OCTOBER 22, 2004

RESULTS OF DNAPL RECONNAISSANCE INVESTIGATION

MONTROSE SITE

TORRANCE, CALIFORNIA

REVISION 1.0

PREPARED FOR:
MONTROSE CHEMICAL CORPORATION OF CALIFORNIA

HARGIS + ASSOCIATES, INC.
HYDROGEOLOGY • ENGINEERING

HARGIS + ASSOCIATES, INC.
HYDROGEOLOGY • ENGINEERING

Mission City Corporate Center
2365 Northside Drive, Suite C-100
San Diego, CA 92108
Phone: 619.521.0165
Fax: 619.521.8580

25th Anniversary 2004

October 22, 2004

VIA FEDERAL EXPRESS

Mr. Jeffrey Dhont
Superfund Project Manager
U.S. ENVIRONMENTAL PROTECTION AGENCY
75 Hawthorn Street (SFD-7-1)
San Francisco, CA 94105-3901

Re: Submittal of Results of DNAPL Reconnaissance Investigation,
Montrose Site, Torrance, California, Revision 1.0

Dear Mr. Dhont:

Enclosed are the replacement pages for the document titled:

Results of DNAPL Reconnaissance Investigation
Montrose Site
Torrance, California
Revision 1.0

Transmitted is the report cover, spine, text, Tables 1 through 3, and Figures 2, 3, 5, 6, 9, and 10 through 13 and a revised CD with logs and data pertaining to boring TSB-16 of the document. Please replace the relevant pages of the draft document dated June 19, 2004, with these replacement pages.

This document has been prepared to incorporate responses to EPA comments received in correspondence dated August 24, 2004 (Attachment 1).

If you have any questions or comments, please contact me.

Sincerely,

HARGIS + ASSOCIATES, INC.

Michael A. Palmer, RG 5915, CHG 146
Principal Hydrogeologist

MAP/ama

Other Offices:
Mesa, AZ
Tucson, AZ
Dallas, TX

Enclosure

cc: Mr. Jeffrey Dhont, U.S. Environmental Protection Agency (3 copies)
Ms. Natasha Raykhman, CH2M Hill (2 copies)
Mr. Steve Acree, U.S. Environmental Protection Agency (1 copy)
Mr. Frank Gonzales, Department of Toxic Substances Control (1 copy)
Mr. Safouh Sayed, Department of Toxic Substances Control (1 copy)
Mr. Joe Kelly, Montrose Chemical Corporation of California (1 copy)
Mr. Paul Sundberg, Consultant to Montrose Chemical Corporation of California (1 copy)
Karl Lytz, Esq., Latham & Watkins (1 copy)
Mr. John Dudley, URS Corporation (1 copy)
Luke Mette, Esq., Stauffer Management Company, LLC (1 copy)
Mr. Lee Erickson, Stauffer Management Company, LLC (1 copy)
Paul Galvani, Esq., Ropes & Gray (without enclosure)

857 I dhont20.ama

ATTACHMENT 1

RESPONSE TO EPA COMMENTS ON
RESULTS OF DNAPL RECONNAISSANCE INVESTIGATION
MONTROSE SITE
TORRANCE, CALIFORNIA
DATED JUNE 19, 2004

Comments received August 24, 2004, in a letter from Ms Susan Keydel, U.S. Environmental Protection Agency, to Mr. Joe Kelly, Montrose Chemical Corporation.

General Comments

1. The revised Report should clarify that this DNAPL Reconnaissance survey focused on DNAPL consisting primarily of chlorobenzene and dichloro-diphenyl-trichloroethane (DDT) in the former Central Processing Area (CPA) within the Montrose Plant Property. Other sources of DNAPL, if present within the Montrose Superfund Site, would require additional characterization. For example, under separate field sampling plans, Montrose has agreed to advance and sample selected borings to 90 feet bgs as part of the supplemental soil sampling plan for the Montrose Plant Property, and at the JCI Jones Chemicals (Jones) property DNAPL samples will also be collected. Should evidence of DNAPL be detected during these sampling events, the extent of that DNAPL would need to be defined and presented in an amendment to the Report.

RESPONSE: The dense non-aqueous phase liquid (DNAPL) Reconnaissance survey focused on DNAPL consisting primarily of chlorobenzene and DDT which is found within and surrounding the former Central Processing Area (CAP) on the Montrose Plant Property. If evidence of DNAPL of another nature is found based on the supplemental soil sampling plan, then that DNAPL data will be defined and documented in an amendment to the DNAPL Reconnaissance Report. A paragraph has been added to Section 1.0 of the report text to clarify this concept.

It is our understanding that the characterization work conducted by Jones is focused on DNAPL of a different nature than found at the Montrose site and the results for their investigation will be documented by Jones. Thus it is not Montrose's intent to assimilate the Jones DNAPL data into this DNAPL Reconnaissance Report.

2. To complete characterization of the extent of DNAPL beyond boring TSB-2, going off property to the north, a step-out boring (location "F") has been identified. Based on communications from Montrose representatives, this boring is scheduled to be drilled on Sunday, August 29, 2004. If evidence of DNAPL is detected in boring "F," additional borings may be needed. The revised version of this Report should include logs and findings from this boring and any additionally needed DNAPL borings.

RESPONSE: Boring TSB-16 was completed at location "F" on August 29, 2004. Evidence of DNAPL was not detected in boring TSB-16, therefore there is no need to drill additional DNAPL borings to the north to asses the extent of DNAPL in the upper Bellflower aquitard. Findings from this boring have been incorporated into the text and tables of the report, where

appropriate. The location of boring TSB-16 has been added to Figures 3, 5, 6, 11, and 12. The log of TSB-16 has been added to Appendix A, Boring Logs.

Comments on Lines of Evidence Approach

3. Multiple lines of evidence were used to estimate the extent of DNAPL in the vadose zone and Upper Bellflower Aquitard (UBA). While EPA supports this approach, there are inevitable uncertainties in the resultant delineation, due to: subsurface heterogeneity and the potential to miss DNAPL in a given boring; the subjectivity of the criteria used for the secondary lines of evidence (i.e., laboratory results and soil vapor concentrations as measured by organic vapor analyzer (OVA) devices); and, areas of limited data (e.g., laboratory analysis samples from the vadose zone are available from only nine borings). These uncertainties in the DNAPL delineation and distribution, should be made clear in the revised report, and the potential effects of such uncertainties (i.e., qualitative and quantitative) on the DNAPL FS evaluations described.

RESPONSE: Given the lithologic heterogeneity of the upper Bellflower aquitard and the complex manner in which DNAPL migrates in the subsurface, there is no practical way to eliminate all uncertainty in estimating the extent of DNAPL at the site. It is clear where DNAPL is detected in one boring and not in an adjacent boring, there is uncertainty as to where the limit of DNAPL occurs between the two borings. It is also possible that DNAPL could have migrated between two borings which do not exhibit DNAPL evidence. However the pattern of the DNAPL distribution appears to be more broad than sinuous which suggests that the likelihood of DNAPL migrating between borings is low.

There is a high degree of certainty that DNAPL exists in soil intervals which exhibited staining on FLUTe Ribbon. There was a clear correlation with ribbon staining with laboratory results for chlorobenzene or DDT that exceeded 1,000 milligrams per kilogram (mg/kg) in soil samples or where flame ionization detector (FID) concentrations exceeded 10,000 parts per million vapor (ppmv). It is therefore nearly certain that DNAPL is present where the results exceeded these values.

The greatest uncertainty regarding DNAPL presence exists in the region indicated on Figures 9 and 10 as “DNAPL possibly present”. Although DNAPL was not confirmed for any samples falling in this region, laboratory and organic vapor analyzer (OVA) concentrations indicate that there is some potential for DNAPL occurrence. In order to reduce the potential uncertainty and provide criteria which are more conservative, lower level threshold concentrations have been added to these figures to identify additional areas where DNAPL may possibly be present based on the laboratory results for both chlorobenzene and DDT. The basis for the lower threshold concentrations is described in greater detail in the response to Comment 7.

OVA results provide a relative indication of the presence of volatile organic compounds in samples which can be present in either the dissolved phase, vapor phase, sorbed phase, or as DNAPL. A strong correlation was observed between samples with FLUTe ribbon confirmation of DNAPL and OVA concentrations above 1,500 ppmv. However, high OVA concentrations can also be generated from soil samples collected from the saturated zone where dissolved phase groundwater concentrations are elevated such as downgradient from the DNAPL-impacted zone. Because of this, OVA readings less than 1,500 ppmv do not

provide a reliable basis for assuming DNAPL presence in these areas. OVA screening criteria are further discussed in the response to Comment 8.

4. In the Report, primary lines of evidence for the presence of DNAPL include ***visual observation****. Visual evidence of DNAPL is not indicated on the logs for any DNAPL Reconnaissance program borings advanced using the rotosonic rig. However, versions of the rotosonic boring logs provided to EPA during the winter and spring of 2004 do indicate visual evidence of DNAPL (e.g., borings PSB-5 at 7.5 feet, 55 - 59.5 feet, and 90.5 - 92 feet bgs; and, SSB-6 at 13 feet bgs). The discussion of visual evidence in the revised Report should be modified to address these previous DNAPL observations, or else an explanation provided as to why the conclusions do not reflect these indications of visually observed DNAPL. The revised Report should be modified to address these observations of white powder or crystals, addressing them as evidence of DNAPL or else providing an explanation as to why the delineated extent of DNAPL does not reflect these crystals, and how that interpretation affects the uncertainty in the extent of DNAPL for the FS evaluations.*

RESPONSE: During the current DNAPL Reconnaissance Program, it was discovered that the purplish sheen that was so often observed during the previous mud rotary boring program in the CPA during the late 1980's and early 1990's was not observed in the cores obtained using the rotosonic drilling method. Only a few notations of sheen were reported during the direct push sampling phase. The reason for this may be due in part to differences in the drilling methods used to obtain the core. The mud rotary method used during the 80's and 90's apparently tended to coat the core with drilling fluid which may have facilitated the appearance of the sheen on the core exterior. When the core is extruded during the sonic drilling method, the sandy portions tend to loosen up. This likely increases the soil porosity which apparently causes any DNAPL to be held in the interior of the core rather than migrate to the core surface where it can be readily observed. Another possible contributing factor to the difference in visual evidence is that DNAPL saturations may have been substantially higher in the portion of the central process area investigated during the prior field investigations, which resulted in DNAPL being more visually apparent. However, even though DNAPL sheen was infrequently observed during the current DNAPL Reconnaissance Program, reliable data regarding DNAPL occurrence was obtained based on the visual observation of FLUTe ribbon staining which is considered more conclusive. Notations of sheen associated with the core are included in the lithologic logs in the visual evidence column for reference purposes.

Several types of crystalline material were observed on or within the cores during the DNAPL Reconnaissance Program. In all, there were 15 notations of crystalline material during the entire DNAPL Reconnaissance Program within 6 different borings: DP-3, PSB-1, PSB-5, PSB-15, PSB-17, and SSB-6. Of the fifteen occurrences, thirteen were within the vadose zone and two were within the saturated zone. Of the two occurrences within the saturated zone, one was directly related to confirmed DNAPL in boring PSB-5, and one was several feet above a confirmed DNAPL zone in boring DP-3, and therefore do not effect the estimated extent of DNAPL within the saturated zone.

Some crystalline material appeared to be included in the core prior to collection. All occurrences of crystalline material included within the core prior to collection were from the vadose zone at depths of less than 30 feet below land surface (bls). This material could be related to commonly occurring natural minerals such as gypsum or calcite, to non-volatile

organic compounds such as para-chlorobenzene sulfonic acid (pCBSA), or to DDT that precipitated from DNAPL as the chlorobenzene evaporated in the vadose zone.

Sometimes a white precipitate was observed to be actively forming on the exterior of cores as the core dried in the field, borings PSB-5 and SSB-6. This crystalline material could be DDT precipitating due to volatization of chlorobenzene from DNAPL, or precipitation of dissolved minerals or non-volatile organic compounds such as pCBSA from the pore water in the soil.

Overall, visual observation of white crystals or precipitate did not provide reliable evidence of DNAPL during the recent field program. All occurrences of crystalline material occurred within the area of known DNAPL, except for two borings: PSB-15 and PSB-17. Boring PSB-15 is located near the southeast corner of the former water recycling pond and falls within the area indicated as possibly containing DNAPL. Boring PSB-17 is located near the southwest corner of the former water recycling pond, just outside the area indicated as possibly containing DNAPL. It does not appear that the crystalline material observed at 19.5 and 20.5 feet bls in boring PSB-17 is related to DNAPL because the OVA-FID concentration associated with the crystalline material was only 128 ppmv, well below the threshold that indicates the potential presence of DNAPL. Given the relatively shallow depth and the proximity to the former pond, the presence of the crystalline material is more likely related to either former DNAPL that has since volatilized, or to the precipitation of minerals or non-volatile organic compounds such as pCBSA from the wastewater historically stored in the pond.

Because of the uncertainty in the source or origin of the crystalline material and precipitates, notations of crystals and precipitates have not been included in the visual evidence column in the lithologic logs, but have been retained in the text of the logs. Text has been added to the report discussing the potential significance of the precipitate/crystal notations. References to DDT in the lithologic logs related to crystals or precipitate have been removed.

5. As described in the EPA-approved DNAPL Reconnaissance Field Sampling Plan (FSP, dated April 3, 2003), "[E]vidence of DNAPL may range from a strong to faint sheen, the appearance of a white powdery substance on the core, which may be indicative of DDT precipitation, or the staining of hydrophobic dye impregnated cloth when brought into contact with the core material."

In the Report, visual observations of white powder or crystals in the boring logs were not included as indicators of DNAPL. However, crystals of precipitated DDT indicate that DNAPL is or was present to transport DDT to that location. Logs indicated the presence of crystals in the vadose zone for several borings, including: PSB-1, PSB-5, PSB-15, PSB-17, and SSB-6. If the visual observations of white powder or crystals were evaluated as primary evidence of DNAPL, the delineated extent of DNAPL (known and possible) would increase toward the southwest The revised Report should be modified to address these observations of white powder or crystals, addressing them as evidence of DNAPL or else providing an explanation as to why the delineated extent of DNAPL does not reflect these crystal, and how that interpretation effects the uncertainty in the extent of DNAPL for the FS evaluations.

RESPONSE: Refer to the Response to Comment 4. In light of the information provided in the previous response, neither the designation of DNAPL nor the lines delineating the extent

of known and possible DNAPL on Figures 11 and 12 have been revised based on the occurrence of crystalline and precipitate materials.

6. FLUTe Ribbon staining was also a primary line of evidence used in the Report to indicate the presence of DNAPL. Section 2.2.2 states that the FLUTe ribbon is capable of detecting DNAPL at lower saturations than visual observations, implying a quantitative level of detection that may not exist. As stated in the Report, the drilling technique used during previous investigations (i.e., mud rotary drilling) may have facilitated visual detection of DNAPL. Therefore, EPA recommends rewording this statement (paragraph 3, second sentence) to simply state that the FLUTe ribbon was more sensitive than visual observations during this investigation (i.e., CPT and Rotosonic drilling).

RESPONSE: Section 2.2.2, paragraph 3, second sentence, has been reworded to read: During the current program, DNAPL was often not apparent visually in zones that caused ribbon staining, indicating that the FLUTe ribbon method is more sensitive in detecting DNAPL than visual observation.

7. Analytical laboratory results are used in the Report as a secondary line of evidence, indicating the presence, possible presence, or lack of presence of DNAPL.

a. The Report uses the concept of threshold concentration limits in soil to suggest the presence of DNAPL. Specifically, the Report states that the presence of DNAPL is indicated by chlorobenzene concentrations greater than 1,000 ppmv. The revised Report should provide examples of the theoretical concentration limits of chlorobenzene in soil, for comparison to the selected DNAPL indicator concentrations (i.e., 1,000 milligrams per kilogram [mg/kg]).

RESPONSE: A threshold limit value of 1,000 mg/kg for chlorobenzene based on laboratory results for soil samples was presented in the report, which if exceeded was presumed to be a positive indication of DNAPL presence. This value was selected based on a review of the combined data obtained from the current program. The combined data allowed comparison of laboratory results and OVA results for samples known to contain DNAPL based on FLUTe ribbon staining.

A theoretical threshold value for indicating the “potential” presence of DNAPL can also be calculated using soil, groundwater, and vapor partitioning theory (Feenstra, et al, 1991). If certain soil properties are known or assumed, a theoretical maximum total soil concentration can be calculated for a soil sample under either saturated or unsaturated porewater conditions. Maximum threshold concentrations for chlorobenzene in the vadose zone of 180 mg/kg, and for the saturated zone of 230 mg/kg were calculated and presented in the Montrose Remedial Investigation (RI) Report (EPA, 1998) as a potential indicator of the presence of DNAPL based on the known soil conditions at the site.

The threshold values based on partitioning theory presented in the RI Report have been incorporated into the DNAPL Reconnaissance Report and were subsequently used to evaluate the extent of possible DNAPL based on the DNAPL Reconnaissance Program data. It was found that the use of 180 or 230 mg/kg threshold concentrations only affected the designation of one sample which was collected from below the water table at Boring DP-2 at 78 feet. Because of this, only the saturated zone threshold concentration of 230 mg/kg was

plotted on Figure 9, although both criteria were used to evaluate the chlorobenzene laboratory data for the vadose and saturated zone samples in Tables 2 and 3.

The application of the lower threshold value for chlorobenzene as a potential indicator of DNAPL presence results in one additional soil sample being indicated as having "DNAPL possibly present": boring DP-1 at 79.5 feet. Both of these borings lie within the known DNAPL-impacted area for the saturated zone and, therefore, the change in status of these two borings does not change the interpretation of the extent of DNAPL.

b. Neither the detected concentrations of DDT nor the limits of detection (LODs) for chlorobenzene and DDT were considered as evidence for the presence of DNAPL (even though the Report states the concentration of DDT is directly correlated to the presence of DNAPL; see Section 3.2.1.3). EPA believes the evaluation of analytical laboratory criteria should formally address both detected concentrations and LODs for both chlorobenzene and DDT. Using these criteria, DNAPL would be positively indicated for additional borings, including the following:

i. PSB-15 - in the vadose zone (13 feet bgs), chlorobenzene was reported as LOD<4,000 ppm, and DDT was detected at 13,000 ppm.

ii. SSB-7 - in the saturated zone (89.5 feet bgs), chlorobenzene was reported as LOD<2,000 ppm, and DDT was detected at 6,200 ppm.

iii. SSB-11 - in the saturated zone(78 feet bgs), chlorobenzene was detected at 990 ppm (just below the criterion), and DDT was detected at 1400 ppm ("J" qualified). An OVA reading of 7500 ppmv provides further support that DNAPL is likely present.

The revised Report should interpret both DDT results and LODs (for both chlorobenzene and DDT) greater than the criteria, as indicative of possible DNAPL. Amending the extent of DNAPL to include these interpretations will increase the known DNAPL area for the vadose and saturated zones.

Response: The detection of DDT in soil samples analyzed in the laboratory was further evaluated as a potential indicator of DNAPL. Because DDT can exist as a single component solid and can be present at very high concentrations in soil samples in the absence of DNAPL, a reliable threshold concentration cannot be calculated in the same manner as was done for chlorobenzene. However, it is known that the solubility of DDT in water is relatively low so that the detection of elevated DDT concentrations at depth may indicate the presence of DNAPL or former DNAPL if the volatile component has dissipated. The presence of DDT at concentrations greater than the laboratory detection limit was used to evaluate the sensitivity of the extent of possible DNAPL presented in the DNAPL Reconnaissance Report. A threshold concentration of 60 mg/kg for the sum of detected isomers and metabolites of DDT was selected, which is slightly above the range in the laboratory detection limit for individual DDT analytes (Figure 10). The addition of this lower threshold concentration limit results in four additional soil samples being classified as having possible DNAPL based on the laboratory analysis of DDT.

As indicated by EPA, there were several samples where chlorobenzene and DDT were not detected, that had elevated laboratory detection limits which were substantially in excess of 100 mg/kg. In all of the samples with elevated chlorobenzene detection limits, DDT was

detected at concentrations in excess of the chlorobenzene detection limit. The same was true for samples with elevated DDT detection limits, i.e., chlorobenzene was detected at a higher concentration. All of the samples with elevated detection limits were classified with respect to DNAPL presence according to the higher corresponding detected concentration.

The following addresses the individual samples mentioned by EPA:

i, PSB-15 - in the vadose zone at 13 feet bls: This sample is now classified as "DNAPL present" in the vadose zone based on the detection of total DDT at a concentration of 13,000 mg/kg, which exceeds the 1,000 mg/kg threshold concentration. This has resulted in a slight southward shift in the line delineating known DNAPL in the vadose zone.

ii. SSB-7 - in the saturated zone at 89.5 feet bls: This sample is now classified as "DNAPL present" in the saturated zone based on the detection of total DDT at a concentration of 6,200 mg/kg which exceeds the 1,000 mg/kg threshold concentration. This has resulted in a slight shift in the line delineating known DNAPL in the saturated zone.

iii. SSB-11 - in the saturated zone at 78 feet bls: This sample is now classified as "DNAPL present" in the saturated zone based on the detection of total DDT at a concentration of 1,400 mg/kg J which exceeds the 1,000 mg/kg threshold concentration. This boring was already located within the area of known DNAPL, therefore no shift in the boundary line was required.

8. OVA readings are also used in the Report as a secondary line of evidence to indicate the presence, possible presence, or lack of presence of DNAPL. In the Report, where OVA readings exceed 10,000 ppmv, DNAPL is considered to be present; if OVA results are between 1,500 and 10,000 ppmv, DNAPL is considered to be possibly present. OVA readings less than 1500 ppmv are interpreted to be an indication that DNAPL is not present.

The inclusion or exclusion of locations were DNAPL is considered to be possibly present effects the lateral extent of DNAPL in the vadose zone and saturated zone, and thus FS alternative evaluations. A defensible argument could be made to consider a more conservative (lower) OVA limit of 1,000 ppm for possible DNAPL, based on the data in Figures 9 and 10. In this case, TSB-5, TSB-6, and SSB-13 would be included in the area of possible DNAPL, extending the boundary of possible DNAPL in the saturated zone farther east. Although the impact of this possible change on the final estimates of the extent of DNAPL may be relatively small, it illustrates the uncertainty associated with selecting criteria to indicated DNAPL presence. Therefore, the revised Report should contain an uncertainty, or sensitivity, analysis addressing the effect on the extent of DNAPL were the lower OVA criterion set to 1,000 ppmv, instead of 1,500 ppmv.

RESPONSE: In accordance with EPA's comment, an evaluation was conducted for OVA-FID readings between 1,000 and 1,500 ppmv. There were 11 borings which had OVA-FID readings which fell between 1,000 and 1,500 ppmv. Borings TSB-6, TSB-7, TSB-13, and TSB-14 had corresponding soil samples which were collected from the saturated zone where OVA readings fell within this range. Chlorobenzene was not detected in three of the four samples analyzed in the laboratory and was detected at the detection limit of 35 mg/kg in only one of the samples. DDT was not detected any of the four soil samples analyzed in the laboratory at a detection limit of 35 mg/kg. The lack of detection of DDT

further supports the conclusion that OVA readings in this range are not associated with DNAPL. DNAPL was also not detected based on the FLUTe ribbon at any of the points where OVA readings fell within this range. Thus, based on laboratory data and FLUTe ribbon results, there is no justification for decreasing the OVA reading to 1,000 ppmv.

Furthermore, to put the OVA readings into perspective, it should first be understood that the OVA readings are reported "as methane" and were intended to be used for relative comparison of concentrations. If the OVA concentrations up to 1,500 ppmv as methane were converted to equivalent chlorobenzene concentrations, then the concentrations would be on the order of one third of the concentrations currently shown in the tables and figures in the report. Based on Henry's Law, which describes equilibrium partitioning of a single volatile organic compound between water and vapor, an OVA reading of 1,500 ppmv "as methane" would develop in the headspace above a water sample containing a dissolved chlorobenzene concentration of about 14,000 micrograms per liter (ug/l). Thus, OVA results in the range of 1,000 to 1,500 ppmv can easily be caused by the dissolved groundwater concentrations detected within the upper Bellflower aquitard in the vicinity of the CPA which range up to 400,000 ug/l. Thus, the relatively low OVA concentration of 1,500 ppmv "as methane" is a reasonably conservative threshold concentration for considering DNAPL "possibly present" and we see no justification for decreasing it to 1,000 ppmv based on the available soil data, groundwater concentrations, or FLUTe ribbon results.

Comments on Findings and Conclusions

9. The Report does not identify any boring intervals not tested using the FLUTe ribbon. However, given the reported OVA readings, a positive FLUTe ribbon test would be expected at specific vadose zone depths in several of the borings. For example, neither FLUTe ribbon staining nor visual evidence of DNAPL are indicated on the boring logs for the following borings:

a. PSB-1 - OVA readings were in the percent range from 31 feet to 45 feet bgs, with a maximum reading of 17% at 45 feet bgs. (Analytical data are not available for the vadose zone in this boring.)

b. PSB-4 - OVA readings were in the percent range from 7.5 feet to 22 feet bgs, 32 feet to 35 feet bgs, and 46 feet to 49 feet bgs. Analytical data for both chloroform and DDT were reported as not detected at 26 ft bgs (LOD<31 ppm) and at 39 ft bgs (LOD<40 ppm). However, EPA has noted that the Soil Gas Survey Report (EarthTech, January 2004) indicated that soil gas sampled at 35 feet bgs contained significant concentrations of chloroform and chlorobenzene (approximately 2250 ppmv and 1350 ppmv, respectively).

While a high OVA reading and no FLUTe ribbon staining could be due to soil heterogeneity (e.g., the core being proximal to but not intersecting DNAPL), the revised Report should clarify whether all depth intervals of all borings were successfully tested using FLUTe ribbon, and identify those boring depth intervals not tested (i.e., in text, tables and boring logs).

RESPONSE: The lithologic logs have been updated to indicate where FLUTe ribbon was applied to the core samples. FLUTe ribbon was applied to nearly 100 percent of core samples collected from below the water table since the saturated zone was the primary focus

of the DNAPL Reconnaissance Program. FLUTe ribbon was generally applied to vadose zone core samples whenever field evidence suggested the potential occurrence of DNAPL.

FLUTe ribbon was applied to the core sample from boring PSB-1 from 31 to 45 feet bls where elevated OVA readings were obtained without observing any staining on DNAPL ribbon. In the vadose zone it would not be unexpected to obtain elevated OVA readings while seeing no other evidence of DNAPL, such as elevated laboratory results or FLUTe ribbon staining. This is because organic vapors readily diffuse away from DNAPL zones through the dry sandy soils allowing detection of high associated OVA concentrations in the vicinity of DNAPL zones.

FLUTe ribbon was applied to the core sample from boring PSB-4 from 5 feet to 38 feet bls, and 48 feet bls to the boring's total depth at 94 feet bls. As stated above, it is not unexpected to see high OVA readings in the vadose zone without observing positive evidence of DNAPL using the other screening methods. It should be noted that all OVA readings in excess of 10,000 ppmv were considered positive evidence of DNAPL in the vicinity of the two borings discussed above, even though other evidence of DNAPL was lacking.

10. A thermal remediation system, if implemented, could not be applied in such as way as to exactly cover the irregular shapes of the areas delineated by the "DNAPL Present" and "DNAPL Possibly Present" lines, as shown on Figures 11 and 12. Applying this type of technology would necessitate a "smoothing" of the treatment area boundaries. Therefore, to support the DNAPL FS alternatives evaluation, in the revised Report aerial estimates of the extent of DNAPL should also include estimates addressing the increased area from such "smoothing" (e.g., all areas where DNAPL is indicated as known, or possible, as well as those small areas where the lines of evidence did not indicate DNAPL was known, or possible, but are included due to the smoothing).

RESPONSE: The actual area that will ultimately be addressed by a potential DNAPL remedy will vary depending on the remedial technology that is being considered. The area may vary due to a number of factors, which include the potential irregularity in the distribution of DNAPL. However, we believe that the potential uncertainty and irregularity of the DNAPL-impacted area and its effect on the potential remedy is more appropriately addressed in the DNAPL Feasibility Study in connection with the specific technology being considered. Thus, the extent of areas delineated as "DNAPL Present" and "DNAPL Possibly Present" have not been smoothed.

11. Based on the extent of DNAPL shown in the cross sections and the EVS simulation, significant amounts of DNAPL extend to the base of the UBA. Given that DNAPL has penetrated through overlying clay units in the UBA, it is not unreasonable to assume that some DNAPL may have penetrated though the fine-grained units at the base of the UBA. While available information suggests that DNAPL-impact may be more severe in the UBA than the Bellflower sand, the extent of DNAPL in Bellflower sand has not been investigated to the same degree as the UBA. However, the Report states: "…this and previous investigations indicate that the majority of the DNAPL-impacted zone lies within the saturated portion of the upper Bellflower aquitard overlying the Bellflower sand..." (section 3.2.3, first paragraph). Reference to the Bellflower Sand in this statement implies that the extent of contamination in the UBA and the Bellflower sand have been sufficiently characterized to quantitatively compare them. This investigation did not assess the extent of

DNAPL in the Bellflower sand, therefore such implied conclusions regarding the extent of DNAPL impact in the Bellflower sand should be removed from the Report.

Furthermore, the response to EPA comments on the Draft Reconnaissance Field Sampling Plan (December 23, 2002) states: " a section will be included in the final report that uses the data generated by this planned work along with other existing data to evaluate 1) the potential for DNAPL to be present in the Bellflower sand, 2) to what degree the presence of DNAPL in the Bellflower sand might affect the DNAPL remedy, and 3) if additional borings or assessment in the Bellflower sand are necessary." These have not been addressed in the Report, and should be included in the revised Report.

RESPONSE: The referenced statement from Section 3.2.3 has been reworded to be more factual.

The issue regarding the need for additional deep borings to evaluate the potential occurrence of DNAPL in the Bellflower sand was discussed during a conference call on January 14, 2004, and was further evaluated in a Technical Memorandum prepared by Hargis + Associates, Inc. dated January 23, 2004. Available data regarding the potential presence of DNAPL in the Bellflower sand, as provided in the Technical Memorandum, has been briefly summarized in the report and an evaluation of the need for additional deep soil borings has been included. No additional borings for the purpose of assessing DNAPL in the Bellflower sand are proposed.

Tables and Figures

12. In Table 2, laboratory analytical data found to have less than 1,000 ppm chlorobenzene is noted as "none." This notation is erroneous, as concentrations of chlorobenzene may be present up to 1000 ppm. In the revised report, "none" should be replaced with an accurate alternative such as "<1000 ppm."

RESPONSE: Tables 2 and 3 in the report have been revised to indicate the laboratory analytical result of chlorobenzene and total DDT in the lines of evidence column with the heading "analytical". In the event that either chlorobenzene or total DDT was not detected, the detection limit was provided.

13. The footnotes for Tables 2 and 3 indicate that OVA readings of 1,000 to 10,000 ppm are indicative of possible DNAPL. These values are inconsistent with both the criteria used the text (1,500 to 10,000 ppmv) and those indicated in Figures 9 and 10. This inconsistency between text and tables should be corrected in the revised Report.

RESPONSE: The footnotes on Tables 2 and 3 have been revised to reflect that OVA readings of 1,500 to 10,000 ppmv are indicative of possible DNAPL.

14. In several Figures (e.g., 2, 3, and 5) the property boundary lines and the extent of the CPA do not appear to correlate with each other. During spring of 2004, EPA requested that Montrose revise maps using aerial photographs of the property and surrounding area, to correctly reflect current and historical facility features and property lines. Figures for the revised report should use, or be based on, these revised base maps.

RESPONSE: The figures have been revised to reflect the surveyed property boundary lines and the extent of the CPA.

15. The Revised Report should include a figure showing the locations of the DNAPL borings relative to the historical facility features and areas. This will allow EPA to easily verify statements such as "outside of the CPA to the east and south, DNAPL is not encountered in the vadose zone" (Section 3.2.3, paragraph 5). If borings showing DNAPL (e.g., SSB-4 and PSB-11) are in fact outside of the CPA, the referenced comment should be corrected.

RESPONSE: Figure 2 has been revised to depict the locations of the DNAPL borings relative to the locations of the historical facility features and areas.

16. The title of Figure 10 and the y-axis title do not correlate; the figure title indicates that the subject is chlorobenzene while the Y-axis title refers to DDT. The revise Report should correct this error.

RESPONSE: The title of Figure 10 has been revised to read: DDT Concentration in Soil Samples VS. FID Readings.

17. On Figures 11 and 12, it would be useful to have the maximum OVA readings and chlorobenzene and DDT concentrations for each boring posted. This would allow the reader to assess the sensitivity of the indicators for the extent of known and possible DNAPL.

RESPONSE: The maximum OVA readings and the maximum chlorobenzene and total DDT concentrations, based on laboratory analyses, have been indicated next to the appropriate borings on Figures 11 and 12.

Errata

18. Section 3.2.3, paragraph 2 identifies borings where DNAPL was observed. Boring S303/S303A is not included, but is indicated in red on Figure 12 (indicating DNAPL). This discrepancy should be corrected.

RESPONSE: The symbol for boring S303/S303A on Figure 12 has been modified to indicate DNAPL is not present.

19. In Section 2.0 (page 4), the text states soil samples were collected for EPA's steam injection testing program from four borings in the southeast portion of the Property. However, page 11 of the Report states that samples were collected from three borings, PSB-4, PSB-15, and SSB-2, which are all located in the Central Processing Area (CPA), not the southeast portion of the property. (Soil may also have been collected from boring SSB-6.) The Revised Report should be corrected to accurately reflect the location from which the soil samples were taken.

RESPONSE: Soil samples were collected for the EPA's steam injection testing from the following borings: PSB-4, PSB-15, SSB-2, and SSB-6. The text in Section 2.0 of the report has been revised. Borings PSB-4, PSB-15, SSB-2, and SSB-6 are located within the CPA.

HARGIS + ASSOCIATES, INC.

RESULTS OF DNAPL RECONNAISSANCE INVESTIGATION

MONTROSE SITE

TORRANCE, CALIFORNIA

REVISION 1.0

TABLE OF CONTENTS

Section Page

ACRONYMS AND ABBREVIATIONS iv

1.0 INTRODUCTION 1
1.1 DEFINITION OF TERMS 2
1.2 OBJECTIVES 3
2.0 DNAPL RECONNAISSANCE 4
2.1 OVERVIEW OF FIELD PROGRAM 5
2.2 RECONNAISSANCE INVESTIGATION PROCEDURES 6
2.2.1 VISUAL OBSERVATION 7
2.2.2 FLUTe DNAPL Ribbon 7
2.2.3 LABORATORY ANALYSIS 8
2.2.4 OVA Screening 10
2.2.5 Lithologic Logging and Photographic Logging 11
2.3 OTHER FIELD PROCEDURES 11
2.3.1 Drilling Method Heat Generation 11
2.3.2 Borehole Abandonment 11
2.3.3 Borehole Survey 12
2.3.4 Steam Injection Test Sample Collection 12
2.3.5 Soil Sample Collection 12
2.3.6 Waste Disposal 13
3.0 DISCUSSION AND CONCLUSIONS 14
3.1 STRATIGRAPHY 14
3.2 DNAPL CONFIRMATION 15
3.2.1 Lines of Evidence of DNAPL Occurrence 17
3.2.1.1 Visual Findings 17
3.2.1.2 FLUTe Ribbon Findings 18
3.2.1.3 Laboratory Analyses Findings 18
3.2.1.4 VA Field Screening Findings 19
3.2.1.5 DNAPL Extent Evaluation 20
3.2.2 DNAPL IN VADOSE ZONE 20
3.2.3 DNAPL IN SATURATED UPPER BELLFLOWER AQUITARD 23
3.2.4 POTENTIAL FOR DNAPL IN THE BELLFLOWER SAND 25
3.3 CONCLUSIONS 28
4.0 REFERENCES 31

TABLE OF CONTENTS (continued)

TABLES

Table	
1	CHLOROBENZENE AND DDT CONCENTRATIONS IN SOIL
2	DNAPL IN VADOSE ZONE
3	DNAPL IN SATURATED ZONE

FIGURES

Figure		Drawing Number
1	SITE LOCATION	410-3831A
2	FORMER MONTROSE PLANT FEATURES	410-4584A
3	BORING LOCATIONS	410-4585B
4	EXAMPLES OF FLUTe RIBBON STAINING	810-1974.CDR
5	CROSS SECTION LOCATIONS	410-4523A
6	CROSS SECTION A-A’	310-0552
7	CROSS SECTION B-B’	310-0553
8	CROSS SECTION C-C’	310-0554
9	CHLOROBENZENE CONCENTRATION IN SOIL SAMPLES VS FID READINGS	HYDROGRAPH
10	DDT CONCENTRATION IN SOIL SAMPLES VS FID READINGS	HYDROGRAPH
11	DNAPL IN VADOSE ZONE	410-4918A
12	DNAPL IN SATURATED UPPER BELLFLOWER AQUITARD	410-4919A

TABLE OF CONTENTS (continued)

Figure		Drawing Number
13	BELLFLOWER SAND SOIL BORINGS	310-0599.cdr

APPENDICES

(ON CD ROM)

Appendix	
A	BORING LOGS
B	PHOTOGRAPHS
C	LABORATORY DATA
D	EVS ANIMATION

ACRONYMS AND ABBREVIATIONS

bls	Below Land Surface
CPA	Central Process Area
CPT	Cone Penetrometer Test
DDD	Dichlorodiphenyldichloroethane
DDE	Dichlorodiphenyldichloroethylene
DDT	Dichlorodiphenyltrichloroethane
DNAPL	Dense Non-Aqueous Phase Liquid
EPA	U.S. Environmental Projection Agency
FID	Flame ionization detector
FLUTe	Flexible Liner Underground Technologies, Ltd. Co.
FSP	Field Sampling Plan
H+A	Hargis + Associates, Inc.
ml	milliliter
mg/kg	milligrams per kilogram
Montrose	Montrose Chemical Corporation of California
OVA	Organic vapor analyzer
ppm	Parts per million (volume)
PID	photoionization detector
Property	Area within the fenced property boundary located at 20201 South Normandie Avenue, in Los Angeles (near Torrance), California
Site	Montrose Chemical Corporation of California Site

RESULTS OF DNAPL RECONNAISSANCE INVESTIGATION
MONTROSE SITE
TORRANCE, CALIFORNIA
REVISION 1.0

1.0 INTRODUCTION

This report has been prepared by Hargis + Associates (H+A) for Montrose Chemical Corporation of California (Montrose) to present the results of a qualitative assessment of the occurrence of Dense Non-Aqueous Phase Liquid (DNAPL) within the vadose zone and upper Bellflower aquitard at the Montrose Site (Site) located at 20201 S. Normandie Avenue, Torrance, California (the Site) (Figures 1 and 2). For the purpose of this report, this program will be referred to as the DNAPL Reconnaissance Program. This report summarizes the occurrence of DNAPL found at the Montrose Property and provides estimates of the extent of the DNAPL-impacted area to be used in the DNAPL Feasibility Study. Additionally, lithologic data obtained during this assessment has enhanced the level of understanding of subsurface geology at the Site, which influences the distribution and mobility of DNAPL in the subsurface.

During this investigation, a total of 61 borings were drilled and sampled in the vicinity of the former central processing area of the Montrose Property (Figure 3). The field program was started on May 6, 2003, using a Cone Penetrometer Test (CPT) rig. However, the program was halted on May 14, 2003, due to difficulties with sample recovery. Field work was halted to allow review of the data collected and to evaluate alternate drilling and sampling methods. Upon completion of this evaluation, the sonic drilling method was selected to continue the DNAPL Reconnaissance Program. Remaining fieldwork was conducted in two phases. Field work resumed using the sonic drill rig on October 7, 2003, and proceeded through December 4, 2003. Field work was then halted to allow the data that had been collected to be compiled and evaluated in order to determine how best to complete the field program. Field work again resumed on January 19, 2004, and was completed, with the exception of one remaining off-Property boring on February 4, 2004. Access was eventually obtained and the off-Property

boring was completed on August 29, 2004. The results from the off-property boring have been incorporated into this report.

The DNAPL Reconnaissance Investigation focused on DNAPL, consisting primarily of chlorobenzene and dichloro-diphenyl-trichloroethane (DDT), which is found within and surrounding the former Central Processing Area (CAP) on the Montrose Property. If other sources of DNAPL are discovered on the Montrose property then the results of the additional DNAPL characterization work will be presented in an addendum to this report.

The work has been performed in accordance with the DNAPL Reconnaissance, Field Sampling Plan (FSP) dated April 3, 2003 (H+A 2003a), subsequent technical memoranda (H+A 2003b; 2003c; and 2004a) and multiple discussions with U.S. Environmental Protection Agency (EPA) and California Environmental Protection Agency, Department of Toxic Substances Control during the drilling phase of the program.

1.1 DEFINITION OF TERMS

To facilitate the discussion within this document, several defined terms are used as described below. For clarity of discussion only, this report will refer to the “Property” as the area within the fenced property boundary located at 20201 South Normandie Avenue, in Los Angeles, near Torrance, California. The term "central process area" (CPA) refers to an approximately 2-acre portion of the Property where most of the manufacturing operations were historically performed (Figure 2).

In addition, unless specifically noted, the term DDT or total DDT will be used to refer to the sum of DDT, DDE (dichlorodiphenyldichloroethylene), and DDD (dichlorodiphenyldichloroethane) concentrations.

Throughout this document, the term “DNAPL” refers only to an actual non-aqueous phase. Hence, “liquid DNAPL” would be redundant, and “dissolved DNAPL” would be contradictory.

The term "DNAPL-impacted zone" refers to the area where DNAPL has been observed at the Property in the vadose zone and/or in the upper Bellflower aquitard.

1.2 OBJECTIVES

As stated in the FSP, the objectives of this investigation are to collect data concerning the distribution of DNAPL at the Site, and to provide soil samples for steam injection testing (H+A, 2003a). Specific objectives for the field investigation are as follows:

- Obtain data sufficient to refine current estimates of the lateral extent of DNAPL within the vadose zone and upper Bellflower aquitard at the Site.
- Obtain data sufficient to refine current estimates of the vertical distribution of DNAPL within the upper Bellflower aquitard at the Site.
- Further characterize the lithology of the upper Bellflower aquitard.
- Obtain soil samples and DNAPL for the steam injection testing program to be conducted by the EPA.

2.0 DNAPL RECONNAISSANCE

The DNAPL reconnaissance program consisted of the drilling and sampling of 61 soil borings (Figure 3). Multiple lines of evidence have been used during the previous and current investigations to assess the presence of DNAPL at the Property. The primary lines of evidence are the occurrence of DNAPL in wells, the visual observation of DNAPL, and the staining of DNAPL on a hydrophobic dye-impregnated fabric. Secondary lines of evidence include laboratory data and organic vapor analyzer (OVA) readings which provide indirect evidence of DNAPL, and may be useful in conjunction with one or more lines of evidence to estimate the extent of DNAPL in the subsurface.

The presence of DNAPL in soil borings drilled during the DNAPL Reconnaissance Program was evaluated using the following lines of evidence:

Primary:

- Visual observation
- Staining of hydrophobic dye-impregnated fabric

Secondary

- Laboratory analysis of soil samples
- Field OVA screening of soil cores

The occurrence of DNAPL in wells was used with these lines of evidence to evaluate the occurrence of DNAPL at the Site.

Soil samples were also obtained for EPA's steam injection testing program. Samples were collected from borings PSB-4, PSB-15, SSB-2, and SSB-6, within the CPA at the request of EPA during this program and are not a part of the DNAPL reconnaissance program.

2.1 OVERVIEW OF FIELD PROGRAM

The FSP, based on available DNAPL occurrence data, originally planned the installation of 32 primary borings and up to 23 optional secondary or "step-out" borings to define the limits of DNAPL occurrence. The intent was to use a CPT rig to collect continuous soil samples starting at approximately 60 feet below land surface (bls), which is about 5 feet above the current water table, to a maximum depth of 95 feet bls. In addition, selected additional vadose zone CPT borings were planned once the primary and any necessary secondary CPT borings had been completed.

Field sampling activities commenced on May 6, 2003, using the CPT drilling technique. A 35-ton CPT rig was used to advance a direct-push soil sampler. Soil samples were collected by advancing the sampling tool approximately 4 feet, then removing the tool to retrieve the sample. Once the soil sample was retrieved, the device was tripped back down hole and advanced 4 more feet. This sampling method was repeated until the target total depth or refusal was encountered. A total of 12 primary soil borings, DP-1 through DP-12, were attempted using the direct-push soil sampling method (Figure 3). Of these 12 borings only 11 were advanced below the water table. Boring DP-6 was terminated near land surface due to refusal. The CPT program encountered two significant problems:

- The percentage of core recovered was less than expected. Core recovery in the direct-push soil borings ranged from 50 to 80 percent.

- The CPT rig was consistently unable to reach the target depth of 95 feet. Only two of the 12 borings reached 95 feet. Refusal was generally encountered at a depth of approximately 90 feet bls, or less. Lithologic logs for the CPT borings, which also indicate the total depth achieved, are provided in Appendix A.

The DNAPL reconnaissance program was halted on May 14, 2003 to address these problems, and after review of alternative drilling methods was completed, a drilling program utilizing sonic drilling was proposed (H+A 2003b). Since the sonic drilling method provides continuous core samples from the land surface to the target depth, sampling and evaluation of the vadose zone soils for all of the sonic borings was added to the DNAPL reconnaissance program.

The DNAPL reconnaissance program resumed on October 7, 2003, utilizing a sonic rig in accordance with the original FSP supplemented by technical memoranda (H+A 2003a; 2003b; 2003c; 2004a). Soil samples were collected from land surface to the water table by advancing the 6-inch core barrel between 2 and 10 feet per core run. Soil core was then extruded into plastic bags. When the water table was encountered, a 5.5-inch diameter conductor casing was installed and the boring was continued using a 4-inch diameter core barrel. After each core run, the conductor casing was advanced through the cored interval to prevent the hole from caving.

Large areas of the Property including much of the CPA were built up with fill to form large pads for future warehouses that are about three feet higher than the rest of the Property. The target total depth of the soil borings drilled on top of the fill pads was 95 feet bls and for borings drilled off the fill pads was 92 feet bls.

When the sonic drilling program began, primary borings and secondary borings were identified. Primary borings are those that were drilled first to assess the general area around the CPA and other specific potential former source locations. Secondary borings were “step out” borings that were drilled based on information from the primary borings to extend the investigation laterally outward, as necessary. Tertiary borings were “step out” borings that were drilled based on information from the secondary borings to determine the extent of DNAPL, as necessary. A total of 49 sonic borings including 19 primary soil borings PSB-1 to PSB-19, 15 secondary soil borings SSB-1 to SSB-15, and 15 tertiary soil borings TSB-1 to TSB-15 were completed using the sonic drilling method (Figure 3). One additional tertiary boring to the north of the Property remains to be installed. Installation during the main drilling program was not possible due to the time necessary to arrange for property access. An addendum to this report will be prepared providing the results of this pending work.

2.2 RECONNAISSANCE INVESTIGATION PROCEDURES

The following investigation and identification techniques were used in accordance with the FSP to assess the presence of DNAPL in the subsurface.

2.2.1 VISUAL OBSERVATION

This method was the primary field technique used to identify DNAPL zones during previous soil sampling programs, which were conducted in the CPA in 1988 using mud-rotary coring techniques. During the previous soil sampling programs DNAPL was frequently observed in core samples as a purplish sheen, typically occurring as thin layers within sand zones perched on top of finer-grained silty intervals. During the current field program, visual evidence of DNAPL was observed less frequently. This may be due to the change in the drilling technique or lower overall DNAPL saturations within the soil in the areas investigated during the current sampling program. The current program focused on surrounding areas, which are further from the principal DNAPL source area.

After the core was extracted from the core barrel, it was immediately laid out, sliced open along the axis, and visually inspected for the presence of DNAPL. Observations regarding sheen, staining, or discoloration of the core that is indicative of DNAPL was noted in the lithologic logs (Appendix A).

2.2.2 FLUTe DNAPL Ribbon

Soil samples were also screened in the field for the presence of DNAPL using a ribbon of hydrophobic dye-impregnated fabric manufactured by Flexible Liner Underground Technologies, Ltd. Co. (FLUTe). This method of DNAPL detection was developed in the last several years and was not available for use during the previous investigations in the CPA. The FLUTe ribbon is used to find layers of DNAPL trapped in the formation that may not be visible to the eye. The FLUTe ribbon consists of a fabric that reacts with DNAPL to produce a stain on the fabric where it encounters DNAPL.

FLUTe ribbon was applied to nearly 100% of core samples collected from below the water table since the saturated zone was the primary focus of the DNAPL Reconnaissance Program. FLUTe ribbon was generally applied to vadose zone core samples whenever field evidence

suggested the potential occurrence of DNAPL. The lithologic logs indicate the intervals where FLUTe ribbon was applied (Appendix A).

Immediately after the soil core samples were cut lengthwise and visually inspected the FLUTe ribbon was applied to the cut surface and the core halves were then pressed back together. This allowed any DNAPL in the core interior to come into direct contact with the FLUTe ribbon and react with the dye in the fabric. The FLUTe ribbon was then inspected for staining that would indicate the presence of DNAPL (Figure 4).

As with direct visual observation, this method provides positive confirmation of DNAPL presence in the core. During the current program DNAPL was often not apparent visually in zones that caused ribbon staining, indicating that the FLUTe ribbon method is more sensitive in detecting DNAPL than visual observation. Following a positive FLUTe ribbon test, the stained FLUTe ribbon was photographed and recorded (Appendix B). Positive FLUTe ribbon results are also recorded on the lithologic logs (Appendix A).

2.2.3 LABORATORY ANALYSIS

Confirmation soil samples were collected for laboratory analysis of chlorobenzene and DDT for the purpose of confirming the presence of DNAPL detected based on visual and FLUTe ribbon field screening results. If DNAPL is present in a soil sample, then the concentration of chlorobenzene detected in the laboratory analysis should exceed the theoretical threshold concentration representing the total mass associated with the sorbed, vapor, and dissolved porewater phases in the soil sample (Feenstra, et al, 1991). Theoretical maximum soil concentrations were presented in the Montrose Remedial Investigation Report (EPA, 1998) for both vadose and saturated soil samples based on soil conditions at the Montrose Property. The maximum threshold concentrations for chlorobenzene were 180 mg/kg and 230 mg/kg for vadose zone and saturated zone soils, respectively (EPA, 1998). These theoretical threshold values, based on partitioning theory, were used for indicating the “potential” presence of DNAPL in vadose and saturated soils during this investigation.

Confirmation soil samples were collected both from core intervals that exhibited positive visual or FLUTe ribbon evidence of DNAPL, and from intervals where these tests did not indicate the presence of DNAPL in order to evaluate potential false negatives.

At a minimum, two confirmation samples were collected per boring. Laboratory samples were collected from the interior of the core using Terra Core™ samplers, and were immediately transferred to a 40-milliliter (ml) glass vial, pre-preserved with 10 ml of methylene chloride. Sample vials were weighed to the nearest 0.01 gram in the field prior to and after sample collection to obtain the sample wet weight. Soil samples were submitted to Del Mar Analytical, a State of California certified laboratory, for analysis of DDT and chlorobenzene using modified EPA Method 8270C. Analytical results are summarized in Table 1, and laboratory reports are provided in Appendix C. When non-aqueous phase liquid is present in a soil sample, accurate moisture content cannot be determined because drying simultaneously removes both the pore water and the NAPL. Therefore, laboratory results for these samples are reported as wet weight.

Several samples had elevated laboratory detection limits which were substantially in excess of 100 mg/kg. In all of the samples with elevated chlorobenzene detection limits, total DDT was detected at concentrations in excess of the chlorobenzene detection limit. The same was true for samples with elevated DDT detection limits i.e. chlorobenzene was detected at a higher concentration. All of the samples with elevated detection limits were classified with respect to DNAPL presence according to the higher corresponding detected concentration. Laboratory results were verified and validated to determine if they meet QC criteria as presented in the Quality Assurance Project Plan. The quality and appropriate use of the data obtained were determined based on the results of routine assessment of 100 percent of the data, on the results of Tier 2 validation procedures performed on 100 percent of the soil sampling analytical data, and on the results of Tier 3 validation procedures performed on 20 percent of the soil sampling analytical data. Data qualifiers were assigned where applicable (Table 1). Laboratory Data Consultants, Inc. (LDC), Carlsbad, California, completed assessment and validation of the soil data. Original assessment and validation reports compiled by LDC are being retained by H+A for Montrose and are available upon request.

2.2.4 OVA Screening

Organic vapor concentrations from soil samples were also measured in the field to provide screening-level information regarding the potential presence of DNAPL. OVA meters are sensitive to a variety of VOCs and the meter sensitivity varies from compound to compound. Because of this and due to the imprecision of the screening technique and the lack of a specific concentration threshold related to the presence of DNAPL, OVA results do not provide conclusive evidence regarding the presence or absence of DNAPL. However, these results can be useful in conjunction with one or more lines of evidence to estimate the potential extent of DNAPL in the subsurface.

Soil samples were screened for organic vapors with a combination OVA meter which incorporated both a flame ionization detector (FID) and a photoionization detector (PID). The PID and FID detectors were calibrated to 100 parts per million vapor (ppm) isobutylene and methane respectively. Although organic vapors from soil samples containing DNAPL are detectable with both a PID and FID it appears that the FID detector gave more reliable results at the higher concentrations associated with DNAPL. In addition, the FID is less likely to be affected by soil moisture.

As soon as possible after sample retrieval and handling, soil sub samples were obtained from the core and placed in a quart-size plastic bag and sealed, allowing volatile contaminants in the soil to diffuse into the air space inside the bag. The OVA probe was then inserted by puncturing the side of the bag, which maintained the integrity of the seal. Vapor concentrations in the plastic bags were measured within minutes of sealing and both FID and PID readings were recorded. OVA readings are provided on the lithologic logs (Appendix A). OVA screening was performed approximately every one to two feet and at intervals more likely to contain DNAPL such as transitions from sand to fine-grained soil.

It should also be noted that FID concentrations are reported “as methane” in this report. The FID meter is actually considerably more sensitive to chlorobenzene than to methane. If the FID reading could be assumed to be based solely on chlorobenzene then the true vapor concentration would be on the order of one third of the concentration indicated in this report, as

long as the reported "as methane" concentration was less than about 1,500 ppm. At higher reported methane-based concentrations the reduction required to correct to chlorobenzene would be even greater due to the non-linearity of the meter at elevated concentrations.

2.2.5 Lithologic Logging and Photographic Logging

A lithologic log was prepared for each boring based on the United Soils Classification System. Lithologic logs are presented in Appendix A.

Pursuant to a request from EPA, the core from several borings was photographed to document the lithology of the upper Bellflower aquitard. Photographic logs of soil borings PSB-5 through PSB-7, PSB-13 through PSB-17, SSB-6 through SSB-8, SSB-10, and TSB-2, are presented in Appendix B.

2.3 OTHER FIELD PROCEDURES

2.3.1 Drilling Method Heat Generation

Under certain conditions, the sonic drilling method has the potential to heat the soil core, which could increase the volatilization rate of chlorobenzene and affect the ability to detect DNAPL. To minimize this possibility, soil sample temperatures were monitored regularly during the sonic drilling program. Upon retrieval of soil core, a thermometer was placed into the soil sample and the soil core temperature was recorded. In accordance with the FSP, when core temperatures exceeded 140°F the driller adjusted the drilling rate and/or shortened the length of the core runs to reduce the core temperature.

2.3.2 Borehole Abandonment

Upon completion of each boring, the borehole was immediately pressure grouted from the bottom of the borehole to land surface with a slurry of 60 percent Portland Type G neat cement

to 40 percent silica flour. The grout was mixed to the manufacturer's specifications and weighed to ensure proper mix proportions prior to grouting. This slurry mix was chosen because of its ability to withstand the heat and pressure that might occur if a thermal remedy is implemented at the Site.

2.3.3 Borehole Survey

The location and elevation of soil borings drilled during this investigation were surveyed during December 2003, and March 2004, and September 2004. Elevations are based on the nearest City of Los Angeles bench mark located near the east curb of Normandie Avenue, approximately 38 feet south of Francisco Street. Dulin and Boynton, Signal Hill, California, a licensed surveyor, performed the survey work.

2.3.4 Steam Injection Test Sample Collection

Soil samples were collected from borings PSB-4, PSB-15, SSB-2, and SSB-6, and provided to EPA for their use in a Thermal Treatability Study using Steam Injection (Figure 3). Samples were collected from intervals where DNAPL was positively identified using FLUTe ribbon. These soil samples were collected and placed in unpreserved 4-ounce glass jars. Eva Davis of the EPA was at the Property on November 5 and 6, 2003, to observe the field program and aid in sample collection.

2.3.5 Soil Sample Collection

Soil samples in addition to those planned in the FSP were collected at secondary soil boring location SSB-15; and tertiary soil boring locations TSB-4, TSB-14, and TSB-15 (Figure 3). These additional soil samples were collected and analyzed at the request of EPA to provide additional data to support the Soil Feasibility Study. Soil samples at these boring locations were collected at 1, 3, 5, 7, 10, 20, 30, 40, 50, 60, 70, 80, and 90 feet bls, and analyzed for volatile organic compounds using EPA Method 8260B and organochlorine pesticides using EPA

Method 8081. Results of these additional analyses have been provided to EPA under separate cover (H+A, 2004c).

2.3.6 Waste Disposal

Soil cuttings and investigation-derived waste were stored at the Property during drilling operations in 20-yard, covered, roll off bins. Ecology Control Industries, Torrance, California, provided the roll off bins, waste characterization, and transportation of the bins to US Ecology, Beatty, Nevada, for disposal.

3.0 DISCUSSION AND CONCLUSIONS

3.1 STRATIGRAPHY

The stratigraphy of the Site starting from land surface consists of fill material, the recent Playa deposits, the Palos Verdes sand, the Bellflower aquitard, the Gage aquifer, an unnamed aquitard, and the Lynwood aquifer. This investigation focused on the vadose zone and the upper Bellflower aquitard, and thus a discussion of the deeper units is not provided. For more information about these deeper units at the Site, the reader is referred to the Remedial Investigation report and the DNAPL Feasibility Study report (EPA, 1998; H+A, 1999).

Additional detailed stratigraphic data were obtained in the area surrounding the CPA from the continuous core samples obtained during the DNAPL Reconnaissance program. Locations of the cross sections are illustrated on Figure 5. Three cross sections have been prepared to illustrate the lithologic data collected during the DNAPL Reconnaissance Program (Figures 6 through 8). Stratigraphy encountered was similar to what was observed during previous soil sampling programs conducted at the CPA.

Fill material consisting of moderately to highly plastic dark brown clay with occasional brick and concrete debris is generally encountered from land surface to approximately 4 feet bls. On the pads, fill material is generally encountered from land surface to approximately 8 feet bls. At soil borings S101A and PSB-16 located at the in the former water recycling pond in the CPA, fill material is approximately 20 and 13 feet thick, respectively (Figure 8). The Playa deposits, consisting of olive-brown silty sand, sandy silt, and silt are generally encountered beneath the fill material to a depth of approximately 22 feet bls. The Palos Verdes sand, consisting of a fine-grained, light yellowish brown to light olive-brown, well sorted sand, is generally encountered to a depth of approximately 44 feet bls. A well-cemented fossiliferous sand is encountered at the base of the Palos Verdes sand. This cemented fossiliferous sand is thickest in the western portions of the Property near soil boring location SSB-9, and appears to dip slightly and pinch out toward the east. The thickness of this unit in the western portion of the

Property was approximately 8 feet and was approximately 2 feet in the eastern portion of the Property.

The upper Bellflower aquitard underlies the Palos Verdes sand. The first groundwater beneath the Site is encountered within the upper Bellflower aquitard at a depth of approximately 60 feet bls. During this investigation approximately 50 feet of the upper Bellflower aquitard was encountered, since borings generally were completed between 92 and 95 feet deep. The upper 25 to 28 feet of the unit is predominantly fine-grained sand with occasional discontinuous silty sand and silt interbeds. The lower 22 to 25 feet of the upper Bellflower aquitard encountered during this investigation, consists of a heterogeneous mixture of fine-grained sand, silty sand, fossiliferous sand, and silt. These sediments are interbedded, discontinuous, and variable in thickness. Sand deposits in the lower 22 to 25 feet are generally well sorted and are approximately 0.1 foot to 4 feet thick. The silt deposits generally range in thickness from approximately 0.1 foot to 4 feet. The silt zones encountered were typically void of sand, firm to hard, and low to non-plastic. Fine- to coarse-grained, non-cemented, fossiliferous sand and fossiliferous silty sand is encountered 75 to 90 feet bls. Continuous core data from closely spaced soil borings drilled throughout the Property indicate that individual interbeds of silt and sand, although similar in character, do not generally correlate between borings.

3.2 DNAPL CONFIRMATION

Multiple lines of evidence have been used during the previous and current investigations to assess the presence of DNAPL at the Property. The primary lines of evidence are the occurrence of DNAPL in wells, the visual observation of DNAPL, and the staining of DNAPL on a FLUTe ribbon. Secondary lines of evidence include laboratory data and OVA readings which provide indirect evidence of DNAPL, and may be useful in conjunction with one or more lines of evidence to estimate the extent of DNAPL in the subsurface.

DNAPL has historically been observed in five wells at the Property. DNAPL accumulates in well MW-2, UBT-1, UBT-2, UBT-3 and UBE-1. In prior investigations at the Site, DNAPL was also observed in soil core samples as an iridescent oily or purple sheen occurring as thin layers in

sand beds overlying silt or clay layers. During the current investigation, the presence of DNAPL was assessed based on the primary lines of evidence, which included visual observation and FLUTe ribbon staining. Secondary lines of evidence were provided by laboratory analysis of confirmation soil samples and OVA screening. In evaluating the various lines of evidence for assessing DNAPL occurrence the following guidelines were used:

Method	DNAPL Not Present	DNAPL Possibly Present	DNAPL Present
Primary			
Visual	Not Visible	Not Visible	Oily Sheen
FLUTe Ribbon	No Staining	No Staining	Ribbon Staining
Secondary			
Laboratory Results	<180 /<230 mg/kg of Chlorobenzene in the vadose/saturated zones or < 60mg/kg of total DDT	180/230 mg/kg to <1,000 mg/kg of Chlorobenzene in the vadose/saturated zones or 60 to <1,000 mg/kg of total DDT	≥1,000 mg/kg of Chlorobenzene or ≥1,000 mg/kg of total DDT
OVA readings	<1,500 ppm	1,500 to <10,000 ppm	≥10,000 ppm

Note: mg/kg = milligrams per kilogram
ppm = parts per million volume

A summary of the DNAPL data obtained for each boring is presented in Tables 2 and 3. Table 2 summarizes the DNAPL data within the vadose zone, and Table 3 summarizes the DNAPL data for the saturated portion of the upper Bellflower aquitard.

As an aid in evaluating the occurrence of DNAPL in the subsurface, a three-dimensional (3-D) visualization of the DNAPL impacted area has been prepared using Environmental Visualization System software developed by C Tech Development Corporation Software. The software was used to create a 3-D visualization of lithologic data collected from the soil borings and previously collected lithologic logs, geophysical data collected within the zone of interest, and the location of detected DNAPL in relation to the lithologic and geophysical data. An animation using this software program has been provided (Appendix D). To aid the reader a “Play by Play” file has also been provided.

3.2.1 Lines of Evidence of DNAPL Occurrence

3.2.1.1 Visual Findings

Visual evidence of DNAPL was only observed in a few samples during the DNAPL reconnaissance, whereas an oily sheen was often observed in soil samples collected beneath the CPA during prior investigations. This difference may be due to lower overall DNAPL saturations away from the source area or may be due in part to a change in drilling technology. Previous DNAPL work at the Site used mud rotary drilling, whereas the current work utilized either a CPT or sonic drilling. The presence of the drilling mud may have facilitated the visual detection of the DNAPL sheen.

Several types of crystalline and white precipitate material were also observed on or within the core samples during the DNAPL Reconnaissance Investigation. This crystalline material could be related to common naturally occurring minerals such as gypsum or calcite, to non-volatile organic compounds such as pCBSA, or to DDT crystals that precipitated from DNAPL as the chlorobenzene volatized in the vadose zone. The majority of the observations of crystalline material were from the vadose zone at depths of less than 30 feet bls. The two instances of crystalline material being observed below the water table were at or near confirmed DNAPL.

Overall, visual observation of white crystals or precipitate did not appear to provide reliable evidence of DNAPL within the vadose zone. Many of the observations were from shallow depths or near the former water recycling pond. Occasionally, the OVA-FID concentration associated with the crystalline material was well below the threshold that indicates the potential presence of DNAPL. Given the relatively shallow depth and the proximity to the former pond, the presence of the crystalline material where OVA concentrations are low is more likely related to either former DNAPL that has since volatilized, or to the precipitation of non-volatile organic compounds such as pCBSA from water associated with the former recycling pond.

Because of the uncertainty in the source or origin of the crystalline and precipitate material, notations of crystals and precipitates have not been included in the visual evidence column in the lithologic logs, but have been retained in the text of the logs.

3.2.1.2 FLUTe Ribbon Findings

Staining of a FLUTe ribbon also indicates the presence of DNAPL. During this study, FLUTe staining was often observed in zones where visual evidence of DNAPL was not apparent. FLUTe ribbon therefore appears to provide the best indication of the location and distribution of DNAPL in the subsurface for the current investigation.

3.2.1.3 Laboratory Analyses Findings

Laboratory analyses for chlorobenzene and DDT were performed on soil samples as noted above. Laboratory results indicate that chlorobenzene and total DDT concentrations typically exceed 1,000 milligrams per kilogram (mg/kg) in zones where DNAPL staining of the FLUTe ribbon was observed (Figure 9 and 10). Because of this, chlorobenzene and DDT concentrations of 1,000 mg/kg or greater are considered positive evidence of DNAPL occurrence. In areas where DNAPL was not directly observed, chlorobenzene was generally detected in laboratory analyses of soil samples at concentrations less than 1,000 mg/l or was not detected at all. This relationship is also true for total DDT (Figure 10).

As described in Section 2.2.3, a maximum threshold concentrations for chlorobenzene in the vadose zone of 180 mg/kg, and for the saturated zone of 230 mg/kg was used to define areas where DNAPL may possibly be present. These concentrations were published in the Montrose RI report (EPA, 1998) and are based on soil property data obtained from the Montrose site. It was found that the use of 180 or 230 mg/kg threshold concentrations only affected the designation of one sample which was collected from below the water table. Because of this, only the saturated zone threshold concentration of 230 mg/kg was plotted on Figure 9, although both criteria were used to evaluate the chlorobenzene laboratory data for the vadose and saturated zone samples in Tables 2 and 3.

3.2.1.4 VA Field Screening Findings

Laboratory results for total DDT were also used for defining areas where DNAPL may possibly be present. Because DDT can exist as a single component solid and can be present at very high concentrations in soil samples in the absence of DNAPL, a reliable threshold concentration cannot be calculated in the same manner as was done for chlorobenzene. However, it is known that the solubility of DDT in water is relatively low so that the detection of elevated DDT concentrations at depth may indicate the presence of DNAPL or former DNAPL if the volatile component has dissipated. The presence of DDT at concentrations greater than the laboratory detection limit was used to estimate the extent of possible DNAPL presented in the DNAPL Reconnaissance Report. A threshold concentration of 60 mg/kg for total DDT was selected, which is slightly above range in the laboratory detection limits for individual DDT analytes (Figure 10).

An OVA was used to screen soil samples for organic vapors as noted above. FID readings appear to be more reliable than PID readings in the high concentration range, as discussed previously, and since they are less likely to be affected by soil moisture. When FID readings are compared to analytical results and FLUTE ribbon results (Figure 9), the data suggest that FID readings between 1,500 and 10,000 ppm may be indicative of possible DNAPL presence, and that concentrations exceeding 10,000 ppm indicate DNAPL presence.

OVA readings were intended to be used for relative comparison of vapor concentrations. To put the OVA-FID readings into perspective, it should first be understood that the FID readings are reported “as methane”. The FID meter response to chlorobenzene, however, happens to be substantially greater than that of methane and becomes non-linear at higher concentrations. Therefore, if the OVA concentrations up to about 1,500 ppm “as methane” were converted to equivalent chlorobenzene concentrations, then the concentrations would be about one third of the concentrations shown in the tables and figures in the report.

Based on Henry’s Law, which describes equilibrium partitioning of a single VOC between water and vapor, an FID reading of 1,500 ppm “as methane” would occur in the headspace above a water sample containing a dissolved chlorobenzene concentration of about 14,000 ug/l. Thus,

OVA results in the range of 1,000 to 1,500 ppm as methane can easily be caused by the dissolved groundwater concentrations detected within the upper Bellflower aquitard in the vicinity of the CPA which range up to 400,000 ug/l. Thus, a FID concentration of 1,500 ppm "as methane" is a reasonably conservative threshold concentration for considering DNAPL "possibly present".

3.2.1.5 DNAPL Extent Evaluation

The estimated extent of DNAPL in the vadose zone and below the water table in the upper Bellflower aquitard is presented below. The extent of DNAPL based on confirmed presence of DNAPL using the primary lines of evidence of visual evidence, FLUTe ribbon and occurrence of wells is illustrated on Figures 11 and 12. In addition, the possible extent of DNAPL based on secondary lines of evidence of laboratory analytical results or OVA readings is also illustrated on Figures 11 and 12.

Depending on the type of technology being evaluated during the DNAPL FS, it may be more appropriate to use confirmed presence of DNAPL versus the possible extent of DNAPL. For instance when evaluating a thermal technology it may be more appropriate to use the possible extent of DNAPL occurrence, since a thermal technology is targeting both residual as well as mobile DNAPL. Conversely, it may be appropriate to use the confirmed extent of DNAPL in evaluating a primary pumping technology since this technology requires DNAPL to be mobile which is more likely to be the case in the area of confirmed DNAPL presence.

3.2.2 DNAPL IN VADOSE ZONE

DNAPL has been positively identified in the vadose zone beneath the CPA in the playa deposits, Palos Verdes sand and in the upper Bellflower aquitard (Figures 6 through 8). The result of this and previous investigations indicate that the lateral extent of DNAPL within the vadose zone is limited to the vicinity of the CPA with two exceptions (Figure 11). DNAPL was positively identified in the vadose zone in one boring just outside of the CPA near the northeast corner of the CPA where chlorobenzene product was unloaded and stored (Figure 2). DNAPL

is possibly present in the vadose zone in a second localized area immediately southeast of the CPA.

During previous investigations, DNAPL was visually observed in the borings drilled for test wells UBT-1, UBT-2, and UBT-3, but was not visually observed in the other soil borings drilled in the CPA (Figure 11). However, analytical data indicate that DNAPL was probably present in the vadose zone in historical soil borings S-101/101A, S-201, S-204, S-301/301A/301B, S-302E/S302F, S-304/304A, S-305/305A, and MW-2 (Figure 11). Note that these borings were drilled in 1988 using two different types of drilling techniques and thus, alphabetical identifiers were added to distinguish between the borings.

During the DNAPL reconnaissance program, vadose zone soil data were collected in 50 borings drilled using the sonic drilling method (Figure 11). Vadose zone soil data were not collected from the 11 initial direct push borings. Six of the fifty soil borings where vadose zone samples were collected indicated the presence of DNAPL based on one or more lines of evidence (Table 2). DNAPL was positively detected in three of the five borings, PSB-5, SSB-4, and SSB-7, based on positive FLUTe ribbon test results (Table 2). Positive FLUTe ribbon results were obtained from depths ranging from 7.75 to 17.5 feet bls, and 56.75 to 57.75 feet bls (Appendix A). In each of these three borings, there was also a secondary line of evidence of DNAPL (Table 2).

Four borings, PSB-1, PSB-4, PSB-5, and SSB-4, also exhibited positive evidence of DNAPL based on OVA readings greater than 10,000 ppm (Table 2, Figure 11, Appendix A). Six borings have possible evidence of DNAPL based on OVA readings between 1,500 ppm and 10,000 ppm (Table 2).

Three cross sections that illustrate the lithology of the DNAPL impacted zone and evidence of DNAPL based on the primary lines of evidence which include visual evidence and FLUTe ribbon evidence, and the secondary lines of evidence which include laboratory results and OVA screening have been provided Figures 6 through 8.

The most significant occurrence of DNAPL in the vadose zone detected during the current investigation was near the northeast corner of the CPA, where chlorobenzene was historically unloaded from rail cars and stored in aboveground storage tanks (Figures 2 and 11). Several positive FLUTe ribbon results were obtained from 9.5 feet and between 16.5 and 17.5 feet bls in soil boring SSB-4 indicating DNAPL is present in these intervals (Figure 11; Appendix A). The drilling of boring SSB-4 was stopped at 20 feet bls due to high organic vapor readings in the work zone. This was the result of significant amounts of DNAPL within the shallow fine-grained vadose zone soils at this location. Soil boring PSB-4, which is located approximately 40 feet northwest of boring SSB-4, had numerous FID readings above 10,000 ppm between land surface and the water table (Figure 6; Appendix A). The OVA readings from this boring indicate DNAPL presence; however positive FLUTe ribbon staining was not observed in the vadose zone in this boring.

A positive FLUTe ribbon result was obtained at 57 feet bls in soil boring PSB-5, located near the historic southeast corner of the DDT processing building (Figures 2, 7 and 11). Additionally, chlorobenzene was detected in this boring at 5,200 mg/kg and 70,000 mg/kg at 17 and 57.5 feet bls, respectively (Table 1). OVA readings, which ranged between 8,210 ppm and 120,100 ppm, were also recorded from 13 feet bls to 57 feet bls. (Figure 7, Appendix A).

A positive FLUTe ribbon result was also obtained at 7 feet bls in soil boring SSB-7 located on the western side of the CPA (Table 2, Figure 11, and Appendix A). Although there were no positive FLUTE ribbon results from soil boring PSB-1, FID readings greater than 10,000 ppm were observed between 31 feet bls and 47 feet bls, indicating DNAPL presence (Table 2, Figure 11, Appendix A). The highest FID reading recorded during the DNAPL reconnaissance program of 173,000 ppm was recorded at 47 feet bls at this boring location.

Borings PSB-6, PSB-11, PSB-15, PSB-16, SSB-6, and SSB-7 have possible DNAPL present based on OVA readings (Table 2, Figure 11). Of these 6 borings, 3 are located within the confirmed DNAPL impacted area and do not alter the estimated extent of the DNAPL impacted zone. Borings, PSB-6, PSB-11, and PSB-16 are located on the perimeter of the confirmed DNAPL impacted area (Figure 11).

Vadose Zone Summary

Based on the data obtained during the current reconnaissance program and previous work done at the Property, it appears that confirmed presence of DNAPL within the vadose zone is mainly beneath the CPA, except for a small area to the northeast near boring SSB-4 (Figure 11). The extent of possible DNAPL impact in the vadose zone is slightly larger and is primarily within the limits of the CPA except for the possible occurrence of DNAPL southeast of the CPA in boring PSB-11. The area where DNAPL is present in the vadose zone is estimated at approximately 52,000 square feet or 1.2 acres (Figure 11). The area where DNAPL is possibly present in the vadose zone is estimated at approximately 71,000 square feet or 1.6 acres. Based on the results of this investigation, the extent of the DNAPL in the vadose zone is adequately defined for the purposes of completing the Soil and DNAPL Feasibility Studies.

3.2.3 DNAPL IN SATURATED UPPER BELLFLOWER AQUITARD

The results of this and previous investigations indicate that the DNAPL-impacted zone within the saturated portion of the upper Bellflower aquitard encompasses a greater area compared to the extent of DNAPL within the vadose zone (Figure 12) (H+A, 2004b). The upper Bellflower aquitard is composed of interbedded sand, silty sand, and silt layers. Sand layers are more prevalent from the water table to approximately 75 feet bls. Below 75 feet bls, the percentage of silt and silty sand layers increases. DNAPL is preferentially, but not exclusively, present within sand layers below 75 feet bls (Figures 6 through 8). Many of these sand layers are only a few inches thick and are underlain by silt lenses.

Previously, DNAPL has been detected in a number of wells and borings in the upper Bellflower aquitard (H+A, 1999). DNAPL has, and continues to accumulate in wells MW-2, UBT-1, UBT-2, UBT-3, and UBE-1 (Figure 12). DNAPL was also observed visually during past investigations in the borings for test wells UBT-1, UBT-2, and UBT-3 and in soil borings S-101/101A, S-301/301A/301B, S-302E/S302F, S-304/304A, and S-305/305A. The DNAPL observed in core samples collected in 1988 consisted of an iridescent oily or purple sheen occurring as thin layers in sand beds overlying silt or clay layers.

Twenty nine of the sixty one borings drilled during the DNAPL reconnaissance program had evidence of DNAPL occurrence within the saturated upper Bellflower aquitard based on one or more lines of evidence (Figure 12). DNAPL was detected in 22 of these borings based on positive FLUTe ribbon evidence (Table 3). In all cases with a positive FLUTe ribbon, there was also either an elevated laboratory result and/or elevated OVA readings indicative of DNAPL. Seven borings have possible evidence of DNAPL based solely on OVA readings and/or laboratory results (Table 3). Direct push boring DP-12 had OVA readings greater than 10,000 ppm (Figure 12; Appendix A). Laboratory results for soil samples from sonic borings PSB-11 and PSB-18 indicated chlorobenzene concentrations greater than 1,000 mg/kg (Table 1; Figure 12). Additionally, DNAPL is likely to be present within the saturated upper Bellflower aquitard at the location of boring SSB-4, which was terminated in the vadose zone (Figure 11).

Seventeen borings had possible DNAPL present based on OVA readings (Table 3). Of these 17 borings, 14 are located within the confirmed DNAPL-impacted area and do not alter the estimated extent of the DNAPL impacted zone. Three borings, SSB-3, TSB-9, and TSB-11, are located on the perimeter of the confirmed DNAPL impacted area (Figure 12).

The detailed cross sections show the heterogeneous, interbedded nature of the upper Bellflower aquitard and the distribution of DNAPL relative to the lithology (Figures 6 through 8). As expected, much of the observed DNAPL appears to be perched on low permeability silt layers throughout the upper Bellflower aquitard. Based on this recent work and the historical work at the Property, it appears that the area directly beneath the CPA has the most DNAPL in both the vadose zone and the upper Bellflower aquitard. DNAPL also appears to have penetrated to a greater depth in the vicinity of the CPA (Figures 6 through 8). DNAPL is not encountered in the vadose zone outside the CPA except in localized areas along the east boundary. DNAPL extends further to the east and south in the upper Bellflower aquitard below the water table, suggesting a stepwise mode of migration.

Upper Bellflower Aquitard Summary

Based on the data collected during this study and previous work, the confirmed presence of DNAPL in the saturated upper Bellflower aquitard extends over an area of approximately

148,000 square feet or 3.4 acres (Figure 12). The extent of possible presence of DNAPL is slightly larger and encompasses an area of approximately 161,000 square feet or 3.7 acres (Figure 12). This area includes much of the CPA and extends approximately 150 to 200 feet to the east, and approximately 50 feet to the south of the CPA in plan view (Figure 12). Additionally, DNAPL extends to the north end of the CPA near the property line. Based on the results of this and previous investigations the lateral extent of DNAPL in the upper Bellflower aquitard is adequately defined for the purposes of completing the DNAPL FS (Figure 12).

3.2.4 POTENTIAL FOR DNAPL IN THE BELLFLOWER SAND

Six soil borings were previously drilled into the Bellflower sand in the vicinity of the CPA for the purpose of evaluating DNAPL in the Bellflower sand (Figures 11 and 12). These borings, S-101/101A, S-301/301A/S301B, S-302E/302F, S-303/303A, S-304/304A, and S-305/305A, were drilled in 1988 as part of the Part 2, Phase 2A Remedial Investigation field work. These deep borings were continuously cored from the water table through the upper Bellflower aquitard to the base of the Bellflower sand to depths ranging from approximately 130 to 136 feet. The cores obtained from these borings were visually inspected for the presence of DNAPL and screened in the field using an organic vapor analyzer (OVA). In addition, soil matrix samples were collected from the cores at selected depths, and analyzed for chlorobenzene and DDT using EPA Methods 8240 and 8080. The results from these borings were summarized in a technical memorandum prepared by H+A dated January 23, 2004.

A chart illustrating the lithology, OVA readings, and the concentrations of chlorobenzene and DDT in soil matrix samples collected from borings S-101/101A, S-301/301A/S301B, S-302E/302F, S-303/303A, S-304/304A, and S-305/305A is provided on Figure 13.

Soil Results

DNAPL was visually observed in core samples collected from the upper Bellflower aquitard in five of the six borings drilled in 1988 (Figure 12). DNAPL was not detected in boring S-303/S303A.. DNAPL was found primarily in the other five borings from the water table at approximately 70 feet bls to 95 feet bls near the base of the upper Bellflower aquitard. This

depth interval is consistent with where DNAPL was detected during the current DNAPL Reconnaissance Investigation. The DNAPL observed in core samples collected in 1988 consisted of an iridescent oily or purple sheen occurring as thin layers in sand beds overlying silt or clay layers. Although DNAPL was observed in core samples collected from the upper Bellflower aquitard, DNAPL was not observed in the core samples collected from the underlying Bellflower sand. Based on the FLUTe ribbon results from the recent DNAPL reconnaissance program DNAPL can be present in soil samples where DNAPL is not visually apparent. However, in these areas DNAPL presence can typically be inferred using secondary lines of evidence such as laboratory and OVA results.

Soil samples from the upper Bellflower aquitard that were identified as having DNAPL had chlorobenzene concentrations in excess of 1,000 milligrams per kilogram (mg/kg) based on laboratory analysis of core samples. Chlorobenzene concentrations detected in soil samples collected from the base of the Bellflower sand, however, ranged from 4.2 mg/kg to 51 mg/kg. In comparison, concentrations of chlorobenzene in the upper Bellflower aquitard from these same borings ranged up to 81,000 mg/kg. Thus, the highest concentration of chlorobenzene detected in the Bellflower sand is one to two orders of magnitude less than those associated with DNAPL in the upper Bellflower aquitard.

Soil samples that are clearly indicative of DNAPL from the upper Bellflower aquitard also tend to have DDT concentrations in excess of 1,000 mg/kg. Concentrations of DDT detected in soil samples in the Bellflower sand collected from beneath the CPA at the Site, at depths of approximately 115 to 130 feet bls, ranged from less than 0.003 mg/kg to 130 mg/kg. In comparison, concentrations of DDT detected in soil samples in the upper Bellflower aquitard from these same borings ranged up to 69,000 mg/kg. Thus, the concentrations of DDT detected at the base of the Bellflower sand are at least one order of magnitude less than those associated with known DNAPL.

One of the samples collected from the Bellflower sand did exceed the DDT lower threshold of 60 mg/kg used during the current program for indicating samples as having “DNAPL possibly present”. This sample was collected from boring S-101A at a depth of 126.5 feet bls. However, the corresponding chlorobenzene concentration in this sample was 9.1 mg/kg, which is

2.5 orders of magnitude below the chlorobenzene lower threshold for indicating samples as having "DNAPL possibly present". This low chlorobenzene concentration strongly suggests that DNAPL was not present in this sample and that the DDT detected was due to cross contamination in the laboratory or from drilling through known DNAPL in the upper Bellflower aquitard.

OVA screening results of soil samples from the Bellflower sand were generally less than 100 parts per million (ppm), with the exception of boring S-302E/S302F at a depth of 126 feet bls in which there was one OVA reading of 200 ppm. In comparison, OVA screening results for soil samples from the upper Bellflower aquitard where DNAPL was present ranged up to 940 ppm. During the recent DNAPL reconnaissance investigation OVA screening results for soil samples collected in the vicinity of DNAPL were in the percent level (i.e., greater than 10,000 ppm). OVA results from the Bellflower sand were at least an order of magnitude less than the elevated levels found in the DNAPL-impacted zone in the upper Bellflower aquitard.

Groundwater Results

To date, three monitor wells, BF-3, BF-4, and BF-9, have been completed in the Bellflower sand in the vicinity, or immediately downgradient, of the CPA. Chlorobenzene laboratory results for groundwater samples collected from monitor wells BF-3, BF-4, and BF-9 were reviewed to evaluate the potential presence of DNAPL in the Bellflower sand. Chlorobenzene results for groundwater samples collected from these three monitor wells in January 2004 along with the historical range from previous samples are presented in the following table:

Well Identifier	Chlorobenzene Concentration, January 2004 (micrograms per liter))	Chlorobenzene Concentration, Historical Range (micrograms per liter)
BF-3	13,000	9,000 to 23,000
BF-4	15,000	18,000 to 42,000
BF-9	19,000	11,000 to 25,000

The chlorobenzene concentrations from January 2004 for monitor wells BF-3 and BF-9 are within the historical concentration range for this well, while the result for monitor well BF-4 is slightly below the historical range. In comparison, the following table presents concentrations of

chlorobenzene in monitor well MW-2, screened in the upper Bellflower aquitard in an area known to be impacted by DNAPL

Well Identifier	Chlorobenzene Concentration Sampled April 1988 (micrograms per liter)	Chlorobenzene Concentration Historical Range (micrograms per liter)
MW-2	380,000	54,000 to 660,000

The concentration of chlorobenzene in the upper Bellflower aquitard in the area where DNAPL has been confirmed is an order of magnitude greater than that in the underlying Bellflower sand. A rough rule of thumb that is commonly used suggests that concentrations of volatile organic compounds in groundwater above 1 percent of their aqueous solubility may be indicative of the presence of DNAPL at a site (Cohen and Mercer, 1993). The solubility limit for chlorobenzene in water is on the order of 500,000 ug/l and thus the concentration of chlorobenzene detected in the Bellflower sand could be construed to indicate the presence of DNAPL. However, it is not possible to conclude from these results whether the elevated chlorobenzene concentrations are related to DNAPL mass in the Bellflower sand or from dissolved phase contamination migrating downward from the DNAPL-impacted zone known to exist in the overlying upper Bellflower aquitard.

Summary

The six soil borings drilled in 1988 to the base of the Bellflower sand were located within the CPA where it was anticipated that DNAPL is most likely to occur within the Bellflower sand and the data obtained did not provide any compelling evidence for the occurrence of DNAPL. Data obtained during the recent DNAPL Reconnaissance program confirmed that the depth of DNAPL penetration in the upper Bellflower aquitard is generally greatest in the CPA compared to the surrounding areas (Figures 6, 7, and 8). This further supports that the previous borings were installed in the area most likely to contain DNAPL.

3.3 CONCLUSIONS

Based on the data collected during the DNAPL reconnaissance program, the lateral and vertical extent of DNAPL within the vadose zone and upper Bellflower aquitard have been

sufficiently delineated to allow completion of the DNAPL Feasibility Study. There is some uncertainty with respect to the exact shape and precise limits of the DNAPL, principally where the area designated as "DNAPL possibly present" extends beyond the area of known DNAPL (Figures 11 and 12). However these areas of uncertainty are small relative to the area known to contain DNAPL. As such, additional borings to characterize the extent of DNAPL within the upper Bellflower do not appear to be warranted.

Given the lithologic heterogeneity of the upper Bellflower aquitard and the complex manner in which DNAPL migrates in the subsurface, there is no practical way to eliminate all uncertainty in estimating the extent of DNAPL at the site. It is clear that where DNAPL is detected in one boring and not in an adjacent boring that there is uncertainty as to where the limit of DNAPL occurs between the two borings. It is also possible that DNAPL could have migrated between two borings which do not exhibit DNAPL evidence. However the pattern of the DNAPL distribution appears to be more broad than sinuous which suggests that the likelihood of DNAPL migrating between borings is low.

DNAPL in the vadose zone occurs primarily within the CPA (Figure 11). Within the vadose zone, the confirmed extent of DNAPL occurs in an area that is approximately 52,000 square feet or 1.2 acres and the area of possible DNAPL encompasses an area that is approximately 71,000 square feet or 1.6 acres

DNAPL below the water table appears to have spread laterally from the CPA to the east and south (Figure 12). The confirmed extent of DNAPL in the upper Bellflower aquitard is estimated to be approximately 148,000 square feet or 3.4 acres and the area of possible DNAPL encompasses an area that is approximately 161,000 square feet or 3.7 acres. Due to the irregular character of the DNAPL areas and uncertainty regarding the exact extent of DNAPL between borings, the actual areas that may be remediated will likely be somewhat larger than the areas indicated above. The potential impact on the DNAPL FS of this uncertainty is primarily related to cost. However the potential cost impact due to the uncertainty in the area to be remediated is expected to be within the uncertainty typically expected of feasibility studies.

Based on the data collected to date, it does not appear that drilling additional borings into the Bellflower sand within the CPA would contribute any additional useful knowledge to the DNAPL FS program. It is even less likely that borings drilled into the Bellflower sand in the area surrounding the CPA would encounter DNAPL within this unit. Furthermore, drilling through known DNAPL zones into an underlying aquifer to search for DNAPL at depth is a high risk endeavor due to the risk of downward migration. Therefore, the installation of additional borings to evaluate the presence of DNAPL in the Bellflower sand is not recommended

4.0 REFERENCES

Cohen, R.M., and J.W. Mercer, 1993. DNAPL Site Evaluation. Published by CRC Press, Inc., Boca Raton, Florida. 1993.

Feenstra, S., D.M. MacKay, and J.A. Cherry. "A Method for Assessing Residual NAPL Based on Organic Chemical Concentrations in Soil Samples." Groundwater Monitoring Review, Volume II, No. 2. 1991.

Hargis + Associates, Inc. (H+A), 1999. Dense Non-Aqueous Phase Liquid Feasibility Study, Montrose Site, Torrance, California. September 29, 1999.

_____, 2003a DNAPL Reconnaissance, Field Sampling Plan, Montrose Site, Torrance, California. April 3, 2003.

_____, 2003b. Technical Memorandum: Alternate Drilling Methods for Completing the DNAPL Reconnaissance Program, Montrose Site, Torrance, California. September 3, 2003.

_____, 2003c. Technical Memorandum: Response to EPA Conditional Approval of the DNAPL Reconnaissance Program, Montrose Site, Torrance, California. September 22, 2003.

_____, 2004a. Technical Memorandum: Summary of DNAPL Reconnaissance Conference Call January 14, 2004, Montrose Site, Torrance, California. January 16, 2004.

_____, 2004b. Technical Memorandum: DNAPL Investigation Results, Bellflower Sand, Montrose Site, Torrance, California. January 23, 2004.

_____, 2004c. Email from M. Palmer, H+A, to S. Keydel, EPA, re Supplemental Soil Sampling Data Borings TSB-14 and TSB-15. March 1, 2004.

U.S. Environmental Protection Agency (EPA), 1998. Final Remedial Investigation Report for the Montrose Superfund Site, Los Angeles, California. May 18, 1998.

HARGIS + ASSOCIATES, INC.

TABLE 1

CHLOROBENZENE AND DDT CONCENTRATIONS IN SOIL

SOIL BORING IDENTIFIER	SAMPLE DEPTH (feet bls)	SAMPLE DATE	CHLOROBENZENE	2,4'-DDD	2,4'-DDE	2,4'-DDT	4,4'-DDD	4,4'-DDE	4,4'-DDT
			……..Concentrations in milligrams per kilogram……						
DP-1	79	05/06/03	310	<51	<51	<51	<51	<51	110
DP-1	85	05/06/03	480	<71	<71	<71	<71	<71	170
DP-2	78	05/06/03	210	<27	<27	<27	<27	<27	42
DP-2	89	05/07/03	130	<29	<29	<29	<29	<29	110
DP-3	71.5	05/07/03	<28	<28	<28	<28	<28	<28	<28
DP-3	78.8	05/07/03	13,000	<3,700	<3,700	<3,700	<3,700	<3,700	8,300
DP-4	76.7	05/08/03	30	<28	<28	<28	<28	<28	<28
DP-4	86.7	05/08/03	45	<28	<28	<28	<28	<28	<28
DP-5	72.7	05/08/03	95	<34	<34	<34	<34	43	85
DP-5	89.6	05/08/03	3,400	<1,400	<1,400	<1,400	<1,400	<1,400	2,400
DP-7	71.9	05/09/03	<31	<31	<31	<31	<31	<31	<31
DP-7	89.5	05/09/03	16,000	<3,900	<3,900	<3,900	<3,900	<3,900	12,000
DP-7	94.9	05/09/03	95	<23	<23	<23	<23	<23	42
DP-8	79.9	05/12/03	100	<24	<24	<24	<24	<24	<24
DP-8	89.1	05/12/03	<27	<27	<27	<27	<27	<27	<27
DP-9	75.3	05/13/03	<22	<22	<22	<22	<22	<22	<22
DP-9	85.6	05/13/03	<30	<30	<30	<30	<30	<30	<30
DP-10	72.9	05/13/03	<30	<30	<30	<30	<30	<30	<30
DP-10	85.6	05/13/03	<26	<26	<26	<26	<26	<26	<26
DP-11	76.4	05/14/03	<28	<28	<28	<28	<28	<28	<28
DP-11	81.3	05/14/03	<27	<27	<27	<27	<27	<27	<27
DP-12	72.0	05/14/03	40	<24	<24	<24	<24	<24	<24
DP-12	80.4	05/14/03	550	<130	<130	130	<130 J	<130	420

TABLE 1

CHLOROBENZENE AND DDT CONCENTRATIONS IN SOIL

SOIL BORING IDENTIFIER	SAMPLE DEPTH (feet bls)	SAMPLE DATE	CHLOROBENZENE	2,4'-DDD	2,4'-DDE	2,4'-DDT	4,4'-DDD	4,4'-DDE	4,4'-DDT
			……..Concentrations in milligrams per kilogram……						
PSB-1	76.5	10/07/03	1,700	<510	<510	<510	<510	<510	1,900
PSB-1	81.0	10/07/03	2,400	<580	<580	620	<580	<580	2,500
PSB-2	75.0	10/08/03	7,100	<1,500	<1,500	2,100	<1,500	<1,500	7,700
PSB-2	92.0	10/08/03	43	<28	<28	<28	<28	<28	<28
PSB-3	75.5	10/09/03	3,000	<630	<630	650	<630	<630	2,500
PSB-3	80.0	10/09/03	480	<120	<120	<120	<120	<120	250
PSB-4	26.0	10/09/03	<31	<31	<31	<31	<31	<31	<31
PSB-4	39.0	10/10/03	<40	<40	<40	<40	<40	<40	<40
PSB-4	75.0	10/10/03	150	<140	<140	200	<140	<140	680
PSB-4	88.0	10/10/03	45,000	<7,000 J	<7,000 J	9,400 J	<7,000 J	<7,000 J	28,000 J
PSB-4	90.7	10/10/03	1,600	<500	<500	<500	<500	<500	920
PSB-5	17.0	10/13/03	5,200	<1,000	<1,000	1,800	<1,000	<1,000	4,700
PSB-5	57.5	10/13/03	70,000	<9,400	<9,400	14,000	<9,400	<9,400	43,000
PSB-5	91	10/13/03	14,000	<2,900	<2,900	4,100	<2,900	<2,900	12,000
PSB-6	84.8	10/14/03	<31	<31	<31	<31	<31	<31	<31
PSB-6	90.4	10/14/03	27,000	<6,800	<6,800	8,100	<6,800	<6,800	19,000
PSB-7	84	10/15/03	<30 J	<30 J	<30 J	<30 J	<30 J	<30 J	<30 J
PSB-7	92	10/15/03	<33 J	<33 J	<33 J	<33 J	<33 J	<33 J	<33 J
PSB-8	84.5	10/16/03	<30	<30	<30	<30	<30	<30	<30
PSB-9	85.5	10/17/03	<34	<34	<34	<34	<34	<34	<34
PSB-9	92.2	10/17/03	2,000	<280	<280	390	<280	<280	1,400
PSB-10	60.5	10/28/03	<30	<30	<30	<30	<30	<30	<30
PSB-10	89.5	10/28/03	44	<33	<33	<33	<33	<33	<33
PSB-11	49.5	10/29/03	<490 J	<490 J	<490 J	<490 J	<490 J	<490 J	830 J

TABLE 1

CHLOROBENZENE AND DDT CONCENTRATIONS IN SOIL

SOIL BORING IDENTIFIER	SAMPLE DEPTH (feet bls)	SAMPLE DATE	CHLOROBENZENE	2,4'-DDD	2,4'-DDE	2,4'-DDT	4,4'-DDD	4,4'-DDE	4,4'-DDT
			……..Concentrations in milligrams per kilogram……						
PSB-11	74.5	10/29/03	3,200 J	<2,000 J	<2,000 J	2,300 J	<2,000 J	<2,000 J	6,400 J
PSB-11	81.6	10/29/03	47 J	<40 J	<40 J	<40 J	<40 J	<40 J	<40 J
PSB-12	65.2	10/30/03	<40 J	<40 J	<40 J	<40 J	<40 J	<40 J	<40 J
PSB-12	72.8	10/30/03	670 J	<630 J	<630 J	<630 J	<630 J	<630 J	1,700 J
PSB-12	77.4	10/30/03	1,400 J	<400 J	<400 J	<400 J	<400 J	<400 J	1,100 J
PSB-13	68.8	10/31/03	<51 J	<51 J	<51 J	<51 J	<51 J	<51 J	<51 J
PSB-13	90	10/31/03	<47 J	<47 J	<47 J	<47 J	<47 J	<47 J	<47 J
PSB-14	78.5	11/04/03	8,600	<3,500	<3,500	<3,500	<3,500	<3,500	9,900
PSB-14	93.5	11/04/03	<40	<40	<40	<40	<40	<40	<40
PSB-15	13	11/05/03	<4,000	<4,000	<4,000	<4,000	<4,000	<4,000	13,000
PSB-15	54.25	11/05/03	<49	<49	<49	<49	<49	<49	<49
PSB-15	75	11/05/03	9,000 J	<2,000 J	<2,000 J	2,600 J	<2,000 J	<2,000 J	8,600 J
PSB-15	79.75	11/05/03	13,000	<3,300	<3,300	<3,300	<3,300	<3,300	11,000
PSB-16	85.25	11/07/03	<36	<36	<36	<36	<36	<36	<36
PSB-16	89.5	11/07/03	49	<35	<35	<35	<35	<35	<35
PSB-17	88.25	11/10/03	9,300	<2,000	<2,000	2,200	<2,000	<2,000	10,000
PSB-17	94	11/10/03	<34	<34	<34	<34	<34	<34	<34
PSB-18	69	11/22/03	400	<400 J	<400 J	510 J	<400 J	<400 J	1,500 J
PSB-18	88.5	11/22/03	5,700	<1,800 J	<1,800 J	<1,800 J	<1,800 J	<1,800 J	5,900 J
PSB-19	71.8	11/23/03	<40	<40 J	<40 J	<40 J	<40 J	<40 J	<40 J
PSB-19	77.2	11/23/03	5,200	<1,500 J	<1,500 J	1,500 J	<1,500 J	<1,500 J	3, 900 J

TABLE 1

CHLOROBENZENE AND DDT CONCENTRATIONS IN SOIL

SOIL BORING IDENTIFIER	SAMPLE DEPTH (feet bls)	SAMPLE DATE	CHLOROBENZENE	2,4'-DDD	2,4'-DDE	2,4'-DDT	4,4'-DDD	4,4'-DDE	4,4'-DDT
			……..Concentrations in milligrams per kilogram……						
SSB-1	83.00	10/20/03	NA	NA	NA	NA	NA	NA	NA
SSB-1	90.5	10/20/03	<21	<21	<21	<21	<21	<21	<21
SSB-2	30	10/21/03	<36	<36	<36	<36	<36	<36	<36
SSB-2	56	10/21/03	<40	<40	<40	<40	<40	<40	<40
SSB-2	77	10/21/03	<30	<30 J	<30 J	<30 J	<30 J	<30 J	<30 J
SSB-2	87	10/21/03	23,000	<2,900	<2,900	6,800	<2,900	<2,900	19,000
SSB-3	31	10/22/03	<40	<40	<40	<40	<40	<40	<40
SSB-3	46	10/22/03	<36	<36	<36	<36	<36	<36	<36
SSB-3	86	10/22/03	<40	<40 J	<40 J	<40 J	<40 J	<40 J	<40 J
SSB-3	90	10/22/03	<34	<34	<34	<34	<34	<34	<34
SSB-4	13	10/23/03	7,900	<1,500	<1,500	<1,500	<1,500	<1,500	<1,500
SSB-4	17	10/23/03	14,000	<2,600	<2,600	<2,600	<2,600	<2,600	<2,600
SSB-5	77.75	10/24/03	2,200	<340	<340	530	<340	<340	1,800
SSB-5	94.5	10/24/03	39	<33	<33	<33	<33	<33	<33
SSB-6	77.5	11/06/03	15,000	<3,100	<3,100	<3,100	<3,100	<3,100	10,000
SSB-6	88	11/06/03	<32	<32	<32	<32	<32	<32	<32
SSB-6	89.5	11/06/03	55,000	<30,000	<30,000	<30,000	<30,000	<30,000	35,000
SSB-6	90.75	11/06/03	49,000	<28,000	<28,000	<28,000	<28,000	<28,000	29,000
SSB-7	10.5	11/11/03	<450	<450	<450	<450	<450	<450	<450
SSB-7	89.5	11/11/03	<2,000	<2,000	<2,000	<2,000	<2,000	<2,000	6,200
SSB-7	94	11/11/03	<40	<40	<40	<40	<40	<40	<40
SSB-8	82.5	11/12/03	<40	<40	<40	<40	<40	<40	<40
SSB-8	91	11/12/03	<40	<40	<40	<40	<40	<40	<40

TABLE 1

CHLOROBENZENE AND DDT CONCENTRATIONS IN SOIL

SOIL BORING IDENTIFIER	SAMPLE DEPTH (feet bls)	SAMPLE DATE	CHLOROBENZENE	2,4'-DDD	2,4'-DDE	2,4'-DDT	4,4'-DDD	4,4'-DDE	4,4'-DDT
			……..Concentrations in milligrams per kilogram……						
SSB-9	72.5	11/14/03	<45	<45	<45	<45	<45	<45	<45
SSB-9	92	11/14/03	<40	<40	<40	<40	<40	<40	<40
SSB-10	82.25	11/18/03	<40	<40 J	<40 J	<40 J	<40 J	<40 J	<40 J
SSB-10	88.75	11/18/03	<34	<34 J	<34 J	<34 J	<34 J	<34 J	<34 J
SSB-11	78	11/19/03	990	<350 J	<350 J	<350 J	<350 J	<350 J	1,400 J
SSB-11	92	11/19/03	40	<40 J	<40 J	<40 J	<40 J	<40 J	<40 J
SSB-12	64.9	11/20/03	<40	<40 J	<40 J	<40 J	<40 J	<40 J	<40 J
SSB-12	82.5	11/20/03	50,000	<20,000 J	<20,000 J	<20,000 J	<20,000 J	<20,000 J	53,000 J
SSB-13	69.2	11/21/03	<40	<40 J	<40 J	<40 J	<40 J	<40 J	<40 J
SSB-13	92	11/21/03	<40	<40 J	<40 J	<40 J	<40 J	<40 J	<40 J
SSB-14	79	11/24/03	<34	<34	<34	<34	<34	<34	<34
SSB-14	90.3	11/24/03	<40	<40	<40	<40	<40	<40	<40
SSB-15	78	12/02/03	<31	<31	<31	<31	<31	<31	<31
SSB-15	88	12/02/03	<34	<34	<34	<34	<34	<34	<34
TSB-1	10	11/13/03	<30	<30	<30	<30	<30	<30	<30
TSB-1	20	11/13/03	<40	<40	<40	<40	<40	<40	<40
TSB-1	30	11/13/03	<45 J	<45 J	<45 J	<45 J	<45 J	<45 J	<45 J
TSB-1	40	11/13/03	<40	<40	<40	<40	<40	<40	<40
TSB-1	50	11/13/03	<40	<40	<40	<40	<40	<40	<40
TSB-1	60	11/13/03	<50	<50	<50	<50	<50	<50	<50
TSB-1	71	11/13/03	<35	<35	<35	<35	<35	<35	<35
TSB-2	78.75	11/17/03	54	<36	<36	<36	<36	<36	<36
TSB-2	87.75	11/17/03	28,000	<4,000	<4,000	4,700	<4,000	<4,000	16,000
TSB-3	74.7	11/25/03	<36	<36	<36	<36	<36	<36	<36

TABLE 1

CHLOROBENZENE AND DDT CONCENTRATIONS IN SOIL

SOIL BORING IDENTIFIER	SAMPLE DEPTH (feet bls)	SAMPLE DATE	CHLOROBENZENE	2,4'-DDD	2,4'-DDE	2,4'-DDT	4,4'-DDD	4,4'-DDE	4,4'-DDT
			……..Concentrations in milligrams per kilogram……						
TSB-3	79.3	11/25/03	14,000	<2,000	<2,000	3,000	<2,000	<2,000	9,900
TSB-3	95.0	11/25/03	34	<32	<32	<32	<32	<32	<32
TSB-4	72	12/04/03	<30	<30	<30	<30	<30	<30	<30
TSB-4	81.7	12/04/03	<28	<28	<28	<28	<28	<28	<28
TSB-5	81	01/19/04	44	<26	<26	<26	<26	<26	<26
TSB-5	94.5	01/19/04	<34	<34	<34	<34	<34	<34	<34
TSB-6	80.25	01/20/04	<36	<36	<36	<36	<36	<36	<36
TSB-6	93.75	01/20/04	<36	<36	<36	<36	<36	<36	<36
TSB-7	83.5	01/21/04	<33	<33	<33	<33	<33	<33	<33
TSB-7	91.5	01/21/04	<34	<34	<34	<34	<34	<34	<34
TSB-8	87	01/22/04	700	<200	<200	<200	<200	<200	460
TSB-8	87.1	01/22/04	5,100	<1,700	<1,700	<1,700	<1,700	<1,700	3,200
TSB-8	91	01/22/04	13,000	<3,500	<3,500	<3,500	<3,500	<3,500	8,000
TSB-9	89	01/23/04	<35	<35	<35	<35	<35	<35	<35
TSB-9	91	01/23/04	47	<35	<35	<35	<35	<35	<35
TSB-10	77.25	01/26/04	<31	<31	<31	<31	<31	<31	<31
TSB-10	84.5	01/26/04	46	<34	<34	<34	<34	<34	<34
TSB-11	81	01/27/04	<34	<34	<34	<34	<34	<34	<34
TSB-11	82.5	01/27/04	280	<66	<66	<66	<66	<66	100
TSB-11	91	01/27/04	<50	<50	<50	<50	<50	<50	<50

TABLE 1

CHLOROBENZENE AND DDT CONCENTRATIONS IN SOIL

SOIL BORING IDENTIFIER	SAMPLE DEPTH (feet bls)	SAMPLE DATE	CHLOROBENZENE	2,4'-DDD	2,4'-DDE	2,4'-DDT	4,4'-DDD	4,4'-DDE	4,4'-DDT
			……..Concentrations in milligrams per kilogram……						
TSB-12	85.5	01/28/04	<40	<40	<40	<40	<40	<40	<40
TSB-12	94.75	01/28/04	<40	<40	<40	<40	<40	<40	<40
TSB-13	69	01/29/04	<33	<33	<33	<33	<33	<33	<33
TSB-13	95	01/29/04	45	<40	<40	<40	<40	<40	<40
TSB-14	88	02/02/04	35	<35	<35	<35	<35	<35	<35
TSB-14	92.5	02/02/04	40	<30	<30	<30	<30	<30	<30
TSB-15	82	02/04/04	<34	<34	<34	<34	<34	<34	<34
TSB-15	88	02/04/04	<35	<35	<35	<35	<35	<35	<35
TSB-15	92	02/04/04	<35	<35	<35	<35	<35	<35	<35
TSB-16	83	08/29/04	<35	<35	<35	<35	<35	<35	<35
TSB-16	90	08/29/04	<40	<40	<40	<40	<40	<40	<40

FOOTNOTES

bls = Below land surface

J = Estimated value

2,2'-DDD = 2,2'-Dichlorodiphenyldichloroethane
2,2'-DDE = 2,2'-Dichlorodiphenyldichloroethylene
2,2'-DDT = 2,2'-Dichlorodiphenyltrichloroethane
4,4'-DDD = 4,4'-Dichlorodiphenyldichloroethane
4,4'-DDE = 4,4'-Dichlorodiphenyldichloroethylene
4,4'-DDT = 4,4'-Dichlorodiphenyltrichloroethane

HARGIS + ASSOCIATES, INC.

TABLE 2

DNAPL IN VADOSE ZONE

SOIL BORING IDENTIFIER	DNAPL PRESENT (1)	……..LINES OF EVIDENCE…… FLUTe RIBBON (2)	LABORATORY ANALYTICAL (3)	OVA (4)
DP-1	--	--	--	--
DP-2	--	--	--	--
DP-3	--	--	--	--
DP-4	--	--	--	--
DP-5	--	--	--	--
DP-6	--	--	--	--
DP-7	--	--	--	--
DP-8	--	--	--	--
DP-9	--	--	--	--
DP-10	--	--	--	--
DP-11	--	--	--	--
DP-12	--	--	--	--
PSB-1	YES	NONE	NT	YES
PSB-2	NONE	NONE	NT	NONE
PSB-3	NONE	NONE	NT	NONE
PSB-4	YES	NONE	<40 / <40	YES
PSB-5	YES	YES	5200 / 6,500	YES
PSB-6	POSSIBLE	NONE	NT	POSSIBLE
PSB-7	NONE	NONE	NT	NONE
PSB-8	NONE	NONE	NT	NONE
PSB-9	NONE	NONE	NT	NONE
PSB-10	NONE	NONE	NT	NONE
PSB-11	POSSIBLE	NONE	<490J / 830J	POSSIBLE
PSB-12	NONE	NONE	NT	NONE
PSB-13	NONE	NONE	NT	NONE
PSB-14	NONE	NONE	NT	NONE
PSB-15	YES	NONE	<4,000 / 13,000	POSSIBLE
PSB-16	POSSIBLE	NONE	NT	POSSIBLE
PSB-17	NONE	NONE	NT	NONE
PSB-18	NONE	NONE	NT	NONE
PSB-19	NONE	NONE	NT	NONE
SSB-1	NONE	NONE	NT	NONE
SSB-2	NONE	NONE	<36 / <36	NONE
SSB-3	NONE	NONE	<36 / <36	NONE
SSB-4	YES	YES	14,000 / <2,600	YES
SSB-5	NONE	NONE	NT	NONE
SSB-6	POSSIBLE	NONE	NT	POSSIBLE
SSB-7	YES	YES	<450 / <450	POSSIBLE
SSB-8	NONE	NONE	NT	NONE
SSB-9	NONE	NONE	NT	NONE

TABLE 2

DNAPL IN VADOSE ZONE

SOIL BORING IDENTIFIER	DNAPL PRESENT [1]	……..LINES OF EVIDENCE…… FLUTe RIBBON [2]	LABORATORY ANALYTICAL [3]	OVA [4]
SSB-10	NONE	NONE	NT	NONE
SSB-11	NONE	NONE	NT	NONE
SSB-12	NONE	NONE	NT	NONE
SSB-13	NONE	NONE	NT	NONE
SSB-14	NONE	NONE	NT	NONE
SSB-15	NONE	NONE	NT	NONE
TSB-1	NONE	NONE	<40 / <40	NONE
TSB-2	NONE	NONE	NT	NONE
TSB-3	NONE	NONE	NT	NONE
TSB-4	NONE	NONE	NT	NONE
TSB-5	NONE	NONE	NT	NONE
TSB-6	NONE	NONE	NT	NONE
TSB-7	NONE	NONE	NT	NONE
TSB-8	NONE	NONE	NT	NONE
TSB-9	NONE	NONE	NT	NONE
TSB-10	NONE	NONE	NT	NONE
TSB-11	NONE	NONE	NT	NONE
TSB-12	NONE	NONE	NT	NONE
TSB-13	NONE	NONE	NT	NONE
TSB-14	NONE	NONE	NT	NONE
TSB-15	NONE	NONE	NT	NONE
TSB-16	NONE	NONE	NT	NONE

FOOTNOTES

[1] YES = DNAPL confirmed.
POSSIBLE = Possible DNAPL confirmed.

[2] YES = Staining on ribbon observed.

[3] Maximum concentration of chlorobenzene/ total DDT in mg/kg, see Table 1 for additional data

[4] YES = FID readings 10,000 ppm or greater
POSSIBLE = FID readings 1,500 to 10,000 ppm.

DNAPL = Dense nonaqueous phase liquid
-- = Not applicable.
NT = Not tested
mg/kg = Milligrams per kilogram
FID = Flame ionization detector
ppm = Parts per million
J = Indicates concentration estimated
DDT = Dichlorodiphenyltrichloroethane

HARGIS + ASSOCIATES, INC.

TABLE 3

DNAPL IN SATURATED ZONE

SOIL BORING IDENTIFIER	DNAPL PRESENT (1)	……LINES OF EVIDENCE…… FLUTe RIBBON (2)	LABORATORY ANALYTICAL (3)	OVA (4)
DP-1	YES	NONE	480 / 170	POSSIBLE
DP-2	POSSIBLE	NONE	130 / 110	POSSIBLE
DP-3	YES	YES	13,000 / 8,300	YES
DP-4	POSSIBLE	NONE	45 / <28	POSSIBLE
DP-5	YES	YES	3,400 / 2,400	POSSIBLE
DP-6	--	--	--	--
DP-7	YES	YES	16,000 / 12,000	YES
DP-8	POSSIBLE	NONE	<27 / <27	POSSIBLE
DP-9	NONE	NONE	<30 / <30	NONE
DP-10	NONE	NONE	<26 / <26	NONE
DP-11	NONE	NONE	<27 / <27	NONE
DP-12	YES	NONE	550 / 550	YES
PSB-1	YES	YES	2,400 / 3,120	YES
PSB-2	YES	YES	7,100 / 9,800	YES
PSB-3	YES	YES	3,000 / 3,150	YES
PSB-4	YES	YES	45,000 / 37,400J	YES
PSB-5	YES	YES	14,000 / 16,100	YES
PSB-6	YES	YES	27,000 / 27,100	YES
PSB-7	NONE	NONE	<33J / <33J	NONE
PSB-8	NONE	NONE	<30 / <30	NONE
PSB-9	YES	YES	2,000 / 1,790	NONE
PSB-10	POSSIBLE	NONE	44 / <33	POSSIBLE
PSB-11	YES	NONE	3,200J / 8,700J	POSSIBLE
PSB-12	YES	YES	1,400J / 1,100J	POSSIBLE
PSB-13	NONE	NONE	<47J / <47J	NONE
PSB-14	YES	YES	8,600 / 9,900	POSSIBLE
PSB-15	YES	YES	9,000J / 11,200J	YES
PSB-16	NONE	NONE	49 / <33	NONE
PSB-17	YES	YES	9,300 / 12,200	YES
PSB-18	YES	NONE	5,700 / 5,900J	POSSIBLE
PSB-19	YES	YES	5,200 / 5,400J	YES
SSB-1	NONE	NONE	<21 / <21	NONE
SSB-2	YES	YES	23,000 / 25,800	YES
SSB-3	POSSIBLE	NONE	<34 / <34	POSSIBLE
SSB-4 (5)	YES	--	--	--
SSB-5	YES	YES	2,200 / 2,330	POSSIBLE
SSB-6	YES	YES	55,000 / 35,000	YES
SSB-7	YES	NONE	<2,000 / 6,200	POSSIBLE
SSB-8	NONE	NONE	<40 / <40	NONE
SSB-9	NONE	NONE	<40 / <40	NONE

TABLE 3

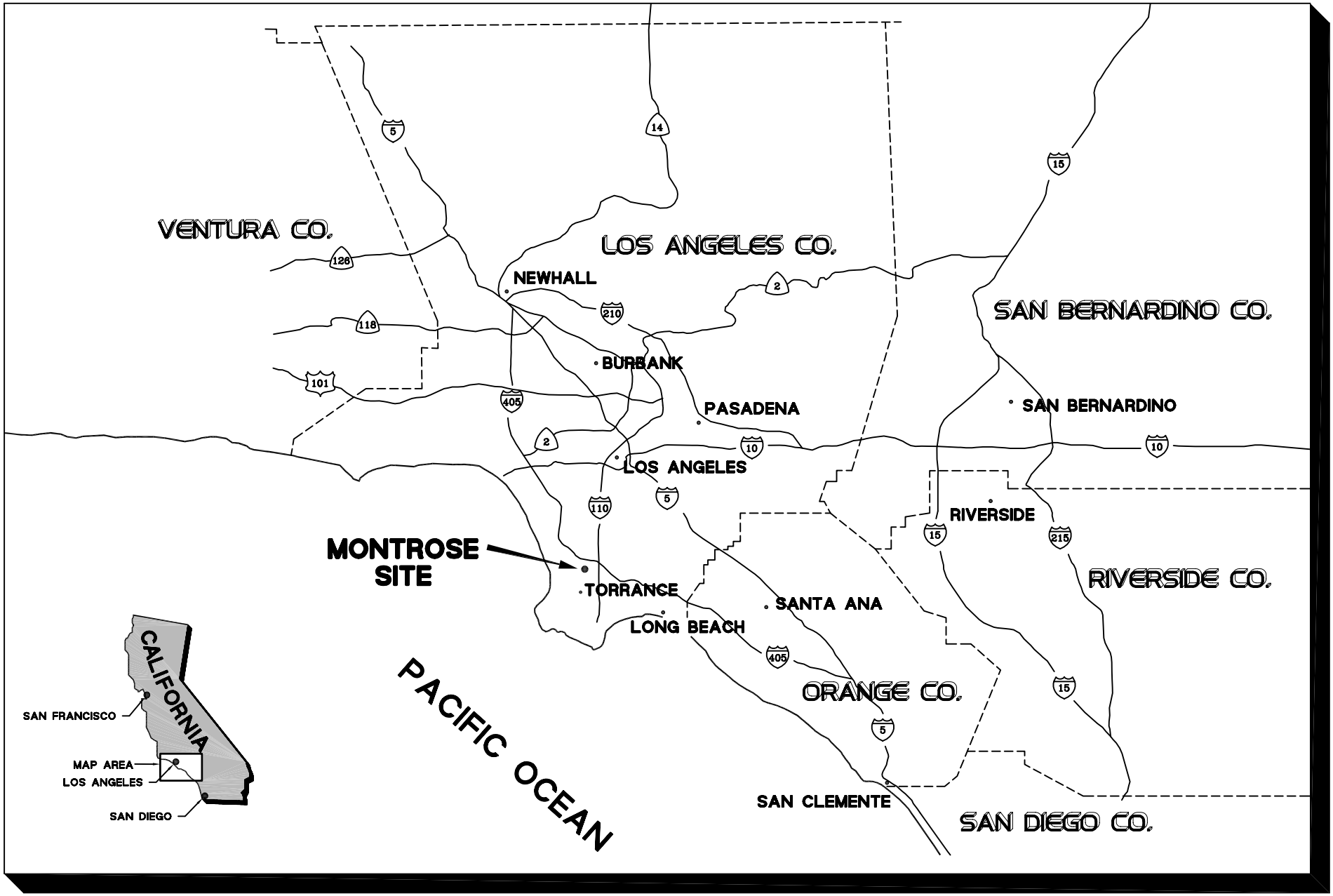
DNAPL IN SATURATED ZONE

SOIL BORING IDENTIFIER	DNAPL PRESENT (1)	……LINES OF EVIDENCE…… FLUTe RIBBON (2)	LABORATORY ANALYTICAL (3)	OVA (4)
SSB-10	NONE	NONE	<34 <34J	NONE
SSB-11	YES	NONE	990 / 1,400J	POSSIBLE
SSB-12	YES	YES	50,000 / 53,000J	POSSIBLE
SSB-13	NONE	NONE	<40 / <40J	NONE
SSB-14	NONE	NONE	<40 / <40J	NONE
SSB-15	NONE	NONE	<34 / <34J	NONE
TSB-1	NONE	NONE	<35 / <35	NONE
TSB-2	YES	YES	28,000 / 20,700	YES
TSB-3	YES	YES	14,000 / 12,900	YES
TSB-4	NONE	NONE	<28 / <28	NONE
TSB-5	NONE	NONE	<34 / <34	NONE
TSB-6	NONE	NONE	<36 / <36	NONE
TSB-7	NONE	NONE	<34 / <34	NONE
TSB-8	YES	YES	13,000 / 8,000	YES
TSB-9	POSSIBLE	NONE	47 / <35	POSSIBLE
TSB-10	NONE	NONE	46 / <34	NONE
TSB-11	POSSIBLE	NONE	<50 / <50	POSSIBLE
TSB-12	NONE	NONE	<40 / <40	NONE
TSB-13	NONE	NONE	45 / <40	NONE
TSB-14	NONE	NONE	40 / <30	NONE
TSB-15	NONE	NONE	<35 / <35	NONE
TSB-16	NONE	NONE	<35 / <35	NONE

FOOTNOTES

(1) YES = DNAPL confirmed.
POSSIBLE = Possible DNAPL confirmed.
(2) YES = Staining on ribbon observed.
(3) Maximum concentration of chlorobenzene/total DDT in mg/kg, see Table 1 for additional data
(4) YES = FID readings 10,000 ppm or greater
POSSIBLE = FID readings 1,500 to 10,000 ppm.
(5) Presence based on occurance in vadose zone.

DNAPL = Dense nonaqueous phase liquid
-- = Not applicable.
mg/kg = Milligrams per kilogram
FID = Flame ionization detector
ppm = Parts per million
J = Indicates concentration estimated
DDT = Dichlorodiphenyltrichloroethane



HARGIS + ASSOCIATES, INC.

RPT NO. 857	410-3831	A

FIGURE 1. SITE LOCATION

McDONNELL DOUGLAS CORPORATION

6" NATURAL GAS PIPELINE

JUNK YARD

MACHINE SHOP

SALVAGE AREA

PROCESSING EQUIPMENT

DDT PROCESSING BUILDING

MAIN GATE

RAW MATERIAL STORAGE/ CHLOROBENZENE, CHLORAL OLEUM ABOVE-GROUND TANKS

MAINTENANCE SHOP

CENTRAL PROCESS AREA

TRUCK REPAIR

COOLING TOWER

FORMER ACID RECOVERY STORAGE TANKS

TRANSFORMER STATION

WATER RECYCLING POND

FILTRATION AREA

WAREHOUSE #2

WAREHOUSE #1

MEN'S LOCKER ROOM

STORAGE

ACID RECOVERY PLANT

OFFICES AND LABORATORY

TRASH DIKE

OIL STORAGE

LUNCH ROOM

BELOW-GRADE TANKS

LACSD 57" TRUNK (J.O.D.)

FORMER 18" SEWER LINE

WOMEN'S LOCKER ROOM

RAW MATERIAL STORAGE/ CHLOROBENZENE, CHLORAL ABOVE-GROUND TANKS

DISTRICT 5 INTERCEPTOR

WAREHOUSE #3 (FORMULATING AND GRINDING PLANT)

SPECIAL PRODUCTS PLANT

VACANT BUILDING

PILOT PLANT

TRANSFORMER STATION

FORMER 10" SEWER LINE

LACFCD WELL No. 795 (DESTROYED)

JONES CHEMICAL COMPANY PROPERTY

6" WATER LINE

NOTE: EXTENDING APPROXIMATELY 3000 FEET TO WESTERN AVE

McDONNELL DOUGLAS CORPORATION

SOUTHERN PACIFIC RAILROAD

NORMANDIE AVENUE

LADWP RIGHT-OF-WAY

EXPLANATION

- DNAPL RECONAISSANCE BORING SEE FIGURE 3 FOR BORING ID
- MONTROSE PROPERTY BOUNDARY
- PROPERTY BOUNDARY
- RAILROAD TRACKS
- ABANDONED RAILROAD BED
- LADWP — LOS ANGELES DEPARTMENT OF WATER AND POWER
- CENTRAL PROCESS AREA
- CHEMICAL AND PETROLEUM PRODUCT PIPELINE CORRIDORS

NOTES:

ADAPTED FROM: METCALF & EDDY, INC., 1986 BASED ON PLANT OPERATIONS IN 1982.

ALL LOCATIONS ARE APPROXIMATE.

LADWP LOS ANGELES DEPARTMENT OF WATER AND POWER

LACSD LOS ANGELES COUNTY SANITATION DISTRICT

0 100 200

FEET

MONTROSE CHEMICAL CORPORATION OF CALIFORNIA

TORRANCE, CALIFORNIA

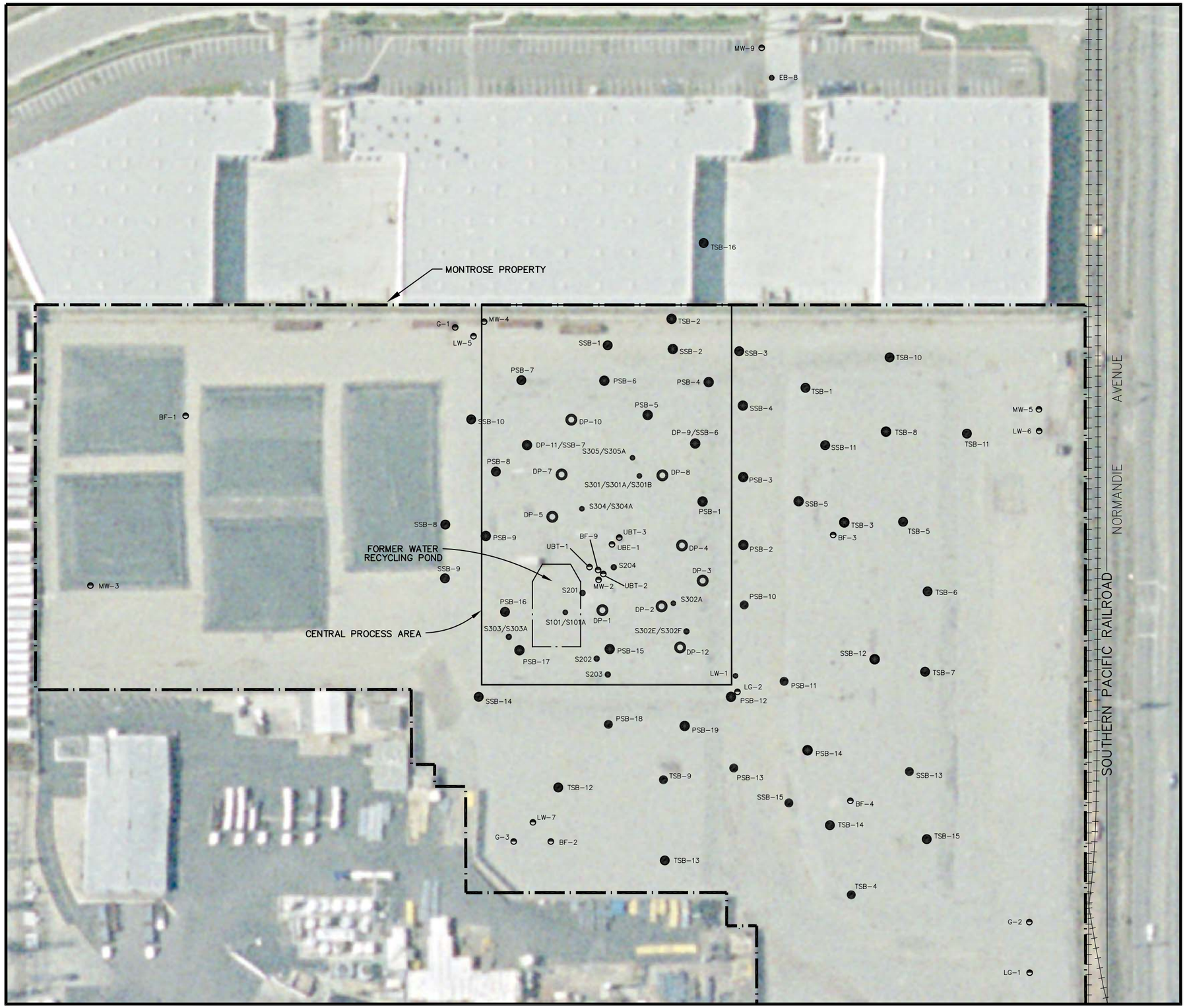
FORMER MONTROSE PLANT FEATURES

HARGIS + ASSOCIATES, INC.

10/04

FIGURE 2

PREP BY GTC REV BY MAP RPT NO. 857.04a 410-4922 B



EXPLANATION

S305/S305A	PREVIOUS SOIL BORING
MW-2	MONITOR WELL
PSB-7	SONIC BORING
DP-10	DIRECT PUSH BORING
— · —	PROPERTY BOUNDARY

0 100 200

FEET

MONTROSE CHEMICAL CORPORATION OF CALIFORNIA

TORRANCE, CALIFORNIA

BORING LOCATIONS

HARGIS + ASSOCIATES, INC.
Hydrogeology/Engineering

10/04

FIGURE 3

PREP BY CAP REV BY MAP RPT NO. 857.04a | 410-4585 | B

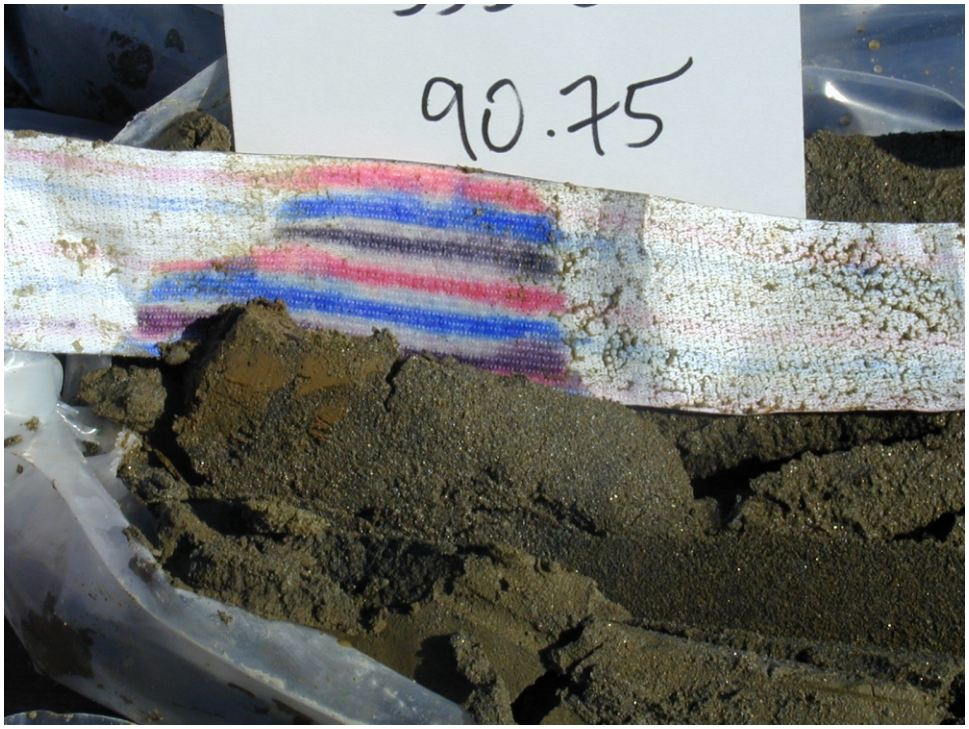
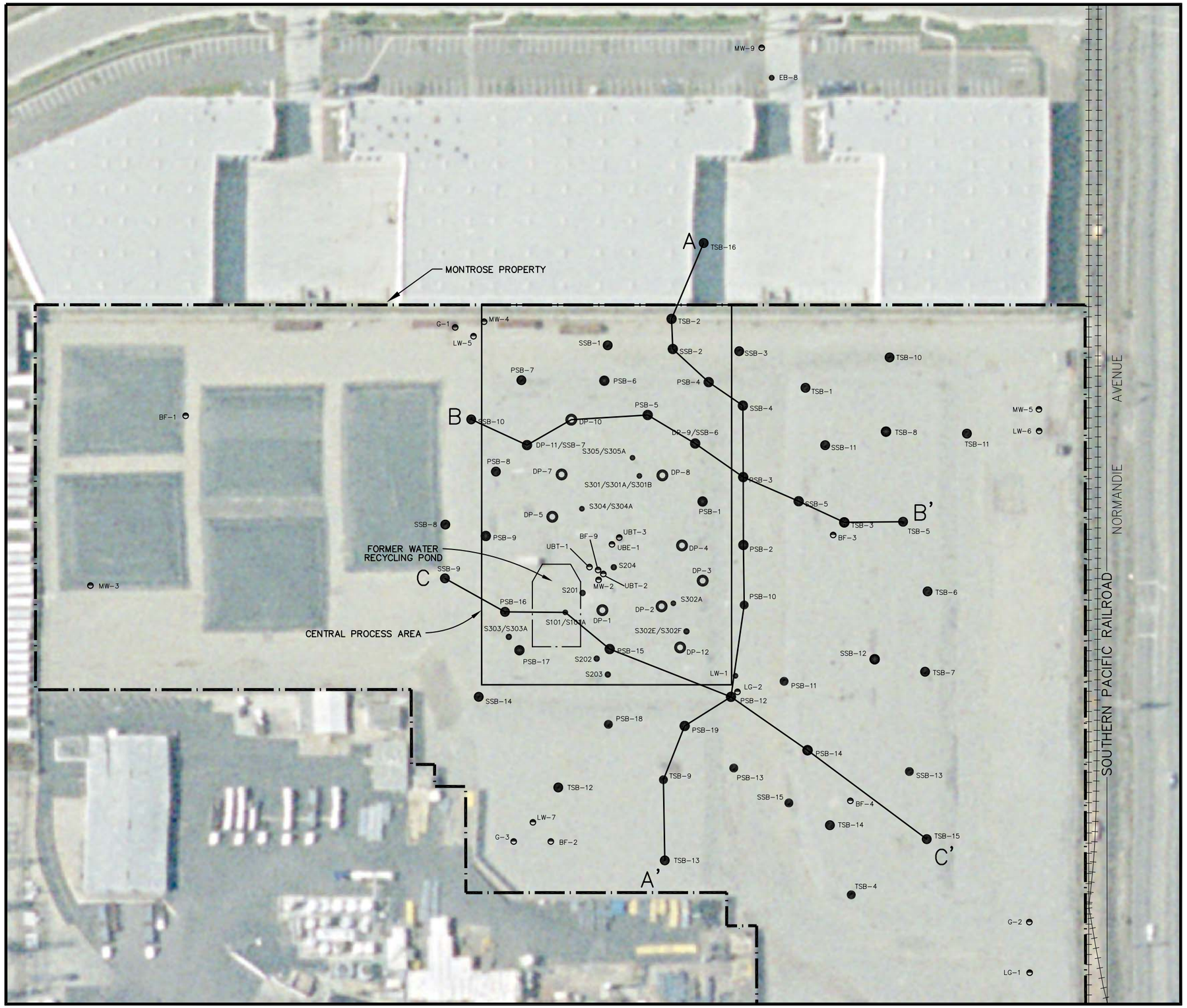


PHOTO 1: DNAPL STAINING IN BORING SSB-6 AT 90.75 FEET BELOW LAND SURFACE

PHOTO 2: DNAPL STAINING IN BORING PSB-15 AT 75 FEET BELOW LAND SURFACE

FIGURE 4. EXAMPLES OF FLUTe RIBBON STAINING



EXPLANATION

S305/S305A	PREVIOUS SOIL BORING
MW-2	MONITOR WELL
PSB-7	SONIC BORING
DP-10	DIRECT PUSH BORING
— · —	PROPERTY BOUNDARY
A——A'	CROSS SECTION LOCATION

0 100 200

FEET

MONTROSE CHEMICAL CORPORATION OF CALIFORNIA

TORRANCE, CALIFORNIA

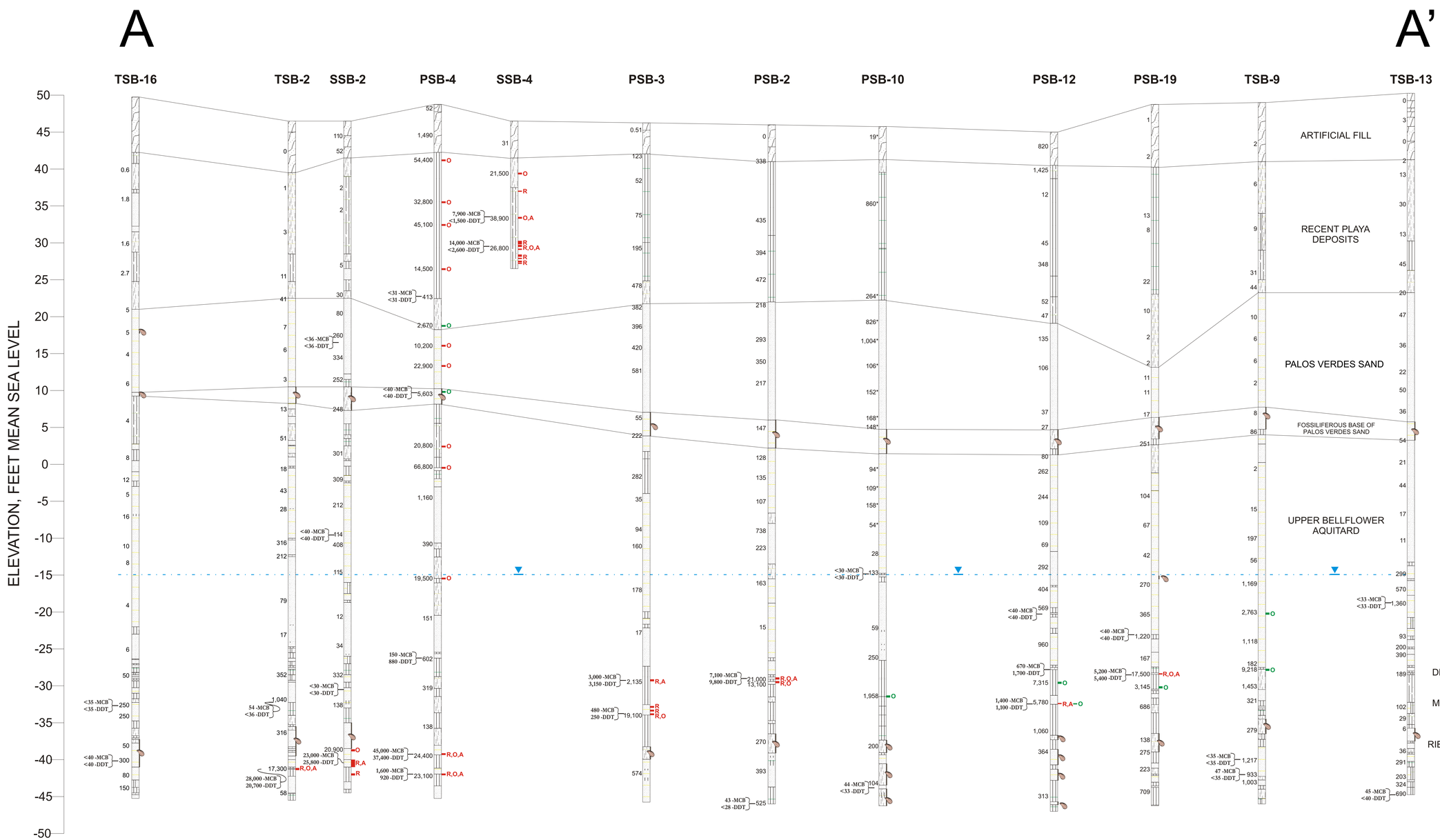
CROSS SECTION LOCATIONS

HARGIS + ASSOCIATES, INC.
Hydrogeology/Engineering

10/04

FIGURE 5

PREP BY CAP REV BY MAP RPT NO. 857.04a | 410-4923 | A



EXPLANATION

- FILL
- SAND
- SILTY SAND
- CLAYEY SAND
- SANDY SILT
- SILT
- CLAY
- SHELLS
- 3,145 — FID READING IN PPM
- <40 -MCB / <40 -DDT — CONCENTRATION OF CHLOROBENZENE AND DDT IN MG/KG
- DNAPL PRESENT
- DNAPL POSSIBLY PRESENT
- V,R,O,A — BASIS OF DETERMINATION OF DNAPL PRESENCE
  - VISUAL
  - RIBBON TEST
  - OVA READING
  - LABORATORY ANALYSIS
- APPROXIMATE GROUNDWATER SURFACE (-15 FEET MSL) BASED ON SEPTEMBER 2002 MEASUREMENTS

VERTICAL SCALE (feet): 0, 6.25, 12.5
HORIZONTAL SCALE (feet): 0, 25, 50
5 TO 1 VERTICAL EXAGGERATION

NOTES

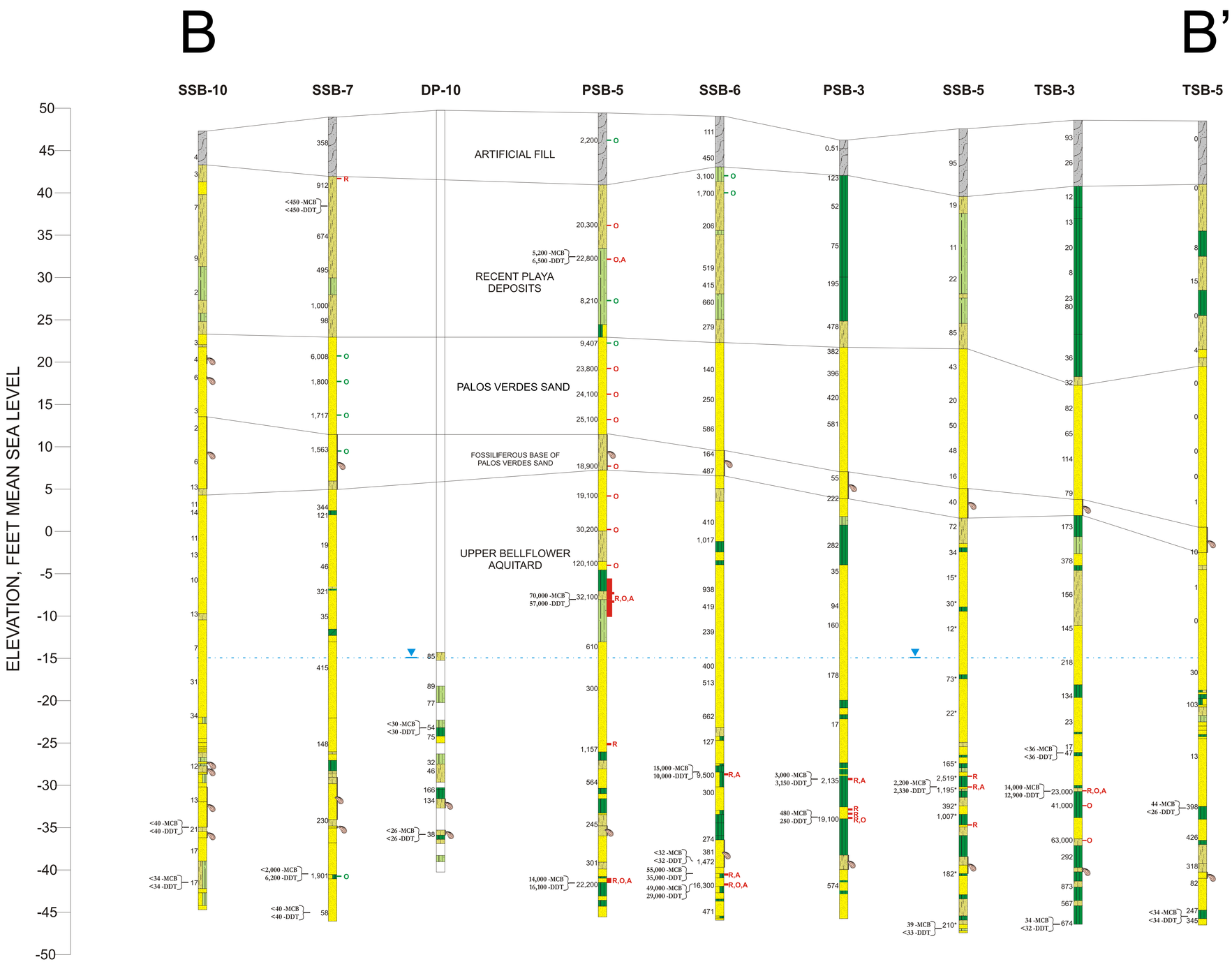
DDT	=	DICHLORODIPHENYLTRICHLOROETHANE
DNAPL	=	DENSE NONAQUEOUS PHASE LIQUID
FID	=	FLAME IONIZATION DETECTOR
MCB	=	CHLOROBENZENE
MG/KG	=	MILLIGRAMS PER KILOGRAM
MSL	=	MEAN SEA LEVEL
OVA	=	ORGANIC VAPOR ANALYZER
PPM	=	PARTS PER MILLION
RIBBON	=	HYDROPHOBIC DYE-IMPREGNATED FABRIC
*	=	READING FROM PHOTOIONIZATION DETECTORS

MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

CROSS SECTION A - A'

HARGIS + ASSOCIATES, INC.
Hydrogeology/ Engineering

10/04
FIGURE 6
310-0552.CDR



EXPLANATION

- FILL
- SAND
- SILTY SAND
- CLAYEY SAND
- SANDY SILT
- SILT
- CLAY
- SHELLS
- 3,145 — FID READING IN PPM
- <40 -MCB, <40 -DDT — CONCENTRATION OF CHLOROBENZENE AND DDT IN MG/KG
- DNAPL PRESENT
- DNAPL POSSIBLY PRESENT
- V,R,O,A — BASIS OF DETERMINATION OF DNAPL PRESENCE
  - VISUAL
  - RIBBON TEST
  - OVA READING
  - LABORATORY ANALYSIS
- APPROXIMATE GROUNDWATER SURFACE (-15 FEET MSL) BASED ON SEPTEMBER 2002 MEASUREMENTS

VERTICAL SCALE (feet): 0, 6.25, 12.5
HORIZONTAL SCALE (feet): 0, 25, 50
5 TO 1 VERTICAL EXAGGERATION

NOTES

DDT	=	DICHLORODIPHENYITRICHLOROETHANE
DNAPL	=	DENSE NONAQUEOUS PHASE LIQUID
FID	=	FLAME IONIZATION DETECTOR
MCB	=	CHLOROBENZENE
MG/KG	=	MILLIGRAMS PER KILOGRAM
MSL	=	MEAN SEA LEVEL
OVA	=	ORGANIC VAPOR ANALYZER
PPM	=	PARTS PER MILLION
RIBBON	=	HYDROPHOBIC DYE-IMPREGNATED FABRIC
*	=	READING FROM PHOTOIONIZATION DETECTORS

MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

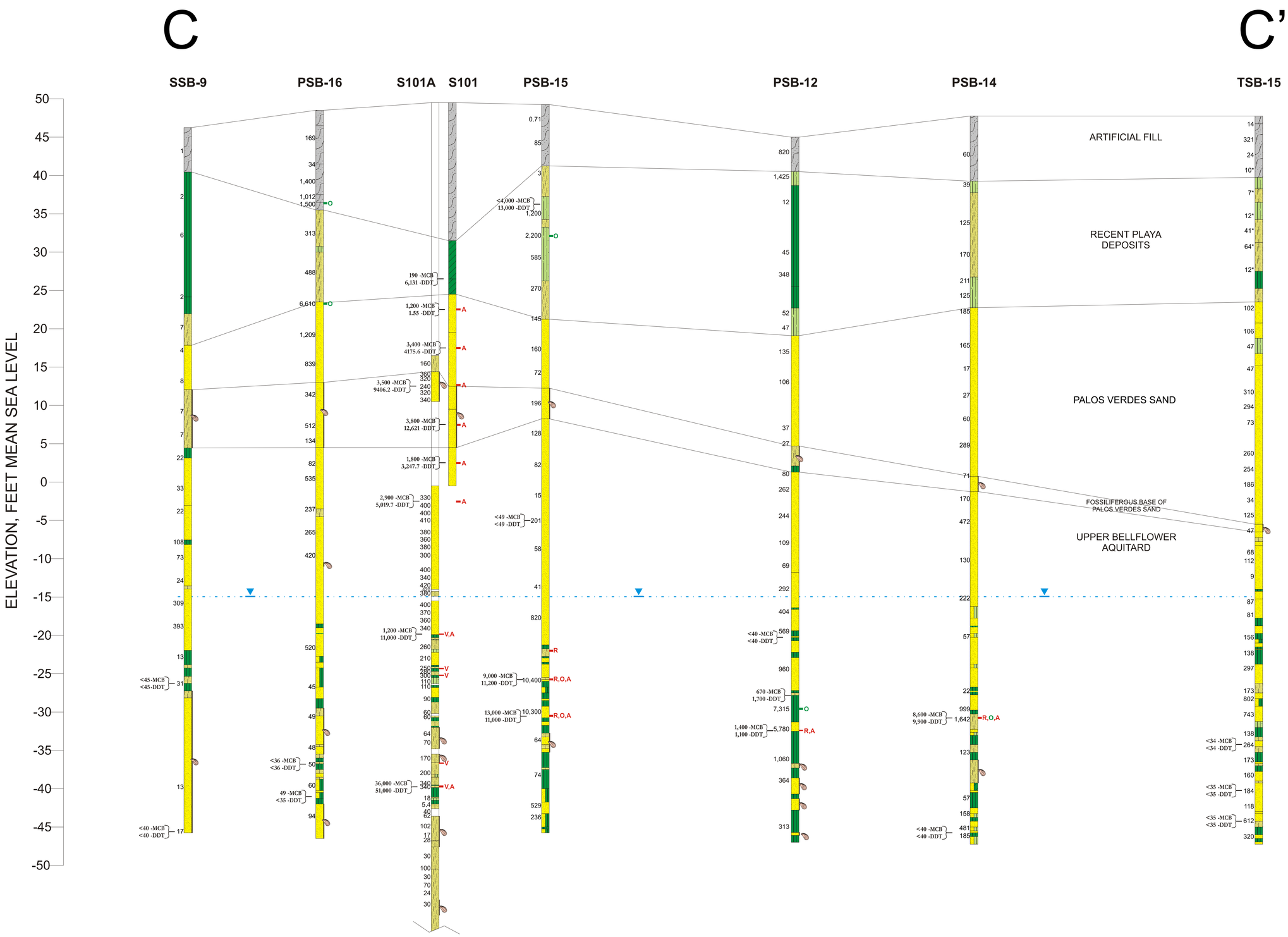
CROSS SECTION B - B'

HARGIS + ASSOCIATES, INC.
Hydrogeology/ Engineering

06/04

FIGURE 7

310-0553.CDR



EXPLANATION

- FILL
- SAND
- SILTY SAND
- CLAYEY SAND
- SANDY SILT
- SILT
- CLAY
- SHELLS
- 3,145 — FID READING IN PPM
- <40 -MCB / <40 -DDT — CONCENTRATION OF CHLOROBENZENE AND DDT IN MG/KG
- DNAPL PRESENT
- DNAPL POSSIBLY PRESENT
- V,R,O,A — BASIS OF DETERMINATION OF DNAPL PRESENCE
  - VISUAL
  - RIBBON TEST
  - OVA READING
  - LABORATORY ANALYSIS
- APPROXIMATE GROUNDWATER SURFACE (-15 FEET MSL) BASED ON SEPTEMBER 2002 MEASUREMENTS

VERTICAL SCALE (feet): 0, 6.25, 12.5
HORIZONTAL SCALE (feet): 0, 25, 50
5 TO 1 VERTICAL EXAGGERATION

NOTES

DDT	=	DICHLORODIPHENYITRICHLOROETHANE
DNAPL	=	DENSE NONAQUEOUS PHASE LIQUID
FID	=	FLAME IONIZATION DETECTOR
MCB	=	CHLOROBENZENE
MG/KG	=	MILLIGRAMS PER KILOGRAM
MSL	=	MEAN SEA LEVEL
OVA	=	ORGANIC VAPOR ANALYZER
PPM	=	PARTS PER MILLION
RIBBON	=	HYDROPHOBIC DYE-IMPREGNATED FABRIC
*	=	READING FROM PHOTOIONIZATION DETECTORS

MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

CROSS SECTION C - C'

06/04

HARGIS + ASSOCIATES, INC.
Hydrogeology/ Engineering

FIGURE 8

310-0554.CDR

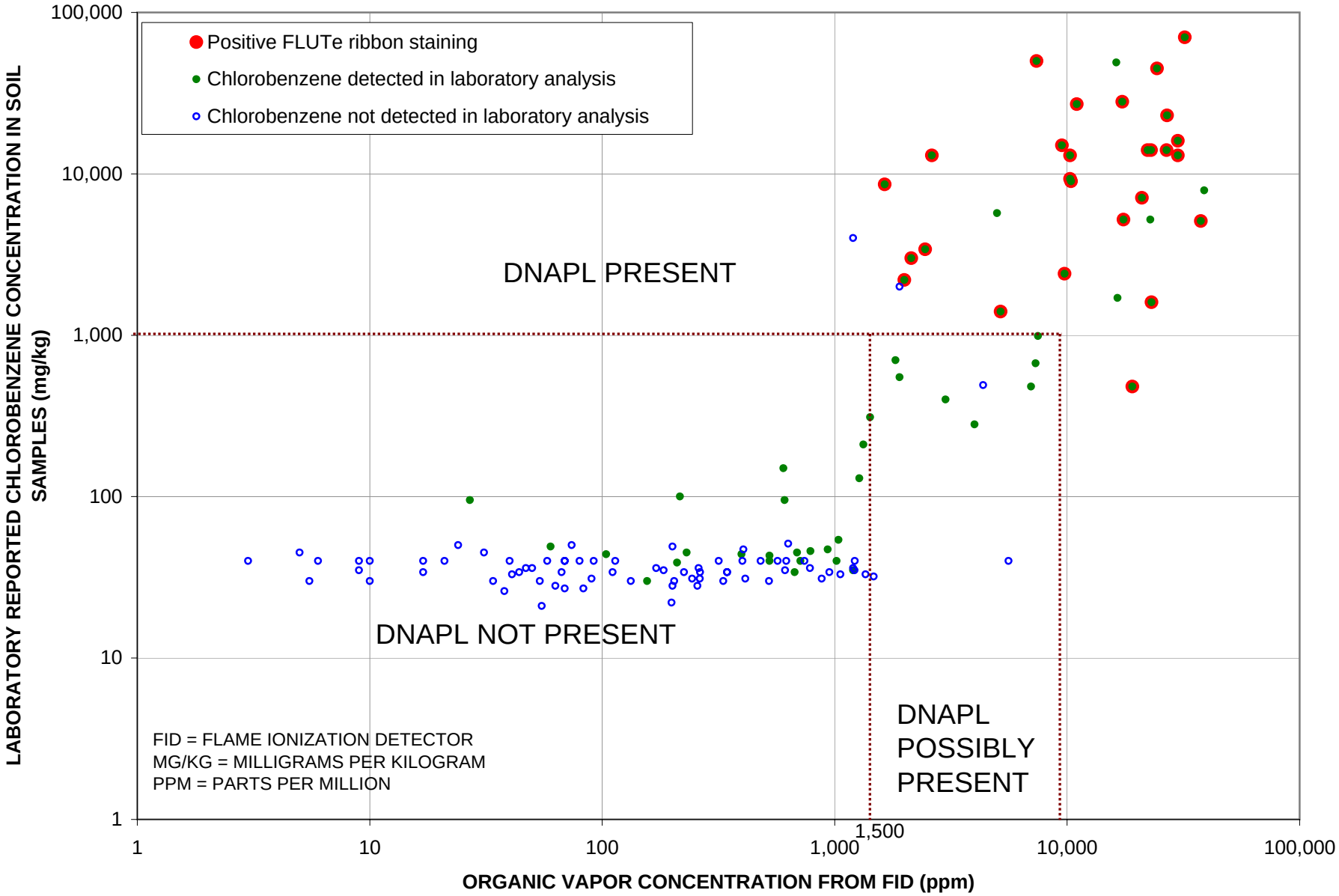


FIGURE 9: CHLOROBENZENE CONCENTRATION IN SOIL SAMPLES VS FID READINGS

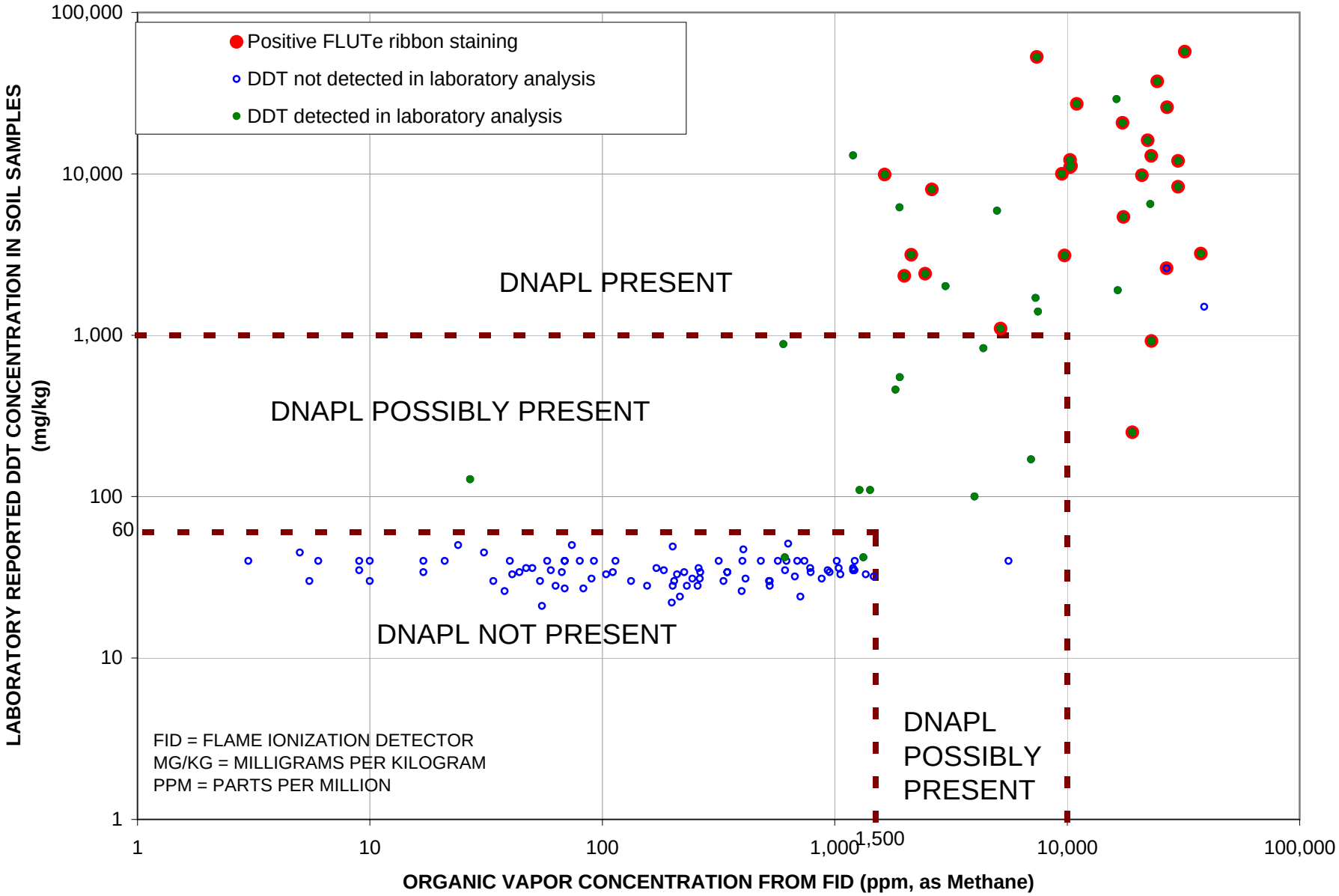
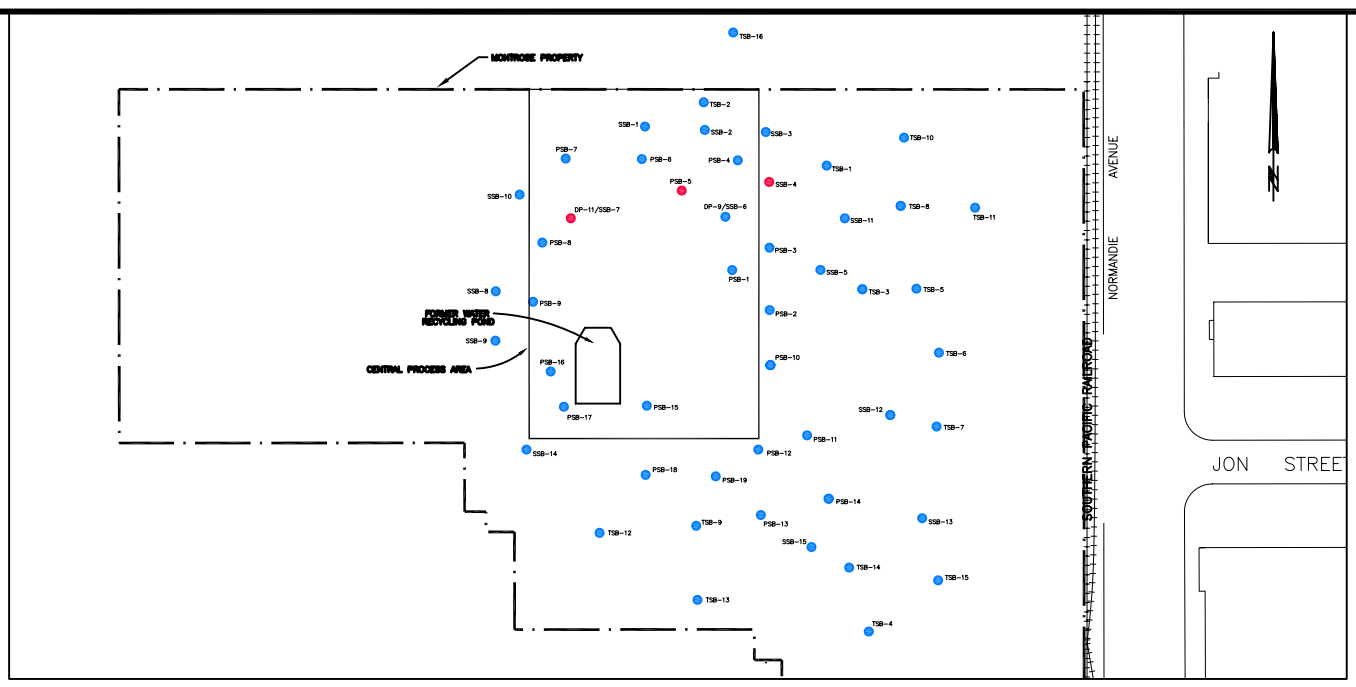
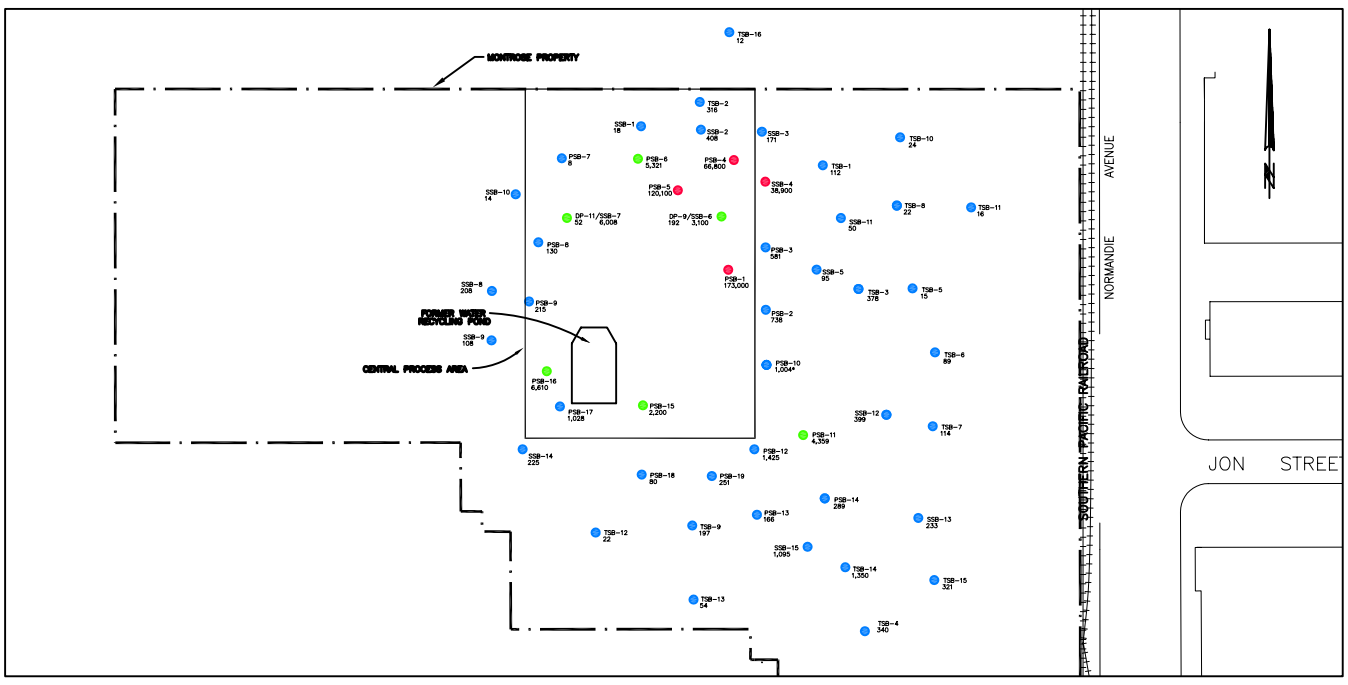


FIGURE 10: DDT CONCENTRATION IN SOIL SAMPLES VS FID READINGS



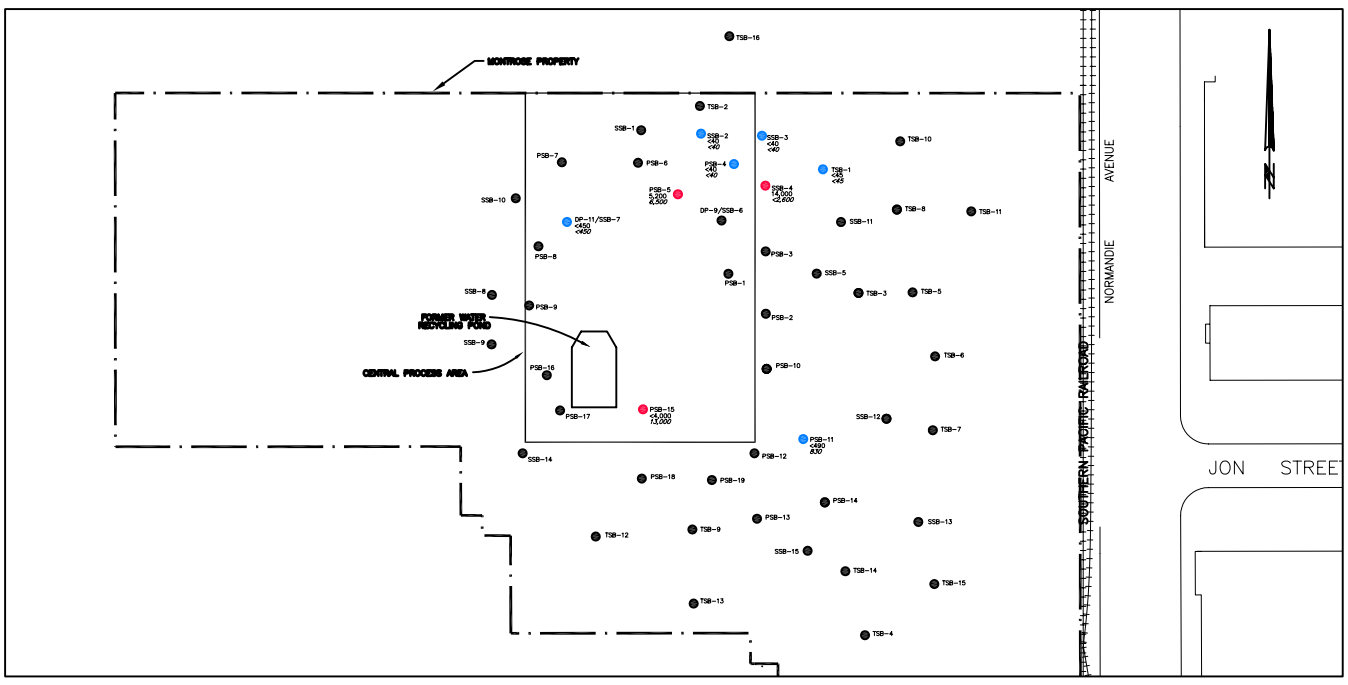
FLUTe RIBBON RESULTS IN VADOSE ZONE

- DIRECT PUSH BORING
- SONIC BORING
- RED = POSITIVE FLUTe RIBBON (STAINING)
- BLUE = NEGATIVE FLUTe RIBBON (NO STAINING)



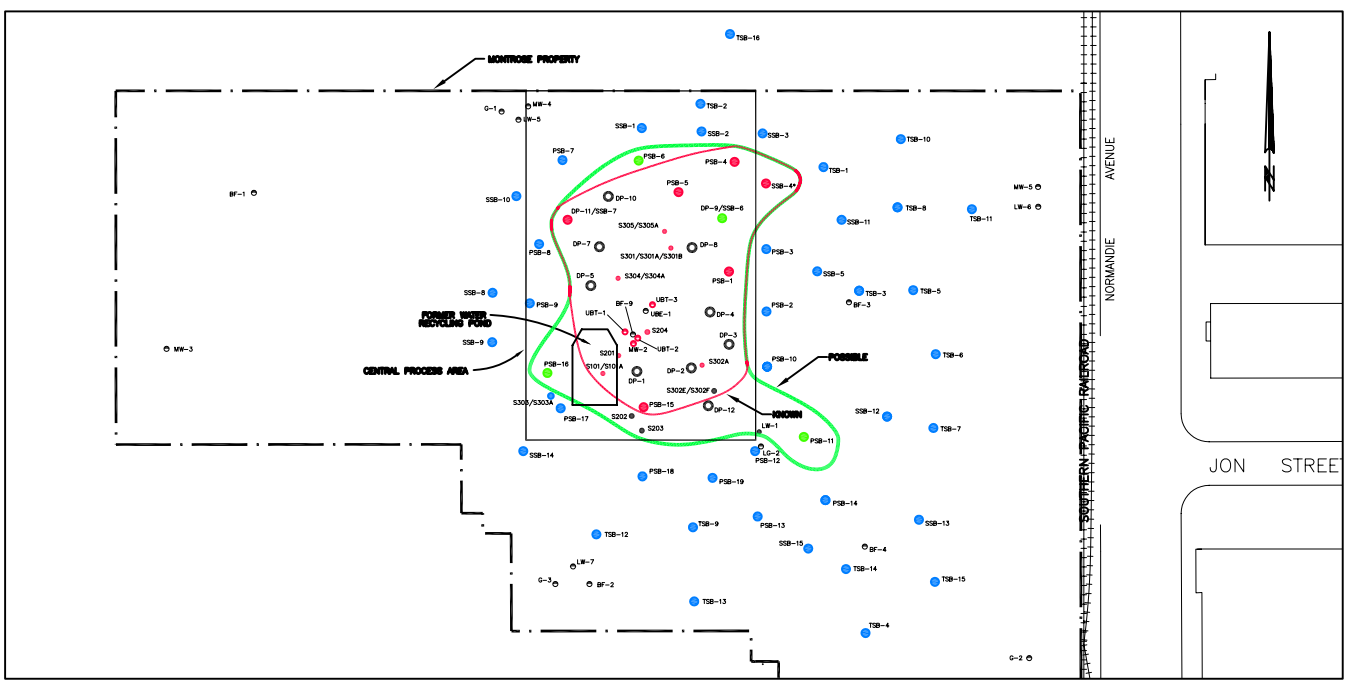
OVA RESULTS IN VADOSE ZONE

- DIRECT PUSH BORING
- SONIC BORING
- 38,900 = MAXIMUM FID READING, SEE BORING LOGS FOR ADDITIONAL FID READINGS (APPENDIX A)
- • = PID READING
- RED = FID READINGS ≥10,000 PPM
- GREEN = FID READINGS 1,500 – <10,000 PPM
- BLUE = FID READINGS 0 – <1,500 PPM



LABORATORY ANALYSIS RESULTS IN VADOSE ZONE

- DIRECT PUSH BORING
- SONIC BORING
- 5,200 = MAXIMUM CHLOROBENZENE CONCENTRATION (MG/KG) SEE TABLE 1 FOR ADDITIONAL DATA
- 6,500 = MAXIMUM TOTAL DDT CONCENTRATION (MG/KG) SEE TABLE 1 FOR ADDITIONAL DATA
- RED = CHLOROBENZENE ≥1,000 MG/KG; TOTAL DDT ≥ 1,000 MG/KG
- GREEN = CHLOROBENZENE 180 – <1,000 MG/KG; TOTAL DDT 60 – <1,000 MG/KG
- BLUE = CHLOROBENZENE ND – <180 MG/KG; TOTAL DDT ND – <60 MG/KG
- BLACK = NO DATA AVAILABLE



DNAPL IN VADOSE ZONE

- PREVIOUS BORING
- MONITOR WELL
- DIRECT PUSH BORING
- SONIC BORING
- RED = DNAPL PRESENT
- GREEN = DNAPL POSSIBLY PRESENT
- BLUE = DNAPL NOT PRESENT

NOTES

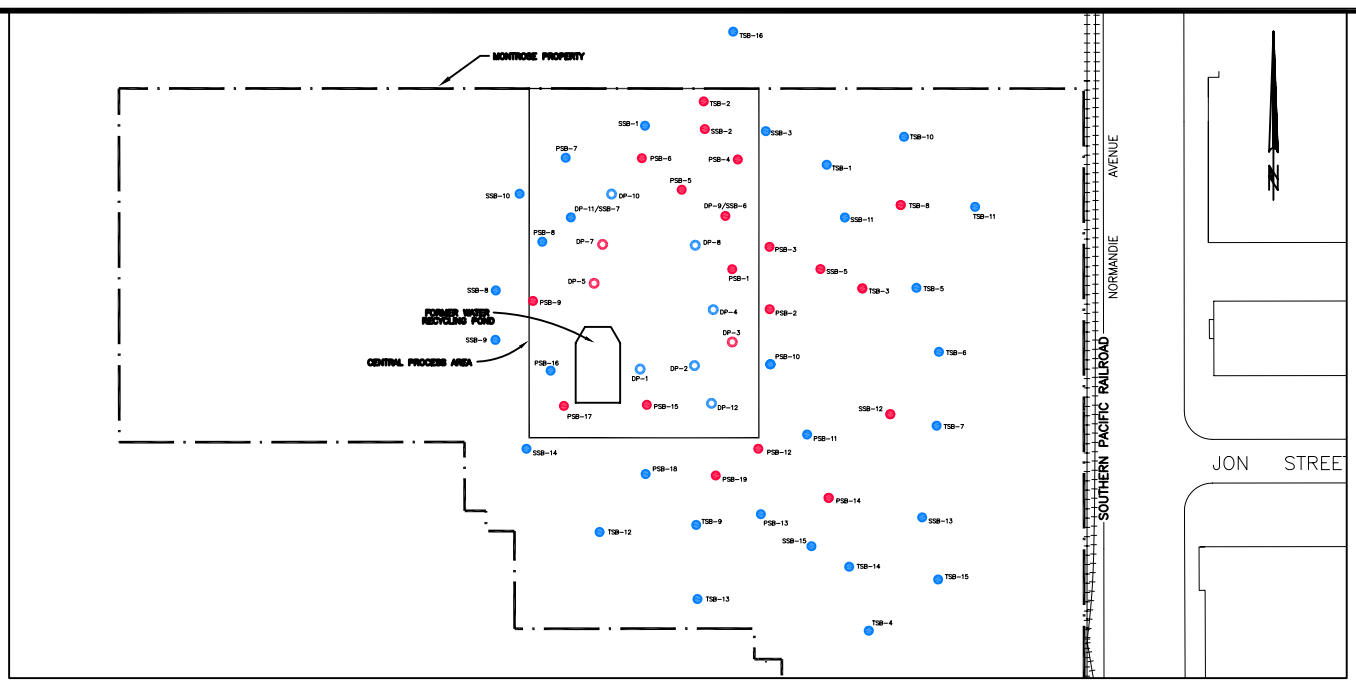
- PPM = PARTS PER MILLION
- MG/KG = MILLIGRAMS PER KILOGRAM
- CPT = CONE PENETROMETER TEST
- FLUTe RIBBON = HYDROPHOBIC DYE – IMPREGNATED FABRIC
- DNAPL = DENSE NONAQUEOUS PHASE LIQUID

HARGIS + ASSOCIATES, INC.
Hydrogeology/Engineering

10/04	RPT NO. 857.04a	410-4918	B

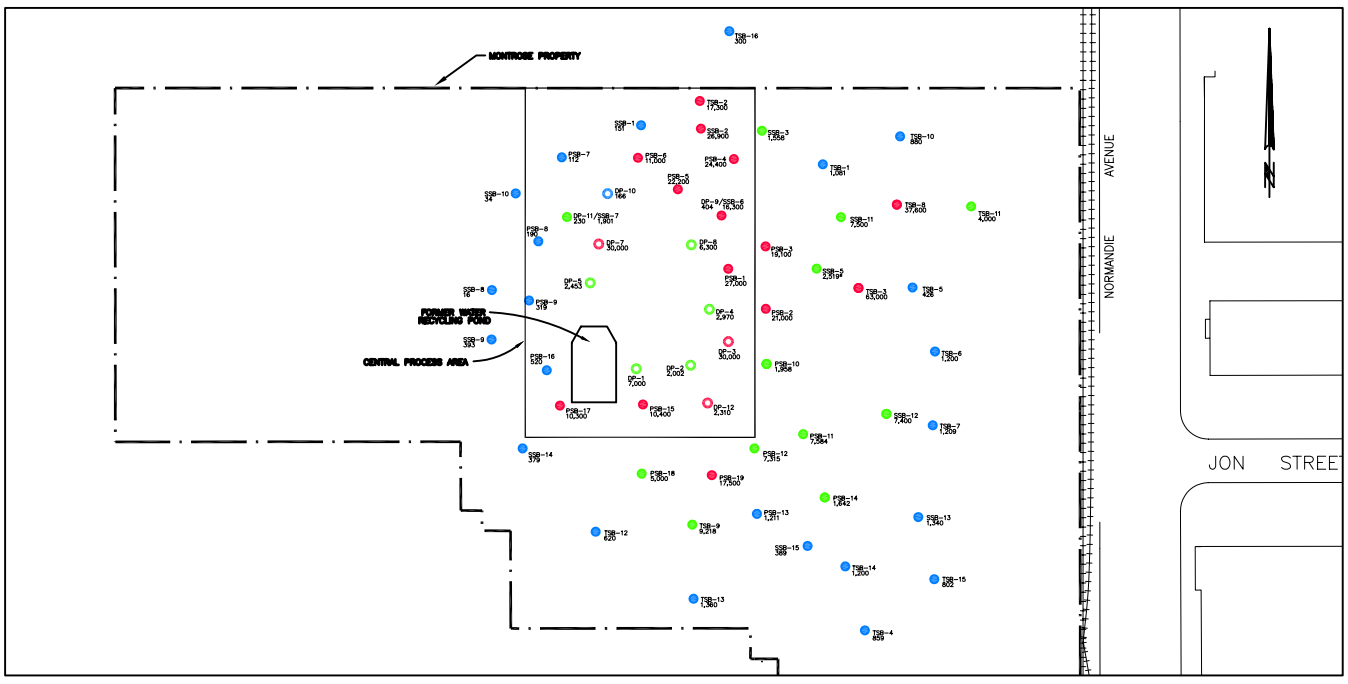
FIGURE 11.
DNAPL IN VADOSE ZONE

0 100 200
FEET



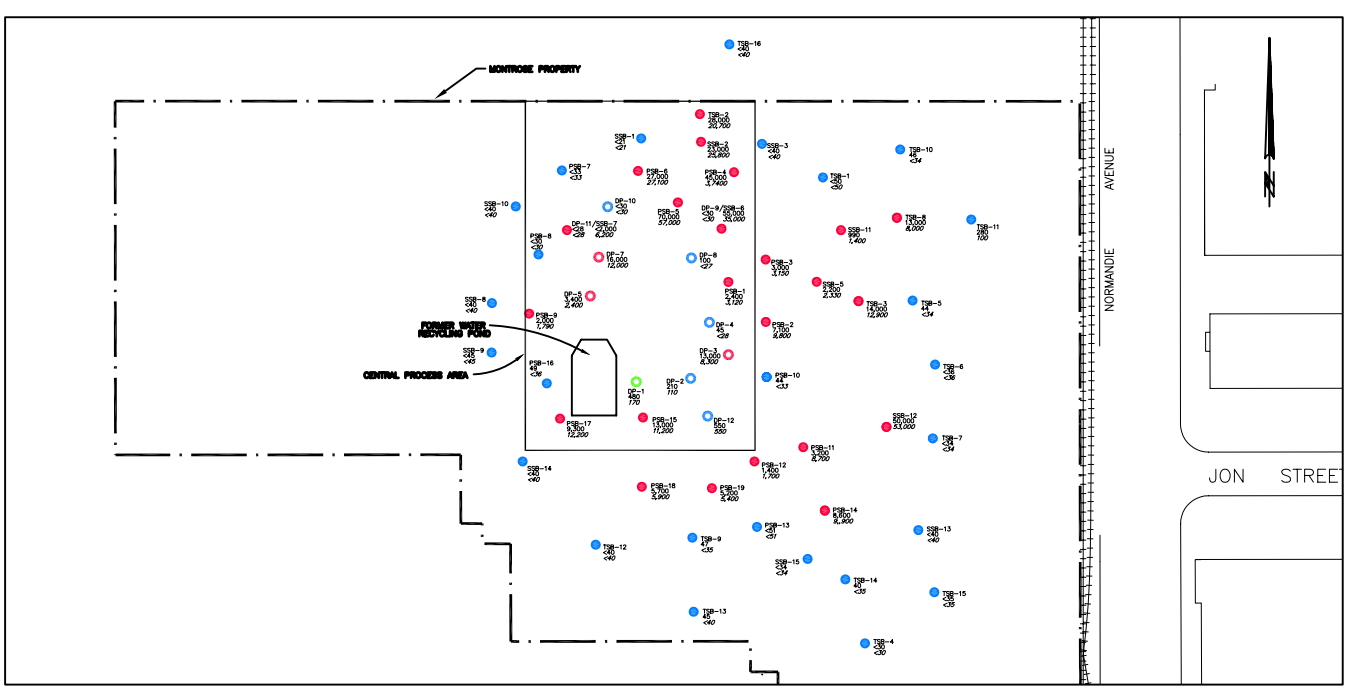
FLUTe RIBBON RESULTS IN SATURATED UPPER BELLFLOWER AQUITARD

- DIRECT PUSH BORING
- SONIC BORING
- RED = POSITIVE FLUTe RIBBON (STAINING)
- BLUE = NEGATIVE FLUTe RIBBON (NO STAINING)



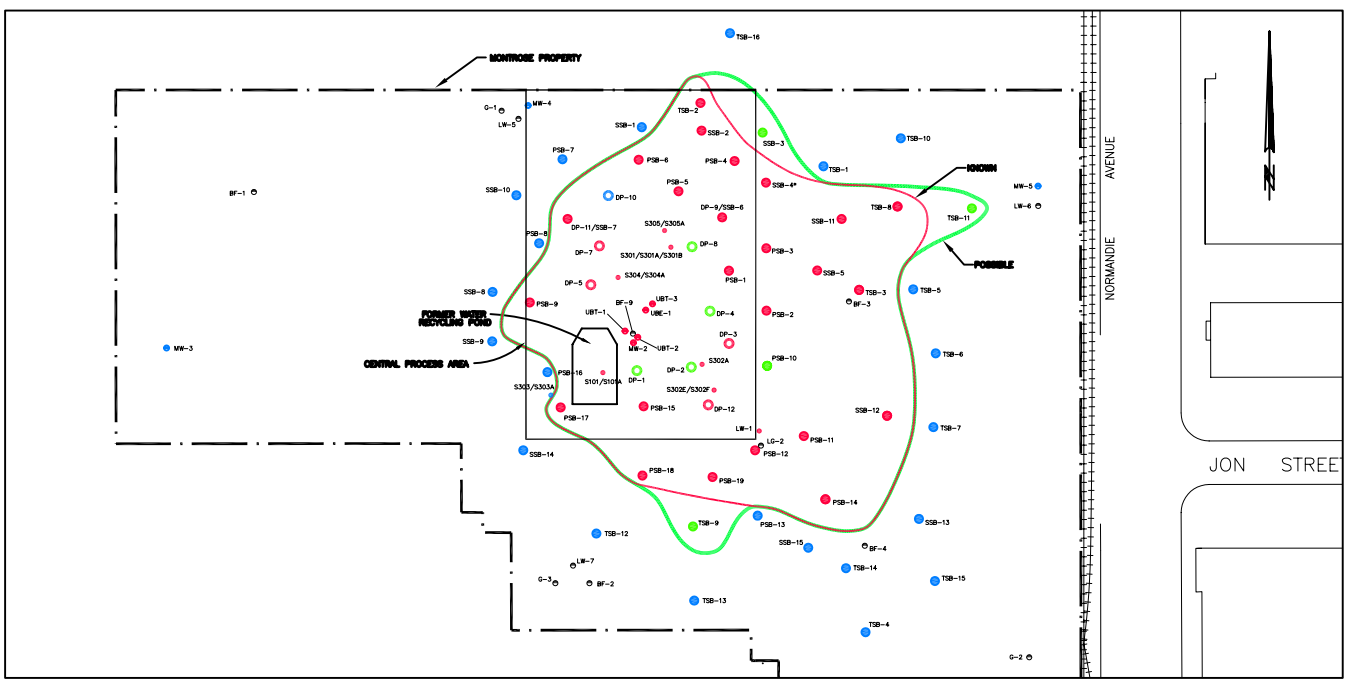
OVA RESULTS IN SATURATED UPPER BELLFLOWER AQUITARD

- DIRECT PUSH BORING
- SONIC BORING
- 1,200 = MAXIMUM FID READING, SEE BORING LOGS FOR ADDITIONAL FID READINGS (APPENDIX A)
- * = PID READING
- RED = FID READINGS ≥10,000 PPM
- GREEN = FID READINGS 1,500 – <10,000 PPM
- BLUE = FID READINGS 0 – <1,500 PPM



LABORATORY ANALYSIS RESULTS IN SATURATED UPPER BELLFLOWER AQUITARD

- DIRECT PUSH BORING
- SONIC BORING
- 280 = MAXIMUM CHLOROBENZENE CONCENTRATION (MG/KG) SEE TABLE 1 FOR ADDITIONAL DATA
- 100 = MAXIMUM TOTAL DDT CONCENTRATION (MG/KG) SEE TABLE 1 FOR ADDITIONAL DATA
- RED = CHLOROBENZENE ≥1,000 MG/KG; TOTAL DDT ≥ 1,000 MG/KG
- GREEN = CHLOROBENZENE 230 – <1,000 mg/kg; TOTAL DDT 60 – <1,000 MG/KG
- BLUE = CHLOROBENZENE ND – <230 MG/KG; TOTAL DDT ND – <60 MG/KG



DNAPL IN SATURATED UPPER BELLFLOWER AQUITARD

- PREVIOUS BORING
- MONITOR WELL
- DIRECT PUSH BORING
- SONIC BORING
- * DNAPL ASSUMED TO BE AT LOCATION BASED ON PRESENCE IN UPPER BELLFLOWER AQUITARD
- BLUE = DNAPL NOT PRESENT
- GREEN = DNAPL POSSIBLY PRESENT
- RED = DNAPL PRESENT

NOTES

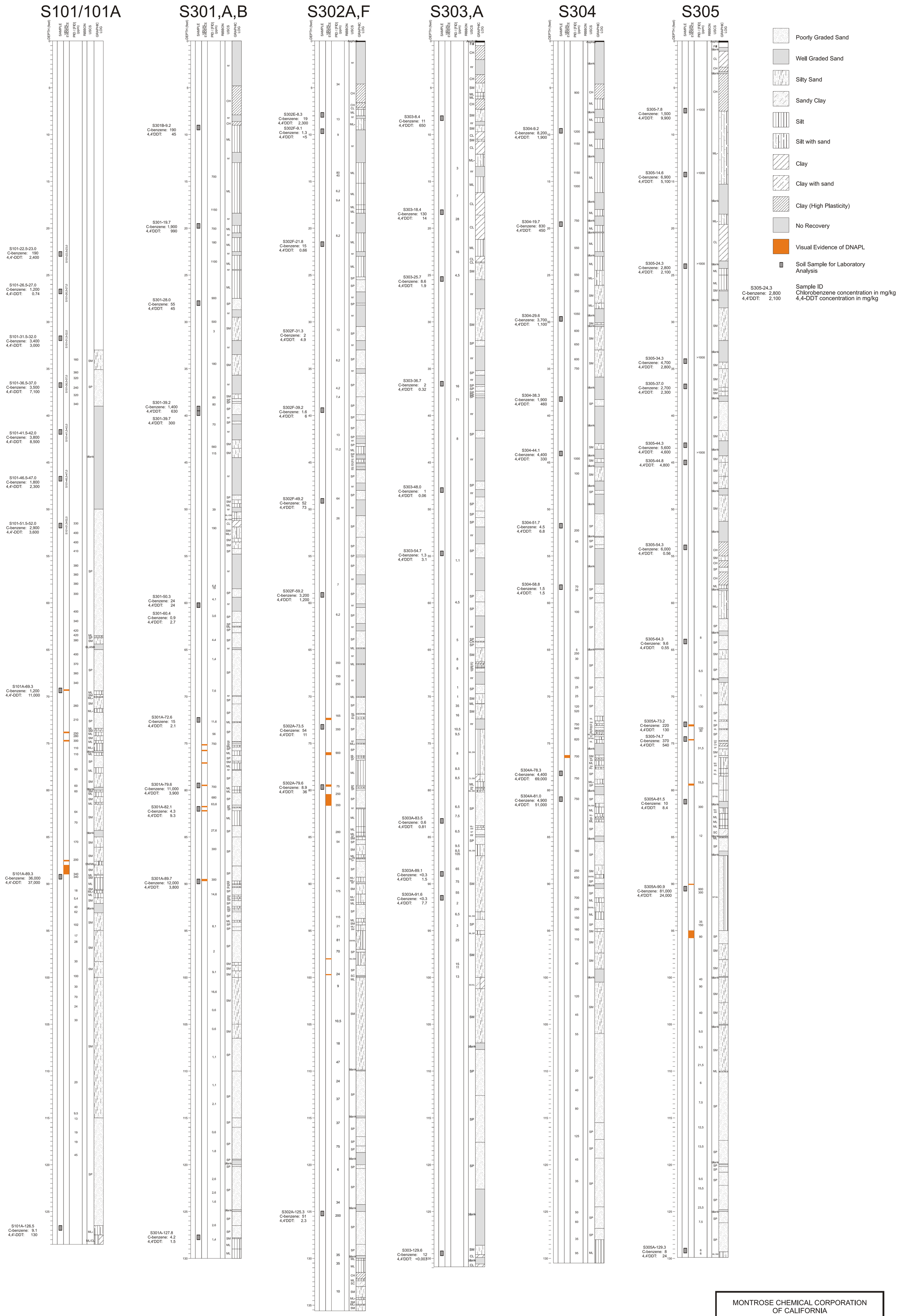
- PPM = PARTS PER MILLION
- MG/KG = MILLIGRAMS PER KILOGRAM
- CPT = CONE PENETROMETER TEST
- FLUTe RIBBON = HYDROPHOBIC DYE – IMPREGNATED FABRIC
- DNAPL = DENSE NONAQUEOUS PHASE LIQUID

HARGIS + ASSOCIATES, INC.
Hydrogeology/Engineering

10/04	RPT NO. 857.04a	410-4919	B

FIGURE 12.
DNAPL IN SATURATED UPPER BELLFLOWER AQUITARD

0 100 200
FEET



MONTROSE CHEMICAL CORPORATION OF CALIFORNIA

TORRANCE, CALIFORNIA

BELLFLOWER SAND SOIL BORINGS

HARGIS + ASSOCIATES, INC.
Hydrogeology/ Engineering

10/04

FIGURE 13

310-0599.CDR