring well for maximum gas migration. This tool can only be run in uncased hole.

Thermal Decay Log

Thermal decay log can be used to determine lithology, porosity and to indicate gas. However, it can only detect gas when it has over 30% saturation as demonstrated during June, 2009, Dec., 2009 and Dec. 2010 logging of the SFI wells. The Thermal Decay Log ran on the 3 wells showed zero gas saturation when the in situ pressurized geochemical analysis recorded 76-99 Mol% CH_4 and 0.2-0.8 Mol% CO_2 (4). We suggest using the in situ pressurized sample to determine the geochemistry of the formation fluid. The lithology can be better determined using the Spontaneous Potential and Gamma Ray curve. The City requests that this test be removed. based on uselessness of the results obtained from the Thermal Decal Log.

Mud Log

The Mud Log sampling will be run on all the wells. Mud logging comprises the physical examination of drilled cuttings obtained from the shale shaker for geological data and lithologic information. This information will be useful to verify the data obtained from the electrical wireline logs.

Core Analysis

A 30 ft section of core or 30 sidewall cores per well will be ordered from all new wells. The actual depth will be determined by correlating the injection well mudlog and the electric logs with existing wireline logs within the area to anticipate the top of the formations in the Terminal Island Water Reclamation Plant (TIWRP) site. The core will be photographed and cut if it is a conventional core. A detailed description of the slab or sidewall cores will include information on grain size and sedimentary structure, the basic rock type, oil staining and fluorescence, facies and special remarks if available. Smaller samples will be taken from the core and analyze for porosity, permeability, rock mechanics and biological analysis (if deemed appropriate).

Porosity, Permeability and Rock Properties and Mechanics Analysis

Routine core analysis will be performed to determine the porosity, permeability and initial saturation of water and oil in the core. Permeability information can be used to predict rock uniformity and assess flow properties for the target formation. These tests will be completed by a qualified laboratory.

If appropriate and a conventional core is taken, we will also conduct special core analyses to evaluate the mechanical properties of other potential injection formation. Triaxial compression tests will be conducted to determine stiffness properties (Young's Modulus, Poisson's Ratio, Compressibility) and strength properties. The strength properties of rock are important both for injection zone exploitation, drilling and hydraulic fracture design and subsequent damage prevention, including analysis of wellbore stability and sand production. Together with porosity measurements, this information will help evaluate the suitability of the injection zone for biosolids.

(b) Well Monitoring after Operation

i. Mechanical Integrity on Injection Well

The mechanical integrity testing (MIT) will be implemented annually (every 12 months) or any time that a workover of the well is conducted where the packer is unseated or the construction of the well is modified. We will notify EPA at least 30 days prior to each MIT test. Results of the test will be submitted to EPA as soon as possible but not later than 30 days after the testing and results included in the quarterly reports.

ii. Tracer Surveys

Oxygen Activation (OA) log for the detection of out of zone fluid injection upward movement will be performed annually. This log will be performed using standard industry protocol from the bottom of the well to 1000ft above the highest perforation. We will notify EPA at least 30 days prior to each scheduled tracer survey. Results of the test will be submitted to EPA as soon as possible but not later than 30 days after the testing.

(c) Field Monitoring and Sampling Program

A detailed monitoring and sampling program has been designed to achieve the following:

1) Verify containment of injected material for environmental protection;

2) Comply with regulatory requirements;
3) Quantify methane generation and carbon dioxide sequestration.

The existing monitoring strategy includes a variety of tools designed to achieve our environmental, regulatory, and experimental quantification objectives. The monitoring and sampling program designed for the injection wells and offset monitoring wells will quantify material placement and containment in the subsurface, changing formation properties, biodegradation rates and constituents, and carbon sequestration. These tools include:

- continuous pressure monitoring and analysis
- continuous temperature monitoring
- quarterly step rate tests and pressure fall off tests in the injection well
- half yearly fluid sample collection and analysis
- quarterly air sample collection and analysis
- temporary microseismic analysis

The City requests to remove the installation of the downhole tiltmeter for two reasons: first, the fiber optic temperature surveys provide the same information (vertical placement); and second, the service is not readily available. Several attempts were made to install a downhole tiltmeter in SFI#1 injection well. The operation failed each time, due to electronic signal problems with the wireline. Additionally, at this time, there are currently no vendors available that offer injection well tiltmeter service. The original vendor (Pinnacle Technologies) informed us they can no longer perform the work because they have reliability issues with injection well tiltmeter.

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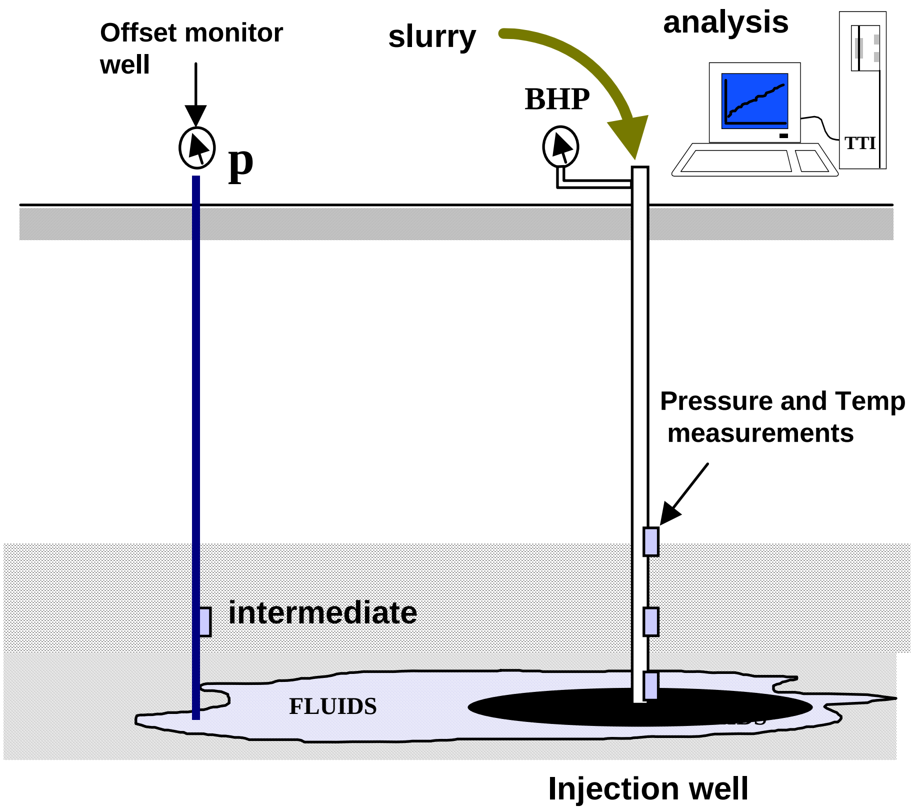


Figure 11: Continuous Pressure and Temperature monitoring schematic

i. Continuous Pressure monitoring and analysis

To date, the analysis of Bottom Hole Pressures (BHP) during injection and shut-in periods has provided the most accurate means of assessing the dynamic changes in formation flow and mechanical behavior during SFI operations. A bottom hole pressure sensor will be permanently installed in SFI#3 and a permanent installation for any new well(s). Through various BHP analyses, details of fracture propagation, stress state and formation flow parameters (such as permeability and transmissivity), assessment of fracture extension pressures, and fracture injection rates can be ascertained. Additional key injection parameters, which are carefully monitored and regulated throughout the injection process, include injection rate, injection pressure, injection volumes, and slurry density.

A BHP sensor will be installed in the annulus of the SFI#4 well. Through experience we have learned that the sensor will tangle with the fibrous materials if we hang the BHP through tubing. The temporary BHP sensor hung while performing the SRT (1 week duration only) had already experienced tanglement with the fibrous materials. By putting the BHP in the annulus with a device attached to tubing to measure the pressure should eliminate this problem. The bottom hole pressure in the injection zone will be monitored continuously during daily injection and nightly shut-in. Slurry injection operations are carried out episodically (8 to 14 hours of daily injection per well followed by shut-in) in order to closely monitor formation response and behavior. At the end of each day's injection period, the well is shut-in to allow formation pressure to dissipate to natural conditions overnight, again, monitoring continuously. We will not commence the subsequent day's injection operations if formation pressures remain high compared to previously established background pressure. "High pressures" are determined by tracking the shut-in pressure behavior. A shut-in pressure is considered "high" if it exceeds 10% of starting values over the weekend. In the event that shut-in pressures are judged too high to start injection, the EPA will be notified within 24 hours.

With Biosolids injection, fibrous materials form a skin effect around the near wellbore region. Pressure analysis indicates that while the skin factor is high, the far field pressure has not significantly increased. During mid week, the near wellbore pressure following well shut-in does not decline as rapidly as during normal drill cutting injection. Pressure does however decline during extended shut-in over the weekend. (see Figure 12) A shut-in pressure is considered "high" if it exceeds 10% of starting values over the weekend**.**

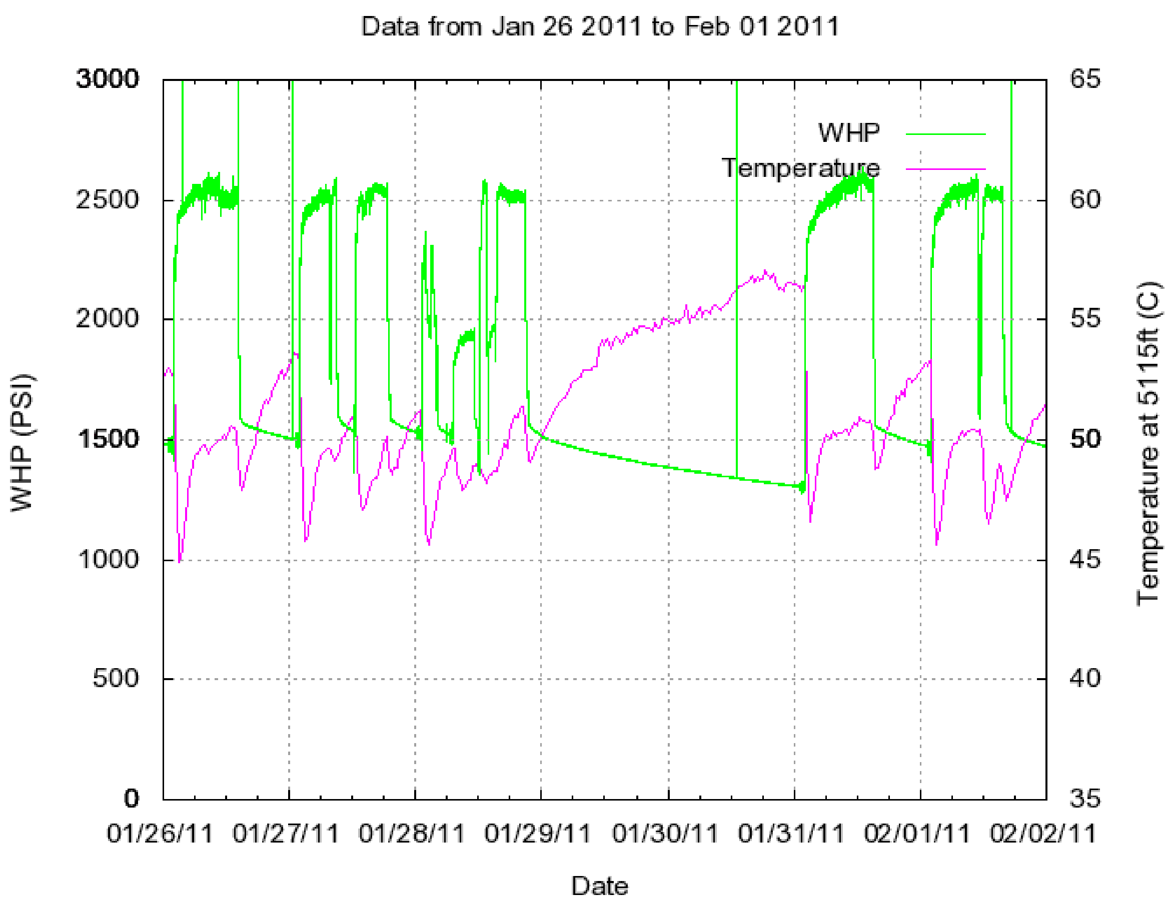


Figure 12: Real Time pressure and Temperature Monitoring

Injection pressures will be continuously monitored and will be analyzed and displayed in real time on a computer screen in the data acquisition and control room. Figure 12 presents an example of bottom hole pressure (BHP) during a solids injection over a one -week period. Slurry injection operations are not carried out continuously, but are episodic with 8 to 14 hours of daily injection followed by shut-in over night. The primary purpose of this episodic injection plan is to closely monitor formation behavior. At the end of each day's injection period, we shut-in the well and allow formation pressure to dissipate to natural conditions overnight.

ii. Continuous Temperature Monitoring

Distributed temperature in the injection well will be continuously monitored for two purposes: first, to monitor reservoir temperature and assess its influence on biodegradation rates; and second, to monitor potential vertical migration of injected slurry and liquids.

The injection wells (SFI#1 and SFI#3) casing are fitted with fiber optic temperature sensors along the length of the well, and will be continuously recorded and displayed in the control room. This will allow real-time monitoring of temperature in the near-well region on the entire length of the well. During injection operations, the fluid traveling down the tubing cools the entire casing string, including the sensors. After shut-in, however, the casing sensor measures only the formation temperature, including any formation zones that have been cooled by the injected fluids. Because the injection fluid temperature (slurry temperature is about 110ºF) is much less than the formation temperature 163 ºF at 5115ft (see orange and gray lines in Figure 13 for pre-injection temperature), temperature surveys provide a good indication of the vertical location of injectate in the near-well region. The slurry is injected at perforation (5176-5206ft in SFI#1 well), the well bore is being cooled by the injected slurry. As seen in figure below the temperature profile between 4890-5115ft shows a cooling trend, thus indicating the slurry is being deposited between this interval.

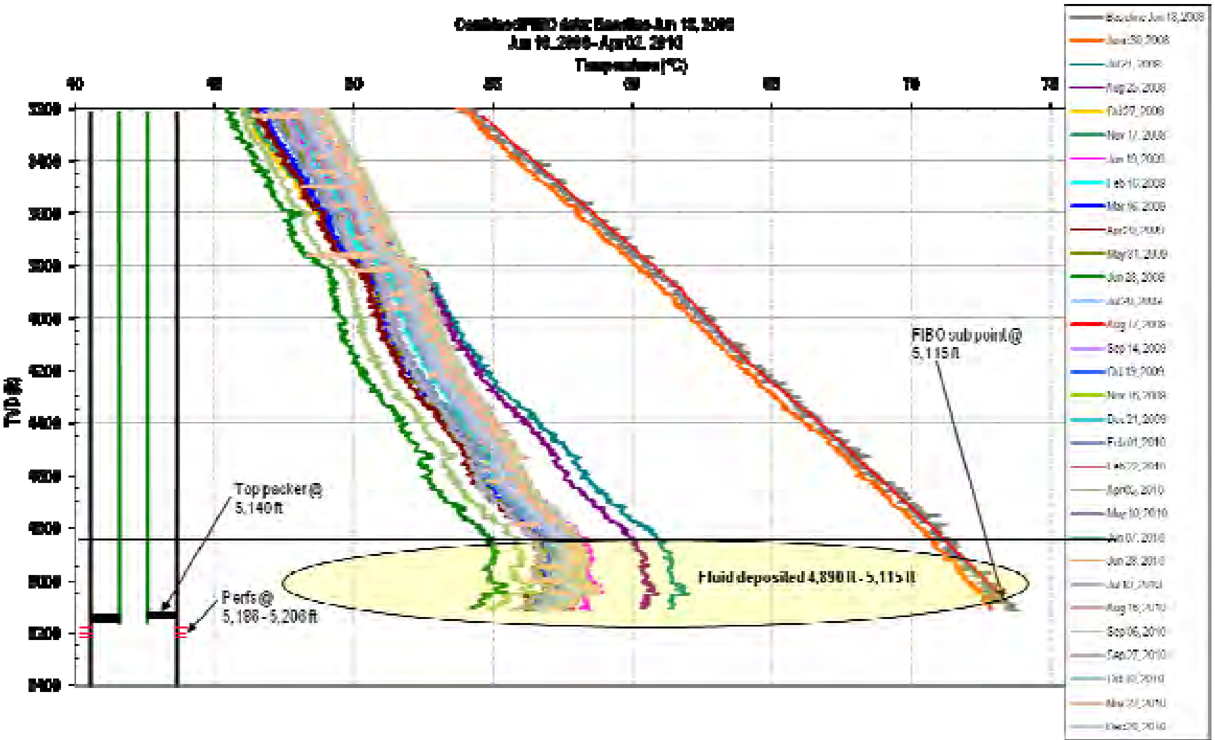


Figure 13: Fiber Optic Temperature Data Showing Cooling Below 4800 ft in the Injection Well

iii. Quarterly step-rate test and pressure fall off analysis

Based on date collected after 2 ½ years of operation, we recommend performing a quarterly Step Rate Test for SFI#1 . We proposed conducting monthly SRT for 6 months for the new injection well (SFI#3 or SFI#4), and then performing the SRT quarterly after 6 months of data has been collected..

The data from SFI#1 have been consistent with no significant changes since early 2009. The monthly step rate tests conducted at the injection well since the inception of the project involve injecting approximately 30m^3 (8000gal) of water at a rate of 0.25m^3/min. The step-rate test and analyses allow us to evaluate formation parting pressure and changes in in-situ stresses. Consistent pressure curves over time indicate that containment of the injected slurry within the target formation is being maintained. Future injection wells will have monthly step rate tests conducted for the first 6 months and then quarterly thereafter.

During 2008 clear fracture behavior was noted as indicated by the bi-linear shape of the pressure versus rate curve (see cluster 1 in Figure 14). After Jan. 2009, the behavior is linear (cluster 2 in Figure 14), indicating there is additional fracturing only in the approved layer. We will inform the EPA when we move to a new fracture zone. The data have been consistent over the past 18 months with no significant changes in formation stress or injectivity

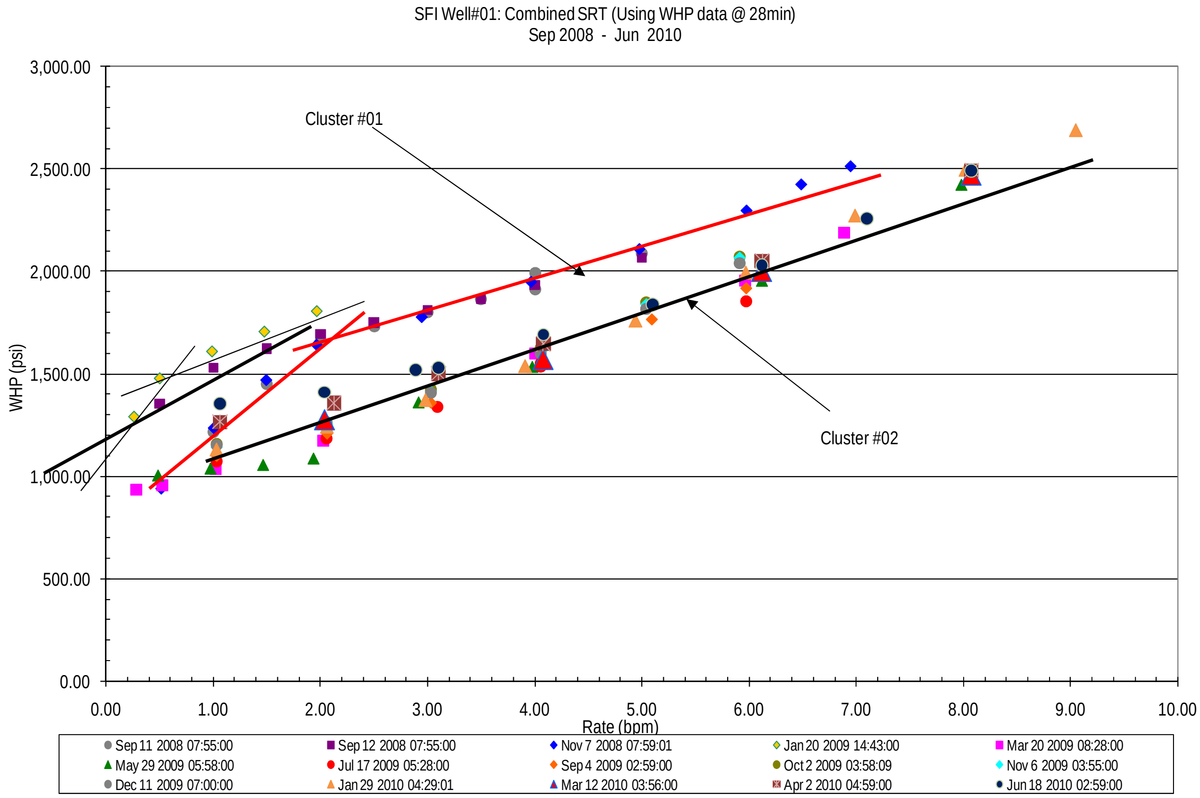


Figure 14: Step Rate Test from Sept 2008 to June 2010

Since Sept 17, 2010, the Step Rate Test was performed with a temporary BHP sensor hanged in the injection well. There are still no significant changes to formation behavior as seen from Figure 15 below.

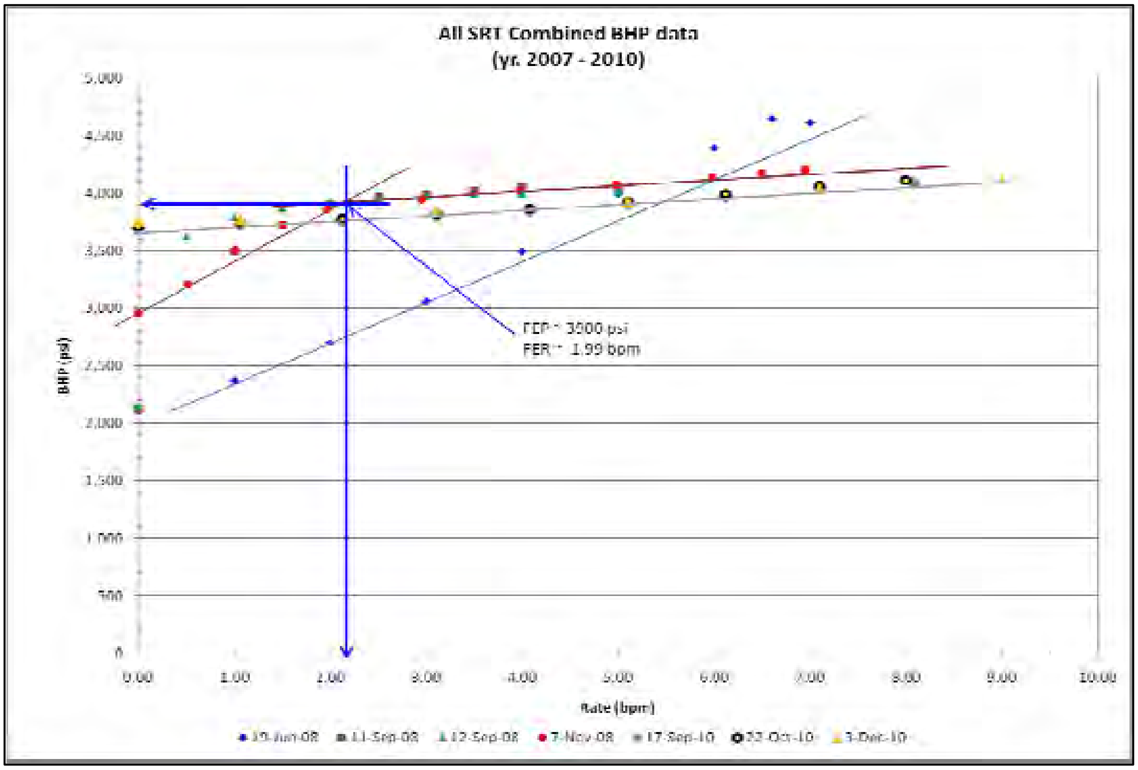


Figure 15: SRT performed with BHP sensors

Extended Pressure Fall Off Test (PFOT) is also performed. The pressure data during fall off will be analyzed using radial/linear well test analysis (Horne, 1995). This data will give us the new in-situ reservoir pressure and properties. This is accomplished by statistically fitting observed pressure decline data to theoretical pressure response, allowing recovery of near well and far field permeability, wellbore storage and skin effects, and closure stress. Figure 16 shows the actual semi log plot from the Terminal Island injection project.

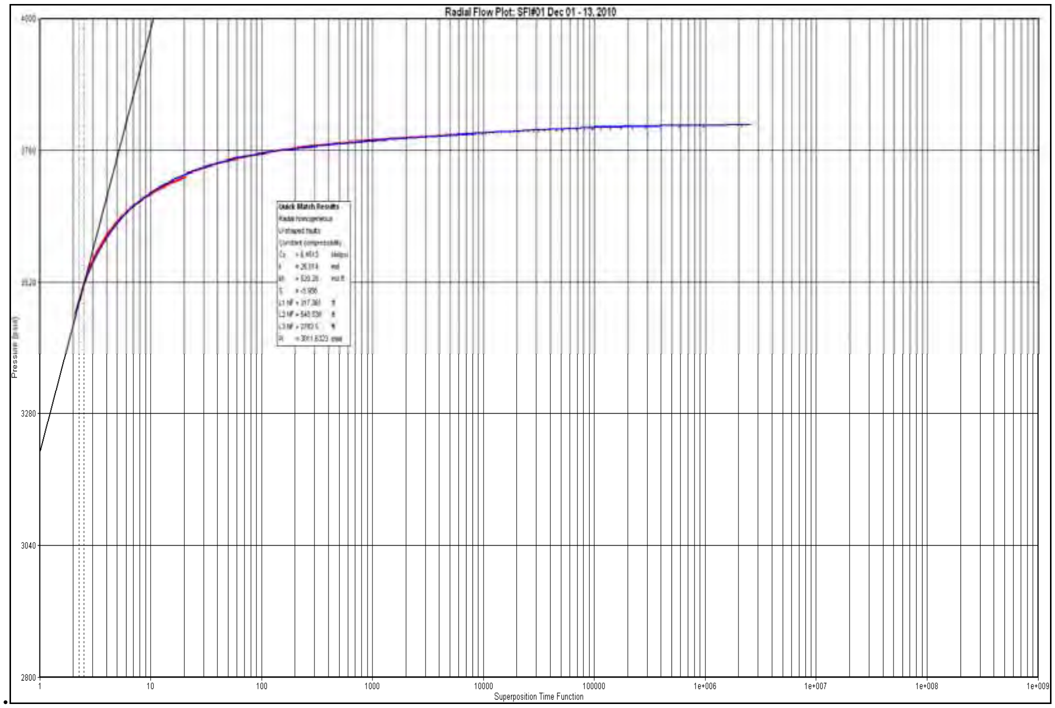


Figure 16: Semi – Log Plot (SRT Dec 03, 2010).

iv. Semi-Annual Fluid Sample Collection and Analysis

Microbiology analysis

Microbiology analysis is being performed to understand the microbial composition in the Biosolids and Digested Sludge that has been injected into the deep surface and to monitor the change of the microbial community over time in the deep surface. Digested Sludge prior to injection was collected as a baseline on November 30, 2009. The list of bacteria and Archaea from Digested Sludge are included in Appendix B. Formation fluid from SFI#2 and SFI#3 were collected and compared. Genomic direct sequencing was used for bacteria cloning. At University of California, Irvine, the bacteria collected will be concentrated onto 0.45µm HA filters (Millippore, USA) by vacuum filtration and re-suspended in 5mL TE buffer. The sludge sample will be concentrated by centrifugation at 3000rpm for 5mins. The pellet will be collected and used for DNA extraction.

We request to collect a fluid sample every 6 months from the monitoring well for microbiology analysis. Through time, we may be able to observe changes in the methanogenic microbial community in the deep subsurface.

Salmonella and fecal coliform analysis

The City of Los Angeles will continue to perform the Salmonella and fecal coliform analysis from the formation fluid that will be taken every 6 months. We can observe if the natural geothermal heat will further pasteurize the digested sludge and Biosolids injected. The Class A

Salmonella and fecal coliform obtained from the surface will be used as a baseline. Future samples will be compared to this baseline for the digestion analysis.

v. Quarterly Air Sample Collection and Analysis

During Biosolids injection operations, gas generation and migration will be evaluated through production data analysis and periodic sampling and laboratory analyses. Any increases from baseline will indicate Biosolids gas has reached the monitoring well. We have obtained 3 in situ pressurized fluid samples, one each from SFI#1, SFI#2 and SFI#3 wells. SFI#1 was taken before any Biosolids injection, and will be taken as the baseline. The pressurized fluid samples were flashed and the dissolved gas composition analyzed. See Table 4: Chemical Composition of the Fluid Samples. Quarterly gas sampling from the monitoring well(s) is proposed. The City will take samples to quantify the amount of CH_4 and CO_2 that may be generated Table 5: shows the air analysis taken from SFI#2 well. Note there is an increase in the CH_4 accumulation trend.

Table 5: SFI#2 Air Sample Analyses

	Feb. 14, 2011 (LA City Lab)	Jan. 19, 2011 (LA City Lab)	Sept. 30, 2010 (LA City Lab)	Sept 21, 2010 Air Technology Lab)
CO_2 (%)	ND	ND	ND	0.011
CH_4 (%)	53.8	52.2	45.9	45
N_2 (%)	40.3	39.2	46.3	50
H_2S (%)		ND	ND	
O_2/AR (%)	DNQ	DNQ	1.11	1.2

ND: non detectable; DNQ: (detected not quantified)

vi. Microseismic Monitoring

Microseismic Hydraulic Fracture Mapping uses sensitive seismic sensors placed in an offset well to detect microseisms (micro earthquakes) generated during treatment. A formation is stressed during hydraulic fracture treatment because of leak off induced pore pressure increases and net treatment pressures. This is similar to earthquakes along faults, although with much lower amplitude. This slippage's (microseisms) emit elastic waves which can be detected by sensitive seismic receivers (accelerometers or geophones). The microseisms are located and the data is used to create maps of the hydraulic fracture geometry. Results from microseismic fracture mapping can be used to "calibrate affects the stability of planes of weakness in the formation near the hydraulic fracture, leading to shear slippages" fracture growth models (Wolhart, S., 2000). However, as stated in our Dec. 31, 2001 Technical Response to EPA, soft sediments like those found at the TIRE site are relative aseismic, and that the vast majority of seismic events occurred in the overlying shales are due to general heaving and subsidence. Thus, the microseismic events are often associated with microslip and deformation on stiff lithologies, not necessarily related to hydraulic fracturing and fluid migration.

A microseismic array containing 12 levels of 3-component accelerometers placed between 4600-5150ft depth was installed in the SFI#2 monitoring well in mid-October, 2008. Data recording commenced in November, 2008. Both local and regional microseismic events have been detected. We noted that seismic activity has declined significantly throughout 2009, to almost no activity by the last quarter of 2009. The microseismic array was removed from SFI#2 well on Nov. 19, 2009 during a work-over program with EPA approval.

The recorded microseismicity events since the start of the project shows that the local injection induced events occurred at about 5000ft level, and range in moment magnitude from about -1 to -3 (see Figure 17). The deeper regional events, which are naturally occurring, are located from about 10,000ft to 25,000ft depth and range in moment magnitude from about -1 to +1.

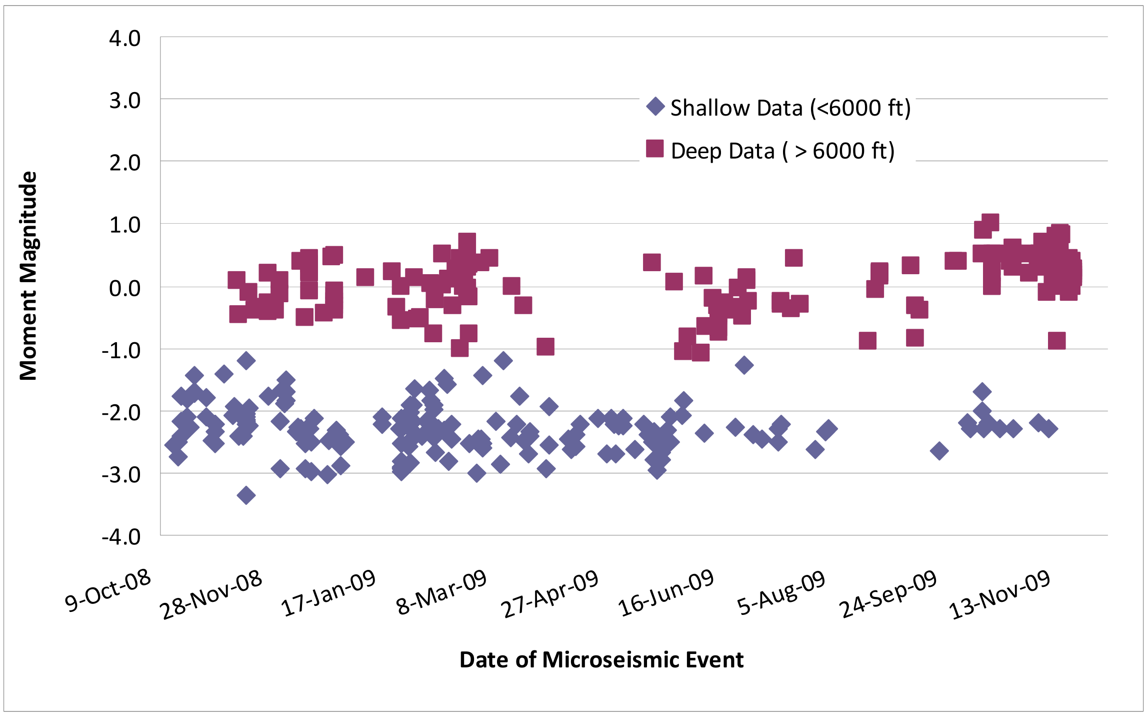


Figure 17: Magnitude Estimates for Microseismic Events Recorded to Nov. 18, 2009

We noted that seismic activity has declined significantly since the installation of the array in Oct. 28, 2008. In general, seismic activity has decreased month to month throughout 2009, to very limited activity. This is likely due to combination of several factors, including:

- With large scale sludge placement, the formation is "softer" and less seismic;
- Step-rate tests indicate fracturing is no longer occurring;
- Finally, it is also possible the seismic sensors have lost good coupling to the casing.

The combination of fiber optic temperature monitoring and microseismic monitoring have provided a very useful technique for observing and tracking the vertical extent of injection fluid placement (or, more accurately, the thermal and geomechanical response of the formation to fluid and slurry placement) during the early stages of the project. Microseismic tracking seems less useful as time progresses.

We also notice that the microseismic array is not sufficiently precise (signals are not large enough) to track lateral fracture azimuth or lateral fluid migration. The injection formation is soft and getting softer, resulting in very few seismic events. Furthermore, these events attenuate with distance. As indicated in Figure **18** the maximum distance from the sensors that events of magnitude -2 and -3 can be detected is about 300 ft. The soft formation properties attenuate signals beyond this distance. The monitoring well is located about 600 feet from the injection well.

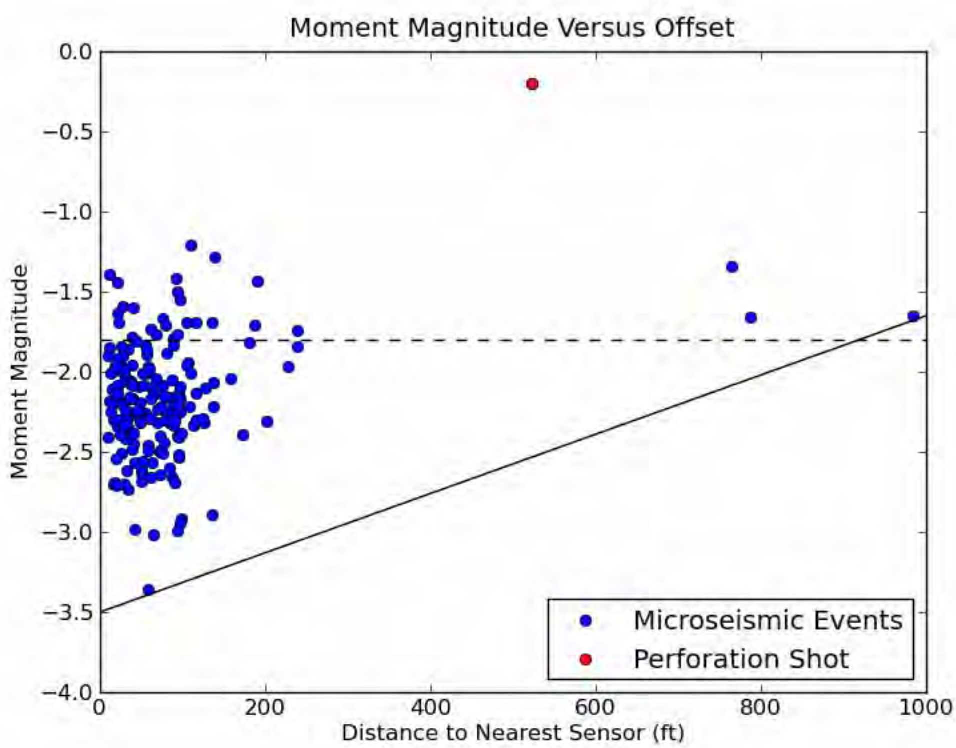


Figure 18**:** Observed Moment Magnitude versus Offset Distance from Microseismic Array (to Nov. 18, 2009)

The microseismic array from SFI#2 monitoring well will be installed into SFI#3 well scheduled for April, 2011. We will continue to test the usability of microseismic on soft sediments in SFI#3 well. We request the flexibility to stop using microseismic for monitoring if SFI#3 results again conclude that the microseismic events are associated with microslip and deformation on stiff lithologies, not necessarily related to hydraulic fracturing and fluid migration.

Q) Plug and Abandonment Plan

Appendix D contains the Plugging and Abandonment Plan for the SFI#4 well.

R) Necessary Resources

City of Los Angeles will provide their financial statement directly to EPA.

S) Aquifer Exemptions

None requested.

T) Existing EPA Permits

We are currently operating under UIC Permit Class V Experimental Permit No. C5060001, granted in November 6, 2006 and will be expiring on November 6, 2011.

A renewal UIC Permit Application is attached in Appendix E.

U) Description of Business

The City of Los Angeles Bureau of Sanitation is responsible for collection, treatment, recycling and disposal of solid and liquid waste generated by residential, commercial and industrial users in the City of Los Angeles and surrounding communities. The Bureau of Sanitation is responsible for operating and maintaining one of the world's largest wastewater collection and treatment systems. Over 6,500 miles of sewers serve more than four million residential and business customers in Los Angeles and 29 contracting cities and agencies. These sewers are connected to the City's four wastewater and water reclamation plants that process an average of 550 million gallons of wastewater each day of the year at its four wastewater treatment facilities (Hyperion, Terminal Island, Donald C. Tillman, and Los Angeles Glendale). The City processes, recycles, and renews 146 billion gallons of this wastewater annually into 21 billion gallons of recycled water for beneficial water conservation purposes and manages the 255 thousand tons of biosolids as a treated valuable commodity. Biosolids are the nutrient-rich organic product of wastewater treatment. During treatment, bacteria and other tiny organisms break sewage down into simpler, harmless organic matter, which contains essential plant nutrients. The City's biosolids, used in growing animal feed as a safe alternative to chemical fertilizer and animal manure, is now considered a potential renewable source of clean energy.

V) Experimental Objectives

For the next five years, we would like to better achieve our research objective. Extensive field monitoring and sampling from offset wells will quantify slurry placement, biodegradation rates, carbon dioxide sequestration and saturation in formation brine, and methane generation and migration. Gas and fluid samples will be collected at the injection well and the offset monitoring wells. We will also compare field and laboratory results with biodegradation experiments at reservoir temperature conditions in large-scale surface digestion vessels conducted by the City of Los Angeles.

After 2 ½ years of Biosolids injection, data has confirmed that CO_2 and CH_4 are indeed generated in the subsurface. Thermophilic and methanogenic bacteria are found in the subsurface. However, there are still a lot of uncertainties. The City propose to continue our research to try to increase our knowledge on:

- Subsurface microbial activities

- Surface and subsurface digestion comparison
- Verifying enhanced sterilization of Biosolids
- Quantifying Air sample analysis for CO_2 and CH_4
- Verifying containment of injected waste pod via different monitoring tools
- Evaluating the viability of microseismic tool in soft rocks
- Fracture propagation, stress state and formation flow parameters to assess fracture extension pressures, and fracture injection rates
- In situ reservoir pressure and properties through step rate test and pressure fall off analysis

For detailed description of the planned experiments, please see (c) Field Monitoring and Sampling Program

W) References

Clarke, D.D., 1987: The Structure of the Wilmington Oil Field, in Clarke, D.D. and Henderson, C.P., Eds. Geologic Field Guide to the Long Beach Area, Pacific Section American Association of Petroleum Geologists, Los Angeles, p.43-56.

Clarke, D.D., 2008, Well Evaluation for SFI#1 and SFI#2, Terralog internal report.

Clarke, D.D., 2010, Well Evaluation for SFI#1, SFI#2 and SFI#3, Terralog internal report.

Fischer , P.J., et al., 1987, The Palos Verdes Fault zone; onshore to offshore, in P.J. Fischer, ed., Geology of the Palos Verdes Peninsula and San Pedro Bay; Volume and Guidebook, Book 55, Pacific Section SEPM and AAPG, p.91 to 133.

Henderson, C.P., 1987: The Stratigraphy of the Wilmington Oil Field, in
in Clarke, D.D. and Henderson, C.P., Eds. Geologic Field Guide to the Long Beach Area, Pacific Section American Association of Petroleum Geologists, Los Angeles, p.57-68.

.

Horne, R.N., 1995: Modern Well Test Analysis, 2nd Edition, Petroway, Inc., Palo Alto, California.

Legg, Mark, 2011, internal Terralog report.

McNeilan, T.W., et al., 1996, Style and rate of slip, Palos Verdes fault, southern California, Journal of Geophysical Research, vol. 101, no. B4, p.8317-8334

Walker 1978

Norris, R.M. and Webb, R.W., 1990: Geology of California, John Wiley and Sons, Inc., pp.324-330.

Norton, T.A. and Otott Jr., G.E., 1996: The Stratigraphy of the Wilmington Oil Field, in Clarke, D.D., Otott Jr., G.E. and Phillips, C.C. Eds, Old Oil Fields and New Life: A Visit to the Giants of the Los Angeles Basin, pp.23-36.

Phillips, C.S., and Prior, S., 2005, Tideland Oil Production Co., in house report

Wolhart, Steve, 2000, Hydraulic Fracture Diagnostics: Technology Summary and Case Histories, Gas Tips, vol. 6, no.3, p.22-27.

Yerkes, R.F., McCulloh, T.H. et al., 1965: Geology of the Los Angeles Basin, California, An Introduction, U.S. Geological Survey Professional Paper, 420A.

Appendix A
Well Schematic
1 Mile Area of Review

	Well Name			Well Status		Cement Status
		TD (ft.)	Year Drilled	Abandon year	Status	
1	Superior B-1	6200	1940	1940	abandon	0-392’
2	Apex Hards-Warnock#1	3448	1957	1957	abandon	250-303’; 1070-1200’
3	SP LA Harbor#301	10,569	1965	1965	abandon	3391-3622’
4	TIRE SFI#1	5550ft	2007		active	Cement turned to surface
5	TIRE SFI#2	5541ft	2007		active	Cement turned to surface
6	TIRE SFI#3	5431ft	2010		active	Cement turned to surface

TERRALOG TECHNOLOGIES INC

TTI

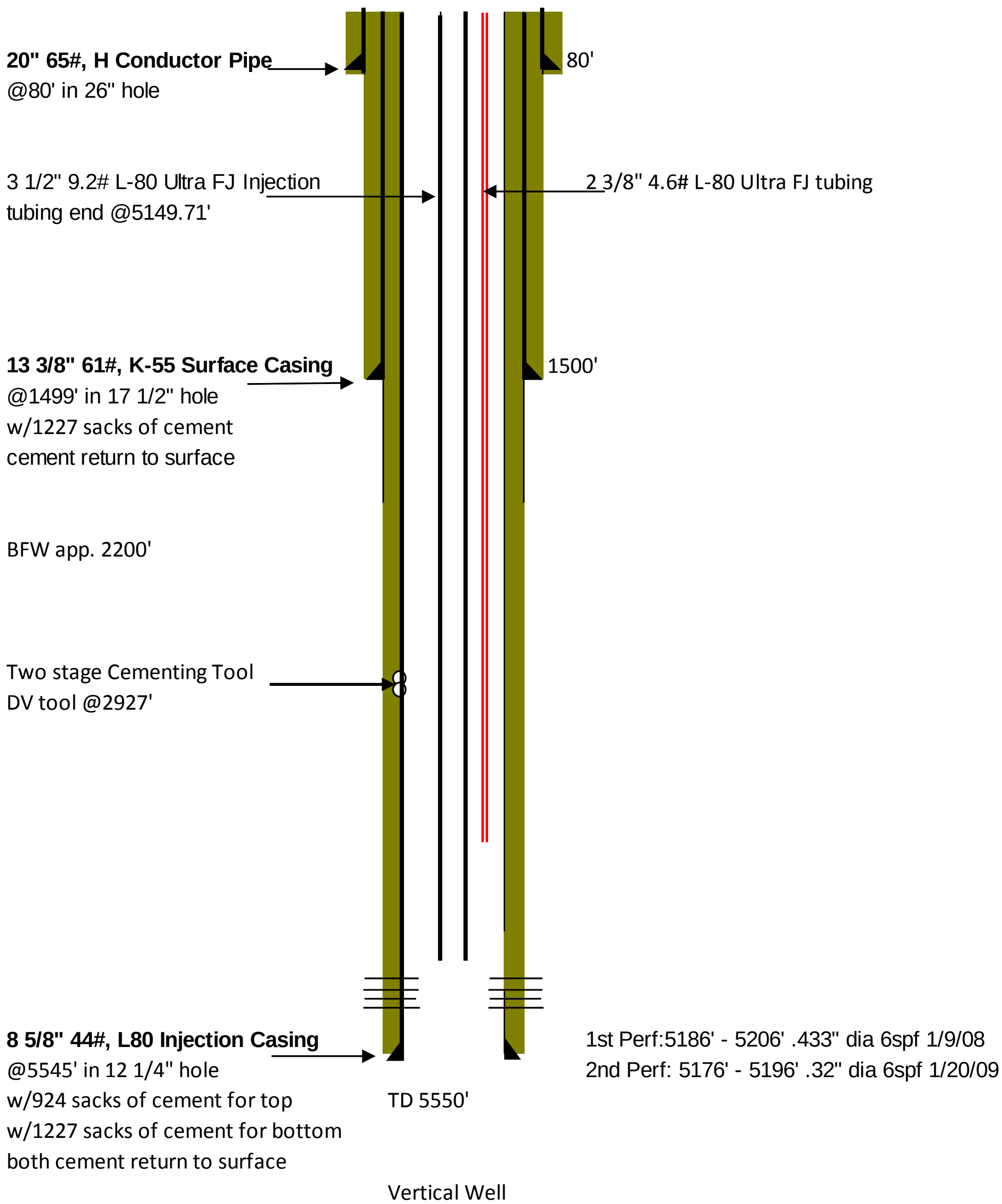
Terminal Island Facility

SFI # 1

Section 8 - T5S - R13W

Slurry Injector

Vertical Well	
Lat:	33.74388 N
Long:	118.265 W
KB (above sea level)	31
GL (above sea level)	10



TERRALOG TECHNOLOGIES INC

TTI

Terminal Island Facility

SFI # 2

Section 8 - T5S - R13W

Monitoring Well

Kick Off @1600ft, max build angle 10 degree @ 1degree/100ft

Surface:

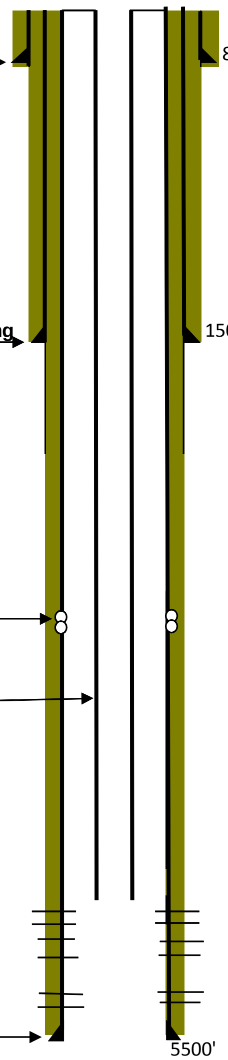
Lat: 33.743852 N

Long: -118.26403 W

KB (above sea level) 31

GL (above sea level) 10

Wellhead Assembly 5K



20" 65#, H Conductor Pipe
@80' ft 26" hole

10 3/4" 40.5#, J-55 Surface Casing
@1533' in 14 3/4" hole
w/920 sacks of cement
cement return to surface

BFW app. 2200'

Two stage Cementing Tool
DV tool @2922'

2 3/8" 4.7# J-55 EUE tubing
end @ 4605'

Perf:4730' to 4750' .49" dia 6spf 11/23/09
Perf:4755' to 4775' .49" dia 6spf 11/23/09

Perf:4982' to 5002' .49" dia 6spf 11/23/09

7" 29#, L80 Injection Casing
@5431' in 9 7/8" hole
w/575 sacks of cement for top
w/700 sacks of cement for bottom
cement return to surface

MD	TVD (from deviation survey)
1500	1499.81
1939	1938.46
2607	2597.49
3147	3129.65
3625	3600.86
4005	3975.96
4482	4446.52
4767	4726.82
4927	4883.97
5118	5071.32
5300	5250.29

BH Location: 559'N & 559'E

TTI

Terminal Island Facility

SFI # 3

Section 8 - T5S - R13W

Slurry Injector

Deviated Well KOP 1600ft, build angle 1degree/100ft

Surface:

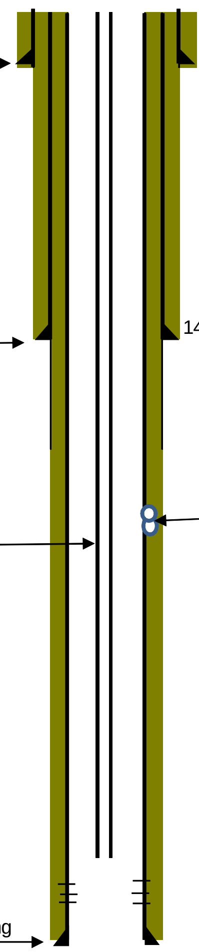
Lat: 33.743971N

Long: 118.263751W

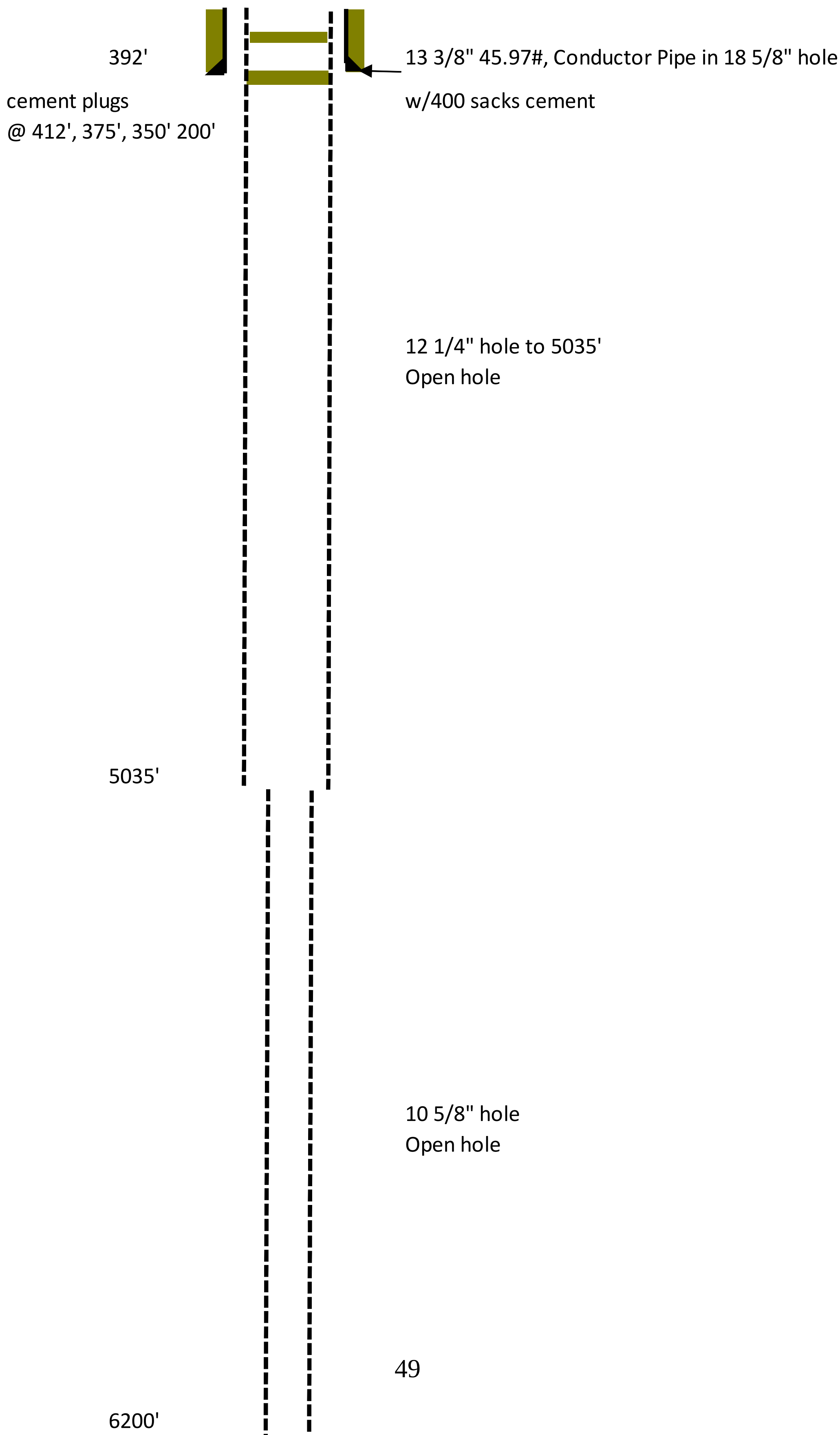
KB (above sea level) 30ft

GL (above sea level) 10ft

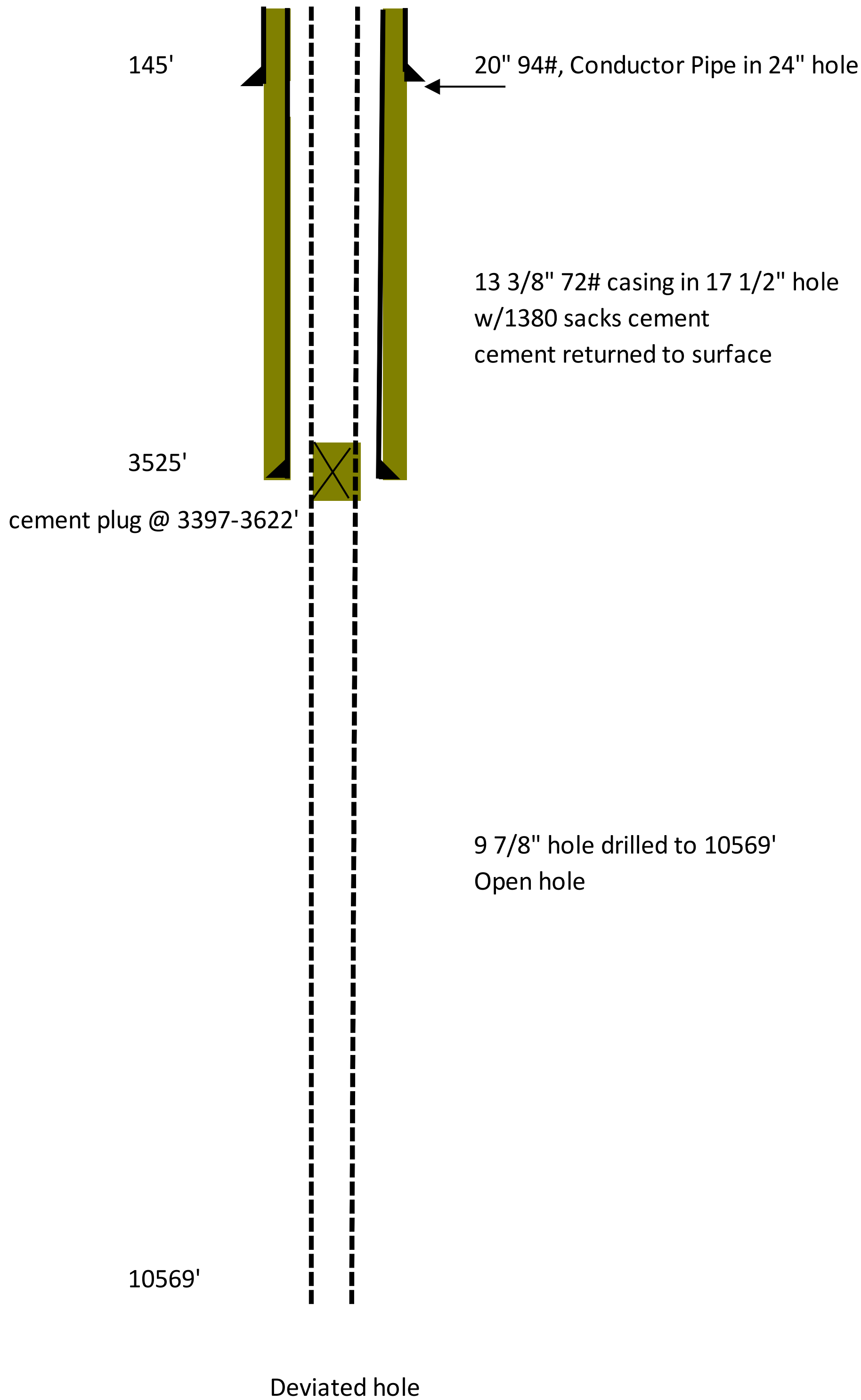
MD	TVD (from deviation survey)
1604	1604
2076	2075
2554	2550
3002	2990
3512	3492
3956	3930
4399	4367
4872	4833
5430	5382



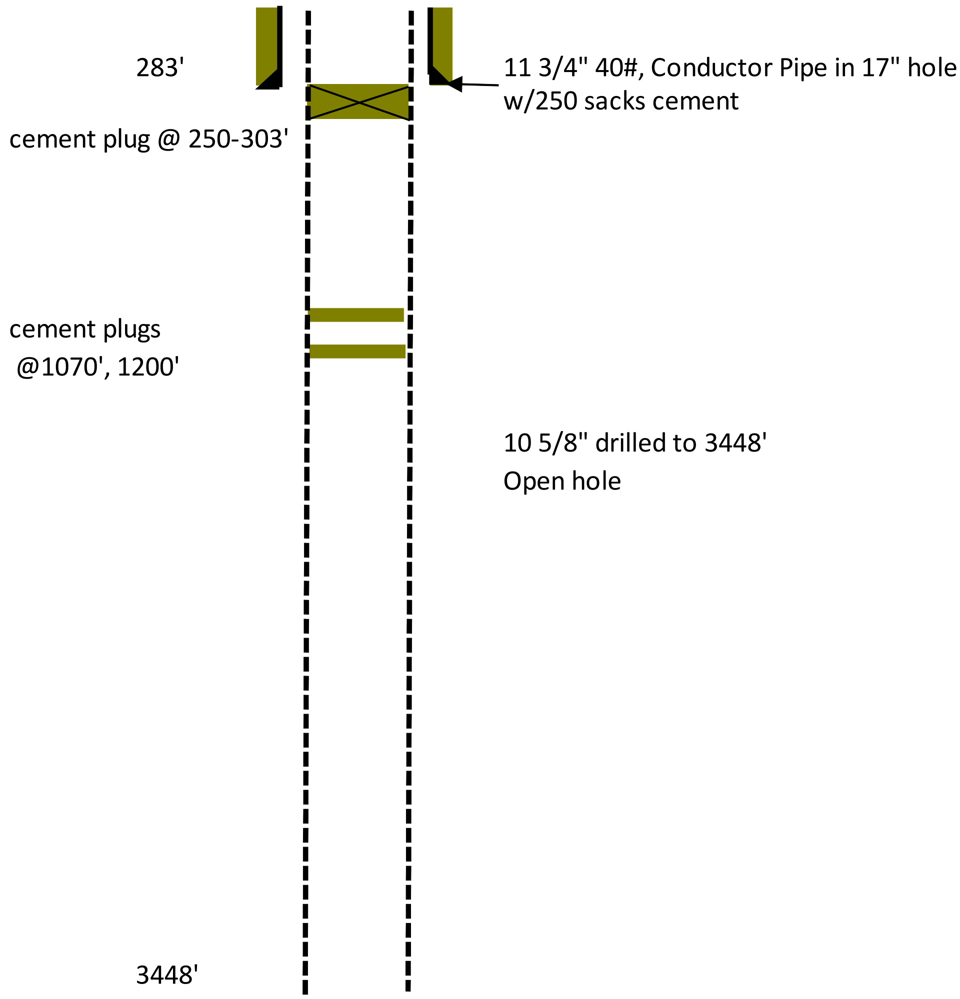
SUPERIOR B-1


392'
13 3/8" 45.97#, Conductor Pipe in 18 5/8" hole
w/400 sacks cement
cement plugs
@ 412', 375', 350' 200'
12 1/4" hole to 5035'
Open hole
5035'
10 5/8" hole
Open hole
6200'

SP LA Harbor 301



Apex Hard Warnock 1



Appendix B

Bacteria and Archaea identified in the Digested Sludge

Bacteria identified in the sludge sample collected immediately before injection

Design. No.	Closest relative in GeneBank database	Origin
c1	FJ625861 Clostridium sp.	Lateral gene transfer in the gut of the Galapagos marine iguana
c2	DQ887970 Uncultured bacterium clone B55_K_B_F05	Stable isotope probing analysis of microorganisms involved in organic metabolism in thermophilic anaerobic solid waste
c4	AB162803 Coprothermobacter sp. P1	Isolation and characterization of Coprothermobacter strain P1, protein-degrading bacteria in thermophilic anaerobic digestion process
c5	AY379977 Acidovorax sp. AHL 5	N-acyl-l-homoserine lactones (AHLs) affect microbial community composition and function in activated sludge
c8	GU363592 Coprothermobacter proteolyticus strain IT3	proteolyticus strain with higher hydrogen-production capability from a thermophilic anaerobic digester
c10	AB162803 Coprothermobacter sp. P1	Isolation and characterization of Coprothermobacter strain P1, protein-degrading bacteria in thermophilic anaerobic digestion process
c14	AY862519 Uncultured bacterium clone TPD-2	Anaerobic treatment of phenol in wastewater under thermophilic condition
c18	AY232833 Streptococcus minor strain LMG 21735	Streptococcus minor sp. nov., from faecal samples and tonsils of domestic animals
c26	AB290399 Uncultured bacterium	Diversity of Anaerobic Microorganisms Involved in Long-Chain Fatty Acid Degradation in Methanogenic Sludges as Revealed by RNA-Based Stable Isotope Probing
c28	EU639069 Uncultured Fervidobacterium sp. clone SHBZ588	A novel ecological role of the Firmicutes identified in thermophilic microbial fuel cells
c41	AB373018 Uncultured bacterium	Polymerase chain reaction-denaturing gradient gel electrophoresis analysis of microbial community structure in landfill leachate
c43	EU075082 Streptococcus minor strain 29-74MPalpha	Streptococcal carriage by canines residing in Australian indigenous communities
c44	AB530686 Uncultured bacterium	Microbial Community in Electricity-generating Microflora Enriched from Thermophilic Methanogenic Sludge Microbial Community in Electricity-generating Microflora Enriched from Thermophilic Methanogenic Sludge
c45	EU075077 Streptococcus minor strain 24-58MP	Streptococcal carriage by canines residing in Australian indigenous communities

c46	CP001146 Dictyoglomus thermophilum H-6-12	complete sequence
c47	AB162803 Coprothermobacter sp. P1	Isolation and characterization of Coprothermobacter strain P1, protein-degrading bacteria in thermophilic anaerobic digestion process
c48	CP001145 Coprothermobacter proteolyticus DSM 5265	complete sequence
c49	CP001145 Coprothermobacter proteolyticus DSM 5265	complete sequence
c50	AY862526 Uncultured bacterium	Anaerobic treatment of phenol in wastewater under thermophilic condition
c51	AY862526 Uncultured bacterium	Anaerobic treatment of phenol in wastewater under thermophilic condition
c52	AB274511 Uncultured bacterium	Microbial population in the biomass adhering to supporting material in a packed-bed reactor degrading organic solid waste
c56	AB377179 Propionibacteriaceae bacterium WR032	Community structure of Bacteria in a methanogenic reactor of cattle waste and some characteristics of fermentative bacterial isolates
c57	AB373018 Uncultured bacterium	Polymerase chain reaction-denaturing gradient gel electrophoresis analysis of microbial community structure in landfill leachate

Archaea identified in the sludge sample immediately before injection.

Design. No	Closest relative in GeneBank database	Origin
D1	FN296155 Uncultured archaeon	Phylogenetic diversity of Archaea in Bulgarian hot spring
D10	FN296155 Uncultured archaeon	Phylogenetic diversity of Archaea in Bulgarian hot spring
D20	EF420183 Uncultured crenarchaeote	Molecular analysis of methanogenic microbial populations from an oil sands tailings pond in northern Alberta, Canada
D30	AB353218 Uncultured crenarchaeote	Quantification of mcrA by fluorescent PCR in methanogenic and methanotrophic microbial communities
D35	EF420183 Uncultured crenarchaeote	Molecular analysis of methanogenic microbial populations from an oil sands tailings pond in northern Alberta, Canada
D38	EF420183 Uncultured crenarchaeote	Molecular analysis of methanogenic microbial populations from an oil sands tailings pond in northern Alberta, Canada
D39	AB353218 Uncultured crenarchaeote	Quantification of mcrA by fluorescent PCR in methanogenic and methanotrophic microbial communities
D42	FN296155 Uncultured archaeon	Phylogenetic diversity of Archaea in Bulgarian hot spring
D49	EF420183 Uncultured crenarchaeote	Molecular analysis of methanogenic microbial populations from an oil sands tailings pond in northern Alberta, Canada

Appendix C
SFI Well Chemical Cleanout

TIRE Site - Standard Operating Procedure for: SFI Well Chemical Cleanout

PURPOSE

The purpose of this SOP is to establish procedures that will ensure proper chemical cleanout of the slurry fracture injection well and the near wellbore formation. Biosolid materials injected through the process at the Terminal Island Renewable Energy (TIRE) Project contain solids (primarily fibrous material) that have a deleterious effect on the well casing perforations and injection formation pore spaces. Caustic chemical cleanout is designed to alleviate the clogging effect this material has. The cleanout process will be carried out semi-annually or when weekly falloff bottom-hole pressures (BHP) are less than 15% of the previous week's bottom BHP. A sufficient amount of a mixture of caustic sodium hydroxide, sodium hypochlorite and/or other material that will aid in dissolving the clogged solids will be injected at the end of the week after a modified high pressure effluent (HPE) step down. The caustic solution will be allowed to rest in the well casing and near wellbore formation area to help dissolve the fibrous material deposited by the injection process. This treatment will help open up the casing perforations as well as the near wellbore formation pore spaces, allowing the injected slurry to further propagate into the pore spaces.

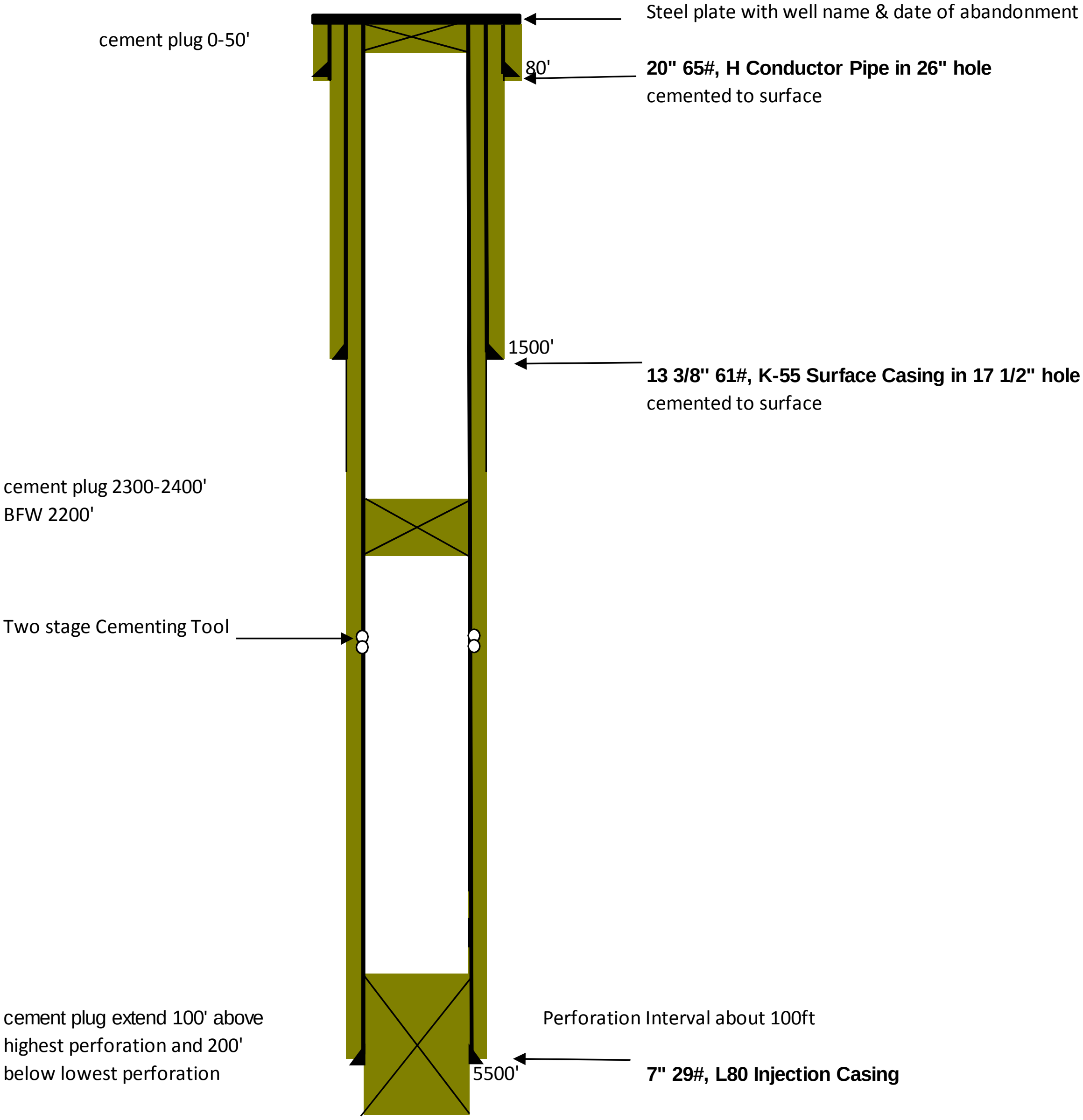
These procedures are to be followed by all GeoEnvironment personnel. Improper handling of the cleanout chemicals can lead to severe chemical burns if the material comes in contact with skin or the eyes. Precautions include wearing of the proper personal protective gear – goggles/face shield, gloves, long sleeve shirt and boots – handling material with proper equipment, and focused attention on the safe handling of the material during off-loading and disposal.

OPERATING PROCEDURES

1. Mix material in subcontracted pump truck - The material to be mixed: 1813 gallons NaOH, and 2310 gallons sodium hypochlorite.
2. Connect pump truck to suction manifold with provided tee and valve assembly.
3. Perform abbreviated injection pump step-down with HPE – inject 10 minutes at 8bpm, 10 minutes at 4bpm, and 10 minutes at 2bpm. Reduce pump rate to 1bpm (24 spm).
4. Pump material from pump truck into injection pump.
5. Inject chemical mixture into the well casing at 1bpm for 100minutes.
6. As the mixture level in the pump truck lowers, begin cleanout of the pump truck with HPE when the level is approximately 10% of the original mixture volume; pumping the rinsate into the well casing at 1bpm for 10 minutes (approximately 400 gallons.)
7. Switch the injection pump suction to the HPE supply and continue pumping material into the well casing at 1bpm for 10min.
8. Shut-in well and let caustic chemicals sit in the well casing/formation over the weekend.
9. Resume normal start-up the following Monday diluting and pushing the caustic chemical into the formation.

Appendix D
Plugging and Abandonment Plan

WELL PLUGGING AND ABANDONMENT SCHEMATIC



All cement plugs shall meet EPA and DOGGR P&A standards, cement plugs shall have max liquid permeability of 0.1md and attain compressive strength of >=1000lb psi within 24 hours. All cement test data will be submitted to EPA and DOGGR and conducted according to DOGGR guidelines. Space between cement plugs will be filled with drilling mud with corrosion inhibitor added, consistent with DOGGR requirements and field practices.

Appendix E
UIC Permit Application

OMB No. 2040-0042 Approval Expires 12/31/2011

United States Environmental Protection Agency

Underground Injection Control Permit Application

(Collected under the authority of the Safe Drinking Water Act. Sections 1421, 1422, 40 CFR 144)

I. EPA ID Number		
	T/A	C
U		

Read Attached Instructions Before Starting

For Official Use Only

Application approved (mo day year)	Date received (mo day year)	Permit Number	Well ID	FINDS Number

II. Owner Name and Address			III. Operator Name and Address		
Owner Name: Bureau of Sanitation, City of Los Angeles			Owner Name: Bureau of Sanitation, City of Los Angeles		
Street Address: 1149 S. Broadway, 9th Floor		Phone Number: (213) 485-2210	Street Address: 1149 S. Broadway, 9th Floor		Phone Number: (213) 485-2210
City: Los Angeles	State: CA	ZIP CODE: 90015	City: Los Angeles	State: CA	ZIP CODE: 90015

IV. Commercial Facility	V. Ownership	VI. Legal Contact	VII. SIC Codes
☐ Yes ☒ No	☐ Private ☐ Federal ☒ Other	☒ Owner ☐ Operator	9999

VIII. Well Status *(Mark "x")*

	Date Started (mo day year)		
☒ A. Operating	07/02/2008	☒ B. Modification/Conversion	☒ C. Proposed

IX. Type of Permit Requested *(Mark "x" and specify if required)*

	Number of Existing Wells	Number of Proposed Wells	Name(s) of field(s) or project(s)
☐ A. Individual ☒ B. Area	3 wells - SFI#1, SFI#2, and SFI#3	1 (and up to 4 replacement wells)	Terminal Island Renewable Energy Project (TIRE)

X. Class and Type of Well *(see reverse)*

A. Class(es) (enter code(s))	B. Type(s) (enter code(s))	C. If class is "other" or type is code 'x,' explain	D. Number of wells per type (if area permit)
Other	N/A	Class V - experimental geologic sequestration	4 (and up to 4 replacement wells)

XI. Location of Well(s) or Approximate Center of Field or Project

Latitude Deg	Latitude Min	Latitude Sec	Longitude Deg	Longitude Min	Longitude Sec	Sec	Twp	Range	1/4 Sec	Feet From	Line	Feet From	Line
33	44	38	118	14	40	17	T5S	R13	NW				

XII. Indian Lands (Mark 'x')

☐ Yes
☒ No

XIII. Attachments

(Complete the following questions on a separate sheet(s) and number accordingly; see instructions)

For Classes I, II, III, (and other classes) complete and submit on a separate sheet(s) Attachments A--U (pp 2-6) as appropriate. Attach maps where required. List attachments by letter which are applicable and are included with your application.

XIV. Certification

I certify under the penalty of law that I have personally examined and am familiar with the information submitted in this document and all attachments and that, based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment. (Ref. 40 CFR 144.32)

A. Name and Title *(Type or Print)*	B. Phone No. *(Area Code and No.)*
Enrique C. Zaldivar, Director	(213) 485-2210
C. Signature	D. Date Signed: 5/18/11

EPA Form 7520-6 (Rev. 12-08)