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**SHELL OIL COMPANY**  
Carson, California



**LOW PERMEABILITY CAP  
EXTENSION**

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OPERATIONS

**ADDENDUM 1  
OF THE  
BACKFILL AND FINAL PROJECT  
COMPLETION REPORT,  
RESERVOIRS 1 AND 2**

**TOSCO LOS ANGELES REFINERY  
(FORMERLY UNOCAL CARSON REFINERY)**

AUGUST 1997

**BROWN AND  
CALDWELL**

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# **PROJECT TEAM**

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CALDWELL

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## EXECUTIVE SUMMARY

Reservoirs 1 and 2, located at the Tosco Los Angeles Refinery (formerly Unocal), were dismantled and backfilled with native soils in 1995. The closure of both reservoirs was performed under Waste Discharge Requirements (WDRs) issued by the California Regional Water Quality Control Board (CRWQCB), Los Angeles Region. Closure included installation of a low permeability cap over fill soils in each reservoir to inhibit the upward migration of free petroleum hydrocarbons. In early 1996, surface soils in the exposed relic berms, located beyond the coverage area of the caps, exhibited localized hydrocarbon seepage. A work plan was developed to mitigate the hydrocarbon seepage by extending the low permeability caps beyond the relic berm. The work plan was reviewed and approved by CRWQCB and field construction activities were initiated in February of 1997.

The primary objective of this project was to install an extension to the existing low permeability caps to inhibit future hydrocarbon seepage. The following primary activities were performed to achieve this objective:

- removed perimeter soils from the planned excavation area;
- treated the excavated soils at an off-site thermal desorption facility to reduce hydrocarbon concentrations;
- evaluated subgrade soils for environmental and geotechnical considerations, and performed corrective actions when warranted;
- installed low permeability clay cap extensions around both reservoirs that tied in with the existing clay caps and met both the WDR and work plan specifications;
- backfilled over the low permeability clay cap extensions, reusing previously excavated soils that were thermally treated at an off-site facility;
- sampled and analyzed the thermally treated cover soils to verify compliance with the WDRs; and
- compacted all fill soils to at least 90% of the maximum laboratory-derived dry density.

## CHAPTER 1

### INTRODUCTION

This amendment to the October 1995 Backfill and Final Project Completion Report describes recent post-closure remedial activities. These remedial activities were performed to mitigate hydrocarbon seepage in the exposed relic berms of two former oil reservoirs. Reservoirs 1 and 2, located at the Tosco Los Angeles Refinery (formerly Unocal), were dismantled in 1994 and 1995. The former reservoirs are located at 1520 to 1622 East Sepulveda Boulevard in Carson, California (Figure 1-1). The reservoir property was previously known as the Wilmington Section of the Wilmington Manufacturing Complex, formerly owned by Shell Oil Company (Shell).

#### Background

Reservoirs 1 and 2, located at the Tosco Los Angeles Refinery, were initially constructed in the 1920s to store unrefined crude oil. The reservoirs were used until the late 1980s. Environmental investigations of the perimeter berms and soils underlying the concrete liner were documented in the following four reports prepared by Brown and Caldwell (BC): "Reservoir Investigation," dated March 1989; "Berm Material Characterization of Reservoirs 1 and 2" dated September 1993; "Berm Material and Underlying Soil Characterization of Reservoirs 1 and 2," dated March 1994; and "Supplemental Investigation of the Underlying Soil of Reservoirs 1 and 2," dated July 1994.

Both reservoirs were dismantled and backfilled with native soils in 1995. The closure was managed by Ralph M. Parsons Company (Parsons), for Shell Oil Company, under the Waste Discharge Requirements (WDRs) for Closure of Two Surface Impoundments (Order No. 94-112), issued by the California Regional Water Quality Control Board (CRWQCB), Los Angeles Region (File No. 85-19) (Appendix A). The WDRs detailed in the CRWQCB Monitoring and Reporting Program No. CI 7452, dated October 1994, included guidelines for groundwater monitoring, excavation monitoring, backfill soil characterization, general provisions for sampling and analysis, and specific reporting requirements. The closure of both reservoirs was managed by Parsons and documented in a report prepared by Brown and Caldwell, titled Backfill and Final Project Completion Report, Reservoirs 1 and 2, dated November 1, 1995.

In early 1996, soils at grade in the exposed relic berms exhibited localized bleeding of hydrocarbons to the surface. These hydrocarbon seeps were observed in fine sandy soils located beyond the perimeter of the existing low permeability caps. Additional site assessment work was performed to determine the nature and extent of the hydrocarbon seeps. Findings of the assessment were documented in a report titled Subgrade Berm Soil Sampling at Reservoirs 1 and 2, dated May 17, 1996. Upon review of this report, the CRWQCB requested an amended work plan to mitigate the hydrocarbon seeps. A work plan was developed for the removal and treatment of the relic berm soils and installation of an extension to the existing low permeability caps (Appendix B). The work plan was reviewed by the CRWQCB and approved in November, 1996.

### Project Objectives

The primary objective of this project was to install a low permeability cap extension (LPCE), designed to inhibit future hydrocarbon seepage in the relic berm area. The following activities were conducted to achieve these objectives:

1. The relic berm soils were excavated from around the circumference of each reservoir, outside and adjacent to the low permeability existing caps. The relic berm soils were removed to a depth of at least equal to the bottom of the existing low permeability cap, extending outward to at least 260 feet from the midpoint of the reservoir. Additional areas were excavated where soils were visibly impacted with residual liquid hydrocarbons.
2. Excavated soils were transported to an off-site thermal desorption facility for treatment that reduced hydrocarbon concentrations below those specified in the WDRs.
3. The LPCE was installed across the excavated area using approved import materials which met or exceeded the minimum thickness and complied with maximum permeability values specified in the WDRs.
4. Thermally treated relic berm soil was reused as cover soil over the LPCE to reestablish the existing grade.
5. Backfill soils were monitored and tested during placement and compaction to verify compliance with WDRs.
6. A report titled; Amendment 1 to the Backfill and Final Project Completion Report (i.e., this report), was prepared, documenting this phase of the work.

### Construction Process

The planned excavation area covered most of the site, allowing little room for materials storage and vehicle use. To increase the area of available ground space, the site was subdivided into four smaller work areas (phases). No more than two phases were excavated at any one time. Subdividing the project site into the four phases allowed for large vacant areas of land that were used for stockpiling import/export soils, truck loading/unloading, truck turn around, and construction equipment parking. The site was subdivided into the following four phases of relatively equal size.

Phase 1	Western Half of Reservoir 1
Phase 2	Western Half of Reservoir 2
Phase 3	Eastern Half of Reservoir 1
Phase 4	Eastern Half of Reservoir 2

Construction activities began in Phase 1 and continued sequentially through completion of Phase 4.

A single phase of construction typically consisted of the following sequence of events:

1. Removal of soils in the planned excavation area.
2. Over-excavation and replacement of unsuitable soils (i.e., soils wet with hydrocarbons or water) with treated soil, if necessary.
3. Installation of the LPCE.
4. Installation of cover soils to final grade.

The construction process within each phase began with removal of the planned excavation area. The planned excavation area consisted of a 37-foot wide band around the perimeter of each reservoir. The boundaries of this band of excavation were at a distance of 223 and 260 feet from the midpoints of each reservoir (Figure 1-2). The depth of the planned excavation area was to the base of the existing low permeability cap, generally 2.5 to 4 feet below ground surface elevation.

Subgrade soils which did not meet geotechnical or environmental standards were reworked or removed and replaced, as appropriate, to provide a stable base for clayey soil placement and compaction.

Soils removed from within the planned excavation area during Phase 1 included approximately 5 lateral feet of the pre-existing low permeability cap. The cap profile exposed in the excavation sidewall was measured and found to be 12 inches or greater in thickness throughout the profile in Phase 1. However, portions of the existing cap were measured to be less than the WDR specified minimum of 12-inches in Phases 2, 3 and 4. Lateral over-excavation was performed in these areas until a minimum thickness of 12 inches was exposed. Areas of lateral over-excavation are depicted on Figure 1-2 and shown in the As-Built drawings (Appendix G). The LPCE was tied in to the existing cap by benching the existing cap (including lateral removal of several feet of cover soil), placement of import clayey soils over the benched contacts, scarification, hydration, and compaction. The LPCE tie-in process is shown on Figure 1-3. A minimum LPCE thickness of 12-inches was confirmed by survey following each phase of construction.

Thermally treated soils originally excavated from the planned excavation areas were reused as cover soil over the completed LPCEs. Cover soils were visually monitored, sampled and analyzed to verify that hydrocarbon concentrations were less than WDR-specified values and to certify that cover soil was compacted to at least 90% of the maximum laboratory derived dry density. Final grading was performed after cover soil installation was complete. The final grade was designed to allow sheet flow runoff of rainfall to reduce the potential for soil erosion by water. The pre-existing dust control sprinkler system was also reconstructed, providing wind erosion protection for more than 70 percent of the property.

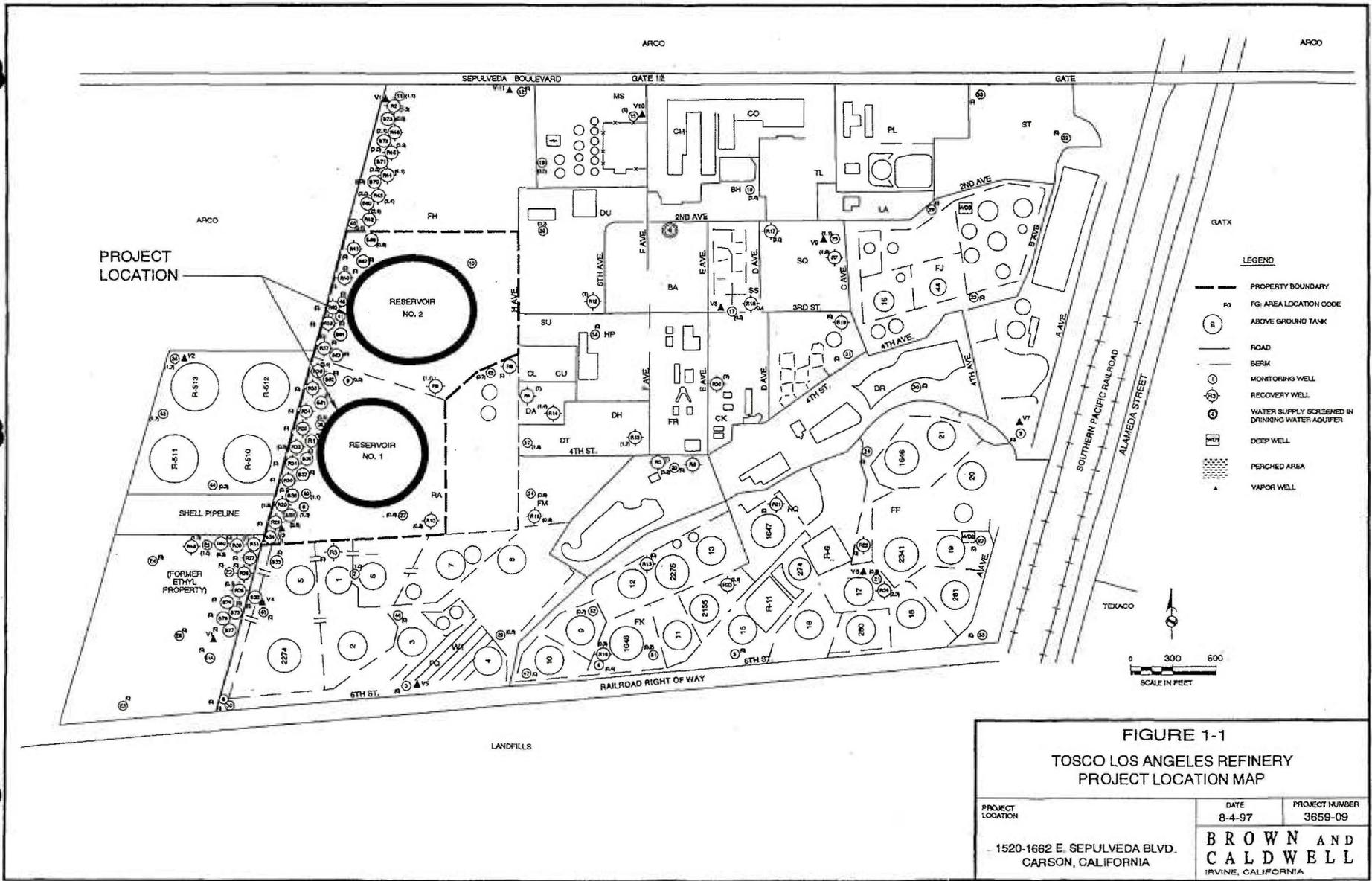
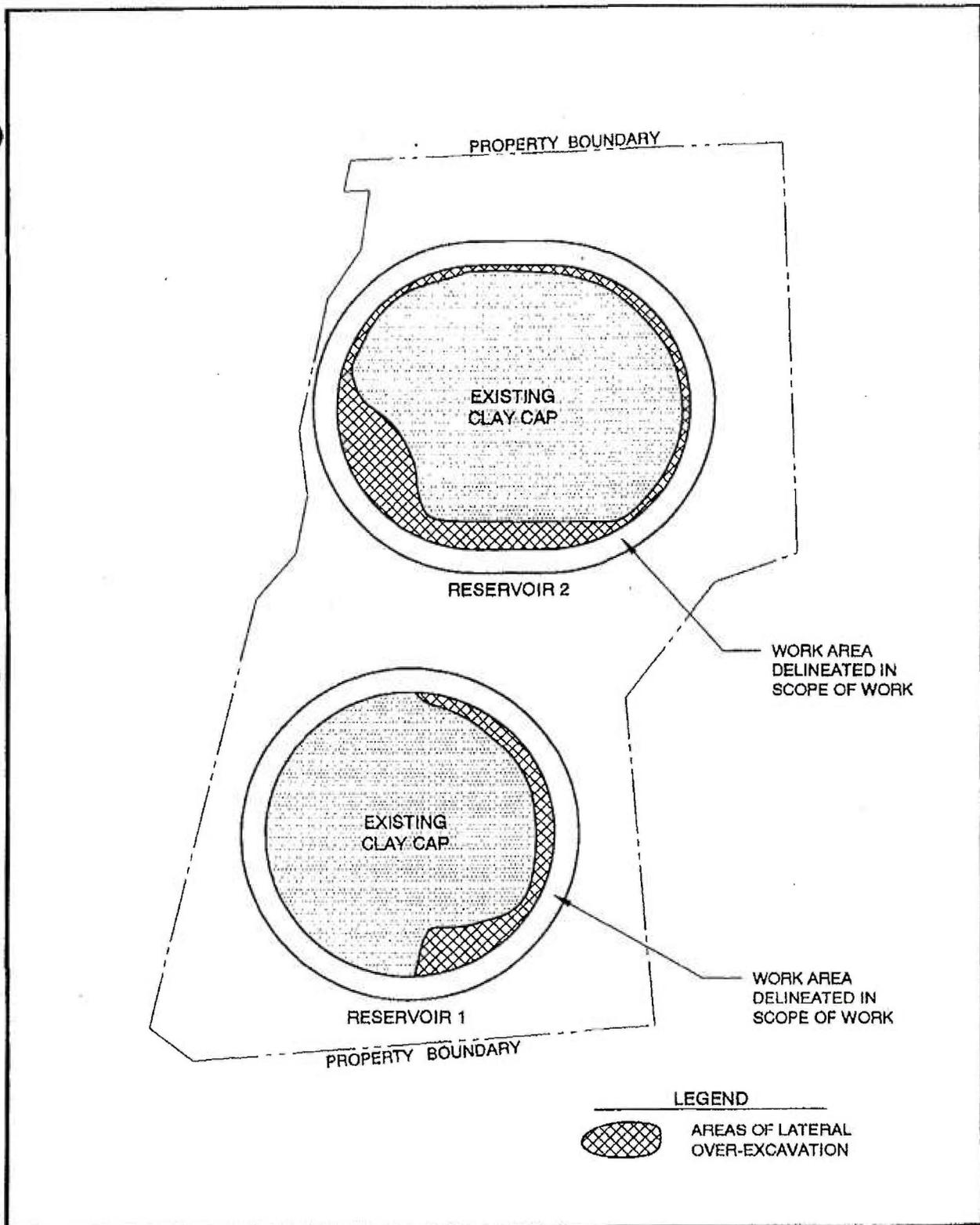


FIGURE 1-1  
 TOSCO LOS ANGELES REFINERY  
 PROJECT LOCATION MAP

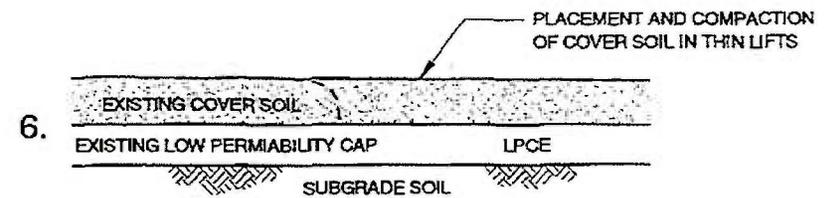
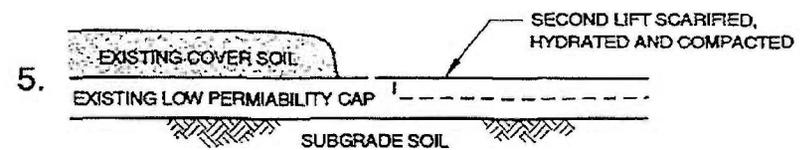
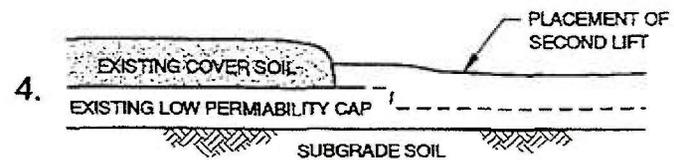
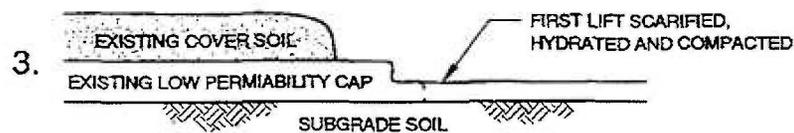
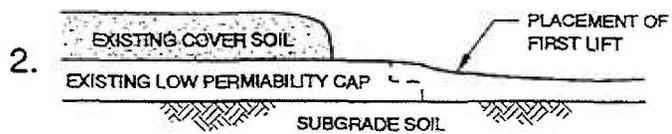
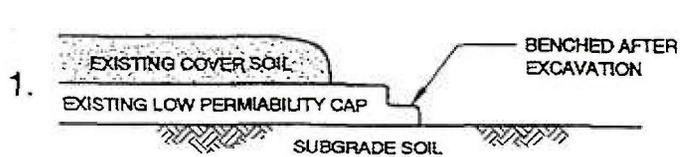
PROJECT LOCATION	DATE	PROJECT NUMBER
1520-1662 E. SEPULVEDA BLVD. CARSON, CALIFORNIA	8-4-97	3659-09
		<b>BROWN AND CALDWELL</b> IRVINE, CALIFORNIA

CU-00001-22



DATE 8-8-97		PROJECT NUMBER 3659-09		<b>WORK AREA SCHEMATIC</b>			
<b>BROWN AND CALDWELL</b> IRVINE, CALIFORNIA							

LARS006



**BROWN AND CALDWELL**  
IRVINE, CALIFORNIA

NOT TO SCALE

PROJECT NUMBER  
3659-09

DATE  
8-22-97

PROJECT LOCATION

1520-1662 E. SEPULVEDA BLVD.  
CARSON, CALIFORNIA

**FIGURE 1-3**  
PROFILE OF LPCE TIE-IN  
WITH EXISTING CAP

## CHAPTER 2

### SUBGRADE CHARACTERIZATION

Soils encountered in each excavation bottom were assessed to determine if they were suitable as subgrade. The assessment process consisted of visual evaluation and physical soil compaction testing. All subgrade soils were visually evaluated during excavation, scarification, and recompaction procedures. Soil compaction testing was performed in the field to determine if the minimum required compaction was achieved.

#### Visual Evaluation

The objective of the visual evaluation was to determine if the subgrade soils possessed the minimum engineering characteristics necessary to provide a solid foundation for the placement and compaction of fill soils. Any oil-saturated soils potentially associated with surface seeps and water-saturated soils required corrective action as described below.

Soils exposed during excavation which contained residual liquid hydrocarbons or were wet with hydrocarbons were removed for subsequent off-site treatment. Soils from which visible liquid hydrocarbons could be produced when a clump was squeezed by hand were considered "wet" with hydrocarbons. There were several areas of subgrade soil containing residual liquid hydrocarbons that required removal, but only a few isolated areas were actually wet with hydrocarbons. The removed soils were combined with soils from the planned excavation areas and exported to an off-site thermal treatment facility.

The subgrade soils were visually evaluated during excavation, scarification, and recompaction procedures. Areas which exhibited pumping, tracking, or other attributes indicative of soft subgrade soils were over-excavated and reworked or replaced with nearby soils of suitable moisture content.

#### Soil Compaction

In-place soil compaction testing was performed after subgrade soils were scarified, recompacted, and appeared suitable for additional soil placement. Relative percent of soil compaction was determined by dividing the field-calculated in-place dry density by the laboratory derived maximum dry density. Soils were reworked when test results indicated that compaction was less than 90 percent of the maximum dry density. All subgrade soils were determined by compaction testing to be at least 90 percent before successive fill soils were placed. Test methods, data, and results are summarized in the Final Compaction Report (Appendix C).

## CHAPTER 3

### LOW PERMEABILITY CAP CONSTRUCTION

A 37-foot wide lateral extension of the existing low permeability caps was constructed around each reservoir, extending the caps to a distance of at least 260 feet from the reservoir center points. The LPCEs were constructed of clayey soils that were imported from two separate off-site locations. The clayey soils were visually evaluated, field tested, sampled, and laboratory tested to verify compliance with the engineering specifications outlined in the WDRs and in the Work Plan.

Clayey soils procured by Lovco Construction Company and used for the construction of the LPCEs originated from construction sites identified as the "Hawaiian Gardens Site" and the "Lomita Site". Soils originating from the Hawaiian Gardens Site were used only in Phase 1 and comprised less than 20 percent of the soils used during LPCE construction. The remaining 80+ percent of the clayey soils originated from the Lomita Site and were used for Phases 2 through 4.

The clayey soils were hydrated, placed, and compacted in 6-inch thick lifts by Lovco Construction Company using a grader, bulldozer, and sheepsfoot compactor fitted with 6-inch pegs. The clayey soils were hydrated during placement and compaction using a water truck equipped with high-pressure spray fittings. The LPCE was tied in to the existing cap by benching the existing cap (including lateral removal of several feet of cover soil), placement of import clayey soils over the benched contact, scarification, hydration, and recompaction.

#### Material Type

The work plan specified that soils used in the low permeability cap extension must have a matrix composed of a high clay content. Example classifications include SC (clayey sand), CL (fat inorganic clay), and CH (lean inorganic clay). Soils from both source locations were laboratory tested in accordance with ASTM D 2487-90 to demonstrate compliance with the performance criteria defined in the WDRs and the Work Plan. The test results, summarized below in Table 3-1, indicate that the soils from both source locations were comprised predominantly of inorganic clay with a low permeability and complied with project requirements.

*Table 3-1 Soil Classification*

SITE	SOIL TYPE	PERMEABILITY	PHASE
Hawaiian Garden Site	Silty Clay ML-CL	3.06 E-8 cm/s	Phase 1
Lomita Site	Lean Clay CH	<1.00 E-10 cm/s	Phase 2, 3, 4

Laboratory test reports included in Appendix D provide specific test data supporting the above soil classifications.

### Density

The moisture-density relations for each soil type, including maximum dry density and optimum moisture content, were determined by laboratory testing (ASTM D 1557-78{90}). Field tests to determine in-place dry density were performed by sand cone method (ASTM D 1556-90). Percent compaction was calculated by dividing the field test value by the laboratory-derived dry density. Final density test results demonstrated that at least 90% of the laboratory-derived maximum dry density was achieved. Test methods, data, and results are summarized in the Final Compaction Report (Appendix C).

### Moisture

The moisture content of all soils was determined in the field by the direct heating test method (ASTM D 4959-89). Interim soil moisture testing was performed during soil hydration and placement to determine if additional moisture was needed. When test results indicated that the moisture content was in the acceptable moisture range, soil placement and compaction was performed. Final moisture content data was collected and recorded during soil density testing. Test results indicate that the clayey soils, as specified in the work plan, were placed and compacted at a moisture content within the range of -1 to +3 percent of their optimum moisture contents. Test results are summarized in the Final Compaction Report (Appendix C).

### Thickness

The thickness of the existing cap was measured in the excavation profile using a hand-held tape measure. In Phases 2, 3 and 4, portions of the existing cap were measured to be less than the WDR specified minimum of 12-inches. Lateral over-excavation was performed in these areas until a minimum thickness of 12 inches was exposed. Lateral over-excavation was performed in these areas until a minimum thickness of 12 inches was exposed. Areas of lateral over-excavation are depicted on Figure 1-2 and shown in the As-Built drawings (Appendix G).

The thickness of the LPCE was measured by Olsen and Detilla, a California licensed survey team. Ground surface elevation was surveyed before and after LPCE construction. LPCE thickness was determined by the difference of the top and bottom elevations measured at a particular survey point. Areas which measured less than 12 inches were thickened by adding more clayey soil, scarifying, and recompacting. The final survey of all LPCEs indicates a minimum 12 inch thickness throughout the work area. As-built drawings of the LPCE construction, certified by Parsons Process Group, are included as Appendix F.

### Permeability

Eight in-situ soil samples, four from each reservoir, were collected from the LPCEs and tested for permeability coefficient. One sample was collected from a randomly selected location within each quadrant of each reservoir. The samples were collected in 6-inch long brass sleeves from a depth interval of three to nine inches below top of LPCE elevation. The WDRs and work plan specify an in-situ permeability of  $1.0 \times 10^{-6}$  centimeters per second (cm/sec) or less.

The coefficient of permeability was determined by the EPA 9100 and reported in millidarcies and cm/sec. The following permeability coefficient results indicate that the LPCEs were constructed to project standards.

#### Reservoir 1 -

SW quadrant  $3.16 \times 10^{-7}$  cm/sec  
SE quadrant  $1.60 \times 10^{-7}$  cm/sec  
NE quadrant  $8.16 \times 10^{-8}$  cm/sec  
NW quadrant  $1.83 \times 10^{-7}$  cm/sec

#### Reservoir 2 -

SW quadrant  $2.56 \times 10^{-8}$  cm/sec  
SE quadrant  $5.41 \times 10^{-8}$  cm/sec  
NE quadrant  $3.39 \times 10^{-8}$  cm/sec  
NW quadrant  $2.83 \times 10^{-7}$  cm/sec

Analytical laboratory reports for the permeability tests are included in Appendix D.

## CHAPTER 4

### COVER SOIL CHARACTERIZATION

Thermally treated soils originating from the planned excavation areas were reused as cover soil over the completed LPCEs. Cover soils were monitored, sampled and analyzed to verify that hydrocarbon concentrations were less than WDR-specified values and to certify that cover soil was compacted to at least 90% of the maximum laboratory derived dry density.

Cover soils were sampled and tested for petroleum hydrocarbons at the frequencies specified below to demonstrate that soils placed into the reservoirs had contaminant concentrations less than the CRWQCB mandated discharge limits specified in the WDR. The discharge limits are summarized below:

Constituent	Limit	Test Method
Benzene	0.1 mg/kg	EPA Method 8015m 1 test/1,000 Yd <sup>3</sup>
Ethylbenzene	2.9 mg/kg	
Toluene	4.2 mg/kg	
Xylenes	1.7 mg/kg	
TPH		
C <sub>4</sub> to C <sub>12</sub>	1,000 mg/kg	EPA Method
C <sub>13</sub> to C <sub>22</sub>	10,000 mg/kg	8015m
C <sub>23</sub> to C <sub>28</sub>	15,000 mg/kg	1 test/500 Yd <sup>3</sup>
PNA's (in TCLP extract)	non detect at the PQL's	EPA Method 8270 1 test/1,000 Yd <sup>3</sup>

Soil compaction testing was also performed to verify that the cover soils were compacted to at least 90% of the maximum dry density. The cover soils were placed and compacted in successive lifts measuring approximately 6 inches in thickness. The final cover soil thickness was at least 1-foot.

#### Soil Hydrocarbon Evaluation

All relic berm soils from the planned excavation area were excavated, stockpiled, loaded into trucks, and transported to a fixed thermal desorption facility. After the soils were treated, they were hydrated to job specifications, loaded into trucks, and returned to the site for use as cover soils. The treated soils were either placed directly on the completed LPCE or were stockpiled adjacent to the excavation for future use. When needed, the soils were hydrated, placed, and compacted in thin lifts by the civil subcontractor. The WDRs specified that samples be collected and analyzed at the following frequencies:

Parameter	Sampling Frequency
Total Petroleum Hydrocarbons (TPH) (C <sub>4</sub> - C <sub>28</sub> )	Once/500 CY
Benzene, Toluene, Ethylbenzene, and Total Xylene Isomers (BTEX)	Once/1,000 CY
Semivolatile Organic Hydrocarbons	Once/1,000 CY

A minimum of one soil sample representative of every 500 cubic yards of cover soil was collected for analysis. Each sample was analyzed for TPH by EPA Method 8015 Modified with results reported in ranges C<sub>13</sub> to C<sub>22</sub> and C<sub>23</sub> to C<sub>28</sub>. Each sample was also analyzed for aromatic volatile organic compounds by EPA Method 5030/8015m with results reported as both TPH in the range of C<sub>6</sub> to C<sub>12</sub> and BTEX. Laboratory test results for BTEX were received at twice the frequency specified in the WDRs, as approved by CRWQCB personnel.

A minimum of one sample representative of every 1000 cubic yards of cover soil was analyzed for semivolatile organic compounds by EPA Method 8270 as specified in the WDRs. No samples had polynuclear aromatic hydrocarbons(PNA) at concentrations greater than 20 times the WDR limit, therefore, no analyses using the TCLP were warranted concentrations (as analyzed by EPA Method 8270) had exceeded 20 times the Practical Quantification Limit (PQL), the Toxicity Characteristic Leaching Procedure (TCLP) with EPA Method 8270 analysis was performed on that sample. PQLs are equal to 3.3 times the Reporting Detection Limit (RDL), which is an industry standard per the American Quality Standards.

### Sample Collection Procedures

Soil samples to be analyzed for petroleum hydrocarbons were collected from treated soil imported from the thermal treatment facility. Soil samples were collected from throughout the area of fill placement prior to compaction of fill soils. Soil sample locations were typically selected at random from within each 500 cubic yard area of fill. The samples were collected directly into sampling sleeves using a 6-inch long solid-barrel core sampler. The core sampler was equipped with two 2-inch diameter, 3-inch long brass or stainless steel sample sleeves. Samples were collected by driving the core sampler into the soils using a hand-driven slide hammer. The sampler was then extracted, retaining the soil sample within the core barrel. After each soil sample was hand-driven, the sample sleeves containing the soil were removed from the core barrel sampler. The lead sample sleeve (bottom 3-inch sleeve) was sealed at each end with a Teflon™ sheet secured by a tight-fitting plastic cap. Samples were generally collected from a depth of three to six inches below surface. Sample collection was conducted using Level D personal protective equipment including Nomex™ coveralls, hard hat, goggles, safety glasses, and work boots.

All exploration and sampling equipment was cleaned between sampling intervals by washing in a

Liquinox™ and water solution and rinsing with distilled water.

A sequential sample identification (ID) number was assigned to each sample at the time of sample collection. This ID number was marked on the sampling container at the time of sample collection, recorded on a drawing within the daily field notes, and recorded on the Chain of Custody (COC) record. Sample identification numbers, the location and identity of each sample were recorded on the field notes.

Pre-printed, gummed, waterproof labels were used on each sample container. Each label also included initials of sampler, sample identification number, method of analysis required, date and time of sampling, and project number. Labels were completed using waterproof ink pens. Each sample was placed in an ice-chilled cooler for delivery to the analytical laboratory following standard chain of custody procedures.

All pertinent field activities were recorded in a daily logbook. Entries included date, time of day, weather conditions, attending personnel and subcontractors, sampling locations and field observations.

#### Laboratory Analysis

Laboratory testing for aromatic volatile hydrocarbons was performed by EPA Method 5030/8015m (modified for gasoline-range hydrocarbons). Results were reported as: Benzene, Toluene, Ethylbenzene, Total Xylenes (BTEX); and Total Petroleum Hydrocarbons (TPH) for carbon chains ranging from C<sub>6</sub> to C<sub>12</sub>. No BTEX or TPH (C<sub>6</sub> to C<sub>12</sub>) was detected in any of the samples.

Laboratory testing for semivolatile hydrocarbons was performed by EPA Methods 8015m (modified for diesel-range hydrocarbons) and 8270. Results for EPA Method 8015m were reported as TPH for carbon chains ranging from C<sub>13</sub> to C<sub>22</sub> and C<sub>23</sub> to C<sub>28</sub>. Hydrocarbons in the C<sub>13</sub> to C<sub>22</sub> range were detected at concentrations from <10 to 40 mg/kg. Hydrocarbons in the C<sub>23</sub> to C<sub>28</sub> range were detected at concentrations from 11 to 290 mg/kg. These levels are significantly below the waste discharge limits specified by the CRWQCB.

EPA Method 8270 results were reported as 70 individual hydrocarbon compounds including polynuclear aromatic (PNA's). Only two samples had detectable levels of PNA's. Phenanthrene was detected in two soil samples at concentrations of 0.24 and 0.31 mg/kg. No samples had PNA's detected at concentrations greater than 20 times the laboratory Practical Quantification Limit (PQL); therefore, no samples were submitted for analysis of semivolatiles using the Toxicity Characteristic Leaching Procedure (TCLP).

Laboratory test results indicated that petroleum hydrocarbons in the thermally treated cover soils were at concentrations well below the limits defined in the WDRs and the work plan. Final laboratory test results representative of the cover soils placed over the LPCE are summarized on Table 4-1 and Table 4-2. The complete analytical reports are enclosed as Appendix E.

### **Soil Compaction**

Field tests to determine in-place dry density were performed by sand cone method (ASTM D 1556-90). Percent compaction was calculated by dividing the field test value by the laboratory-derived dry density. Final density test results demonstrated that at least 90% of the maximum dry density was achieved. Test methods, data, and results are summarized in the Final Compaction Report (Appendix C).

### **Final Grading**

Final grading was performed after cover soil installation was complete. The final grade was designed to allow sheet flow of rainfall runoff from the capped area to reduce the potential for soil erosion by water. The pre-existing dust control sprinkler system was also reconstructed, providing wind erosion protection for more than 70 percent of the property. The specifics of the fill grading and compaction are detailed in the approved grading and drainage plan included with the previous work plan reference. The surface condition will be monitored and maintained. Final grade is shown in the "as built" drawings included as Appendix G.

**Table 4-1.  
Summary of Analytical Results  
EPA Method 8015 Modified**

Representative Section	Initial Screening	Phase 1				Phase 2				Phase 3	
Sample Number	TS-1	TS-2	TS-4	TS-5	TS-7	TS-8	TS-9	TS-11	TS-12	TS-14	TS-15
<b>Volatile Hydrocarbons and Volatile Total Petroleum Hydrocarbons, EPA Method 8015 Modified, mg/kg</b>											
Benzene	<0.5	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Ethylbenzene	<0.5	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Toluene	<0.5	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Xylenes	<1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
TPH C6-C12	<10	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
<b>Semivolatile Total Petroleum Hydrocarbons, EPA Method 8015 Modified, mg/kg</b>											
TPH C13-C22	<100	<100	<100	<100	<100	<100	36	26	28	35	33
TPH C23-C28	<100	<100	105	<100	<100	<100	87	93	95	100	110

Representative Section	Phase 3					Phase 4					WDR Limits
Sample Number	TS-17	TS-19	TS-20	TS-21	TS-23	TS-24	TS-26	TS-27	TS-29	TS-31	
<b>Volatile Hydrocarbons and Volatile Total Petroleum Hydrocarbons, EPA Method 8015 Modified, mg/kg</b>											
Benzene	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.1
Ethylbenzene	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	2.9
Toluene	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	4.2
Xylenes	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	1.7
TPH C6-C12	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	1,000
<b>Semivolatile Total Petroleum Hydrocarbons, EPA Method 8015 Modified, mg/kg</b>											
TPH C13-C22	<10	<10	40	<20	37	22	10	<10	30	29	10,000
TPH C23-C28	51	23	290	165	130	61	23	11	48	52	15,000

Notes: < = Indicates that compound was not detected at specified detection limit.  
WDR = Waste Discharge Requirements

**Table 4-2.**  
**Summary of Analytical Results**  
**EPA Method 8270**

Representative Section	Phase 1		Phase 2	Phase 3			Phase 4				WDR Limit
	TS-3	TS-6	TS-10	TS-13	TS-16	TS-18	TS-22	TS-25	TS-28	TS-30	
<b>Sample Number</b>	TS-3	TS-6	TS-10	TS-13	TS-16	TS-18	TS-22	TS-25	TS-28	TS-30	
<b>Semivolatile Hydrocarbons, EPA Method 8270, mg/kg</b>											
Acenaphthene	<0.2	<0.2	<0.2	<0.2	<0.2	<1	<1	<2	<0.2	<2	14 <sup>1</sup>
Acenaphthylene	<0.2	<0.2	<0.2	<0.2	<0.2	<1	<1	<2	<0.2	<2	
Anthracene	<0.2	<0.2	<0.2	<0.2	<0.2	<1	<1	<2	<0.2	<2	14 <sup>1</sup>
Benzo(a)anthracene	<0.2	<0.2	<0.2	<0.2	<0.2	<1	<1	<2	<0.2	<2	14 <sup>1</sup>
Benzo(a)pyrene	<0.2	<0.2	<0.2	<0.2	<0.2	<1	<1	<2	<0.2	<2	
Benzo(b)fluoranthene	<0.2	<0.2	<0.2	<0.2	<0.2	<1	<1	<2	<0.2	<2	
Benzo(g,h,i)perylene	<0.2	<0.2	<0.2	<0.2	<0.2	<1	<1	<2	<0.2	<2	
Benzo(k)fluoranthene	<0.2	<0.2	<0.2	<0.2	<0.2	<1	<1	<2	<0.2	<2	
Chrysene	<0.2	<0.2	<0.2	<0.2	<0.2	<1	<1	<2	<0.2	<2	14 <sup>1</sup>
Dibenzo(a,h)anthracene	<0.2	<0.2	<0.2	<0.2	<0.2	<1	<1	<2	<0.2	<2	
Fluoranthene	<0.2	<0.2	<0.2	<0.2	<0.2	<1	<1	<2	<0.2	<2	14 <sup>1</sup>
Fluorene	<0.2	<0.2	<0.2	<0.2	<0.2	<1	<1	<2	<0.2	<2	14 <sup>1</sup>
Indeno(1,2,3-c,d)pyrene	<0.2	<0.2	<0.2	<0.2	<0.2	<1	<1	<2	<0.2	<2	
Naphthalene	<0.2	<0.2	<0.2	<0.2	<0.2	<1	<1	<2	<0.2	<2	14 <sup>1</sup>
Phenanthrene	<0.2	<0.2	<0.2	<b>0.24</b>	<b>0.31</b>	<1	<1	<2	<0.2	<2	14 <sup>1</sup>
Pyrene	<0.2	<0.2	<0.2	<0.2	<0.2	<1	<1	<2	<0.2	<2	14 <sup>1</sup>

Notes: < = Indicates that compound was not detected at the specified detection limit.

N/A = Not Applicable

WDR = Waste Discharge Requirements

1 = The WDR limit is equal to 20 times the Practical Quantification Limit.

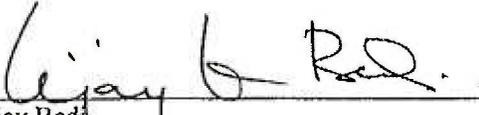
Samples with semivolatile concentrations above this value were submitted for analysis using the TCLP extraction and EPA Method 8270.

CHAPTER 5

SHELL OIL COMPANY CLOSURE STATEMENT

REGISTERED GEOLOGIST'S CERTIFICATION

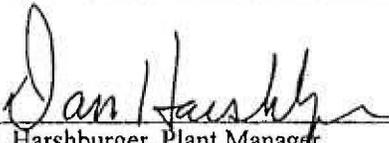
The enclosed report has been reviewed by a certified engineering geologist who is registered in the State of California and whose license number and signature appear below.

  
\_\_\_\_\_  
Vijay Bedi  
Registered Geologist, Certified Engineering Geologist  
R.G. 4015, C.E.G. 1247

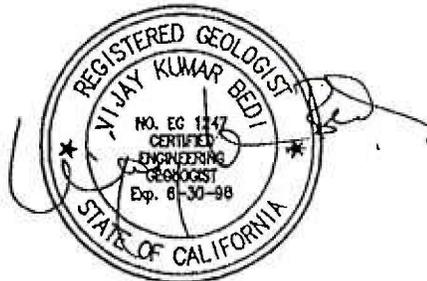
August 27, 1997  
Date

FACILITY OWNER/OPERATOR CERTIFICATION

I certify under penalty of law that this document and all attachments were prepared under my direction and supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who managed the project, to the best of my knowledge and belief the reservoirs closure was completed in accordance with the requirements and provisions of Order No. 94-112. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

  
\_\_\_\_\_  
D. Harshburger, Plant Manager  
Carson Plant  
Shell Oil Company

8-27-97  
Date



*Draft Report—Use or disclosure of data contained on this sheet is subject to the restriction specified at the beginning of this document.*

CHAPTER 5

SHELL OIL COMPANY CLOSURE STATEMENT

REGISTERED GEOLOGIST'S CERTIFICATION

The enclosed report has been reviewed by a certified engineering geologist who is registered in the State of California and whose license number and signature appear below.

\_\_\_\_\_  
Vijay Bedi  
Registered Geologist, Certified Engineering Geologist  
R.G. 4015, C.E.G. 1247

\_\_\_\_\_  
Date

FACILITY OWNER/OPERATOR CERTIFICATION

I certify under penalty of law that this document and all attachments were prepared under my direction and supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who managed the project, to the best of my knowledge and belief the reservoirs closure was completed in accordance with the requirements and provisions of Order No. 94-112. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

\_\_\_\_\_  
D. Harshburger, Plant Manager  
Carson Plant  
Shell Oil Company

\_\_\_\_\_  
Date

## REFERENCES

- Brown and Caldwell Consultants, 1989. *Reservoir Investigation*, Prepared for Shell Oil Company.
- Brown and Caldwell Consultants, 1993. *Berm Material Characterization of Reservoirs 1 and 2, Unocal Carson Refinery*, Prepared for Shell Oil Company.
- Brown and Caldwell Consultants, 1994a. *Berm Material and Underlying Soil Characterization of Reservoirs 1 and 2, Unocal Carson Refinery*, Prepared for Shell Oil Company.
- Brown and Caldwell Consultants, 1994b. *Supplemental Investigation of the Underlying Soil of Reservoirs 1 and 2, Unocal Carson Refinery*, Prepared for Shell Oil Company.
- Brown and Caldwell Consultants, 1995. *Backfill and Final Project Completion Report, Reservoirs 1 and 2, Unocal Carson Refinery*, Prepared for Shell Oil Company.
- Brown and Caldwell Consultants, 1996. *Sub-Grade Berm Soil Sampling at Reservoirs 1 and 2, Unocal Carson Refinery*, Prepared for Shell Oil Company.
- California Regional Water Quality Control Board, Los Angeles Region, 1994. *Shell Oil Company - 1520 to 1622 East Sepulveda Boulevard Carson - Waste Discharge Requirements for Closure of Reservoirs 1 and 2 (File No. 85-19)*.
- Shell Oil Company, 1994. *Work Plan, Reservoir Removal Project, Shell/Unocal Facility, 1520 - 1622 East Sepulveda Boulevard, Carson, California*.

**APPENDIX A**

*WASTE DISCHARGE REQUIREMENTS  
FOR CLOSURE OF RESERVOIRS 1 & 2  
(FILE NO. 85-19)*

**CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD  
LOS ANGELES REGION**

101 CENTRE PLAZA DRIVE  
MONTEREY PARK, CA 91754-2156  
(213) 266-7500  
FAX: (213) 266-7600



November 1, 1994

Mr. T. F. Maher  
Shell Oil Company - Carson Plant  
20945 S. Wilmington Avenue  
Carson, CA 90749

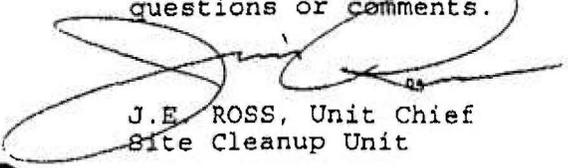
**SHELL OIL COMPANY - 1520 TO 1622 EAST SEPULVEDA BOULEVARD CARSON -  
WASTE DISCHARGE REQUIREMENTS FOR CLOSURE OF RESERVOIRS ONE & TWO  
(FILE NO. 85-19)**

Our letter of September 30, 1994, transmitted tentative waste discharge requirements for closure of two surface impoundments, referred to as Reservoirs One and Two, at the Wilmington Section of the former Shell Wilmington Manufacturing Complex.

Pursuant to Section 13263 of the California Code of Regulations, this Regional Board at a public hearing held on October 31, 1994, reviewed the tentative Order, considered all factors in the case, and adopted Order No. 94-112 and Monitoring and Reporting Program No. CI 7452 (copy attached) relative to the discharge. Please note that finding four, requirement one, provision six, and the expiration date were modified between September 30, 1994, and the adoption of the Order. These modifications were minor in nature.

The "Monitoring and Reporting Program" requires you to implement the monitoring program and submit your first technical report under this program by the 15th of the month following start-up of closure activities. Please reference all technical and monitoring reports to our Compliance File number CI 7452. We would appreciate it if you would not combine other reports, such as progress or technical, with your monitoring reports but would submit each type of report as a separate document. All monitoring reports should be sent to the Regional Board, ATTN: Technical Support Unit.

Please call Keith Elliott at (213) 266-~~7500~~ if you have any questions or comments. 7614

  
J.E. ROSS, Unit Chief  
Site Cleanup Unit

cc: See mailing list

Enclosures

Mr. T. F. Maher  
Shell Oil Company - Carson Plant  
Page 2

MAILING LIST

Mr. Archie Matthews, State Water Resources Control Board,  
Division of Water Quality  
Department of Toxic Substances Control, Region 4 - Long Beach  
South Coast Air Quality Management District  
U. S. Army Corps of Engineers  
Department of Interior, U. S. Fish and Wildlife Service  
Department of Fish and Game, Region 5  
Los Angeles County, Department of Public Works,  
Waste Management Division  
Los Angeles County, Fire Department - Health Hazardous  
Materials Division  
City of Carson, Department of Building and Safety  
Mr. Chris Nagler, Department of Water Resources  
Mr. Robert Hastings, Shell Oil Company - Houston Texas  
Ms. Meg George, Unocal Los Angeles Refinery - Carson Plant

State of California  
CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD  
LOS ANGELES REGION

ORDER NO. 94-112

WASTE DISCHARGE REQUIREMENTS  
FOR  
SHELL OIL COMPANY  
1520 TO 1622 EAST SEPULVEDA BOULEVARD  
CARSON CALIFORNIA  
(CLOSURE OF TWO SURFACE IMPOUNDMENTS)

(File No. 85-19)

The California Regional Water Quality Control Board, Los Angeles Region, finds:

1. Shell Oil Company (the discharger) has filed a report of waste discharge for the closure of two surface impoundments, Reservoir One and Reservoir Two. These reservoirs are located at the Wilmington Section of the former Shell Wilmington Manufacturing Complex, at 1520 to 1622 East Sepulveda Boulevard in Carson, California. These reservoirs were built in the 1920s and were originally used to store crude oil originating from the Signal Hill Oil Field. The reservoirs were also used occasionally to store vacuum tower feed oil and coker feed oil which are heavier intermediates. In addition, Reservoir Two occasionally stored marine fuel oil. The reservoirs were in continuous use until December 1991, when they were drained and scheduled for shutdown and eventual dismantling after Unocal purchased the facility. Under the terms of the sale of the facility to Union Oil Company of California (dba Unocal Los Angeles Refinery-Carson Plant) in December 1991, Shell retained the responsibility for closure of the reservoirs.
2. The reservoir berms are about 18 feet above refinery grade and have approximate slopes of 1.5 to 1 on both the inside and outside walls. The bottoms of the reservoirs are about 15 feet below refinery grade. The top and outside walls were covered with asphalt and the inside walls and bottoms were lined with concrete.
3. On August 31, 1994, staff granted the discharger permission to remove and crush the concrete liner covering the interior berm walls and floor of each reservoir and to remove any soils under the liner that are saturated with hydrocarbons for disposal off-site at a licensed point of disposal. With the liner removed, a more accurate estimation of the volume of material requiring remediation can be determined.

Shell Oil Company  
1520 to 1622 East Sepulveda Boulevard, Carson  
(Closure of Two Surface Impoundments)

Order No. 94-112

4. The proposed TPH soil cleanup levels detailed in the requirements section of this Order have been developed by staff from research conducted by the Western States Petroleum Association (WSPA). Staff have modified the application of these levels to reflect conservatism. The Technical Review Committee (TRC), formed to review soil cleanup criteria, is planning on recommending use of these levels in appropriate cases and we believe issuing this Order will allow a test case application at a real site. Since this Order applies to a smaller site cleanup within a larger area cleanup, staff believes this provides an excellent opportunity for collection of data to determine suitability of using levels higher than those previously used with little or no risk to the environment in an actual case.
5. Subsurface investigations in Reservoir One identified petroleum-hydrocarbon-contaminated soils, up to 71,000 mg/kg total recoverable petroleum hydrocarbons (TRPH), 16.5 feet below the reservoir bottom (brb). Petroleum-hydrocarbon-contamination (63 mg/kg TRPH) was identified as deep as 46.5 feet brb. Subsurface investigations in Reservoir Two identified petroleum-hydrocarbon-contaminated soils, up to 36,000 mg/kg TRPH, 26.5 feet brb. Petroleum-hydrocarbon-contamination (21 mg/kg TRPH) was identified as deep as 51.5 feet brb. Analyses of 30 soil samples from Reservoir One and 17 soil samples from Reservoir Two indicate that the ratio of asphaltenes to TRPH, in the soils underlying the reservoirs, range from a low of 1% to a high of 51% with an average of 15%. This indicates the soil contamination has a large percentage of petroleum-hydrocarbon contamination lighter and more mobile than asphaltenes.
6. Free-phase petroleum hydrocarbon has previously been identified on the ground water underlying the reservoirs. Subsurface investigations at the site indicate that this ground water pollution originated from on-site and off-site sources other than the reservoirs. Remediation and monitoring of this pollution is addressed under Cleanup and Abatement Order No. 88-69.
7. Cleanup and Abatement Order No. 88-69, adopted by this Regional Board on June 27, 1988, directed Shell Oil Company to cleanup and abate the ground water pollution caused by the uncontrolled release of hydrocarbons, including refined product, from their Wilmington Manufacturing Complex (WMC). Under the terms of the sale of the Shell Wilmington Section of the WMC to Unocal in December 1991, Unocal is responsible for

Shell Oil Company  
1520 to 1622 East Sepulveda Boulevard, Carson  
(Closure of Two Surface Impoundments)

Order No. 94-112

all provisions of Cleanup and Abatement Order No. 88-69, as they apply to the Wilmington Section.

8. The Regional Board adopted a revised Water Quality Control Plan for the Los Angeles River Basin (4B) on June 3, 1991. The plan contained water quality objectives for ground water within the Coastal Plain of Los Angeles County. The requirements contained in this Order, as they are met, will be in conformance with the goals of the Water Quality Control Plan.
9. Three basic aquifer units (Gage, Lynwood, and Silverado) are found beneath the site. The Gage aquifer is from about 40 feet bgs to about 200 feet bgs. The Lynwood aquifer is located from about 200 feet to about 400 feet bgs. Below and hydraulically connected through an unnamed aquiclude from about 350 feet to 400 feet below ground surface is the Silverado aquifer. The Dominguez Gap Barrier Project, which is designed to impede sewer intrusion into the Gaspur, Gage, and Lynwood aquifers, is located about two-thirds of a mile east of the site.
10. Ground water in the Coastal Plain is beneficially used for municipal and domestic supply, agricultural supply, and industrial service and process supply. Ground water in the first aquifer underlying this site is typically low in yield and high in salinity. Ground water in the Silverado aquifer is usually of the best quality and quantity.
11. Water levels beneath the facility vary from 60 feet bgs in five perched aquifers to about 80 feet bgs in the semi-perched aquifer. The ground water flow in the semi-perched aquifer is to the west in the eastern portion and to the northwest in the western portion. Ground water beneath the reservoirs is 73 feet bgs or 58 feet brb.
12. A January 1991 report by Brown and Caldwell identified the presence of TPH and toluene, xylene, and ethylbenzene in three deep (200 feet bgs) ground water monitoring wells screened in the Gage aquifer. These wells were also sampled in May 1990 and April/May 1991 identifying low concentration levels of phenolic compounds and benzene (only in WD-3 in May 1990). The water supply well WW-4 screened in the Silverado aquifer did not detect any contaminants above the detection limits when tested in May 1990 and April/May 1991.
13. A 72-well light nonaqueous phase liquid (LNAPL) hydrocarbon recovery system has been installed. The system consists of 48

Shell Oil Company  
1520 to 1622 East Sepulveda Boulevard, Carson  
(Closure of Two Surface Impoundments)

Order No. 94-112

hydraulically downgradient LNAPL containment wells along the western property line and 24 wells located in the interior of the plant. The waste water disposal problem that has delayed operation of the recovery system has recently been resolved and start-up of this system is anticipated to begin by December 1994.

14. A grading and drainage plan for the engineered grading of 135,000 cubic yards of material, prepared by the Ralph M. Parsons Company, was approved on July 2, 1994, by the County of Los Angeles Department of Public Works Land Development Division.
15. This project involves an action taken for the protection of the environment and as such is exempt from the provisions of the California Environmental Quality Act (Public Resources Code, commencing with Section 21100) in accordance with Section 15321, Chapter 3, Title 14, of the California Code of Regulations.

The Regional Board has notified the discharger and interested agencies and persons of its intent to adopt waste discharge requirements for this discharge and has provided them with an opportunity to submit their written views and recommendations.

The Regional Board, in a public meeting, heard and considered all comments pertaining to the discharge and to the tentative requirements.

IT IS HEREBY ORDERED that Shell Oil Company (the discharger), in order to meet the provisions contained in Division 7 of the California Water Code and regulations adopted thereunder, shall comply with the following:

- A. Waste discharge requirements:
  1. Any soils placed into or onto the reservoirs shall have contaminant concentrations less than the following discharge limits:

Shell Oil Company  
1520 to 1622 East Sepulveda Boulevard, Carson  
(Closure of Two Surface Impoundments)

Order No. 94-112

<u>CONSTITUENT</u>	<u>LIMIT</u> (mg/kg)
<u>ORGANIC COMPOUNDS</u>	
Aromatic Volatile Organic Compounds	
benzene	0.1
ethylbenzene	2.9
toluene	4.2
xylene	1.7
Total Petroleum Hydrocarbons (EPA Method 8015)	
C <sub>4</sub> - C <sub>12</sub>	1,000
C <sub>13</sub> - C <sub>22</sub>	10,000
C <sub>23</sub> .	15,000
Polynuclear Aromatic Hydrocarbons in the Toxic Characteristic Leaching Potential (TCLP) extract (mg/l).	Non-detect <sup>1</sup>

2. Within 60 days of this Order the discharger shall submit for approval by the Executive Officer a plan for closure of the reservoirs in accordance with the requirements of Chapter 15, Title 23, California Code of Regulations (hereafter referred to as Chapter 15). The plan shall specify the placement of a cap or cover with a permeability of  $1 \times 10^{-6}$  cm/sec or less, precipitation and drainage controls, and post-closure maintenance including but not limited to Article 4, Article 8, and Article 9 - Section 2596 and Section 2597 of Chapter 15. In addition, the plan shall specify the removal of all soils which exhibit the presence of free-phase petroleum hydrocarbon.
3. Backfill material must be compacted to 90% compaction to ensure maximum cap protection and ensure maximum usefulness of the site.
4. The current ground water monitoring program, required under cleanup and abatement Order No. 88-69, may be used to show compliance with Section 2550.8 of the Code for this waste management unit.

---

<sup>1</sup> Non-detect in TCLP extract at the practical quantification limits of detection for each compound.

Shell Oil Company  
1520 to 1622 East Sepulveda Boulevard, Carson  
(Closure of Two Surface Impoundments)

Order No. 94-112

5. Within 30 days of completing the closure of the reservoirs, in accordance with the above approved closure plan, the discharger shall submit a report documenting the closure.
6. Any off-site disposal of wastes shall be to a legal point of disposal. For the purpose of these requirements, a legal point of disposal is defined as one for which waste discharge requirements have been established by a California Regional Water Quality Control Board, and which is in full compliance therewith.
7. Any material handling shall be in such a manner as to prevent its reaching surface waters or water courses.

B. PROVISIONS

1. A copy of this Order shall be maintained at the discharge facility and be available at all times to operating personnel.
2. This Order includes "Standard Provisions Applicable to Waste Discharge Requirements". If there is any conflict between provisions stated herein and the "Standard Provisions Applicable to Waste Discharge Requirements", these provisions stated herein will prevail.
3. The enclosed Monitoring and Reporting Program is made a requirement of this Order.
4. Neither the disposal nor any handling of waste shall cause pollution or nuisance odor at the facility boundary.
5. The discharger must notify this Board by telephone within 24 hours, followed by written notification within one week, in the event they are unable to comply with any of the conditions of this Order due to:
  - a. Breakdown of waste treatment equipment,
  - b. Accidents caused by human error or negligence,
  - c. Other causes such as acts of nature, or
  - d. Facility operations.

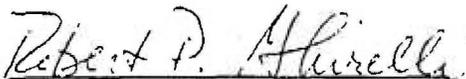
Shell Oil Company  
1520 to 1622 East Sepulveda Boulevard, Carson  
(Closure of Two Surface Impoundments)

Order No. 94-112

6. This Order is not intended to permit or allow the discharger to cease any work required by any other Order issued by this Regional Board, nor shall it be used as a reason to stop or redirect any investigation or mitigation activities not required by this Order or any other agency.
7. These requirements do not exempt the discharger from compliance with any other laws, regulations, or ordinances which may be applicable, they do not legalize these waste treatment and disposal facilities and they leave unaffected any further restraints on those facilities which may be contained in other statutes or required by other agencies.
8. Compliance with this Order does not release the discharger from the responsibility for correcting any future problems that may arise during subsequent use of the land and result from contamination left in place at this time.

C. Expiration Date: This Order expires on October 31, 1995.

I, Robert P. Ghirelli, Executive Officer, do hereby certify that the foregoing is a full, true and correct copy of an Order adopted by the California Regional Water Quality Control Board, Los Angeles Region on October 31, 1994.

  
ROBERT P. GHIRELLI, D.Env.  
Executive Officer

STATE OF CALIFORNIA  
CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD  
LOS ANGELES REGION

MONITORING AND REPORTING PROGRAM NO. CI 7452  
FOR  
SHELL OIL COMPANY  
1520 TO 1622 EAST SEPULVEDA BOULEVARD, CARSON  
(CLOSURE OF TWO SURFACE IMPOUNDMENTS)

(File No. 85-19)

The discharger shall implement this Monitoring and Reporting Program on the date of issuance of the Waste Discharge Requirements. The reports detailed in Order No. 94-112 (hereafter the Order) shall be submitted as required.

The first monthly monitoring report under this program is due on the 15th of the month following start-up of closure activities for the previous month.

I. GROUND WATER MONITORING

Ground water monitoring reports shall be submitted according to Cleanup and Abatement Order Number 88-69.

II. EXCAVATION MONITORING

A sampling grid shall be established for the reservoirs prior to backfilling. Sampling locations shall be located where representative soil samples can be obtained. Soil samples shall be collected and analyzed for the following Parameters:

<u>Parameter</u>	<u>Unit</u>	<u>Frequency</u>
Total Petroleum Hydrocarbons (EPA Method 8015-C, to C <sub>11</sub> Hydrocarbon Scan)	mg/kg	Once/5,000 sq. ft.
Aromatic Volatile Organic Compounds (EPA Method 8240 or Method 8020)	µg/kg	Once/5,000 sq. ft.
Semivolatile Organic Hydrocarbons (EPA Method 8270)	mg/kg and mg/l <sup>1</sup>	Once/5,000 sq. ft.

---

<sup>1</sup> Results of TCLP extractions are reported in mg/l.

Monitoring and Reporting Program For  
Shell Oil Company  
1520 to 1622 East Sepulveda Boulevard, Carson  
(Closure of Two Surface Impoundments)

Order No. 94-112  
CI No. 7452

### III. BACKFILL SOIL CHARACTERIZATION

All backfill soil shall be tested, characterized and determined to be clean soils before it is discharged into the reservoirs. The discharger shall collect representative samples of this material and analyze it as follows:

<u>Parameter</u>	<u>Unit</u>	<u>Frequency</u>
Total Petroleum Hydrocarbons (TPH) (EPA Method 8015-C, to C <sub>28</sub> Hydrocarbon Scan)	mg/kg	Once/500 CY
Aromatic Volatile Organic Compounds (EPA Method 8240 or Method 8020 or Method 8015M)	µg/kg	Once/1,000 CY
Semivolatile Organic Hydrocarbons (EPA Method 8270)	mg/kg	Once/1,000 CY

### III. GENERAL PROVISIONS FOR SAMPLING AND ANALYSIS

- A. All chemical, bacteriological, and bioassay analyses shall be conducted at a laboratory certified for such analyses by the State Department of Health Services, or approved by the Executive Officer. No changes shall be made in sampling points without prior approval of the Executive Officer.
- B. All verification sampling require 72 hours written and verbal notice to the Board in order for staff to participate in the sampling.

### V. SPECIFIC REPORTING REQUIREMENTS

- A. The following technical reports shall be filed with the Regional Board:
  1. A "Closure Plan for Reservoirs One and Two" shall be submitted within 60 days of the adoption of the Order, as required in Requirement A.2. of the Order.
  2. A "Petroleum Hydrocarbon Contamination Removal Report", shall be submitted within 30 days of removal of contaminated soil for treatment. This report shall describe the facility name, and location where the contaminated soil is treated. This report shall summarize

Monitoring and Reporting Program For  
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(Closure of Two Surface Impoundments)

Order No. 94-112  
CI No. 7452

all final verification sampling, summarize the final hydrocarbon contamination levels underlying the reservoirs, including laboratory analysis data, and indicate the quantity and the final disposition of any material removed from the reservoirs for treatment. The report shall include all data collected to date verifying that cleanup levels set by the Order have been met.

3. A "Backfill and Final Project Completion Report" shall be submitted within 30 days of completing backfill of the reservoirs, verifying that the backfilling and cleanup or the construction of a low permeability cap were completed according to the closure plan approved by the Executive Officer, according to Requirement A.2. of the Order. A statement, signed by a responsible official of the Shell Oil Company, shall be included stating that the closure was completed in accordance with the requirements and provisions of Order No. 94-112 and all other signed statements required by the Order shall also be included.
- B. All technical reports prepared for submittal to the Regional Board shall be signed by either a California registered Civil Engineer, a registered geologist, or certified engineering geologist.
- C. In reporting the monitoring data, the discharger shall arrange the data in tabular form so that the data, the constituents, and the concentrations are readily discernible. The data shall be summarized to determine compliance with waste discharge requirements and, where applicable, shall include receiving ground water observations.
- D. Monitoring reports submitted to the Regional Board shall be signed by:
  1. In the case of a corporation, the principal executive officer, at least of the level of Vice President or his duly authorized representative, if such representative is responsible for the overall operation of the facility from which the discharge originates;
  2. In case of a partnership, a general partner;
  3. In case of a sole proprietorship, the proprietor;
  4. In the case of a municipal, state or public facility, either a principal executive officer, ranking elected official, or other duly authorized employee.

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Each report shall contain the following completed declaration:

" I declare under penalty of perjury that the foregoing is true and correct.

Executed on the day of \_\_\_\_\_ at \_\_\_\_\_

\_\_\_\_\_ (Signature)

\_\_\_\_\_ (Title)"

- E. For every item where the requirements are not met the discharger shall submit a statement of the actions undertaken or proposed, together with a timetable, to bring the discharge back into full compliance with the requirements at the earliest time.

Ordered by

Robert P. Ghirelli  
ROBERT P. GHIRELLI, D.Env.  
Executive Officer

Date: October 31, 1994

STANDARD PROVISIONS  
APPLICABLE TO WASTE DISCHARGE REQUIREMENTS

1. DUTY TO COMPLY

The discharger must comply with all conditions of these waste discharge requirements. A responsible party has been designated in the Order for this project, and is legally bound to maintain the monitoring program and permit. Violations may result in enforcement actions, including Regional Board orders or court orders requiring corrective action or imposing civil monetary liability, or in modification or revocation of these waste discharge requirements by the Regional Board. [CWC Section 13261, 13263, 13265, 13268, 13300, 13301, 13304, 13340, 13350].

2. GENERAL PROHIBITION

Neither the treatment nor the discharge of waste shall create a pollution, contamination or nuisance, as defined by Section 13050 of the California Water Code (CWC). [H & SC Section 5411, CWC Section 13263]

3. AVAILABILITY

A copy of these waste discharge requirements shall be maintained at the discharge facility and be available at all times to operating personnel. [CWC Section 13263]

4. CHANGE IN OWNERSHIP

The discharger must notify the Executive Officer, in writing at least 30 days in advance of any proposed transfer of this Order's responsibility and coverage to a new discharger. The notice must include a written agreement between the existing and new discharger containing a specific date for the transfer of this Order's responsibility and coverage between the current discharger and the new discharger. This agreement shall include an acknowledgement that the existing discharger is liable for violations up to the transfer date and that the new discharger is liable from the transfer date on. [CWC Sections 13267 and 13263]

5. CHANGE IN DISCHARGE

In the event of a material change in the character, location, or volume of a discharge, the discharger shall file with this Regional Board a new Report of Waste Discharge. [CWC Section 13260(c)]. A material change includes, but is not limited to, the following:

Standard Provisions Applicable to  
Waste Discharge Requirements

9. SEVERABILITY

Provisions of these waste discharge requirements are severable. If any provision of these requirements are found invalid, the remainder of these requirements shall not be affected. [CWC 921]

10. OPERATION AND MAINTENANCE

The discharger shall, at all times, properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) which are installed or used by the discharger to achieve compliance with conditions of this Order. Proper operation and maintenance includes effective performance, adequate funding, adequate operator staffing and training, and adequate laboratory and process controls including appropriate quality assurance procedures. This provision requires the operation of backup or auxiliary facilities or similar systems only when necessary to achieve compliance with the conditions of this Order. [CWC Section 13263(f)]

11. HAZARDOUS RELEASES

Except for a discharge which is in compliance with these waste discharge requirements, any person who, without regard to intent or negligence, causes or permits any hazardous substance or sewage to be discharged in or on any waters of the State, or discharged or deposited where it is, or probably will be, discharged in or on any waters of the State, shall, as soon as (a) that person has knowledge of the discharge, (b) notification is possible, and (c) notification can be provided without substantially impeding cleanup or other emergency measures, immediately notify the Office of Emergency Services of the discharge in accordance with the spill reporting provision of the State toxic disaster contingency plan adopted pursuant to Article 3.7 (commencing with Section 8574.7) of Chapter 7 of Division 1 of Title 2 of the Government Code, and immediately notify the State Board or the appropriate Regional Board of the discharge. This provision does not require reporting of any discharge of less than a reportable quantity as provided for under subdivisions (f) and (g) of Section 13271 of the Water Code unless the discharger is in violation of a prohibition in the applicable Water Quality Control plan. [CWC Section 13271(a)]

Standard Provisions Applicable to  
Waste Discharge Requirements

14. MONITORING PROGRAM AND DEVICES

The discharger shall furnish, under penalty of perjury, technical monitoring program reports; such reports shall be submitted in accordance with specifications prepared by the Executive Officer, which specifications are subject to periodic revisions as may be warranted. [CWC Section 13267]

All monitoring instruments and devices used by the discharger to fulfill the prescribed monitoring program shall be properly maintained and calibrated as necessary to ensure their continued accuracy. All flow measurement devices shall be calibrated at least once per year, or more frequently, to ensure continued accuracy of the devices. Annually, the discharger shall submit to the Executive Officer a written statement, signed by a registered professional engineer, certifying that all flow measurement devices have been calibrated and will reliably achieve the accuracy required.

Unless otherwise permitted by the Regional Board Executive officer, all analyses shall be conducted at a laboratory certified for such analyses by the State Department of Health Services.—The Regional Board Executive Officer may allow use of an uncertified laboratory under exceptional circumstances, such as when the closest laboratory to the monitoring location is outside the State boundaries and therefore not subject to certification. All analyses shall be required to be conducted in accordance with the latest edition of "Guidelines Establishing Test Procedures for Analysis of Pollutants" [40 CFR Part 136] promulgated by the U.S. Environmental Protection Agency. [CCR Title 23, Section 2230]

15. TREATMENT FAILURE

In an enforcement action, it shall not be a defense for the discharger that it would have been necessary to halt or to reduce the permitted activity in order to maintain compliance with this Order.—Upon reduction, loss, or failure of the treatment facility, the discharger shall, to the extent necessary to maintain compliance with this Order, control production or all discharges, or both, until the facility is restored or an alternative method of treatment is provided. This provision applies, for example, when the primary source of power of the treatment facility fails, is reduced, or is lost. [CWC Section 13263(f)]

Standard Provisions Applicable to  
Waste Discharge Requirements

of any unresolved litigation regarding this discharge or when requested by the Regional Board Executive Officer.

Records of monitoring information shall include:

- (a) The date, exact place, and time of sampling or measurements;
  - (b) The individual(s) who performed the sampling or measurements;
  - (c) The date(s) analyses were performed;
  - (d) The individual(s) who performed the analyses;
  - (e) The analytical techniques or method used; and
  - (f) The results of such analyses.
19. (a) All application reports or information to be submitted to the Executive Officer shall be signed and certified as follows:
- (1) For a corporation -- by a principal executive officer or at least the level of vice president.
  - (2) For a partnership or sole proprietorship -- by a general partner or the proprietor, respectively.
  - (3) For a municipality, state, federal, or other public agency -- by either a principal executive officer or ranking elected official.
- (b) A duly authorized representative of a person designated in paragraph (a) of this provision may sign documents if:
- (1) The authorization is made in writing by a person described in paragraph (a) of this provision.
  - (2) The authorization specifies either an individual or position having responsibility for the overall operation of the regulated facility or activity; and

Standard Provisions Applicable to  
Waste Discharge Requirements

the Regional Board showing flow volumes will be prevented from exceeding capacity, or how capacity will be increased, within 120 days after providing notification to the Regional Board, or within 120 days after receipt of notification from the Regional Board, of a finding that the treatment plant will reach capacity within four years. The time for filing the required technical report may be extended by the Regional Board. An extension of 30 days may be granted by the Executive Officer, and longer extensions may be granted by the Regional Board itself. [CCR Title 23, Section 2232]

**APPENDIX B**

*AMENDMENT NO. 1,  
WORK PLAN FOR CLOSURE,  
RESERVOIR REMOVAL PROJECT*

AMENDMENT NO. 1  
WORK PLAN FOR CLOSURE

RESERVOIR REMOVAL PROJECT

SHELL/UNOCAL FACILITY  
1520-1622 EAST SEPULVEDA BLVD.  
CARSON, CA  
(FILE NO. 85-19)

INTRODUCTION

This amendment to the November 1994 work plan describes the remaining activities required to complete the removal and closure of two historic crude oil reservoirs. The reservoirs, known as Reservoirs 1 and 2, are located at the Wilmington Section of the former Shell Oil Company Wilmington Manufacturing Complex, at 1520-1662 East Sepulveda Boulevard in Carson, CA. This site is now the UNOCAL Los Angeles Refinery - Carson Plant.

The reservoirs were built in the 1920's and were originally used to store crude oil. Later, they were also used to store heavier refinery intermediate streams such as vacuum flasher feed and coker feed. Reservoir 2 was occasionally used to also store marine fuel oil. The reservoirs were in continuous use until December 1991.

Each reservoir was constructed as an excavated center depression encircled by elevated soil berms. The interior berm walls and floors of each reservoir were surfaced with steel reinforced concrete. The top and outside perimeter of the berm walls were asphalt-covered. There was a roof supported by timbers covering each reservoir.

Waste Discharge Requirements (WDR's) for Closure of Two Surface Impoundments (Order No. 94-112), were issued by the California Regional Water Quality Control Board (CRWQCB), Los Angeles Region (File No. 85-19) in October of 1994. The WDR's detailed in the CRWQCB Monitoring and Reporting Program No. CI 7452, dated October 1994, include guidelines for groundwater monitoring, excavation monitoring, backfill soil characterization, general provisions for sampling and analysis, and specific reporting requirements.

Previous reservoir work completed to date includes:

- a) emptying the reservoirs,
- b) dismantling and removal of the roofs and concrete liners,
- c) backfilling the reservoir depressions with berm soils that were mechanically blended to meet established WDR's,
- d) compacting the backfill to at least 90% compaction,
- e) covering the backfill soils with clay caps and cover soil.

Completion of this work was documented in a report titled, "Backfill and Final Project Completion Report, Reservoirs 1 and 2" dated October, 1995 and transmitted to the CRWQCB with a letter dated November 1, 1995.

It was originally anticipated that completion of the above steps would result in a satisfactory closure. However, soils near the surface in the relic berms exhibited localized bleeding of hydrocarbons to the surface. These hydrocarbon impacts were observed in fine sandy soils located beyond the perimeter of the existing clay caps. Consequently, additional site assessment work was performed across the relic berms as described in the report titled, "Sub-Grade Berm Soil Sampling at Reservoirs 1 and 2", dated May 17, 1996. Upon review of this report, the CRWQCB requested this amended work plan.

### SCOPE OF PROJECT

The scope of this work plan amendment is to complete closure of the reservoirs. All work will meet or exceed applicable WDR's. Work necessary to complete the closure of the reservoirs are as follows:

1. Excavation of relic berm soils from around the circumference of each reservoir, outside and adjacent to the existing clay caps. Relic berm soils will be removed to a depth equal to the bottom of the existing clay cap, extending outward to the midpoint of the relic berms.
2. Treat the excavated soil in a thermal desorption unit to reduce hydrocarbon concentrations in soil to below the specified WDR's.
3. Extend the clay cap across the excavated area using approved import materials which exceed minimum thickness and comply with maximum permeability values as specified in the WDR's.
4. Reuse the treated relic berm soil, as feasible, for backfill over the clay cap to reestablish the existing grade.
5. Sample and analyze backfill soils during placement and compaction to verify compliance with WDR's.
6. Completion and submittal of a Backfill and Final Project Completion Report (Amendment 1), documenting this phase of the work.

Note: Any residual liquid hydrocarbons or soils that are wet with hydrocarbons (soils from which liquid hydrocarbons can be produced when a clump is squeezed by hand) which are exposed during the excavation will be removed for treatment or offsite disposal in compliance with WDR's.

The following sections provide additional details for the activities described above.

### LOW PERMEABILITY COVER INSTALLATION

A low permeability cover will be installed consisting of a clay liner and a protective cover layer consisting of treated backfill (relic berm) soils. Soils will be tested using approved ASTM standards. The clay liner will have as a minimum the following characteristics:

- Material type: Predominately clay matrix, classified as SC, CL, or CH (ASTM D-2487).
- Density: Minimum compaction requirement of 90% of the maximum dry density (ASTM D-1557-78 (90) or other equivalent ASTM method). Density testing will be performed in accordance with current applicable L.A. County grading codes. Maximum density and optimum moisture content will be determined in accordance with ASTM D-1556 or other equivalent.
- Moisture: Soil moisture range of -1 to +3% of optimum moisture content.
- Thickness: Minimum compacted thickness of 12 inches. Compaction will be performed using a footed vibratory compactor. Clay will be placed and compacted in lifts with a thickness that exceeds the length of the compactor prongs, but not exceeding 12 inches in thickness.
- Permeability: Maximum permeability of  $10E-6$  cm/sec (ASTM D-5084 or other equivalent ASTM method). Four permeability tests will be performed for each reservoir at regular intervals.

### PLACEMENT OF BACKFILL

A protective topsoil layer consisting of thermally treated relic berm soils will overlie the clay cap. Soils will be graded, sampled and characterized to insure that the material conforms to the requirements of the WDR's.

One representative sample will be collected every 500 cubic yards and analyzed for TPH. One representative sample from each 1,000 cubic yards will be collected and analyzed for BTEX and polynuclear aromatics (PNA's). Samples which contain PNA's in excess of 20 times the practical quantification limits (PQL's) will be further assessed by performing the toxicity characteristic leaching procedure (TCLP) extraction followed by an additional PNA analysis. Results of the analyses will be compared to the following limits established in the WDR's for this project.

<u>CONSTITUENT</u>	<u>LIMIT</u>	<u>TEST METHOD</u>
Benzene	0.1 mg/kg	
Ethylbenzene	2.9 mg/kg	EPA Method 8015m
Toluene	4.2 mg/kg	1 test/1,000 Yd <sup>3</sup>
Xylenes	1.7 mg/kg	
TPH		
C <sub>4</sub> to C <sub>12</sub>	1,000 mg/kg	EPA Method 8015m
C <sub>13</sub> to C <sub>22</sub>	10,000 mg/kg	1 test/500 Yd <sup>3</sup>
C <sub>23</sub> to C <sub>28</sub>	15,000 mg/kg	
PNA's (in TCLP extract)	non detect at the PQL's	EPA Method 8270 1 test/1,000 Yd <sup>3</sup>

Material which is suitable for use as backfill will be placed and compacted as protective topsoil. The soils will be placed in horizontal lifts and compacted to at least 90% relative density. Density testing will be performed at a frequency of one test per 1,000 cubic yards. The topsoil layer will be a minimum thickness of 12 inches. The specifics of the fill grading and compaction are detailed in the approved grading and drainage plan included with the previous work plan. The surface will be graded and maintained to prevent ponding of water.

#### POST CLOSURE MAINTENANCE

Post-closure maintenance will consist of regular inspection and maintenance of the cover materials. Inspections will be conducted once a quarter for the first year after closure and then annually thereafter. Any damage to the cover materials such as erosion gullies, cracking or settlement of the final cover, or any slumping or sliding of the cover materials will be noted and repaired. Drainage structures will also be inspected and repaired as part of post-closure maintenance.

#### REPORTING REQUIREMENTS

A "Backfill and Final Project Completion Report" will be submitted within 30 days of the completion of the field work. This report will include as-built plans and specifications of any cover materials and drainage features and will include the results of all soils testing, compaction, grading, and permeability tests conducted during the phase of work covered by this work plan.

#### REVIEWED BY:

Ross Williams, R.G. # 6327

**APPENDIX C**

***SOIL COMPACTION REPORT***

August 8, 1997

Mr. Alan Hargraves  
c/o Mr. Terry Ower  
Parsons Process Group, Inc.  
100 West Walnut Street  
Pasadena, California 91124

42/3659-08

Subject: Final Compaction Report,  
Amendment No. 1, Reservoir Removal Project,  
1520-1622 East Sepulveda Boulevard,  
Carson, California.

Dear Mr. Hargraves:

Brown and Caldwell provided construction supervision and soil compaction testing to support grading operations at the above referenced site. Grading operations began in mid-February and were completed at the end of July, 1997. The primary objective of the grading operations was to install a lateral extension to the existing low permeability cap.

Grading generally consisted of:

1. excavation;
2. subgrade scarification and recompaction;
3. overexcavation, backfill, and recompaction;
4. clayey soil placement and compaction;
5. cover soil placement and compaction.

Soil placement and compaction procedures observed during the course of this project were performed in general accordance with current industry standards.

#### **Site Grading**

Fill soils were hydrated to near optimum moisture prior to placement. The fill soils were placed in lifts generally 6-inches thick or less. Each lift of fill was compacted to a minimum of 90% relative compaction. Soil compaction tests were taken at a frequency of at least one

Mr. Alan Hargraves  
August 8, 1997  
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test for every 1000 cubic yards of materials placed and compacted. Estimated total quantities of soils placed and compacted during this project are shown on the following table.

Reservoir 1, Subgrade.....1,000 cu.yds.  
Reservoir 1, Cap soils.....2,600 cu.yds.  
Reservoir 1, Cover Soils.....6,000 cu.yds.  
Reservoir 1, Total.....9,600 cu.yds.

Reservoir 2, Subgrade.....1,500 cu.yds.  
Reservoir 2, Cap soils.....4,000 cu.yds.  
Reservoir 2, Cover Soils.....4,000 cu.yds.  
Reservoir 2, Total.....9,500 cu.yds.

Project Total.....19,100 cu. yds.

A rubber-tire grader, a D-6 bulldozer equipped with a pull behind sheepsfoot roller, and a 966 loader were utilized to control soil placement and compaction. A water truck equipped with several high-pressure spray fittings provided moisture control.

### Laboratory Testing

The moisture-density relations for each soil type, including maximum dry density and optimum moisture content, were determined by laboratory testing (ASTM D 1557-78{90}) and are shown in Table 1. The laboratory test reports are included in Attachment A.

Field tests to determine the in-place dry density of compacted soils were performed by sand cone method (ASTM D 1556-90). Moisture content was determined in the field by direct heating method (ASTM D 4959-89). Percent compaction was calculated by dividing the field-derived dry density value by the laboratory-derived maximum dry density. Final density test results demonstrated that all soils were compacted to at least 90% of the laboratory-derived maximum dry density. Results of the field density tests are shown on Table 2. The generalized test locations are shown on the attached Figures 1 and 2.

### Conclusions

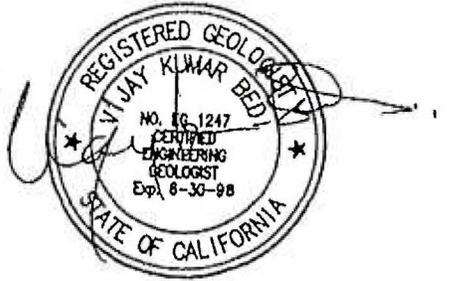
Both field observations and test data indicate that fill placement and compaction was completed in compliance with the parameters specified in the work plan.

Mr. Alan Hargraves  
August 8, 1997  
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We appreciate this opportunity to provide our services. If you have any further questions, please do not hesitate to contact the undersigned.

Very truly yours,

BROWN AND CALDWELL



Vijay Bedi, C.E.G. 1247  
Chief Geologist

  
Robert Pope  
Geologist

RP:re

**TABLE C-1**  
**COMPACTION DATA**  
**(ASTM D1557-78(90))**

<u>Identification Number</u>	<u>Soil Classification</u>	<u>Optimum Moisture (Percent)</u>	<u>Maximum Dry Density (lbs/cu.ft.)</u>	<u>Source/Description</u>
#5	ML	7.5	128.0	Subgrade
#3	ML-CL	10.8	124.9	Hawaiian Gardens Site
#6	SM	10.2	122.5	Treated Cover Soil
#11	CH	14.9	115.7	Lomita Site
FT-1	SM	10.0	123.4	Blend of #6 and I
I	SM	9.0	126.0	Pre-existing Cover Soil

**TABLE C-2**  
**SAND CONE DENSITY TEST DATA**  
 (ASTM D1556-90)

Date	6-Mar-97	6-Mar-97	10-Mar-97	10-Mar-97	10-Mar-97
Test Number	COMP-11	COMP-12	(See COMP-11) COMP-13	COMP-14	COMP-15
Location	Reservoir 1 320 deg ~250 ft. f. c.	Reservoir 1 345 deg ~235 ft. f. c.	Reservoir 1 335 deg ~245 ft. f. c.	Reservoir 1 290 deg ~255 ft. f. c.	Reservoir 1 305 deg ~230 ft. f. c.
Fill Depth	Cover soil 6" above clay cap	Cover soil 12" above clay cap	Cover soil 12" above clay cap	Cover soil 15" above clay cap	Cover soil 18" above clay cap
Test Elevation	PENDING COMPLETION OF SURVEY.....				
Dry Density (lbs/cu.ft.)	107.54	111.60	113.07	120.17	114.05
Laboratory Maximum Dry Density	122.5	122.5	122.5	122.5	122.5
PERCENT COMPACTION	87.8	91.1	92.3	98.1	93.1
RESULTS	FAIL	PASS	PASS	PASS	PASS
Notes	Passed after soils reworked See COMP-13				

Date	13-Mar-97	13-Mar-97	14-Mar-97	17-Mar-97	17-Mar-97
Test Number	COMP-16	COMP-17	COMP-18	COMP-19	COMP-20
Location	Reservoir 2 250 deg ~250 ft. f. c.	Reservoir 2 295 deg ~255 ft. f. c.	Reservoir 2 330 deg ~230 ft. f. c.	Reservoir 2 340 deg ~235 ft. f. c.	Reservoir 2 200 deg ~225 ft. f. c.
Fill Depth	Subgrade 3" below clay cap	Subgrade 4" below clay cap	Subgrade 4" below clay cap	Subgrade 2" below clay cap	Subgrade 3 ft. below clay cap
Test Elevation	PENDING COMPLETION OF SURVEY.....				
Dry Density (lbs/cu.ft.)	120.02	118.66	110.48	117.38	116.50
Laboratory Maximum Dry Density	128.0	128.0	128.0	128.0	128.0
PERCENT COMPACTION	93.8	92.7	86.3	91.7	91.0
RESULTS	PASS	PASS	FAIL	PASS	PASS
Notes			Passed after soils reworked See COMP-21		

**TABLE C-2**  
**SAND CONE DENSITY TEST DATA**  
 (ASTM D1556-90)

Date	20-Mar-97	25-Mar-97	31-Mar-97	31-Mar-97	31-Mar-97
Test Number	(See COMP-18) COMP-21	COMP-22	COMP-23	COMP-24	COMP-25
Location	Reservoir 2 330 deg ~230 ft. f. c.	Reservoir 2 337 deg ~235 ft. f. c.	Reservoir 1 260 deg ~245 ft. f. c.	Reservoir 1 240 deg ~230 ft. f. c.	Reservoir 1 220 deg ~255 ft. f. c.
Fill Depth	Subgrade 6" below clay cap	Subgrade 3" below clay cap	Cover soil 18" above clay cap	Cover soil 14" above clay cap	Cover soil 8" above clay cap
Test Elevation	PENDING COMPLETION OF SURVEY.....				
Dry Density (lbs/cu.ft.)	118.61	116.06	112.22	113.17	112.47
Laboratory Maximum Dry Density	128.0	128.0	122.5	122.5	122.5
PERCENT COMPACTION	92.7	90.7	91.6	92.4	91.8
RESULTS	PASS	PASS	PASS	PASS	PASS
Notes					

Date	2-Apr-97	9-Apr-97	14-Apr-97	14-Apr-97	14-Apr-97
Test Number	COMP-26	COMP-27	COMP-28	COMP-29	COMP-30
Location	Reservoir 2 195 deg ~225 ft. f. c.	Reservoir 2 275 deg ~200 ft. f. c.	Reservoir 2 210 deg ~220 ft. f. c.	Reservoir 2 250 deg ~245 ft. f. c.	Reservoir 2 285 deg ~240 ft. f. c.
Fill Depth	Subgrade 16" below clay cap	Subgrade at bottom of clay cap	Clay cap	Clay cap	Clay cap
Test Elevation	PENDING COMPLETION OF SURVEY.....				
Dry Density (lbs/cu.ft.)	119.74	121.21	112.59	110.49	110.41
Laboratory Maximum Dry Density	128.0	128.0	115.7	115.7	115.7
PERCENT COMPACTION	93.5	94.7	97.3	95.5	95.4
RESULTS	PASS	PASS	PASS	PASS	PASS
Notes					

**TABLE C-2**  
**SAND CONE DENSITY TEST DATA**  
 (ASTM D1556-90)

Date	21-Feb-97	21-Feb-97	21-Feb-97	25-Feb-97	26-Feb-97
Test Number	COMP-1	COMP-2	COMP-3	(See COMP-3) COMP-4	(See COMP-1) COMP-5
Location	Reservoir 1 345 deg ~235 ft. f. c.	Reservoir 1 280 deg ~250 ft. f. c.	Reservoir 1 225 deg ~240 ft. f. c.	Reservoir 1 225 deg ~240 ft. f. c.	Reservoir 1 345 deg ~235 ft. f. c.
Fill Depth	Top of subgrade	Top of subgrade	Top of subgrade	Top of subgrade	Top of subgrade
Test Elevation	PENDING COMPLETION OF SURVEY.....				
Dry Density (lbs/cu.ft.)	113.13	120.01	110.14	117.63	118.58
Laboratory Maximum Dry Density	128.0	128.0	128.0	128.0	128.0
PERCENT COMPACTION	88.4	93.8	86.0	91.9	92.6
RESULTS	FAIL	PASS	FAIL	PASS	PASS
Notes	Passed after soils reworked See COMP-5		Passed after soils reworked See COMP-4		

Date	27-Feb-97	27-Feb-97	28-Feb-97	3-Mar-97	4-Mar-97
Test Number	COMP-6	COMP-7	COMP-8	COMP-9	COMP-10
Location	Reservoir 1 350 deg ~240 ft. f. c.	Reservoir 1 305 deg ~255 ft. f. c.	Reservoir 1 225 deg ~230 ft. f. c.	Reservoir 1 235 deg ~245 ft. f. c.	Reservoir 1 280 deg ~225 ft. f. c.
Fill Depth	Clay cap 6" above subgrade	Clay cap 8" above subgrade	Top of clay cap	Clay cap 10" above subgrade	Clay cap 10" above subgrade
Test Elevation	PENDING COMPLETION OF SURVEY.....				
Dry Density (lbs/cu.ft.)	114.29	121.73	112.89	119.21	118.14
Laboratory Maximum Dry Density	124.9	124.9	124.9	124.9	124.9
PERCENT COMPACTION	91.5	97.5	90.4	95.4	94.6
RESULTS	PASS	PASS	PASS	PASS	PASS
Notes					

**TABLE C-2**  
**SAND CONE DENSITY TEST DATA**  
 (ASTM D1556-90)

Date	15-Apr-97	24-Apr-97	24-Apr-97	29-Apr-97	29-Apr-97
Test Number	COMP-31	COMP-32	COMP-33	COMP-34	COMP-35
Location	Reservoir 2 305 deg ~235 ft. f. c.	Reservoir 2 255 deg / ~190 ft. f. c.	Reservoir 2 300 deg / ~210 ft. f. c.	Reservoir 2 200 deg / ~205 ft. f. c.	Reservoir 2 225 deg / ~200 ft. f. c.
Fill Depth	Clay cap	Cover soil 6" above clay cap	Cover soil 8" above clay cap	Cover soil 10" above clay cap	Cover soil 10" above clay cap
Test Elevation	PENDING COMPLETION OF SURVEY.....				
Dry Density (lbs/cu.ft.)	110.25	113.03	111.85	111.13	115.57
Laboratory Maximum Dry Density	115.7	123.4	123.4	126.0	126.0
PERCENT COMPACTION	95.3	91.6	90.6	88.2	91.7
RESULTS	PASS	PASS	PASS	FAIL	PASS
Notes				Passed after soils reworked See COMP-62	

Date	5-May-97	5-May-97	5-May-97	6-May-97	6-May-97
Test Number	COMP-36	COMP-37	COMP-38	COMP-39	COMP-40
Location	Reservoir 1 70 deg / ~255 ft. f. c.	Reservoir 1 115 deg / ~240 ft. f. c.	Reservoir 1 150 deg / ~250 ft. f. c.	Reservoir 1 45 deg / ~230 ft. f. c.	Reservoir 1 130 deg / ~215 ft. f. c.
Fill Depth	Top of subgrade	Top of subgrade	Top of subgrade	Top of subgrade	Top of subgrade
Test Elevation	PENDING COMPLETION OF SURVEY.....				
Dry Density (lbs/cu.ft.)	119.62	116.18	119.62	113.08	122.73
Laboratory Maximum Dry Density	128.0	128.0	128.0	128.0	128.0
PERCENT COMPACTION	93.5	90.8	93.5	88.3	95.9
RESULTS	PASS	PASS	PASS	FAIL	PASS
Notes				Passed after soils reworked See COMP-42	

**TABLE C-2**  
**SAND CONE DENSITY TEST DATA**  
 (ASTM D1556-90)

Date	6-May-97	6-May-97	7-May-97	15-May-97	15-May-97
Test Number	COMP-41	(See COMP-39) COMP-42	COMP-43	COMP-44	COMP-46
Location	Reservoir 1 185 deg / ~225 ft. f. c.	Reservoir 1 50 deg / ~230 ft. f. c.	Reservoir 1 200 deg / ~255 ft. f. c.	Reservoir 1 70 deg / ~240 ft. f. c.	Reservoir 1 120 deg / ~220 ft. f. c.
Fill Depth	Top of subgrade	Top of subgrade	Top of subgrade	Clay cap	Clay cap
Test Elevation	PENDING COMPLETION OF SURVEY.....				
Dry Density (lbs/cu.ft.)	121.28	116.51	123.32	113.96	109.82
Laboratory Maximum Dry Density	128.0	128.0	128.0	115.7	115.7
PERCENT COMPACTION	94.8	91.0	96.3	98.5	94.9
RESULTS	PASS	PASS	PASS	PASS	PASS
Notes					

Date	15-May-97	16-May-97	19-May-97	19-May-97	9-Jun-97
Test Number	COMP-46	COMP-47	COMP-48	COMP-49	COMP-50
Location	Reservoir 1 170 deg / ~200 ft. f. c.	Reservoir 1 90 deg / ~250 ft. f. c.	Reservoir 1 150 deg / ~250 ft. f. c.	Reservoir 1 45 deg / ~230 ft. f. c.	Reservoir 2 40 deg / ~240 ft. f. c.
Fill Depth	Clay cap	Clay cap	Clay cap	Clay cap	Top of subgrade
Test Elevation	PENDING COMPLETION OF SURVEY.....				
Dry Density (lbs/cu.ft.)	110.47	108.58	109.07	106.57	115.37
Laboratory Maximum Dry Density	115.7	115.7	115.7	115.7	128.0
PERCENT COMPACTION	95.5	93.8	94.3	92.1	90.1
RESULTS	PASS	PASS	PASS	PASS	PASS
Notes					

**TABLE C-2**  
**SAND CONE DENSITY TEST DATA**  
 (ASTM D1556-90)

Date	9-Jun-97	9-Jun-97	9-Jun-97	10-Jun-97	10-Jun-97
Test Number	COMP-51	COMP-52	COMP-53	(See COMP-52) COMP-54	COMP-55
Location	Reservoir 2 110 deg / ~250 ft. f. c.	Reservoir 2 155 deg / ~225 ft. f. c.	Reservoir 2 75 deg / ~230 ft. f. c.	Reservoir 2 160 deg / ~230 ft. f. c.	Reservoir 2 0 deg / ~245 ft. f. c.
Fill Depth	Top of subgrade	Top of subgrade	Top of subgrade	Top of subgrade	Top of subgrade
Test Elevation	PENDING COMPLETION OF SURVEY.....				
Dry Density (lbs/cu.ft.)	117.72	113.18	116.60	115.46	119.09
Laboratory Maximum Dry Density	128.0	128.0	128.0	128.0	128.0
PERCENT COMPACTION	92.0	88.4	91.1	90.2	93.0
RESULTS	PASS	FAIL	PASS	PASS	PASS
Notes		Passed after soils reworked See COMP-54			

Date	12-Jun-97	17-Jun-97	17-Jun-97	17-Jun-97	18-Jun-97
Test Number	COMP-56	COMP-57	COMP-58	COMP-59	COMP-60
Location	Reservoir 1 185 deg / ~225 ft. f. c.	Reservoir 2 200 deg / ~230 ft. f. c.	Reservoir 2 280 deg / ~240 ft. f. c.	Reservoir 2 340 deg / ~245 ft. f. c.	Reservoir 2 240 deg / ~250 ft. f. c.
Fill Depth	Clay cap	Cover soil 6" above clay cap	Cover soil 6" above clay cap	Cover soil 8" above clay cap	Cover soil 10" above clay cap
Test Elevation	PENDING COMPLETION OF SURVEY.....				
Dry Density (lbs/cu.ft.)	109.03	115.34	118.53	112.59	116.47
Laboratory Maximum Dry Density	115.7	122.5	122.5	122.5	122.5
PERCENT COMPACTION	94.2	94.2	96.8	91.9	95.1
RESULTS	PASS	PASS	PASS	PASS	PASS
Notes					

**TABLE C-2**  
**SAND CONE DENSITY TEST DATA**  
 (ASTM D1556-90)

Date	18-Jun-97	18-Jun-97	24-Jun-97	24-Jun-97	24-Jun-97
Test Number	COMP-61	(See COMP-34) COMP-62	COMP-63	COMP-64	COMP-65
Location	Reservoir 2 310 deg / ~225 ft. f. c.	Reservoir 2 200 deg / ~200 ft. f. c.	Reservoir 1 40 deg / ~230 ft. f. c.	Reservoir 1 180 deg / ~235 ft. f. c.	Reservoir 1 80 deg / ~245 ft. f. c.
Fill Depth	Cover soil 10" above clay cap	Cover soil 12" above clay cap	Cover soil 8" above clay cap	Cover soil 10" above clay cap	Cover soil 5" above clay cap
Test Elevation	PENDING COMPLETION OF SURVEY.....				
Dry Density (lbs/cu.ft.)	116.46	114.01	117.72	119.72	110.81
Laboratory Maximum Dry Density	122.5	126.0	122.5	122.50	122.5
PERCENT COMPACTION	95.1	90.5	96.1	97.7	90.5
RESULTS	PASS	PASS	PASS	PASS	PASS
Notes					

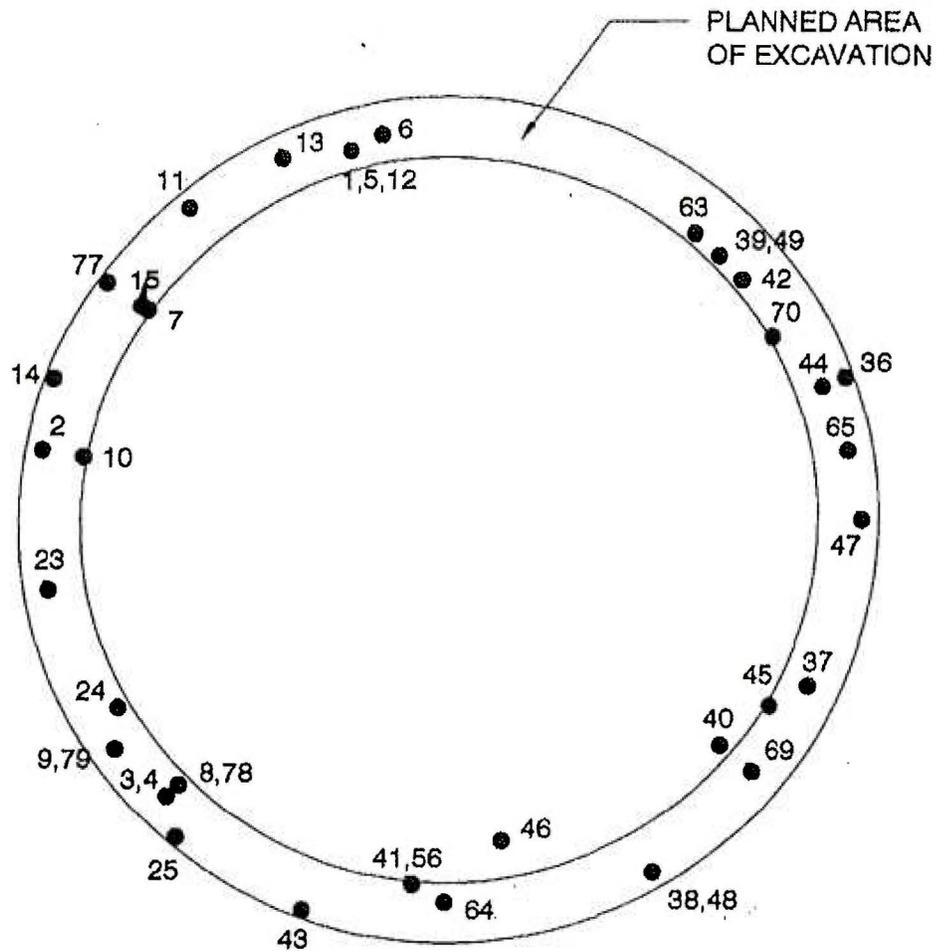
Date	2-Jul-97	2-Jul-97	2-Jul-97	3-Jul-97	3-Jul-97
Test Number	COMP-66	COMP-67	COMP-68	COMP-69	COMP-70
Location	Reservoir 2 25 deg / ~250 ft. f. c.	Reservoir 2 100 deg / ~230 ft. f. c.	Reservoir 2 160 deg / ~220 ft. f. c.	Reservoir 1 130 deg / ~240 ft. f. c.	Reservoir 1 60 deg / ~225 ft. f. c.
Fill Depth	Clay cap	Clay cap	Clay cap	Cover soil 16" above clay cap	Cover soil 3" below finished
Test Elevation	PENDING COMPLETION OF SURVEY.....				
Dry Density (lbs/cu.ft.)	112.85	108.93	107.67	114.25	106.36
Laboratory Maximum Dry Density	115.7	115.7	115.7	122.5	122.5
PERCENT COMPACTION	97.5	94.1	93.1	93.3	86.8
RESULTS	PASS	PASS	PASS	PASS	FAIL
Notes					Passed after soils reworked See COMP-77

**TABLE C-2**  
**SAND CONE DENSITY TEST DATA**  
 (ASTM D1556-90)

Date	10-Jul-97	11-Jul-97	14-Jul-97	15-Jul-97	16-Jul-97
Test Number	COMP-71	COMP-72	COMP-73	COMP-74	COMP-75
Location	Reservoir 2 170 deg / ~215 ft. f. c.	Reservoir 2 168 deg / ~215 ft. f. c.	Reservoir 2 10 deg / ~250 ft. f. c.	Reservoir 2 90 deg / ~235 ft. f. c.	Reservoir 2 135 deg / ~245 ft. f. c.
Fill Depth	Subgrade 20" below clay cap	Top of subgrade	Cover soil 8" above clay cap	Cover soil 3" below finished	Top of clay cap
Test Elevation	PENDING COMPLETION OF SURVEY.....				
Dry Density (lbs/cu.ft.)	115.35	126.40	116.14	113.99	109.96
Laboratory Maximum Dry Density	128.0	128.0	122.5	122.5	115.7
PERCENT COMPACTION	90.1	98.8	94.8	93.1	95.0
RESULTS	PASS	PASS	PASS	PASS	PASS
Notes					

Date	18-Jul-97	18-Jul-97	18-Jul-97	18-Jul-97
Test Number	COMP-76	(See COMP-70) COMP-77	COMP-78	COMP-79
Location	Reservoir 2 170 deg / ~230 ft. f. c.	Reservoir 1 60 deg / ~255 ft. f. c.	Reservoir 1 125 deg / ~260 ft. f. c.	Reservoir 1 195 deg / ~260 ft. f. c.
Fill Depth	Cover soil 3" below finished	Cover soil 3" below finished	Cover soil 3" below finished	Cover soil 3" below finished
Test Elevation	PENDING COMPLETION OF SURVEY.....			
Dry Density (lbs/cu.ft.)	112.76	112.99	114.89	113.49
Laboratory Maximum Dry Density	122.5	122.5	122.5	122.5
PERCENT COMPACTION	92.1	92.2	93.8	92.6
RESULTS	PASS	PASS	PASS	PASS
Notes				

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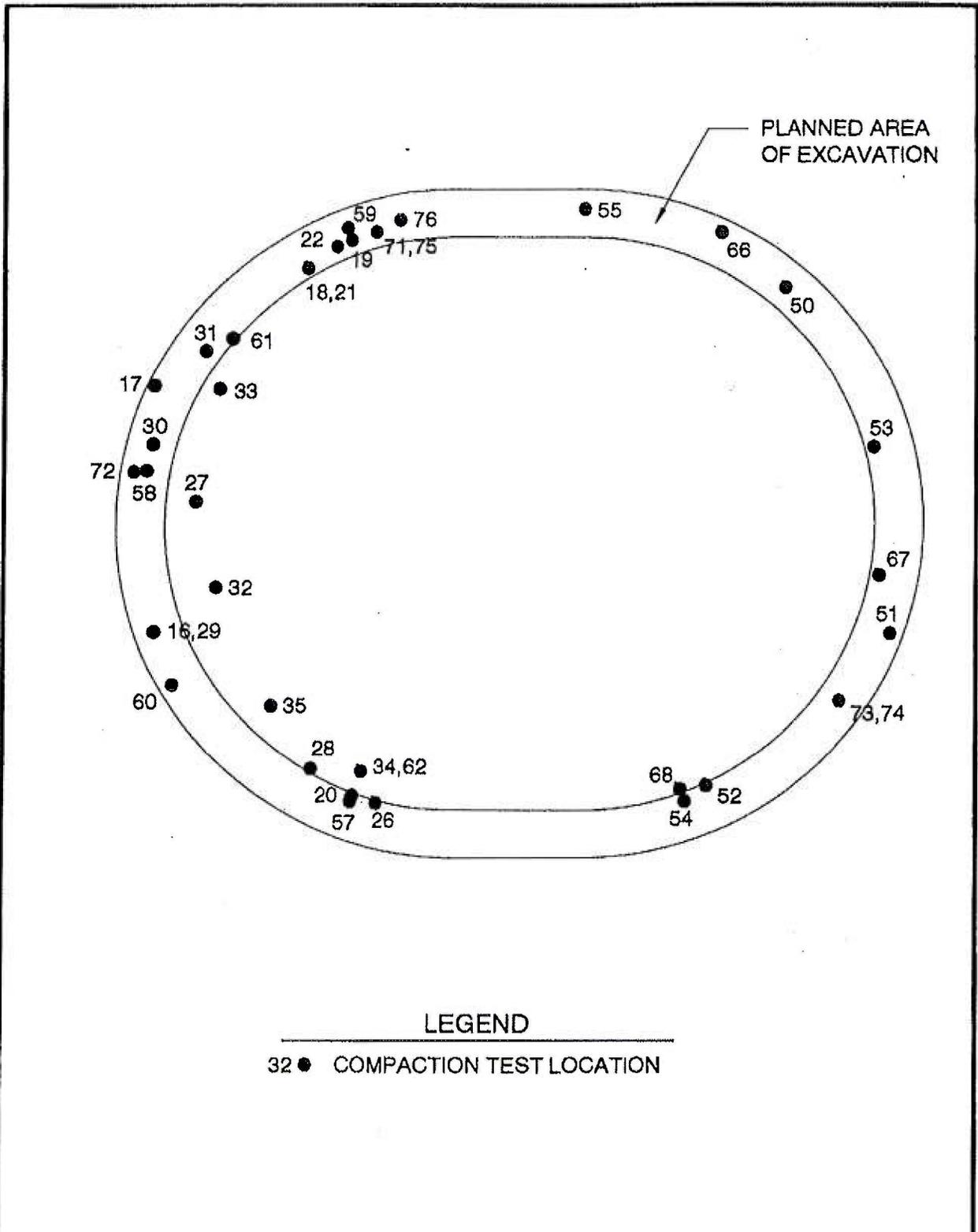


LEGEND

8 ● COMPACTION TEST LOCATION

DATE 8-22-97	PROJECT NUMBER 3659-08	TOSCO LOS ANGELES REFINERY RESERVOIR 1 COMPACTION TEST LOCATIONS	
<b>BROWN AND CALDWELL</b> IRVINE, CALIFORNIA			
PROJECT LOCATION 1520-1662 E. SEPULVEDA BLVD. CARSON, CALIFORNIA		0      50      100  SCALE IN FEET	FIGURE C-1

EL000907



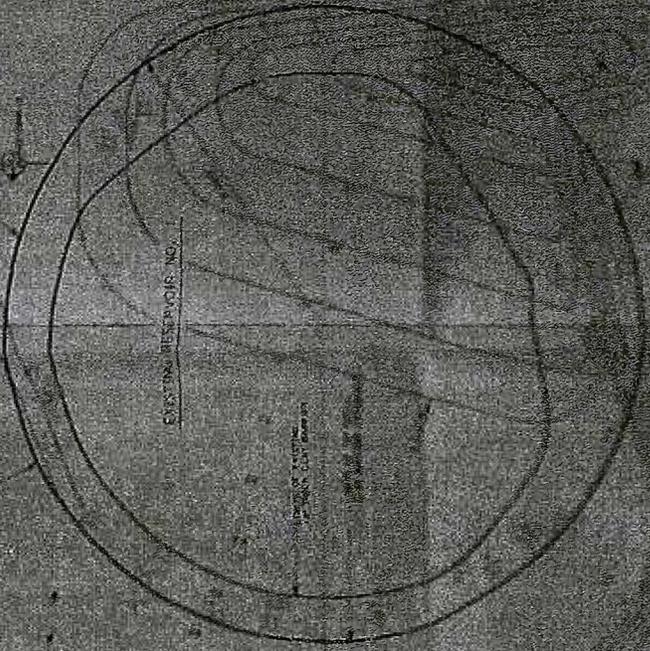
**LEGEND**

32 ● COMPACTION TEST LOCATION

DATE 8-22-97	PROJECT NUMBER 3659-08	<b>TOSCO LOS ANGELES REFINERY RESERVOIR 2 COMPACTION TEST LOCATIONS</b>		
<b>BROWN AND CALDWELL</b> IRVINE, CALIFORNIA				PROJECT LOCATION 1520-1662 E. SEPULVEDA BLVD. CARSON, CALIFORNIA

PL 3659-08

MATCH LINE - N. 1000 - SEE TRANS PROFILE 7800' D.



EXISTING RESERVOIR NO.

RESERVOIR NO. 1000

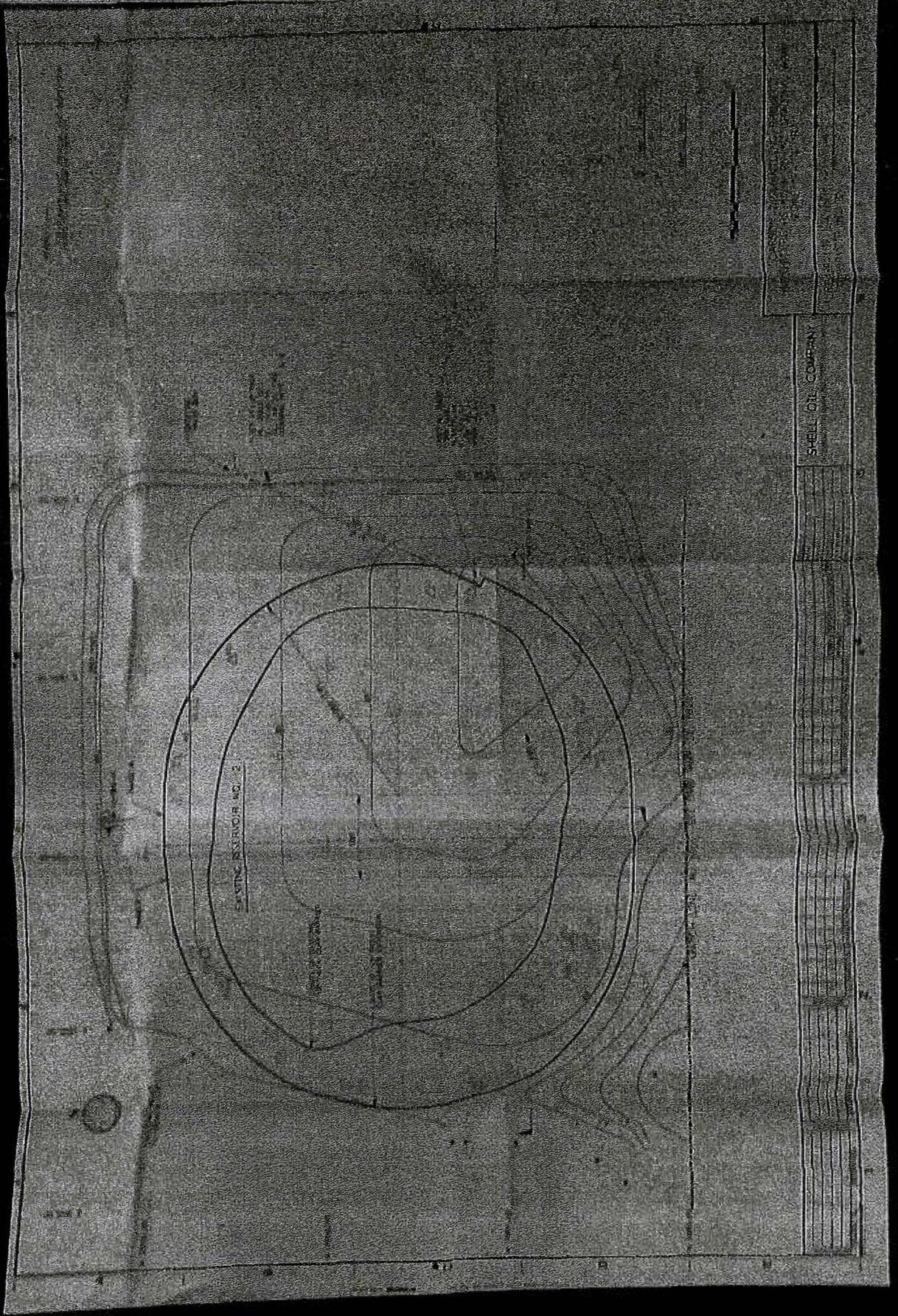
RESERVOIR NO. 1000

RESERVOIR NO. 1000

RESERVOIR NO. 1000

STELLING COUNTY

EXISTING RESERVOIR NO. 2



**APPENDIX D**

***PERMEABILITY TEST RESULTS***

**Permeability of Preliminary Samples  
Data Summary**

<u>Source Location</u>	<u>Sample Number</u>	<u>Test Results (millidarcy)</u>	<u>Test Results (cm/s)</u>
Hawaiian Gardens Site	3	0.032	3.06E-08
Lomita Site	11	< 0.00001	<1.00E-10

**PHYSICAL PROPERTIES DATA**

(METHODOLOGY: ASTM D1557, D5084)

PROJECT NAME: N/A  
PROJECT NO: 3659-08

SAMPLE ID.	DEPTH, ft.	SAMPLE TYPE	VISUAL CLASSIFICATION	OPTIMUM MOISTURE, (%)	MAXIMUM DRY DENSITY, (pcf)	25.0 PSI CONFINING STRESS	
						PERMEABILITY TO WATER (millidarcy)	HYDRAULIC CONDUCTIVITY (cm/s)
<del>#2</del>	<del>na</del>	<del>BULK</del>		<del>not requested</del>		<del>0.533</del>	<del>5.16 X 10<sup>-7</sup></del>
#3	na	BULK	ML-CL	10.8	124.9	0.032	3.06 X 10 <sup>-8</sup>

**PHYSICAL PROPERTIES DATA**

(METHODOLOGY: ASTM D4318, EPA 9100)

PROJECT NAME: Shell Reservoirs  
PROJECT NO: 3659-05

SAMPLE ID.	DEPTH, ft.	SAMPLE ORIENT. (1)	MOISTURE CONTENT	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	USCS CLASS	25.0 PSI CONFINING STRESS	
								NATIVE STATE EFFECTIVE PERMEABILITY TO WATER (mildarcy)	NATIVE STATE EFFECTIVE WATER CONDUCTIVITY (cm/s)
# 11	N/A	V	26.0	63	19	44	CH	<0.00001	<1.00E-10

LPCE In-Situ Permeability  
Data Summary

<u>Reservoir</u>	<u>Quadrant</u>	<u>Sample Number</u>	<u>Test Results (millidarcy)</u>	<u>Test Results (cm/s)</u>
1	Northeast	15	0.0797	8.16E-08
	Southeast	14	0.1565	1.60E-07
	Southwest	8	0.327	3.16E-07
	Northwest	7	0.187	1.83E-07
2	Northeast	16	0.0524	3.39E-08
	Southeast	17	0.0336	5.41E-08
	Southwest	13	0.026	2.56E-08
	Northwest	12	0.283	2.83E-07

**PHYSICAL PROPERTIES DATA**  
(METHODOLOGY: ASTM D2216, API RP40, EPA 9100)

PROJECT NAME: Shell Reservoir  
PROJECT NO: 3659-06

SAMPLE ID.	DEPTH, ft.	SAMPLE TYPE	25.0 PSI CONFINING STRESS	
			NATIVE STATE EFFECTIVE PERMEABILITY TO WATER (millidarcy)	NATIVE STATE EFFECTIVE WATER CONDUCTIVITY (cm/s)
#7	N/A	BULK	0.187	1.83E-07
#8	N/A	BULK	0.327	3.16E-07

(1) Sample Orientation: H = Horizontal; V = Vertical

Vb = Bulk Volume, cc  
Pv = Pore Volume, cc  
ND = Not Detected

**PHYSICAL PROPERTIES DATA**  
(METHODOLOGY: ASTM D2216, API RP40, EPA 9100)

PROJECT NAME: Shell Reservoirs  
PROJECT NO: 3659-07

SAMPLE ID	DEPTH, R.	SAMPLE ORIENT. (1)	25.0 PSI CONFINING STRESS	
			NATIVE STATE EFFECTIVE PERMEABILITY TO WATER (millidarcy)	NATIVE STATE EFFECTIVE WATER CONDUCTIVITY (cm/s)
#12	N/A	V	0.283	2.83E-07
#13	N/A	V	0.026	2.56E-08

(1) Sample Orientation: H = Horizontal; V = Vertical

**HYDRAULIC CONDUCTIVITY DATA**

(METHODOLOGY: EPA 9100)

PROJECT NAME: SHELL RESERVOIRS  
PROJECT NO: 3659-07

SAMPLE ID.	DEPTH, ft.	SAMPLE ORIENTATION	25.0 PSI CONFINING STRESS	
			NATIVE PERMEABILITY TO WATER (millidarcy)	NATIVE HYDRAULIC CONDUCTIVITY (cm/s)
# 14	N/A	V	0.1565	1.60E-07
#15	N/A	V	0.0797	8.16E-08

(1) Sample Orientation: H = Horizontal; V = Vertical

**PHYSICAL PROPERTIES DATA**

(METHODOLOGY: EPA 9100)

PROJECT NAME: Shell Reservoirs  
PROJECT NO: 3659-07

SAMPLE ID.	SAMPLE ORIENT. (1)	25.0 PSI CONFINING STRESS	
		NATIVE STATE EFFECTIVE PERMEABILITY TO WATER (millidarcy)	NATIVE STATE EFFECTIVE HYDRAULIC CONDUCTIVITY (cm/s)
#16	V	0.0336	3.39E-08
#17	V	0.0524	5.41E-08

(1) Sample Orientation: H = Horizontal; V = Vertical

Vb = Bulk Volume, cc  
Pv = Pore Volume, cc  
ND = Not Detected

**APPENDIX E**

*ANALYTICAL LABORATORY  
AND QC REPORTS FOR  
COVER SOIL CHARACTERIZATION*

VOC ANALYTICAL REPORT  
 SUPPLEMENTAL REPORT FOR 9703317  
 DATE PRINTED: 02 APR 1997

NON-AQUEOUS SAMPLES

Batch: 8270\*9755 Method: 8270 - GC/MS for Semivolatile Organics, Capillary column

	UNITS	B703890*1 MB	C7031689*1 LC	..... LT	C7031690*1 LC	..... LT	9703307*5 R1	R2	S1	S2	T
Date Analyzed	Date	03/17/97	03/17/97	03/17/97	03/17/97	03/17/97	03/17/97	-	03/18/97	03/18/97	03/18/97
Date Extracted	Date	03/13/97	03/13/97	03/13/97	03/13/97	03/13/97	03/13/97	-	03/13/97	03/13/97	03/13/97
Dilution Factor	Times	1	1	1	1	1	1	-	1	1	1
Acenaphthene	mg/kg	0	3.09	3.33	3.01	3.33	<0.2	-	1.52	1.50	1.67
Acenaphthylene	mg/kg	0	3.20	3.33	3.11	3.33	<0.2	-	-	-	-
Anthracene	mg/kg	0	2.68	3.33	2.79	3.33	<0.2	-	-	-	-
Benzo(a)anthracene	mg/kg	0	3.25	3.33	3.36	3.33	<0.2	-	-	-	-
Benzo(a)pyrene	mg/kg	0	3.11	3.33	3.13	3.33	<0.2	-	-	-	-
Benzo(b)fluoranthene	mg/kg	0	3.21	3.33	3.35	3.33	<0.2	-	-	-	-
Benzo(g,h,i)perylene	mg/kg	0	3.25	3.33	3.59	3.33	<0.2	-	-	-	-
Benzo(k)fluoranthene	mg/kg	0	3.30	3.33	3.19	3.33	<0.2	-	-	-	-
Chrysene	mg/kg	0	3.31	3.33	3.68	3.33	<0.2	-	-	-	-
Dibenzo(a,h)anthracene	mg/kg	0	3.18	3.33	3.47	3.33	<0.2	-	-	-	-
Fluoranthene	mg/kg	0	2.52	3.33	2.83	3.33	<0.2	-	-	-	-
Fluorene	mg/kg	0	3.04	3.33	2.99	3.33	<0.2	-	-	-	-
Indeno(1,2,3-c,d)pyrene	mg/kg	0	3.86	3.33	4.20	3.33	<0.2	-	-	-	-
Naphthalene	mg/kg	0	2.94	3.33	3.12	3.33	<0.2	-	-	-	-
Phenanthrene	mg/kg	0	2.59	3.33	2.76	3.33	<0.2	-	-	-	-
Pyrene	mg/kg	0	3.30	3.33	3.24	3.33	<0.2	-	1.62	1.59	1.67
2-Fluorobiphenyl Reported	mg/kg	1.03	1.71	1.67	1.63	1.67	1.75	-	1.46	1.43	1.67
2-Fluorobiphenyl Theo.	mg/kg	1.67	1.67	1.67	1.67	1.67	1.67	-	1.67	1.67	1.67
Nitrobenzene-d5 Reported	mg/kg	1.04	1.67	1.67	1.74	1.67	1.72	-	1.39	1.46	1.67
Nitrobenzene-d5 Theoretical	mg/kg	1.67	1.67	1.67	1.67	1.67	1.67	-	1.67	1.67	1.67
Terphenyl-d14 Reported	mg/kg	0.861	1.83	1.67	1.83	1.67	1.70	-	1.49	1.45	1.67
Terphenyl-d14 Theoretical	mg/kg	1.67	1.67	1.67	1.67	1.67	1.67	-	1.67	1.67	1.67

Batch: FUEL\*9735 Method: 8015M - Modified 8015

	UNITS	B703841*1 MB	C7031596*1 LC	..... LT	C7031597*1 LC	..... LT	N/A R1	R2	S1	S2	T
Date Analyzed	Date	03/12/97	03/12/97	03/12/97	03/12/97	03/12/97	-	-	-	-	-
Date Extracted	Date	03/12/97	03/12/97	03/12/97	03/12/97	03/12/97	-	-	-	-	-
Dilution Factor	Times	1	1	1	1	1	-	-	-	-	-
TPH-d C13-C22	mg/kg	0	213	200	239	200	-	-	-	-	-
TPH-d C23-C28	mg/kg	0	-	-	-	-	-	-	-	-	-
1,3-Dichlorobenzene Reported	mg/kg	25.0	26.3	25.0	26.2	25.0	-	-	-	-	-
1,3-Dichlorobenzene Theoretical	mg/kg	25.0	25.0	25.0	25.0	25.0	-	-	-	-	-

CHAIN OF CUSTODY RECORD

VOC Log Number 6473314

Client name <b>BCI SHELL</b>			Project or PO# <b>3659-06</b>		Analyses required													
Address <b>16735 VON KARMAN, #200</b>			Phone # <b>(714) 660-1070</b>		<div style="display: flex; justify-content: space-between;"> <div style="writing-mode: vertical-rl; transform: rotate(180deg);">8015M/0020</div> <div style="writing-mode: vertical-rl; transform: rotate(180deg);">8270</div> <div style="writing-mode: vertical-rl; transform: rotate(180deg);">Hazardous sample Special handling required</div> </div>													
City, State, Zip <b>IRVINE, CA 92606</b>			Report attention <b>BOB POPE</b>															
Lab Sample number	Date sampled	Time sampled	Type* See key below	Sampled by <b>FABIO MINERVINI</b>	Number of containers	Remarks												
	3/11/97	14:45	So	TS-5	1	X												
	3/12/97	13:15	So	TS-6	1		X											
Regular turnaround time - Please FAX results to Bob Pope at (714) 474-0940 as soon as available																		

Signature	Print Name	Company	Date	Time
Relinquished by <i>Fabio Minervini</i>	FABIO MINERVINI	BC	3/12/97	15:10
Received by <i>[Signature]</i>	Maria Canseco	VOC Analytical	3/12/97	15:10
Relinquished by				
Received by				
Relinquished by				
Received by Laboratory				

- VOC ANALYTICAL**
- 1085 Shary Circle, Concord, CA 94518 (510) 825-3894
  - 801 Western Avenue, Glendale, CA 91201 (818) 247-5737
  - 1200 Gene Autry Way, Anaheim, CA 92805 (714) 978-0113

Note: Samples are discarded 30 days after results are reported unless other arrangements are made. Hazardous samples will be returned to client or disposed of at client's expense.

Disposal arrangements: \_\_\_\_\_

\*KEY: AQ—Aqueous NA—Nonaqueous SL—Sludge  
 GW—Groundwater SO—Soil PE—Petroleum  
 WW—Wastewater



Our Quality Control Is Your Quality Assurance

April 11, 1997

LOG NO.: G97-03-520

Brown and Caldwell  
16735 Von Karman, Suite 200  
Irvine, CA 92606  
Attn: Mr. Bob Pope

Reference: Client Project # 3659-06, Shell Reservoir

Dear Mr. Pope,

Enclosed is the analytical report for the chemical testing of samples collected in support of the above-referenced project. Samples were identified and tracked in the BCA/VOC system as log number **G97-03-520**. When making inquiries about this report, please provide the log number.

The contents of this package are based on the requirements specified in the BC Analytical, A Division of V.O.C. Analytical Laboratories, Inc. "Quality Assurance Management Plan". The case narrative addresses batch specific quality control as it pertains to this document.

If you have any questions, please do not hesitate to call me at (714) 978-0113.

Sincerely,

Patty Mata  
Project Manager



Our Quality Control Is Your Quality Assurance

## ACRONYMS AND FLAG DEFINITIONS

### Flag Definitions:

- \* Replicate values. Used when replicate results are entered into the MS/MSD column of the QC report.
- B Blank contamination. Used when associated method blank concentration is greater than the PQL.
- J Estimated value. Used for sample results greater than or equal to MDL, but less than the PQL.
- NC Not calculated. Used when sample result is greater than two times the spike amount added, or when extracted surrogates were diluted at least 1:10.
- Q Quality objectives were not met. Used for Method Blank, Laboratory Control Samples, Matrix Spikes, Matrix Duplicates and Surrogates.

### Acronyms:

COC	Chain of Custody
FLG	Flag
LC	Actual LCS/LCSD concentration recovered
LCL	Lower Control Limit
LCS	Laboratory Control Sample
LCSD	Laboratory Control Sample Duplicate
LT	True LCS/LCSD concentration
MB	Method Blank
MS	Matrix Spike
MSD	Matrix Spike Duplicate
R1	Unspiked sample concentration
RDL	Reporting Detection Limit
%REC	Percent Recovery
Rep.	Surrogate Reported value
RPD	Relative Percent Difference
S1	Actual MS concentration
S2	Actual MSD concentration
T	True concentration of MS/MSD
Theo.	Surrogate Theoretical value
UCL	Upper Control Limit



Our Quality Control Is Your Quality Assurance

LOG NO.: G97-03-520

### CASE NARRATIVE

The following narrative addresses all project specific data quality objectives with respect to: holding times, method blanks, lab control standards, matrix spike and duplicate samples. Analytical anomalies encountered during sample analysis are also discussed as necessary.

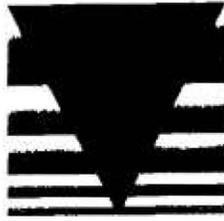
**Sample receipt:**

Samples were received under COC from Brown and Caldwell at the Anaheim office on 3/21/97. All containers were received intact and properly preserved.

**Method 8015M/8020 (Gas/BTEX):**

Surrogate recovery for a,a,a-Trifluorotoluene was above the UCL for sample TS-8. Since the recovery was high and the target analytes were not detected, no further corrective action was performed.

No anomalies were encountered during the analysis of the project.



Our Quality Control Is Your Quality Assurance

# ANALYTICAL REPORT

LOG NO: G97-03-520

Received: 21 MAR 97

Mailed: APR 11 1997

Mr. Bob Pope  
Brown and Caldwell Consultants  
16735 Von Karman, Suite 200  
Irvine, CA 92606-4953

Purchase Order: 4708

Project: 3659-06/SHELLRES.

## REPORT OF ANALYTICAL RESULTS

Page 1

LOG NO	03-520-1	03-520-2
DATE SAMPLED	20 MAR 97	21 MAR 97
SAMPLE DESCRIPTION	TS-7	TS-8
NON-AQUEOUS		
Semi-volatile HC (8015M)		
Date Analyzed	03/25/97	03/25/97
Date Extracted	03/24/97	03/24/97
Dilution Factor, Times	1	1
TPH-d C13-C22, mg/kg	<100	<100
TPH-d C23-C28, mg/kg	<100	<100
Other Semi-volatile HC (8015M)	---	---
Surrogates **		
1,3-Dichlorobenzene Reported, mg/kg	28.8	27.3
1,3-Dichlorobenzene Theoretical, mg/kg	25.0	25.0



Our Quality Control Is Your Quality Assurance

LOG NO: G97-03-520

Received: 21 MAR 97

Mr. Bob Pope  
Brown and Caldwell Consultants  
16735 Von Karman, Suite 200  
Irvine, CA 92606-4953

Purchase Order: 4708

Project: 3659-06/SHELLRES.

REPORT OF ANALYTICAL RESULTS

Page 2

LOG NO	03-520-1	03-520-2
DATE SAMPLED	20 MAR 97	21 MAR 97
SAMPLE DESCRIPTION	TS-7	TS-8
NON-AQUEOUS		
-----		
Volatile HC (8015M)		
Date Analyzed	03/27/97	03/27/97
Dilution Factor, Times	1	1
Benzene, mg/kg	<0.005	<0.005
Toluene, mg/kg	<0.005	<0.005
Ethylbenzene, mg/kg	<0.005	<0.005
Total Xylene Isomers, mg/kg	<0.01	<0.01
TPH-g C6-C12, mg/kg	<0.1	<0.1
Other Volatile HC (8015M)	---	---
Surrogates **		
a,a,a-Trifluorotoluene Rep., mg/kg	0.0995	0.0623
a,a,a-Trifluorotoluene Th., mg/kg	0.0500	0.0500



Our Quality Control Is Your Quality Assurance

LOG NO: G97-03-520

Received: 21 MAR 97

Mr. Bob Pope  
Brown and Caldwell Consultants  
16735 Von Karman, Suite 200  
Irvine, CA 92606-4953

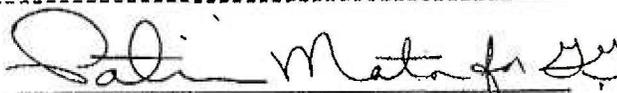
Purchase Order: 4708

Project: 3659-06/SHELLRES.

REPORT OF ANALYTICAL RESULTS

Page 3

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Greta Galoustian, Laboratory Director

The analytical results within this report relate only to the specific compounds and samples investigated and may not necessarily reflect other apparently similar material from the same or a similar location.

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ORDER PLACED FOR CLIENT: Brown and Caldwell Consultants 9703520 :  
BC ANALYTICAL : GLEN LAB : 15:57:59 02 APR 1997 - P. 1 :

=====

UNES...	SAMPLE DESCRIPTION..	DETERM.....	DATE.....	METHOD.....	EQUIP. BATCH..	ID.NO
			ANALYZED			
1703520*1	TS-7	FUEL.C28	03.25.97	8015M	536-37 9740	1010
		GAS.C12	03.27.97	8015M	536-30 9747015	6843
1703520*2	TS-8	FUEL.C28	03.25.97	8015M	536-37 9740	1010
		GAS.C12	03.27.97	8015M	536-30 9747015	6843

\*\*\*

Notes: Equipment = BC Analytical identification number for a particular piece of analytical equipment.

ID.NO = BC Analytical employee identification number of analyst.

SURROGATE RECOVERIES :  
BC ANALYTICAL : GLEN LAB : 15:57:32 02 APR 1997 - P. 1 :

=====

	ANALYTE	BATCH	ANALYZED	REPORTED	TRUE	%REC	FLAG
I703520*1							
I015M	1,3-Dichlorobenzene	9740	03/25/97	28.8	25.0	115	
I015M	a,a,a-Trifluorotoluene	Re9747015	03/27/97	0.0995	0.0500	199	
I703520*2							
I015M	1,3-Dichlorobenzene	9740	03/25/97	27.3	25.0	109	
I015M	a,a,a-Trifluorotoluene	Re9747015	03/27/97	0.0623	0.0500	125	



VOC ANALYTICAL REPORT  
 SUPPLEMENTAL REPORT FOR 9703520  
 DATE PRINTED: 02 APR 1997

NON-AQUEOUS SAMPLES

Batch: GAS\*9747015 Method: 8015M - Modified 8015

	87032034*1	C7033916*1	.....	C7033918*1	.....	9703597*2	.....	.....	.....	.....	.....
UNITS	MB	LC	LT	LC	LT	R1	R2	S1	S2	T	
Date Analyzed	Date	03/27/97	03/27/97	03/27/97	03/27/97	03/27/97	-	03/27/97	03/27/97	03/27/97	
Dilution Factor	Times	1	1	1	1	1	-	1	1	1	
Benzene	mg/kg	0	0.0480	0.0500	0.0549	0.0500	-	-	-	-	
Toluene	mg/kg	0	0.0473	0.0500	0.0554	0.0500	-	-	-	-	
Ethylbenzene	mg/kg	0	0.0484	0.0500	0.0552	0.0500	-	-	-	-	
Total Xylene Isomers	mg/kg	0	0.142	0.150	0.159	0.150	-	-	-	-	
TPH-g C6-C12	mg/kg	0	1.06	1.10	-	-	0	0.975	0.875	1.10	
a,a,a-Trifluorotoluene Rep.	mg/kg	0.0458	0.0436	0.0500	0.0495	0.0500	0.0470	-	0.0566	0.0513	0.0500
a,a,a-Trifluorotoluene Th.	mg/kg	0.0500	0.0500	0.0500	0.0500	0.0500	0.0500	-	0.0500	0.0500	0.0500

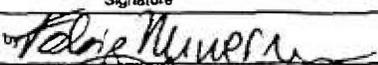
Batch: FUEL\*9740 Method: 8015M - Modified 8015

	B7031837*1	C7033531*1	.....	C7033532*1	.....	N/A	.....	.....	.....	.....
UNITS	MB	LC	LT	LC	LT	R1	R2	S1	S2	T
Date Analyzed	Date	03/24/97	03/24/97	03/24/97	03/24/97	03/24/97	-	-	-	-
Date Extracted	Date	03/24/97	03/24/97	03/24/97	03/24/97	03/24/97	-	-	-	-
Dilution Factor	Times	1	1	1	1	1	-	-	-	-
TPH-d C13-C22	mg/kg	0	165	200	147	200	-	-	-	-
TPH-d C23-C28	mg/kg	0	-	-	-	-	-	-	-	-
1,3-Dichlorobenzene Reported	mg/kg	26.9	23.8	25.0	24.0	25.0	-	-	-	-
1,3-Dichlorobenzene Theoretical	mg/kg	25.0	25.0	25.0	25.0	25.0	-	-	-	-

CHAIN OF CUSTODY RECORD

VOC Log Number 0970020

Client name <b>BC SHELL</b>				Project or PO# <b>3659-06</b>		Analyses required						
Address <b>16735 VON KARMAN AVE, #200</b>				Phone # <b>(714) 660-1070</b>		<div style="border: 1px solid black; padding: 5px; transform: rotate(-45deg); display: inline-block;">8015H/8020</div> <div style="border: 1px solid black; padding: 5px; transform: rotate(-45deg); display: inline-block;">Hazardous sample Special handling required</div> <div style="text-align: right; font-size: 2em;">Page 1 of 1.</div>						
City, State, Zip <b>IRVINE, CA 92606</b>			Report attention <b>BOB POPE</b>									
Lab Sample number	Date sampled	Time sampled	Type* See key below	Sampled by	Number of containers	Remarks						
				<b>FABIO MINERVINI</b>								
-1	3/20/97	10:15	SO	TS-7	1	X						
-2	3/21/97	12:30	SO	TS-8	1	X						Regular turn around time
												Please FAX results to Bob Pope @ (714) 474-0940 as soon as available

Signature	Print Name	Company	Date	Time
Relinquished by 	FABIO MINERVINI	BC	3/21/97	14:35
Received by 	Maria Consello	VOC Analytical	3/21/97	14:35
Relinquished by				
Received by				
Relinquished by				
Received by Laboratory				

VOC ANALYTICAL

- 1085 Shary Circle, Concord, CA 94518 (510) 825-3894
- 801 Western Avenue, Glendale, CA 91201 (818) 247-5737
- 1200 Gene Autry Way, Anaheim, CA 92805 (714) 978-0113
- 4411 S. 40th Street Phoenix AZ 85040 (602) 470-9707

Note: Samples are discarded 30 days after results are reported unless other arrangements are made. Hazardous samples will be returned to client or disposed of at client's expense.

Disposal arrangements: \_\_\_\_\_

\*KEY: AQ—Aqueous NA—Nonaqueous SL—Sludge  
GW—Groundwater SO—Soil PE—Petroleum  
WW—Wastewater



Our Quality Control Is Your Quality Assurance

July 23, 1997

LOG NO.: G97-06-209

Brown and Caldwell  
16735 Von Karman, Suite 200  
Irvine, CA 92714-0940  
Attn: Mr. Bob Pope

Reference: Client Project # 3659-06, Shell.

Dear Mr. Pope,

Enclosed is the analytical report for the chemical testing of samples collected in support of the above-referenced project. Samples were identified and tracked in the BCA/VOC system as log number **G97-06-209**. When making inquiries about this report, please provide the log number.

The contents of this package are based on the requirements specified in the BC Analytical, A Division of V.O.C. Analytical Laboratories, Inc. "Quality Assurance Management Plan". The case narrative addresses batch specific quality control as it pertains to this document.

If you have any questions, please do not hesitate to call me at (714) 978-0113.

Sincerely,

Patty Mata  
Project Manager

LOG NO.: G97-06-209

### CASE NARRATIVE

The following narrative addresses all project specific data quality objectives with respect to: holding times, method blanks, lab control standards, matrix spike and duplicate samples. Analytical anomalies encountered during sample analysis are also discussed as necessary.

**Sample receipt:**

Samples were received under COC and delivered to VOC's Glendale lab on 6/9/97. All containers were received intact and properly preserved.

**Gas and Diesel (Method 8015M):**

Samples TS-9 and TS-11 had surrogate recoveries above the control limits for Gasoline analysis. Due to acceptable QC surrogate recovery, it's believed that possible matrix interference caused the high surrogate recoveries.

Benzene, Gasoline and the surrogate had MS/MSD percent recoveries outside of control limits for batch GAS\*9766020. The LCS/LCSD set had acceptable recoveries and were used to control the batch.

No other anomalies were encountered during the analysis of the project.

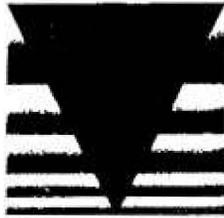
## ACRONYMS AND FLAG DEFINITIONS

### Flag Definitions:

- \* Replicate values. Used when replicate results are entered into the MS/MSD column of the QC report.
- B Blank contamination. Used when associated method blank concentration is greater than the PQL.
- J Estimated value. Used for sample results greater than or equal to MDL, but less than the PQL.
- NC Not calculated. Used for MS/MSD when sample result is greater than two times the spike amount added, or when extracted surrogates were diluted below detectable levels. Used for sample results that are over calibration range.
- Q Quality objectives were not met. Used for Method Blank, Laboratory Control Samples, Matrix Spikes, Matrix Duplicates and Surrogates.

### Acronyms:

COC	Chain of Custody
FLG	Flag
LC	Actual LCS/LCSD concentration recovered
LCL	Lower Control Limit
LCS	Laboratory Control Sample
LCSD	Laboratory Control Sample Duplicate
LT	True LCS/LCSD concentration
MB	Method Blank
MS	Matrix Spike
MSD	Matrix Spike Duplicate
R1	Unspiked sample concentration
RDL	Reporting Detection Limit
%REC	Percent Recovery
Rep.	Surrogate Reported value
RPD	Relative Percent Difference
S1	Actual MS concentration
S2	Actual MSD concentration
T	True concentration of MS/MSD
Theo.	Surrogate Theoretical value
UCL	Upper Control Limit



Our Quality Control Is Your Quality Assurance

# ANALYTICAL REPORT

LOG NO: G97-06-209

Received: 09 JUN 97

Mailed:

Mr. Bob Pope  
Brown and Caldwell Consultants  
16735 Von Karman, Suite 200  
Irvine, CA 92606-4953

Project: 3659-06

## REPORT OF ANALYTICAL RESULTS

Page 1

LOG NO	06-209-1	06-209-2
DATE SAMPLED	06 JUN 97	06 JUN 97
SAMPLE DESCRIPTION	TS-9	TS-11
NON-AQUEOUS		
Semi-volatile HC (8015M)		
Date Analyzed	06/23/97	06/23/97
Date Extracted	06/20/97	06/20/97
Dilution Factor, Times	1	1
TPH-d C13-C22, mg/kg	36	26
TPH-d C23-C28, mg/kg	87	93
Other Semi-volatile HC (8015M)	---	---
Surrogates **		
1,3-Dichlorobenzene Reported, mg/kg	29.4	28.4
1,3-Dichlorobenzene Theoretical, mg/kg	25.0	25.0

LOG NO: G97-06-209

Received: 09 JUN 97

Mr. Bob Pope  
Brown and Caldwell Consultants  
16735 Von Karman, Suite 200  
Irvine, CA 92606-4953

Project: 3659-06

REPORT OF ANALYTICAL RESULTS

Page 2

LOG NO	06-209-1	06-209-2
DATE SAMPLED	06 JUN 97	06 JUN 97
SAMPLE DESCRIPTION	TS-9	TS-11
NON-AQUEOUS		
-----		
Volatile HC (8015M)		
Date Analyzed	06/11/97	06/11/97
Dilution Factor, Times	1	1
Benzene, mg/kg	<0.005	<0.005
Toluene, mg/kg	<0.005	<0.005
Ethylbenzene, mg/kg	<0.005	<0.005
Total Xylene Isomers, mg/kg	<0.01	<0.01
TPH-g C6-C12, mg/kg	<0.1	<0.1
Other Volatile HC (8015M)	---	---
Surrogates **		
a,a,a-Trifluorotoluene Rep., mg/kg	0.0824	0.0688
a,a,a-Trifluorotoluene Th., mg/kg	0.0500	0.0500

LOG NO: G97-06-209

Received: 09 JUN 97

Mr. Bob Pope  
Brown and Caldwell Consultants  
16735 Von Karman, Suite 200  
Irvine, CA 92606-4953

Project: 3659-06

REPORT OF ANALYTICAL RESULTS

Page 3

LOG NO	06-209-3
DATE SAMPLED	06 JUN 97
SAMPLE DESCRIPTION	TS-10 (F.M. TS-10)
NON-AQUEOUS	
-----	
Polynuclear Aromatics (8270)	
Date Analyzed	06/14/97
Date Extracted	06/10/97
Dilution Factor, Times	1
Acenaphthene, mg/kg	<0.2
Acenaphthylene, mg/kg	<0.2
Anthracene, mg/kg	<0.2
Benzo(a)anthracene, mg/kg	<0.2
Benzo(a)pyrene, mg/kg	<0.2
Benzo(b)fluoranthene, mg/kg	<0.2
Benzo(g,h,i)perylene, mg/kg	<0.2
Benzo(k)fluoranthene, mg/kg	<0.2
Chrysene, mg/kg	<0.2

LOG NO: G97-06-209

Received: 09 JUN 97

Mr. Bob Pope  
Brown and Caldwell Consultants  
16735 Von Karman, Suite 200  
Irvine, CA 92606-4953

Project: 3659-06

REPORT OF ANALYTICAL RESULTS

Page 4

LOG NO	06-209-3
DATE SAMPLED	06 JUN 97
SAMPLE DESCRIPTION	TS-10 (F.M. TS-10)
NON-AQUEOUS	
Dibenzo(a,h)anthracene, mg/kg	<0.2
Fluoranthene, mg/kg	<0.2
Fluorene, mg/kg	<0.2
Indeno(1,2,3-c,d)pyrene, mg/kg	<0.2
Naphthalene, mg/kg	<0.2
Phenanthrene, mg/kg	<0.2
Pyrene, mg/kg	<0.2
Surrogates **	
2-Fluorobiphenyl Reported, mg/kg	1.73
2-Fluorobiphenyl Theo., mg/kg	1.67
Nitrobenzene-d5 Reported, mg/kg	1.57
Nitrobenzene-d5 Theoretical, mg/kg	1.67
Terphenyl-d14 Reported, mg/kg	1.99

LOG NO: G97-05-209

Received: 09 JUN 97

Mr. Bob Pope  
Brown and Caldwell Consultants  
16735 Von Karman, Suite 200  
Irvine, CA 92606-4953

Project: 3659-06

REPORT OF ANALYTICAL RESULTS

Page 5

LOG NO	06-209-3
DATE SAMPLED	06 JUN 97
SAMPLE DESCRIPTION	TS-10 (F.M. TS-10)
NON-AQUEOUS	
Terphenyl-d14 Theoretical, mg/kg	1.67

  
Greta Galoustian, Laboratory Director

The analytical results within this report relate only to the specific compounds and samples investigated and may not necessarily reflect other apparently similar material from the same or a similar location.

This report shall not be reproduced, except in full, without the written approval of VOC. No use of this report for promotional or advertising purposes is permitted without prior written VOC approval.

ORDER PLACED FOR CLIENT: Brown and Caldwell Consultants 9706209 :  
VOC ANALYTICAL : GLEN LAB : 13:10:24 21 JUL 1997 - P. 1 :

=====

AMPLES...	SAMPLE DESCRIPTION..	DETERM.....	DATE..... ANALYZED	METHOD.....	EQUIP. BATCH..	ID.NO
706209*1	TS-9	GAS.C12	06.11.97	8015M	536-33 9766020	
		FUEL,C28	06.23.97	8015M	536-37 9774	1010
706209*2	TS-11	GAS.C12	06.11.97	8015M	536-33 9766020	
		FUEL,C28	06.23.97	8015M	536-37 9774	1010
706209*3	TS-10 (F.M. TS-10)	8270,PNA	06.14.97	8270	537-14 97125	1009

\*\*

Notes: Equipment = VOC Analytical identification number for a particular piece of analytical equipment.

ID.NO = VOC Analytical employee identification number of analyst.

: SURROGATE RECOVERIES :  
: BC ANALYTICAL : GLEN LAB : 13:31:46 23 JUL 1997 - P. 1 :  
=====

MOD	ANALYTE	BATCH	ANALYZED	REPORTED	TRUE	%REC	FLAG	LCL	UCL
9706209*1									
8015M	a,a,a-Trifluorotoluene	Re9766020	06/11/97	0.0824	0.0500	165	Q	71	131
8015M	1,3-Dichlorobenzene	9774	06/23/97	29.4	25.0	118		52	145
9706209*2									
8015M	a,a,a-Trifluorotoluene	Re9766020	06/11/97	0.0688	0.0500	138	Q	71	131
8015M	1,3-Dichlorobenzene	9774	06/23/97	28.4	25.0	114		52	145
9706209*3									
8270	Nitrobenzene-d5	97125	06/14/97	1.57	1.67	94		34	110
	2-Fluorobiphenyl	97125	06/14/97	1.73	1.67	104		38	110
	Terphenyl-d14	97125	06/14/97	1.99	1.67	119		18	130



JGC ANALYTICAL GLENDALE  
 SUPPLEMENTAL REPORT FOR 9706209  
 DATE PRINTED: 23 JUL 1997

NON-AQUEOUS SAMPLES

Batch: GAS\*9766020 Method: 8015M - Modified 8015

	B706764*1	C7061494*1	C7061517*1	9706209*1						
UNITS	MB	LC	LT	LC	LT	R1	R2	S1	S2	T
Date Analyzed	Date	06/11/97	06/11/97	06/11/97	06/11/97	06/11/97	-	06/11/97	06/11/97	06/11/97
Dilution Factor	Times	1	1	1	1	1	-	1	1	1
Benzene	mg/kg	0	0.0519	0.0500	0.0476	0.0500	<0.005	0.0237	0.0272	0.0152
Toluene	mg/kg	0	0.0524	0.0500	0.0480	0.0500	<0.005	0.0992	0.116	0.0974
Ethylbenzene	mg/kg	0	0.0537	0.0500	0.0494	0.0500	<0.005	0.0182	0.0208	0.0204
Total Xylene Isomers	mg/kg	0	0.168	0.150	0.154	0.150	<0.01	0.0953	0.110	0.119
TPH-g C6-C12	mg/kg	0	0.963	1.10	1.01	1.10	<0.1	0.350	0.362	1.10
a,a,a-Trifluorotoluene Rep.	mg/kg	0.0453	0.0492	0.0500	0.0479	0.0500	0.0824	0.0531	0.0681	0.0500
a,a,a-Trifluorotoluene Th.	mg/kg	0.0500	0.0500	0.0500	0.0500	0.0500	-	0.0500	0.0500	0.0500

NON-AQUEOUS SAMPLES

Batch: 8270\*97125 Method: 8270 - GC/MS for Semivolatile Organics, Capillary column

	UNITS	B706552*1	C7061047*1	C7061048*1	C7061048*1	C7061048*1	9706104*5					
	MB	LC	LT	LC	LT	LC	R1	R2	S1	S2	T	
Date Analyzed	Date	06/10/97	06/10/97	06/10/97	06/10/97	06/10/97	06/10/97	-	06/10/97	06/10/97	06/10/97	
Date Extracted	Date	06/10/97	06/10/97	06/10/97	06/10/97	06/10/97	06/10/97	-	06/10/97	06/10/97	06/10/97	
Dilution Factor	Times	1	1	1	1	1	1	-	1	1	1	
Acenaphthene	mg/kg	0	2.58	3.33	2.64	3.33	0	-	2.32	3.08	3.33	
Acenaphthylene	mg/kg	0	2.63	3.33	2.73	3.33	0	-	2.28	3.18	3.33	
Anthracene	mg/kg	0	2.42	3.33	2.52	3.33	0	-	2.18	2.94	3.33	
Benzo(a)anthracene	mg/kg	0	2.64	3.33	2.77	3.33	0	-	2.37	3.26	3.33	
Benzo(a)pyrene	mg/kg	0	2.53	3.33	2.66	3.33	0	-	2.28	3.11	3.33	
Benzo(b)fluoranthene	mg/kg	0	2.54	3.33	2.83	3.33	0	-	2.21	3.35	3.33	
Benzo(g,h,i)perylene	mg/kg	0	2.64	3.33	2.73	3.33	0	-	2.10	2.84	3.33	
Benzo(k)fluoranthene	mg/kg	0	2.31	3.33	2.10	3.33	0	-	2.21	2.45	3.33	
Chrysene	mg/kg	0	2.58	3.33	2.70	3.33	0	-	2.35	3.15	3.33	
Dibenzo(a,h)anthracene	mg/kg	0	2.59	3.33	2.69	3.33	0	-	2.17	2.95	3.33	
Fluoranthene	mg/kg	0	2.60	3.33	2.74	3.33	0	-	2.36	3.19	3.33	
Fluorene	mg/kg	0	2.82	3.33	2.93	3.33	0	-	2.52	3.43	3.33	
Indeno(1,2,3-c,d)pyrene	mg/kg	0	2.95	3.33	3.06	3.33	0	-	2.06	2.83	3.33	
Naphthalene	mg/kg	0	2.46	3.33	2.65	3.33	0	-	2.28	3.13	3.33	
Phenanthrene	mg/kg	0	2.64	3.33	2.78	3.33	0	-	2.40	3.22	3.33	
Pyrene	mg/kg	0	2.70	3.33	2.76	3.33	0	-	2.45	3.34	3.33	
2-Fluorobiphenyl Reported	mg/kg	1.77	1.32	1.67	1.31	1.67	1.32	-	1.17	1.58	1.67	
2-Fluorobiphenyl Theo.	mg/kg	1.67	1.67	1.67	1.67	1.67	1.67	-	1.67	1.67	1.67	
Nitrobenzene-d5 Reported	mg/kg	1.65	1.20	1.67	1.23	1.67	1.19	-	1.09	1.49	1.67	
Nitrobenzene-d5 Theoretical	mg/kg	1.67	1.67	1.67	1.67	1.67	1.67	-	1.67	1.67	1.67	
Terphenyl-d14 Reported	mg/kg	1.89	1.43	1.67	1.43	1.67	1.43	-	1.26	1.72	1.67	
Terphenyl-d14 Theoretical	mg/kg	1.67	1.67	1.67	1.67	1.67	1.67	-	1.67	1.67	1.67	

Batch: FUEL,C28\*9774 Method: 8015M - Modified 8015

	UNITS	B7061455*1	C7062779*1	C7062780*1	C7062780*1	C7062780*1	N/A					
	MB	LC	LT	LC	LT	LC	R1	R2	S1	S2	T	
Date Analyzed	Date	06/23/97	06/23/97	06/23/97	06/23/97	06/23/97	-	-	-	-	-	
Date Extracted	Date	06/20/97	06/20/97	06/20/97	06/20/97	06/20/97	-	-	-	-	-	
Dilution Factor	Times	1	1	1	1	1	-	-	-	-	-	
TPH-d C13-C22	mg/kg	0	258	200	266	200	-	-	-	-	-	
TPH-d C23-C28	mg/kg	0	-	-	-	-	-	-	-	-	-	
1,3-Dichlorobenzene Reported	mg/kg	26.2	27.1	25.0	26.8	25.0	-	-	-	-	-	
1,3-Dichlorobenzene Theoretical	mg/kg	25.0	25.0	25.0	25.0	25.0	-	-	-	-	-	

CHAIN OF CUSTODY RECORD

VOC Log Number 0411004

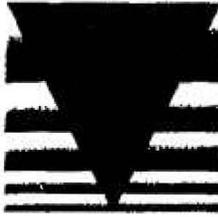
Client name: <u>BC (SHELL RESERVOIRS)</u>			Project or File # <u>3659-06</u>		Analysis required					
Address: <u>16735 YON KARWAN, #200</u>			Phone # <u>(714) 660-1070</u>		<div style="display: flex; justify-content: space-around;"> <div style="writing-mode: vertical-rl; transform: rotate(180deg);">8015M/8020</div> <div style="writing-mode: vertical-rl; transform: rotate(180deg);">8270</div> <div style="writing-mode: vertical-rl; transform: rotate(180deg);">Hazardous Waste Special Handling Required</div> </div>					
City, State, Zip: <u>IRVINE, CA 92606</u>			Report affiliation: <u>BOB POPE</u>							
Lab Sample number	Date sampled	Time sampled	REF: See key below	Sampled by	Number of containers	Remarks				
	6/6/97	14:00	SO	TS-9	1	Please FAX results to Bob Pope @ (714) 474-0940 as soon as available (regular turn around time) Follow w/ report methodology				
	6/6/97	14:15	SO	TS-10 (FM. TS-10)	1					
	6/6/97	14:30	SO	TS-11	1					

Signature	Print Name	Company	Date	Time
Relinquished by <u>Fabio Minervini</u>	<u>FABIO MINERVINI</u>	<u>BC</u>	6/9/97	15:50
Received by <u>Hal Cochran</u>	<u>HAL COCHRAN</u>	<u>VOC ANALYTICAL</u>	6/9/97	15:45
Relinquished by <u>Hal Cochran</u>	<u>HAL COCHRAN</u>	<u>VOC ANALYTICAL</u>	6/9/97	17:00
Received by <u>Todd Carter</u>	<u>TODD CARTER</u>	<u>VOC</u>	6/9/97	17:00
Relinquished by <u>Todd Carter</u>	<u>TODD CARTER</u>	<u>VOC</u>	6/9/97	18:00
Received by Laboratory <u>Sharon Malone</u>	<u>Sharon Malone</u>	<u>VOC</u>	6/9/97	18:00

**VOC ANALYTICAL**  
 1025 Shary Circle, Concord, CA 94518 (510) 525-2894  
 801 Western Avenue, Glendale, CA 91201 (818) 247-5737  
 1200 Civic Airy Way, Anaheim, CA 92806 (714) 978-0113

Note: Samples are discarded 30 days after results are reported unless other arrangements are made. Hazardous samples will be returned to client or disposed of at client's expense.  
 Disposal arrangements: \_\_\_\_\_

\*KEY: AO-Aqueous NA-Nonaqueous SL-Sludge  
 GW-Groundwater SO-Soil PE-Petroleum  
 WW-Wastewater



Our Quality Control Is Your Quality Assurance

July 23, 1997

LOG NO.: G97-06-386

Brown and Caldwell  
16735 Von Karman, Suite 200  
Irvine, CA 92714-0940  
Attn: Mr. Bob Pope

Reference: Client Project # 3659-06, Shell.

Dear Mr. Pope,

Enclosed is the analytical report for the chemical testing of samples collected in support of the above-referenced project. Samples were identified and tracked in the BCA/VOC system as log number **G97-06-386**. When making inquiries about this report, please provide the log number.

The contents of this package are based on the requirements specified in the BC Analytical, A Division of V.O.C. Analytical Laboratories, Inc. "Quality Assurance Management Plan". The case narrative addresses batch specific quality control as it pertains to this document.

If you have any questions, please do not hesitate to call me at (714) 978-0113.

Sincerely,

  
Patty Mata  
Project Manager

LOG NO.: G97-06-386

#### CASE NARRATIVE

The following narrative addresses all project specific data quality objectives with respect to: holding times, method blanks, lab control standards, matrix spike and duplicate samples. Analytical anomalies encountered during sample analysis are also discussed as necessary.

**Sample receipt:**

Samples were received under COC and delivered to VOC's Glendale lab on 6/17/97. All containers were received intact and properly preserved.

**Gas/BTEX (Method 8015M):**

Samples had high recovery of the Gas/BTEX surrogate possibly due to matrix interference. The QC samples associated with this batch had acceptable surrogate recovery.

**PNA's (Method 8270):**

One of the three surrogates had recovery higher than the UCL for both samples. Matrix interference is the suspected cause of high recovery due to acceptable QC surrogate recovery.

No other anomalies were encountered during the analysis of the project.

## ACRONYMS AND FLAG DEFINITIONS

### Flag Definitions:

- \* Replicate values. Used when replicate results are entered into the MS/MSD column of the QC report.
- B Blank contamination. Used when associated method blank concentration is greater than the PQL.
- J Estimated value. Used for sample results greater than or equal to MDL, but less than the PQL.
- NC Not calculated. Used for MS/MSD when sample result is greater than two times the spike amount added, or when extracted surrogates were diluted below detectable levels. Used for sample results that are over calibration range.
- Q Quality objectives were not met. Used for Method Blank, Laboratory Control Samples, Matrix Spikes, Matrix Duplicates and Surrogates.

### Acronyms:

COC	Chain of Custody
FLG	Flag
LC	Actual LCS/LCSD concentration recovered
LCL	Lower Control Limit
LCS	Laboratory Control Sample
LCSD	Laboratory Control Sample Duplicate
LT	True LCS/LCSD concentration
MB	Method Blank
MS	Matrix Spike
MSD	Matrix Spike Duplicate
R1	Unspiked sample concentration
RDL	Reporting Detection Limit
%REC	Percent Recovery
Rep.	Surrogate Reported value
RPD	Relative Percent Difference
S1	Actual MS concentration
S2	Actual MSD concentration
T	True concentration of MS/MSD
Theo.	Surrogate Theoretical value
UCL	Upper Control Limit



Our Quality Control Is Your Quality Assurance

## ANALYTICAL REPORT

LOG NO: G97-06-386

Received: 17 JUN 97

Mailed: JUL 23 1997

Mr. Bob Pope  
Brown and Caldwell Consultants  
16735 Von Karman, Suite 200  
Irvine, CA 92606-4953

Project: 3659-06

### REPORT OF ANALYTICAL RESULTS

Page 1

LOG NO	06-386-1	06-386-2	06-386-3
DATE SAMPLED	16 JUN 97	16 JUN 97	16 JUN 97
SAMPLE DESCRIPTION	TS-12	TS-14	TS-15
NON-AQUEOUS			
Semi-volatile HC (8015M)			
Date Analyzed	06/23/97	06/23/97	06/23/97
Date Extracted	06/20/97	06/20/97	06/20/97
Dilution Factor, Times	1	1	1
TPH-d C13-C22, mg/kg	28	35	33
TPH-d C23-C28, mg/kg	95	100	110
Other Semi-volatile HC (8015M)	---	---	---
Surrogates **			
1,3-Dichlorobenzene Reported, mg/kg	27.7	27.6	27.5
1,3-Dichlorobenzene Theoretical, mg/kg	25.0	25.0	25.0

LOG NO: 697-06-386

Received: 17 JUN 97

Mr. Bob Pope  
Brown and Caldwell Consultants  
16735 Von Karman, Suite 200  
Irvine, CA 92606-4953

Project: 3659-06

REPORT OF ANALYTICAL RESULTS

Page 2

LOG NO	06-386-1	06-386-2	06-386-3
DATE SAMPLED	16 JUN 97	16 JUN 97	16 JUN 97
SAMPLE DESCRIPTION	TS-12	TS-14	TS-15
NON-AQUEOUS			
Volatile HC (8015M)			
Date Analyzed	06/24/97	06/24/97	06/24/97
Dilution Factor, Times	1	1	1
Benzene, mg/kg	<0.005	<0.005	<0.005
Toluene, mg/kg	<0.005	<0.005	<0.005
Ethylbenzene, mg/kg	<0.005	<0.005	<0.005
Total Xylene Isomers, mg/kg	<0.01	<0.01	<0.01
TPH-g C6-C12, mg/kg	<0.1	<0.1	<0.1
Other Volatile HC (8015M)	---	---	---
Surrogates **			
a,a,a-Trifluorotoluene Rep., mg/kg	0.0669	0.0717	0.0665
a,a,a-Trifluorotoluene Th., mg/kg	0.0500	0.0500	0.0500

LOG NO: G97-06-386

Received: 17 JUN 97

Mr. Bob Pope  
Brown and Caldwell Consultants  
16735 Von Karman, Suite 200  
Irvine, CA 92606-4953

Project: 3659-06

REPORT OF ANALYTICAL RESULTS

Page 3

LOG NO	06-386-4	06-386-5
DATE SAMPLED	16 JUN 97	16 JUN 97
SAMPLE DESCRIPTION	TS-13	TS-16
NON-AQUEOUS		
Polynuclear Aromatics (8270)		
Date Analyzed	06/30/97	06/30/97
Date Extracted	06/24/97	06/24/97
Dilution Factor, Times	1	1
Acenaphthene, mg/kg	<0.2	<0.2
Acenaphthylene, mg/kg	<0.2	<0.2
Anthracene, mg/kg	<0.2	<0.2
Benzo(a)anthracene, mg/kg	<0.2	<0.2
Benzo(a)pyrene, mg/kg	<0.2	<0.2
Benzo(b)fluoranthene, mg/kg	<0.2	<0.2
Benzo(g,h,i)perylene, mg/kg	<0.2	<0.2
Benzo(k)fluoranthene, mg/kg	<0.2	<0.2
Chrysene, mg/kg	<0.2	<0.2

LOG NO: G97-06-386

Received: 17 JUN 97

Mr. Bob Pope  
Brown and Caldwell Consultants  
16735 Von Karman, Suite 200  
Irvine, CA 92606-4953

Project: 3659-06

REPORT OF ANALYTICAL RESULTS

Page 4

LOG NO	06-386-4	06-386-5
DATE SAMPLED	16 JUN 97	16 JUN 97
SAMPLE DESCRIPTION	TS-13	TS-16
NON-AQUEOUS		
Dibenzo(a,h)anthracene, mg/kg	<0.2	<0.2
Fluoranthene, mg/kg	<0.2	<0.2
Fluorene, mg/kg	<0.2	<0.2
Indeno(1,2,3-c,d)pyrene, mg/kg	<0.2	<0.2
Naphthalene, mg/kg	<0.2	<0.2
Phenanthrene, mg/kg	0.24	0.31
Pyrene, mg/kg	<0.2	<0.2
Surrogates **		
2-Fluorobiphenyl Reported, mg/kg	1.97	1.93
2-Fluorobiphenyl Theo., mg/kg	1.67	1.67
Nitrobenzene-d5 Reported, mg/kg	1.78	1.76
Nitrobenzene-d5 Theoretical, mg/kg	1.67	1.67
Terphenyl-d14 Reported, mg/kg	1.71	1.67

LOG NO: G97-06-386

Received: 17 JUN 97

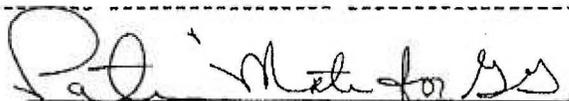
Mr. Bob Pope  
Brown and Caldwell Consultants  
16735 Von Karman, Suite 200  
Irvine, CA 92606-4953

Project: 3659-06

REPORT OF ANALYTICAL RESULTS

Page 5

LOG NO	06-386-4	06-386-5
DATE SAMPLED	16 JUN 97	16 JUN 97
SAMPLE DESCRIPTION	TS-13	TS-16
NON-AQUEOUS		
Terphenyl-d14 Theoretical, mg/kg	1.67	1.67

  
Greta Galoustian, Laboratory Director

The analytical results within this report relate only to the specific compounds and samples investigated and may not necessarily reflect other apparently similar material from the same or a similar location.

This report shall not be reproduced, except in full, without the written approval of VOC. No use of this report for promotional or advertising purposes is permitted without prior written VOC approval.

: ORDER PLACED FOR CLIENT: Brown and Caldwell Consultants 9706386 :  
: VOC ANALYTICAL : GLEN LAB : 13:14:00 21 JUL 1997 - P. 1 :  
=====

SAMPLES...	SAMPLE DESCRIPTION..	DETERM.....	DATE.....	METHOD.....	EQUIP.	BATCH..	ID.NO
			ANALYZED				
9706386*1	TS-12	GAS.C12	06.24.97	8015M	536-33	9766040	
		FUEL,C28	06.23.97	8015M	536-37	9774	1010
9706386*2	TS-14	GAS.C12	06.24.97	8015M	536-33	9766040	
		FUEL,C28	06.23.97	8015M	536-37	9774	1010
9706386*3	TS-15	GAS.C12	06.24.97	8015M	536-33	9766040	
		FUEL,C28	06.23.97	8015M	536-37	9774	1010
9706386*4	TS-13	8270.PNA	06.30.97	8270	537-11	97139	6750
9706386*5	TS-16	8270.PNA	06.30.97	8270	537-11	97139	6750

\*\*\*

Notes: Equipment = VOC Analytical identification number for a particular piece of analytical equipment.  
ID.NO = VOC Analytical employee identification number of analyst.

: SURROGATE RECOVERIES :  
 : BC ANALYTICAL : GLEN LAB : 13:35:14 23 JUL 1997 - P. 1 :  
 =====

ID	ANALYTE	BATCH	ANALYZED	REPORTED	TRUE	%REC	FLAG	LCL	UCL
}706386*1									
3015M	a,a,a-Trifluorotoluene	Re9766040	06/24/97	0.0669	0.0500	134	Q	71	131
3015M	1,3-Dichlorobenzene	9774	06/23/97	27.7	25.0	111		52	145
}706386*2									
3015M	a,a,a-Trifluorotoluene	Re9766040	06/24/97	0.0717	0.0500	143	Q	71	131
3015M	1,3-Dichlorobenzene	9774	06/23/97	27.6	25.0	110		52	145
}706386*3									
3015M	a,a,a-Trifluorotoluene	Re9766040	06/24/97	0.0665	0.0500	133	Q	71	131
3015M	1,3-Dichlorobenzene	9774	06/23/97	27.5	25.0	110		52	145
}706386*4									
3270	Nitrobenzene-d5	97139	06/30/97	1.78	1.67	107		34	110
	2-Fluorobiphenyl	97139	06/30/97	1.97	1.67	118	Q	38	110
	Terphenyl-d14	97139	06/30/97	1.71	1.67	102		18	130
}706386*5									
3270	Nitrobenzene-d5	97139	06/30/97	1.76	1.67	105		34	110
	2-Fluorobiphenyl	97139	06/30/97	1.93	1.67	116	Q	38	110
	Terphenyl-d14	97139	06/30/97	1.67	1.67	100		18	130



VOC ANALYTICAL REPORT  
 SUPPLEMENTAL QC REPORT FOR 9706386  
 DATE PRINTED: 23 JUL 1997

NON-AQUEOUS SAMPLES

Batch: GAS\*9766040 Method: 8015M - Modified 8015

	B7061503*1			C7062876*1			N/A		9706460*1			
	UNITS	MB	LC	LT	LC	LT	R1	R2	S1	S2	T	
Date Analyzed	Date	06/24/97	06/24/97	06/24/97	-	-	06/24/97	-	06/24/97	06/24/97	06/24/97	
Dilution Factor	Times	1	1	1	-	-	1	-	1	1	1	
Benzene	mg/kg	0	0.0490	0.0500	-	-	<0.005	-	0.0187	0.0178	0.0152	
Toluene	mg/kg	0	0.0489	0.0500	-	-	<0.005	-	0.0802	0.0760	0.0974	
Ethylbenzene	mg/kg	0	0.0512	0.0500	-	-	<0.005	-	0.0195	0.0184	0.0204	
Total Xylene Isomers	mg/kg	0	0.163	0.150	-	-	<0.01	-	0.101	0.0954	0.119	
TPH-g C6-C12	mg/kg	0	1.02	1.10	-	-	-	-	-	-	-	
a,a,a-Trifluorotoluene Rep.	mg/kg	0.0493	0.0462	0.0500	-	-	0.0492	-	0.0446	0.0460	0.0500	
a,a,a-Trifluorotoluene Th.	mg/kg	0.0500	0.0500	0.0500	-	-	0.0500	-	0.0500	0.0500	0.0500	

NON-AQUEOUS SAMPLES

Batch: 8270\*97139 Method: 8270 - GC/MS for Semivolatile Organics, Capillary column

	B7061474*1	C7062816*1	C7062817*1	C7062817*1	9706390*15						
UNITS	MB	LC	LT	LC	LT	R1	R2	S1	S2	T	
Date Analyzed	Date	06/25/97	06/25/97	06/25/97	06/25/97	06/26/97	-	06/26/97	06/26/97	06/26/97	
Date Extracted	Date	06/24/97	06/24/97	06/24/97	06/24/97	06/24/97	-	06/24/97	06/24/97	06/24/97	
Dilution Factor	Times	1	1	1	1	1	-	1	1	1	
Acenaphthene	mg/kg	0	2.61	3.33	2.72	3.33	<0.2	1.51	1.62	1.67	
Acenaphthylene	mg/kg	0	2.93	3.33	3.05	3.33	<0.2	-	-	-	
Anthracene	mg/kg	0	2.19	3.33	2.26	3.33	<0.2	-	-	-	
Benzo(a)anthracene	mg/kg	0	3.00	3.33	3.28	3.33	<0.2	-	-	-	
Benzo(a)pyrene	mg/kg	0	2.71	3.33	2.89	3.33	<0.2	-	-	-	
Benzo(b)fluoranthene	mg/kg	0	2.67	3.33	2.87	3.33	<0.2	-	-	-	
Benzo(g,h,i)perylene	mg/kg	0	2.81	3.33	3.17	3.33	<0.2	-	-	-	
Benzo(k)fluoranthene	mg/kg	0	2.77	3.33	2.52	3.33	<0.2	-	-	-	
Chrysene	mg/kg	0	2.94	3.33	3.20	3.33	<0.2	-	-	-	
Dibenzo(a,h)anthracene	mg/kg	0	2.77	3.33	3.09	3.33	<0.2	-	-	-	
Fluoranthene	mg/kg	0	2.50	3.33	2.61	3.33	<0.2	-	-	-	
Fluorene	mg/kg	0	2.87	3.33	2.94	3.33	<0.2	-	-	-	
Indeno(1,2,3-c,d)pyrene	mg/kg	0	3.34	3.33	3.80	3.33	<0.2	-	-	-	
Naphthalene	mg/kg	0	2.48	3.33	2.56	3.33	<0.2	-	-	-	
Phenanthrene	mg/kg	0	2.36	3.33	2.44	3.33	<0.2	-	-	-	
Pyrene	mg/kg	0	2.77	3.33	2.95	3.33	<0.2	-	-	-	
2-Fluorobiphenyl Reported	mg/kg	1.60	1.41	1.67	1.40	1.67	1.57	1.07	1.15	1.67	
2-Fluorobiphenyl Theo.	mg/kg	1.67	1.67	1.67	1.67	1.67	1.67	1.45	1.53	1.67	
Nitrobenzene-d5 Reported	mg/kg	1.41	1.42	1.67	1.40	1.67	1.53	1.67	1.67	1.67	
Nitrobenzene-d5 Theoretical	mg/kg	1.67	1.67	1.67	1.67	1.67	1.67	1.57	1.72	1.67	
Terphenyl-d14 Reported	mg/kg	1.38	1.70	1.67	1.75	1.67	1.24	1.67	1.67	1.67	
Terphenyl-d14 Theoretical	mg/kg	1.67	1.67	1.67	1.67	1.67	1.67	1.19	1.28	1.67	

Batch: FUEL,C28\*9774 Method: 8015M - Modified 8015

	B7061455*1	C7062779*1	C7062780*1	C7062780*1	N/A						
UNITS	MB	LC	LT	LC	LT	R1	R2	S1	S2	T	
Date Analyzed	Date	06/23/97	06/23/97	06/23/97	06/23/97	-	-	-	-	-	
Date Extracted	Date	06/20/97	06/20/97	06/20/97	06/20/97	-	-	-	-	-	
Dilution Factor	Times	1	1	1	1	-	-	-	-	-	
TPH-d C13-C22	mg/kg	0	258	200	266	200	-	-	-	-	
TPH-d C23-C28	mg/kg	0	-	-	-	-	-	-	-	-	
1,3-Dichlorobenzene Reported	mg/kg	26.2	27.1	25.0	26.8	25.0	-	-	-	-	
1,3-Dichlorobenzene Theoretical	mg/kg	25.0	25.0	25.0	25.0	25.0	-	-	-	-	

CHAIN OF CUSTODY RECORD

VOC Log Number

Client name <b>BC / SHELL</b>				Project or PO# <b>3659-06</b>		Analyses required				Page 1 of 1	
Address <b>16735 VON KARMAN #200</b>				Phone <b>(714) 660-1070</b>		<div style="border: 1px solid black; padding: 5px; transform: rotate(-45deg); display: inline-block;">8015M / 8020</div> <div style="border: 1px solid black; padding: 5px; transform: rotate(-45deg); display: inline-block;">8270</div>					
City, State, Zip <b>IRVINE, CA 92606</b>				Report attention <b>BOB POPE</b>							
Lab Sample number	Date sampled	Time sampled	Type* See key below	Sampled by	Number of containers	Remarks					
				<b>FABIO MINERVINI</b>							
	6/16/97	13:30	So	TS-12	1	✓					
	6/16/97	14:00	So	TS-13	1		✓				Please FAX results to attention of Bob Pope @ (714) 474-0940 as soon as available
	6/17/97	9:00	So	TS-14	1	✓					
	6/17/97	13:30	So	TS-15	1	✓					
	6/17/97	14:30	So	TS-16	1		✓				

Signature	Print Name	Company	Date	Time
<i>Fabio Minervini</i>	FABIO MINERVINI	BC	6/17/97	17:00
<i>Ruth Mata</i>	Ruth Mata	VOC	6/17/97	17:00
<i>Ruth Mata</i>	Ruth Mata	VOC	6/17/97	12:00
<i>A. Makija</i>	A. Makija	ARIA	6/17/97	17:00
<i>A. Makija</i>	A. Makija	ARIA	6/17/97	5:50
<i>L. Pharis</i>	L. Pharis	VOC	6/17/97	5:50

VOC ANALYTICAL

- 1065 Shary Circle, Concord, CA 94518 (510) 825-3894
- 801 Western Avenue, Glendale, CA 91201 (818) 247-5737
- 1200 Gene Autry Way, Anaheim, CA 92805 (714) 978-0113
- 4411 S. 40th Street, Phoenix, AZ 85040 (602) 470-9707

Note: Samples are discarded 30 days after results are reported unless other arrangements are made. Hazardous samples will be returned to client or disposed of at client's expense.

Disposal arrangements: \_\_\_\_\_

\*KEY: AQ—Aqueous NA—Nonaqueous SL—Sludge  
GW—Groundwater SO—Soil PE—Petroleum  
WW—Wastewater



Our Quality Control Is Your Quality Assurance

July 23, 1997

LOG NO.: G97-06-598

Brown and Caldwell  
16735 Von Karman, Suite 200  
Irvine, CA 92714-0940  
Attn: Mr. Bob Pope

Reference: Client Project # 3659-06, Shell.

Dear Mr. Pope,

Enclosed is the analytical report for the chemical testing of samples collected in support of the above-referenced project. Samples were identified and tracked in the BC/VOC system as log number **G97-06-598**. When making inquiries about this report, please provide the log number.

The contents of this package are based on the requirements specified in the BC Analytical, A Division of V.O.C. Analytical Laboratories, Inc. "Quality Assurance Management Plan". The case narrative addresses batch specific quality control as it pertains to this document.

If you have any questions, please do not hesitate to call me at (714) 978-0113.

Sincerely,

Patty Mata  
Project Manager

LOG NO.: G97-06-598

### CASE NARRATIVE

The following narrative addresses all project specific data quality objectives with respect to: holding times, method blanks, lab control standards, matrix spike and duplicate samples. Analytical anomalies encountered during sample analysis are also discussed as necessary.

**Sample receipt:**

Samples were received under COC and delivered to VOC's Glendale lab on 6/27/97. All containers were received intact and properly preserved.

**PNA'S (Method 8270):**

Naphthalene had a LCS recovery above the UCL for batch 8270\*97146. The LCSD had acceptable percent recovery. Since the LCS was high and no target compounds were detected in the associated sample, the data was released with no further corrective action.

No other anomalies were encountered during the analysis of the project.

VOC Analytical Laboratories, Inc.

1212 East Katella Avenue, Anaheim CA 92805 - Phone: (714) 978-0113 - Fax: (714) 978-9284

## ACRONYMS AND FLAG DEFINITIONS

### Flag Definitions:

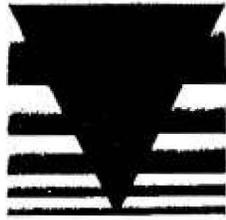
- \* Replicate values. Used when replicate results are entered into the MS/MSD column of the QC report.
- B Blank contamination. Used when associated method blank concentration is greater than the PQL.
- J Estimated value. Used for sample results greater than or equal to MDL, but less than the PQL.
- NC Not calculated. Used for MS/MSD when sample result is greater than two times the spike amount added, or when extracted surrogates were diluted below detectable levels. Used for sample results that are over calibration range.
- Q Quality objectives were not met. Used for Method Blank, Laboratory Control Samples, Matrix Spikes, Matrix Duplicates and Surrogates.

### Acronyms:

COC	Chain of Custody
FLG	Flag
LC	Actual LCS/LCSD concentration recovered
LCL	Lower Control Limit
LCS	Laboratory Control Sample
LCSD	Laboratory Control Sample Duplicate
LT	True LCS/LCSD concentration
MB	Method Blank
MS	Matrix Spike
MSD	Matrix Spike Duplicate
R1	Unspiked sample concentration
RDL	Reporting Detection Limit
%REC	Percent Recovery
Rep.	Surrogate Reported value
RPD	Relative Percent Difference
S1	Actual MS concentration
S2	Actual MSD concentration
T	True concentration of MS/MSD
Theo.	Surrogate Theoretical value
UCL	Upper Control Limit

VOC Analytical Laboratories, Inc.

1212 East Katella Avenue, Anaheim CA 92805 - Phone: (714) 978-0113 - Fax: (714) 978-9284



Our Quality Control Is Your Quality Assurance

# ANALYTICAL REPORT

LOG NO: 697-06-598

Received: 27 JUN 97

Mailed: JUL 21 1997

Mr. Bob Pope  
Brown and Caldwell Consultants  
16735 Von Karman, Suite 200  
Irvine, CA 92606-4953

Purchase Order: 3659

Project: 3659/SHELL

## REPORT OF ANALYTICAL RESULTS

Page 1

LOG NO	05-598-1	06-598-2
DATE SAMPLED	27 JUN 97	27 JUN 97
SAMPLE DESCRIPTION	TS-17	TS-19
NON-AQUEOUS		
Semi-volatile HC (8015M)		
Date Analyzed	07/09/97	07/09/97
Date Extracted	07/09/97	07/09/97
Dilution Factor, Times	1	1
TPH-d C13-C22, mg/kg	<10	<10
TPH-d C23-C28, mg/kg	51	23
Other Semi-volatile HC (8015M)	---	---
Surrogates **		
1,3-Dichlorobenzene Reported, mg/kg	24.7	24.6
1,3-Dichlorobenzene Theoretical, mg/kg	25.0	25.0

LOG NO: G97-06-598

Received: 27 JUN 97

Mr. Bob Pope  
Brown and Caldwell Consultants  
16735 Von Karman, Suite 200  
Irvine, CA 92606-4953

Purchase Order: 3659

Project: 3659/SHELL

REPORT OF ANALYTICAL RESULTS

Page 2

LOG NO	06-598-1	06-598-2
DATE SAMPLED	27 JUN 97	27 JUN 97
SAMPLE DESCRIPTION	TS-17	TS-19
NON-AQUEOUS		
-----		
Volatile HC (8015M)		
Date Analyzed	07/02/97	07/02/97
Dilution Factor, Times	1	1
Benzene, mg/kg	<0.005	<0.005
Toluene, mg/kg	<0.005	<0.005
Ethylbenzene, mg/kg	<0.005	<0.005
Total Xylene Isomers, mg/kg	<0.01	<0.01
TPH-g C6-C12, mg/kg	<0.1	<0.1
Other Volatile HC (8015M)	---	---
Surrogates **		
a,a,a-Trifluorotoluene Rep., mg/kg	0.0580	0.0508
a,a,a-Trifluorotoluene Th., mg/kg	0.0500	0.0500

LOG NO: 697-06-598

Received: 27 JUN 97

Mr. Bob Pope  
Brown and Caldwell Consultants  
16735 Von Karman, Suite 200  
Irvine, CA 92606-4953

Purchase Order: 3659

Project: 3659/SHELL

REPORT OF ANALYTICAL RESULTS

Page 3

LOG NO	06-598-3
DATE SAMPLED	27 JUN 97
SAMPLE DESCRIPTION	TS-18
NON-AQUEOUS	
-----	
Polynuclear Aromatics (8270)	
Date Analyzed	07/10/97
Date Extracted	07/07/97
Dilution Factor, Times	5
Acenaphthene, mg/kg	<1
Acenaphthylene, mg/kg	<1
Anthracene, mg/kg	<1
Benzo(a)anthracene, mg/kg	<1
Benzo(a)pyrene, mg/kg	<1
Benzo(b)fluoranthene, mg/kg	<1
Benzo(g,h,i)perylene, mg/kg	<1
Benzo(k)fluoranthene, mg/kg	<1
Chrysene, mg/kg	<1

LOG NO: G97-06-598

Received: 27 JUN 97

Mr. Bob Pope  
Brown and Caldwell Consultants  
16735 Von Karman, Suite 200  
Irvine, CA 92606-4953

Purchase Order: 3659

Project: 3659/SHELL

REPORT OF ANALYTICAL RESULTS

Page 4

LOG NO	06-598-3
DATE SAMPLED	27 JUN 97
SAMPLE DESCRIPTION	TS-18
NON-AQUEOUS	
Dibenzo(a,h)anthracene, mg/kg	<1
Fluoranthene, mg/kg	<1
Fluorene, mg/kg	<1
Indeno(1,2,3-c,d)pyrene, mg/kg	<1
Naphthalene, mg/kg	<1
Phenanthrene, mg/kg	<1
Pyrene, mg/kg	<1
Surrogates **	
2-Fluorobiphenyl Reported, mg/kg	1.67
2-Fluorobiphenyl Theo., mg/kg	1.67
Nitrobenzene-d5 Reported, mg/kg	1.38
Nitrobenzene-d5 Theoretical, mg/kg	1.67
Terphenyl-d14 Reported, mg/kg	1.95

LOG NO: G97-06-598

Received: 27 JUN 97

Mr. Bob Pope  
Brown and Caldwell Consultants  
16735 Von Karman, Suite 200  
Irvine, CA 92606-4953

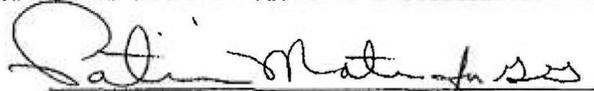
Purchase Order: 3659

Project: 3659/SHELL

REPORT OF ANALYTICAL RESULTS

Page 5

LOG NO	06-598-3
DATE SAMPLED	27 JUN 97
SAMPLE DESCRIPTION	TS-18
NON-AQUEOUS	
Terphenyl-d14 Theoretical, mg/kg	1.67

  
Greta Galoustian, Laboratory Director

The analytical results within this report relate only to the specific compounds and samples investigated and may not necessarily reflect other apparently similar material from the same or a similar location.

This report shall not be reproduced, except in full, without the written approval of VOC. No use of this report for promotional or advertising purposes is permitted without prior written VOC approval.

ORDER PLACED FOR CLIENT: Brown and Caldwell Consultants 9706598 :  
VOC ANALYTICAL : GLEN LAB : 13:17:52 21 JUL 1997 - P. 1 :  
=====

IMPLES...	SAMPLE DESCRIPTION..	DETERM.....	DATE..... ANALYZED	METHOD.....	EQUIP. BATCH..	ID.NO
706598*1	TS-17	FUEL,C28	07.09.97	8015M	536-37 9779	1010
		GAS.C12	07.02.97	8015M	536-33 9766056	
706598*2	TS-19	FUEL,C28	07.09.97	8015M	536-37 9779	1010
		GAS.C12	07.02.97	8015M	536-33 9766056	
706598*3	TS-18	B270.PNA	07.10.97	8270	537-14 97146	1009

\*\*

Notes: Equipment = VOC Analytical identification number for a particular piece of analytical equipment.

ID.NO = VOC Analytical employee identification number of analyst.

: SURROGATE RECOVERIES :  
: BC ANALYTICAL : GLEN LAB : 13:34:35 23 JUL 1997 - P. 1 :  
=====

ID	ANALYTE	BATCH	ANALYZED	REPORTED	TRUE	%REC	FLAG	LCL	UCL
1706598*1									
3015M	1,3-Dichlorobenzene	9779	07/09/97	24.7	25.0	99		52	145
3015M	a,a,a-Trifluorotoluene	Re9766056	07/02/97	0.0580	0.0500	116		71	131
1706598*2									
3015M	1,3-Dichlorobenzene	9779	07/09/97	24.6	25.0	98		52	145
3015M	a,a,a-Trifluorotoluene	Re9766056	07/02/97	0.0508	0.0500	102		71	131
1706598*3									
3270	Nitrobenzene-d5	97146	07/10/97	1.38	1.67	83		34	110
	2-Fluorobiphenyl	97146	07/10/97	1.67	1.67	100		38	110
	Terphenyl-d14	97146	07/10/97	1.95	1.67	117		18	130



VOC ANALYTICAL REPORT  
 SUPPLEMENTAL REPORT FOR 9706598  
 DATE PRINTED: 23 JUL 1997

NON-AQUEOUS SAMPLES

Batch: GAS\*9766056 Method: 8015M - Modified 8015

	8707106*1			C707192*1			N/A	9706498*10			
	UNITS	MB	LC	LT	LC	LT	R1	R2	S1	S2	T
Date Analyzed	Date	07/02/97	07/02/97	07/02/97	-	-	07/02/97	-	07/02/97	07/02/97	07/02/97
Dilution Factor	Times	1	1	1	-	-	1	-	1	1	1
Benzene	mg/kg	0	0.0491	0.0500	-	-	<0.005	-	0.0182	0.0175	0.0152
Toluene	mg/kg	0	0.0503	0.0500	-	-	<0.005	-	0.0804	0.0786	0.0974
Ethylbenzene	mg/kg	0	0.0516	0.0500	-	-	<0.005	-	0.0201	0.0196	0.0204
Total Xylene Isomers	mg/kg	0	0.164	0.150	-	-	<0.01	-	0.103	0.100	0.119
IPH-g C6-C12	mg/kg	0	1.04	1.10	-	-	-	-	-	-	-
a,a,a-Trifluorotoluene Rep.	mg/kg	0.0473	0.0454	0.0500	-	-	0.0461	-	0.0476	0.0462	0.0500
a,a,a-Trifluorotoluene Th.	mg/kg	0.0500	0.0500	0.0500	-	-	0.0500	-	0.0500	0.0500	0.0500

JOC ANALYTICAL LABORATORY  
 SUPPLEMENTAL REPORT FOR 9706598  
 DATE PRINTED: 23 JUL 1997

NON-AQUEOUS SAMPLES

Batch: 8270\*97146 Method: 8270 - GC/MS for Semivolatile Organics, Capillary column

		B707204*1	C707408*1	C707409*1	C707409*1	9707103*2					
	UNITS	MB	LC	LT	LC	LT	R1	R2	S1	S2	T
Date Analyzed	Date	07/08/97	07/08/97	07/08/97	07/08/97	07/08/97	-	-	-	-	-
Date Extracted	Date	07/07/97	07/07/97	07/07/97	07/07/97	07/07/97	-	-	-	-	-
Dilution Factor	Times	1	1	1	1	1	-	-	-	-	-
Acenaphthene	mg/kg	0	3.76	3.33	3.07	3.33	-	-	-	-	-
Acenaphthylene	mg/kg	0	3.84	3.33	3.21	3.33	-	-	-	-	-
Anthracene	mg/kg	0	3.56	3.33	3.01	3.33	-	-	-	-	-
Benzo(a)anthracene	mg/kg	0	4.07	3.33	3.28	3.33	-	-	-	-	-
Benzo(a)pyrene	mg/kg	0	3.90	3.33	3.13	3.33	-	-	-	-	-
Benzo(b)fluoranthene	mg/kg	0	4.37	3.33	3.15	3.33	-	-	-	-	-
Benzo(g,h,i)perylene	mg/kg	0	3.92	3.33	3.25	3.33	-	-	-	-	-
Benzo(k)fluoranthene	mg/kg	0	3.10	3.33	2.92	3.33	-	-	-	-	-
Chrysene	mg/kg	0	3.96	3.33	3.26	3.33	-	-	-	-	-
Dibenzo(a,h)anthracene	mg/kg	0	3.84	3.33	3.17	3.33	-	-	-	-	-
Fluoranthene	mg/kg	0	3.80	3.33	3.11	3.33	-	-	-	-	-
Fluorene	mg/kg	0	4.14	3.33	3.38	3.33	-	-	-	-	-
Indeno(1,2,3-c,d)pyrene	mg/kg	0	4.39	3.33	3.18	3.33	-	-	-	-	-
Naphthalene	mg/kg	0	3.66	3.33	3.08	3.33	-	-	-	-	-
Phenanthrene	mg/kg	0	3.99	3.33	3.27	3.33	-	-	-	-	-
Pyrene	mg/kg	0	4.24	3.33	3.41	3.33	-	-	-	-	-
2-Fluorobiphenyl Reported	mg/kg	1.66	1.80	1.67	1.46	1.67	-	-	-	-	-
2-Fluorobiphenyl Theo.	mg/kg	1.67	1.67	1.67	1.67	1.67	-	-	-	-	-
Nitrobenzene-d5 Reported	mg/kg	1.35	1.65	1.67	1.35	1.67	-	-	-	-	-
Nitrobenzene-d5 Theoretical	mg/kg	1.67	1.67	1.67	1.67	1.67	-	-	-	-	-
Terphenyl-d14 Reported	mg/kg	2.03	2.05	1.67	1.67	1.67	-	-	-	-	-
Terphenyl-d14 Theoretical	mg/kg	1.67	1.67	1.67	1.67	1.67	-	-	-	-	-

Batch: FBEL,C28\*9779 Method: 8015M - Modified 8015

		B707384*1	C707784*1	C707785*1	C707785*1	N/A					
	UNITS	MB	LC	LT	LC	LT	R1	R2	S1	S2	T
Date Analyzed	Date	07/09/97	07/09/97	07/09/97	07/09/97	07/09/97	-	-	-	-	-
Date Extracted	Date	07/09/97	07/09/97	07/09/97	07/09/97	07/09/97	-	-	-	-	-
Dilution Factor	Times	1	1	1	1	1	-	-	-	-	-
TPH-d C13-C22	mg/kg	0	227	200	212	200	-	-	-	-	-
TPH-d C23-C28	mg/kg	0	-	-	-	-	-	-	-	-	-
1,3-Dichlorobenzene Reported	mg/kg	26.3	25.4	25.0	25.3	25.0	-	-	-	-	-
1,3-Dichlorobenzene Theoretical	mg/kg	25.0	25.0	25.0	25.0	25.0	-	-	-	-	-





*Our Quality Control Is Your Quality Assurance*

August 6, 1997

LOG NO.: G97-07-012

Brown and Caldwell  
16735 Von Karman, Suite 200  
Irvine, CA 92714-0940  
Attn: Mr. Bob Pope

Reference: Client Project # 3659-06, Shell.

Dear Mr. Pope,

Enclosed is the analytical report for the chemical testing of samples collected in support of the above-referenced project. Samples were identified and tracked in the BCA/VOC system as log number **G97-07-012**. When making inquiries about this report, please provide the log number.

The contents of this package are based on the requirements specified in the BC Analytical, A Division of V.O.C. Analytical Laboratories, Inc. "Quality Assurance Management Plan". The case narrative addresses batch specific quality control as it pertains to this document.

If you have any questions, please do not hesitate to call me at (714) 978-0113.

Sincerely,

Patty Mata  
Project Manager

**CASE NARRATIVE**

The following narrative addresses all project specific data quality objectives with respect to: holding times, method blanks, lab control standards, matrix spike and duplicate samples. Analytical anomalies encountered during sample analysis are also discussed as necessary.

**Sample receipt:**

Samples were received under COC and delivered to VOC's Glendale lab on 7/3/97. All containers were received intact and properly preserved.

**Gas/BTEX (Method 8020/8015M):**

Sample TS-23 had high recovery of the Gas/BTEX surrogate possibly due to matrix interference. As the bias was high and the samples did not have detectable levels of Gas/BTEX, the data was reported with no further corrective action. The QC samples associated with this batch had acceptable surrogate recovery.

Benzene had MS/MSD recoveries above the UCL for batch 9766060. The LCS/LCSD had acceptable recovery for this batch.

**PNA's (Method 8270):**

Sample TS-22 required dilution due to matrix interference.

Naphthalene had a LCS recovery above the UCL for batch 8270\*97146. The LCSD had acceptable percent recovery. Since the LCS was high and no target compounds were detected in the associated sample, the data was released with no further corrective action.

**Diesel (Method 8015M):**

The QC batch was controlled by a LCS/LCSD in place of a MS/MSD for diesel.

No other anomalies were encountered during the analysis of the project.

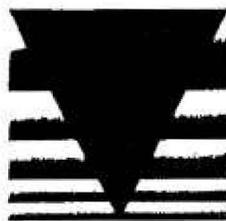
## ACRONYMS AND FLAG DEFINITIONS

### Flag Definitions:

- Replicate values. Used when replicate results are entered into the MS/MSD column of the QC report.
- B Blank contamination. Used when associated method blank concentration is greater than the PQL.
- J Estimated value. Used for sample results greater than or equal to MDL, but less than the PQL.
- NC Not calculated. Used for MS/MSD when sample result is greater than two times the spike amount added, or when extracted surrogates were diluted below detectable levels. Used for sample results that are over calibration range.
- Q Quality objectives were not met. Used for Method Blank, Laboratory Control Samples, Matrix Spikes, Matrix Duplicates and Surrogates.

### Acronyms:

COC	Chain of Custody
FLG	Flag
LC	Actual LCS/LCSD concentration recovered
LCL	Lower Control Limit
LCS	Laboratory Control Sample
LCSD	Laboratory Control Sample Duplicate
LT	True LCS/LCSD concentration
MB	Method Blank
MS	Matrix Spike
MSD	Matrix Spike Duplicate
R1	Unspiked sample concentration
RDL	Reporting Detection Limit
%REC	Percent Recovery
Rep.	Surrogate Reported value
RPD	Relative Percent Difference
S1	Actual MS concentration
S2	Actual MSD concentration
T	True concentration of MS/MSD
Theo.	Surrogate Theoretical value
UCL	Upper Control Limit



Our Quality Control Is Your Quality Assurance

# ANALYTICAL REPORT

LOG NO: G97-07-012

Received: 03 JUL 97

Mailed: AUG 28 1997

Mr. Bob Pope  
Brown and Caldwell Consultants  
16735 Von Karman, Suite 200  
Irvine, CA 92606-4953

Project: 3659-06

## REPORT OF ANALYTICAL RESULTS

Page 1

LOG NO	07-012-1	07-012-2	07-012-3
DATE SAMPLED	02 JUL 97	02 JUL 97	02 JUL 97
SAMPLE DESCRIPTION	TS-20	TS-21	TS-23
NON-AQUEOUS			
Semi-volatile HC (8015M)			
Date Analyzed	07/10/97	07/10/97	07/10/97
Date Extracted	07/09/97	07/09/97	07/09/97
Dilution Factor, Times	2.5	2	1
TPH-d C13-C22, mg/kg	40	<20	37
TPH-d C23-C28, mg/kg	290	165	130
Other Semi-volatile HC (8015M)	---	---	---
Surrogates **			
1,3-Dichlorobenzene Reported, mg/kg	18.4	15.0	23.3
1,3-Dichlorobenzene Theoretical, mg/kg	25.0	25.0	25.0

LOG NO: G97-07-012

Received: 03 JUL 97

Mr. Bob Pope  
Brown and Caldwell Consultants  
16735 Von Karman, Suite 200  
Irvine, CA 92606-4953

Project: 3659-06

REPORT OF ANALYTICAL RESULTS

Page 2

LOG NO	07-012-1	07-012-2	07-012-3
DATE SAMPLED	02 JUL 97	02 JUL 97	02 JUL 97
SAMPLE DESCRIPTION	TS-20	TS-21	TS-23
NON-AQUEOUS			
-----			
Volatile HC (8015M)			
Date Analyzed	07/07/97	07/07/97	07/07/97
Dilution Factor, Times	1	1	1
Benzene, mg/kg	<0.005	<0.005	<0.005
Toluene, mg/kg	<0.005	<0.005	<0.005
Ethylbenzene, mg/kg	<0.005	<0.005	<0.005
Total Xylene Isomers, mg/kg	<0.01	<0.01	<0.01
TPH-g C6-C12, mg/kg	<0.1	<0.1	<0.1
Other Volatile HC (8015M)	---	---	---
Surrogates **			
a,a,a-Trifluorotoluene Rep., mg/kg	0.0502	0.0542	0.0690
a,a,a-Trifluorotoluene Th., mg/kg	0.0500	0.0500	0.0500

LOG NO: G97-07-012

Received: 03 JUL 97

Mr. Bob Pope  
Brown and Caldwell Consultants  
16735 Von Karman, Suite 200  
Irvine, CA 92606-4953

Project: 3659-06

REPORT OF ANALYTICAL RESULTS

Page 3

LOG NO	07-012-4
DATE SAMPLED	02 JUL 97
SAMPLE DESCRIPTION	TS-22
NON-AQUEOUS	
-----	
Polynuclear Aromatics (8270)	
Date Analyzed	07/09/97
Date Extracted	07/07/97
Dilution Factor, Times	5
Acenaphthene, mg/kg	<1
Acenaphthylene, mg/kg	<1
Anthracene, mg/kg	<1
Benzo(a)anthracene, mg/kg	<1
Benzo(a)pyrene, mg/kg	<1
Benzo(b)fluoranthene, mg/kg	<1
Benzo(g,h,i)perylene, mg/kg	<1
Benzo(k)fluoranthene, mg/kg	<1
Chrysene, mg/kg	<1

LOG NO: G97-C7-012

Received: 03 JUL 97

Mr. Bob Pope  
Brown and Caldwell Consultants  
16735 Von Karman, Suite 200  
Irvine, CA 92606-4953

Project: 3659-06

REPORT OF ANALYTICAL RESULTS

Page 4

LOG NO	07-012-4
DATE SAMPLED	02 JUL 97
SAMPLE DESCRIPTION	TS-22
NON-AQUEOUS	
Dibenzo(a,h)anthracene, mg/kg	<1
Fluoranthene, mg/kg	<1
Fluorene, mg/kg	<1
Indeno(1,2,3-c,d)pyrene, mg/kg	<1
Naphthalene, mg/kg	<1
Phenanthrene, mg/kg	<1
Pyrene, mg/kg	<1
Surrogates **	
2-Fluorobiphenyl Reported, mg/kg	1.43
2-Fluorobiphenyl Theo., mg/kg	1.67
Nitrobenzene-d5 Reported, mg/kg	1.15
Nitrobenzene-d5 Theoretical, mg/kg	1.67
Terphenyl-d14 Reported, mg/kg	1.82

LOG NO: 697-07-012

Received: 03 JUL 97

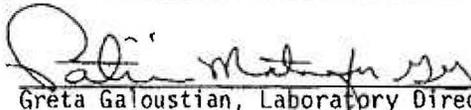
Mr. Bob Pope  
Brown and Caldwell Consultants  
16735 Von Karman, Suite 200  
Irvine, CA 92606-4953

Project: 3659-06

REPORT OF ANALYTICAL RESULTS

Page 5

LOG NO	07-012-4
DATE SAMPLED	02 JUL 97
SAMPLE DESCRIPTION	TS-22
NON-AQUEOUS	
Terphenyl-d14 Theoretical, mg/kg	1.67

  
Greta Galoustian, Laboratory Director

The analytical results within this report relate only to the specific compounds and samples investigated and may not necessarily reflect other apparently similar material from the same or a similar location.

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: ORDER PLACED FOR CLIENT: Brown and Caldwell Consultants 9707012 :  
: VOC ANALYTICAL : GLEN LAB : 13:19:12 21 JUL 1997 - P. 1 :  
=====

SAMPLES...	SAMPLE DESCRIPTION..	DETERM.....	DATE..... ANALYZED	METHOD.....	EQUIP. BATCH..	ID.NO
9707012*1	TS-20	FUEL,C28	07.10.97	8015M	536-37 9779	1010
		GAS.C12	07.07.97	8015M	536-33 9766060	
9707012*2	TS-21	FUEL,C28	07.10.97	8015M	536-37 9779	1010
		GAS.C12	07.07.97	8015M	536-33 9766060	
9707012*3	TS-23	FUEL,C28	07.10.97	8015M	536-37 9779	1010
		GAS.C12	07.07.97	8015M	536-33 9766060	
9707012*4	TS-22	8270.PNA	07.09.97	8270	537-14 97146	1009

\*\*\*

Notes: Equipment = VOC Analytical identification number for a particular piece of analytical equipment.

ID.NO = VOC Analytical employee identification number of analyst.

SURROGATE RECOVERIES :

BC ANALYTICAL : GLEN LAB : 13:33:54 23 JUL 1997 - P. 1 :

MOD	ANALYTE	BATCH	ANALYZED	REPORTED	TRUE	%REC	FLAG	LCL	UCL
3707012*1									
3015M	1,3-Dichlorobenzene	9779	07/10/97	18.4	25.0	74		52	145
3015M	a,a,a-Trifluorotoluene	Re9766060	07/07/97	0.0502	0.0500	100		71	131
3707012*2									
3015M	1,3-Dichlorobenzene	9779	07/10/97	15.0	25.0	60		52	145
3015M	a,a,a-Trifluorotoluene	Re9766060	07/07/97	0.0542	0.0500	108		71	131
3707012*3									
3015M	1,3-Dichlorobenzene	9779	07/10/97	23.3	25.0	93		52	145
3015M	a,a,a-Trifluorotoluene	Re9766060	07/07/97	0.0690	0.0500	138	Q	71	131
3707012*4									
3270	Nitrobenzene-d5	97146	07/09/97	1.15	1.67	69		34	110
	2-Fluorobiphenyl	97146	07/09/97	1.43	1.67	86		38	110
	Terphenyl-d14	97146	07/09/97	1.82	1.67	109		18	130



NON-AQUEOUS SAMPLES

Batch: GAS\*9766060 Method: 8015M - Modified 8015

		B707258*1	C707539*1	.....	C7072261*1	.....	9707127*8	.....	.....	.....	.....	.....
	UNITS	MB	LC	LT	LC	LT	R1	R2	S1	S2	T	
Date Analyzed	Date	07/07/97	07/07/97	07/07/97	07/07/97	07/07/97	07/07/97	-	07/07/97	07/07/97	07/07/97	
Dilution Factor	Times	1	1	1	1	1	1	-	1	1	1	
Benzene	mg/kg	0	0.0507	0.0500	0.0496	0.0500	<0.05	-	0.0217	0.0205	0.0152	
Toluene	mg/kg	0	0.0511	0.0500	0.0502	0.0500	<0.05	-	0.0916	0.0882	0.0974	
Ethylbenzene	mg/kg	0	0.0520	0.0500	0.0508	0.0500	<0.05	-	0.0226	0.0216	0.0204	
Total Xylene Isomers	mg/kg	0	0.165	0.150	0.162	0.150	<0.1	-	0.116	0.110	0.119	
TPH-g C6-C12	mg/kg	0	0.987	1.10	1.03	1.10	-	-	-	-	-	
a,a,a-Trifluorotoluene Rep.	mg/kg	0.0493	0.0434	0.0500	0.0485	0.0500	0.0471	-	0.0463	0.0499	0.0500	
a,a,a-Trifluorotoluene Th.	mg/kg	0.0500	0.0500	0.0500	0.0500	0.0500	0.0500	-	0.0500	0.0500	0.0500	

NON-AQUEOUS SAMPLES

Batch: 8270\*97146 Method: 8270 - GC/MS for Semivolatile Organics, Capillary column

	UNITS	8707204*1 MB	C707408*1 LC	LT	C707409*1 LC	LT	9707103*2 R1	R2	S1	S2	T
Date Analyzed	Date	07/08/97	07/08/97	07/08/97	07/08/97	07/08/97	-	-	-	-	-
Date Extracted	Date	07/07/97	07/07/97	07/07/97	07/07/97	07/07/97	-	-	-	-	-
Dilution Factor	Times	1	1	1	1	1	-	-	-	-	-
Acenaphthene	mg/kg	0	3.76	3.33	3.07	3.33	-	-	-	-	-
Acenaphthylene	mg/kg	0	3.84	3.33	3.21	3.33	-	-	-	-	-
Anthracene	mg/kg	0	3.56	3.33	3.01	3.33	-	-	-	-	-
Benzo(a)anthracene	mg/kg	0	4.07	3.33	3.28	3.33	-	-	-	-	-
Benzo(a)pyrene	mg/kg	0	3.90	3.33	3.13	3.33	-	-	-	-	-
Benzo(b)fluoranthene	mg/kg	0	4.37	3.33	3.15	3.33	-	-	-	-	-
Benzo(g,h,i)perylene	mg/kg	0	3.92	3.33	3.25	3.33	-	-	-	-	-
Benzo(k)fluoranthene	mg/kg	0	3.10	3.33	2.92	3.33	-	-	-	-	-
Chrysene	mg/kg	0	3.96	3.33	3.26	3.33	-	-	-	-	-
Dibenzo(a,h)anthracene	mg/kg	0	3.84	3.33	3.17	3.33	-	-	-	-	-
Fluoranthene	mg/kg	0	3.80	3.33	3.11	3.33	-	-	-	-	-
Fluorene	mg/kg	0	4.14	3.33	3.38	3.33	-	-	-	-	-
Indeno(1,2,3-c,d)pyrene	mg/kg	0	4.39	3.33	3.18	3.33	-	-	-	-	-
Naphthalene	mg/kg	0	3.66	3.33	3.08	3.33	-	-	-	-	-
Phenanthrene	mg/kg	0	3.99	3.33	3.27	3.33	-	-	-	-	-
Pyrene	mg/kg	0	4.24	3.33	3.41	3.33	-	-	-	-	-
2-Fluorobiphenyl Reported	mg/kg	1.66	1.80	1.67	1.46	1.67	-	-	-	-	-
2-Fluorobiphenyl Theo.	mg/kg	1.67	1.67	1.67	1.67	1.67	-	-	-	-	-
Nitrobenzene-d5 Reported	mg/kg	1.35	1.65	1.67	1.35	1.67	-	-	-	-	-
Nitrobenzene-d5 Theoretical	mg/kg	1.67	1.67	1.67	1.67	1.67	-	-	-	-	-
Terphenyl-d14 Reported	mg/kg	2.03	2.05	1.67	1.67	1.67	-	-	-	-	-
Terphenyl-d14 Theoretical	mg/kg	1.67	1.67	1.67	1.67	1.67	-	-	-	-	-

Batch: FUEL,C28\*9779 Method: 8015M - Modified 8015

	UNITS	8707384*1 MB	C707784*1 LC	LT	C707785*1 LC	LT	N/A R1	R2	S1	S2	T
Date Analyzed	Date	07/09/97	07/09/97	07/09/97	07/09/97	07/09/97	-	-	-	-	-
Date Extracted	Date	07/09/97	07/09/97	07/09/97	07/09/97	07/09/97	-	-	-	-	-
Dilution Factor	Times	1	1	1	1	1	-	-	-	-	-
TPH-d C13-C22	mg/kg	0	227	200	212	200	-	-	-	-	-
TPH-d C23-C28	mg/kg	0	-	-	-	-	-	-	-	-	-
1,3-Dichlorobenzene Reported	mg/kg	26.3	25.4	25.0	25.3	25.0	-	-	-	-	-
1,3-Dichlorobenzene Theoretical	mg/kg	25.0	25.0	25.0	25.0	25.0	-	-	-	-	-





*Our Quality Control Is Your Quality Assurance*

August 6, 1997

LOG NO.: G97-07-296

Brown and Caldwell  
16735 Von Karman, Suite 200  
Irvine, CA 92714-0940  
Attn: Mr. Bob Pope

Reference: Client Project # 3659-06, Shell.

Dear Mr. Pope,

Enclosed is the analytical report for the chemical testing of samples collected in support of the above-referenced project. Samples were identified and tracked in the BCA/VOC system as log number G97-07-296. When making inquiries about this report, please provide the log number.

The contents of this package are based on the requirements specified in the BC Analytical, A Division of V.O.C. Analytical Laboratories, Inc. "Quality Assurance Management Plan". The case narrative addresses batch specific quality control as it pertains to this document.

If you have any questions, please do not hesitate to call me at (714) 978-0113.

Sincerely,

Patty Mata  
Project Manager

VOC Analytical Laboratories, Inc.

VOC Analytical Laboratories, Inc.

1212 East Katella Avenue, Anaheim CA 92805 - Phone: (714) 978-0113 - Fax: (714) 978-9284

LOG NO.: G97-07-296

#### CASE NARRATIVE

The following narrative addresses all project specific data quality objectives with respect to: holding times, method blanks, lab control standards, matrix spike and duplicate samples. Analytical anomalies encountered during sample analysis are also discussed as necessary.

**Sample receipt:**

Samples were received under COC and delivered to VOC's Glendale lab on 7/14/97. All containers were received intact and properly preserved.

**Gas/BTEX (Method 8020/8015M):**

Samples TS-26 and TS-27 had high recovery of Gas/BTEX surrogates possibly due to matrix interference. As the bias was high and the samples did not have detectable levels of Gas/BTEX, the data was reported with no further corrective action. The QC samples associated with this batch had acceptable surrogate recovery.

Benzene, Gasoline and the surrogate had MS/MSD recoveries outside of control limits for batch 9766085. The LCS/LCSD had acceptable recoveries for this batch.

**PNA's (Method 8270):**

Samples TS-13A, TS-16A and TS-25 required dilution due to matrix interference. Surrogate concentrations were diluted below detectable levels and were reported as NC.

No other anomalies were encountered during the analysis of the project.

## ACRONYMS AND FLAG DEFINITIONS

### Flag Definitions:

*	Replicate values. Used when replicate results are entered into the MS/MSD column of the QC report.
B	Blank contamination. Used when associated method blank concentration is greater than the PQL.
J	Estimated value. Used for sample results greater than or equal to MDL, but less than the PQL.
NC	Not calculated. Used for MS/MSD when sample result is greater than two times the spike amount added, or when extracted surrogates were diluted below detectable levels. Used for sample results that are over calibration range.
Q	Quality objectives were not met. Used for Method Blank, Laboratory Control Samples, Matrix Spikes, Matrix Duplicates and Surrogates.

### Acronyms:

COC	Chain of Custody
FLG	Flag
LC	Actual LCS/LCSD concentration recovered
LCL	Lower Control Limit
LCS	Laboratory Control Sample
LCSD	Laboratory Control Sample Duplicate
LT	True LCS/LCSD concentration
MB	Method Blank
MS	Matrix Spike
MSD	Matrix Spike Duplicate
R1	Unspiked sample concentration
RDL	Reporting Detection Limit
%REC	Percent Recovery
Rep.	Surrogate Reported value
RPD	Relative Percent Difference
S1	Actual MS concentration
S2	Actual MSD concentration
T	True concentration of MS/MSD
Theo.	Surrogate Theoretical value
UCL	Upper Control Limit



Our Quality Control Is Your Quality Assurance

# ANALYTICAL REPORT

LOG NO: G97-07-296

Received: 14 JUL 97

Mailed: AUG 03 1997

Mr. Bob Pope  
Brown and Caldwell Consultants  
16735 Von Karman, Suite 20C  
Irvine, CA 92606-4953

Purchase Order: 3659

Project: 3659/SHFLL

## REPORT OF ANALYTICAL RESULTS

Page 1

LOG NO	07-296-1	07-296-2	07-296-3
DATE SAMPLED	14 JUL 97	14 JUL 97	14 JUL 97
SAMPLE DESCRIPTION	TS-13A	TS-16A	TS-25
NON-AQUEOUS			
Polynuclear Aromatics (8270)			
Date Analyzed	07/16/97	07/16/97	07/16/97
Date Extracted	07/15/97	07/15/97	07/15/97
Dilution Factor, Times	10	10	10
Acenaphthene, mg/kg	<2	<2	<2
Acenaphthylene, mg/kg	<2	<2	<2
Anthracene, mg/kg	<2	<2	<2
Benzo(a)anthracene, mg/kg	<2	<2	<2
Benzo(a)pyrene, mg/kg	<2	<2	<2
Benzo(b)fluoranthene, mg/kg	<2	<2	<2
Benzo(g,h,i)perylene, mg/kg	<2	<2	<2
Benzo(k)fluoranthene, mg/kg	<2	<2	<2
Chrysene, mg/kg	<2	<2	<2
Dibenzo(a,h)anthracene, mg/kg	<2	<2	<2

LOG NO: G97-07-296

Received: 14 JUL 97

Mr. Bob Pope  
Brown and Caldwell Consultants  
16735 Von Karman, Suite 200  
Irvine, CA 92606-4953

Purchase Order: 3659

Project: 3659/SHELL

REPORT OF ANALYTICAL RESULTS

Page 2

LOG NO	07-296-1	07-296-2	07-296-3
DATE SAMPLED	14 JUL 97	14 JUL 97	14 JUL 97
SAMPLE DESCRIPTION	TS-13A	TS-16A	TS-25
NON-AQUEOUS			
Fluoranthene, mg/kg	<2	<2	<2
Fluorene, mg/kg	<2	<2	<2
Indeno(1,2,3-c,d)pyrene, mg/kg	<2	<2	<2
Naphthalene, mg/kg	<2	<2	<2
Phenanthrene, mg/kg	<2	<2	<2
Pyrene, mg/kg	<2	<2	<2
Surrogates **			
2-Fluorobiphenyl Reported, mg/kg	0 NC	0 NC	0 NC
2-Fluorobiphenyl Theo., mg/kg	1.67	1.67	1.67
Nitrobenzene-d5 Reported, mg/kg	0 NC	0 NC	0 NC
Nitrobenzene-d5 Theoretical, mg/kg	1.67	1.67	1.67
Terphenyl-d14 Reported, mg/kg	0 NC	0 NC	0 NC
Terphenyl-d14 Theoretical, mg/kg	1.67	1.67	1.67

LOG NO: 697-07-296

Received: 14 JUL 97

Mr. Bob Pope  
Brown and Caldwell Consultants  
16735 Von Karman, Suite 200  
Irvine, CA 92606-4953

Purchase Order: 3659

Project: 3659/SHELL

REPORT OF ANALYTICAL RESULTS

Page 3

-----  
LOG NO 07-296-4  
-----

DATE SAMPLED 14 JUL 97  
SAMPLE DESCRIPTION TS-28  
NON-AQUEOUS  
-----

Polynuclear Aromatics (8270)

Date Analyzed 07/17/97

Date Extracted 07/15/97

Dilution Factor, Times 1

Acenaphthene, mg/kg <0.2

Acenaphthylene, mg/kg <0.2

Anthracene, mg/kg <0.2

Benzo(a)anthracene, mg/kg <0.2

Benzo(a)pyrene, mg/kg <0.2

Benzo(b)fluoranthene, mg/kg <0.2

Benzo(g,h,i)perylene, mg/kg <0.2

Benzo(k)fluoranthene, mg/kg <0.2

Chrysene, mg/kg <0.2  
-----

LOG NO: 697-07-296

Received: 14 JUL 97

Mr. Bob Pope  
Brown and Caldwell Consultants  
16735 Von Karman, Suite 200  
Irvine, CA 92606-4953

Purchase Order: 3659

Project: 3659/SHELL

REPORT OF ANALYTICAL RESULTS

Page 4

LOG NO	07-296-4
DATE SAMPLED	14 JUL 97
SAMPLE DESCRIPTION	TS-28
NON-AQUEOUS	
Dibenzo(a,h)anthracene, mg/kg	<0.2
Fluoranthene, mg/kg	<0.2
Fluorene, mg/kg	<0.2
Indeno(1,2,3-c,d)pyrene, mg/kg	<0.2
Naphthalene, mg/kg	<0.2
Phenanthrene, mg/kg	<0.2
Pyrene, mg/kg	<0.2
Surrogates **	
2-Fluorobiphenyl Reported, mg/kg	1.66
2-Fluorobiphenyl Theo., mg/kg	1.67
Nitrobenzene-d5 Reported, mg/kg	1.49
Nitrobenzene-d5 Theoretical, mg/kg	1.67
Terphenyl-d14 Reported, mg/kg	1.84

LOG NO: G97-07-296

Received: 14 JUL 97

Mr. Bob Pope  
Brown and Caldwell Consultants  
16735 Von Karman, Suite 200  
Irvine, CA 92606-4953

Purchase Order: 3659

Project: 3659/SHELL

REPORT OF ANALYTICAL RESULTS

Page 5

LOG NO	07-296-4
DATE SAMPLED	14 JUL 97
SAMPLE DESCRIPTION	TS-28
NON-AQUEOUS	
Terphenyl-d14 Theoretical, mg/kg	1.67

LOG NO: 697-07-296

Received: 14 JUL 97

Mr. Bob Pope  
Brown and Caldwell Consultants  
16735 Von Karman, Suite 200  
Irvine, CA 92606-4953

Purchase Order: 3659

Project: 3659/SHELL

REPORT OF ANALYTICAL RESULTS

Page 6

LOG NO	07-296-5	07-296-6	07-296-7
DATE SAMPLED	14 JUL 97	14 JUL 97	14 JUL 97
SAMPLE DESCRIPTION	TS-24	TS-26	TS-27
NON-AQUEOUS			
Semi-volatile HC (8015M)			
Date Analyzed	07/22/97	07/22/97	07/22/97
Date Extracted	07/21/97	07/21/97	07/21/97
Dilution Factor, Times	2	1	1
TPH-d C13-C22, mg/kg	22	10	<10
TPH-d C23-C28, mg/kg	61	23	11
Other Semi-volatile HC (8015M)	---	---	---
Surrogates **			
1,3-Dichlorobenzene Reported, mg/kg	14.5	22.3	21.5
1,3-Dichlorobenzene Theoretical, mg/kg	25.0	25.0	25.0

LOG NO: 697-07-296

Received: 14 JUL 97

Mr. Bob Pope  
Brown and Caldwell Consultants  
16735 Von Karman, Suite 200  
Irvine, CA 92606-4953

Purchase Order: 3659

Project: 3659/SHELL

REPORT OF ANALYTICAL RESULTS

Page 7

LOG NO	07-296-5	07-296-6	07-296-7
DATE SAMPLED	14 JUL 97	14 JUL 97	14 JUL 97
SAMPLE DESCRIPTION	TS-24	TS-26	TS-27
NON-AQUEOUS			
-----			
Volatile HC (8015M)			
Date Analyzed	07/17/97	07/17/97	07/18/97
Dilution Factor, Times	1	1	1
Benzene, mg/kg	<0.005	<0.005	<0.005
Toluene, mg/kg	<0.005	<0.005	<0.005
Ethylbenzene, mg/kg	<0.005	<0.005	<0.005
Total Xylene Isomers, mg/kg	<0.01	<0.01	<0.01
TPH-g C6-C12, mg/kg	<0.1	<0.1	<0.1
Other Volatile HC (8015M)	---	---	---
Surrogates **			
a,a,a-Trifluorotoluene Rep., mg/kg	0.0553	0.0728	0.0732
a,a,a-Trifluorotoluene Th., mg/kg	0.0500	0.0500	0.0500

LOG NO: G97-07-296

Received: 14 JUL 97

Mr. Bob Pope  
Brown and Caldwell Consultants  
16735 Von Karman, Suite 200  
Irvine, CA 92606-4953

Purchase Order: 3659

Project: 3659/SHELL

REPORT OF ANALYTICAL RESULTS

Page 8

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*Greta Galoustian*  
Greta Galoustian, Laboratory Director

The analytical results within this report relate only to the specific compounds and samples investigated and may not necessarily reflect other apparently similar material from the same or a similar location.

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ORDER PLACED FOR CLIENT: Brown and Caldwell Consultants 9707296 :  
: VOC ANALYTICAL : GLEN LAB : 15:19:35 23 JUL 1997 - P. 1 :  
=====

SAMPLES...	SAMPLE DESCRIPTION..	DETERM.....	DATE.....	METHOD.....	EQUIP.	BATCH..	ID.NO
			ANALYZED				
9707296*1	TS-13A	8270.PNA	07.16.97	8270	537-14	97151	1009
9707296*2	TS-16A	8270.PNA	07.16.97	8270	537-14	97151	1009
9707296*3	TS-25	8270.PNA	07.16.97	8270	537-14	97151	1009
9707296*4	TS-28	8270.PNA	07.17.97	8270	537-14	97151	1009
9707296*5	TS-24	FUEL,C28	07.22.97	8015M	536-37	9783	1010
		GAS.C12	07.17.97	8015M	536-33	9766085	
9707296*6	TS-26	FUEL,C28	07.22.97	8015M	536-37	9783	1010
		GAS.C12	07.17.97	8015M	536-33	9766085	
9707296*7	TS-27	FUEL,C28	07.22.97	8015M	536-37	9783	1010
		GAS.C12	07.18.97	8015M	536-33	9766085	

\*\*\*

Notes: Equipment = VOC Analytical identification number for a particular piece of analytical equipment.

ID.NO = VOC Analytical employee identification number of analyst.

SURROGATE RECOVERIES :  
 BC ANALYTICAL : GLEN LAB : 15:19:47 23 JUL 1997 - P. 1 :

```

=====
ID ANALYTE BATCH ANALYZED REPORTED TRUE %REC FLAG LCL UCL
707296*1
270 Nitrobenzene-d5 97151 07/16/97 NC 1.67 NC NC 34 110
2-Fluorobiphenyl 97151 07/16/97 NC 1.67 NC NC 38 110
Terphenyl-d14 97151 07/16/97 NC 1.67 NC NC 18 130
707296*2
270 Nitrobenzene-d5 97151 07/16/97 NC 1.67 NC NC 34 110
2-Fluorobiphenyl 97151 07/16/97 NC 1.67 NC NC 38 110
Terphenyl-d14 97151 07/16/97 NC 1.67 NC NC 18 130
707296*3
270 Nitrobenzene-d5 97151 07/16/97 NC 1.67 NC NC 34 110
2-Fluorobiphenyl 97151 07/16/97 NC 1.67 NC NC 38 110
Terphenyl-d14 97151 07/16/97 NC 1.67 NC NC 18 130
707296*4
270 Nitrobenzene-d5 97151 07/17/97 1.49 1.67 89 34 110
2-Fluorobiphenyl 97151 07/17/97 1.66 1.67 99 38 110
Terphenyl-d14 97151 07/17/97 1.84 1.67 110 18 130
707296*5
015M 1,3-Dichlorobenzene 9783 07/22/97 14.5 25.0 58 52 145
015M a,a,a-Trifluorotoluene Re9766085 07/17/97 0.0553 0.0500 111 71 131
707296*6
015M 1,3-Dichlorobenzene 9783 07/22/97 22.3 25.0 89 52 145
015M a,a,a-Trifluorotoluene Re9766085 07/17/97 0.0728 0.0500 146 Q 71 131
707296*7
015M 1,3-Dichlorobenzene 9783 07/22/97 21.5 25.0 86 52 145
015M a,a,a-Trifluorotoluene Re9766085 07/18/97 0.0732 0.0500 146 Q 71 131
  
```

VOC ANALYSIS - LENDALE  
 QC REPORT # 107296  
 DATE PRINTED: 23 JUL 1997

NON-AQUEOUS SAMPLES

	----- METHOD BLANK -----				----- LAB CONTROL -----						----- MATRIX QC -----											
	UNITS	RESULT	RDL	FLG	LCS		LCS D		RPD		MS		MSD		RPD		FLG					
					%REC	FLG	%REC	FLG	LCL	UCL	RPD	UCL	FLG	%REC	FLG	%REC		FLG	LCL	UCL	RPD	UCL
Batch: GAS*9766085 Method: 8015M - Modified 8015																						
Benzene	mg/kg	0	0.005	-	91	-	97	-	88	150	7	-	-	165	Q	157	Q	67	134	5	25	-
Toluene	mg/kg	0	0.005	-	92	-	99	-	75	130	7	-	-	108	-	104	-	65	137	4	25	-
Ethylbenzene	mg/kg	0	0.005	-	94	-	101	-	83	118	7	-	-	99	-	91	-	51	150	8	25	-
Total Xylene Isomers	mg/kg	0	0.01	-	99	-	107	-	80	117	7	-	-	87	-	79	-	53	140	9	25	-
TPH-g C6-C12	mg/kg	0	0.1	-	92	-	90	-	79	123	2	-	-	31	Q	28	Q	45	134	10	30	-
[a,a,a-Trifluorotoluene]	Percent	95	-	-	95	-	90	-	71	131	-	-	-	148	Q	132	Q	71	131	-	-	-
Batch: 8270*97151 Method: 8270 - GC/MS for Semivolatile Organics, Capillary column																						
Acenaphthene	mg/kg	0	0.2	-	71	-	77	-	57	117	9	-	-	83	-	87	-	44	128	4	34	-
Acenaphthylene	mg/kg	0	0.2	-	76	-	87	-	56	136	13	-	-	-	-	-	-	-	-	-	-	-
Anthracene	mg/kg	0	0.2	-	64	-	71	-	57	115	10	-	-	-	-	-	-	-	-	-	-	-
Benzo(a)anthracene	mg/kg	0	0.2	-	71	-	82	-	44	138	14	-	-	-	-	-	-	-	-	-	-	-
Benzo(a)pyrene	mg/kg	0	0.2	-	70	-	79	-	36	128	12	-	-	-	-	-	-	-	-	-	-	-
Benzo(b)fluoranthene	mg/kg	0	0.2	-	69	-	82	-	24	137	17	-	-	-	-	-	-	-	-	-	-	-
Benzo(g,h,i)perylene	mg/kg	0	0.2	-	77	-	88	-	25	157	12	-	-	-	-	-	-	-	-	-	-	-
Benzo(k)fluoranthene	mg/kg	0	0.2	-	94	-	99	-	39	142	5	-	-	-	-	-	-	-	-	-	-	-
Chrysene	mg/kg	0	0.2	-	72	-	83	-	43	147	13	-	-	-	-	-	-	-	-	-	-	-
Dibenzo(a,h)anthracene	mg/kg	0	0.2	-	75	-	85	-	30	154	12	-	-	-	-	-	-	-	-	-	-	-
Fluoranthene	mg/kg	0	0.2	-	65	-	73	-	39	137	11	-	-	-	-	-	-	-	-	-	-	-
Fluorene	mg/kg	0	0.2	-	81	-	93	-	57	128	14	-	-	-	-	-	-	-	-	-	-	-
Indeno(1,2,3-c,d)pyrene	mg/kg	0	0.2	-	86	-	97	-	25	162	11	-	-	-	-	-	-	-	-	-	-	-
Naphthalene	mg/kg	0	0.2	-	67	-	74	-	49	106	11	-	-	-	-	-	-	-	-	-	-	-
Phenanthrene	mg/kg	0	0.2	-	66	-	74	-	61	122	10	-	-	-	-	-	-	-	-	-	-	-
Pyrene	mg/kg	0	0.2	-	73	-	82	-	52	149	12	-	-	78	-	81	-	41	156	5	36	-
[2-Fluorobiphenyl]	Percent	84	-	-	80	-	88	-	43	116	-	-	-	93	-	96	-	38	110	-	-	-
[Nitrobenzene-d5]	Percent	75	-	-	75	-	83	-	37	114	-	-	-	84	-	89	-	34	110	-	-	-
[Terphenyl-d14]	Percent	74	-	-	82	-	91	-	33	141	-	-	-	83	-	86	-	18	130	-	-	-
Batch: FUEL,C28*9783 Method: 8015M - Modified 8015																						
TPH-d C13-C22	mg/kg	0	10	-	76	-	75	-	37	166	1	-	-	83	-	87	-	43	151	4	38	-
TPH-d C23-C28	mg/kg	0	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
[1,3-Dichlorobenzene]	Percent	116	-	-	100	-	72	-	55	127	-	-	-	100	-	112	-	52	145	-	-	-

VOC ANALYTICAL BLENDALE  
 SUPPLEMENTAL REPORT FOR 9707296  
 DATE PRINTED: 23 JUL 1997

NON-AQUEOUS SAMPLES

Batch: GAS\*9766085 Method: 8015M - Modified 8015

	UNITS	B707875*1	C7071717*1	.....	C7071742*1	.....	9707296*7	.....	.....	.....	.....	.....
		MB	LC	LT	LC	LT	R1	R2	S1	S2	T	
Date Analyzed	Date	07/17/97	07/17/97	07/17/97	07/17/97	07/17/97	07/18/97	-	07/17/97	07/17/97	07/17/97	
Dilution Factor	Times	1	1	1	11	1	1	-	1	1	1	
Benzene	mg/kg	0	0.0454	0.0500	0.0485	0.0500	<0.005	-	0.0251	0.0239	0.0152	
Toluene	mg/kg	0	0.0462	0.0500	0.0494	0.0500	<0.005	-	0.105	0.101	0.0974	
Ethylbenzene	mg/kg	0	0.0472	0.0500	0.0505	0.0500	<0.005	-	0.0202	0.0186	0.0204	
Total Xylene Isomers	mg/kg	0	0.149	0.150	0.160	0.150	<0.01	-	0.103	0.0946	0.119	
TPH-g C6-C12	mg/kg	0	1.01	1.10	0.990	1.10	<0.1	-	0.345	0.313	1.10	
a,a,a-Trifluorotoluene Rep.	mg/kg	0.0475	0.0475	0.0500	0.0452	0.0500	0.0732	-	0.0742	0.0659	0.0500	
a,a,a-Trifluorotoluene Th.	mg/kg	0.0500	0.0500	0.0500	0.0500	0.0500	0.0500	-	0.0500	0.0500	0.0500	

NON-AQUEOUS SAMPLES

Batch: 8270\*97151 Method: 8270 - GC/MS for Semivolatile Organics, Capillary column

	UNITS	B707612*1 MB	C7071224*1 LC	..... LT	C7071225*1 LC	..... LT	9707222*2 R1	..... R2	S1	S2	T
Date Analyzed	Date	07/15/97	07/15/97	07/15/97	07/15/97	07/15/97	07/15/97	-	07/16/97	07/16/97	07/16/97
Date Extracted	Date	07/15/97	07/15/97	07/15/97	07/15/97	07/15/97	07/15/97	-	07/15/97	07/15/97	07/15/97
Dilution Factor	Times	1	1	1	1	1	1	-	1	1	1
Acenaphthene	mg/kg	0	2.35	3.33	2.57	3.33	<0.2	-	1.39	1.45	1.67
Acenaphthylene	mg/kg	0	2.53	3.33	2.89	3.33	<0.2	-	-	-	-
Anthracene	mg/kg	0	2.12	3.33	2.35	3.33	<0.2	-	-	-	-
Benzo(a)anthracene	mg/kg	0	2.37	3.33	2.72	3.33	<0.2	-	-	-	-
Benzo(a)pyrene	mg/kg	0	2.33	3.33	2.62	3.33	<0.2	-	-	-	-
Benzo(b)fluoranthene	mg/kg	0	2.31	3.33	2.73	3.33	<0.2	-	-	-	-
Benzo(g,h,i)perylene	mg/kg	0	2.58	3.33	2.92	3.33	<0.2	-	-	-	-
Benzo(k)fluoranthene	mg/kg	0	3.12	3.33	3.29	3.33	<0.2	-	-	-	-
Chrysene	mg/kg	0	2.41	3.33	2.75	3.33	<0.2	-	-	-	-
Dibenzo(a,h)anthracene	mg/kg	0	2.50	3.33	2.82	3.33	<0.2	-	-	-	-
Fluoranthene	mg/kg	0	2.17	3.33	2.43	3.33	<0.2	-	-	-	-
Fluorene	mg/kg	0	2.70	3.33	3.11	3.33	<0.2	-	-	-	-
Indeno(1,2,3-c,d)pyrene	mg/kg	0	2.87	3.33	3.22	3.33	<0.2	-	-	-	-
Naphthalene	mg/kg	0	2.22	3.33	2.47	3.33	<0.2	-	-	-	-
Phenanthrene	mg/kg	0	2.21	3.33	2.45	3.33	<0.2	-	-	-	-
Pyrene	mg/kg	0	2.43	3.33	2.74	3.33	<0.2	-	1.30	1.36	1.67
2-Fluorobiphenyl Reported	mg/kg	1.41	1.34	1.67	1.47	1.67	1.67	-	1.56	1.61	1.67
2-Fluorobiphenyl Theo.	mg/kg	1.67	1.67	1.67	1.67	1.67	1.67	-	1.67	1.67	1.67
Nitrobenzene-d5 Reported	mg/kg	1.26	1.26	1.67	1.38	1.67	1.47	-	1.41	1.48	1.67
Nitrobenzene-d5 Theoretical	mg/kg	1.67	1.67	1.67	1.67	1.67	1.67	-	1.67	1.67	1.67
Terphenyl-d14 Reported	mg/kg	1.23	1.37	1.67	1.52	1.67	1.50	-	1.38	1.44	1.67
Terphenyl-d14 Theoretical	mg/kg	1.67	1.67	1.67	1.67	1.67	1.67	-	1.67	1.67	1.67

Batch: FUEL,C28\*9783 Method: 8015M - Modified 8015

	UNITS	B7071065*1 MB	C7072063*1 LC	..... LT	C7072064*1 LC	..... LT	9707296*7 R1	..... R2	S1	S2	T
Date Analyzed	Date	07/22/97	07/22/97	07/22/97	07/22/97	07/22/97	07/22/97	-	07/22/97	07/22/97	07/22/97
Date Extracted	Date	07/21/97	07/21/97	07/21/97	07/21/97	07/21/97	07/21/97	-	07/21/97	07/21/97	07/21/97
Dilution Factor	Times	1	1	1	1	1	1	-	1	1	1
TPH-d C13-C22	mg/kg	0	152	200	150	200	<100	-	166	173	200
TPH-d C23-C28	mg/kg	0	-	-	-	-	11	-	<100	<100	<100
1,3-Dichlorobenzene Reported	mg/kg	28.9	24.9	25.0	17.9	25.0	21.5	-	24.9	28.1	25.0
1,3-Dichlorobenzene Theoretical	mg/kg	25.0	25.0	25.0	25.0	25.0	25.0	-	25.0	25.0	25.0

**VOC Analytical Laboratories**

1212 E. KATE AVE.  
ANAHEIM, CA 92805  
 1085 SHARY CIRCLE  
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801 WESTERN AVE.  
GLENDALE, CA 91201  
 4411 S. BROADWAY Ste. D-1  
PHOENIX, AZ 85040

V.O.C. Log # 17294

**Chain of Custody Record**

Quote # \_\_\_\_\_

Company Name		LAB ANALYSIS										Matrix Codes *		
Address <u>16735 Van Karman Ave</u>		Sample											SD Solid Waste	OL Oil
City <u>Fresno</u> State <u>CA</u> Zip <u>92606</u>		pH											GW Ground Water	SL Sludge
Phone: <u>POPE</u> Fax # <u>714 474 0940</u>		Pres Codes											EFF Effluent	SO Soil Sediment
Project Name / Number <u>Reservoirs 3659</u> <u>PO# 3659-08</u>		Parameters	<u>8015/8270</u>	<u>8270</u>									APW Analyte Free H <sub>2</sub> O	AQ Aqueous
Implementer Name / Signature <u>[Signature]</u> Phone # <u>714 260 6178</u>													Field Filtered (Y/N)	Integrity OK (Y/N)
Sample Label (Client ID)	Collected Date	Time	Matrix Code	# of Cont									DW Drinking Water	PE Petroleum
													SU Surface Water	O Other (Please Specify)
													Pres Codes	
													A- None	E- HCl
													B- HNO <sub>3</sub>	F- MeOH
													C- H <sub>2</sub> SO <sub>4</sub>	I- Ice
													D- NaOH	O- Other
													REMARKS	
-1	TS-13A	7-14-97	11:51	SO	2									
-2	TS-16A		2:28	SO	2									Please See Project Instructions
-3	TS-24		12:20	SO	1	X								
-4	TS-25		12:31	SO	1			X						* If any 8270 analytes are detected immediately run STLC-8270.
-5	TS-26		12:48	SO	1	X								
-6	TS-27		1:26	SO	1	X								
-7	TS-28		1:35	SO	1				X					
-8														
-9														
-10														

Short Hold	Ice	Item	Relinquished by	Date	Time	Received by	Date	Time
Y ___ N ___	Y ___ N ___		<u>[Signature]</u>	7-14-97	4:30pm	<u>Sally Math</u>	7/14/97	4:30pm
A/QC Report Level <u>STICK</u> <u>PROTOCOL</u>	COC OK	Initials	<u>[Signature]</u>	7/14/97	5:00pm			
one ___ 1 ___ 2 ___ 3 ___ Other <u>X</u>	Y N		<u>[Signature]</u>	7/14/97	5:55	<u>A. Matijevic</u>	7/14/97	5:55
A.T. Request	RUSH	Custody Seals	Temp Control	Local Job		<u>[Signature]</u>	7/14/97	5:55
Standard	Date required	Y N	°C	Y N				

C.O.C. # 1005136



Our Quality Control Is Your Quality Assurance

August 6, 1997

LOG NO.: G97-07-386

Brown and Caldwell  
16735 Von Karman, Suite 200  
Irvine, CA 92714-0940  
Attn: Mr. Bob Pope

Reference: Client Project # 3659-06, Shell.

Dear Mr. Pope,

Enclosed is the analytical report for the chemical testing of samples collected in support of the above-referenced project. Samples were identified and tracked in the BCA/VOC system as log number **G97-07-386**. When making inquiries about this report, please provide the log number.

The contents of this package are based on the requirements specified in the BC Analytical, A Division of V.O.C. Analytical Laboratories, Inc. "Quality Assurance Management Plan". The case narrative addresses batch specific quality control as it pertains to this document.

If you have any questions, please do not hesitate to call me at (714) 978-0113.

Sincerely,

Patty Mata  
Project Manager

LOG NO.: G97-07-386

#### CASE NARRATIVE

The following narrative addresses all project specific data quality objectives with respect to: holding times, method blanks, lab control standards, matrix spike and duplicate samples. Analytical anomalies encountered during sample analysis are also discussed as necessary.

**Sample receipt:**

Samples were received under COC and delivered to VOC's Glendale lab on 7/21/97. All containers were received intact and properly preserved.

**PNA's (Method 8270):**

Sample TS-30 required dilution due to matrix interference. The surrogate concentration was diluted below detectable levels and was reported as NC.

No other anomalies were encountered during the analysis of the project.

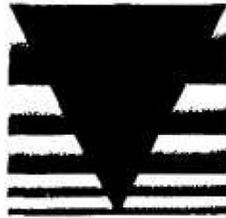
## ACRONYMS AND FLAG DEFINITIONS

### Flag Definitions:

- \* Replicate values. Used when replicate results are entered into the MS/MSD column of the QC report.
- B Blank contamination. Used when associated method blank concentration is greater than the PQL.
- J Estimated value. Used for sample results greater than or equal to MDL, but less than the PQL.
- NC Not calculated. Used for MS/MSD when sample result is greater than two times the spike amount added, or when extracted surrogates were diluted below detectable levels. Used for sample results that are over calibration range.
- Q Quality objectives were not met. Used for Method Blank, Laboratory Control Samples, Matrix Spikes, Matrix Duplicates and Surrogates.

### Acronyms:

COC	Chain of Custody
FLG	Flag
LC	Actual LCS/LCSD concentration recovered
LCL	Lower Control Limit
LCS	Laboratory Control Sample
LCSD	Laboratory Control Sample Duplicate
LT	True LCS/LCSD concentration
MB	Method Blank
MS	Matrix Spike
MSD	Matrix Spike Duplicate
R1	Unspiked sample concentration
RDL	Reporting Detection Limit
%REC	Percent Recovery
Rep.	Surrogate Reported value
RPD	Relative Percent Difference
S1	Actual MS concentration
S2	Actual MSD concentration
T	True concentration of MS/MSD
Theo.	Surrogate Theoretical value
UCL	Upper Control Limit



Our Quality Control Is Your Quality Assurance

## ANALYTICAL REPORT

LOG NO: G97-07-386

Received: 21 JUL 97

Mailed: JUL 26 1997

Mr. Bob Pope  
Brown and Caldwell Consultants  
16735 Von Karman, Suite 200  
Irvine, CA 92606-4953

Purchase Order: 3659

Project: 3659.06/SHELL

### REPORT OF ANALYTICAL RESULTS

Page 1

LOG NO	07-386-1	07-386-2
DATE SAMPLED	18 JUL 97	18 JUL 97
SAMPLE DESCRIPTION	TS-29	TS-31
NON-AQUEOUS		
Semi-volatile HC (8015M)		
Date Analyzed	07/22/97	07/22/97
Date Extracted	07/21/97	07/21/97
Dilution Factor, Times	1	1
TPH-d C13-C22, mg/kg	30	29
TPH-d C23-C28, mg/kg	48	52
Other Semi-volatile HC (8015M)	---	---
Surrogates **		
1,3-Dichlorobenzene Reported, mg/kg	25.3	23.9
1,3-Dichlorobenzene Theoretical, mg/kg	25.0	25.0

LOG NO: G97-07-386

Received: 21 JUL 97

Mr. Bob Pope  
Brown and Caldwell Consultants  
16735 Von Karman, Suite 200  
Irvine, CA 92605-4953

Purchase Order: 3659

Project: 3659.06/SHELL

REPORT OF ANALYTICAL RESULTS

Page 2

LOG NO	07-386-1	07-386-2
DATE SAMPLED	18 JUL 97	18 JUL 97
SAMPLE DESCRIPTION	TS-29	TS-31
NON-AQUEOUS		
-----		
Volatile HC (8015M)		
Date Analyzed	07/25/97	07/25/97
Dilution Factor, Times	1	1
Benzene, mg/kg	<0.005	<0.005
Toluene, mg/kg	<0.005	<0.005
Ethylbenzene, mg/kg	<0.005	<0.005
Total Xylene Isomers, mg/kg	<0.01	<0.01
TPH-g C6-C12, mg/kg	<0.1	<0.1
Other Volatile HC (8015M)	---	---
Surrogates **		
a,a,a-Trifluorotoluene Rep., mg/kg	0.0459	0.0529
a,a,a-Trifluorotoluene Th., mg/kg	0.0500	0.0500

LOG NO: 697-07-386

Received: 21 JUL 97

Mr. Bob Pope  
Brown and Caldwell Consultants  
16735 Von Karman, Suite 200  
Irvine, CA 92606-4953

Purchase Order: 3659

Project: 3659.06/SHELL

REPORT OF ANALYTICAL RESULTS

Page 3

LOG NO	07-386-3
DATE SAMPLED	18 JUL 97
SAMPLE DESCRIPTION	TS-30
NON-AQUEOUS	
-----	
Polynuclear Aromatics (8270)	
Date Analyzed	07/28/97
Date Extracted	07/23/97
Dilution Factor, Times	10
Acenaphthene, mg/kg	<2
Acenaphthylene, mg/kg	<2
Anthracene, mg/kg	<2
Benzo(a)anthracene, mg/kg	<2
Benzo(a)pyrene, mg/kg	<2
Benzo(b)fluoranthene, mg/kg	<2
Benzo(g,h,i)perylene, mg/kg	<2
Benzo(k)fluoranthene, mg/kg	<2
Chrysene, mg/kg	<2

LOG NO: G97-07-386

Received: 21 JUL 97

Mr. Bob Pope  
Brown and Caldwell Consultants  
16735 Von Karman, Suite 200  
Irvine, CA 92606-4953

Purchase Order: 3659

Project: 3659.06/SHELL

REPORT OF ANALYTICAL RESULTS

Page 4

LOG NO	07-386-3
DATE SAMPLED	18 JUL 97
SAMPLE DESCRIPTION	TS-30
NON-AQUEOUS	
Dibenzo(a,h)anthracene, mg/kg	<2
Fluoranthene, mg/kg	<2
Fluorene, mg/kg	<2
Indeno(1,2,3-c,d)pyrene, mg/kg	<2
Naphthalene, mg/kg	<2
Phenanthrene, mg/kg	<2
Pyrene, mg/kg	<2
Surrogates **	
2-Fluorobiphenyl Reported, mg/kg	0 NC
2-Fluorobiphenyl Theo., mg/kg	1.67
Nitrobenzene-d5 Reported, mg/kg	0 NC
Nitrobenzene-d5 Theoretical, mg/kg	1.67
Terphenyl-d14 Reported, mg/kg	0 NC

LOG NO: 697-07-386

Received: 21 JUL 97

Mr. Bob Pope  
Brown and Caldwell Consultants  
16735 Von Karman, Suite 200  
Irvine, CA 92606-4953

Purchase Order: 3659

Project: 3659.06/SHELL

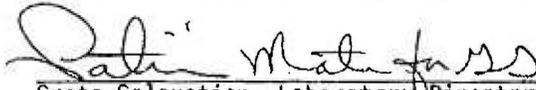
REPORT OF ANALYTICAL RESULTS

Page 5

LOG NO 07-386-3

DATE SAMPLED 18 JUL 97  
SAMPLE DESCRIPTION TS-30  
NON-AQUEOUS

Terphenyl-d14 Theoretical, mg/kg 1.67

  
Greta Galoustian, Laboratory Director

The analytical results within this report relate only to the specific compounds and samples investigated and may not necessarily reflect other apparently similar material from the same or a similar location.

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ORDER PLACED FOR CLIENT: Brown and Caldwell Consultants 9707386 ;  
VOC ANALYTICAL : GLEN LAB : 09:31:19 04 AUG 1997 - P. 1 :

=====

AMPLES...	SAMPLE DESCRIPTION..	DETERM.....	DATE.....	METHOD.....	EQUIP.	BATCH..	ID.NO
			ANALYZED				
1707386*1	TS-29	FUEL,C28	07.22.97	8015M	536-37	9783	1010
		GAS.C12	07.25.97	8015M	536-33	9766104	
1707386*2	TS-31	FUEL,C28	07.22.97	8015M	536-37	9783	1010
		GAS.C12	07.25.97	8015M	536-33	9766104	
1707386*3	TS-30	8270.PNA	07.28.97	8270	537-11	97153	6750

\*\*\*

Notes: Equipment = VOC Analytical identification number for a particular piece of analytical equipment.

ID.NO = VOC Analytical employee identification number of analyst.

SURROGATE RECOVERIES :

BC ANALYTICAL : GLEN LAB : 09:31:32 04 AUG 1997 - P. 1 :

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ID	ANALYTE	BATCH	ANALYZED	REPORTED	TRUE	%RFC	FLAG	LCL	UCL
707386*1									
015M	1,3-Dichlorobenzene	9783	07/22/97	25.3	25.0	101		52	145
015M	a,a,a-Trifluorotoluene	Re9766104	07/25/97	0.0469	0.0500	94		71	131
707386*2									
015M	1,3-Dichlorobenzene	9783	07/22/97	23.9	25.0	96		52	145
015M	a,a,a-Trifluorotoluene	Re9766104	07/25/97	0.0529	0.0500	105		71	131
707386*3									
270	Nitrobenzene-d5	97153	07/28/97	NC	1.67	NC NC		34	110
	2-Fluorobiphenyl	97153	07/28/97	NC	1.67	NC NC		38	110
	Terphenyl-d14	97153	07/28/97	NC	1.67	NC NC		18	130

NON-AQUEOUS SAMPLES

	METHOD BLANK				LAB CONTROL								MATRIX QC									
	UNITS	RESULT	RDL	FLG	LCS %REC	LCS FLG	LCS D %REC	LCS D FLG	LCL	UCL	RPD	RPD UCL	FLG	MS %REC	MS FLG	MSD %REC	MSD FLG	LCL	UCL	RPD	RPD UCL	FLG
Batch: GAS*9766104 Method: 8015M - Modified 8015																						
Benzene	mg/kg	0	0.005	-	94	-	-	-	88	150	-	-	-	128	-	128	-	67	134	0	25	-
Toluene	mg/kg	0	0.005	-	95	-	-	-	75	130	-	-	-	85	-	86	-	65	137	1	25	-
Ethylbenzene	mg/kg	0	0.005	-	97	-	-	-	83	118	-	-	-	98	-	98	-	51	150	0	25	-
Total Xylene Isomers	mg/kg	0	0.01	-	103	-	-	-	80	117	-	-	-	87	-	88	-	53	140	1	25	-
TPH-g C6-C12	mg/kg	0	0.1	-	93	-	-	-	79	123	-	-	-	-	-	-	-	-	-	-	-	-
[a,a,a-Trifluorotoluene]	Percent	94	-	-	98	-	-	-	71	131	-	-	-	90	-	93	-	71	131	-	-	-
Batch: 8270*97153 Method: 8270 - GC/MS for Semivolatile Organics, Capillary column																						
Acenaphthene	mg/kg	0	0.2	-	89	-	89	-	57	117	1	-	-	79	-	80	-	44	128	2	34	-
Acenaphthylene	mg/kg	0	0.2	-	87	-	90	-	56	136	3	-	-	79	-	80	-	51	110	2	34	-
Anthracene	mg/kg	0	0.2	-	82	-	85	-	57	115	4	-	-	74	-	76	-	50	112	2	35	-
Benzo(a)anthracene	mg/kg	0	0.2	-	92	-	95	-	44	138	3	-	-	82	-	85	-	38	132	3	36	-
Benzo(a)pyrene	mg/kg	0	0.2	-	89	-	92	-	36	128	3	-	-	79	-	82	-	41	138	3	30	-
Benzo(b)fluoranthene	mg/kg	0	0.2	-	86	-	91	-	24	137	5	-	-	77	-	84	-	24	149	9	50	-
Benzo(g,h,i)perylene	mg/kg	0	0.2	-	90	-	93	-	25	157	3	-	-	80	-	81	-	39	134	1	46	-
Benzo(k)fluoranthene	mg/kg	0	0.2	-	87	-	83	-	39	142	4	-	-	78	-	76	-	54	148	3	34	-
Chrysene	mg/kg	0	0.2	-	90	-	92	-	43	147	2	-	-	81	-	86	-	50	124	6	34	-
Dibenzo(a,h)anthracene	mg/kg	0	0.2	-	90	-	91	-	30	154	2	-	-	78	-	80	-	46	138	3	41	-
Fluoranthene	mg/kg	0	0.2	-	89	-	90	-	39	137	2	-	-	79	-	80	-	52	119	1	31	-
Fluorene	mg/kg	0	0.2	-	94	-	95	-	57	128	1	-	-	84	-	86	-	59	117	2	36	-
Indeno(1,2,3-c,d)pyrene	mg/kg	0	0.2	-	93	-	88	-	25	162	6	-	-	75	-	77	-	42	141	3	50	-
Naphthalene	mg/kg	0	0.2	-	85	-	88	-	49	106	3	-	-	77	-	78	-	28	120	2	36	-
Phenanthrene	mg/kg	0	0.2	-	91	-	94	-	61	122	3	-	-	81	-	83	-	54	120	3	37	-
Pyrene	mg/kg	0	0.2	-	95	-	97	-	52	149	2	-	-	84	-	88	-	41	156	4	36	-
[2-Fluorobiphenyl]	Percent	99	-	-	88	-	88	-	43	116	-	-	-	76	-	77	-	38	110	-	-	-
[Nitrobenzene-d5]	Percent	95	-	-	83	-	85	-	37	114	-	-	-	72	-	72	-	34	110	-	-	-
[Terphenyl-d14]	Percent	111	-	-	97	-	100	-	33	141	-	-	-	86	-	89	-	18	130	-	-	-
Batch: FUEL,C28*9783 Method: 8015M - Modified 8015																						
TPH-d C13-C22	mg/kg	0	10	-	76	-	75	-	37	166	1	-	-	83	-	87	-	43	151	4	38	-
TPH-d C23-C28	mg/kg	0	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
[1,3-Dichlorobenzene]	Percent	116	-	-	100	-	72	-	55	127	-	-	-	100	-	112	-	52	145	-	-	-

VOC ANALYTICAL SLENDALE  
 SUPPLEMENTAL REPORT FOR 9707386  
 DATE PRINTED: 04 AUG 1997

NON-AQUEOUS SAMPLES

Batch: GAS\*9766104 Method: 8015M - Modified 8015

	B7071205*1 C7072370*1 .....			N/A .....	9707488*1 .....						
	UNITS	MB	LC		LT	LC	LT	R1	R2	S1	S2
Date Analyzed	Date	07/25/97	07/25/97	07/25/97	-	-	07/25/97	-	07/25/97	07/25/97	07/25/97
Dilution Factor	Times	1	1	1	-	-	1	-	1	1	1
Benzene	mg/kg	0	0.0471	0.0500	-	-	<0.005	-	0.0194	0.0194	0.0152
Toluene	mg/kg	0	0.0476	0.0500	-	-	<0.005	-	0.0825	0.0836	0.0974
Ethylbenzene	mg/kg	0	0.0484	0.0500	-	-	<0.005	-	0.0200	0.0200	0.0204
Total Xylene Isomers	mg/kg	0	0.154	0.150	-	-	<0.01	-	0.104	0.105	0.119
TPH-g C6-C12	mg/kg	0	1.02	1.10	-	-	-	-	-	-	-
a,a,a-Trifluorotoluene Rep.	mg/kg	0.0469	0.0492	0.0500	-	-	0.0458	-	0.0449	0.0464	0.0500
a,a,a-Trifluorotoluene Yh.	mg/kg	0.0500	0.0500	0.0500	-	-	0.0500	-	0.0500	0.0500	0.0500

NON-AQUEOUS SAMPLES

Batch: 8270\*97153 Method: 8270 - GC/MS for Semivolatile Organics, Capillary column

	UNITS	B7071019*1 MB	C7071977*1 LC	..... LT	C7071978*1 LC	..... LT	9707331*5 R1	..... R2	S1	S2	T
Date Analyzed	Date	07/23/97	07/23/97	07/23/97	07/23/97	07/23/97	07/23/97	-	07/23/97	07/23/97	07/23/97
Date Extracted	Date	07/22/97	07/22/97	07/22/97	07/22/97	07/22/97	07/22/97	-	07/22/97	07/22/97	07/22/97
Dilution Factor	Times	1	1	1	1	1	1	-	1	1	1
Acenaphthene	mg/kg	0	2.95	3.33	2.97	3.33	<0.2	-	2.62	2.68	3.33
Acenaphthylene	mg/kg	0	2.91	3.33	2.99	3.33	<0.2	-	2.63	2.68	3.33
Anthracene	mg/kg	0	2.72	3.33	2.82	3.33	<0.2	-	2.48	2.53	3.33
Benzo(a)anthracene	mg/kg	0	3.06	3.33	3.15	3.33	<0.2	-	2.74	2.83	3.33
Benzo(a)pyrene	mg/kg	0	2.96	3.33	3.05	3.33	<0.2	-	2.64	2.73	3.33
Benzo(b)fluoranthene	mg/kg	0	2.88	3.33	3.02	3.33	<0.2	-	2.57	2.80	3.33
Benzo(g,h,i)perylene	mg/kg	0	3.01	3.33	3.10	3.33	<0.2	-	2.65	2.69	3.33
Benzo(k)fluoranthene	mg/kg	0	2.90	3.33	2.78	3.33	<0.2	-	2.59	2.52	3.33
Chrysene	mg/kg	0	3.01	3.33	3.07	3.33	<0.2	-	2.69	2.87	3.33
Dibenzo(a,n)anthracene	mg/kg	0	2.99	3.33	3.04	3.33	<0.2	-	2.60	2.68	3.33
Fluoranthene	mg/kg	0	2.95	3.33	3.00	3.33	<0.2	-	2.63	2.66	3.33
Fluorene	mg/kg	0	3.14	3.33	3.17	3.33	<0.2	-	2.80	2.85	3.33
Indeno(1,2,3-c,d)pyrene	mg/kg	0	3.11	3.33	2.94	3.33	<0.2	-	2.50	2.58	3.33
Naphthalene	mg/kg	0	2.84	3.33	2.92	3.33	<0.2	-	2.56	2.60	3.33
Phenanthrene	mg/kg	0	3.03	3.33	3.13	3.33	<0.2	-	2.71	2.78	3.33
Pyrene	mg/kg	0	3.15	3.33	3.22	3.33	<0.2	-	2.81	2.92	3.33
2-Fluorobiphenyl Reported	mg/kg	1.66	1.47	1.67	1.47	1.67	1.65	-	1.27	1.28	1.67
2-Fluorobiphenyl Theo.	mg/kg	1.67	1.67	1.67	1.67	1.67	1.67	-	1.67	1.67	1.67
Nitrobenzene-d5 Reported	mg/kg	1.59	1.38	1.67	1.42	1.67	1.59	-	1.20	1.20	1.67
Nitrobenzene-d5 Theoretical	mg/kg	1.67	1.67	1.67	1.67	1.67	1.67	-	1.67	1.67	1.67
Terphenyl-d14 Reported	mg/kg	1.85	1.62	1.67	1.67	1.67	1.89	-	1.44	1.48	1.67
Terphenyl-d14 Theoretical	mg/kg	1.67	1.67	1.67	1.67	1.67	1.67	-	1.67	1.67	1.67

Batch: FUEL,C28\*9783 Method: 8015M - Modified 8015

	UNITS	B7071065*1 MB	C7072063*1 LC	..... LT	C7072064*1 LC	..... LT	9707296*7 R1	..... R2	S1	S2	T
Date Analyzed	Date	07/22/97	07/22/97	07/22/97	07/22/97	07/22/97	07/22/97	-	07/22/97	07/22/97	07/22/97
Date Extracted	Date	07/21/97	07/21/97	07/21/97	07/21/97	07/21/97	07/21/97	-	07/21/97	07/21/97	07/21/97
Dilution Factor	Times	1	1	1	1	1	1	-	1	1	1
TPH-d C13-C22	mg/kg	0	152	200	150	200	<100	-	166	173	200
TPH-d C23-C28	mg/kg	0	-	-	-	-	11	-	<100	<100	<100
1,3-Dichlorobenzene Reported	mg/kg	28.9	24.9	25.0	17.9	25.0	21.5	-	24.9	28.1	25.0
1,3-Dichlorobenzene Theoretical	mg/kg	25.0	25.0	25.0	25.0	25.0	25.0	-	25.0	25.0	25.0

- V.O.C. ANALYSIS LABORATORIES
- 1212 E. KATE AVE. ANAHEIM, CA 92805
  - 1085 SHARY CIRCLE CONCORD, CA 94518
  - 801 WESTERN AVE. GLENDALE, CA 91201
  - 4411 S. BROADWAY Ste. D-1 PHOENIX, AZ 85040

V.O.C. Log # 157386

### Chain of Custody Record

Quote # \_\_\_\_\_

Company Name <u>Brown and Caldwell</u>						<b>LAB ANALYSIS</b>										<b>Matrix Codes *</b>																																																																					
Address <u>16735 Von Karman</u>						Sample										SD Solid Waste      OL Oil GW Ground Water    SL Sludge EFF Effluent        SO Soil Sediment APW Analyte Free H <sub>2</sub> O    AQ Aqueous WW Waste Water        NA Nonaqueous DW Drinking Water      PE Petroleum SU Surface Water        O Other (Please Specify)																																																																					
City <u>Fairfield</u> State <u>CA</u> Zip <u>92606</u>						pH																																																																															
Phone: <u>POBE</u> Fax # <u>(714) 474-0940</u>						Pres Codes <u>A</u> <u>A</u>										<b>Pres Codes</b> A- None                    E- HCl B- HNO <sub>3</sub> F- MeOH C- H <sub>2</sub> SO <sub>4</sub> I- Ice D- NaOH                    O- Other																																																																					
Project Name / Number <u>3659706</u> PO# <u>3659</u>						Parameters <u>8015/8020</u> <u>8270 *</u>																																																																															
Analyst Name / Signature <u>[Signature]</u> Phone # <u>(714) 260-6178</u>																<b>REMARKS</b> <u>See Project Instructions</u>  <u>* IF 8270 analytes are detected run STCC.</u>																																																																					
<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>#</th> <th>Sample Label (Client ID)</th> <th>Collected Date</th> <th>Collected Time</th> <th>Matrix Code</th> <th># of Cont</th> </tr> </thead> <tbody> <tr><td>-1</td><td>TS-29</td><td>7-18</td><td>1:50</td><td>SO</td><td>1</td></tr> <tr><td>-2</td><td>TS-30</td><td>7-18</td><td>2:00</td><td>SO</td><td>1</td></tr> <tr><td>-3</td><td>TS-31</td><td>7-18</td><td>2:30</td><td>SO</td><td>1</td></tr> <tr><td>-4</td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>-5</td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>-6</td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>-7</td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>-8</td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>-9</td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>-0</td><td></td><td></td><td></td><td></td><td></td></tr> </tbody> </table>						#	Sample Label (Client ID)	Collected Date	Collected Time	Matrix Code	# of Cont	-1	TS-29	7-18	1:50					SO	1	-2	TS-30	7-18	2:00	SO	1	-3	TS-31	7-18	2:30	SO	1	-4						-5						-6						-7						-8						-9						-0															
#	Sample Label (Client ID)	Collected Date	Collected Time	Matrix Code	# of Cont																																																																																
-1	TS-29	7-18	1:50	SO	1																																																																																
-2	TS-30	7-18	2:00	SO	1																																																																																
-3	TS-31	7-18	2:30	SO	1																																																																																
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Short Hold Y ___ N ___		Ice Y ___ N ___		Item		Relinquished by		Date		Time		Received by		Date		Time																																																																					
IA/QC Report Level One ___ 1 ___ 2 ___ 3 ___ Other ___				COC OK Y ___ N ___		Initials		A. Makijani		7/21/02		5:00		A. Makijani		7/21/02		5:00																																																																			
A.T. Request		RUSH <input checked="" type="checkbox"/>		Custody Seals		Temp Control		Local Job																																																																													
Standard		Date required		Y ___ N ___		°C		Y ___ N ___																																																																													

C.O.C. # 1005091

**APPENDIX E**

*ANALYTICAL LABORATORY  
AND QC REPORTS FOR  
COVER SOIL CHARACTERIZATION*



Our Quality Control Is Your Quality Assurance

# ANALYTICAL REPORT

LOG NO: G97-02-566

Received: 24 FEB 97

Mailed: MAR 06 1997

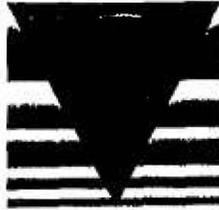
Mr. Robert Pope  
Brown and Caldwell Consultants  
16735 Von Karman, Suite 200  
Irvine, CA 92606-4953

Project: 3659-06/SHELL

## REPORT OF ANALYTICAL RESULTS

Page 1

LOG NO	02-566-1
DATE SAMPLED	24 FEB 97
SAMPLE DESCRIPTION	TS-1
NON-AQUEOUS	
Semi-volatile HC (8015M)	
Date Analyzed	02/26/97
Date Extracted	02/26/97
Dilution Factor, Times	1
TPH-d C13-C22, mg/kg	<100
TPH-d C23-C28, mg/kg	<100
Other Semi-volatile HC (8015M)	---
Surrogates **	
1,3-Dichlorobenzene Reported, mg/kg	23.1
1,3-Dichlorobenzene Theoretical, mg/kg	25.0



Our Quality Control Is Your Quality Assurance

LOG NO: G97-02-566

Received: 24 FEB 97

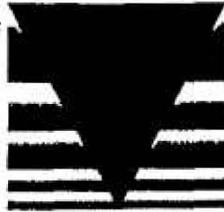
Mr. Robert Pope  
Brown and Caldwell Consultants  
16735 Von Karman, Suite 200  
Irvine, CA 92606-4953

Project: 3659-06/SHELL

REPORT OF ANALYTICAL RESULTS

Page 2

LOG NO	02-566-1
DATE SAMPLED	24 FEB 97
SAMPLE DESCRIPTION	TS-1
NON-AQUEOUS	
-----	
Volatile HC (8015M)	
Date Analyzed	02/26/97
Date Extracted	02/26/97
Dilution Factor, Times	100
Benzene, mg/kg	<0.5
Toluene, mg/kg	<0.5
Ethylbenzene, mg/kg	<0.5
Total Xylene Isomers, mg/kg	<1
TPH-g C6-C12, mg/kg	<10
Surrogates **	
a,a,a-Trifluorotoluene Rep., mg/kg	4.46
a,a,a-Trifluorotoluene Th., mg/kg	5.00



Our Quality Control Is Your Quality Assurance

LOG NO: G97-02-566

Received: 24 FEB 97

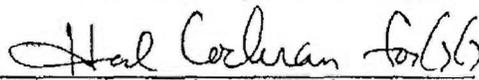
Mr. Robert Pope  
Brown and Caldwell Consultants  
16735 Von Karman, Suite 200  
Irvine, CA 92606-4953

Project: 3659-06/SHELL

REPORT OF ANALYTICAL RESULTS

Page 3

LOG NO	02-566-2
DATE SAMPLED	24 FEB 97
SAMPLE DESCRIPTION	TS-1 Dupl.
NON-AQUEOUS	
Sample Held, Not Analyzed	HOLD

  
Greta Galoustian, Laboratory Director

The analytical results within this report relate only to the specific compounds and samples investigated and may not necessarily reflect other apparently similar material from the same or a similar location.

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: ORDER PLACED FOR CLIENT: Brown and Caldwell Consultants 9702566 :  
: BC ANALYTICAL : GLEN LAB : 15:26:53 05 MAR 1997 - P. 1 :  
=====

SAMPLES...	SAMPLE DESCRIPTION..	DETERM.....	DATE.....	METHOD.....	EQUIP. BATCH..	ID.NO
9702566*1	TS-1	FUEL.C28	02.26.97	8015M	536-37 9722	1010
		GAS.C12	02.26.97	8015M	536-33 9723111	6843
9702566*2	TS-1 Dupl.	HOLD	02.24.97			7362

\*\*\*

Notes: Equipment = BC Analytical identification number for a particular piece of analytical equipment.

ID.NO = BC Analytical employee identification number of analyst.

: SURROGATE RECOVERIES :  
: BC ANALYTICAL : GLEN LAB : 15:27:17 05 MAR 1997 - P. 1 :  
=====

MOD	ANALYTE	BATCH	ANALYZED	REPORTED	TRUE	%REC	FLAG
9702566*1							
8015M	1,3-Dichlorobenzene	9722	02/26/97	23.1	25.0	92	
8015M	a,a,a-Trifluorotoluene	Re9723111	02/26/97	4.46	5.00	89	

: SURROGATE RECOVERIES :  
 : BC ANALYTICAL : GLEN LAB : 15:27:25 05 MAR 1997 - P. 1 :  
 =====

MOD	ANALYTE	BATCH	ANALYZED	REPORTED	TRUE	%REC	FLAG
9702351*2*R1							
8270	2-Fluorophenol	9733	02/27/97	0 NC	2.50	0	
	Phenol-d5	9733	02/27/97	0 NC	2.50	0	
	Nitrobenzene-d5	9733	02/27/97	0 NC	1.67	0	
	2-Fluorobiphenyl	9733	02/27/97	0 NC	1.67	0	
	2,4,6-Tribromophenol Rep.	9733	02/27/97	0 NC	2.50	0	
	Terphenyl-d14	9733	02/27/97	0 NC	1.67	0	
8015M.TXa,a,a-	Trifluorotoluene	Re9723111	02/24/97	84.2	100	84	
9702351*2*S1							
8015M.TXa,a,a-	Trifluorotoluene	Re9723111	02/24/97	168	200	84	
9702351*2*S2							
8015M.TXa,a,a-	Trifluorotoluene	Re9723111	02/24/97	168	200	84	
9702351*2*T							
8015M.TXa,a,a-	Trifluorotoluene	Re9723111	02/24/97	200	200	100	
B7021717*1*MB							
8015M.TXa,a,a-	Trifluorotoluene	Re9723111	02/24/97	5.48	5.00	110	
B703232*1*MB							
8015M	1,3-Dichlorobenzene	9722	02/26/97	24.7	25.0	99	
C7023219*1*LC							
8015M.TXa,a,a-	Trifluorotoluene	Re9723111	02/24/97	5.36	5.00	107	
C7023219*1*LT							
8015M.TXa,a,a-	Trifluorotoluene	Re9723111	02/24/97	5.00	5.00	100	
C703456*1*LC							
8015M	1,3-Dichlorobenzene	9722	02/26/97	18.1	25.0	72	
C703456*1*LT							
8015M	1,3-Dichlorobenzene	9722	02/26/97	25.0	25.0	100	
C703457*1*LC							
8015M	1,3-Dichlorobenzene	9722	02/26/97	18.1	25.0	72	
C703457*1*LT							
8015M	1,3-Dichlorobenzene	9722	02/26/97	25.0	25.0	100	



VOC ANALYTICAL GLENDALE  
 SUPPLEMENTAL REPORT FOR 9702566  
 DATE PRINTED: 05 MAR 1997

NON-AQUEOUS SAMPLES

Batch: GAS\*9723111 Method: 8015M - Modified 8015

	B7021717*1			C7023219*1			N/A		9702351*2			
	UNITS	MB	LC	LT	LC	LT	R1	R2	S1	S2	T	
Date Analyzed	Date	02/24/97	02/24/97	02/24/97	-	-	02/24/97	-	02/24/97	02/24/97	02/24/97	
Date Extracted	Date	02/24/97	02/24/97	02/24/97	-	-	-	-	-	-	-	
Dilution Factor	Times	100	100	100	-	-	2000	-	4000	4000	4000	
Benzene	mg/kg	0	1.71	1.52	-	-	11	-	66.0	68.8	71.8	
Toluene	mg/kg	0	9.68	9.74	-	-	120	-	470	467	510	
Ethylbenzene	mg/kg	0	2.11	2.04	-	-	62	-	170	171	144	
Total Xylene Isomers	mg/kg	0	12.1	11.9	-	-	350	-	972	970	824	
TPH-g C6-C12	-	-	-	-	-	-	-	-	-	-	-	
a,a,a-Trifluorotoluene Rep.	mg/kg	5.48	5.36	5.00	-	-	84.2	-	168	168	200	
a,a,a-Trifluorotoluene Th.	mg/kg	5.00	5.00	5.00	-	-	100	-	200	200	200	

Batch: FUEL\*9722 Method: 8015M - Modified 8015

	B703232*1			C703456*1			C703457*1		N/A			
	UNITS	MB	LC	LT	LC	LT	R1	R2	S1	S2	T	
Date Analyzed	Date	02/26/97	02/25/97	02/26/97	02/26/97	02/26/97	-	-	-	-	-	
Date Extracted	Date	02/26/97	02/25/97	02/26/97	02/26/97	02/26/97	-	-	-	-	-	
Dilution Factor	Times	1	1	1	1	1	-	-	-	-	-	
TPH-d C13-C22	-	-	-	-	-	-	-	-	-	-	-	
TPH-d C23-C28	-	-	-	-	-	-	-	-	-	-	-	
1,3-Dichlorobenzene Reported	mg/kg	24.7	18.1	25.0	18.1	25.0	-	-	-	-	-	
1,3-Dichlorobenzene Theoretical	mg/kg	25.0	25.0	25.0	25.0	25.0	-	-	-	-	-	

CHAIN OF CUSTODY RECORD

VOC Log Number G-566

Client name <u>BC / SHELL</u>			Project or PO# <u>3659-06</u>			Analyses required					
Address <u>16735 VON KARMAN #200</u>			Phone # <u>(714) 660-1070</u>			<div style="border: 1px solid black; padding: 5px; transform: rotate(-45deg); display: inline-block;">8015/8020</div> <div style="border: 1px solid black; padding: 5px; transform: rotate(-45deg); display: inline-block;">Hazardous sample Special handling required</div> <div style="text-align: right; font-size: 2em;">Page 1 of 1</div>					
City, State, Zip <u>IRVINE, CA 92606</u>			Report attention <u>BOB POPE</u>								
Lab Sample number	Date sampled	Time sampled	Type See key below	Sampled by	Number of containers	Remarks					
	2/24	11:00	SO	TS-1	1	Results by Wed. no per Grete 2/24 Please FAX results in 24 hrs to Bob Pope @ (714) 474-0940 <div style="border: 1px solid black; border-radius: 50%; padding: 10px; width: fit-content; margin: 10px auto;">RUSH</div>					
	2/24	11:00	SO	TS-1 dupl.	1						

Signature	Print Name	Company	Date	Time
<i>Fabio Minervini</i>	FABIO MINERVINI	BC	2/24/97	13:00
<i>[Signature]</i>	Maria Candeco	BCA/VOC	2/24/97	13:00
<i>[Signature]</i>	Maria Candeco	BCA/VOC	2/24/97	18 <sup>45</sup>
<i>[Signature]</i>	TODD CARTER	VOC	2/24/97	18 <sup>45</sup>
<i>[Signature]</i>	TODD CARTER	VOC	2/24/97	19:30
<i>Sharon Malone</i>	Sharon Malone	VOC	2-24-97	19:30

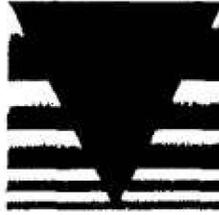
VOC ANALYTICAL

- 1085 Shary Circle, Concord, CA 94518 (510) 825-3894
- 801 Western Avenue, Glendale, CA 91201 (818) 247-5737
- 1200 Gene Autry Way, Anaheim, CA 92805 (714) 978-0113
- 4411 S. 40th Street, Phoenix, AZ 85040 (602) 470-9707

Note: Samples are discarded 30 days after results are reported unless other arrangements are made. Hazardous samples will be returned to client or disposed of at client's expense.

Disposal arrangements: \_\_\_\_\_

\*KEY: AQ—Aqueous NA—Nonaqueous SL—Sludge  
 GW—Groundwater SO—Soil PE—Petroleum  
 WW—Wastewater



Our Quality Control Is Your Quality Assurance

April 7, 1997

LOG NO.: G97-03-070

Brown and Caldwell  
16735 Von Karman, Suite 200  
Irvine, CA 92606  
Attn: Mr. Bob Pope

Reference: Client Project # 3659-06, Shell Reservoir

Dear Mr. Pope,

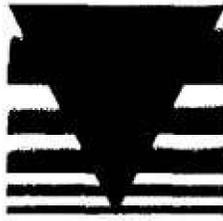
Enclosed is the analytical report for the chemical testing of samples collected in support of the above-referenced project. Samples were identified and tracked in the BCA/VOC system as log number **G97-03-070**. When making inquiries about this report, please provide the log number.

The contents of this package are based on the requirements specified in the BC Analytical, A Division of V.O.C. Analytical Laboratories, Inc. "Quality Assurance Management Plan". The case narrative addresses batch specific quality control as it pertains to this document.

If you have any questions, please do not hesitate to call me at (714) 978-0113.

Sincerely,

Patty Mata  
Project Manager



*Our Quality Control Is Your Quality Assurance*

LOG NO.: G97-03-070

### **CASE NARRATIVE**

The following narrative addresses all project specific data quality objectives with respect to: holding times, method blanks, lab control standards, matrix spike and duplicate samples. Analytical anomalies encountered during sample analysis are also discussed as necessary.

**Sample receipt:**

Samples were received under COC from Brown and Caldwell at the Anaheim office on 3/4/97. All containers were received intact and properly preserved.

No anomalies were encountered during the analysis of the project.



Our Quality Control Is Your Quality Assurance

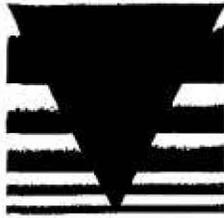
## ACRONYMS AND FLAG DEFINITIONS

### Flag Definitions:

- \* Replicate values. Used when replicate results are entered into the MS/MSD column of the QC report.
- B Blank contamination. Used when associated method blank concentration is greater than the PQL.
- J Estimated value. Used for sample results greater than or equal to MDL, but less than the PQL.
- NC Not calculated. Used when sample result is greater than two times the spike amount added, or when extracted surrogates were diluted at least 1:10.
- Q Quality objectives were not met. Used for Method Blank, Laboratory Control Samples, Matrix Spikes, Matrix Duplicates and Surrogates.

### Acronyms:

COC	Chain of Custody
FLG	Flag
LC	Actual LCS/LCSD concentration recovered
LCL	Lower Control Limit
LCS	Laboratory Control Sample
LCSD	Laboratory Control Sample Duplicate
LT	True LCS/LCSD concentration
MB	Method Blank
MS	Matrix Spike
MSD	Matrix Spike Duplicate
R1	Unspiked sample concentration
RDL	Reporting Detection Limit
%REC	Percent Recovery
Rep.	Surrogate Reported value
RPD	Relative Percent Difference
S1	Actual MS concentration
S2	Actual MSD concentration
T	True concentration of MS/MSD
Theo.	Surrogate Theoretical value
UCL	Upper Control Limit



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# ANALYTICAL REPORT

LOG NO: G97-03-070

Received: 04 MAR 97

Mailed: APR 11 1997

Purchase Order: 4708

Mr. Bob Pope  
Brown and Caldwell Consultants  
16735 Von Karman, Suite 200  
Irvine, CA 92606-4953

Project: 3659-06/SHELLRES.

## REPORT OF ANALYTICAL RESULTS

Page 1

LOG NO	03-070-1	03-070-2
DATE SAMPLED	03 MAR 97	03 MAR 97
SAMPLE DESCRIPTION	TS-2	TS-4
NON-AQUEOUS		
Semi-volatile HC (8015M)		
Date Analyzed	03/06/97	03/06/97
Date Extracted	03/05/97	03/05/97
Dilution Factor, Times	1	1
TPH-d C13-C22, mg/kg	<100	<100
TPH-d C23-C28, mg/kg	<100	105
Other Semi-volatile HC (8015M)	---	---
Surrogates **		
Naphthalene Reported, mg/kg	10.6	10.5
Naphthalene Theoretical, mg/kg	10.0	10.0



Our Quality Control Is Your Quality Assurance

LOG NO: G97-03-070

Received: 04 MAR 97

Mr. Bob Pope  
Brown and Caldwell Consultants  
16735 Von Karman, Suite 200  
Irvine, CA 92606-4953

Purchase Order: 4708

Project: 3659-06/SHELLRES.

REPORT OF ANALYTICAL RESULTS

Page 2

LOG NO	03-070-1	03-070-2
DATE SAMPLED	03 MAR 97	03 MAR 97
SAMPLE DESCRIPTION	TS-2	TS-4
NON-AQUEOUS		
-----		
Volatile HC (8015M)		
Date Analyzed	03/05/97	03/05/97
Dilution Factor, Times	1	1
Benzene, mg/kg	<0.005	<0.005
Toluene, mg/kg	<0.005	<0.005
Ethylbenzene, mg/kg	<0.005	<0.005
Total Xylene Isomers, mg/kg	<0.01	<0.01
TPH-g C6-C12, mg/kg	<0.1	<0.1
Other Volatile HC (8015M)	---	---
Surrogates **		
a,a,a-Trifluorotoluene Rep., mg/kg	0.0500	0.0664
a,a,a-Trifluorotoluene Th., mg/kg	0.0500	0.0500



Our Quality Control Is Your Quality Assurance

LOG NO: G97-03-070

Received: 04 MAR 97

Mr. Bob Pope  
Brown and Caldwell Consultants  
16735 Von Karman, Suite 200  
Irvine, CA 92606-4953

Purchase Order: 4708

Project: 3659-06/SHELLRES.

REPORT OF ANALYTICAL RESULTS

Page 3

LOG NO	03-070-3
DATE SAMPLED	04 MAR 97
SAMPLE DESCRIPTION	TS-3
NON-AQUEOUS	
-----	
Polynuclear Aromatics (8270)	
Date Analyzed	03/05/97
Date Extracted	03/05/97
Dilution Factor, Times	1
Acenaphthene, mg/kg	<0.2
Acenaphthylene, mg/kg	<0.2
Anthracene, mg/kg	<0.2
Benzo(a)anthracene, mg/kg	<0.2
Benzo(a)pyrene, mg/kg	<0.2
Benzo(b)fluoranthene, mg/kg	<0.2
Benzo(g,h,i)perylene, mg/kg	<0.2
Benzo(k)fluoranthene, mg/kg	<0.2
Chrysene, mg/kg	<0.2



Our Quality Control Is Your Quality Assurance

LOG NO: G97-03-070

Received: 04 MAR 97

Mr. Bob Pope  
Brown and Caldwell Consultants  
16735 Von Karman, Suite 200  
Irvine, CA 92606-4953

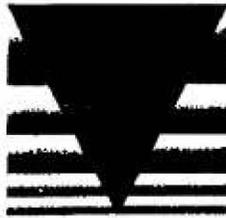
Purchase Order: 4708

Project: 3659-06/SHELLRES.

REPORT OF ANALYTICAL RESULTS

Page 4

LOG NO	03-070-3
DATE SAMPLED	04 MAR 97
SAMPLE DESCRIPTION	TS-3
NON-AQUEOUS	
Dibenzo(a,h)anthracene, mg/kg	<0.2
Fluoranthene, mg/kg	<0.2
Fluorene, mg/kg	<0.2
Indeno(1,2,3-c,d)pyrene, mg/kg	<0.2
Naphthalene, mg/kg	<0.2
Phenanthrene, mg/kg	<0.2
Pyrene, mg/kg	<0.2
Surrogates **	
2-Fluorobiphenyl Reported, mg/kg	1.42
2-Fluorobiphenyl Theo., mg/kg	1.67
Nitrobenzene-d5 Reported, mg/kg	1.41
Nitrobenzene-d5 Theoretical, mg/kg	1.67
Terphenyl-d14 Reported, mg/kg	1.25



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LOG NO: G97-03-070

Received: 04 MAR 97

Mr. Bob Pope  
Brown and Caldwell Consultants  
16735 Von Karman, Suite 200  
Irvine, CA 92606-4953

Purchase Order: 4708

Project: 3659-06/SHELLRES.

REPORT OF ANALYTICAL RESULTS

Page 5

LOG NO	03-070-3
DATE SAMPLED	04 MAR 97
SAMPLE DESCRIPTION	TS-3
NON-AQUEOUS	
Terphenyl-d14 Theoretical, mg/kg	1.67

  
Greta Galoustian, Laboratory Director

The analytical results within this report relate only to the specific compounds and samples investigated and may not necessarily reflect other apparently similar material from the same or a similar location.

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ORDER PLACED FOR CLIENT: Brown and Caldwell Consultants 9703070 :  
BC ANALYTICAL : GLEN LAB : 16:50:58 28 MAR 1997 - P. 1 :  
=====

AMPLES...	SAMPLE DESCRIPTION..	DETERM.....	DATE.....	METHOD.....	EQUIP. BATCH..	ID.NO
			ANALYZED			
703070*1	TS-2	FUEL.C28	03.06.97	8015M	536-01 9728	1010
		GAS.C12	03.05.97	8015M	536-35 9723142	1012
703070*2	TS-4	FUEL.C28	03.06.97	8015M	536-01 9728	1010
		GAS.C12	03.05.97	8015M	536-35 9723142	1012
703070*3	TS-3	8270.PNA	03.05.97	8270	537-14 9747	6750

\*\*

Notes: Equipment = BC Analytical identification number for a particular piece of analytical equipment.

ID.NO = BC Analytical employee identification number of analyst.

SURROGATE RECOVERIES :  
BC ANALYTICAL : GLEN LAB : 16:51:42 28 MAR 1997 - P. 1 :

=====

ANALYTE	BATCH	ANALYZED	REPORTED	TRUE	%REC	FLAG
703070*1						
.015M Naphthalene	9728	03/06/97	10.6	10.0	106	
.015M a,a,a-Trifluorotoluene	Re9723142	03/05/97	0.0500	0.0500	100	
703070*2						
.015M Naphthalene	9728	03/06/97	10.5	10.0	105	
.015M a,a,a-Trifluorotoluene	Re9723142	03/05/97	0.0664	0.0500	133	
703070*3						
1270 Nitrobenzene-d5	9747	03/05/97	1.41	1.67	84	
2-Fluorobiphenyl	9747	03/05/97	1.42	1.67	85	
Terphenyl-d14	9747	03/05/97	1.25	1.67	75	



VOC ANALYTICAL REPORT  
 SUPPLEMENTAL REPORT FOR 9703070  
 DATE PRINTED: 02 APR 1997

NON-AQUEOUS SAMPLES

Batch: GAS\*9723142 Method: 8015M - Modified 8015

	UNITS	B703402*1 MB	C703765*1 LC	..... LT	N/A LC	9701898*15 LT	..... R1	..... R2	..... S1	..... S2	..... T
Date Analyzed	Date	03/05/97	03/05/97	03/05/97	-	-	03/05/97	-	03/05/97	03/05/97	03/05/97
Dilution Factor	Times	1	1	1	-	-	1	-	1	1	1
Benzene	mg/kg	0	0.0185	0.0152	-	-	<0.005	-	0.0172	0.0175	0.0152
Toluene	mg/kg	0	0.0935	0.0974	-	-	<0.005	-	0.0918	0.0932	0.0974
Ethylbenzene	mg/kg	0	0.0194	0.0204	-	-	<0.005	-	0.0192	0.0195	0.0204
Total Xylene Isomers	mg/kg	0	0.110	0.119	-	-	<0.01	-	0.110	0.111	0.119
TPH-g C6-C12	mg/kg	0	1.11	1.10	-	-	<0.05	-	1.12	1.12	1.10
a,a,a-Trifluorotoluene Rep.	mg/kg	0.0482	0.0580	0.0500	-	-	0.0526	-	0.0529	0.0530	0.0500
a,a,a-Trifluorotoluene Th.	mg/kg	0.0500	0.0500	0.0500	-	-	0.0500	-	0.0500	0.0500	0.0500

NON-AQUEOUS SAMPLES

Batch: 8270\*9747 Method: 8270 - GC/MS for Semivolatile Organics, Capillary column

	B703825*1	C7031565*1	.....	C7031566*1	.....	9703065*1	.....	.....	.....	.....	.....	.....
	UNITS	MB	LC	LT	LC	LT	R1	R2	S1	S2	T	
Date Analyzed	Date	03/11/97	03/11/97	03/11/97	03/11/97	03/11/97	03/12/97	-	03/12/97	03/12/97	03/12/97	
Date Extracted	Date	03/05/97	03/05/97	03/05/97	03/05/97	03/05/97	03/05/97	-	03/05/97	03/05/97	03/05/97	
Dilution Factor	Times	1	1	1	1	1	1	-	1	1	1	
Acenaphthene	mg/kg	0	2.43	3.33	2.85	3.33	<0.2	-	1.61	1.41	1.67	
Acenaphthylene	mg/kg	0	2.43	3.33	2.93	3.33	<0.2	-	-	-	-	
Anthracene	mg/kg	0	2.10	3.33	2.39	3.33	<0.2	-	-	-	-	
Benzo(a)anthracene	mg/kg	0	2.58	3.33	3.43	3.33	<0.2	-	-	-	-	
Benzo(a)pyrene	mg/kg	0	2.51	3.33	2.79	3.33	<0.2	-	-	-	-	
Benzo(b)fluoranthene	mg/kg	0	2.53	3.33	2.50	3.33	<0.2	-	-	-	-	
Benzo(g,h,i)perylene	mg/kg	0	2.76	3.33	2.28	3.33	<0.2	-	-	-	-	
Benzo(k)fluoranthene	mg/kg	0	2.60	3.33	2.17	3.33	<0.2	-	-	-	-	
Chrysene	mg/kg	0	2.75	3.33	3.32	3.33	<0.2	-	-	-	-	
Dibenzo(a,h)anthracene	mg/kg	0	2.63	3.33	2.09	3.33	<0.2	-	-	-	-	
Fluoranthene	mg/kg	0	2.11	3.33	2.58	3.33	<0.2	-	-	-	-	
Fluorene	mg/kg	0	2.44	3.33	2.84	3.33	<0.2	-	-	-	-	
Indeno(1,2,3-c,d)pyrene	mg/kg	0	2.74	3.33	2.43	3.33	<0.2	-	-	-	-	
Naphthalene	mg/kg	0	2.40	3.33	2.96	3.33	<0.2	-	-	-	-	
Phenanthrene	mg/kg	0	2.07	3.33	2.58	3.33	<0.2	-	-	-	-	
Pyrene	mg/kg	0	2.56	3.33	3.39	3.33	<0.2	-	1.62	1.43	1.67	
2-Fluorobiphenyl Reported	mg/kg	1.28	1.50	1.67	1.78	1.67	1.88	-	1.64	1.49	0 NC	
2-Fluorobiphenyl Theo.	mg/kg	1.67	1.67	1.67	1.67	1.67	1.67	-	1.67	1.67	1.67	
Nitrobenzene-d5 Reported	mg/kg	1.22	1.49	1.67	1.83	1.67	1.63	-	1.65	1.35	0 NC	
Nitrobenzene-d5 Theoretical	mg/kg	1.67	1.67	1.67	1.67	1.67	1.67	-	1.67	1.67	1.67	
Terphenyl-d14 Reported	mg/kg	1.15	1.57	1.67	1.96	1.67	1.78	-	1.74	1.53	0 NC	
Terphenyl-d14 Theoretical	mg/kg	1.67	1.67	1.67	1.67	1.67	1.67	-	1.67	1.67	1.67	

Batch: FUEL\*9728 Method: 8015M - Modified 8015

	B703374*1	C703721*1	.....	C703722*1	.....	N/A	.....	.....	.....	.....	.....	.....
	UNITS	MB	LC	LT	LC	LT	R1	R2	S1	S2	T	
Date Analyzed	Date	03/05/97	03/05/97	03/05/97	03/05/97	03/05/97	-	-	-	-	-	
Date Extracted	Date	03/06/97	03/05/97	03/05/97	03/05/97	03/05/97	-	-	-	-	-	
Dilution Factor	Times	1	1	1	1	1	-	-	-	-	-	
TPH-d C13-C22	mg/kg	0	135	100	133	100	-	-	-	-	-	
TPH-d C23-C28	mg/kg	0	-	-	-	-	-	-	-	-	-	
Naphthalene Reported	mg/kg	11.2	10.4	10.0	9.80	10.0	-	-	-	-	-	
Naphthalene Theoretical	mg/kg	10.0	10.0	10.0	10.0	10.0	-	-	-	-	-	





*Our Quality Control Is Your Quality Assurance*

April 11, 1997

LOG NO.: G97-03-317

Brown and Caldwell  
16735 Von Karman, Suite 200  
Irvine, CA 92606  
Attn: Mr. Bob Pope

Reference: Client Project # 3659-06, Shell Reservoir

Dear Mr. Pope,

Enclosed is the analytical report for the chemical testing of samples collected in support of the above-referenced project. Samples were identified and tracked in the BCA/VOC system as log number **G97-03-317**. When making inquiries about this report, please provide the log number.

The contents of this package are based on the requirements specified in the BC Analytical, A Division of V.O.C. Analytical Laboratories, Inc. "Quality Assurance Management Plan". The case narrative addresses batch specific quality control as it pertains to this document.

*If you have any questions, please do not hesitate to call me at (714) 978-0113.*

Sincerely,

Patty Mata  
Project Manager



*Our Quality Control Is Your Quality Assurance*

LOG NO.: G97-03-317

### **CASE NARRATIVE**

The following narrative addresses all project specific data quality objectives with respect to: holding times, method blanks, lab control standards, matrix spike and duplicate samples. Analytical anomalies encountered during sample analysis are also discussed as necessary.

**Sample receipt:**

Samples were received under COC from Brown and Caldwell at the Anaheim office on 3/12/97. All containers were received intact and properly preserved.

No anomalies were encountered during the analysis of the project.



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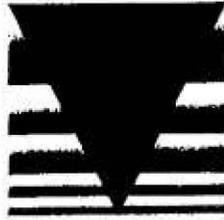
## ACRONYMS AND FLAG DEFINITIONS

### Flag Definitions:

- \* Replicate values. Used when replicate results are entered into the MS/MSD column of the QC report.
- B Blank contamination. Used when associated method blank concentration is greater than the PQL.
- J Estimated value. Used for sample results greater than or equal to MDL, but less than the PQL.
- NC Not calculated. Used when sample result is greater than two times the spike amount added, or when extracted surrogates were diluted at least 1:10.
- Q Quality objectives were not met. Used for Method Blank, Laboratory Control Samples, Matrix Spikes, Matrix Duplicates and Surrogates.

### Acronyms:

COC	Chain of Custody
FLG	Flag
LC	Actual LCS/LCSD concentration recovered
LCL	Lower Control Limit
LCS	Laboratory Control Sample
LCSD	Laboratory Control Sample Duplicate
LT	True LCS/LCSD concentration
MB	Method Blank
MS	Matrix Spike
MSD	Matrix Spike Duplicate
R1	Unspiked sample concentration
RDL	Reporting Detection Limit
%REC	Percent Recovery
Rep.	Surrogate Reported value
RPD	Relative Percent Difference
S1	Actual MS concentration
S2	Actual MSD concentration
T	True concentration of MS/MSD
Theo.	Surrogate Theoretical value
UCL	Upper Control Limit



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## ANALYTICAL REPORT

LOG NO: G97-03-317

Received: 12 MAR 97

Mailed: APR 11 1997

Mr. Robert Pope  
Brown and Caldwell Consultants  
16735 Von Karman, Suite 200  
Irvine, CA 92606-4953

Project: 3659-06/SHELLRES

### REPORT OF ANALYTICAL RESULTS

Page 1

-----  
LOG NO 03-317-1  
-----

DATE SAMPLED 11 MAR 97  
SAMPLE DESCRIPTION TS-5  
NON-AQUEOUS  
-----

#### Semi-volatile HC (8015M)

Date Analyzed 03/13/97

Date Extracted 03/12/97

Dilution Factor, Times 1

TPH-d C13-C22, mg/kg <100

TPH-d C23-C28, mg/kg <100

Other Semi-volatile HC (8015M) ---

#### Surrogates \*\*

1,3-Dichlorobenzene Reported, mg/kg 18.2

1,3-Dichlorobenzene Theoretical, mg/kg 25.0  
-----



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REPORT OF ANALYTICAL RESULTS.

Page 2

LOG NO	03-317-1
DATE SAMPLED	11 MAR 97
SAMPLE DESCRIPTION	TS-5
NON-AQUEOUS	
-----	
Volatile HC (8015M)	
Date Analyzed	03/15/97
Date Extracted	
Dilution Factor, Times	1
Benzene, mg/kg	<0.005
Toluene, mg/kg	<0.005
Ethylbenzene, mg/kg	<0.005
Total Xylene Isomers, mg/kg	<0.01
TPH-g C6-C12, mg/kg	<0.1
Surrogates **	
a,a,a-Trifluorotoluene Rep., mg/kg	0.0516
a,a,a-Trifluorotoluene Th., mg/kg	0.0500



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LOG NO: G97-03-317

Received: 12 MAR 97

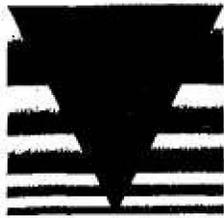
Mr. Robert Pope  
Brown and Caldwell Consultants  
16735 Von Karman, Suite 200  
Irvine, CA 92606-4953

Project: 3659-06/SHELLRES

REPORT OF ANALYTICAL RESULTS

Page 3

LOG NO	03-317-2
DATE SAMPLED	12 MAR 97
SAMPLE DESCRIPTION	TS-6
NON-AQUEOUS	
-----	
Polynuclear Aromatics (8270)	
Date Analyzed	03/18/97
Date Extracted	03/13/97
Dilution Factor, Times	1
Acenaphthene, mg/kg	<0.2
Acenaphthylene, mg/kg	<0.2
Anthracene, mg/kg	<0.2
Benzo(a)anthracene, mg/kg	<0.2
Benzo(a)pyrene, mg/kg	<0.2
Benzo(b)fluoranthene, mg/kg	<0.2
Benzo(g,h,i)perylene, mg/kg	<0.2
Benzo(k)fluoranthene, mg/kg	<0.2
Chrysene, mg/kg	<0.2



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Project: 3659-06/SHELLRES

REPORT OF ANALYTICAL RESULTS

Page 4

LOG NO	03-317-2
DATE SAMPLED	12 MAR 97
SAMPLE DESCRIPTION	TS-6
NON-AQUEOUS	
Dibenzo(a,h)anthracene, mg/kg	<0.2
Fluoranthene, mg/kg	<0.2
Fluorene, mg/kg	<0.2
Indeno(1,2,3-c,d)pyrene, mg/kg	<0.2
Naphthalene, mg/kg	<0.2
Phenanthrene, mg/kg	<0.2
Pyrene, mg/kg	<0.2
Surrogates **	
2-Fluorobiphenyl Reported, mg/kg	1.50
2-Fluorobiphenyl Theo., mg/kg	1.67
Nitrobenzene-d5 Reported, mg/kg	1.40
Nitrobenzene-d5 Theoretical, mg/kg	1.67
Terphenyl-d14 Reported, mg/kg	1.47



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LOG NO: G97-03-317

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Project: 3659-06/SHELLRES

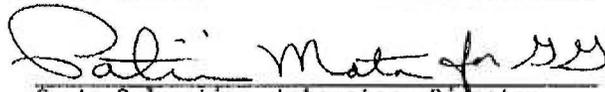
REPORT OF ANALYTICAL RESULTS

Page 5

LOG NO 03-317-2

DATE SAMPLED 12 MAR 97  
SAMPLE DESCRIPTION TS-6  
NON-AQUEOUS

Terphenyl-d14 Theoretical, mg/kg 1.67

  
Greta Galoustian, Laboratory Director

The analytical results within this report relate only to the specific compounds and samples investigated and may not necessarily reflect other apparently similar material from the same or a similar location.

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ORDER PLACED FOR CLIENT: Brown and Caldwell Consultants 9703317 :  
BC ANALYTICAL : GLEN LAB : 15:00:47 19 MAR 1997 - P. 1 :

=====

FILES...	SAMPLE DESCRIPTION..	DETERM.....	DATE.....	METHOD.....	EQUIP. BATCH..	ID.NO
			ANALYZED			
1703317*1	TS-5	FUEL.C28	03.13.97	8015M	536-37 9735	1010
		GAS.C12	03.15.97	8015M	536-33 9723162	6843
1703317*2	TS-6	8270.PNA	03.18.97	8270	537-12 9755	1009

\*\*\*

Notes: Equipment = BC Analytical identification number for a particular piece of analytical equipment.

ID.NO = BC Analytical employee identification number of analyst.

SURROGATE RECOVERIES :  
BC ANALYTICAL : GLEN LAB : 15:00:24 19 MAR 1997 - P. 1 :

=====

	ANALYTE	BATCH	ANALYZED	REPORTED	TRUE	%REC	FLAG
703317*1							
015M	1,3-Dichlorobenzene	9735	03/13/97	18.2	25.0	73	
015M	a,a,a-Trifluorotoluene	Re9723162	03/15/97	0.0516	0.0500	103	
703317*2							
270	Nitrobenzene-d5	9755	03/18/97	1.40	1.67	84	
	2-Fluorobiphenyl	9755	03/18/97	1.50	1.67	90	
	Terphenyl-d14	9755	03/18/97	1.47	1.67	88	

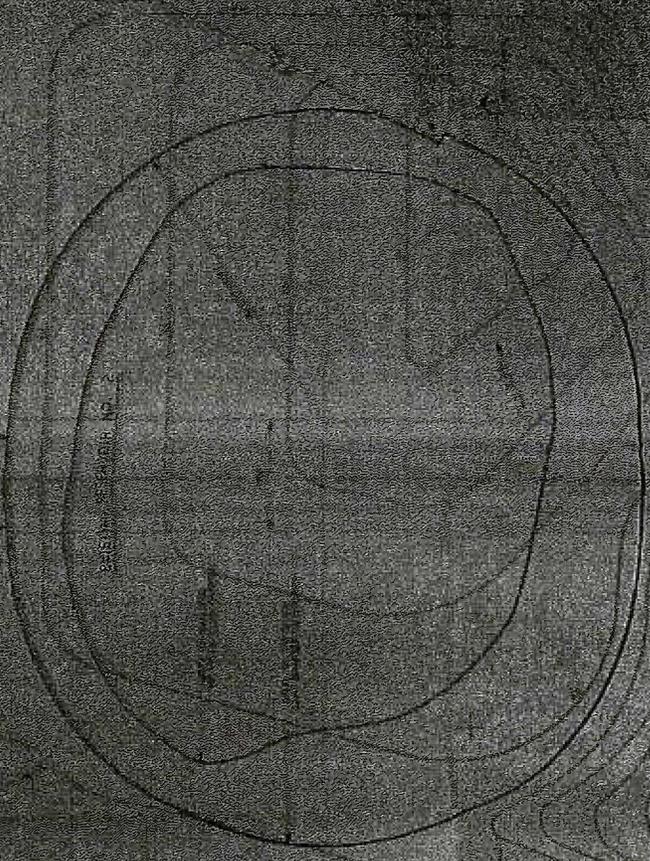




**APPENDIX F**

*AS BUILT DRAWINGS*

SMITHSONIAN INSTITUTION



SMITHSONIAN INSTITUTION



