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April 24, 2018

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DEPARTMENT OF TOXIC SUBSTANCES CONTROL'S COMMENTS ON THE DEPARTMENT OF ENERGY'S DRAFT CHEMICAL DATA SUMMARY REPORT, SANTA SUSANA FIELD LABORATORY, VENTURA COUNTY, CALIFORNIA

Dear Mr. Jones:

The Department of Toxic Substances Control (DTSC) reviewed the *"Draft Chemical Data Summary Report, Santa Susana Field Laboratory, Ventura County, California"*, (DSR Report) dated January 2017 and prepared for the United States Department of Energy (DOE).

Per our discussions, the development and submittal of DTSC's comments on the DSR Report were not a high priority relative to the status of DOE's Final Environmental Impact Statement and DTSC's efforts to develop and issue the Draft Program Environmental Impact Report.

Attached is a technical memorandum from DTSC's Geologic Services Branch presenting comments on the DSR Report. DTSC's review identifies necessary revisions and the DSR Report should be revised and resubmitted to the DTSC prior to final approval. Although the text of the report requires further work, DTSC has determined that additional field investigation or data collection is not required to revise and finalize the document.

Please review the comments and begin preparing responses. DTSC would like to meet with DOE on May 16, 2018 to discuss the responses to comments and revisions to the report. If you have any questions regarding DTSC's review comments, please contact Laura Rainey via email at Laura.Rainey@dtsc.ca.gov or at (714) 484-5434.

Sincerely,

Roger Paulson, PE, Chief
Santa Susana Field Laboratory Unit
Department of Toxic Substances Control

Attachment: *Tech Memo with report comments: L. Rainey DTSC/GSB to R. Paulson SSFL Unit*

cc: (via e-mail)

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TO: Mark Malinowski
Branch Chief
Santa Susana Field Laboratory and Northern California Schools
Brownfields and Environmental Restoration Program

FROM: Laura Rainey, P.G.
Senior Engineering Geologist
Geological Services Branch
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PROFESSIONAL GEOLOGIST
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4/23/2018

DATE: April 23, 2018

SUBJECT: DRAFT CHEMICAL DATA SUMMARY REPORT, SANTA SUSANA FIELD LABORATORY, VENTURA COUNTY, CALIFORNIA

PCA: 27018 Site Code: 300381-35

DOCUMENT REVIEWED

Draft Chemical Data Summary Report, Santa Susana Field Laboratory, Ventura County, California prepared by CDM Federal Programs Corporation (CDM Smith) for U.S. Department of Energy (DOE), dated January 2017.

As requested, the Geological Services Branch (GSB) of the Department of Toxic Substances Control (DTSC) reviewed the above-referenced document. If you have any questions or comments regarding this memorandum, please contact Laura Rainey at (714) 484-5434

BACKGROUND

The 2010 Administrative Order on Consent for Remedial Action (AOC; Docket No. HSA-CO 10/11 – 037) was signed by the United States Department of Energy (DOE) and the California Department of Toxic Substances Control (DTSC). The AOC applies to Area IV and the Northern Buffer Zone of the Santa Susana Field Laboratory (SSFL). Section

2.5 of the AOC specifies the requirement to conduct chemical investigation activities for soils in Area IV and the Northern Buffer Zone (the Site). This section requires completion of Phase 1 co-located sampling with the United States Environmental Protection Agency (USEPA) for chemical analyses. Phase 2 sampling is also required, which consists of co-located samples from random locations selected by U.S. EPA for chemical analyses. The required Phase 3 chemical data gap investigation is required to focus on collection of data needed to complete the soil chemical investigation. Section 2.7 of the AOC requires that a Chemical Data Summary Report (CDSR) be prepared and submitted for DTSC review and approval. The CDSR is to contain a summary of the entirety of the data collection efforts, and shall include the horizontal and vertical extent of contamination in the soils at the Site that exceed background levels of chemical contaminants.

DTSC received the Draft CDSR, dated January 2017. This technical memorandum is a summary of the GSB's comments regarding the draft CDSR. GSB requests that the comments be addressed and a revised final CDSR be submitted for review. Upon receipt of DTSC's approval of the CDSR, within 60 days, DOE shall prepare and submit a draft Soils Remedial Action Implementation Plan to DTSC for review and approval. Completion and approval of the CDSR is thus an important milestone in progressing towards implementation of Site cleanup.

GENERAL COMMENTS

1. **Report content and format:** The report is generally well organized and complete. Specific items that are either missing or require clarification are referenced in the following specific comments. A significant volume of data and documents are presented in the DOE draft Chemical Data Summary Report (CDSR). To ease access of this voluminous information, please consider providing the following:
    - Provide links in Section 2 for relevant documents cited to the documents provided electronically in Appendix B.
    - Provide an Index file listing all documents in the appendices (e.g., analytical summary tables included in Appendix A and all technical documents in Appendix B, etc.), with each title in the index hyperlinked directly to the relevant document. Alternatively, please indicate for each title listed, the CD where the document is located.
    - Please submit relevant information and data as an ARCGIS map file (mxd), and associated databases as future remediation planning documents are submitted.

2. **Deriving Constituents of Concern:** The CDSR introduces the process for deriving chemical constituents of concern (COCs). The proposed use of COCs for remediation planning is consistent with the Administrative Order on Consent

for Remedial Action (AOC) requirements, as the AOC's Confirmation Sampling Protocol states that "the concentrations of radiological and chemical contaminants of concern observed in the confirmation samples will be compared directly to the concentrations listed in the "Look-up" Tables of radiological and chemical cleanup levels."

3. **Addressing Analytical Method Uncertainty for use with the Look-Up Table Process:** The CDSR includes a summary of considerable efforts taken throughout the chemical investigation to ensure that data quality objectives (DQOs) were met. All analytical measurements have some inherent level of random analytical method uncertainty, and various steps are taken by the laboratory to manage and constrain these uncertainties. The data quality review section of the CDSR describes the evolution of how some analytical uncertainties for various chemical classes were identified and ultimately addressed in data presentation (e.g., calculation of dioxin toxicity equivalency (TEQ) and benzo(a)pyrene (BaP) TEQs, and adjustments of low level MRLs for some pesticides, herbicides, and PCBs). The data validation and evaluation efforts conducted throughout the chemical investigation were comprehensive, and ensured that data met the quality required for its intended use (for characterization). Demonstration of DQO achievement on a per sample batch basis for low level MRLs (having a target of an order of magnitude less than routine MRLs) for some organic methods during the earliest phase of co-located sampling was not conducted, and this limitation was recognized later on. Future MRL analyses will require a demonstration of achievement of MRLs that meet acceptable data quality criteria. A lesson learned from these efforts was an increased awareness for the need to demonstrate both up front and throughout the analytical program that MRLs can be achieved with sufficient data quality, as low level MRLs are targeted.

   While the CDSR notes the importance of managing uncertainty for cleanup decisions, more discussion should be provided up front regarding the levels of uncertainty addressed when making characterization decisions, and how uncertainty must be even further constrained when making confirmation cleanup decisions. For example, during characterization, estimated values, which are values estimated at concentrations between the Method Detection Limit and the Method Reporting Limit, were used for point-by-point comparisons of the Look-up Table, and carry a higher level of analytical uncertainty than when making point-by-point comparisons with sample results quantified at the Method Reporting Limit. While this process was adequate for purposes of making characterization decisions, use of the LUT for making cleanup decisions should require data whose uncertainty is constrained within the limits specified within the LUT at the specified level of confidence. As noted in DTSC's chemical Look-up Table Technical Memorandum (DTSC, June 11, 2013), the LUT provides analytical

goals for multiple laboratories to report and use when establishing data quality objectives. Several Geological Services Branch (GSB) recommendations below are related to addressing analytical uncertainty issues identified during characterization in the upcoming remediation planning documents.

4. **Use of Risk-Based Screening Levels:** Inclusion of the risk-based screening level (RBSL) screening step for identifying COCs ultimately had no effect on selection of COCs. Of all the data evaluated, the few chemical classes identified as COCs that also exceeded their respective RBSL criteria (percent detects greater than respective RBSL at 5 percent or more) were the Dioxin TEQ, Benzo(a)pyrene (BaP) TEQ, and hexavalent chromium. However, none of these chemical classes relied on the RBSL screening criteria for selection as COCs. Based on these findings, incorporation of RBSLs into the final CDSR does not seem necessary, and thus should be removed prior to finalizing the CSDR.

   It may be worthy to note in the final CDSR that the key chemical risk driver at the site (in terms of frequency of detects greater than the RBSL) is arsenic, which was determined to be mostly naturally occurring. Regardless of the assumed receptor exposure scenario (e.g., suburban residential, suburban residential with garden, rural residential or recreator), the associated listed RBSLs in the Final SRAM Revision 2 Addendum (MWH, August 2014) are so low, most detects of arsenic are likely to exceed any of the RBSLs. Background concentrations of arsenic thus appear to be the greatest risk driver of all the chemicals evaluated.

5. **Section 3 Identification of Chemicals of Concern:** for clarity, please consider the following suggestions:
   - Explain criteria used to identify detected values (e.g., MDL or MRL);
   - With respect to managing analytical method uncertainty, please describe and explain the Look-up Table requirement for use of Measurement Quality Objectives (MQO) when generating confirmation data to be compared to the Look-up Table for determining whether Cleanup Levels have been exceeded . DTSC's Chemical Look-up Table Technical Memorandum requires that the analytical method uncertainty at the Cleanup Level [BTV or MRL] be constrained to a specified fraction of the Cleanup Level at a specified level of confidence (95 percent), or in other words, at a specified decision error rate (5 percent). The 95 percent confidence level is the complement of the error rate, and the specified confidence level was determined by the US EPA to be an appropriate balance between 5 percent Type I and Type II decision error rates.
   - Rather than state that laboratories are more likely to "falsely" report the presence of a chemical at the reporting limit concentration, please consider restating that analytical method uncertainty increases, and thus the likelihood of encountering false positives increases, as reporting limits

are pushed to increasingly lower levels. Use of MQOs is an important tool to manage this uncertainty, in that it requires specified parameters for generating data of defensible quality and accuracy and precision at the Method Reporting Limit Cleanup Level;

- Please clarify that while the Look-up Table (LUT) is designed to manage and constrain analytical uncertainty at the MRL, use of estimated data values that are not quantified at the MRL will have an even higher likelihood of analytical method uncertainty and thus don't meet the LUT's assumed MQOs. The AOC thus defines the "detection limit" as the Method Reporting Limit, which is the lowest concentration at which an analyte can be confidently detected in a sample and its concentration can be reported with a reasonable degree of accuracy and precision;
- Describe up front how the hot spot analysis was conducted, as it currently is not clear;
- Cross check sections to ensure all COCs identified are included in the relevant section write up;
- Explain the need for and benefit of using dioxin/furans Toxicity Equivalent (dioxin TEQ) and Benzo(a)pyrene (BaP) TEQ with respect to managing uncertainty associated with making point-by-point decisions when multiple analytes are involved. Please use consistent terminology when referring to dioxin TEQs;
- Please consider either revising or merging Sections 3 and 4, as information in Section 4 is often relevant to that of Section 3.

6. **Use of Measurement Quality Objectives:** The Look-up Table's Footnotes 1 and 2 indicate that in order to evaluate 2,3,7,8-Tetrachlorodibenzo-p-dioxin and Benzo(a)pyrene toxicity equivalents (Dioxin and BaP TEQs), dioxin-furans and carcinogenic PAHs need to meet their respective background study MRLs. The Summary of Data Quality Review and Findings section describes how analytical uncertainty was addressed when deriving TEQ values for characterization data for these analytes.

   For future confirmation sampling, please verify that during procurement, the laboratories to be used for confirmation sampling analysis will target the background study's MRLs, and will provide a demonstration of the lowest concentration at which the analyte can be detected in a sample and its concentration reported with a reasonable degree of accuracy and precision. If a laboratory cannot achieve the Measurement Quality Objectives (MQO) at the target, then the laboratory shall specify a concentration at which the MQO can be met. Please address this requirement in the remediation planning documents by providing project-specific MQOs for this purpose.

7. **Completion of Characterization:** While Section 4 figures show the locations of LUT exceedances, they do not depict how the exceedances are delineated with data that are less than the LUT values. Please include in the text of this section a discussion of delineation of contaminants in Area IV and the Northern Buffer Zone.

   GSB has been involved at all stages of the chemical investigation, and based on evaluation of the data summarized in the CDSR (evaluated with GIS and filterable datasets), GSB concurs that characterization of COCs is sufficiently complete to allow for making remediation decisions. A statement of completion of characterization for purposes of remediation planning should be included in the text.

8. **Address Potential for Localized Mineralization:** Previous "Preliminary Remediation Area" (PRA) maps have shown areas having Look-up Table value exceedances that extend to the western boundary of Area IV in Subarea 8 South. The presence of the western extent of this PRA is largely attributed to exceedances of polycyclic aromatic hydrocarbons (PAHs), total petroleum hydrocarbons (TPH), and metals (primarily strontium). TPH and the PAHs were identified as COCs. Numerous samples on and near the lower portion of the hillsides have detected TPH concentrations up to 100 times the LUT value (500 mg/kg). TPH exceedances are ubiquitous throughout the area, which has steep vegetated hillside and no identified operational history. Based on findings from the TPH Study (discussed below) and given the analytical issues for TPH at these concentrations, and the steep terrain and non-operational history, these TPH results are not considered significant to warrant additional sampling. All PAH exceedances are delineated at the boundary. Metals have the greatest number of exceedances in Subarea 8 South, at low levels (mostly up to two times the LUT values). Most of the exceedances are attributed to strontium, which was not identified as a COC, due to its low frequency of Look-up Table exceedances. Where the strontium exceedances do occur, they are generally concentrated in this subarea, and the highest concentrations generally appear to overlap with samples showing higher calcium concentrations near weathered bedrock having calcium carbonate-filled fractures throughout Subarea 8 South. The highest strontium exceedance at each location is generally found in the deepest sample, possibly indicating the source may be from underlying bedrock. Strontium was not identified as a COC and its exceedances near the property boundary were not delineated. Given the relatively higher frequency of LUT exceedances in this subarea, please provide justification to support that this analyte should not be considered a COC for this area, and address the potential for localized mineralization.

GSB's specific comments are noted below.

SPECIFIC COMMENTS

1. **Title Page:** Please revise the title to reflect the contents of this document apply to the Site (e.g., Area IV and the Northern Buffer Zone of SSFL). Also, please ensure that the date on the report cover is consistent with the date on the title page.

2. **Introduction, page 1-1**: When citing DTSC's chemical Look-up Table (LUT), please cite the actual document referenced and date (e.g., DTSC, June 11, 2013).

3. **Section 1, Figure 1-1:** The base map for Figure 1-1 – SSFL Regional Setting should be revised to more clearly and accurately show the current limits of residential development that surround and approach SSFL.

4. **Section 2, Table 2-1:**
   - **Page 2-1:** Under "Facilities Addressed", the Radioactive Materials Disposal Facility (RMDF) is also currently referred to as the Radioactive Materials Handling Facility (RMHF). Please correct the text to reflect this. On page 2-6, third line down, CDM Smith 2013a is dated as January 2013, yet the Technical Memorandum appears to be dated July 2013. On the sixth line down, CDM Smith 2012p appears to be June 2012, rather than October 2012. On the seventh line down, CDM Smith 2013c appears to be 2013e (August 2013, revised), rather than May 2013. On the eighth line down, DOE, 2014 cited appears to be November 2013. Please clarify the above citations in the Reference Section (Section 6) and revise as needed.

   - **Page 2-5:** The CDM Smith Master Work Plan/Field Sampling Analysis Plan is depicted as dated 2010b, yet the first site-wide Co-Located Master Work Plan was dated February 2011. Please clarify. On the same page, ninth line down, the cited Technical Memorandum for Co-located sampling results for Subareas 5D North and South (CDM Smith, 2012g), is listed in the reference Section 6 as March 2012, yet the referenced report appears to be dated June 2012.

   - **Page 2-6:** On the third line down, CDM Smith 2013a is dated as January 2013, yet the Technical Memorandum appears to be dated July 2013. On the sixth line down, CDM Smith 2012p appears to be June 2012, rather than October 2012. On the seventh line down, CDM Smith 2013c appears to be 2013e (August 2013, revised), rather than May 2013. On the eighth

line down, DOE, 2014 cited appears to be November 2013. Please clarify the above citations and revise as needed.

5. **Section 3.1, Table 3-1:**
   - **Page 3-1:** The list of chemical groups and associated analytical methods were cross checked with those listed in the AOC Phase 1, 2, and 3 Quality Assurance Project Plans (QAPP). Additional analytes associated with the Phase 1 and 2 QAPP that are not shown on the table include volatile organic compounds (EPA 8260B) and organotin (NOAA status and trends). Additional analytes associated with the Phase 3 QAPP that are not shown on the list include anions (EPA 300.0/9056A), ammonia (EPA 350.1/350.3), 1,4-dioxane (EPA 8260B/C Sim and 8270 C/D Sim). Additional methods, other than those listed on the table were also identified (e.g., chromium VI (EPA 7199/7196A), mercury (EPA 7174B/7470A), and perchlorate (EPA 314.0/331.0/6850//6860)). Please clarify, and revise Table 3-1 for consistency with the applicable QAPPs.

6. **Section 3.2:**
   - **Page 3-2, first paragraph:** The text describes that the first step during Chemical of Concern (COC) determination consists of identifying which chemicals were detected. Although the description is unclear regarding the definition of chemical detection, the CDSR appears to use Method Detection Limits (MDLs) as the basis for chemical "detection". The AOC does not prescribe the COC development process, and development of COCs using either MDL or MRL-based detections is not inconsistent with the AOCs. However, when making confirmation cleanup decisions based on point-by-point comparisons to the LUT, the LUT-based MRL values, as well as the Site confirmation sample values should utilize MRLs as the detection limit, as specified in the AOC. The Administrative Order on Consent (AOC) required development of a Look Up Table (LUT) that contains MRL values, which will be used for making decisions for soil cleanup. Specifically, Section 1.8.3.1 of the AOC defines the detection limit as the method reporting limit (MRL), which is the lowest concentration at which an analyte can be confidently detected in a sample and its concentration can be reported with a reasonable degree of accuracy and precision.

   - **Page 3-3, second paragraph:** The text in this section describes a third data assessment step used during COC determination consisting of comparing Area IV soil analytical results to human health risk based screening levels (RBSLs). If the percentage of detections exceeding the RBSL was greater than 5 percent, than the chemical was to be identified as a COC. However, it appears that the RBSL screening had little to no

effect on ultimate selection of COCs. Based on this, please rewrite this section and remove reference to the RBSL screening step in the text and tables.

7. **Section 3.3:**
   - **Page 3-4, Second paragraph:** This section is unclear regarding the findings for the hot spot analysis for all metals. Please refer the reader to table 3-14 for a summary of the findings for each step of the COC determination analysis. Table 3-14 is inconsistent with the text of Sections 3.3 and 4.1 in that it shows zinc not selected as a COC, yet the text indicates zinc was selected as a COC based on the findings of the hot spot analysis. Please include a column in the COC Summary Tables for all chemicals that indicates "Y" or "N" for the hot spot analysis step, and reconcile the table with the text.

     This section indicates that due to low LUT exceedance rates for arsenic, thallium, and zirconium, it can be concluded that these metals are naturally occurring at these concentrations and should not be considered as site COCs. Note that some of the LUT value exceedances are quite high (e.g., arsenic was detected up to 428 mg/kg), and the number of exceedances of the respective LUT values is too low (between 1 and 12) to allow for a robust hot spot analysis. Of the very few samples that do exceed the LUT (as shown on Figure 4.12), they appear to be located within operational areas, and thus may potentially be retained as COCs, since the hot spot analysis trumps the LUT exceedance step in the COC selection process. Hówever, given the few LUT exceedances for these metals, if the assumption is that these metals are indicative of localized mineralization, as required in DTSC's Chemical LUT Technical Memorandum (page 6, last paragraph), more lines-of-evidence in evaluating the potential local mineralization of these metals will be required based on mineralogy, soil geochemistry, spatial distribution of chemicals, etc. A discussion regarding multiple lines of evidence for locally elevated natural background levels for these metals should be presented in the remediation planning documents to support the basis for choosing not to include these metals as COCs.

8. **Section 3.5:**
   - **Text and embedded table, page 3-5:** Application of the 2,3,7,8-tetrachlorodibenzo-p-dioxin toxicity equivalent (dioxin TEQ) plays an important role in terms of managing analytical method uncertainty in the Look-up Table decision making process. Please include more discussion in this section regarding what the TEQ is, and how its use benefits the Look-up Table process. Also, please include an explanation for the

Cal/EPA Cancer Potency Equivalency Factors listed in parentheses in the table, and provide reference to Appendix C for derivation of the example dioxin TEQ.

Also, for consistency and as noted in the DTSC dioxin data evaluation technical memorandum included in Appendix C, the Look-up Table's dioxin TEQ was derived on a sample basis, rather than the congener-method basis, since the site sample TEQs to be compared to the LUT will also be derived on a sample basis. Based on the evaluation, DTSC's technical team provided recommendations regarding a process for deriving dioxin TEQs having nondetects and estimated maximum potential concentration (EMPC) values, and utilizing all of the background dioxin dataset, to capture the full variability of this unimpacted dataset. Using the recommended method for derivation, an updated (alternative) dioxin TEQ was recommended (1.127 pg/g compared to the LUT dioxin TEQ of 0.912 pg/g). GSU considered this value when evaluating the extent of dioxin TEQs in a manner that is consistent with the intent of the LUT. This value is recommended for use in remediation planning to help minimize the potential impact of false positives and to minimize reliance on estimated dioxin-congener results for calculation of background sample TEQs and to make use of all background dioxin-TEQ data.

9. **Section 3.6:**
   - **Text and embedded table, page 3-6:** Similar to the dioxin TEQ, application of the Benzo(a)pyrene toxicity equivalent (BaP TEQ) plays an important role in terms of managing analytical method uncertainty in the LUT decision making process. Please include more discussion in this section regarding what the BaP TEQ is, and how it is calculated. Appendix D provides example calculations, plus a series of email correspondence relaying the status of DTSC's evolving guidance on use of preferred cancer potency equivalence factors (PEFs). DTSC's current preferred PEFs are now consistent with those used by U.S.EPA. For clarity, please replace the compilation of emails with the attached DTSC Technical Memorandum "Updated 95%USL for the Carcinogenic Polynuclear Aromatic Hydrocarbon (cPAH) Benzo(a)pyrene Toxicity Equivalent (BaP-TEQ) in Background Soils for Santa Susana Field Laboratory (SSFL)".

     Also, for consistency and as noted in the DTSC cPAH data evaluation technical memorandum, the Look-up Table's BaP TEQ was derived on a sample basis, rather than the congener-method basis, since the site sample TEQs to be compared to the LUT will also be derived on a sample basis. Based on the data evaluation, DTSC derived and recommended use of an updated representative background BaP-EQ of 2.99 µg/kg. This

value should be considered during remediation planning as an updated alternative to the LUT's listed value of 4.47 µg/kg.

10. Section 3.10:

- **First paragraph, page 3-7:** The last sentence in paragraph; "Therefore, NDMA is a SSFL overall contamination is retained as an Area IV COC (Table 3-9)" is unclear and should be revised.

11. Section 3.11:

- **First paragraph, page 3-7:** While fluoride was identified as a COC, it was not discussed in this section. Please include discussion of fluoride in this section of the Final CDSR.

12. Section 3.12:

- **Third paragraph, page 3-8:** The text should indicate that the heavier range hydrocarbons are considered to be a COC based on the evaluation criteria. The reference to further discussion regarding TPH in Section 4 should be removed and any relevant information included in Section 3.12. Discussions regarding the MDL, MRL, and the LUT value should be included in the COC evaluation.

  The LUT Footnote 3 is applicable to "locations where TPH is the sole contaminant", yet the Soil Treatability Study's Phase 1 Phytoremediation Study findings showed extractable fuel hydrocarbons (EFH) were observed in roots and foliage of all observed plant species. The EFHs observed in plant tissues appeared to be produced by plants. PAHs were also detected in the roots of most plant species, but similar to EFHs, the PAHs detected in some species appeared to be plant-produced. Please evaluate the potential for co-located naturally occurring plant-produced PAH and EFH LUT exceedances at the Site and indicate the ranges of concentrations in soil that these are expected to occur as co-located naturally occurring organic materials. The cleanup strategy assumption for TPH as "the sole contaminant" should take into account the potential presence of co-located naturally occurring PAHs.

  The LUT Footnote 3 goes on to state that "where TPH is the sole contaminant, the cleanup strategy will be considered based on the findings of the soil treatability study. Please include discussion in the text regarding findings from the "Chemical Characterization of Residual Fuel Hydrocarbons in Soils at the Santa Susana Field Laboratory" (Nelson et al, July 31, 2015), in terms of the extent that natural organic material (NOM) is expected to contribute to the TPH analysis signal, describes possible methods (and their limitations) of preparing a sample to remove

polar NOM before TPH analysis to provide a more accurate measure of actual petroleum hydrocarbons, and describe the limitations in accurately quantifying TPH at low TPH concentrations of Area IV soils used in the study (e.g., 100 to 300 mg/kg). Based on the findings of the soil treatability studies, for the remediation planning documents, please consider developing Measurement Quality Objectives for TPH that will result in the lowest concentration at which TPH can be confidently detected in a sample and its concentration can be reliably reported by multiple laboratories with a reasonable degree of accuracy and precision.

13. **Section 3.14:**
    - **Page 3-9, second paragraph:** The statement regarding RBSL criteria should be removed as it is not needed in COC selection process.

14. **Section 3.15:**
    - **Page 3-9, third paragraph:** The text indicates that findings for soil gas sampling within Area IV will be addressed in the groundwater remedial investigation, and will assess the need for VOC remediation. DOE's "Final RCRA Facility Investigation (RFI) Groundwater Work Plan Portions of Area IV under DOE Responsibility" (CDM Smith, November 9, 2015) evaluates and addresses the presence of VOCs in soil vapor as part of the data gap process evaluation for Area IV groundwater investigation areas. Additional follow on work to further refine understanding of the nature and extent of VOCs potentially off-gassing from groundwater is ongoing in support of the groundwater corrective measures study.

15. **Section 3.16:**
    - **Page 3-10, first paragraph:** The text indicates that plots of the spatial distribution of chromium VI, lead, and zinc were used to conclude that detections were related to site activities. The description references Section 4 for inspection of plots. Review of Section 4, Figure 4-11 identified a plot of chromium VI and lead. Figure 4-11 should also include the zinc locations exceeding LUT values. Please clarify and correct the text.

16. **Section 3.17**:
    - **Page 3-10, first paragraph:** Please include dioxin TEQ (for dioxins and furans) and BaP TEQ (for PAHs) as COCs in this section.

17. **Section 3, Potential Chemicals of Concern Summary Tables:** Please revise the COC column to correctly reflect selected COCs, and include a column indicating which COCs were selected due to hot spot analysis.

18. **Section 4.1**:
    - **Page 4-1, first paragraph:** This section indicates that based on Figure 4.1, the distribution of antimony above background is primarily in former operational areas, and not within areas remote from Area IV research activities. However, five locations of antimony exceedances (four at surface and one at five feet depth) are present off-site northwest of the Northern Buffer Zone, well outside of operational areas. The antimony results were reported as estimated values (from 1.15J to 2.22J mg/kg; LUT value of 0.86 mg/kg). It is notable that these exceedances do not appear to be co-located with other contaminants. Please address the localized presence of these off-site antimony exceedances in the remediation planning documents.
    - **Page 4-1, fourth paragraph:** Based on review with GIS, numerous low level exceedances of selenium (between 1 to 2 times the LUT value) are not depicted in Figures 4-7 and 4.8. For example, three sample exceedance locations occur on Burro Flats at the base of the hill, east/southeast of ESADA and north of the former water tower. Please revise the figures to depict all LUT exceedance locations at the Site. Please explain if the observed exceedances at depth may be related to the presence of excavated bedrock within the B56 landfill debris.
    - **Page 4-1, fifth paragraph:** The text indicates that silver observed to be present in soil is assumed to be the result of photographic wastes. The text also indicates that apparent areas of localized silver impacts are observed in soil and sediment from OCY/NCY, PDU, 17th Street Pond, and dredge spoils area. The description of the photographic waste assumed source of silver contamination should include additional information describing two most likely photographic waste sources consisting of liquid photographic waste originating from photo processing units released into the reclaimed water system and solid photographic waste associated with the incineration of photographs at the facility. The two separate photographic waste sources (liquid and solid) aid in understanding the apparent silver distribution in soil. Silver in the OCY/NCY may likely have originate from the Building 4040 incinerator and ash pile located adjacent to OCY/NCY area. The silver in the PDU, 17th Street Pond, and dredge spoils area most likely originated from silver contamination associated with the reclaimed water distribution system.
    - **Page 4-2, second and third paragraph:** The text should be revised to include zinc identified as a COC based on the hot spot analysis. Review of Figure 4-12 appears to show arsenic, thallium, and zirconium as being located primarily within or in the vicinity of former operational areas. Please revise the text to clarify which analytes were identified as COCs, based on hot spot analysis.

19. **Section 4.3:**
    - **Page 4-2, first paragraph:** Figures 4-16 and 4-17 show dioxinTEQ exceedances extending up into the Northern Buffer Zone, but do not show the limited number of LUT exceedances that are present north of the Northern Buffer Zone. Sample results from these locations had reported dioxin TEQs up to 1.33 ng/kg, which somewhat exceeded the LUT value (0.912 ng/kg), and were all less than the RBSL (4.81 ng/kg). The dioxin/furan soil congener data used for deriving the dioxin-TEQ for each sample are typically reported as estimated values. DTSC recognized the potential elevated analytical uncertainty associated with these reported estimated values, and prepared a technical memorandum that describes how to use these estimated values for purposes of calculating Site sample dioxin-TEQs (see Appendix A of the CDSR) which will be compared to the LUT dioxin-TEQ value. The approach described in the DTSC's technical memorandum focuses on managing and constraining the analytical uncertainties associated with the estimated data, resulting in a higher level of confidence when determining exceedances near the LUT dioxin-TEQ.

      DTSC's technical memorandum also describes verification of dioxin-TEQs, as calculated on a "sample-basis", rather than a congener basis, as was originally used for derivation of the LUT dioxin-TEQ value. This verification was conducted by DTSC's Human and Ecological Risk Office, since the sample-basis calculation approach for derivation of dioxin-TEQs is conducted for Site samples, and should be similarly conducted for deriving the background LUT values using the background dioxin dataset. Based on the evaluation that utilized all the background dioxin-TEQ data, DTSC recommended a dioxin-TEQ of 1.127 ng/kg to help minimize potential impact of false positives and minimize reliance on estimated dioxin congener results. When considering this recommended background dioxin-TEQ (1.127 ng/kg), all but one of the off-site (north of the Northern Buffer Zone) locations having LUT dioxin-TEQ exceedances are within background. The one single exceedance of 1.33 ng/kg doesn't necessarily represent contamination, but this and other low-level LUT exceedances should be evaluated and addressed in the remediation planning documents.

      Future remediation planning documents should consider the potential use of the updated (alternative) background dioxin-TEQ, derived on a sample-basis, for remediation planning and implementation.

20. **Section 4.4:**
    - **Page 4-2, first paragraph:** This section and Figures 4-20 and 4-21 do not depict or address all of the non-carcinogenic PAH COCs that have LUT

exceedances. For example, a limited number of sample locations north of the Northern Buffer Zone (well outside of operational areas) show exceedances of LUT values (generally less than a factor of 2) for fluorine, 2-methylnaphthalene, naphthalene, and phenanthrene. The results for these anaytes were in the single to low double digits (µg/kg). Although they are not based on estimated values, there is some uncertainty regarding the range of background for these types of analytes. The SSFL Soils Treatability Studies noted that PAHs (and extractable fuel hydrocarbons) were detected in the roots of most plant species, and the presence of these PAHs appears to be phytogenic (i.e., produced by plants) (CDM Smith, November 2015). The Soils Treatability Studies findings were published after development of the chemical LUT. The presence of low level PAHs in soils in vegetated areas located well outside of former operational areas may potentially be plant produced.

Future remediation planning documents should evaluate and address if low level exceedances of PAH COCs may be attributed to naturally occurring conditions (e.g., plant-produced), by considering the Soil Treatability Study findings. The documents should describe a process to ensure that low level PAH COC data can be generated and used to determine exceedances from local background and/or MRLs with a higher level of confidence.

21. **Section 4.5:**

- **Page 4-2, first paragraph:** The pesticides 4,4'-DDD, Beta-BHC, Delta–BHC, and Dieldrin were identified as COCs and are not addressed in this section or in the figures. While pesticide COCs were selected based on exceeding the LUT threshold of 2.5 percent, overall, they show a relatively low percentage of samples exceeding the LUT values (from 2.33 percent for 4,4'-DDD, up to 5.22 percent for dieldrin). This relatively lower level of LUT exceedance may potentially be attributed to elevated analytical method uncertainty. For example, a limited number of sample locations north of the Northern Buffer Zone (well outside of operational areas) show exceedances of LUT values for Beta-BHC, Delta–BHC, and Dieldrin, all with results reported as estimated values. Some of the pesticide results were also qualified as estimated due to field duplicate results outside of the acceptable range of precision (relative percent difference [RPD]). The data report noted that there is no discernable pattern or reason for the laboratory and field sample RPD exceedances identified. No field sampling issues were identified from the RPD results that were outside of criteria and the exceedances are reasonable for this type of activity. The random nature of these exceedances further supports that these may potentially be attributable to elevated analytical uncertainty and/or sample

heterogeneity. The LUT requires analytical method uncertainty for pesticides to be constrained within 20 percent at the associated background threshold value (BTV) for analytes such as Beta and Delta-BHC, which have LUT values based on the BTV.

The "Revised, DOE Herbicide, Pesticide, Polychlorinated Bi-phenol Method Verification Summary" (MRL Verification Study) presented in Appendix E of the CDSR describes the challenges in constraining analytical method uncertainty when attempting to achieve MRLs that are lower than routinely achieved by commercial laboratories for these organic analytes. The results of the pesticide evaluation in Appendix E indicate that the sample preparation modifications used in an effort to achieve low level MRLs affected the accuracy and precision of the reported data at the lowered reporting limit for several of the compounds evaluated, including some of the pesticides that are identified as COCs.

Future remediation planning documents should consider the findings of the MRL Verification Study, as it was completed after the LUT was established, and should address 1) sampling efforts, including analytical quality control measures that will be taken to ensure that pesticide COCs with LUT values that are based on the BTV will be analyzed in a way to ensure that analytical method uncertainty due to analytical method uncertainty and sample heterogeneity is adequately constrained, as required by the LUT; and 2) for MRLs-based LUT values, specify the analytical quality control measures that will be implemented to ensure that pesticide MRLs will be achieved in a way to maintain a reasonable degree of accuracy and precision, as required by the AOC.

22. **Section 4.6:**

- **Page 4-3, first paragraph:** This section and Figures 4-24 and 4-25 do not depict or address the herbicide COC 2,4-DB, nor do the figures depict off-site (northeast of the Northern Buffer Zone) LUT exceedances for MCPP. The Figures are truncated to the east and do not show the full extent of the Northern Buffer Zone. Similar to the issue encountered with pesticides, elevated analytical uncertainty was identified with herbicides during the MRL Method Verification Study (see Tables 2 and 4a in Appendix E). These tables show that for MCPP, the spread of data around the mean of the MDL values generated during the MDL study was significant. The relative standard deviation (RSD) is a measure of the spread of the data about the mean. The RSD calculated for the 21-point MDL study for MCPP was 52.0 percent, whereas the LUT requires an RSD of 20 percent of the BTV or MRL. The MCDD LUT exceedances were estimated values

reported for samples north of the Northern Buffer Zone at 1,200 J and 1,300 J µg/kg. These values are well within the range of the standard method MCPP MDL (750 µg/kg) and MRL (2,500 µg/kg) used for the Phase 3 investigation (see Table 4a in Appendix E). These exceedances, even with use of the standard method, could potentially be attributed to elevated analytical method uncertainty.

Future remediation planning documents should consider the findings of the MRL Verification Study, as it was completed after the LUT was established, and should address 1) sampling efforts, including analytical quality control measures that will be taken to ensure that herbicide COCs with LUT values that are based on the BTV will be analyzed in a way to ensure that analytical method uncertainty due to analytical error and sample heterogeneity is adequately constrained, as required by the LUT; and 2) for MRL-based LUT values, specify the analytical quality control measures that will be implemented to ensure that herbicide MRLs will be achieved in a way to maintain a reasonable degree of accuracy and precision, as required by the AOC.

23. **Section 4.7:**
    - **Page 4-3, first paragraph:** The text incorrectly indicates that Bis(2-ethylhexyl)phthalate is depicted on Figure 4-26. Please include this COC on the figure.

24. **Section 4.10:**
    - **Page 4-3, first paragraph:** The discussion should include more detail regarding TPH distribution and number of LUT exceedances observed for TPH High Diesel >C20. The discussion reference to 500 mg/kg criteria must be explained to demonstrate that it is relevant.

25. **Section 4, Figures:** Some COCs are not shown on the figures in this section. Please include the following COCs in the figures: pesticides (4,4'-DDD, Beta BHC, Delta BHC, and Dieldrin); herbicides (2,4-DB); phthalates (Bis(2-ethylhexyl)phthalate); and miscellaneous chemicals (fluoride).

26. **Section 4, Figures 4-1 through 4-32:** The figures do not show the Northeast Buffer Zone area and associated chemical data in this area. Figures should show the entire investigation area and all of the relevant soil data associated with the figure.

    The figures should identify locations where chemicals were determined to be below LUT values. This information would help communicate more complete picture of spatial limits chemicals in soil exceeding LUT values. The figure should

have the ability to scale data symbols (detect and non detect at LUT) size for viewing in electronic format to allow for ability to zoom in and view data on a smaller scale.

27. **Section 4, Figure 4-11:** The figure shows surface soil results for hexavalent chromium and lead. The figure should be replaced by two figures showing hexavalent chromium and lead separately. Additional figures showing LUT exceedances by depth should also be created.

28. **Section 4, Figure 4-12:** The figure shows surface soil results for arsenic thallium, zinc, and zirconium. The figure should be replaced by figures showing zinc and the three metals arsenic, thallium and zirconium, separately. Additional figures showing zinc LUT exceedances by depth should also be created. Arsenic, thallium, and zirconium do not appear to warrant LUT exceedances by depth figures.

29. **Section 4, Figures 4-20 and 4-21:** The figures show detected soil results exceeding LUT values for non-carcinogenic PAHs anthracene, fluoranthene, and pyrene. It is unclear why anthracene is included in the figure instead of other more frequently detected non-carcinogenic PAHs. The top three most frequently detected non-carcinogenic PAHs above LUT values are fluoranthene (19.5 %), pyrene (19.1%), and benzo(g,h,i)perlene (18.9 %). The figures should be revised to show results of benzo(g,h,i)perlene in place of anthracene. Additional figures should be created showing the other non-carcinogenic PAHs detected in soil above LUT values (1-methynaphthalene, 2-methylnapthalene, acenapthalene, anthracene, naphthalene, and phenanthrene).

30. **Section 5.1, page 5:** The Section 5 – Summary of Data Quality Review and Findings is deficient in that it does not describe or discuss the data quality and ability for the soil dataset to achieve LUT MRLs. A general discussion and evaluation of the data set's ability to achieve MRLs that are consistent with LUT values should be included.

31. **Appendix A – All Sample Results:** The Appendix A –All Sample Results is formatted as a pdf limiting data searching and data evaluation. The Appendix should contain all of the soil and analytical data collected and referenced in the CDSR including both data from AOC directed investigations and historic investigations preceding the AOC directed work. The data files should be formatted in searchable spreadsheets such as excel to allow for data review and use. As formatted, the Appendix A cannot be easily used or verified to be complete.

32. **Appendix B:** DOE's CDSR web site (accessed February 13/2018) shows additional documents are included in Appendix B, that do not appear to have been provided in GSB's report copy. Please provide all relevant documents in Appendix B of the Final CDSR.

The CDSR review included an evaluation of previously prepared data reports to evaluate report for completeness and presence of chemistry data created during the multiple investigation and reporting activities. The review was focused on HSA Subarea 5B was selected for the focused review as a representative area with multiple RFI sites which include System for Nuclear Auxiliary Power (SNAP), Department of Energy Leach Field 2 (DOE LF2), Hazardous Material Storage Area (HMSA), Process Development Unit (PDU), Boeing Area 4 Leach Field (Boeing A4LF), and Environmental Effects Laboratory (EEL). The review area includes former or existing buildings; B4010, B4012, B4013, B4019, B4355/B4356, B4006, B4011, and 17th Street Pond area.

The chemical data from the initial RFI activities was reported in Appendices T, P, R, I, D, and G of the Group 5 –Central Portion of Areas III and IV RCRA Facility Investigation Report, Working Draft (CH2M Hill, November 2008). The RFI data was confirmed to be accurately included in the CDSR.

Subsequent to the initial RFI chemical investigation activities, soil and sediment chemistry investigation in subarea 5B was conducted in multiple phases, with the first phase described in Addendum #1 Master Work Plan / Field Sampling and Analysis Plan, Co-Located Chemical Sampling at Area VI, Santa Susana Field Laboratory, Subarea 5B (CDM, January 2011) and reported in Technical Memorandum, Co-Located Chemical Sampling Results at Historical Site Assessment Subarea 5B in Area IV (CDM, January 2012).

Subsequent phase of investigation is described in Master Field Sampling Plan for Chemical Data Gap Investigation Sampling at Area VI, Santa Susana and Field Laboratory, Subarea 5B (CDM, April 2012), Addendum #2 Master Field Sampling Plan for Chemical Data Gap Investigation, Phase 3 Chemical Sampling at Area VI, Santa Susana Field Laboratory, Subarea 5B (CDM, June 2012), Addendum #10 to Master Field Sampling Plan for Chemical Data Gap Investigation, Phase 3 Go-Back Soil Sampling at Area IV, Subareas 5B, 5C, and 3/6 (CDM, 2014), Addendum #12 to Master Field Sampling Plan for Chemical Data Gap Investigation, Phase 3 Soil Vapor Implementation for Area IV (CDM, 2014) and reported in Technical Memorandum, Phase 3 Chemical Data Gap Investigation Sampling Results, Subarea 5B in Area IV (CDM, October 2013), and Technical Memorandum, Phase 3 Chemical Data Gap Investigation Sampling Results Go-Backs, Trenches and Soil Vapor Locations (CDM, June 2015).

The CDSR Exhibit 1 was found to be complete and accurately included all Subarea 5B chemical data sampling locations. Chemical data described in CDSR Appendix A was spot checked and confirmed to be present and equivalent to chemical data previously presented in investigation results reports. The soil chemistry data set for Subarea 5B defines the general nature and extent of potential chemicals of concern targeted during investigation activities. The most significant chemical detections observed at concentrations exceeding characterization criteria in Subarea 5B and the entire Area IV are dioxins quantified as 2378 TCDD TEQ (CDSR Figure 4-17), poly aromatic hydrocarbons (PAHs) carcinogens quantified as BaP TEQ (CDSR Figure 4-19), and Total Petroleum Hydrocarbons - High Diesel Range Organics (CDSR Figure 4-32).

33. **Appendix C and D:** Appendices C, D and E on the CD have duplicative files. Also, please consider including the relevant TEQ Summary Table (currently in Appendix A) in Appendix C (dioxin TEQ) and Appendix D (BaP TEQ).

34. **Appendix E:**
    - **Page 1:** Please revise title to "Final" when finalizing CDSR.
    - **Page 2, first paragraph:** Please consider rewriting the last three sentences of this paragraph to emphasize that although the Look-up Table's decision error rate (and level of confidence) is pre-determined, the Look-up Table also requires and assumes that analytical method uncertainty is constrained within the limits specified at the cleanup level (e.g., 20 percent for herbicides, pesticides and PCBs, see Table 1 of LUT Technical Memorandum). The MDL Study described in this document shows the dispersion of the data for numerous analytes at the low MDLs (e.g., relative standard deviation) was higher than what is considered acceptable by the LUT process. The specified decision error only applies when the measurement quality objectives are achieved. If they are not achieved, the additional analytical method uncertainty compromises the Look-up Table process, and can result in determination of the need for cleanup of areas that may not actually exceed background.
    - **Page 3, first sentence:** Please include reference here to where the low-level quality control program is described - (i.e., see section 7).
    - **Page 3 last two sentences of last paragraph:** Please indicate that EMAX also performed a 7-point MDL study and method verification study for the low-level herbicide method (Attachment B). Include a summary of EMAX findings, in addition to LLI findings.
    - **Page 4:** Please delete reference to prior draft versions of this document when finalizing this document for the Final CDSR. Second to last paragraph: please check this paragraph for grammar and correct.

- **Page 7, second paragraph:** Please include reference; third paragraph, last sentence: please correct spacing; last paragraph: please clarify – did the laboratory perform a seven replicate analysis on three separate days, in addition to processing 21 replicate spikes (e.g., MDL 21-point study)? Also, please explain rationale for why some of the target compounds were spiked above and below the MRLs.
- **Page 9, Section 4.0:** The flow of the text could be improved. Please consider discussion of all the pesticide information first, then discussion of the PCB information, followed by a generalized summary of the tests at the end. Also, please consider using the text from the Phase 3 QAPP to more fully describe LCS and MS as QC spike samples, and please clarify and explain importance of using site-specific sample matrix rather than selecting a sample from a batch of samples that are potentially from multiple sites.
- **Page 9, last paragraph:** Please clarify - the list of spiked parameters for pesticides utilized pesticides listed in the Look-up Table that are based on the background study's low level MRLs. Explain why some of the pesticides in this category were not spiked (toxaphene, chlordane, endosulfan I and endosulfan II). Please explain the rationale for selecting Aroclors 1016 and 1260 by moving explanatory text up from two paragraphs below.
- **Page 10, first paragraph, last sentence:** Please explain that DDD, DDE, DDT, and dieldrin are four of the seven pesticides that were ultimately identified as COCs. These had relatively low percentages of samples above LUT values based on the background study low level MRLs (range from 2.3 to 5.2 percent).
- **Page 11, last line:** Please move "Phase 3" down to header line below.
- **Page 13:** Please move "EMAX Laboratories Inc." down to header line below; text indicates EMAX only performed Phase 2 work, yet emails in Attachment C indicates EMAX performed Phase 1 and 3 work. Please clarify. Under "Herbicides, Pesticides, and PCBs", please clarify (and provide supporting data) if EMAX's MDL Study was conducted for all analytes, or just for herbicides, as only data for herbicides are presented in Table 6 and Attachment B. Under "Herbicides" section, please verify the statement that indicates references of results that were greater than 1/10 the spike level. DTSC's chemists have previously commented on this, and requested that this issue be addressed. Under "Pesticides" and "PCBs", please clarify if EMAX MDL study and LOQ verifications were conducted for these analytes, as no supporting data was provided in Table 6 or Attachment B.
- **Page 16:** second paragraph, last sentence: Please correct sentence for grammar.

- **Page 17, third paragraph:** please check MDL calculations in tables, as spot checking has identified some inconsistent results. Also, please include detailed list of attachments, and consider bookmarking the listed items for ease in accessing the data. At a minimum, the cover pages for the attachments should be searchable, but currently are not.
- **Page 19, second paragraph, last sentence:** this sentence is incomplete. Please revise.
- **Attachment B:** Please note on cover page if this is for herbicides only.
- **Attachments D and E:** please indicate on cover page which laboratory generated the data.

35. **Exhibit A:** The cover page indicates "Exhibit 1", and should be revised to indicate "Exhibit A".

36. **Exhibit 1, Exhibit A-12:** The figure is missing the outline of former Building 4012. Review of historical figures from the area indicates that building location information included in the exhibit is consistent with the information presented in the Group 5 –Central Portion of Areas III and IV RCRA Facility Investigation Report, Working Draft (CH2M Hill, November 2008). The outline of former Building 4012 appears in "Final Technical Memorandum, Subarea-5B, Historical Site Assessment (HSA)" (HGL, February 2012) and subsequent Subarea 5B sampling plans and chemical data reports prepared by CDM. The building omission indicates that the GIS information for building locations is not the most current or complete data. The exhibits should be revised to reflect the building information associated with the 2012 HSA and subsequent chemical data sampling plans and reports prepared by CDM.

    The Exhibit 1 should be supported by GIS based information system that includes the information such as building outlines, sample locations, excavation areas, backfilled excavation areas, lined surface water drainages, unlined surface water drainages, areas / features identified as potential input locations to groundwater contamination. The Exhibit 1 should also include a filterable chemical dataset that includes all of the chemistry data. The filterable chemical data sets may be organized based on subarea designations used during the HSA and subsequent chemical data sampling plans and data reports.

Thank you for the opportunity to comment on this document.

Peer reviewed by: Jon Buckalew (Buck) King, CHG, Senior Engineering Geologist Buck King

Attached: "Updated 95%USL for the Carcinogenic Polynuclear Aromatic Hydrocarbon (cPAH) Benzo(a)pyrene Toxicity Equivalent (BaP-TEQ) in Background Soils for Santa

Susana Field Laboratory (SSFL)", prepared by Donald Greenlee, Ph.D, DABT, Staff Toxicologist, Human & Ecological Risk Office, DTSC. March 9, 2018.

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DATE: March 9, 2018

SUBJECT: Updated 95%USL for the Carcinogenic Polynuclear Aromatic Hydrocarbon (cPAH) Benzo(a)pyrene Toxicity Equivalent (BaP-EQ) in Background Soils for Santa Susana Field Laboratory (SSFL)

Background: In December 2012, URS provided their final version of the Santa Susana Field Laboratory (SSFL) Chemical Soil Background Study Report, contracted for and soil testing managed by the DTSC (URS, 2012). Two chemical background reference areas (CBRAs) were selected for soil sampling such that they met several criteria, including accessibility. The CBRAs were:

- Three to four miles from the SSFL Site and because of their distance, were not expected to have been influenced by on-Site activities;
- Selected to be representative of geologic formations at SSFL, ie, one of the CBRAs was located within the Chatsworth Formation and the other was located within the Santa Susana Formation. To account for the influence of topography on natural sample collection areas, soil samples were collected from both drainage and non-drainage areas in both CBRAs; and
- Close enough to SSFL to have a similar fire history (since 2005).

Background soils were tested for naturally occurring analytes (metals) and for analytes possibly derived from anthropogenic or natural causes (eg, PAHs from forest fires, insecticides/herbicides from agricultural pesticide spray drifts, dioxins/furans from regional combustion of plastics). For analysis of organic analytes, of which PAHs constitute one subset, it was assumed that these analytes might be deposited onto surface soils, but were unlikely to occur in the subsurface. A total of 148 background soil samples were tested for PAHs (URS, 2012). Test results for each analyte were statistically evaluated to derive upper threshold limits on the respective dataset.

For DOE and NASA RCRA Facility Investigation sites (RFI Sites), the 95% Upper Simultaneous Limit (95% USL) was selected as representative of the background concentration for each analyte to ensure this value accounted for practically all background concentrations that one might encounter. According to DOE's and NASA's 2010 Administrative Orders on Consent for Remedial Action, cleanup of contaminants resulting from industrial activities at their RFI sites was to occur relative to background threshold values for chemicals tested within the CBRAs, or to detection limits (implemented as Method Reporting Limits) for chemicals not expected nor analyzed in background soils (eg, volatile organic chemicals (VOCs) and polychlorinated biphenyls (PCBs)). For cleanup of DOE and NASA RFI sites, background 95% USLs were incorporated as BTVs into DTSC's Chemical Lookup Table (LUT) for quick reference during identification of potential remediation areas (similar to Corrective Measures Study areas). This included a LUT value for carcinogenic polynuclear aromatic hydrocarbons (cPAHs) expressed as a benzo(a)pyrene equivalents (BaP-EQs), as defined below. The use of 95% USLs during this selection process helps to minimize false positive selections, ie, selection of an area for cleanup where its representative upper limit concentration does not truly exceed that of background.

Boeing elected to evaluate their potential remediation areas (or Corrective Measures Study [CMS] areas) using human health and ecological risk assessment processes, and did not enter into an AOC agreement. For Boeing RFI Sites, Chemicals of Potential Concern (COPCs) were selected by comparing maximum detected RFI-site concentrations to background soil 95% Upper Tolerance Limits with 95% Coverage (95-95 UTLs) for those chemicals analyzed in the Chemical Background Study. For those chemicals not included in this Chemical Background Study, any on-Site detections resulted in selection of this chemical as a COPC. In preparation for identifying CMS areas, incremental human health risks were determined (ie, total health risks for RFI site soils that exceeded background soil health risks). For those chemicals not included in the Chemical Background Study, the Site health risk was considered the incremental health risk (ie, the health risk in background soils was considered to be "0"). Exposure point concentrations used in human health risk determinations were 95% Upper Confidence Limits (95% UCLs) on the mean concentrations of either Site COPCs or background chemicals. The 95% UCLs are typically lower than 95% USLs, as they represent a measure of central tendency rather than an upper threshold value. And, the 95-95 UTLs are typically less than the 95% USLs. Use of the 95-95 UTLs rather than the 95% USLs in the risk assessment process provides greater flexibility to minimize background false negatives, such as during selection of Chemicals of Potential Concern (COPCs).

Purpose: The purpose of this memo is to document derivation of an updated SSFL-specific BaP-EQ for background soils for inclusion in the LUT. This update was necessary because of recent changes by the USEPA in the BaP Potency Equivalency Factor (PEF) values for three of seven cPAHs used to calculate the BaP-EQ, as further explained below.

BaP-EQ Calculation Method: As discussed above, NASA and DOE use the LUT to select potential remediation (or CMS) areas. In select instances, where a LUT value is based on relative congener toxicities, such as a BaP-EQ or a dioxin-TEQ (dioxin toxicity equivalent), updates in toxicity values results in a changed LUT value. The BaP-EQ is expressed relative to the toxicity of BaP, where the BaP PEF is assigned a value of 1.0. To calculate the BaP-EQ for a soil sample, the concentrations of each of seven cPAHs analyzed in a sample are multiplied by their respective PEFs, and these values are summed yielding a sample-specific, total BaP-EQ. For identification of potential remediation areas, sample-specific BaP-EQs are then compared against the background BaP-EQ. This update to the background BaP-EQ was necessary because the PEFs recommended by USEPA for the three cPAHs shown below changed as of 2013 (USEPA, 2013). HERO's updated PEFs are now identical to those currently used by the USEPA (USEPA, 2017).

cPAHs	Former PEF*	New PEF
Benzo(a)pyrene	1.0	NC
Benzo(a)anthracene	0.1	NC
Benzo(b)fluoranthene	0.1	NC
Benzo(k)fluoranthene	0.1	**0.01**
Chrysene	0.01	**0.001**
Dibenzo(a,h)anthracene	0.34	**1.0**
Indeno(1,2,3-c,d)pyrene	0.1	NC

*Former PEFs presented in Table 1 (Classification of PAHs by Category) in HERO's July 1, 2009 advisory entitled "Use of the Northern and Southern California Polynuclear Aromatic Hydrocarbon (PAH) Studies in the Manufactured Gas Plant Site Cleanup Process." NC = no change.

Method of Updating the Soil Background BaP-EQ: The SSFL 2012 Chemical Soil Background Report cPAH data (comprising 148 samples; Table 1-column A; URS, 2012) and updated cPAH-PEF values (shown in the above table) were used to calculate total BaP-EQs for each background sample. Where duplicate samples were tested, only the higher BaP-EQ between the primary and duplicate samples was included in the dataset. On Table 1, columns labeled "d_BaP-EQs" denote whether at least one cPAH was detected in the respective sample ("1"), or whether none of the cPAHs were detected ("0"). These data served as the beginning input for statistical determination of the 95% USL for background soils. Upon further statistical analyses as described below, the three highest sample BaP-EQs (highlighted in Table 1-column A) were identified as outliers and were excluded from the dataset. USEPA's SCOUT statistical software (version 1.00.01) was used for all statistical analyses.

Beginning with the raw background cPAH-EQ data (Table 1-column A; n = 148), three potential outliers were identified by reviewing this dataset and using graphical methods supplied in SCOUT comprised of box plots, histograms and Q-Q probability plots. Examination of the raw BaP-EQ dataset (Table 1-column A) revealed that the third highest BaP-EQ (ie, 8.646 ug/kg) was 140% higher than the fourth largest BaP-EQ (ie, 3.549 ug/kg), whereas these nearest neighbor intervals for each of the remainder of the lower BaP-EQs were no greater than 13%. Thus, the top three BaP-EQs in the raw dataset were identified as potential outliers. This conclusion was supported by review of graphical plots of the raw dataset (Figures 1a-c) and the censored dataset after

excluding the highest BaP-EQ (51.93 ug/kg, Table 1-column C, n=147; Figures 2a-c). In the box plot, histogram and Q-Q probability plot of the raw dataset, separation between the top three BaP-EQ values from the remainder of the dataset was apparent. After removal of the highest BaP-EQ, separation between the next two higher BaP-EQs and the remaining dataset became more obvious (Figures 2a-c). Confirmation of the top three BaP-EQs as outliers (ie, 51.93, 9.17 and 8.65 ug/kg) from the raw dataset was performed using the Rosner Outlier Test (Table 2) provided in the SCOUT program. To be conservative, a statistical significance level of 1% was selected for the Rosner Outlier Test.

After exclusion of the top three outliers, the final censored BaP-EQ dataset (Table 1-column E, n=145) was right-skewed (Figure 3b) and appeared comprised of two potential populations of BaP-EQ data (Figure 3c). Thus, these data were not normally distributed. Because the Rosner outlier test assumes a normal distribution of data (USEPA, 2008), confirmation of the three outliers initially identified by this test was obtained by statistically evaluating the raw dataset (Table 1-column A, n=148) using the robust outlier test identified as "PROP" in the SCOUT program. Within PROP, a beta distribution was selected, which can accommodate multiple shapes of probability functions.

One possible interpretation of the biphasic probability plot (Figure 3c) could be that the higher BaP-EQs represent soil samples impacted by local wildfires, whereas the lower BaP-EQs represent soil samples that were less impacted or unimpacted by wildfires. It should be noted that the inflection between the upper and lower data depicted on Figure 3C approximately coincides with the maximum non-detect value of 1.687 ug/kg. This value also coincides with the background study's lowest target Method Reporting Limit (MRL). Non-detects are reported at the MRL and values detected between the Method Detection Limit and MRL are reported as estimated values. Thus, the range of the lower data would be inclusive of detected values at and below the respective MRL, which may potentially have elevated analytical uncertainty. In the final censored dataset (Table 1-column E), the upper 18 BaP-EQ data points were more identified as drainage samples (n=11) than as non-drainage samples (n=7), but this set of 18 data points was not exclusively collected in drainages. Hence, the biphasic nature of the probability plot was not explained by accumulation of cPAHs in storm washdown collection areas. Regardless, all the data within the final censored dataset were generated from samples selected as representative of the background cPAH population.

The Kaplan-Meier method in the SCOUT program was used previously to derive 95% USL values for other background soil analyte datasets that contained one or more non-detects (URS, 2012). Because the background soil BaP-EQ dataset also contains several non-detects, and the Kaplan-Meier method enables statistical evaluation of the entire censored BaP-EQ dataset, which itself was not consistent with a defined distribution (eg, normal, log-normal, or gamma), HERO used the Kaplan Meier statistical method in SCOUT to derive a 95% USL of 2.99 ug/kg for the final censored BaP-EQ dataset (Figure 4a). Thus, HERO recommends that the existing LUT USL background

BaP-EQ (4.47 ug/kg) be updated to the new sample-based USL background BaP-EQ of 2.99 ug/kg. For this censored dataset, Figure 4b documents that the 95% Upper Confidence Limit (95% UCL) on the mean background BaP-EQ is 1.82 ug/kg.

Reviewed by:

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	A	B	C	D	E	F
1	**Table 1. Raw BaP-EQ Sample Data and Two Datasets of Sequentially Censored**					
2	**BaP-EQ Data Evaluated Using SCOUT**					
3	BaP-EQs Raw Data (n=148)	d_BaP-EQs	BaP-EQs-1out 51.93 outlier excluded (n=147)	d_BaP-EQs-1out	BaP-EQs-3out 51.9, 9.2 & 8.6 outliers excluded (n=145)	d_BaP-EQs-3out
4	51.932	1	9.169	1	3.549	1
5	9.169	1	8.646	1	3.5257	1
6	8.646	1	3.549	1	3.4937	1
7	3.549	1	3.5257	1	3.1375	1
8	3.5257	1	3.4937	1	2.8861	1
9	3.4937	1	3.1375	1	2.5644	1
10	3.1375	1	2.8861	1	2.5318	1
11	2.8861	1	2.5644	1	2.4461	1
12	2.5644	1	2.5318	1	2.3511	1
13	2.5318	1	2.4461	1	2.3281	1
14	2.4461	1	2.3511	1	2.3133	1
15	2.3511	1	2.3281	1	2.2686	1
16	2.3281	1	2.3133	1	2.2584	1
17	2.3133	1	2.2686	1	1.9963	1
18	2.2686	1	2.2584	1	1.9813	1
19	2.2584	1	1.9963	1	1.9302	1
20	1.9963	1	1.9813	1	1.9098	1
21	1.9813	1	1.9302	1	1.8946	1
22	1.9302	1	1.9098	1	1.89122	1
23	1.9098	1	1.8946	1	1.8833	1
24	1.8946	1	1.89122	1	1.8709	1
25	1.89122	1	1.8833	1	1.8469	1
26	1.8833	1	1.8709	1	1.8248	1
27	1.8709	1	1.8469	1	1.815	1
28	1.8469	1	1.8248	1	1.785	1
29	1.8248	1	1.815	1	1.7811	1
30	1.815	1	1.785	1	1.7746	1
31	1.785	1	1.7811	1	1.75887	1
32	1.7811	1	1.7746	1	1.7511	1
33	1.7746	1	1.75887	1	1.7496	1
34	1.75887	1	1.7511	1	1.7406	1
35	1.7511	1	1.7496	1	1.7352	1
36	1.7496	1	1.7406	1	1.7321	1
37	1.7406	1	1.7352	1	1.7306	1
38	1.7352	1	1.7321	1	1.72421	1
39	1.7321	1	1.7306	1	1.7223	1
40	1.7306	1	1.72421	1	1.72209	1
41	1.72421	1	1.7223	1	1.7185	1
42	1.7223	1	1.72209	1	1.71417	1
43	1.72209	1	1.7185	1	1.71399	1

	A	B	C	D	E	F
1	**Table 1. Raw BaP-EQ Sample Data and Two Datasets of Sequentially Censored**					
2	**BaP-EQ Data Evaluated Using SCOUT**					
3	BaP-EQs Raw Data (n=148)	d_BaP-EQs	BaP-EQs-1out 51.93 outlier excluded (n=147)	d_BaP-EQs-1out	BaP-EQs-3out 51.9, 9.2 & 8.6 outliers excluded (n=145)	d_BaP-EQs-3out
84	1.65377	1	1.65182	1	1.65166	1
85	1.65182	1	1.65169	1	1.64785	1
86	1.65169	1	1.65166	1	1.64777	1
87	1.65166	1	1.64785	1	1.64735	1
88	1.64785	1	1.64777	1	1.64636	1
89	1.64777	1	1.64735	1	1.646	1
90	1.64735	1	1.64636	1	1.64373	1
91	1.64636	1	1.646	1	1.6411	1
92	1.646	1	1.64373	1	1.641	1
93	1.64373	1	1.6411	1	1.64089	1
94	1.6411	1	1.641	1	1.64072	1
95	1.641	1	1.64089	1	1.64056	1
96	1.64089	1	1.64072	1	1.64054	1
97	1.64072	1	1.64056	1	1.64046	0
98	1.64056	1	1.64054	1	1.64045	0
99	1.64054	1	1.64046	0	1.64045	0
100	1.64046	0	1.64045	0	1.63987	1
101	1.64045	0	1.64045	0	1.63767	1
102	1.64045	0	1.63987	1	1.6361	1
103	1.63987	1	1.63767	1	1.63488	1
104	1.63767	1	1.6361	1	1.6341	1
105	1.6361	1	1.63488	1	1.63188	1
106	1.63488	1	1.6341	1	1.63092	1
107	1.6341	1	1.63188	1	1.62971	1
108	1.63188	1	1.63092	1	1.6235	1
109	1.63092	1	1.62971	1	1.61975	1
110	1.62971	1	1.6235	1	1.61775	1
111	1.6235	1	1.61975	1	1.6176	1
112	1.61975	1	1.61775	1	1.6176	1
113	1.61775	1	1.6176	1	1.61748	1
114	1.6176	1	1.6176	1	1.61744	1
115	1.6176	1	1.61748	1	1.61735	0
116	1.61748	1	1.61744	1	1.61735	0
117	1.61744	1	1.61735	0	1.61735	0
118	1.61735	0	1.61735	0	1.61735	0
119	1.61735	0	1.61735	0	1.61462	1
120	1.61735	0	1.61735	0	1.61371	1
121	1.61735	0	1.61462	1	1.61259	1
122	1.61462	1	1.61371	1	1.61157	1
123	1.61371	1	1.61259	1	1.61064	1

	A	B	C	D	E	F
1	**Table 1. Raw BaP-EQ Sample Data and Two Datasets of Sequentially Censored**					
2	**BaP-EQ Data Evaluated Using SCOUT**					
3	BaP-EQs Raw Data (n=148)	d_BaP-EQs	BaP-EQs-1out 51.93 outlier excluded (n=147)	d_BaP-EQs-1out	BaP-EQs-3out 51.9, 9.2 & 8.6 outliers excluded (n=145)	d_BaP-EQs-3out
44	1.7185	1	1.71417	1	1.71	1
45	1.71417	1	1.71399	1	1.7096	1
46	1.71399	1	1.71	1	1.7082	1
47	1.71	1	1.7096	1	1.7061	1
48	1.7096	1	1.7082	1	1.7048	1
49	1.7082	1	1.7061	1	1.7039	1
50	1.7061	1	1.7048	1	1.7003	1
51	1.7048	1	1.7039	1	1.70006	1
52	1.7039	1	1.7003	1	1.6961	1
53	1.7003	1	1.70006	1	1.69011	1
54	1.70006	1	1.6961	1	1.6901	1
55	1.6961	1	1.69011	1	1.68976	1
56	1.69011	1	1.6901	1	1.6879	1
57	1.6901	1	1.68976	1	1.68735	1
58	1.68976	1	1.6879	1	1.68667	0
59	1.6879	1	1.68735	1	1.6859	1
60	1.68735	1	1.68667	0	1.68281	1
61	1.68667	0	1.6859	1	1.6799	1
62	1.6859	1	1.68281	1	1.67908	1
63	1.68281	1	1.6799	1	1.67797	1
64	1.6799	1	1.67908	1	1.6762	1
65	1.67908	1	1.67797	1	1.67459	1
66	1.67797	1	1.6762	1	1.67382	1
67	1.6762	1	1.67459	1	1.66996	1
68	1.67459	1	1.67382	1	1.66901	1
69	1.67382	1	1.66996	1	1.6687	1
70	1.66996	1	1.66901	1	1.66507	1
71	1.66901	1	1.6687	1	1.6649	1
72	1.6687	1	1.66507	1	1.66371	1
73	1.66507	1	1.6649	1	1.66278	1
74	1.6649	1	1.66371	1	1.66171	1
75	1.66371	1	1.66278	1	1.6581	1
76	1.66278	1	1.66171	1	1.65791	1
77	1.66171	1	1.6581	1	1.65683	1
78	1.6581	1	1.65791	1	1.656	1
79	1.65791	1	1.65683	1	1.6546	1
80	1.65683	1	1.656	1	1.6542	1
81	1.656	1	1.6546	1	1.65377	1
82	1.6546	1	1.6542	1	1.65182	1
83	1.6542	1	1.65377	1	1.65169	1

	A	B	C	D	E	F
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2	**BaP-EQ Data Evaluated Using SCOUT**					
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124	1.61259	1	1.61157	1	1.60967	1
125	1.61157	1	1.61064	1	1.60956	1
126	1.61064	1	1.60967	1	1.60449	1
127	1.60967	1	1.60956	1	1.60361	1
128	1.60956	1	1.60449	1	1.60068	1
129	1.60449	1	1.60361	1	1.59657	1
130	1.60361	1	1.60068	1	1.59463	1
131	1.60068	1	1.59657	1	1.59456	1
132	1.59657	1	1.59463	1	1.5945	1
133	1.59463	1	1.59456	1	1.59441	1
134	1.59456	1	1.5945	1	1.5944	1
135	1.5945	1	1.59441	1	1.59429	1
136	1.59441	1	1.5944	1	1.59428	1
137	1.5944	1	1.59429	1	1.59426	1
138	1.59429	1	1.59428	1	1.59424	0
139	1.59428	1	1.59426	1	1.58649	1
140	1.59426	1	1.59424	0	1.58545	1
141	1.59424	0	1.58649	1	1.58159	1
142	1.58649	1	1.58545	1	1.58148	1
143	1.58545	1	1.58159	1	1.57748	1
144	1.58159	1	1.58148	1	1.57553	1
145	1.58148	1	1.57748	1	1.5714	1
146	1.57748	1	1.57553	1	1.57126	1
147	1.57553	1	1.5714	1	1.57122	1
148	1.5714	1	1.57126	1	1.54808	1
149	1.57126	1	1.57122	1		
150	1.57122	1	1.54808	1		
151	1.54808	1				

Table 2. Rosner Outlier Test for Three Highest BaP-EQ Values

	Univariate Outlier Test Excluding Non-Detects
User Selected Options	
Date/Time of Computation	2/23/2018 1:39:51 PM
From File	K:\Don Greenlee\SSFL Site\DOE\SSLs\BaP-TEQ for LUT per LR_2018-01-98\ID_Outliers_Using_Scout\Data\Scout_In
Full Precision	OFF
t for Suspected Outliers for Dixon test	1
for Suspected Outliers for Rosner test	3

Rosner's Outlier Test for BaP-TEQs

Mean	2.241
Standard Deviation	4.345
Number of data	139
Number of suspected outliers	3

#	Mean	sd	Potential outlier	Obs. Number	Test value	Critical value (5%)	Critical value (1%)
1	2.241	4.329	51.93	1	11.48	3.489	3.859
2	1.881	0.927	9.169	2	7.861	3.481	3.859
3	1.828	0.687	8.646	3	9.919	3.481	3.859

For 5% significance level, there are 3 Potential Outliers
Therefore, Potential Statistical Outliers are
51.93, 9.169, 8.646

For 1% Significance Level, there are 3 Potential Outliers
Therefore, Potential Statistical Outliers are
51.93, 9.169, 8.646

Figure 1a - Box Plot of Raw Data

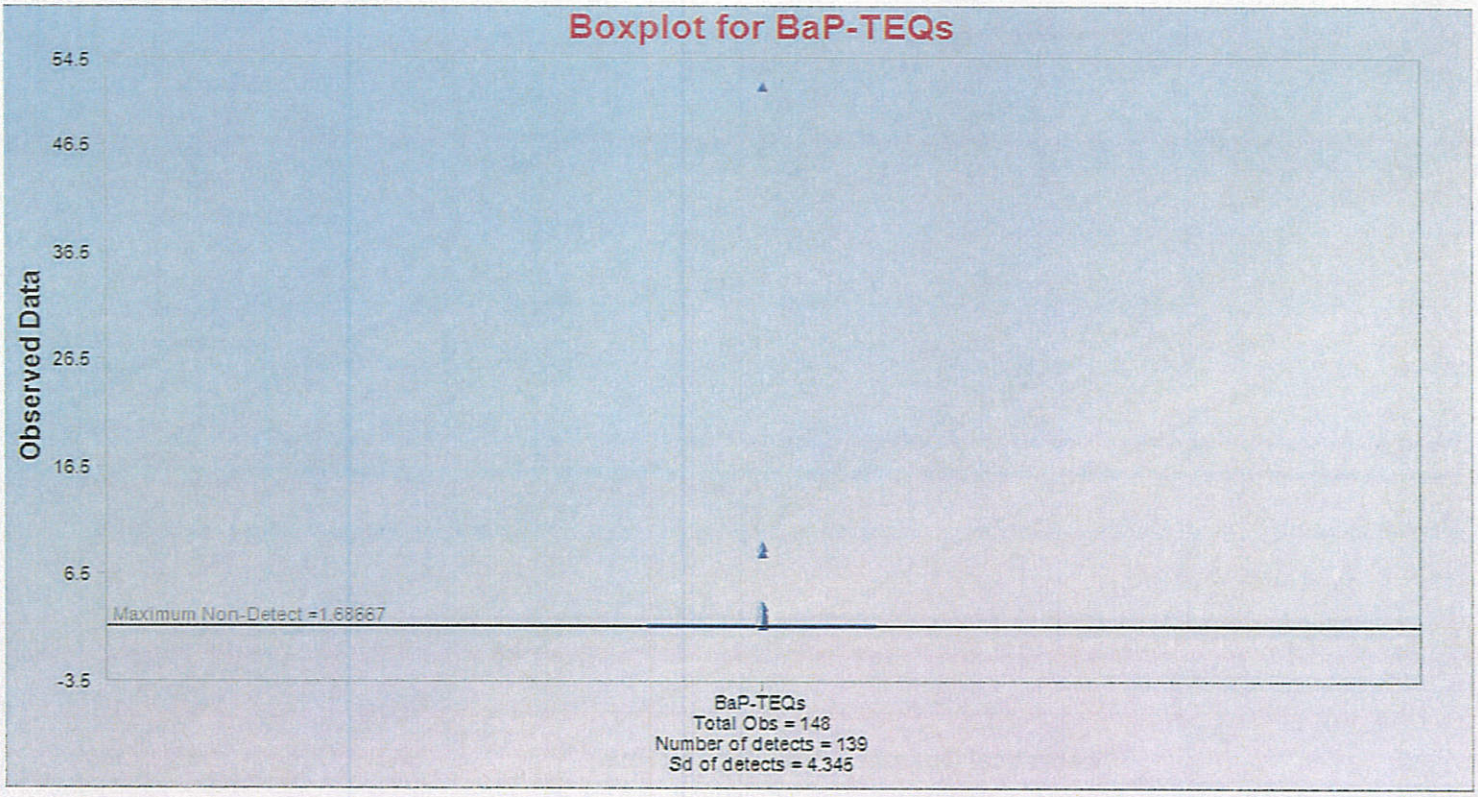

Figure 1b - Histogram of Raw Data

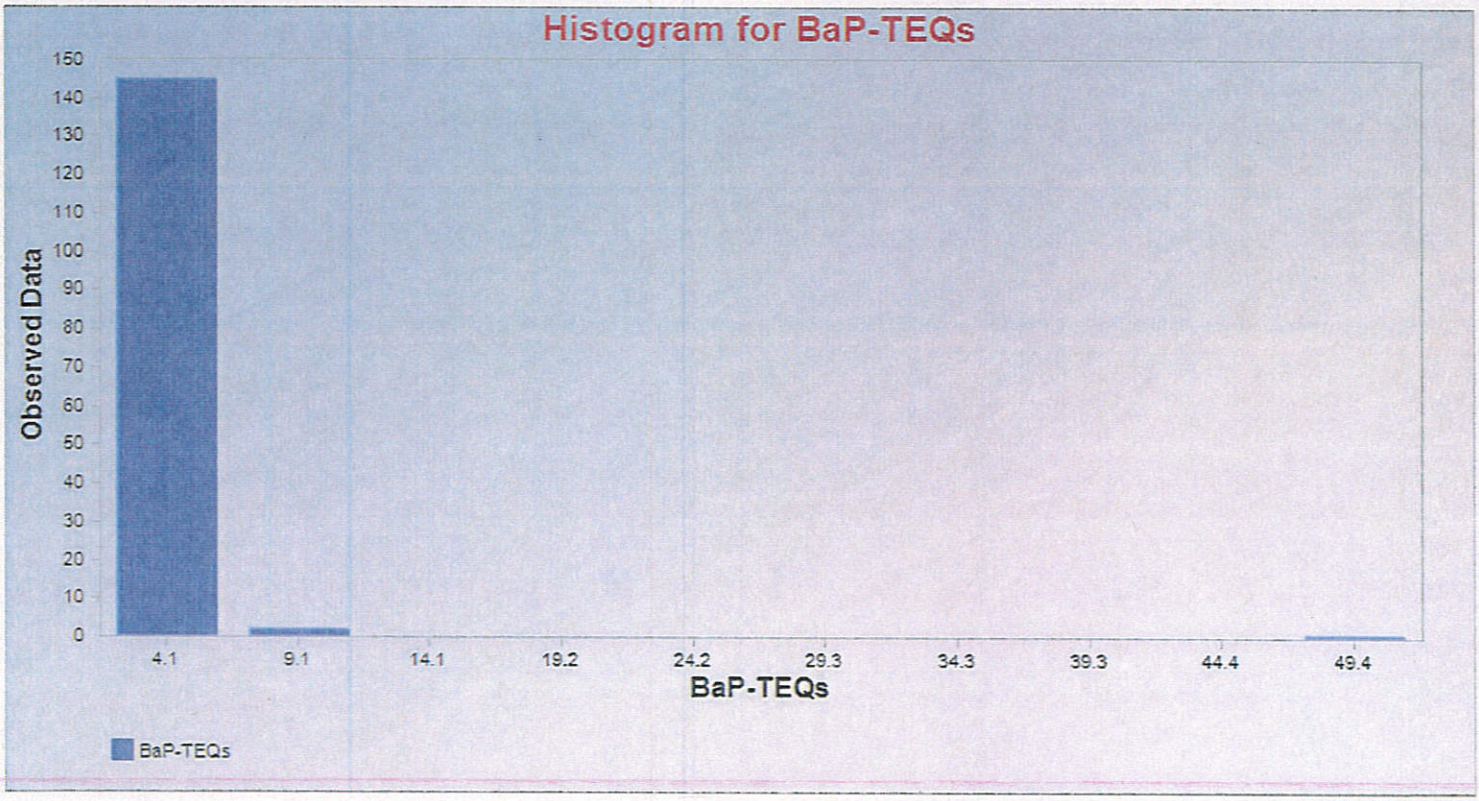

Figure 1c - Q-Q Probability Plot of Raw Data

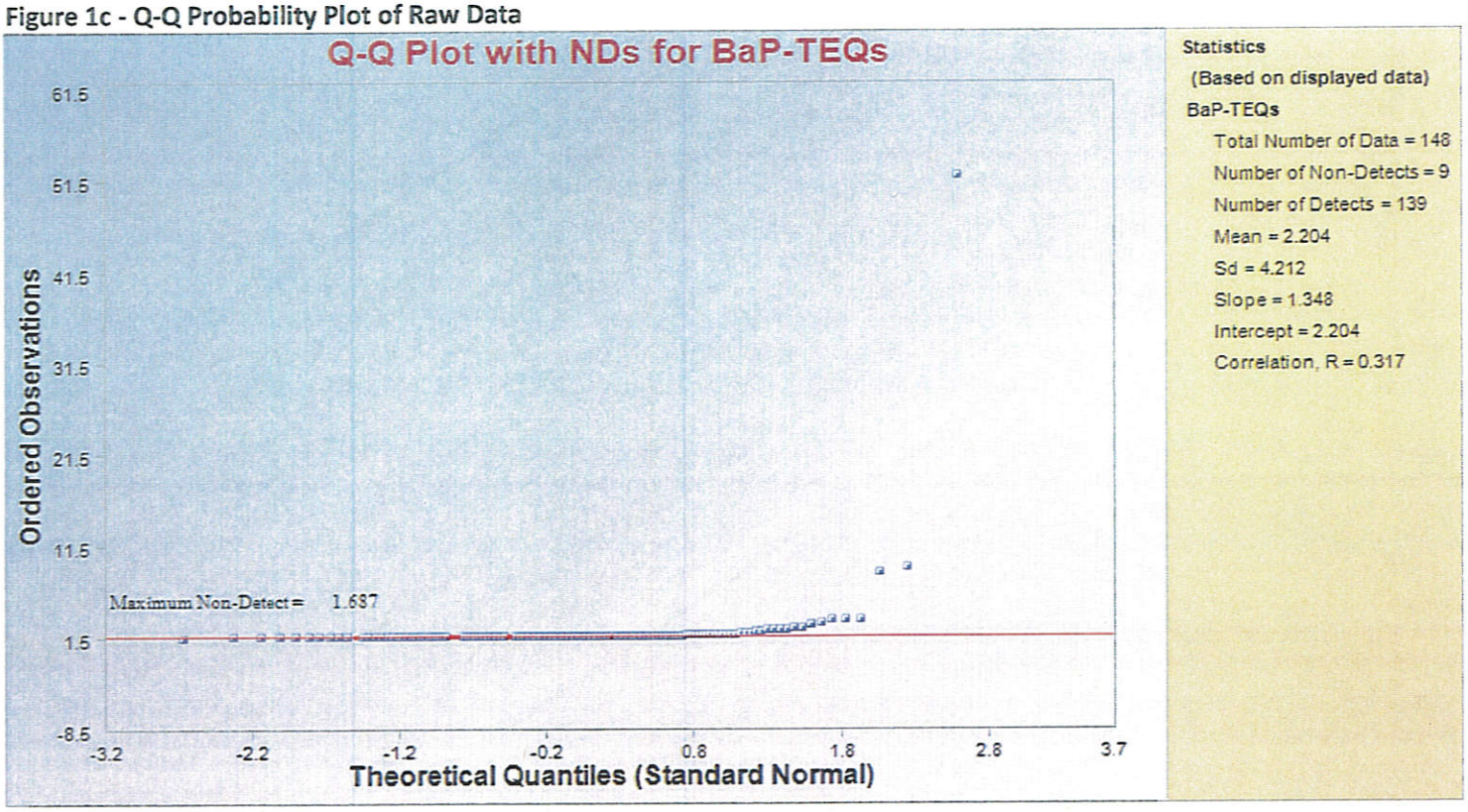

Figure 2a - Box Plot After Exclusion of Top Outlier

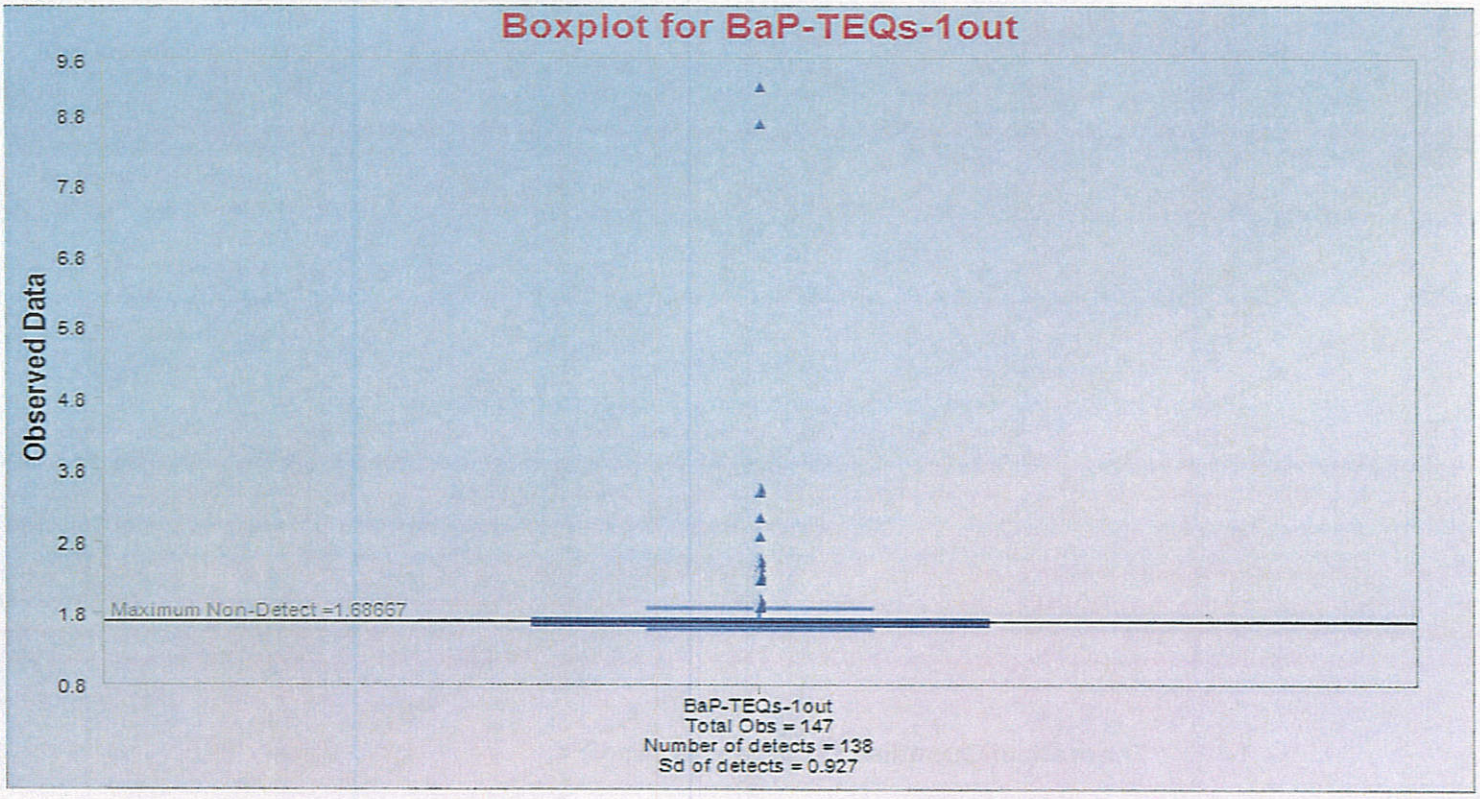

Figure 2b - Histogram After Exclusion of Top Outlier

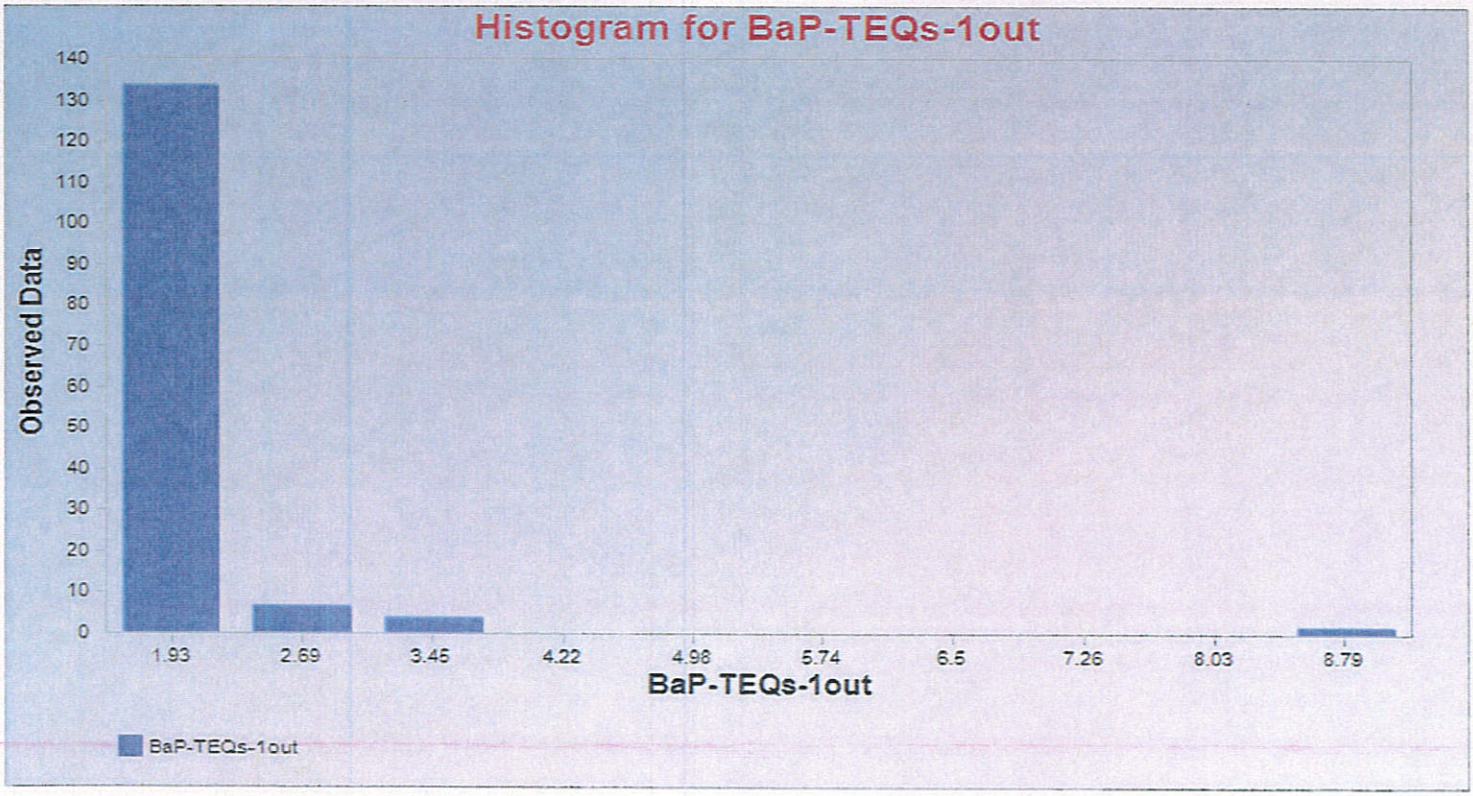

Figure 2c - Q-Q Probability Plot After Exclusion of Top Outlier

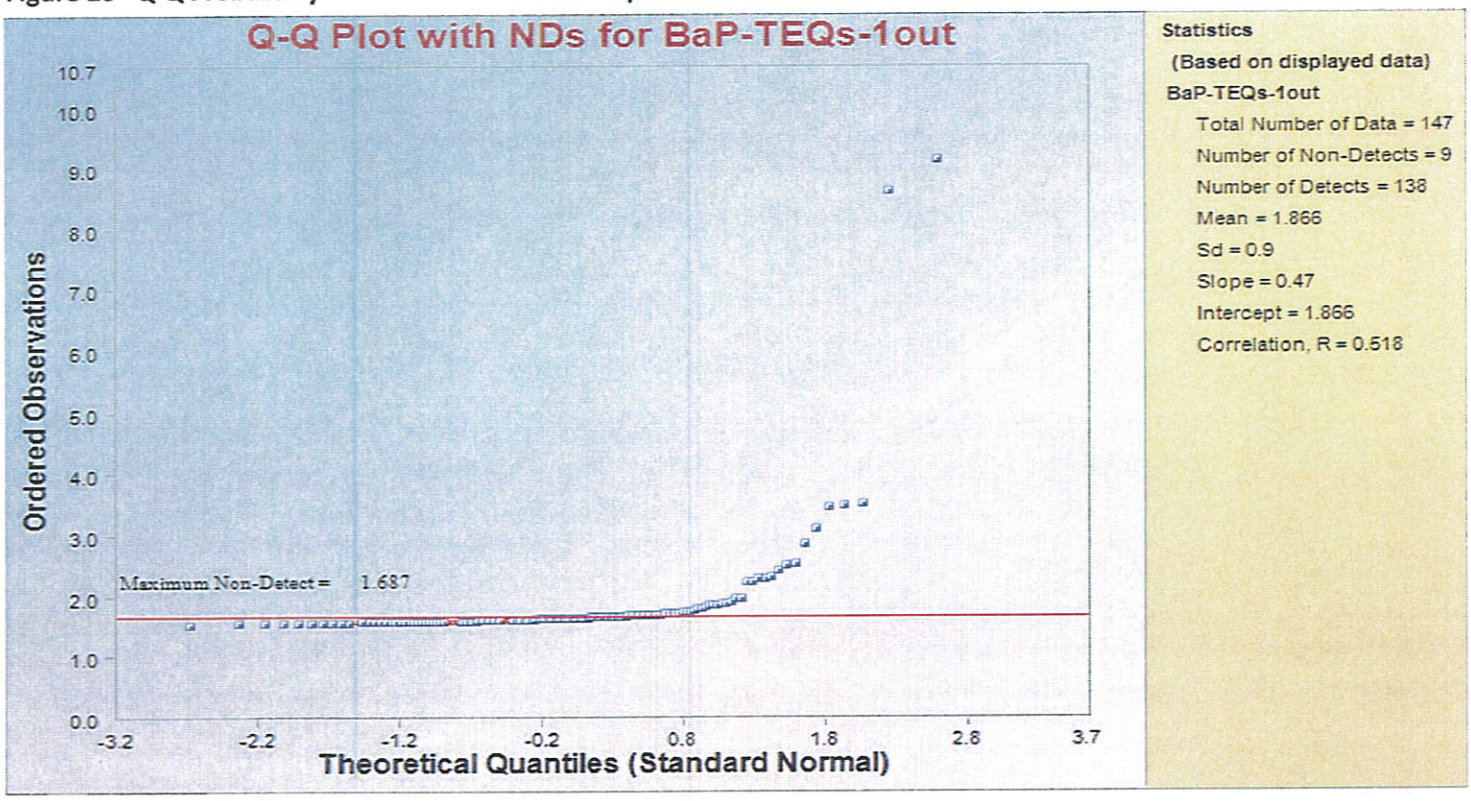

Figure 3a - Box Plot After Exclusion of Top 3 Outliers

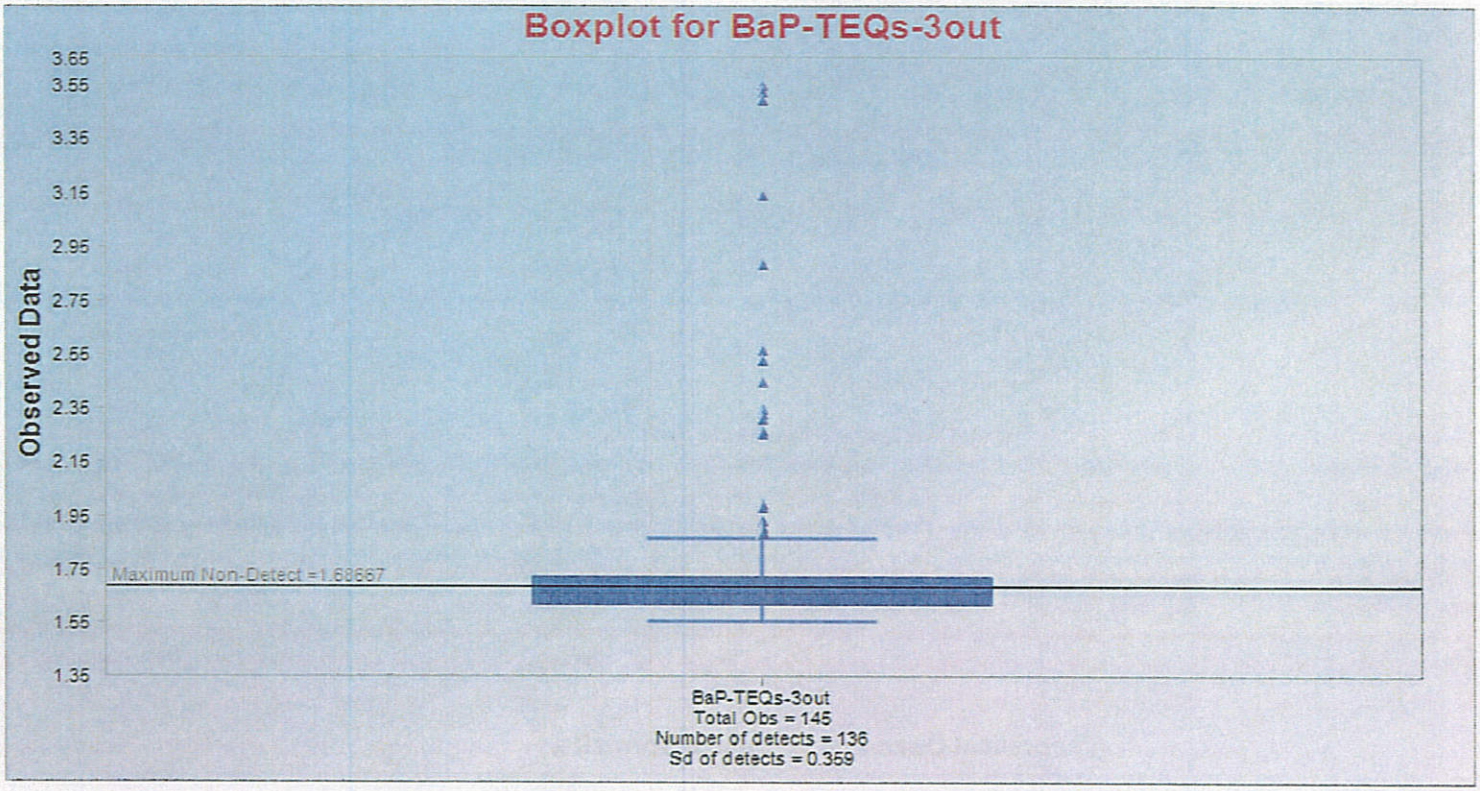

Figure 3b - Histogram After Exclusion of Top 3 Outliers

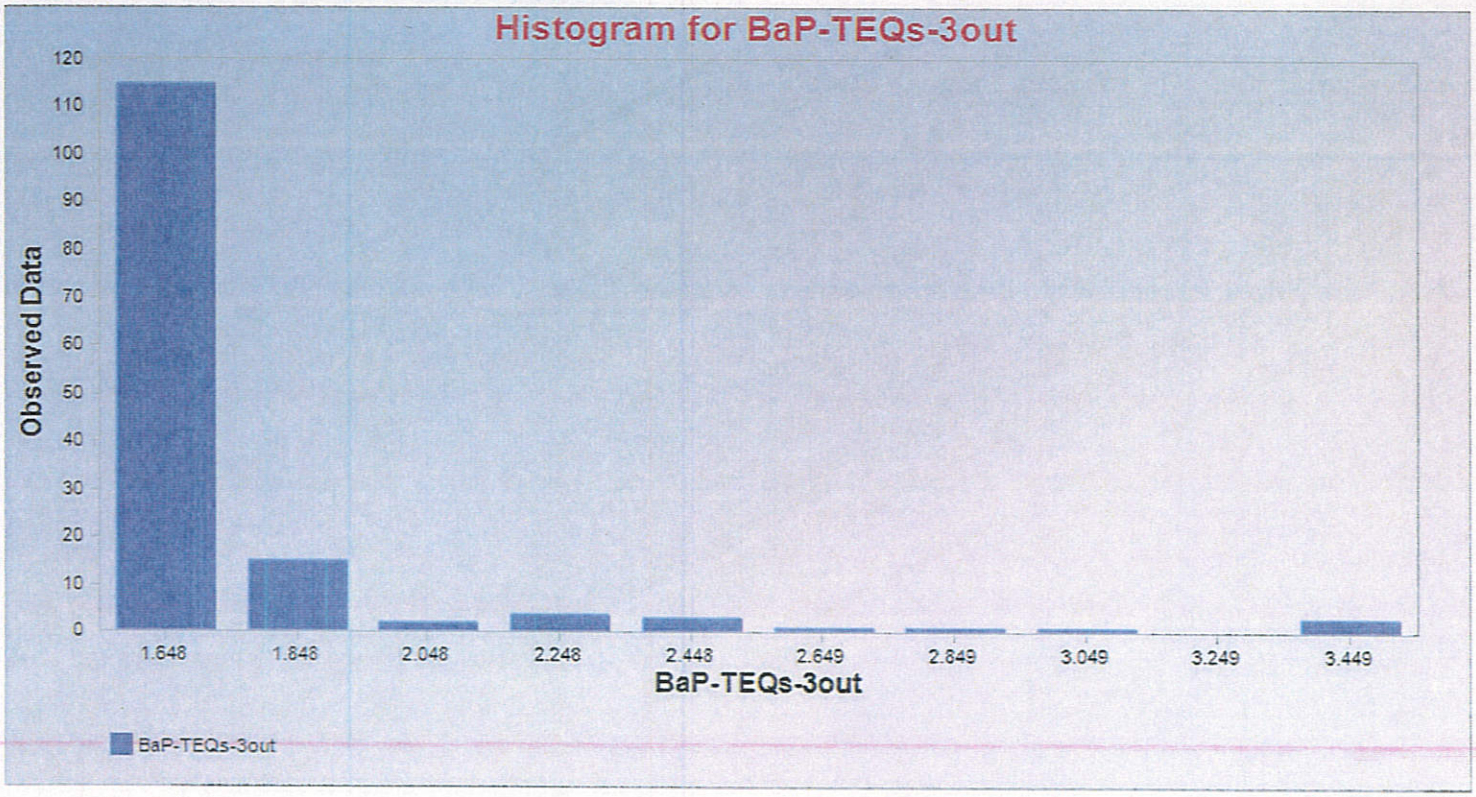

Figure 3c - Q-Q Probability Plot After Exclusion of Top 3 Outliers

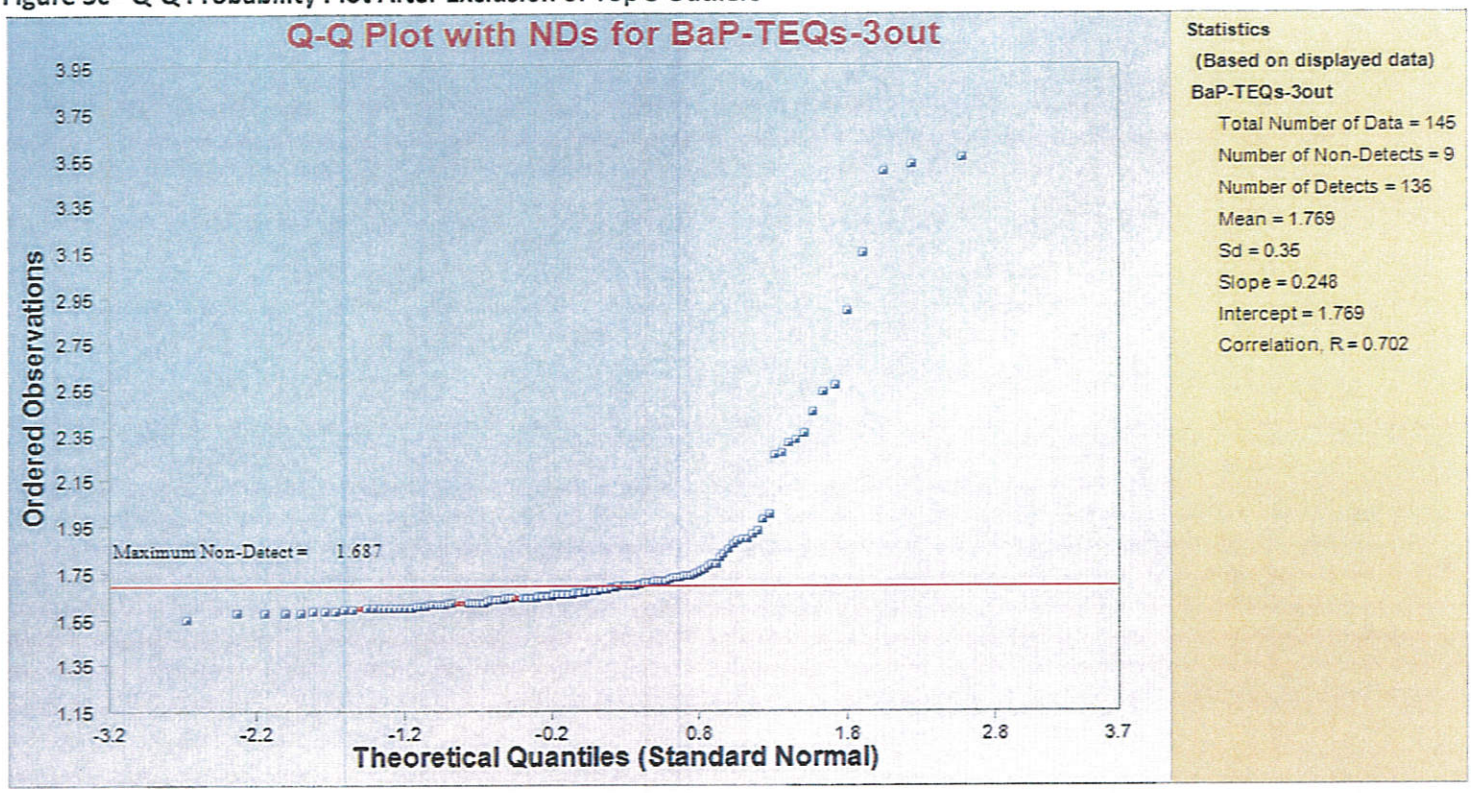

Figure 4a. SCOUT-Derived 95%USL for Background Soils BaP-EQ Data Excluding Top 3 Outliers

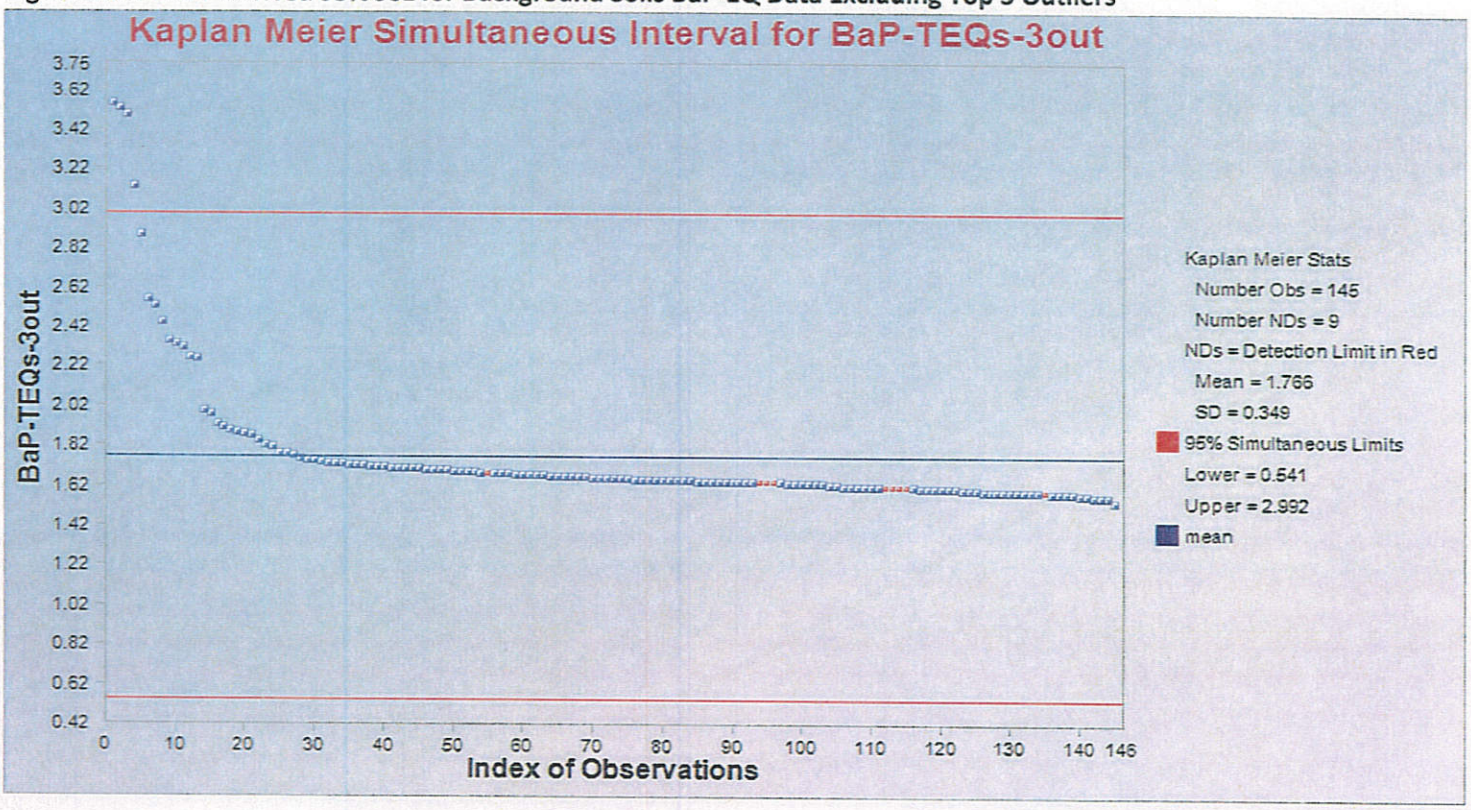

Figure 4b. SCOUT-Derived 95%UCL for Background Soils BaP-EQ Data Excluding Top 3 Outliers