FINAL
ADDENDUM 1 TO FINAL PRE-2005 HUMAN HEALTH RISK ASSESSMENT REVIEW

SPRING VALLEY FORMERLY USED DEFENSE SITE WASHINGTON, D.C.

Contract No.: W912DR-06-D-0002, Delivery Order 0011 and W912QR-08-D-0012, DA03
DERP FUDS MMRP/CWM Project No. C03DC091801 and
DERP FUDS HTRW Project No. C03DC091802

US Army Corps of Engineers®
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Prepared for:

US ARMY CORPS OF ENGINEERS
BALTIMORE DISTRICT

Prepared by:

ERT, Inc.
Laurel, MD 20707

DECEMBER 16, 2013

December 16, 2013

Attn: Lan Reeser
CENAB-EN-HN
10 S. Howard Street
Baltimore, MD 21201-1715

Dear Mr. Reeser,

ERT, Inc., is pleased to present the Final Addendum 1 to the Final Pre-2005 Human Health Risk Assessment Review for the Spring Valley FUDS Integrated Site-Wide Remedial Investigation/Feasibility Study, Washington, DC.

This Final incorporates changes based on USACE and Stakeholder comments received on the Draft-Final version.

Electronic and hard copy distribution has been made as shown below. Please do not hesitate to call me at 301-323-1442 if you need anything more.

Sincerely,

Thomas J. Bachovchin
Project Manager

DISTRIBUTION:

CENAB – Reeser (4)
CEHNC – Anderson-Hudgins (1)
USEPA – Hirsh (1)
DCDOE – Sweeney (1)
RAB TAPP – deFur (1)
AU – Bridgham (1)

Written Comments were received December 02, 2013, via email from the USEPA on the October 31, 2013 Draft Final Addendum 1 to the Pre-2005 Human Health Risk Assessment Review for SVFUDS.

Written Comments were received November 15, 2013, via email from the DDOE on the October 31, 2013 Draft Final Addendum 1 to the Pre-2005 Human Health Risk Assessment Review for SVFUDS.

Written Comments were received December 06, 2013, from the RAB TAPP on the October 31, 2013 Draft Final Addendum 1 to the Pre-2005 Human Health Risk Assessment Review for SVFUDS.

Written Comments were received December 12, 2013, from the American University on the October 31, 2013 Draft Final Addendum 1 to the Pre-2005 Human Health Risk Assessment Review for SVFUDS.

USEPA

From: Hirsh, Steven <Hirsh.Steven@epa.gov> Mon, Dec 2, 2013 at 9:52 AM
To: "Reeser, Leland H NAB" <Leland.H.Reeser@usace.army.mil>, "Mr. Jim Sweeney" <james.sweeney@dc.gov>, Environmental Stewardship Concepts LLC <pldefur@igc.org>, Bethany Bridgham <bjbesq@american.edu>, Paul Chrostowski <pc@cpfassociates.com>, "Anderson-Hudgins, Sherri K HNC" <Sherri.Anderson- Hudgins@usace.army.mil>

Cc: "Noble, Dan G NAB" <Dan.G.Noble@usace.army.mil>, Thomas Bachovchin <thomas.bachovchin@ertcorp.com>

Hi Lan,
EPA has complete its review of the Draft-Final Addendum 1 to the Pre-2005 HHRA Review Report for the Spring Valley FUDS. EPA agrees with the conclusions presented in the Addendum and has no comments on the draft document.

Thanks for the opportunity to review this draft.

Steven Hirsh
U.S. EPA, Region III (3HS10)
Office of Federal Facility Remediation
1650 Arch Street (3HS10)
Philadelphia, PA 19103-2029

USACE RESPONSE:
Noted.

DCDOE

From: Sweeney, James (DDOE) <james.sweeney@dc.gov> Fri, Nov 15, 2013 at 12:31 PM
To: "Reeser, Leland H NAB" <Leland.H.Reeser@usace.army.mil>, Hirsh.Steven@epamail.epa.gov <Hirsh.Steven@epamail.epa.gov>, Environmental Stewardship Concepts LLC <pldefur@igc.org>, Bethany Bridgham <bjbesq@american.edu>, Paul Chrostowski <pc@cpfassociates.com>, "Anderson-Hudgins, Sherri K HNC" <Sherri.Anderson-Hudgins@usace.army.mil>

Cc: "Noble, Dan G NAB" <Dan.G.Noble@usace.army.mil>, Thomas Bachovchin <thomas.bachovchin@ertcorp.com>, "Jackson, Richard (DDOE)" <richard.jackson2@dc.gov>

Lan:
Due to the lack of a staff toxicologist assigned to the Spring Valley project, the District Department of the Environment (DDOE) will defer to the Environmental Protection Agency (EPA) regarding comments on any risk assessment documents related to the Spring Valley FUDS. Therefore, we will not be making any comments on the subject document.

If you have any comments, please let me know.

USACE RESPONSE:
Noted.

RAB TAPP

To: Lan Reeser, CENAB
From: Peter deFur, ESC, LLC

Re: HHRA Pre-2005 data
Date: 6 Dec 2013
CC: Greg Beumel, RAB

Basically, we agree that the document accomplishes the intended task, that the conclusions and recommendations are logical and supported by the evidence and that the document should be finalized and further work should proceed as recommended.

The current document is Addendum 1 to the August 2013 Final Pre-2005 HHRA for site-wide evaluation of human health risks for the Spring Valley FUDS. The evaluation presented here constitutes the follow-on screening recommended the previous version of this document. Risks were estimated on the basis of exposure units (EUs) with the objective of identifying remaining areas of the SVFUDS that require additional HHRA.

The combining of the data sets, with consideration of data quality, is consistent and effective in this case. The data were correctly combined into a single set and applied as exposure units (13 EUs).

The COPCs were selected appropriately and we agree with the data selection and the results, using exposure point concentrations that resulted from the data set. The analysis with ProUCL was appropriate and seems to avoided the problem of EUs so large they dilute higher concentration at some locations. The separate screening of "outliers" on the basis of maximum concentrations greater than 10X the average of the remaining sample values seems acceptable.

We agree with the Conclusions and recommendations:

- Complete HHRA: exposure assessment, toxicity assessment, and risk characterization steps
- Southern AU area should be evaluated as a stand-alone; AOI 9 and S-R into one HHRA document
- Single comprehensive work plan for the HHRAs
- All detected chemicals will be included in the HHRA, not just those COPCs resulting from this follow-on screening
- Exposure scenario assessments that are listed are appropriate for this effort

The text did not provide sample sizes (number of samples/data points) for most of the EUs. Giving these values would be helpful in interpreting the results.

The elevated thalium in Dalecarlia Woods remains an elevated result, regardless of the quality of the toxicity studies that are noted in the document.

USACE RESPONSE:
Please note that sample sizes are provided in the left-most column of the Appendix A tables.

USACE stands by the report recommendation for the single thallium sample in the Dalecarlia Woods area, based on the expanded PPRTV toxicity discussion presented in Section 2.3.6.

American University

American University (AU) appreciates the opportunity to review and comment on the Draft-Final Addendum 1 to the Final Pre-2005 Human Health Risk Assessment Review (HHRAR) dated October 31, 2013. AU's review and comments are limited to the portion of this document that pertains to AU property and should not be construed to apply to any other portions of the SVFUDS. In general, we agree with the scope and content of this investigation. Overall, however, the utility of this exercise is not readily apparent since it revolves around COPC screening and "All detected chemicals in that particular EU will be included in the HHRA, not just those COPCs resulting from this follow-on screen" (p. 26). Some of the comments, below, are intended to assist USACE in the formulation of the actual HHRA for the Southern AU EU that is to follow. Our detailed comments, recommendations, and questions are:

1. The data in this report have not been presented in the context of a remedial investigation (RI) report detailing the nature and extent of contamination. Such a report would typically contain information regarding sampling, preparation, and analytical methods; data validation; summary statistics including concentration contours; problems or issues encountered during sampling; contaminant fate and transport, and other relevant information[1]. The actual analytical data is normally included or appended to the report. Although we assume that this type of information will be presented in a final RI document, it normally precedes a risk assessment that starts with an analysis of data suitability based on information presented in the RI[2]. This type of information is available for the older studies included in the HHRAR, but not for the most recent data. Because of this, AU reserves the right to modify its comments on the HHRAR upon receipt and review of the RI report that contains this information. Hopefully this RI will precede the HHRA for the Southern AU EU.

USACE RESPONSE:

AU was provided an XL table of almost all of the analytical data with a few exceptions (only non-detects from the old RA data sets, shown as the black sample dots on Figures 12 and 13, are not available in the tables provided). However, the complete data set will be made available during your review of the Draft-Final Risk Assessment Work Plan. Other RI-related information will be included in the Site-Wide RI.

2. We were unable to replicate the calculations shown in the various appendices using the data that were transmitted in spreadsheet format. For example, Table E13 refers to 86 total samples, however, a dataset containing these values could not be located in the spreadsheet. It is also not apparent how the data uploaded to ProUCL were selected. AU requests copies of all datasets required to replicate the calculations presented in this document.

USACE RESPONSE:

The sample count was qualified in the report for several reasons (including the difficulty in counting samples when one backfill sample replaces multiple original samples, or in counting location vs data sets). It has been clarified throughout the document that the 86 locations comprise 115 separate data sets when splits and/or multiple depth increments from the same location are counted. The third tab of the XL table (AU Detects only) provides every sample used (minus a few parameters that were non-detect in the old data set as described in Comment 1 above). A more complete data set will be made available during your review of the Draft-Final Risk Assessment Work Plan.

3. This document appears to introduce the novel concept of statistical outliers as a screen to eliminate COPCs from consideration by eliminating data points containing these COPCs. This concept has been employed for several metals and polycyclic aromatic hydrocarbons (PAHs) in the Southern AU exposure unit. This practice was not used in the parent document, nor is it mentioned in Exhibit 1 – Screening Process Flow Chart. The justification for excluding outliers in risk assessment is not apparent. A statistical outlier is merely a data point that is distant from other points in the distribution. It may be due to natural variability or measurement error. Due to many considerations, EPA has noted that "the treatment and handling of outliers is a controversial and subjective topic." In any event, EPA guidance[3] recommends that formal outlier tests (e.g. Rosner, Dixon) should be supplemented by graphical methods such as box and Q-Q plots to statistically evaluate outliers. EPA also recommends that the influence of outliers on the various statistics should be assessed by computing all relevant statistics for the datasets with and without outliers and performing a comparison of the results. Finally, EPA recommends that the entire project team should come to an agreement whether to treat the outlying observations separately or to include them in summary statistics. None of these recommendations has been followed and, in fact, the procedures used in this document to identify outliers are not generally accepted in the environmental statistics community. If any concepts relating to outliers are to be followed in the HHRA for the Southern AU EU, AU requests that they strictly follow EPA guidance and the team approach.

USACE RESPONSE:

The document explains in Section 2.1.3 and other places, that these 'outliers' are not discarded. Rather, conservatively, they are evaluated separately, specifically so that they do not dilute the concentrations across the larger EU. This was done at EPA's request at a meeting AU attended and the method used was discussed and approved by the participants. The last section of the Appendix C Screening Procedures Memo explains this. In addition, a paragraph will be added to Section 2.3.13 to further clarify.

4. Thallium was apparently omitted from the screening analysis due to the fact that its toxicity value is a PPTRV. It should be noted, however, that the November 2013 version of the RSL tables contains a screening level for thallium of 7.8E-02 (HQ=0.1) that should be used for screening.

USACE RESPONSE:

Thallium was screened, but was not taken to the next level for the reasons stated in the document. Section 2.3.6 will be expanded to provide further information on the approach to thallium.

5. It is difficult to determine what happened to benzo(a)pyrene data during the course of this analysis. It occurs in the data set, but does not show up in the summary tables for chemicals potentially posing risk. EPA Region 3's position regarding cPAH at other sites has been "that if a carcinogenic PAH fails the screening, the concentration term should be based on all detected cPAHs regardless of whether their individual concentrations failed the screen, since the cPAH concentrations are additive". AU requests that USACE adhere to this policy for the HHRA for the Southern AU EU[4]

USACE RESPONSE:

Table A.13 shows B(a)P to have been less than Background via ProUCL testing (output sheet contained in Appendix D) and so is not a COPC. However, the maximum value was determined

to be an outlier by the approved approach, was removed, and will be screened separately in the RA Work Plan. Note that this screening has already been completed and the RA Work Plan will show in more detail how B(a)P is still a Provisional COPC following that separate screen and is included in the RA.

6. AU is pleased to note that the HHRA will include a hypothetical residential scenario, however, the size of the current EU is too large to be plausible for residential occupancy and could cause dilution due to the small number of samples from some areas. AU recommends that a series of smaller residential EUs, similar in area to typical Spring Valley residential lots, be used for this analysis.[5]

USACE RESPONSE:

The establishment of EUs was done in accordance with the rationale provided in the previous document, the Final Pre-2005 HHRA Review. See section 7.1 (7.1.1).

7. AU is also pleased to note that all detected chemicals will be included in the HHRA for the Southern AU EU. Hopefully this will include all potential carcinogens (e.g., As, Be, cPAHs), and non-carcinogens (e.g., Hg, Al, Co, Sb, Tl, non-carcinogernic PAHs, phthalates, etc).

USACE RESPONSE:

All chemicals analyzed are in the AU EU data set for the RA.

8. Data from L-18 and PSB have been excluded from this risk assessment on the basis that they have been evaluated in other risk assessments. However, as evident from Figure 9, there may be overlap from these and other investigations with the boundaries of the Southern AU EU. Since the purpose of a risk assessment is to characterize exposures that could actually occur, it is important that all data be included regardless of its degree of prior characterization. USACE should examine all relevant investigations including L-18, PSB, CDC, and TCRA Critical Lots to determine if any data from these investigations falls within the Southern AU EU boundaries. The HHRA should be based on all of this relevant and available data.

USACE RESPONSE:

A site figure was provided previously to AU and it formed the eastern reaches of the AU EU in the Pre-2005 HHRA Review document (figure 5). This figure was specifically developed to exclude Lot 18, the PSB, and the CDC, for the reasons stated. The TCRA Lots results, within the AU EU, are included in the data set.

9. USACE has yet to justify the adequacy of the Southern AU dataset for use in a risk assessment. Even a quick perusal of Figures 12 and 13 shows that the majority of the data is spatially clustered in the south portion of the EU and that the north portion is relatively uncharacterized. Many of the samples were tested only for selected metals despite the prevalence of PAHs. Few samples were tested for chemical agents or breakdown products and it is difficult to ascertain if even one sample was tested for the comprehensive SVFUDS list. No calculations have been provided to determine if the number of samples is even statistically adequate (e.g., $\alpha = 0.05$, $\beta=0.2$) for comparison to the RSLs with any meaningful level of confidence. Since we are unsure of the composition of the database, we are unable to perform such calculations ourselves. Finally, AU has been on record advocating the use of state-of-the-art geostatistical techniques to evaluate adequacy of sampling[6] . USACE has been resistant to using these methods, however, AU has been unable to perform the calculations since the coordinates of the data points are

unavailable. AU recommends that calculations of sample size be performed to determine sample number adequacy for RSL comparison and that geostatistical methods, as outlined in our earlier comments, be used to determine spatial adequacy. At the very least, a document should be prepared that shows exactly what data USACE plans to use in the HHRA along with all data qualifiers and geographical coordinates.

USACE RESPONSE:

There are 115 sets of results from 86 sample locations for an approximately 9 acre area, averaging to approximately 12+ samples per acre. The complete data set will be made available during your review of the Draft-Final Risk Assessment Work Plan. Sample coordinates wil be provided with the Work Plan.

From email message:

In addition to the other comments made, the University is particularly concerned by the disparity in the sample density between the northern section and the southern section (shown on the map attached below). One of the samples (AU-10) in this area has been removed as an "outlier". Another – the cluster around Baker-05 is actually a single composite sample. Taking these into account, that leaves only 10 samples to evaluate an area of approximately 3.5 acres (less than 3 samples per acre) which the University believes is insufficient for risk assessment purposes.

USACE RESPONSE:

See above response. Also, the statement about Baker-05 in incorrect. These are 6 discrete samples as can be seen in the third tab of the XL table, AU Detects only (TCRA-AU-BK05A, B, C, D, E, F). Note that much of the northern half of the EU has undergone the TCRA where much of this dirt was removed and replaced with clean backfill.

[1] EPA 1988. Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA. EPA/540/G-89/004.

[2] EPA 1992. Guidance for Data Useability in Risk Assessment. Publication 9285.7-09A *et seq*.

[3] EPA 2007. ProUCL Version 4.0 Technical Guide. EPA/600/R-07/041.

[4] This should not be construed as an endorsement of EPA's policy by AU.

[5] Also see, Hartmann, H.M., et al. 1993. Use of the exposure unit concept in risk assessment. ANL/EA/CP-797

[6] AU (2012) American University Response to "Final Evaluation of Remaining Sampling Requirements": Site-Wide Remedial Investigation/Feasibility Study dated June 22, 2012.

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ADDENDUM 1 TO

FINAL PRE-2005 HUMAN HEALTH RISK ASSESSMENT REVIEW

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Prepared for:

Baltimore District

US Army Corps of Engineers®
BUILDING STRONG®

Prepared by:

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December 16, 2013

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Prepared by:

Amy B. Rosenstein Date: 12/12/13
SENIOR RISK ASSESSOR

Prepared by:

ELECTRONIC SIGNATURE

Thomas J. Bachovchin, PG Date: 12/16/13
PROJECT MANAGER

COMPLETION OF SENIOR TECHNICAL REVIEW

This document has been produced within the framework of the ERT, Inc. (ERT) quality management system. As such, a senior technical review has been conducted. This included review of all elements addressed within the document, proposed or utilized technologies and alternatives and their applications with respect to project objectives and framework of U.S. Army Corps of Engineers regulatory constraints under the current project, within which this work has been completed.

Jennifer Harlan Date: 9/05/13
SENIOR TECHNICAL REVIEWER/PROGRAM MANAGER

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LIST OF ACRONYMS AND ABBREVIATIONS

AOI	area of interest
AU	American University
AUES	American University Experiment Station
CENAB	United States Army Corps of Engineers, Baltimore District
COPC	chemical of potential concern
CWM	chemical warfare materiel
DERP	Defense Environmental Restoration Program
EE/CA	Engineering Evaluation/Cost Analysis
EPC	exposure point concentration
ERT	ERT, Inc.
EU	exposure unit
FUDS	Formerly Used Defense Site
HI	hazard index
HHRA	Human Health Risk Assessment
HQ	hazard quotient
HTRW	hazardous, toxic, and radiologic waste
IRIS	Integrated Risk Information System
kg	kilogram
MEC	munitions and explosives of concern
mg	milligram
MMRP	Military Munitions Response Program
OSR	Operation Safe Removal
OU	Operable Unit
POI	point of interest
PPRTV	Provisional Peer-reviewed Toxicity Value
RAGS	Risk Assessment Guidance for Superfund
RfD	Reference Dose
RI/FS	Remedial Investigation and Feasibility Study
RSL	Regional or Risk-Based Screening Level
SVFUDS	Spring Valley Formerly Used Defense Site
UCL	Upper Confidence Limit
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency

EXECUTIVE SUMMARY

This document is Addendum 1 to the August 2013 *Final Pre-2005 Human Health Risk Assessment Review*. In the Final Pre-2005 Human Health Risk Assessment (HHRA) Review, re-screening of all soil data from the Spring Valley Formerly Used Defense Site (SVFUDS) in Washington, D.C., was done using updated risk-based screening levels and background data, to ensure that any potential risks associated with soils still in place at SVFUDS were evaluated.

Using the screening procedure presented in the Final Pre-2005 HHRA Review, this addendum presents the follow-on screening that was recommended in Section 7.3 of that document. The follow-on screening was conducted on Exposure Units (EUs) within the SVFUDS, as identified in the Final Pre-2005 HHRA Review, with the objective of identifying remaining areas of the SVFUDS that require additional human health risk assessment.

The approach for further risk evaluation for the EUs was to combine the older pre-2005 risk assessment samples with newer more recent sample results into a single data set for each of the EUs, and then apply the screening steps. This follow-on screening of the combined data sets was completed for all chemicals in the data set, not just the chemicals of potential concern (COPCs) determined to be remaining in the Final Pre-2005 HHRA Review.

Exposure Units and Data Used in the Follow-on Screen

An EU is a geographical area in which a receptor is randomly exposed to a contaminated medium for a relevant exposure duration; it considers similar past practices, similar receptor populations and exposure pathways, and geography. The Final Pre-2005 HHRA Review document derived EUs based on the screen of the data used in the pre-2005 risk assessments. Those EUs plus other discrete areas defined by sampling data not otherwise covered in any risk assessments totaled 13 areas screened in this document.

Three sets of sample data were used in this follow-on screen. Some EUs had samples from all three sets, while some EUs only had data from one or two of the sets. The first data set comprises all of the samples used in the pre-2005 risk assessments, i.e., all the data points used in the Final Pre-2005 HHRA Review document. The second data set comprises samples from miscellaneous sampling efforts conducted during anomaly investigations, or other samples collected for various reasons, which were not captured in any prior risk assessments. These included samples with collection dates from as early as 2001 to as late as 2011.

The third data set comprises samples resulting from the *Final Evaluation Document* (United States Army Corps of Engineers [USACE], 2012) recommendations. The sampling was based on the recommendations in the Area of Interest Memoranda that summarized possible historical American University Experiment Station (AUES) impacts not addressed in ongoing investigations, or possible data gaps, and made recommendations regarding whether any additional investigation was necessary. This relatively recent sampling was primarily completed in 2012, but also includes Area of Interest (AOI) 8 and AOI 11 sampling, some of which was completed as early as 2009.

Selection of Chemicals of Potential Concern

The follow-on screening process is basically the same one used in the Final Pre-2005 HHRA Review, consisting of an initial screen for all detected chemicals in soil that selects provisional

COPCs, and an additional screen incorporating other factors to identify remaining COPCs.

The initial screen compared the maximum detected value of each constituent against current risk-based screening levels and current background concentrations. This initial screen resulted in the identification of provisional COPCs. This is a conservative approach because a single maximum concentration is not a realistic representation of actual contamination at a site, and so an additional screen, incorporating other factors to make the evaluation more realistic and representative of current site conditions, was also performed.

The additional screen comprised two steps performed on the provisional COPCs using United States Environmental Protection Agency's (USEPA's) statistical software ProUCL: 1) an exposure point concentration (EPC) of each provisional COPC was calculated and a risk ratio determined, and 2) a two-sample hypothesis test comparing site concentrations to background concentrations was completed.

In addition, as part of the follow-on screen, detected concentrations using the combined data sets were reviewed to ensure that the identified EUs are not so large that they dilute higher concentrations of a chemical over the larger area. The process evaluated whether maximum concentrations of each chemical are more than 10 times higher than the average of the remaining concentrations of that chemical (i.e., identifies whether the maximum is an outlier). Where an outlier was determined, that sample location was removed from the data set and the EU was evaluated by the remaining samples; the outlier sample was then screened separately using the screening procedure (i.e., risk is assessed on the individual outlier location).

Findings

COPCs remained following the initial and additional screening steps. For some EUs, only a few naturally occurring metals remained as COPCs. In some cases, these were areas where the COPC was based on a single maximum value because there were insufficient samples to conduct statistical testing. These factors were considered in evaluating whether these areas could reasonably be eliminated from further assessment in a quantitative HHRA.

To further evaluate whether the COPCs for a given EU would be associated with potential human health risks if carried through a quantitative HHRA, non-cancer hazard quotient (HQ) values were calculated and incremental cancer risks were estimated for the remaining COPCs, assuming standard residential receptor scenarios.

The findings for each EU are summarized in Table ES.1 below.

Table ES.1. Summary of COPCs by EU

Exposure Unit	COPCs Identified	Table Reference	Conclusion
4256 Warren Street Property	Aluminum Arsenic Cobalt Iron Magnesium Vanadium	A.1	Non-cancer HQs < 1, no further evaluation
4900 Quebec Street Property	Mercury	A.2	Non-cancer HQ < 1, no further evaluation
3949 52nd Street Property	Cobalt	A.3	Non-cancer HQ < 1, no further evaluation
4015 52nd Street Property	Aluminum Cobalt Iron Magnesium	A.4	Non-cancer HQs < 1, no further evaluation
POI 39	Aluminum Manganese	A.5	Non-cancer HQs < 1, no further evaluation
Dalecarlia Woods	Zinc (identified as an outlier)	A.6	Non-cancer HQ < 1, no further evaluation
AOI 8	Manganese	A.7	Non-cancer HQ < 1, no further evaluation
AOI 11	Aluminum Magnesium	A.8	Non-cancer HQs < 1, no further evaluation
AOI 9	Aluminum Cobalt Manganese	A.9	Cobalt Non-cancer HQ > 1, conduct HHRA
AOI 13	Aluminum Cobalt Iron Mercury (identified as an outlier)	A.10	Non-cancer HQs < 1, no further evaluation
Western POI 53 EU	Aluminum Vanadium	A.11	Non-cancer HQs < 1, no further evaluation
Spaulding-Rankin	Aluminum Cobalt Iron, Manganese Vanadium	A.12	Cobalt Non-cancer HQ > 1, conduct HHRA
Southern AU	Aluminum Cobalt, Iron Magnesium, Manganese Vanadium Outliers: antimony, beryllium, mercury, benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene indeno(1,2,3-cd) pyrene phenanthrene	A.13	Antimony and cobalt HQs > 1, benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, and indeno (1,2,3-cd) pyrene exceed USEPA cancer risk range, conduct HHRA

Conclusions and Recommendations
The follow-on screen determined that:

- For the AOI 9 EU, based on the cobalt HQ exceeding one, further evaluation is required.
- For the Spaulding-Rankin EU, based on the cobalt HQ exceeding one, further evaluation is required.
- For the Southern American University (AU) EU, based on the HQs for antimony and cobalt exceeding one, and the estimated incremental cancer risks for benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, and indeno (1,2,3-cd) pyrene being greater than the USEPA acceptable range, further evaluation is required.
- For all other EUs, no COPCs presenting potential risk remain and no further evaluation is required.

The follow-on screen determined that for three exposure units, COPCs remain that may present a risk. Based on the COPCs identified and the risks calculated, HQs that exceed one, and, for some chemicals, estimated incremental cancer risks greater than the USEPA acceptable range, quantitative HHRAs are recommended for the AOI 9, Spaulding-Rankin, and Southern AU EUs, as shown in Table ES.2. These EUs will undergo a complete HHRA consisting of exposure assessment, toxicity assessment, and risk characterization steps.

For all other EUs, no quantitative HHRAs are recommended.

Table ES.2. Recommended HHRAs

Exposure Unit	COPCs Potentially Presenting Risk	HHRA Organization
AOI 9	Cobalt	The HHRA for this EU and the HHRA for the Spaulding-Rankin EU will be bundled in the same document based on similar receptors (largely private residences)
Spaulding – Rankin	Cobalt	The HHRA for this EU and the HHRA for the AOI 9 EU will be bundled in the same document based on similar receptors (largely private residences)
Southern AU	Antimony Cobalt Benzo(a)anthracene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Indeno (1,2,3-cd) pyrene	The HHRA for this EU will be a standalone document addressing the Southern AU EU only based on similar receptors for this portion of AU

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1.0 INTRODUCTION

1.1 Purpose and Objective

This document is Addendum 1 to the August 2013 *Final Pre-2005 Human Health Risk Assessment Review* (August 2013). In the Final Pre-2005 Human Health Risk Assessment (HHRA) Review, re-screening of all soil data from the Spring Valley Formerly Used Defense Site (SVFUDS) in Washington, D.C., was done using updated risk-based screening levels and background data, to ensure that any potential risks associated with soils still in place at SVFUDS were evaluated. The methodology was outlined in the *Final Evaluation Document for the Spring Valley FUDS Integrated Site-Wide Remedial Investigation/Feasibility Study, Washington, DC* (USACE, 2012), and was based on the historical information, analytical data, and recommendations/conclusions presented in five pre-2005 discrete HHRAs.

Using the screening procedure presented in the Final Pre-2005 HHRA Review, this addendum presents the follow-on screening that was recommended in Section 7.3 of that document. The follow-on screening was conducted on Exposure Units (EUs) within the SVFUDS, as identified in the Final Pre-2005 HHRA Review, with the objective of identifying remaining areas of the SVFUDS that require additional human health risk assessment.

ERT, Inc. (ERT) has been contracted by the U.S. Army Corps of Engineers (USACE), Baltimore District (CENAB), to perform a Remedial Investigation and Feasibility Study (RI/FS) for the SVFUDS (Defense Environmental Restoration Program [DERP] FUDS Military Munitions Response Program [MMRP]/Chemical Warfare Materiel [CWM] Project No. C03DC091801 and DERP FUDS Hazardous, Toxic, and Radioactive Waste (HTRW) Project No. C03DC091802). ERT is performing activities in support of ongoing sampling and remedial investigations addressing munitions and explosives of concern (MEC) and CWM under Contract W912DR-06-D-0002, Task Order 0011.

1.2 SVFUDS Background

The SVFUDS is an area of northwest Washington, DC, that was formerly occupied by the American University Experiment Station (AUES). During World War I, the U.S. government established the AUES to investigate the testing, production, and effects of noxious gases, antidotes, and protective masks. The AUES was located on the grounds of the current American University (AU) and used additional property in the vicinity to conduct this research and development on CWM, including mustard and lewisite agents, as well as adamsite, irritants, and smokes. After the war, these activities were transferred to other locations and the site was returned to the owners. The SVFUDS location map is presented as Figure 1 (all figures are presented in Appendix B).

1.3 Overview of Approach

As described in Section 7.3 of the Final Pre-2005 HHRA Review, the approach for further risk evaluation for the EUs developed was to combine the older pre-2005 risk assessment samples with newer more recent sample results into a single data set for each of the EUs, and then screen the data following the steps described in Section 2.0. This follow-on screening of the combined data sets was completed for all chemicals in the data set, not just the chemicals of potential

concern (COPCs) determined to be remaining in the Final Pre-2005 HHRA Review. If no COPCs remain in an EU through the follow-on screen, that EU drops out and is not considered further. If COPCs remain through the follow-on screen, that EU will undergo a complete HHRA consisting of exposure assessment, toxicity assessment, and risk characterization steps.

Figure 2 shows all individual EUs or areas covered in this follow-on screen addendum.

1.4 Organization of the Document

This review document is organized as follows: Section 1 provides the introduction (purpose and objective, and data used); Section 2 summarizes the procedures for the follow-on screen and further evaluates the identified COPCs; Section 3 contains the uncertainty discussion; Section 4 presents conclusions; Section 5 presents recommendations; and, Section 6 contains references. Appendix A contains the detailed screening tables, Appendix B contains the figures, Appendix C provides the screening steps procedural memorandum, Appendix D contains the ProUCL statistical output (Appendix D provided on CD only), and Appendix E provides risk calculations.

1.5 Data Used in the Follow-on Screen

Three sets of sample data were used in this follow-on screen as described below. Some EUs had samples from all three sets, while some EUs only had data from one or two of the sets. Appendix B presents figures of the individual EUs screened showing all sample locations. Note that in some cases, these locations represent more than one sample result, for example, where a sample location contained multiple depth increments, or where a single location contained a split result (as was the case for some of the USACE 1995 and United States Environmental Protection Agency (USEPA) 1999 risk assessment locations). Due to scale and space limitations, not every individual sample name is shown on the figures and some of the sample names shown are abbreviated. However, all results were used in the follow-on screen, including all depth increments and all split results.

1.5.1 Pre-2005 Risk Assessment Samples

The first data set comprises all of the samples used in the pre-2005 risk assessments, i.e., all the data points used in the Final Pre-2005 HHRA Review document. On the figures, these samples are color-coded using black dots.

1.5.2 Miscellaneous Grab Samples

The second data set comprises samples from miscellaneous sampling efforts conducted during anomaly investigations, or other samples collected for various reasons, which were not captured in any prior risk assessments. These included samples with collection dates from as early as 2001 to as late as 2011. On the figures, these samples are color-coded using blue dots.

1.5.3 Recent (2012) Evaluation Document Samples

The third data set comprises samples resulting from the *Final Evaluation Document* (USACE, 2012) recommendations. That document provided a plan for supplemental sampling to fill identified data gaps and ensure that areas were fully characterized to support conclusions about potential human health risks. The sampling was based on the recommendations in the Area of Interest Memoranda that summarized possible historical AUES impacts not addressed in ongoing

investigations, or possible data gaps, and made recommendations regarding whether any additional investigation was necessary. This relatively recent sampling was primarily completed in 2012. However, it also includes Area of Interest (AOI) 8 and AOI 11 sampling, some of which was completed as early as 2009. On the figures, these samples are color-coded using red dots.

1.6 Exposure Units (EUs)

An EU is a geographical area in which a receptor is randomly exposed to a contaminated medium for a relevant exposure duration; it considers similar past practices, similar receptor populations and exposure pathways, and geography. The intent of the follow-on screen was to assess an EU based on all data available, without regard as to when the data were collected.

The Final Pre-2005 HHRA Review document derived EUs based on the screen of the data used in the pre-2005 risk assessments. Those EUs, as well as other discrete areas defined by sampling data not otherwise covered in any risk assessments, formed the basis of the areas screened in this document. The EUs discussed below were assessed in this follow-on screen.

1.6.1 Individual Property EUs

Four separate private properties contained one or more data points and were screened: 4256 Warren Street, 4900 Quebec Street, 3949 52nd Street, and 4015 52nd Street. Each of these properties had miscellaneous grab samples (second data set). Two of the properties had a single sample, one property had two samples, and one property had 12 samples (see Figure 3). These properties were not identified in the Final Pre-2005 HHRA Review as EUs, but were defined by the miscellaneous grab samples that required the follow-on screen.

1.6.2 POI 39 EU

This point of interest (POI) was addressed in the Final Pre-2005 HHRA Review and was not recommended for further evaluation. However, a new data point, part of the miscellaneous grab data set, was added to a property within POI 39. Therefore, the entire POI 39 EU was re-screened using the combined data set of 14 samples (see Figure 4).

1.6.3 Dalecarlia Woods EU

This EU just west of the Dalecarlia Parkway, representing fenced woodlands with no residents, was investigated for geophysical anomalies and generated multiple miscellaneous grab samples. In addition to those, one pre-2005 risk assessment sample (from LTC Bancroft area) that was within the same area, was added and the entire EU was screened using the combined data set of 13 samples (see Figure 5). This area was not identified in the Final Pre-2005 HHRA Review as an EU, but was defined by the miscellaneous grab samples that required the follow-on screen.

1.6.4 AOI 8 EU

AOI 8 is the Former POI 12 (possible graded area as defined in the USACE 1995 *OSR FUDS RI Report*). It includes five properties between Van Ness and Upton Streets. The *Final Evaluation Document* (USACE, 2012) includes the background of this area and the rationale for the sampling completed there. This EU includes multiple residential properties and defines an area with common receptors and exposure pathways. It was screened using a data set of 4 samples

(recent Evaluation document data set) (see Figure 6).

1.6.5 AOI 11 EU

AOI 11 is defined as an expanded area of POI 13 and POI 14 encompassing the ten properties on 52nd Court and 5120, 5122, and 5124 52nd Street). The *Final Evaluation Document* (USACE, 2012) includes the background of this area and the rationale for the sampling completed there. This EU includes multiple residential properties and defines an area with common receptors and exposure pathways. It was screened using a data set of 6 samples (recent Evaluation document data set) (see Figure 7).

1.6.6 AOI 9 EU

This EU is defined by AOI 9, which contains POI 1, the circular trenches where static testing of CWM munitions was conducted, and POI 7, where agent persistency testing was reportedly conducted. There are a number of ground scars in the vicinity of POI 1 that became POIs 2, 3, 4, 5, 6, and 8. Portions of AOI 9 fall within the downrange impact areas of the Range Fan. This EU includes multiple residential properties and defines an area with common receptors and exposure pathways. It was screened using a combined data set of 59 samples (all three data sets)(see Figure 8).

1.6.7 AOI 13 EU

This EU is defined by AOI 13, which is located between Quebec Street and Woodway Lane. AOI 13 contains multiple 1918 ground scars, including POI 26. Three AUES buildings were located within AOI 13 and the northern edge of the Range Fan passes through a portion of it. This EU boundary includes 13 residential properties and defines an area with common receptors and exposure pathways. It was screened using a combined data set of 17 samples (all three data sets) (see Figure 9).

1.6.8 Western POI 53 EU

This EU is defined by that portion of POI 53 not covered by other EUs. It comprises residential properties along Glenbrook Road with common receptors and exposure pathways, and was screened using a combined data set of 10 samples (two data sets) (see Figure 10).

1.6.9 Spaulding-Rankin EU

This EU is defined by previous areas of investigation. It is limited to a single residential property previously known as the Spaulding-Rankin area, where the Range Fan firing point and concrete shell pits were located. The EU includes POIs 21, 22, 23, and 25 (POI 25 location as identified and as sampled for the 1995 Remedial Investigation). This property was maintained as a discrete EU based on the differences in past activities that occurred within this EU versus the other nearby residential properties. (Note that the POI 23 terminus samples are actually located on the 4845 Glenbrook Road property, but these data were included with the Spaulding-Rankin data set based on similar analytes and past practices). It was screened using a combined data set of 60 samples (all three data sets) (see Figure 11). Also note that the mercury data from USACE 1995 (and USEPA 1999, where USEPA used USACE split data) were not used in the screen because the inappropriate analytical method (inductively coupled plasma) had been used resulting in

unrealistically high mercury values, as has been documented in various SVFUDS presentations and discussions.

1.6.10 Southern AU EU

This EU is defined by previous areas of investigation conducted at AU. The 'Southern AU' EU combines the area addressed in the USEPA 2000 HHRA, and POI AU and portions of POIs 24 and 53 addressed in the USACE 1995 and USEPA 1999 HHRAs. However, the southeastern reaches of the POI AU and USEPA 2000 footprints are not included as that acreage is covered under the AU Lot 18 and AU Public Safety Building Human Health Risk Assessments (two separate documents). This EU is an active university campus with no full time permanent residences, and the EU boundary defines an area with common receptors and exposure pathways. It was screened using a combined data set of 86 sample locations comprising 115 sets of results (all three data sets) (see Figure 12).

2.0 SELECTION OF CHEMICALS OF POTENTIAL CONCERN

This section presents the procedures used in the follow-on screen, summarizing the more detailed presentation contained in the Final Pre-2005 HHRA Review.

The follow-on screening process described in this addendum consists of an initial screen for all detected chemicals in soil that selects provisional COPCs using a conservative approach, and an additional screen incorporating other factors to identify remaining COPCs. The follow-on screen was conducted on all EUs described in Section 1.6.

Tables A.1 through A.13 of Appendix A provide the detail of the screening steps described below.

2.1 Initial Screen

An *initial screen* of all detected chemicals in soil in the EU was conducted using current criteria. The initial screen compared the maximum detected value of each constituent against current risk-based screening levels and current background concentrations. This initial screen resulted in the identification of provisional COPCs. However, the use of the maximum detected value for this initial screen is a conservative approach because the use of a single maximum concentration is not a realistic representation of the distribution of actual contamination at a site. Therefore, an *additional screen*, incorporating other factors to make the evaluation more realistic and representative of current site conditions, was also performed, as described in Section 2.2.

A memorandum providing the detailed procedures for each step of the screen is contained in Appendix C.

2.1.1 Risk-Based Screening Levels

For the follow-on screen, the May 2013 USEPA Regional or Risk-Based Screening Levels (RSLs) (USEPA, 2013) were used to select COPCs in the initial screen, using the maximum detected concentration. USEPA RSLs reflect current toxicity values from sources used in the USEPA's toxicity hierarchy, and thus are updated by USEPA over time, if necessary, based on their review of newly published toxicity research. The USEPA RSLs are developed based on multiple exposure pathways and for chemicals with both carcinogenic and non-carcinogenic effects. RSLs correspond to either a 10^{-6} risk level for carcinogens or a Hazard Quotient (HQ) of 1 for non-carcinogens. The RSLs for non-cancer endpoints were adjusted to an HQ of 0.1 for the re-screening of COPCs in this HHRA review; this approach is commonly taken in an initial screening step to account for potential cumulative effects of non-carcinogens.

2.1.2 Background Concentrations

The current 2008 SVFUDS soil background data (USACE, 2008) were used. Comparison to background to determine which COPCs are elevated over background is consistent with USEPA (1989, 1992, 2002) guidance.

2.1.3 EU Dilution Testing

As described in Section 7.1 of the Final Pre-2005 HHRA Review, detected concentrations using the combined data sets were reviewed to ensure that the identified EUs are not so large that they dilute higher concentrations of a chemical over the larger area. In general, an assessment of the compatibility between EU size and the exposure scenarios that are applicable at SVFUDS indicates that, because of the similar residential exposure scenarios across all of the SVFUDS, excluding the AU campus, the EU sizes are compatible with potential exposures to residents and workers in these neighborhoods.

However, formal testing of whether there might be outliers in the larger EUs was included as a screening step. The procedural memorandum in Appendix C describes the detail of this testing, which evaluates whether maximum concentrations of each chemical are more than 10 times higher than the average of the remaining concentrations of that chemical (i.e., identifies whether the maximum is an outlier). Where an outlier was determined, that sample location was removed from the data set and the EU was evaluated by the remaining samples; the outlier sample was then screened separately using the screening procedure (i.e., risk is assessed on the individual outlier location).

2.2 Additional Screening Incorporating Other Factors

2.2.1 Additional Screening Steps

This section describes the additional screening factors used to further evaluate the provisional COPCs remaining following the initial screen. The additional screen comprised two steps performed on the provisional COPCs. Following the detail presented below, Exhibit 1 provides a screening process flow chart to capture all the steps conducted for this follow-on screen.

Step 1: Calculate a Risk Ratio

Assuming a sufficient quantity of samples (5 or greater) was available, USEPA's statistical software ProUCL (USEPA, 2011) was used to calculate the exposure point concentration (EPC) of each remaining provisional COPC. The risk ratio is the EPC divided by the most current RSL (adjusted down by 10 if based on a non-carcinogenic effect). This step results in one of two outcomes:

- If the risk ratio is less than or equal to one, the EPC does not exceed the RSL, and that COPC drops out.
- If the risk ratio is greater than one, the EPC exceeds the RSL, proceed to Step 2 (statistical comparison to background).

Step 2: Background Comparison

Assuming a sufficient quantity of samples (5 or greater) was available, a two-sample hypothesis test comparing site concentrations to background concentrations was completed using ProUCL-recommended procedures. This step results in one of two outcomes:

- If ProUCL determines that site concentrations are less than or equal to background, then the COPC drops out.

- If ProUCL determines that site concentrations are greater than background, the COPC is retained.

The detailed output of the ProUCL calculations for all steps is presented in Appendix D.

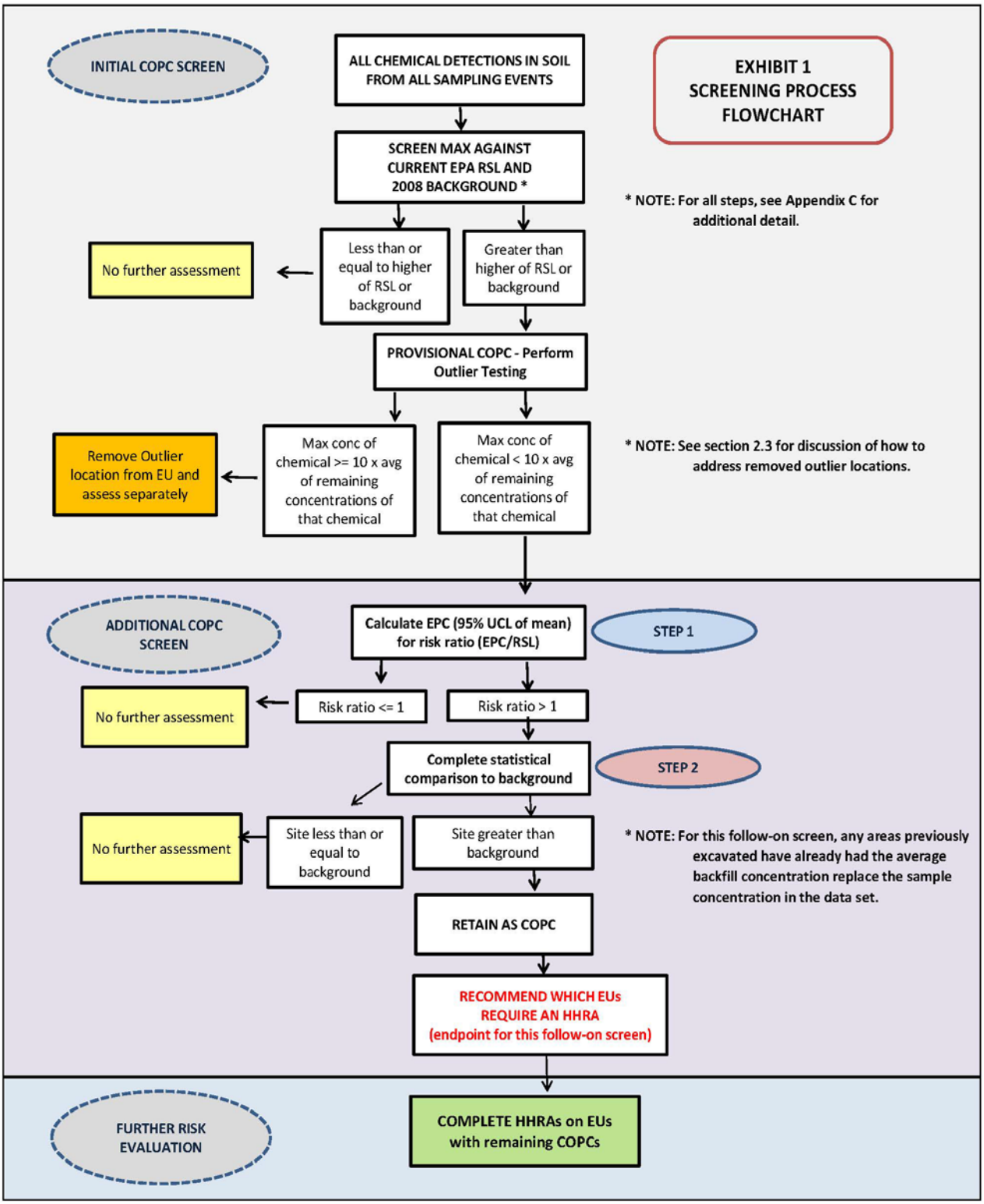
Excavated and Backfilled Areas:

In many areas, significant soil excavation has occurred and clean soil was used to backfill the excavations. The sub-steps of re-analyzing data after removing samples that represent excavated soil and then re-analyzing data after the backfill data have been included in the Step 1 and 2 analysis above. For additional details on those steps (previously Steps 3a and 3b) see Appendix C in the Final Pre-2005 HHRA Review document.

2.2.2 Organization of Tables

The analysis of COPCs using all of the steps described above is organized in tables specific to each EU. Appendix A presents Tables A.1 through A.13 showing the steps as applied per each of the EUs. These tables show all chemicals detected across all data sets applicable to that EU. On all tables, individual chemicals that remain COPCs following all initial and additional screening steps are highlighted in yellow.

Exhibit 1: Screening Process Flow Chart



2.3 Identification and Evaluation of Follow-on Screen COPCs

For some of the EUs, COPCs still remain through the initial and additional screening steps. Table 2.1 at the end of this section summarizes the remaining COPCs by EU.

The results of the follow-on screening identified EUs where only a few naturally occurring metals remained as COPCs. These COPCs may have been selected based on comparisons to an RSL that is based on uncertain toxicity data, or were naturally occurring metals that would not be associated with potential human health risks if carried through an HHRA. In some cases, these were areas where the COPC was based on a single maximum value because there were insufficient samples to conduct statistical testing.

The discussions in Sections 2.3.1 through 2.3.13 below consider these factors in evaluating whether these areas can reasonably be eliminated from further assessment in a quantitative HHRA. Although this differs from the standard screening of COPCs approach used at typical National Priority List (NPL) sites, based on professional judgment and the practical considerations of the SVFUDS, it is a reasonable means to focus efforts on more significant areas. This approach is particularly applicable at a site such as the SVFUDS, which is not an NPL site, and which comprises many different AOIs, POIs, or areas of investigation that have been identified based on past site history.

To support the statement that a given area would not be associated with potential human health risks if carried through an HHRA, HQ values were calculated. Appendix E provides tables with the calculations of HQ values as discussed in the paragraphs below. The procedure used to calculate the HQs is a standard EPA approach for residential receptors as follows: risks for a residential receptor were evaluated assuming that the resident would be exposed to soil via the incidental soil ingestion route. The dermal pathway was only quantified when arsenic was found to be a COPC because EPA recommends that only those COPCs with dermal absorption fractions listed in USEPA (2004) be quantified for the dermal pathway. The inhalation route provides a very small additional HQ for non-cancer effects, and does not change the conclusions of the paragraphs below; therefore, it is not discussed further. The assumptions and the equations used to assess the incidental soil ingestion pathway to calculate non-cancer HQs are shown in Table E.1; these apply to all the rest of the tables in Appendix E. Note that for the discussions below, the COPCs either impact different target organs, or if they impact the same target organ, the cumulative HQ is still less than or equal to one.

2.3.1 4256 Warren Street Property

At the 4256 Warren Street property, aluminum, arsenic, cobalt, iron, magnesium, and vanadium were determined to be COPCs through the screen (see Table A.1). These chemicals were selected based on a very limited data set (one sample).

For aluminum, the single sample result of 25,500 milligrams per kilogram (mg/kg) is greater than both the background value (19,100 mg/kg) and the adjusted RSL (7,700 mg/kg). However, the RSL for aluminum is based on a provisional peer-reviewed toxicity value (PPRTV) reference dose (RfD) of 1 mg/kg-day, which is not included in EPA's approved toxicity value database (the Integrated Risk Information System, [IRIS]), and the PPRTV is presented as having "low confidence" in the EPA support document (EPA, 2006). Further, as shown in Table E.1, by

applying the PPRTV, when residential non-cancer risks were calculated for aluminum, the HQ was less than one.

The detected concentration of arsenic (14.3 mg/kg) exceeded background (12.6 mg/kg) and the Regional or Risk-Based Screening Level (RSL) (0.61 mg/kg). However, as shown in Table E.1, when residential non-cancer risks were calculated for arsenic, the HQ was less than one.

The maximum detected concentration of cobalt (19.6 mg/kg) exceeded background (17.8 mg/kg) and the adjusted RSL (2.3 mg/kg). The RSL for cobalt is also based on a PPRTV, an RfD of 3.00E-4 mg/kg-day, for which EPA concludes there is a low-medium confidence level (EPA, 2008). However, as shown in Table E.1, by applying the PPRTV, when residential non-cancer risks were calculated for cobalt, the HQ was less than one.

Iron and magnesium were found to be greater than background in this one sample, but these are considered essential nutrients. Further, magnesium has no screening level.

The maximum detected concentration of vanadium (83.2 mg/kg) exceeded both background (75.5 mg/kg) and the adjusted RSL (39 mg/kg). The vanadium RSL is based on a PPRTV, an RfD of 5.00E-3 mg/kg-day for metallic vanadium (USEPA, 2009), which has been suspended by EPA, and the IRIS file for vanadium pentoxide is under review; thus there are no current EPA-approved toxicity values for inorganic vanadium. However, as shown in Table E.1, by applying the PPRTV, when residential non-cancer risks were calculated for vanadium, the HQ was less than one.

Due to there being only one sample, the uncertainties associated with the toxicity values used as the basis of the RSLs for some of the COPCs, the fact that two of the COPCs are essential nutrients, and that these chemicals are unlikely to cause unacceptable risks at these concentrations at this small discrete area, the elimination of these metals in soil as final COPCs is supported. Therefore, the 4256 Warren Street property will not be further considered in a quantitative HHRA.

2.3.2 4900 Quebec Street Property

At the 4900 Warren Street property, mercury was the only sampled analyte and it was determined to be a COPC through the screen (see Table A.2). The maximum detected concentration of mercury (2.61 mg/kg) exceeded background (0.25 mg/kg) and the adjusted RSL (1 mg/kg). However, as shown in Table E.2, when residential non-cancer risks were calculated for mercury, the HQ was less than one. As mercury is unlikely to cause unacceptable risk at this small discrete area, the elimination of it as a final COPC is supported. Therefore, the 4900 Quebec Street property will not be further considered in a quantitative HHRA.

2.3.3 3949 52nd Street Property

At the 3949 52nd Street property, cobalt was determined to be a COPC through the screen (see Table A.3). The data set was only two samples. The maximum detected concentration of cobalt (19.7 mg/kg) exceeded background (17.8 mg/kg) and the adjusted RSL (2.3 mg/kg). As noted above, the RSL for cobalt is based on a PPRTV for which EPA concludes there is a low-medium confidence level. As shown in Table E.3, by applying the PPRTV, when residential non-cancer risks were calculated for cobalt, the HQ was less than one. As cobalt is unlikely to cause

unacceptable risk at this small discrete area, the elimination of it as a final COPC is supported. Therefore, the 3949 52nd Street property will not be further considered in a quantitative HHRA.

2.3.4 4015 52nd Street Property

At the 4015 52nd Street property, aluminum, cobalt, iron, and magnesium, were determined to be COPCs through the screen (see Table A.4). These chemicals were selected based on a very limited data set (one sample).

For aluminum, the single sample result of 28,000 mg/kg is greater than both the background value (19,100 mg/kg) and the adjusted RSL (7,700 mg/kg). However, as shown in Table E.4, by applying the PPRTV, when residential non-cancer risks were calculated for aluminum, the HQ was less than one.

The maximum detected concentration of cobalt (22.8 mg/kg) exceeded background (17.8 mg/kg) and the adjusted RSL (2.3 mg/kg). However, as shown in Table E.4, by applying the PPRTV, when residential non-cancer risks were calculated for cobalt, the HQ was less than one.

Iron and magnesium were found to be greater than background in this one sample, but these are considered essential nutrients. Further, magnesium has no screening level.

Due to there being only one sample, the uncertainties associated with the toxicity values used as the basis of the RSLs for some of the COPCs, the fact that two of the COPCs are essential nutrients, and that these chemicals are unlikely to cause unacceptable risks at these concentrations at this small discrete area, the elimination of these metals in soil as final COPCs is supported. Therefore, the 4015 52nd Street property will not be further considered in a quantitative HHRA.

2.3.5 POI 39 EU Screening

At the POI 39 EU, aluminum and manganese were determined to be COPCs through the screen (see Table A.5). While POI 39 was eliminated from further review in the Final Pre-2005 HHRA Review, an additional miscellaneous grab sample was added to the data set and the EU was re-screened.

For aluminum, the maximum result of 28,400 mg/kg is greater than both the background value (19,100 mg/kg) and the adjusted RSL (7,700 mg/kg). However, as shown in Table E.5, by applying the PPRTV, if residential non-cancer risks were calculated for aluminum, the HQ would be less than one. The maximum detected concentration of manganese (2,580 mg/kg) exceeded background (968 mg/kg) and the adjusted RSL (180 mg/kg). However, as shown in Table E.5, when residential non-cancer risks were calculated for manganese, the HQ was less than one.

As aluminum and manganese are unlikely to cause unacceptable risk at this EU, the elimination of them as final COPCs is supported. Therefore, the POI 39 EU will not be further considered in a quantitative HHRA.

2.3.6 Dalecarlia Woods EU Screening

At the Dalecarlia Woods EU, no chemicals were determined to be COPCs through the screen (see Table A.6). However, the maximum zinc concentration (2,548 mg/kg) in one sample was

shown to be an outlier. That outlier location was removed from the data set and the conclusion based on the remaining samples was that there were no COPCs. The outlier location sample was then screened, and as shown in Table E.6, when residential non-cancer risks were calculated for zinc, as well as aluminum and cadmium (maximum concentrations associated with the zinc outlier sample), the HQs were less than one.

For thallium, the outlier sample result of 8 mg/kg is greater than the adjusted non-cancer RSL of 0.078 mg/kg and greater than the background value of 2.2 mg/kg. However, the toxicity value for thallium is a PPRTV, and is based on an uncertain data set. PPRTVs are provisional values are not yet published on USEPA's IRIS database. PPRTVs may be published as regular or "screening" PPRTVs - PPRTVs that are classified as "screening" are considered less well-supported and are approved for use only in a screening assessment (USEPA, 2013). PPRTVs will be used in the follow-on HHRAs, with the exception of thallium, for which only a screening PPRTV is available. The PPRTV document for thallium (USEPA, 2012) states the following: "For the reasons noted in the main document, it is inappropriate to derive a subchronic or chronic p-RfD for thallium. However, information is available which, although insufficient to support derivation of a provisional toxicity value, under current guidelines, may be of limited use to risk assessors. In such cases, the Superfund Health Risk Technical Support Center summarizes available information in an appendix and develops a screening value. Users of screening toxicity values in an appendix to a PPRTV assessment should understand that there is considerably more uncertainty associated with the derivation of a supplemental screening toxicity value than for a value presented in the body of the assessment."

Due to the uncertainties associated with the toxicity values used as the basis of the RSL for thallium, and the HQs for aluminum, cadmium, and zinc being less than one, these chemicals are unlikely to cause unacceptable risks at these concentrations. Therefore, the elimination of these metals in soil as COPCs is supported, and the Dalecarlia Woods EU will not be further considered in a quantitative HHRA.

2.3.7 AOI 8 EU Screening

At the AOI 8 EU, manganese was determined to be the only COPC through the screen (see Table A.7), based on a limited data set (four samples).

The maximum detected concentration of manganese (1,130 mg/kg) exceeded background (968 mg/kg) and the adjusted RSL (180 mg/kg). However, as shown in Table E.7, when residential non-cancer risks were calculated for manganese, the HQ was less than one. As manganese is unlikely to cause unacceptable risk at this EU, the elimination of it as a final COPC is supported. Therefore, the AOI 8 EU will not be further considered in a quantitative HHRA.

2.3.8 AOI 11 EU Screening

At the AOI 11 EU, aluminum and magnesium were determined to be COPCs through the screen (see Table A.8).

For aluminum, the maximum result of 21,000 mg/kg is greater than both the background value (19,100 mg/kg) and the adjusted RSL (7,700 mg/kg). However, as shown in Table E.8, by applying the PPRTV, when residential non-cancer risks were calculated for aluminum, the HQ

was less than one. The maximum detected concentration of magnesium (7,060 mg/kg) was found to be greater than background, but it has no screening level, and it is considered to be an essential nutrient.

As aluminum and magnesium are unlikely to cause unacceptable risk at this EU, the elimination of them as final COPCs is supported. Therefore, the AOI 11 EU will not be further considered in a quantitative HHRA.

2.3.9 AOI 9 EU Screening

At the AOI 9 EU, aluminum, cobalt, and manganese were determined to be COPCs through the screen (see Table A.9).

For aluminum, the maximum result of 51,900 mg/kg is greater than both the background value (19,100 mg/kg) and the adjusted RSL (7,700 mg/kg). However, as shown in Table E.9, by applying the PPRTV, when residential non-cancer risks were calculated for aluminum, the HQ was less than one.

The maximum detected concentration of cobalt (69.2 mg/kg) exceeded background (17.8 mg/kg) and the adjusted RSL (2.3 mg/kg). Table E.9 indicates that when residential non-cancer risks were calculated for cobalt, the HQ exceeded one for a child resident.

The maximum detected concentration of manganese (2,040 mg/kg) exceeded background (968 mg/kg) and the adjusted RSL (180 mg/kg). However, as shown in Table E.9, when residential non-cancer risks were calculated for manganese, the HQ was less than one.

While risks from the other chemicals are unlikely, since the cobalt HQ exceeds one, a quantitative HHRA is recommended for the AOI 9 EU.

2.3.10 AOI 13 EU Screening

At the AOI 13 EU, aluminum, cobalt, and iron, were determined to be COPCs through the screen (see Table A.10). The maximum mercury concentration (2.3 mg/kg) in one sample was shown to be an outlier and therefore, that sample was removed from the data set to evaluate the EU.

For aluminum, the maximum detected concentration (29,700 mg/kg) is greater than both the background value (19,100 mg/kg) and the adjusted RSL (7,700 mg/kg). However, as shown in Table E.10, by applying the PPRTV, when residential non-cancer risks were calculated for aluminum, the HQ was less than one.

The maximum detected concentration of cobalt (30.7 mg/kg) exceeded background (17.8 mg/kg) and the adjusted RSL (2.3 mg/kg). However, as shown in Table E.10, by applying the PPRTV, when residential non-cancer risks were calculated for cobalt, the HQ was less than one.

The maximum detected concentration of iron (38,500 mg/kg) exceeded background (32,400 mg/kg) and the adjusted RSL (5,500 mg/kg). However, iron is considered to be an essential nutrient.

The mercury outlier location was then screened separately, and as shown in Table E.10, when residential non-cancer risks were calculated for mercury, the HQ was less than one. In this outlier sample, cobalt was the only other chemical determined to be a COPC, but as shown in

Table E.10, when residential non-cancer risks were calculated for cobalt, the HQ was less than one.

As these chemicals are unlikely to cause unacceptable risks at this EU (including the outlier location), the elimination of these metals in soil as final COPCs is supported. Therefore, the AOI 13 EU will not be further considered in a quantitative HHRA.

2.3.11 Western POI 53 EU Screening

At the Western POI 53 EU, aluminum and vanadium were determined to be COPCs through the screen (see Table A.11).

For aluminum, the maximum detected concentration (26,500 mg/kg) is greater than both the background value (19,100 mg/kg) and the adjusted RSL (7,700 mg/kg). However, as shown in Table E.11, by applying the PPRTV, when residential non-cancer risks were calculated for aluminum, the HQ was less than one.

The maximum detected concentration of vanadium (129 mg/kg) exceeded both background (75.5 mg/kg) and the adjusted RSL (39 mg/kg). As noted previously, the vanadium RSL is based on a PPRTV which has been suspended by EPA, and the IRIS file for vanadium pentoxide is under review; thus there are no current EPA-approved toxicity values for inorganic vanadium. However, as shown in Table E.11, by applying the PPRTV, when residential non-cancer risks were calculated for vanadium, the HQ was less than one.

As these chemicals are unlikely to cause unacceptable risks at this EU, the elimination of these metals in soil as final COPCs is supported. Therefore, the Western POI 53 EU will not be further considered in a quantitative HHRA.

2.3.12 Spaulding-Rankin EU Screening

At the Spaulding-Rankin EU, aluminum, cobalt, iron, manganese, and vanadium, were determined to be COPCs through the screen (see Table A.12).

For aluminum, the maximum detected concentration (37,428 mg/kg) is greater than both the background value (19,100 mg/kg) and the adjusted RSL (7,700 mg/kg). However, as shown in Table E.12, by applying the PPRTV, when residential non-cancer risks were calculated for aluminum, the HQ was less than one.

The maximum detected concentration of cobalt (426 mg/kg) exceeded background (17.8 mg/kg) and the adjusted RSL (2.3 mg/kg). Table E.12 indicates that when residential non-cancer risks were calculated for cobalt, the HQ exceeded one for a child resident.

The maximum detected concentration of manganese (3,248 mg/kg) exceeded background (968 mg/kg) and the adjusted RSL (180 mg/kg). However, as shown in Table E.12, by applying the PPRTV, when residential non-cancer risks were calculated for manganese, the HQ was less than one.

The maximum detected concentration of iron (140,536 mg/kg) exceeded background (32,400 mg/kg) and the adjusted RSL (5,500 mg/kg). However, iron is considered to be an essential nutrient.

The maximum detected concentration of vanadium (195 mg/kg) exceeded both background (75.5 mg/kg) and the adjusted RSL (39 mg/kg). However, as shown in Table E.12, by applying the PPRTV, when residential non-cancer risks were calculated for vanadium, the HQ was less than one.

While risks from the other chemicals are unlikely, since the cobalt HQ exceeds one, a quantitative HHRA is recommended for the Spaulding-Rankin EU.

2.3.13 Southern AU EU Screening

At the Southern AU EU, aluminum, cobalt, iron, magnesium, manganese, and vanadium, were determined to be COPCs through the screen (see Table A.13). In addition, seven samples contained a total of eight outlier chemicals. Those samples were removed from the data set to evaluate the EU. The eight outlier chemicals in these seven sample locations were: antimony, beryllium, mercury, benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, indeno (1,2,3-cd) pyrene, and phenanthrene. These outliers were evaluated separately.

For aluminum, the maximum detected concentration (56,138 mg/kg) is greater than both the background value (19,100 mg/kg) and the adjusted RSL (7,700 mg/kg). However, as shown in Table E.13, by applying the PPRTV, when residential non-cancer risks were calculated for aluminum, the HQ was less than one.

The maximum detected concentration of cobalt (193 mg/kg) exceeded background (17.8 mg/kg) and the adjusted RSL (2.3 mg/kg). Table E.13 indicates that when residential non-cancer risks were calculated for cobalt, the HQ exceeded one for a child resident.

The maximum detected concentration of iron (68,056 mg/kg) exceeded background (32,400 mg/kg) and the adjusted RSL (5,500 mg/kg). However, iron is considered to be an essential nutrient. The maximum detected concentration of magnesium (21,639 mg/kg) was found to be greater than background, but it has no screening level and is considered to be an essential nutrient.

The maximum detected concentration of manganese (3,070 mg/kg) exceeded background (968 mg/kg) and the adjusted RSL (180 mg/kg). However, as shown in Table E.13, by applying the PPRTV, when residential non-cancer risks were calculated for manganese, the HQ was less than one.

The maximum detected concentration of vanadium (627 mg/kg) exceeded both background (75.5 mg/kg) and the adjusted RSL (39 mg/kg). However, as shown in Table E.13, by applying the PPRTV, when residential non-cancer risks were calculated for vanadium, the HQ was less than one.

With regard to the outliers, Table A.13 is color-coded to track the process of outlier removal; green font indicates the first outlier test and the resulting five samples removed, while blue font indicates that after the maximum concentration was removed, for two samples, the next highest maximum concentration was still determined to be an outlier and it was also removed. This process resulted in seven sample locations being identified as outliers. Figure 13 shows that the seven samples are from six discrete locations (Baker-03 and SV-Baker-03 being a split of the same sample). Three of these locations contained outlier chemicals that were determined to be

COPCs through the screen, as discussed below.

Table E.13 also provides this color coding. As shown in page 2 of Table E.13 (green coded), when residential non-cancer risks were calculated for beryllium and mercury, the HQs were less than one. However, the HQ for antimony exceeds one for a child resident. No HQ was calculated for thallium, because, as previously described, the toxicity value is a PPRTV, and is based on an uncertain data set. (For this same reason, thallium, though technically an outlier in one sample, was not included in the outlier sample counts above.) For benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, and indeno (1,2,3-cd) pyrene, Table E.13 indicates that the estimated incremental cancer risks are greater than the USEPA acceptable range. Phenanthrene is also an outlier chemical but it has no published toxicity value and it is therefore not identified as a final COPC.

As shown in page 3 of Table E.13 (blue coded), when residential non-cancer risks were calculated for mercury, the HQ was less than one. However, for antimony, the HQ would exceed one for a child resident.

Please note that for each outlier sample, the entire data set will be screened in accordance with the screening procedures. However, this screening will be conducted in the comprehensive RA Work Plan to be completed for the areas requiring quantitative HHRAs. This process will separately assess risk on the individual outlier location.

In summary, for the Southern AU EU, the HQs for antimony and cobalt exceed one, and the estimated incremental cancer risks are greater than the USEPA acceptable range for benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, and indeno (1,2,3-cd) pyrene.

Therefore, a quantitative HHRA is recommended for the Southern AU EU.

Table 2.1. Summary of Follow-on Screen

Exposure Unit	COPCs Identified	Table Reference
4256 Warren Street Property	Aluminum Arsenic Cobalt Iron Magnesium Vanadium	A.1
4900 Quebec Street Property	Mercury	A.2
3949 52nd Street Property	Cobalt	A.3
4015 52nd Street Property	Aluminum Cobalt Iron Magnesium	A.4
POI 39	Aluminum Manganese	A.5
Dalecarlia Woods	Zinc (identified as an outlier)	A.6
AOI 8	Manganese	A.7
AOI 11	Aluminum Magnesium	A.8
AOI 9	Aluminum Cobalt Manganese	A.9
AOI 13	Aluminum Cobalt Iron Mercury (identified as an outlier)	A.10
Western POI 53 EU	Aluminum Vanadium	A.11
Spaulding-Rankin	Aluminum Cobalt Iron, Manganese Vanadium	A.12
Southern AU	Aluminum Cobalt, Iron Magnesium, Manganese Vanadium Outliers: antimony, beryllium, mercury, benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene indeno(1,2,3-cd) pyrene phenanthrene	A.13

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3.0 UNCERTAINTY DISCUSSION

All HHRAs involve the use of assumptions, judgments, and imperfect data to varying degrees, resulting in uncertainties in the final estimates of risk. These uncertainties are generally associated with each step of the HHRA process (data evaluation and identification of COPCs, exposure assessment, toxicity assessment, and risk characterization) (USEPA, 1989). However, the parameters used in this follow-on screening of soil COPCs at SVFUDS were conservative, in order to ensure that all potential site-related risks are considered. While the discussions below are specific to this follow-on screen addendum, the uncertainties described in the Final Pre-2005 HHRA Review also apply.

Generally, the uncertainties associated with this follow-on soil screening procedure include:

- Screening levels are not available for all detected analytes (e.g., magnesium).
- Generic screening levels are based on conservative exposure assumptions that may not be appropriate for a site, possibly resulting in a greater number of analytes selected as COPCs.
- Use of a single detected concentration (as in the case of some EUs with limited sampling data) adds uncertainty to the screening.
- USEPA's published toxicity values, although peer-reviewed and based on available data, have uncertainties associated with the selection of the toxic effect level and the application of uncertainty factors to that effect level.
- Several screening levels use toxicity values that are not currently approved by USEPA including aluminum, cobalt, iron, thallium, and vanadium. The toxicity values for these metals are PPRTVs; PPRTVs were used in this follow-on screen, both in screening levels and to assess the potential for HQs greater than one, but are not approved for use in quantitative HHRAs by the USEPA.

Although there is uncertainty associated with this follow-on screening, the potential for EU-associated risks was assessed using conservative exposure assumptions (e.g., residential access to even the highest concentrations 350 days per year), accounting to some extent for this uncertainty and possibly resulting in selection of additional COPCs that are not associated with unacceptable risks. A more accurate and site-specific assessment of risk will be conducted for the EUs for which a full HHRA has been recommended, as discussed in Section 5.

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4.0 CONCLUSIONS

The discussions below summarize the analysis presented in Section 2.3. Table 4.1 is a summary of the COPCs selected in the initial and additional screening steps conducted in this follow-on screening review. It is organized by EU and presents the COPCs, screening table reference, and conclusions.

4.1 Exposure Unit Summary

4.1.1 4256 Warren Street Property

Based on the COPCs identified and the risks calculated, these chemicals are unlikely to cause unacceptable risks at these concentrations at this small discrete area. Therefore, the 4256 Warren Street property will not be further considered in a quantitative HHRA.

4.1.2 4900 Quebec Street Property

Based on the COPC identified and the risks calculated, mercury is unlikely to cause unacceptable risk at this small discrete area. Therefore, the 4900 Quebec Street property will not be further considered in a quantitative HHRA.

4.1.3 3949 52nd Street Property

Based on the COPC identified and the risks calculated, cobalt is unlikely to cause unacceptable risk at this small discrete area. Therefore, the 3949 52nd Street property will not be further considered in a quantitative HHRA.

4.1.4 4015 52nd Street Property

Based on the COPCs identified and the risks calculated, these chemicals are unlikely to cause unacceptable risks at these concentrations at this small discrete area. Therefore, the 4015 52nd Street property will not be further considered in a quantitative HHRA.

4.1.5 POI 39 EU

Based on the COPCs identified and the risks calculated, these chemicals are unlikely to cause unacceptable risk at this EU. Therefore, the POI 39 EU will not be further considered in a quantitative HHRA.

4.1.6 Dalecarlia Woods EU

Based on the COPC identified and the risks calculated, zinc is unlikely to cause unacceptable risk at this EU. Therefore, the Dalecarlia Woods EU will not be further considered in a quantitative HHRA.

4.1.7 AOI 8 EU

Based on the COPC identified and the risks calculated, manganese is unlikely to cause unacceptable risk at this EU. Therefore, the AOI 8 EU will not be further considered in a quantitative HHRA.

4.1.8 AOI 11 EU

Based on the COPCs identified and the risks calculated, these chemicals are unlikely to cause unacceptable risk at this EU. Therefore, the AOI 11 EU will not be further considered in a quantitative HHRA.

4.1.9 AOI 9 EU

Based on the COPCs identified and the risks calculated, since the cobalt HQ exceeds one, a quantitative HHRA is recommended for the AOI 9 EU.

4.1.10 AOI 13 EU

Based on the COPCs identified and the risks calculated, these chemicals are unlikely to cause unacceptable risks at this EU. Therefore, the AOI 13 EU will not be further considered in a quantitative HHRA.

4.1.11 Western POI 53 EU

Based on the COPCs identified and the risks calculated, these chemicals are unlikely to cause unacceptable risks at this EU. Therefore, the Western POI 53 EU will not be further considered in a quantitative HHRA.

4.1.12 Spaulding-Rankin EU

Based on the COPCs identified and the risks calculated, since the cobalt HQ exceeds one, a quantitative HHRA is recommended for the Spaulding-Rankin EU.

4.1.13 Southern AU EU

Based on the COPCs identified and the risks calculated, the HQs for antimony and cobalt exceed one, and the estimated incremental cancer risks are greater than the USEPA acceptable range for benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, and indeno (1,2,3-cd) pyrene. Therefore, a quantitative HHRA is recommended for the Southern AU EU.

Table 4.1. Summary of COPCs by EU

Exposure Unit	COPCs Identified	Table Reference	Conclusion
4256 Warren Street Property	Aluminum Arsenic Cobalt Iron Magnesium Vanadium	A.1	Non-cancer HQs < 1, no further evaluation
4900 Quebec Street Property	Mercury	A.2	Non-cancer HQ < 1, no further evaluation
3949 52nd Street Property	Cobalt	A.3	Non-cancer HQ < 1, no further evaluation
4015 52nd Street Property	Aluminum Cobalt Iron Magnesium	A.4	Non-cancer HQs < 1, no further evaluation
POI 39	Aluminum Manganese	A.5	Non-cancer HQs < 1, no further evaluation
Dalecarlia Woods	Zinc (identified as an outlier)	A.6	Non-cancer HQ < 1, no further evaluation
AOI 8	Manganese	A.7	Non-cancer HQ < 1, no further evaluation
AOI 11	Aluminum Magnesium	A.8	Non-cancer HQs < 1, no further evaluation
AOI 9	Aluminum Cobalt Manganese	A.9	Cobalt Non-cancer HQ > 1, conduct HHRA
AOI 13	Aluminum Cobalt Iron Mercury (identified as an outlier)	A.10	Non-cancer HQs < 1, no further evaluation
Western POI 53 EU	Aluminum Vanadium	A.11	Non-cancer HQs < 1, no further evaluation
Spaulding-Rankin	Aluminum Cobalt Iron, Manganese Vanadium	A.12	Cobalt Non-cancer HQ > 1, conduct HHRA
Southern AU	Aluminum Cobalt, Iron Magnesium, Manganese Vanadium Outliers: antimony, beryllium, mercury, benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene indeno(1,2,3-cd) pyrene phenanthrene	A.13	Antimony and cobalt HQs > 1, benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, and indeno (1,2,3-cd) pyrene exceed USEPA cancer risk range, conduct HHRA

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5.0 RECOMMENDATIONS

Table 4.1 indicates which EUs are recommended for a full HHRA. Those EUs, the COPCs for which potential risk was shown in the Appendix E tables, and the organization of the HHRAs, are summarized in Table 5.1 below. Figure 14 shows the EUs recommended for an HHRA.

Table 5.1. Recommended HHRAs

Exposure Unit	COPCs Potentially Posing Risk	HHRA Organization
AOI 9	Cobalt	The HHRA for this EU and the HHRA for the Spaulding-Rankin EU will be bundled in the same document based on similar receptors (largely private residences)
Spaulding – Rankin	Cobalt	The HHRA for this EU and the HHRA for the AOI 9 EU will be bundled in the same document based on similar receptors (largely private residences)
Southern AU	Antimony Cobalt Benzo(a)anthracene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Indeno (1,2,3-cd) pyrene	The HHRA for this EU will be a standalone document addressing AU only based on similar receptors for this portion of AU

5.1 Recommended Approach for Conducting HHRAs

The EUs indicated in Table 5.1 will undergo a complete HHRA consisting of exposure assessment, toxicity assessment, and risk characterization steps.

The HHRA for the Southern AU EU will be a standalone document addressing AU only, based on similar receptors for this portion of AU. While risk will be quantified on an EU level, the HHRA for the Spaulding-Rankin and AOI 9 EUs will be bundled into a single HHRA document based on similar receptors (largely private residences).

A single comprehensive Work Plan will be prepared to provide the procedures to complete the HHRAs. The process is summarized in the paragraphs below.

All detected chemicals in that particular EU will be included in the HHRA, not just those COPCs resulting from this follow-on screen.

The exposure assessments will include the following receptors at residential locations: adult and child residents, outdoor (groundskeeper) workers, and construction/utility workers, while

university properties will be assessed for outdoor workers, student recreational users (representing lounging activities associated with a 4-year college student), and future theoretical residential users. Exposure pathways will include incidental soil ingestion, dermal contact, inhalation, and vegetable ingestion pathways, as appropriate for each EU.

The steps of a toxicity evaluation will include:

- Gathering toxicity information for the chemicals being evaluated;
- Identifying exposure periods for which toxicity values are necessary (e.g., chronic or sub-chronic); and
- Determining toxicity values for carcinogenic and non-carcinogenic effects (i.e., carcinogenic slope factors [SFs] and inhalation unit risks for carcinogens, and RfDs and reference concentrations [RfCs] for non-carcinogens).

Toxicity information would be obtained from the following hierarchy of primary sources:

- USEPA's IRIS on-line;
- USEPA's PPRTV;
- Agency for Toxic Substances and Disease Registry's Minimal Risk Levels;
- Toxicity Criteria Database (CalEPA, Office of Environmental Health Hazard Assessment, 2009); and
- USEPA's Health Effects Summary Tables (USEPA, 1997).

The final step of an HHRA is the risk characterization step, integrating the toxicity and exposure assessment outputs into quantitative expressions of risk. The total pathway-specific risk for a receptor will be derived by summing all the risks or hazards for all the chemicals in that pathway. The total carcinogenic risk for a receptor across all media and pathways will be derived by adding all the pathway specific risks or hazards. The acceptable incremental risk range of $1x10^{-6}$ to $1x10^{-4}$ is used to evaluate total cancer risks. The sum of HQs is referred to as a hazard index (HI). If a total receptor-specific HI exceeds one (HI > 1), there is a potential for non-cancer health effects, and the COPCs that contribute to that HI will be separated by target organ.

The conclusions of the EU-specific HHRAs will be taken into account in the risk management phase, when considering whether additional actions are required to protect public health at these locations.

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APPENDIX A:
TABLES

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Table A.1											ADDITIONAL SCREEN of PROVISIONAL COPCs				
4256 Warren Str - Screening Review							**INITIAL SCREEN**				STEP 1		STEP 2		
Exposure Unit	Detected Analytes*	Units		USEPA May 2013 RSLs[1]	2008 Background Conc.	Maximum Detected Value	Provisional COPC (max > higher of current RSL or 2008 background)?	Rationale	Outlier - Is Max ≥ 10X the Avg of Remaining Data?	Notes	95% UCL of the mean[2]	Risk Ratio[3]	Statistical Comparison to Background[4]	COPC?	NOTES
4256 Warren	Aluminum	mg/kg	NC	7700	19100	25500	**YES**	**MAX > BG and RSL**	NA		25500	3.31	insufficient no. samples	**YES, risk ratio >1**	
	Antimony	mg/kg	NC	3.1	5.2	1.3	NO	MAX < BG and RSL							
1 sample	Arsenic	mg/kg	C	0.61	12.6	14.3	**YES**	**MAX > BG and RSL**	NA		14.3	23.44	insufficient no. samples	**YES, risk ratio >1**	
	Barium	mg/kg	NC	1500	172	179	NO	MAX < RSL							
	Beryllium	mg/kg	NC	1.6	1.9	1.5	NO	MAX < BG and RSL							
	Cadmium	mg/kg	NC	7	2.36	1	NO	MAX < BG and RSL							
	Calcium	mg/kg		NS	NA	1180	NO	No BG or RSL							
	Chromium	mg/kg	NC	12000	51.3	66.6	NO	MAX < RSL							
	Cobalt	mg/kg	NC	2.3	17.8	19.6	**YES**	**MAX > BG and RSL**	NA		19.6	8.52	insufficient no. samples	**YES, risk ratio >1**	
	Copper	mg/kg	NC	310	49.65	169	NO	MAX < RSL							
	Iron	mg/kg	NC	5500	32400	67600	**YES**	**MAX > BG and RSL**	NA		67600	12.29	insufficient no. samples	**YES, risk ratio >1**	
	Lead	mg/kg	--	400	194	279	NO	MAX < RSL							
	Magnesium	mg/kg	NS	NS	6950	7430	**YES**	**MAX > BG**	NA		7430	No RSL	insufficient no. samples	**YES, Max > BG**	
	Manganese	mg/kg	NC	180	968	952	NO	MAX < BG							
	Mercury	mg/kg	NC	1	0.25	0.051	NO	MAX < BG and RSL							
	Nickel	mg/kg	NC	150	33.5	42.1	NO	MAX < RSL							
	Potassium	mg/kg		NS	NA	3770	NO	No BG or RSL							
	Selenium	mg/kg	NC	39	1.2	0.94	NO	MAX < BG and RSL							
	Sodium	mg/kg		NS	NA	86.2	NO	No BG or RSL							
	Thallium	mg/kg	NC	0.078	2.2	ND (DL = 0.65)	NO	MAX DL < BG							
	Vanadium	mg/kg	NC	39	75.5	83.2	**YES**	**MAX > BG and RSL**	NA		83.2	2.13	insufficient no. samples	**YES, risk ratio >1**	
	Zinc	mg/kg	NC	2300	158	113	NO	MAX < BG and RSL							
	Methylene chloride	µg/kg	NC	36000	18	3.8	NO	MAX < BG and RSL							
	bis(2-Ethylhexyl) phthalate	µg/kg	C	35000	1479	74	NO	MAX < BG and RSL							

1. USEPA May 2013 RSLs. NC adjusted downward by factor of 10

2. Calculated using EPA's ProUCL software (minimum of 5 samples)

3. EPC divided by adjusted RSL; Drop out COPC if < or = 1. If insufficient sample number, then risk ratio is max value divided by adjusted RSL

4. Statistical background comparisons using ProUCL two-sample hypothesis test to determine if site results greater than background (minimum of 5 samples)

NA not applicable; previous HHRA not conducted

NC non-carcinogen

C carcinogen

NS none specified

mg/kg milligrams per kilogram

µg/kg micrograms per kilogram

ND non detect

DL detection Limit

* If detected in the old risk assessment data set, but not a Provisional COPC (from Pre-2005 HHRA Review document), chemical is not shown on this table unless more recent sample also contains a detection of that chemical.

Table A. 2											ADDITIONAL SCREEN of PROVISIONAL COPCs				
4900 Quebec Str - Screening Review							**INITIAL SCREEN**				STEP 1		STEP 2		
Exposure Unit	Detected Analytes*	Units		USEPA May 2013 RSLs[1]	2008 Background Conc.	Maximum Detected Value	Provisional COPC (max > higher of current RSL or 2008 background)?	Rationale	Outlier - Is Max ≥ 10X the Avg of Remaining Data?	Notes	95% UCL of the mean[2]	Risk Ratio[3]	Statistical Comparison to Background[4]	COPC?	NOTES
4900 Quebec	Mercury	mg/kg	NC	1	0.25	2.61	**YES**	**MAX > BG and RSL**	NO		1.44	1.44	**Site > BG**	**YES**	
13 samples															
1. USEPA May 2013 RSLs. NC adjusted downward by factor of 10															
2. Calculated using EPA's ProUCL software (minimum of 5 samples)															
3. EPC divided by adjusted RSL; Drop out COPC if < or = 1. If insufficient sample number, then risk ratio is max value divided by adjusted RSL															
4. Statistical background comparisons using ProUCL two-sample hypothesis test to determine if site results greater than background (minimum of 5 samples)															
NA not applicable; previous HHRA not conducted															
NC non-carcinogen															
C carcinogen															
NS none specified															
mg/kg milligrams per kilogram															
µg/kg micrograms per kilogram															
** If detected in the old risk assessment data set, but not a Provisional COPC (from Pre-2005 HHRA Review document), chemical is not shown on this table unless more recent sample also contains a detection of that chemical.*															

Table A.3											ADDITIONAL SCREEN of PROVISIONAL COPCs				
3949 52nd Str - Screening Review							**INITIAL SCREEN**				STEP 1		STEP 2		
Exposure Unit	Detected Analytes*	Units		USEPA May 2013 RSLs[1]	2008 Background Conc.	Maximum Detected Value	Provisional COPC (max > higher of current RSL or 2008 background)?	Rationale	Outlier - Is Max ≥ 10X the Avg of Remaining Data?	Notes	95% UCL of the mean[2]	Risk Ratio[3]	Statistical Comparison to Background[4]	COPC?	NOTES
3949 52nd	Aluminum	mg/kg	NC	7700	19100	16500	NO	MAX < BG							
	Antimony	mg/kg	NC	3.1	5.2	ND (DL = 0.71 - 0.94)	NO	MAX DL < BG and RSL							
2 samples	Arsenic	mg/kg	C	0.61	12.6	4.4	NO	MAX < RSL							
	Barium	mg/kg	NC	1500	172	64.3	NO	MAX < BG and RSL							
	Beryllium	mg/kg	NC	1.6	1.9	1.2	NO	MAX < BG and RSL							
	Chromium	mg/kg	NC	12000	51.3	25	NO	MAX < BG and RSL							
	Cobalt	mg/kg	NC	2.3	17.8	19.7	**YES**	**MAX > BG and RSL**	NO		19.7	8.57	insufficient no. samples	**YES, risk ratio >1**	
	Copper	mg/kg	NC	310	49.65	40.7	NO	MAX < BG and RSL							
	Lead	mg/kg	L	400	194	60.3	NO	MAX < RSL							
	Manganese	mg/kg	NC	180	968	730	NO	MAX < BG							
	Mercury	mg/kg	NC	1	0.25	0.13	NO	MAX < BG and RSL							
	Nickel	mg/kg	NC	150	33.5	24.8	NO	MAX < BG and RSL							
	Strontium	mg/kg	NC	4700	53	5.8	NO	MAX < BG and RSL							
	Tellurium	mg/kg		NS	5	1.2	NO	MAX < BG							
	Thallium	mg/kg	NC	0.078	2.2	ND (DL = 0.18 - 0.6)	NO	MAX DL < BG							
	Tin	mg/kg	NC	4700	8.4	0.78	NO	MAX < BG and RSL							
	Vanadium	mg/kg	NC	39	75.5	39	NO	MAX < BG							
	Zinc	mg/kg	NC	2300	158	69.7	NO	MAX < BG and RSL							
	Zirconium	mg/kg	NC	0.63	48.3	1.75	NO	MAX < BG							
	Perchlorate	µg/kg	NC	5500	0.612	2.9	NO	MAX < RSL							

1. USEPA May 2013 RSLs. NC adjusted downward by factor of 10

2. Calculated using EPA's ProUCL software (minimum of 5 samples)

3. EPC divided by adjusted RSL; Drop out COPC if < or = 1. If insufficient sample number, then risk ratio is max value divided by adjusted RSL

4. Statistical background comparisons using ProUCL two-sample hypothesis test to determine if site results greater than background (minimum of 5 samples)

NC non-carcinogen

C carcinogen

NS none specified

mg/kg milligrams per kilogram

µg/kg micrograms per kilogram

** If detected in the old risk assessment data set, but not a Provisional COPC (from Pre-2005 HHRA Review document), chemical is not shown on this table unless more recent sample also contains a detection of that chemical.*

Table A.4												ADDITIONAL SCREEN of PROVISIONAL COPCs				
4015 52nd Str - Screening Review							**INITIAL SCREEN**					STEP 1		STEP 2		
Exposure Unit	Detected Analytes*	Units		USEPA May 2013 RSLs[1]	2008 Background Conc.	Maximum Detected Value	Provisional COPC (max > higher of current RSL or 2008 background)?	Rationale	Outlier - Is Max ≥ 10X the Avg of Remaining Data?	Notes		95% UCL of the mean[2]	Risk Ratio[3]	Statistical Comparison to Background[4]	COPC?	NOTES
4015 52nd	Aluminum	mg/kg	NC	7700	19100	28000	**YES**	**MAX > BG and RSL**	NA			28000	3.64	insufficient no. samples	**YES, risk ratio >1**	
	Antimony	mg/kg	NC	3.1	5.2	ND (DL = 0.34)	NO	MAX DL < BG and RSL								
1 sample	Arsenic	mg/kg	C	0.61	12.6	3.4	NO	MAX < BG								
	Barium	mg/kg	NC	1500	172	109	NO	MAX < BG and RSL								
	Beryllium	mg/kg	NC	1.6	1.9	1.7	NO	MAX < BG								
	Cadmium	mg/kg	NC	7	2.36	0.57	NO	MAX < BG and RSL								
	Calcium	mg/kg		NS	NA	423	NO	No BG or RSL								
	Chromium	mg/kg	NC	12000	51.3	49	NO	MAX < BG and RSL								
	Cobalt	mg/kg	NC	2.3	17.8	22.8	**YES**	**MAX > BG and RSL**	NA			22.8	9.91	insufficient no. samples	**YES, risk ratio >1**	
	Copper	mg/kg	NC	310	49.65	37.6	NO	MAX < BG and RSL								
	Iron	mg/kg	NC	5500	32400	38300	**YES**	**MAX > BG and RSL**	NA			38300	6.96	insufficient no. samples	**YES, risk ratio >1**	
	Lead	mg/kg	--	400	194	20.7	NO	MAX < BG and RSL								
	Magnesium	mg/kg	NS	NS	6950	7160	**YES**	**MAX > BG**	NA			7160	No RSL	insufficient no. samples	**YES, Max > BG**	
	Manganese	mg/kg	NC	180	968	582	NO	MAX < BG								
	Mercury	mg/kg	NC	1	0.25	0.086	NO	MAX < BG and RSL								
	Nickel	mg/kg	NC	150	33.5	42.2	NO	MAX < RSL								
	Potassium	mg/kg		NS	NA	4120	NO	No BG or RSL								
	Selenium	mg/kg	NC	39	1.2	0.44	NO	MAX < BG and RSL								
	Sodium	mg/kg		NS	NA	89.1	NO	No BG or RSL								
	Thallium	mg/kg	NC	0.078	2.2	1.1	NO	MAX < BG								
	Vanadium	mg/kg	NC	39	75.5	53.4	NO	MAX < BG								
	Zinc	mg/kg	NC	2300	158	122	NO	MAX < BG and RSL								
	Methylene chloride	µg/kg	NC	36000	18	1.6	NO	MAX < BG and RSL								

1. USEPA May 2013 RSLs. NC adjusted downward by factor of 10

2. Calculated using EPA's ProUCL software (minimum of 5 samples)

3. EPC divided by adjusted RSL; Drop out COPC if < or = 1. If insufficient sample number, then risk ratio is max value divided by adjusted RSL

4. Statistical background comparisons using ProUCL two-sample hypothesis test to determine if site results greater than background (minimum of 5 samples)

NA not applicable; previous HHRA not conducted

NC non-carcinogen

C carcinogen

NS none specified

mg/kg milligrams per kilogram

µg/kg micrograms per kilogram

** If detected in the old risk assessment data set, but not a Provisional COPC (from Pre-2005 HHRA Review document), chemical is not shown on this table unless more recent sample also contains a detection of that chemical.*

Table A.5										ADDITIONAL SCREEN of PROVISIONAL COPCs				
POI 39 - Screening Review							**INITIAL SCREEN**			STEP 1		STEP 2		
Exposure Unit	Detected Analytes*	Units		USEPA May 2013 RSLs[1]	2008 Background Conc.	Maximum Detected Value	Provisional COPC (max > higher of current RSL or 2008 background)?	Rationale	Outlier - Is Max ≥ 10X the Avg of Remaining Data?	95% UCL of the mean[2]	Risk Ratio[3]	Statistical Comparison to Background[4]	COPC?	NOTES
POI 39	Aluminum	mg/kg	NC	7700	19100	28400	**YES**	**MAX > BG and RSL**	NO	24437	3.17	**Site > BG**	**YES**	
	Antimony	mg/kg	NC	3.1	5.2	13.5	**YES**	**MAX > BG and RSL**	NO	11.8	3.81	Site ≤ BG	NO	
	Arsenic	mg/kg	C	0.61	12.6	5.30	NO	MAX < BG						
14 samples	Barium	mg/kg	NC	1500	172	172	NO	MAX < RSL						
	Beryllium	mg/kg	NC	16	1.9	3.40	NO	MAX < RSL						
	Chromium	mg/kg	NC	12000	51.3	43.6	NO	MAX < BG and RSL						
	Cobalt	mg/kg	NC	2.3	17.8	11.7	NO	MAX < BG						
	Copper	mg/kg	NC	310	49.65	27.7	NO	MAX < BG and RSL						
	Lead	mg/kg	--	400	194	96.7	NO	MAX < BG and RSL						
	Manganese	mg/kg	NC	180	968	2580	**YES**	**MAX > BG and RSL**	NO	1197	6.65	**Site > BG**	**YES**	
	Mercury	mg/kg	NC	1	0.25	0.090	NO	MAX < BG and RSL						
	Nickel	mg/kg	NC	150	33.5	34.7	NO	MAX < RSL						
	Strontium	mg/kg	NC	4700	53	12.0	NO	MAX < BG and RSL						
	Tellurium	mg/kg		NS	5	0.045	NO	MAX < BG						
	Thallium	mg/kg	NC	0.078	2.2	0.980	NO	MAX < BG						
	Vanadium	mg/kg	NC	39	75.5	49.3	NO	MAX < BG						
	Zinc	mg/kg	NC	2300	158	95.6	NO	MAX < BG and RSL						
	Zirconium	mg/kg	NC	0.63	48.3	6.67	NO	MAX < BG						
	Perchlorate	µg/kg	NC	5500	0.612	4.00	NO	MAX < RSL						

1. USEPA May 2013 RSLs. NC adjusted downward by factor of 10

2. Calculated using EPA's ProUCL software (minimum of 5 samples)

3. EPC divided by adjusted RSL; Drop out COPC if < or = 1. If insufficient sample number, then risk ratio is max value divided by adjusted RSL

4. Statistical background comparisons using ProUCL two-sample hypothesis test to determine if site results greater than background (minimum of 5 samples)

NA not applicable

NC non-carcinogen

C carcinogen

NS none specified

mg/kg milligrams per kilogram

µg/kg micrograms per kilogram

** If detected in the old risk assessment data set, but not a Provisional COPC (from Pre-2005 HHRA Review document), chemical is not shown on this table unless more recent sample also contains a detection of that chemical.*

Table A.6

Dalecarlia Woods - Screening Review

							INITIAL SCREEN							ADDITIONAL SCREEN of PROVISIONAL COPCs					
														STEP 1			STEP 2		
Exposure Unit	Detected Analytes*	Units		USEPA May 2013 RSLs[1]	2008 Background Conc.	Maximum Detected Value	Provisional COPC (max > higher of current RSL or 2008 background)?	Rationale	Outlier - Is Max ≥ 10X the Avg of Remaining Data?	Notes	NEXT Maximum Detected Value	Provisional COPC (NEXT max > higher of current RSL or 2008 background)?	Rationale	95% UCL of the mean[2]	Risk Ratio[3]	NOTES	Statistical Comparison to Background[4]	COPC?	NOTES
Dalecarlia Woods	Aluminum	mg/kg	NC	7700	19100	27783	**YES**	**MAX > BG and RSL**	NO	max associated with removed sample	17800	NO	MAX < BG						Evaluate aluminum in outlier sample separately (see Table E.6)
	Arsenic	mg/kg	C	0.61	12.6	7.60	NO	MAX < BG											
13 samples	Barium	mg/kg	NC	1500	172	197	NO	MAX < RSL											
	Beryllium	mg/kg	NC	16	1.9	2.65	NO	MAX < RSL											
	Cadmium	mg/kg	NC	7	2.36	29	**YES**	**MAX > BG and RSL**	All others ND	max associated with removed sample	1.3 U	NO	ND, but DL < BG and RSL						Evaluate cadmium in outlier sample separately (see Table E.6)
	Chromium	mg/kg	NC	12000	51.3	42.8	NO	MAX < BG and RSL											
	Cobalt	mg/kg	NC	2.3	17.8	13.4	NO	MAX < BG											
	Copper	mg/kg	NC	310	49.65	36.2	NO	MAX < BG and RSL											
	Lead	mg/kg	--	400	194	152	NO	MAX < BG and RSL											
	Manganese	mg/kg	NC	180	968	899	NO	MAX < BG											
	Mercury	mg/kg	NC	1	0.25	0.130	NO	MAX < BG and RSL											
	Nickel	mg/kg	NC	150	33.5	34.0	NO	MAX < RSL											
	Silver	mg/kg	NC	39	0.87	0.73	NO	MAX < BG and RSL											
	Strontium	mg/kg	NC	4700	53	18.0	NO	MAX < BG and RSL											
	Tellurium	mg/kg		NS	5	3.00	NO	MAX < BG											
	Thallium	mg/kg	NC	0.078	2.2	7.89	**YES**	**MAX > BG and RSL**	All others ND	max associated with removed sample	3.3 U	**YES**	**ND, but DL > BG**	0.49	6.29	All ND; used 1/2 of average DL as the EPC in the risk ratio.	Site ≤ BG	NO	Evaluate thallium in outlier sample separately (see sect 2.3.6)
	Tin	mg/kg	NC	4700	8.4	2.80	NO	MAX < BG and RSL											
	Vanadium	mg/kg	NC	39	75.5	48.0	NO	MAX < BG											
	Zinc	mg/kg	NC	2300	158	2548	**YES**	**MAX > BG and RSL**	YES	remove sample SV-ZONE9-A1 (LTC Bancroft)	100	NO	MAX < BG and RSL						Evaluate zinc in outlier sample separately (see Table E.6)
	Zirconium	mg/kg	NC	0.63	48.3	6.15	NO	MAX < BG											
	Cyanide	mg/kg	NC	2.2	0.26	1.00	NO	MAX < RSL											
	Perchlorate	µg/kg	NC	5500	0.612	7.00	NO	MAX < RSL											
	2,4,6-Trinitrotoluene	µg/kg	NC	3600	NA	196	NO	MAX < RSL											
	2-amino-4,6-Dinitrotoluene	µg/kg	NC	15000	NA	183	NO	MAX < RSL											
	4-amino-2,6-Dinitrotoluene	µg/kg	NC	15000	NA	166	NO	MAX < RSL											

1. USEPA May 2013 RSLs. NC adjusted downward by factor of 10

2. Calculated using EPA's ProUCL software (minimum of 5 samples)

3. EPC divided by adjusted RSL; Drop out COPC if < or = 1. If insufficient sample number, then risk ratio is max value divided by adjusted RSL

4. Statistical background comparisons using ProUCL two-sample hypothesis test to determine if site results greater than background (minimum of 5 samples)

NA not applicable

NC non-carcinogen

C carcinogen

NS none specified

mg/kg milligrams per kilogram

µg/kg micrograms per kilogram

U not detected

** If detected in the old risk assessment data set, but not a Provisional COPC (from Pre-2005 HHRA Review document), chemical is not shown on this table unless more recent sample also contains a detection of that chemical.*

Table A.7										ADDITIONAL SCREEN OF PROVISIONAL COPCs				
AOI 8 Screening Review							**INITIAL SCREEN**			STEP 1		STEP 2		
Exposure Unit	Detected Analytes*	Units		USEPA May 2013 RSLs[1]	2008 Background Conc.	Maximum Detected Value	Provisional COPC (max > higher of current RSL or 2008 background)?	Rationale	Outlier - Is Max ≥ 10X the Avg of Remaining Data?	95% UCL of the mean[2]	Risk Ratio[3]	Statistical Comparison to Background[4]	COPC?	NOTES
AOI 8	Aluminum	mg/kg	NC	7700	19100	17600	NO	MAX < BG						
	Antimony	mg/kg	NC	3.1	5.2	0.88	NO	MAX < BG and RSL						
4 samples	Arsenic	mg/kg	C	0.61	12.6	6.3	NO	MAX < BG						
	Barium	mg/kg	NC	1500	172	111	NO	MAX < BG and RSL						
	Beryllium	mg/kg	NC	1.6	1.9	1.2	NO	MAX < BG and RSL						
	Boron	mg/kg	NC	160	NS	33.4	NO	MAX < RSL						
	Cadmium	mg/kg	NC	7	2.36	0.66	NO	MAX < BG and RSL						
	Chromium	mg/kg	NC	12000	51.3	49.8	NO	MAX < BG and RSL						
	Cobalt	mg/kg	NC	2.3	17.8	16.5	NO	MAX < BG						
	Copper	mg/kg	NC	310	49.65	94.8	NO	MAX < RSL						
	Iron	mg/kg	NC	5500	32400	21500	NO	MAX < BG						
	Lead	mg/kg	--	400	194	71.9	NO	MAX < BG and RSL						
	Magnesium	mg/kg	NS	NS	6950	3690	NO	MAX < BG						
	Manganese	mg/kg	NC	180	968	1130	**YES**	**MAX > BG and RSL**	NO	1130	6.28	NA	**YES, risk ratio >1**	
	Nickel	mg/kg	NC	150	33.5	35.2	NO	MAX < RSL						
	Selenium	mg/kg	NC	39	1.2	0.6	NO	MAX < BG and RSL						
	Silver	mg/kg	NC	39	0.87	1.7	NO	MAX < RSL						
	Strontium	mg/kg	NC	4700	53	31.2	NO	MAX < BG and RSL						
	Tellurium	mg/kg	NS	NS	5	4.8	NO	MAX < BG						
	Thallium	mg/kg	NC	0.078	2.2	0.38	NO	MAX < BG						
	Tin	mg/kg	NC	4700	8.4	4.5	NO	MAX < BG and RSL						
	Titanium	mg/kg	NS	NS	2690	727	NO	MAX < BG						
	Vanadium	mg/kg	NC	39	75.5	30.4	NO	MAX < BG and RSL						
	Zinc	mg/kg	NC	2300	158	138	NO	MAX < BG and RSL						
	Zirconium	mg/kg	NC	0.63	48.3	23.5	NO	MAX < BG						
	Mercury	mg/kg	NC	1	0.25	0.148	NO	MAX < BG and RSL						
	Cyanide, Total	mg/kg	NC	2.2	0.26	0.572	NO	MAX < RSL						
	Fluoride	mg/kg	NC	310	NS	16	NO	MAX < RSL						
	2-Butanone	µg/kg	NC	2800000	18	5.1	NO	MAX < BG and RSL						
	1,1'-Biphenyl	µg/kg	NC	5100	510	5.1	NO	MAX < BG and RSL						
	Acenaphthene	µg/kg	NC	340000	510	32	NO	MAX < BG and RSL						
	Anthracene	µg/kg	NC	1700000	510	71	NO	MAX < BG and RSL						
	Benzaldehyde	µg/kg	NC	780000	510	8.8	NO	MAX < BG and RSL						
	Benzo(a)anthracene	µg/kg	C	150	357.5	230	NO	MAX < BG						
	Benzo(a)pyrene	µg/kg	C	15	375	190	NO	MAX < BG						
	Benzo(b)fluoranthene	µg/kg	C	150	365.7	240	NO	MAX < BG						
	Benzo(ghi)perylene	µg/kg	NS	NS	331.5	110	NO	MAX < BG						
	Benzo(k)fluoranthene	µg/kg	C	1500	356.6	100	NO	MAX < BG and RSL						
	Benzoic acid	µg/kg	NC	24000000	510	100	NO	MAX < BG and RSL						
	bis(2-Ethylhexyl) phthalate	µg/kg	C	35000	1479	200	NO	MAX < BG and RSL						
	Caprolactam	µg/kg	NC	3100000	510	47	NO	MAX < BG and RSL						
	Carbazole	µg/kg	NS	NS	510	43	NO	MAX < BG						
	Chrysene	µg/kg	C	15000	400.9	260	NO	MAX < BG and RSL						
	Dibenz(a,h)anthracene	µg/kg	C	15	510	36	NO	MAX < BG						
	Dibenzofuran	µg/kg	NC	7800	510	8	NO	MAX < BG and RSL						
	Dimethyl phthalate	µg/kg	NS	NS	510	300	NO	MAX < BG						
	Di-n-butyl phthalate	µg/kg	NC	610000	510	70	NO	MAX < BG and RSL						
	Fluoranthene	µg/kg	NC	230000	699.9	470	NO	MAX < BG and RSL						
	Fluorene	µg/kg	NC	230000	510	26	NO	MAX < BG and RSL						
	Indeno(1,2,3-cd)pyrene	µg/kg	C	150	334.7	95	NO	MAX < BG and RSL						
	Phenanthrene	µg/kg	NS	NS	407.4	370	NO	MAX < BG						
	Pyrene	µg/kg	NC	170000	626.4	500	NO	MAX < BG and RSL						
	Perchlorate	µg/kg	NC	5500	0.612	7.2	NO	MAX < RSL						

1. USEPA May 2013 RSLs. NC adjusted downward by factor of 10

2. Calculated using EPA's ProUCL software (minimum of 5 samples required)

3. EPC divided by adjusted RSL; Drop out COPC if < or = 1. If insufficient sample number, then risk ratio is max value divided by adjusted RSL

4. Statistical background comparisons using ProUCL two-sample hypothesis test to determine if site results greater than background. (minimum of 5 samples required)

NA not applicable; previous HHRA not conducted

NC non-carcinogen, C carcinogen, NS none specified

mg/kg = milligrams per kilogram - µg/kg = micrograms per kilogram

** If detected in the old risk assessment data set, but not a Provisional COPC (from Pre-2005 HHRA Review document), chemical is not shown on this table unless more recent sample also contains a detection of that chemical.*

Table A.8											ADDITIONAL SCREEN of PROVISIONAL COPCs				
AOI 11 Screening Review							**INITIAL SCREEN**				STEP 1		STEP 2		
Exposure Unit	Detected Analytes*	Units		USEPA May 2013 RSLs[1]	2008 Background Conc.	Maximum Detected Value	Provisional COPC (max > higher of current RSL or 2008 background)?	Rationale	Outlier - Is Max ≥ 10X the Avg of Remaining Data?	Notes	95% UCL of the mean[2]	Risk Ratio[3]	Statistical Comparison to Background[4]	COPC?	Notes
AOI 11	Aluminum	mg/kg	NC	7700	19100	21000	**YES**	**MAX > BG and RSL**	NO		19462	2.53	**Site > BG**	**YES**	
	Antimony	mg/kg	NC	3.1	5.2	0.45	NO	MAX < BG and RSL							
6 samples	Arsenic	mg/kg	C	0.61	12.6	5.8	NO	MAX < BG							
	Barium	mg/kg	NC	1500	172	75.4	NO	MAX < BG and RSL							
	Beryllium	mg/kg	NC	1.6	1.9	1.7	NO	MAX < BG							
	Cadmium	mg/kg	NC	7	2.36	0.32	NO	MAX < BG and RSL							
	Chromium	mg/kg	NC	12000	51.3	32.6	NO	MAX < BG and RSL							
	Cobalt	mg/kg	NC	2.3	17.8	14	NO	MAX < BG							
	Copper	mg/kg	NC	310	49.65	32.2	NO	MAX < BG and RSL							
	Iron	mg/kg	NC	5500	32400	28000	NO	MAX < BG							
	Lead	mg/kg	--	400	194	14	NO	MAX < BG and RSL							
	Magnesium	mg/kg	NS	NS	6950	7060	**YES**	**MAX > BG**	NO		6401	No RSL	**Site > BG**	**YES**	
	Manganese	mg/kg	NC	180	968	611	NO	MAX < BG							
	Nickel	mg/kg	NC	150	33.5	27.5	NO	MAX < BG and RSL							
	Silver	mg/kg	NC	39	0.87	0.32	NO	MAX < BG and RSL							
	Strontium	mg/kg	NC	4700	53	42.6	NO	MAX < BG and RSL							
	Tellurium	mg/kg	NS	NS	5	4.3	NO	MAX < BG							
	Thallium	mg/kg	NC	0.078	2.2	ND (DL = 4.1 - 4.4)	**YES**	**ND, but DL > BG and RSL**	NO		2.12	27.18	Site ≤ BG	NO	All ND; used 1/2 average DL as the EPC in the risk ratio
	Tin	mg/kg	NC	4700	8.4	1.9	NO	MAX < BG and RSL							
	Titanium	mg/kg	NS	NS	2690	817	NO	MAX < BG							
	Vanadium	mg/kg	NC	39	75.5	34.8	NO	MAX < BG and RSL							
	Zinc	mg/kg	NC	2300	158	86.1	NO	MAX < BG and RSL							
	Zirconium	mg/kg	NC	0.63	48.3	40.8	NO	MAX < BG							
	Mercury	mg/kg	NC	1	0.25	0.04	NO	MAX < BG and RSL							
	Fluoride	mg/kg	NC	310	11	16	NO	MAX < RSL							
	2-Butanone	µg/kg	NC	2800000	18	9.1	NO	MAX < BG and RSL							
	Acetone	µg/kg	NC	6100000	554.7	53	NO	MAX < BG and RSL							
	Methyl Acetate	µg/kg	NC	7800000	18	11	NO	MAX < BG and RSL							
	Methylene Chloride	µg/kg	NC	56000	18	6.6	NO	MAX < BG and RSL							
	Bis(2-ethylhexyl) phthalate	µg/kg	C	35000	1479	39	NO	MAX < BG and RSL							
	Perchlorate	µg/kg	NC	5500	0.612	0.41	NO	MAX < BG and RSL							

1. USEPA May 2013 RSLs. NC adjusted downward by factor of 10

2. Calculated using EPA's ProUCL software (minimum of 5 samples)

3. EPC divided by adjusted RSL; Drop out COPC if < or = 1. If insufficient sample number, then risk ratio is max value divided by adjusted RSL

4. Statistical background comparisons using ProUCL two-sample hypothesis test to determine if site results greater than background (minimum of 5 samples)

NA not applicable; previous HHRA not conducted

NC non-carcinogen

C carcinogen

NS none specified

mg/kg milligrams per kilogram

µg/kg micrograms per kilogram

** If detected in the old risk assessment data set, but not a Provisional COPC (from Pre-2005 HHRA Review document), chemical is not shown on this table unless more recent sample also contains a detection of that chemical.*

Table A.9										ADDITIONAL SCREEN of PROVISIONAL COPCs				
AOI 9 - Screening Review							INITIAL SCREEN			STEP 1		STEP 2		
Exposure Unit	Detected Analytes*	Units		USEPA May 2013 RSLs[1]	2008 Background Conc.	Maximum Detected Value	Provisional COPC (max > higher of current RSL or 2008 background)?	Rationale	Outlier - Is Max ≥ 10X the Avg of Remaining Data?	95% UCL of the mean[2]	Risk Ratio[3]	Statistical Comparison to Background[4]	COPC?	NOTES
AOI 9	Aluminum	mg/kg	NC	7700	19100	51900	**YES**	**MAX > BG and RSL**	NO	21199	2.75	**Site > BG**	**YES**	
	Antimony	mg/kg	NC	3.1	5.2	44.2	**YES**	**MAX > BG and RSL**	NO	10.12	3.26	Site ≤ BG	NO	
59 samples	Arsenic	mg/kg	C	0.61	12.6	8.6	NO	MAX < BG						
	Barium	mg/kg	NC	1500	172	110	NO	MAX < BG and RSL						
	Beryllium	mg/kg	NC	16	1.9	6.0	NO	MAX < RSL						
	Boron	mg/kg	NC	160	NS	8.9	NO	MAX < RSL						
	Chromium	mg/kg	NC	12000	51.3	118	NO	MAX < RSL						
	Cobalt	mg/kg	NC	2.3	17.8	69.2	**YES**	**MAX > BG and RSL**		27.92	12.14	**Site > BG**	**YES**	
	Copper	mg/kg	NC	310	49.65	66.2	NO	MAX < RSL						
	Iron	mg/kg	NC	5500	32400	25800	NO	MAX < BG						
	Lead	mg/kg	--	400	194	367	NO	MAX < RSL						
	Magnesium	mg/kg	NS	NA	6950	7490	**YES**	**MAX > BG**	NO	6578	No RSL	Site ≤ BG	NO	
	Manganese	mg/kg	NC	180	968	2040	**YES**	**MAX > BG and RSL**	NO	678	3.77	**Site > BG**	**YES**	
	Mercury	mg/kg	NC	1	0.25	0.32	NO	MAX < RSL						
	Nickel	mg/kg	NC	150	33.5	73.5	NO	MAX < RSL						
	Strontium	mg/kg	NC	4700	53	9.3	NO	MAX < BG and RSL						
	Tellurium	mg/kg	NS	NS	5	3.4	NO	MAX < BG						
	Thallium	mg/kg	NC	0.078	2.2	2.1	NO	MAX < BG						
	Tin	mg/kg	NC	4700	8.4	30.5	NO	MAX < RSL						
	Titanium	mg/kg		NA	2690	701	NO	MAX < BG						
	Vanadium	mg/kg	NC	39	75.5	307	**YES**	**MAX > BG and RSL**	NO	72.08	1.85	Site ≤ BG	NO	
	Zinc	mg/kg	NC	2300	158	162	NO	MAX < RSL						
	Zirconium	mg/kg	NC	0.63	48.3	6.38	NO	MAX < BG						
	Perchlorate	µg/kg	NC	5500	0.612	0.75	NO	MAX < RSL						
	Cyanide	mg/kg	NC	2.2	0.26	0.51	NO	MAX < RSL						
	Fluoride	mg/kg	NC	310	11	9.7	NO	MAX < BG and RSL						
	1,4-dithiane	µg/kg		61000	NS	9.6	NO	MAX < RSL						
	1,4-oxathiane	µg/kg	NC	61000	NS	12	NO	MAX < RSL						
	Acetone	µg/kg	NC	340000	554.7	429	NO	MAX < BG and RSL						
	Acrolein	µg/kg	NC	1700000	NS	30.3	NO	MAX < RSL						
	Ethyl benzene	µg/kg		NS	18	1.5	NO	MAX < BG						
	Methyl Tertbutyl Ether	µg/kg	C	150	357.5	0.84	NO	MAX < BG and RSL						
	Methylene chloride	µg/kg	C	56000	18	2.6	NO	MAX < BG and RSL						
	Toluene	µg/kg	NC	500000	18	11.3	NO	MAX < BG and RSL						
	Total Xylenes	µg/kg	NC	63000	18	3.5	NO	MAX < BG and RSL						
	Benzo(a)pyrene	µg/kg	C	15	375	168	NO	MAX < BG						
	Benzo(b)fluoranthene	µg/kg	C	150	365.7	300	NO	MAX < BG						
	Benzo(k)fluoranthene	µg/kg	C	1500	356.6	155	NO	MAX < BG and RSL						
	Benzoic Acid	µg/kg		NS	510	419	NO	MAX < BG						
	Bis(2-Ethylhexyl)phthalate	µg/kg	C	35000	1479	51	NO	MAX < BG and RSL						
	Chrysene	µg/kg	C	15000	400.9	169	NO	MAX < BG and RSL						
	Fluoranthene	µg/kg	NC	230000	699.9	650	NO	MAX < BG and RSL						
	Phenanthrene	µg/kg		NS	407.4	350	NO	MAX < BG						
	Pyrene	µg/kg	NC	170000	626.4	450	NO	MAX < BG and RSL						

1. USEPA May 2013 RSLs. NC adjusted downward by factor of 10

2. Calculated using EPA's ProUCL software (minimum of 5 samples)

3. EPC divided by adjusted RSL; Drop out COPC if < or = 1. If insufficient sample number, then risk ratio is max value divided by adjusted RSL

4. Statistical background comparisons using ProUCL two-sample hypothesis test to determine if site results greater than background (minimum of 5 samples)

NA not applicable; previous HHRA not conducted

NC non-carcinogen

C carcinogen

NS none specified

mg/kg milligrams per kilogram

µg/kg micrograms per kilogram

** If detected in the old risk assessment data set, but not a Provisional COPC (from Pre-2005 HHRA Review document), chemical is not shown on this table unless more recent sample also contains a detection of that chemical.*

Table A.10														ADDITIONAL SCREEN of PROVISIONAL COPCs				
AOI 13 - Screening Review							**INITIAL SCREEN**							STEP 1		STEP 2		
Exposure Unit	Detected Analytes*	Units		USEPA May 2013 RSLs[1]	2008 Background Conc.	Maximum Detected Value	Provisional COPC (max > higher of current RSL or 2008 background)?	Rationale	Outlier - Is Max ≥ 10X the Avg of Remaining Data?	Notes	NEXT Maximum Detected Value	Provisional COPC (NEXT max > higher of current RSL or 2008 background)?	Rationale	95% UCL of the mean[2]	Risk Ratio[3]	Statistical Comparison to Background[4]	COPC?	NOTES
AOI 13	Aluminum	mg/kg	NC	7700	19100	29700	**YES**	**MAX > BG and RSL**	NO					20637	2.68	**Site > BG**	**YES**	
	Antimony	mg/kg	NC	3.1	5.2	0.996	NO	MAX < BG and RSL										
17 samples	Arsenic	mg/kg	C	0.61	12.6	12	NO	MAX < BG										
	Barium	mg/kg	NC	1500	172	168	NO	MAX < BG and RSL										
	Beryllium	mg/kg	NC	16	1.9	1.9	NO	MAX < RSL										
	Cadmium	mg/kg	NC	7	2.36	1.37	NO	MAX < BG and RSL										
	Calcium	mg/kg		NS	NS	3520	NO	No BG or RSL										
	Chromium	mg/kg	NC	12000	51.3	125	NO	MAX < RSL										
	Cobalt	mg/kg	NC	2.3	17.8	30.7	**YES**	**MAX > BG and RSL**	NO					21.53	9.36	**Site > BG**	**YES**	
	Copper	mg/kg	NC	310	49.65	116	NO	MAX < RSL										
	Iron	mg/kg	NC	5500	32400	38500	**YES**	**MAX > BG and RSL**	NO					36225	6.59	**Site > BG**	**YES**	
	Lead	mg/kg	--	400	194	51.6	NO	MAX < BG and RSL										
	Magnesium	mg/kg	NS	NA	6950	13100	**YES**	**MAX > BG**	NO					9141	No RSL	Site ≤ BG	NO	
	Manganese	mg/kg	NC	180	968	992	**YES**	**MAX > BG and RSL**	NO					636.1	3.53	Site ≤ BG	NO	
	Mercury	mg/kg	NC	1	0.25	2.3	**YES**	**MAX > BG and RSL**	YES	remove sample 4707WL-1(0.5)	0.29	NO	MAX < RSL					Evaluate outlier sample separately (see Table E.10)
	Nickel	mg/kg	NC	150	33.5	54.2	NO	MAX < RSL										
	Potassium	mg/kg		NS	NS	9580	NO	No BG or RSL										
	Selenium	mg/kg	NC	39	1.2	6.85	NO	MAX < RSL										
	Silver	mg/kg	NC	39	0.87	0.714	NO	MAX < BG and RSL										
	Sodium	mg/kg		NS	NS	112	NO	No BG or RSL										
	Strontium	mg/kg	NC	4700	53	17	NO	MAX < BG and RSL										
	Tellurium	mg/kg		NS	5	0.064	NO	MAX < BG										
	Thallium	mg/kg	NC	0.078	2.2	3.2	**YES**	**MAX > BG and RSL**	NO					1.42	18.22	Site ≤ BG	NO	
	Tin	mg/kg	NC	4700	8.4	3.1	NO	MAX < BG and RSL										
	Titanium	mg/kg		NS	2690	1440	NO	MAX < BG										
	Vanadium	mg/kg	NC	39	75.5	103	**YES**	**MAX > BG and RSL**	NO					77.92	2.00	Site ≤ BG	NO	
	Zinc	mg/kg	NC	2300	158	203	NO	MAX < RSL										
	Zirconium	mg/kg	NC	0.63	48.3	3.6	NO	MAX < BG										
	Iodine	mg/kg	NC	78	0.08	45.67	NO	MAX < RSL										
	Fluoride	mg/kg	NC	310	11	12	NO	MAX < RSL										
	Perchlorate	µg/kg	NC	5500	0.612	2.9	NO	MAX < RSL										
	Cyanide	mg/kg	NC	2.2	0.26	0.318	NO	MAX < RSL										
	Acetone	µg/kg	NC	340000	554.7	57	NO	MAX < BG and RSL										
	Chloroform	µg/kg	C	290	18	4.5	NO	MAX < BG and RSL										
	Methylene chloride	µg/kg		56000	18	4.4	NO	MAX < BG and RSL										
	Toluene	µg/kg	NC	500000	18	21	NO	MAX < RSL										
	m- & p-Xylene	µg/kg	NC	59000	18	26	NO	MAX < RSL										
	o-Xylene	µg/kg	NC	69000	18	10	NO	MAX < RSL										
	Dimethyl phthalate	µg/kg		NS	510	310	NO	MAX < BG										

1. USEPA May 2013 RSLs. NC adjusted downward by factor of 10

2. Calculated using EPA's ProUCL software (minimum of 5 samples)

3. EPC divided by adjusted RSL; Drop out COPC if < or = 1. If insufficient sample number, then risk ratio is max value divided by adjusted RSL

4. Statistical background comparisons using ProUCL two-sample hypothesis test to determine if site results greater than background (minimum of 5 samples)

NA not applicable; previous HHRA not conducted

NC non-carcinogen

C carcinogen

NS none specified

mg/kg milligrams per kilogram

µg/kg micrograms per kilogram

** If detected in the old risk assessment data set, but not a Provisional COPC (from Pre-2005 HHRA Review document), chemical is not shown on this table unless more recent sample also contains a detection of that chemical.*

Table A.11											ADDITIONAL SCREEN of PROVISIONAL COPCs				
Western POI 53 Screening Review							INITIAL SCREEN				STEP 1		STEP 2		
Exposure Unit	Detected Analytes*	Units		USEPA May 2013 RSLs[1]	2008 Background Conc.	Maximum Detected Value	Provisional COPC (max > higher of current RSL or 2008 background)?	Rationale	Outlier - Is Max ≥ 10X the Avg of Remaining Data?	Notes	95% UCL of the mean[2]	Risk Ratio[3]	Statistical Comparison to Background[4]	COPC?	NOTES
Western POI 53	Aluminum	mg/kg	NC	7700	19100	26500	**YES**	**MAX > BG and RSL**	NO		22022	2.86	**Site > BG**	**YES**	
	Antimony	mg/kg	NC	3.1	5.2	5	NO	MAX < BG							
10 samples	Arsenic	mg/kg	C	0.61	12.6	4	NO	MAX < BG							
	Manganese	mg/kg	NC	180	968	1380	**YES**	**MAX > BG and RSL**	NO		1189	6.61	Site ≤ BG	NO	
	Thallium	mg/kg	NC	0.078	2.2	3.41	**YES**	**MAX > BG and RSL**	NO		2.54	32.51	Site ≤ BG	NO	
	Vanadium	mg/kg	NC	39	75.5	129	**YES**	**MAX > BG and RSL**	NO		84.68	2.17	**Site > BG**	**YES**	

1. USEPA May 2013 RSLs. NC adjusted downward by factor of 10

2. Calculated using EPA's ProUCL software (minimum of 5 samples required)

3. EPC divided by adjusted RSL; Drop out COPC if < or = 1. If insufficient sample number, then risk ratio is max value divided by adjusted RSL

4. Statistical background comparisons using ProUCL two-sample hypothesis test to determine if site results greater than background (minimum of 5 samples required)

NA not applicable

NC non-carcinogen

C carcinogen

NS none specified

mg/kg milligrams per kilogram

µg/kg micrograms per kilogram

** If detected in the old risk assessment data set, but not a Provisional COPC (from Pre-2005 HHRA Review document), chemical is not shown on this table unless more recent sample also contains a detection of that chemical.*

Table A.12										ADDITIONAL SCREEN of PROVISIONAL COPCs				
Spaulding-Rankin - Screening Review							**INITIAL SCREEN**			STEP 1		STEP 2		
Exposure Unit	Detected Analytes*	Units		USEPA May 2013 RSLs[1]	2008 Background Conc.	Maximum Detected Value	Provisional COPC (max > higher of current RSL or 2008 background)?	Rationale	Notes	95% UCL of the mean[2]	Risk Ratio[3]	Statistical Comparison to Background[4]	COPC?	NOTES
Spaulding-Rankin	Aluminum	mg/kg	NC	7700	19100	37428	**YES**	**MAX > BG and RSL**		16885	2.19	**Site > BG**	**YES**	
	Antimony	mg/kg	NC	3.1	5.2	18.5	**YES**	**MAX > BG and RSL**		4.492	1.45	Site ≤ BG	NO	
60 samples	Arsenic	mg/kg	C	0.61	12.6	131	**YES**	**MAX > BG and RSL**		16.46	26.98	Site ≤ BG	NO	
	Barium	mg/kg	NC	1500	172	293.57	NO	MAX < BG						
	Beryllium	mg/kg	NC	16	1.9	3.3	NO	MAX < RSL						
	Cadmium	mg/kg	NC	7	2.36	30.1	NO	MAX < RSL						
	Calcium	mg/kg		NS	NA	25590.57	NO	No BG or RSL						
	Chromium	mg/kg	NC	12000	51.3	15866.71	**YES**	**MAX > BG and RSL**		2137	0.18	**--**	NO, risk ratio < 1	
	Cobalt	mg/kg	NC	2.3	17.8	426.52	**YES**	**MAX > BG and RSL**		99.95	43.46	**Site > BG**	**YES**	
	Copper	mg/kg	NC	310	49.65	481	**YES**	**MAX > BG and RSL**		129.5	0.42	**--**	NO, risk ratio < 1	
	Iron	mg/kg	NC	5500	32400	140536.16	**YES**	**MAX > BG and RSL**		63501	11.55	**Site > BG**	**YES**	
	Lead	mg/kg	--	400	194	868	**YES**	**MAX > BG and RSL**		78.93	0.20	**--**	NO, risk ratio < 1	
	Magnesium	mg/kg		NS	6950	14900	**YES**	**MAX > BG**		5630	No RSL	Site ≤ BG	NO	
	Manganese	mg/kg	NC	180	968	3248	**YES**	**MAX > BG and RSL**		1286	7.14	**Site > BG**	**YES**	
	Mercury	mg/kg	NC	1	0.25	2.5	**YES**	**MAX > BG and RSL**		0.445	0.45	**--**	NO, risk ratio < 1	
	Nickel	mg/kg	NC	150	33.5	335	**YES**	**MAX > BG and RSL**		132.6	0.88	**--**	NO, risk ratio < 1	
	Potassium	mg/kg		NS	NA	3246.43	NO	No BG or RSL						
	Selenium	mg/kg	NC	39	1.2	47.07	**YES**	**MAX > BG and RSL**		16.45	0.42	**--**	NO, risk ratio < 1	
	Silver	mg/kg	NC	39	0.87	3.73	NO	MAX < RSL						
	Sodium	mg/kg		NS	NA	199.29	NO	No BG or RSL						
	Strontium Total	mg/kg	NC	4700	53	24	NO	MAX < RSL						
	Thallium	mg/kg	NC	0.078	2.2	75.72	**YES**	**MAX > BG and RSL**		10.45	133.97	Site ≤ BG	NO	
	Tin	mg/kg	NC	4700	8.4	25.2	NO	MAX < RSL						
	Titanium	mg/kg		NS	2690	685	NO	MAX < BG						
	Vanadium	mg/kg	NC	39	75.5	195	**YES**	**MAX > BG and RSL**		102.1	2.62	**Site > BG**	**YES**	
	Zinc	mg/kg	NC	2300	158	13600	**YES**	**MAX > BG and RSL**		2501	1.09	Site ≤ BG	NO	
	Zirconium	mg/kg	NC	0.63	48.3	3.94	NO	MAX < BG						
	Cyanide	mg/kg	NC	2.2	0.26	1.86	NO	MAX < RSL						
	Benzo(a)anthracene	µg/kg	C	150	357.5	110	NO	MAX < BG and RSL						
	Benzo(a)pyrene	µg/kg	C	15	375	86	NO	MAX < BG						
	Benzo(b)fluoranthene	µg/kg	C	150	365.7	84	NO	MAX < BG and RSL						
	Chrysene	µg/kg	C	15000	400.9	110	NO	MAX < BG and RSL						

1. USEPA May 2013 RSLs. NC adjusted downward by factor of 10

2. Calculated using EPA's ProUCL software (minimum of 5 samples)

3. EPC divided by adjusted RSL; Drop out COPC if < or = 1. If insufficient sample number, then risk ratio is max value divided by adjusted RSL

4. Statistical background comparisons using ProUCL two-sample hypothesis test to determine if site results greater than background (minimum of 5 samples)

NA not applicable

NC non-carcinogen

C carcinogen

NS none specified

mg/kg milligrams per kilogram

µg/kg micrograms per kilogram

** If detected in the old risk assessment data set, but not a Provisional COPC (from Pre-2005 HHRA Review document), chemical is not shown on this table unless more recent sample also contains a detection of that chemical.*

Table A.13

Southern AU - Screening Review

Exposure Unit	Detected Analytes*	Units		USEPA May 2013 RSLs[1]	2008 Background Conc.	Maximum Detected Value	INITIAL SCREEN: Provisional COPC (max > higher of current RSL or 2008 background)?	Rationale	**Outlier Test 1** Is Max ≥ 10X the Avg of Remaining Data?	NEXT Maximum Detected Value	Provisional COPC (NEXT max > higher of current RSL or 2008 background)?	Rationale	**Outlier Test 2** Is NEXT Max ≥ 10X the Avg of Remaining Data?	NEXT Maximum Detected Value	Provisional COPC (2nd NEXT max > higher of current RSL or 2008 background)?	Rationale	**Outlier Test 3** Is NEXT Max ≥ 10X the Avg of Remaining Data?	ADDITIONAL SCREEN of PROVISIONAL COPCs: STEP 1 95% UCL of the mean[2]	STEP 1 Risk Ratio[3]	STEP 2 Statistical Comparison to Background[4]	COPC?	NOTES
Southern AU	Aluminum	mg/kg	NC	7700	19100	57700	**YES**	**MAX > BG and RSL**	NO, but max was from removed sample	56138	**YES**	**MAX > BG and RSL**	NO					20727	2.69	**Site > BG**	**YES**	
	Antimony	mg/kg	NC	3.1	5.2	**40.4**	**YES**	**MAX > BG and RSL**	**YES, remove sample AU-03**	**36.3**	**YES**	**MAX > BG and RSL**	**YES, remove sample AU-10**	19.1	**YES**	**MAX > BG and RSL**	NO	3.73	1.20	Site ≤ BG	NO	**AU-03 and AU-10 are Outliers (see Table E.13)**
115	Arsenic	mg/kg	C	0.61	12.6	17.1	**YES**	**MAX > BG and RSL**	NO									5.63	9.22	Site ≤ BG	NO	
samples	Barium	mg/kg	NC	1500	172	170	NO	MAX < BG and RSL														
	Beryllium	mg/kg	NC	16	1.9	**19**	**YES**	**MAX > BG and RSL**	**YES, remove sample SV-12A**	4.5	NO	MAX < BG										**SV-12A is an Outlier (see Table E.13)**
	Cadmium	mg/kg	NC	7	2.36	3.21	NO	MAX < RSL														
	Calcium	mg/kg		NS	NA	6540	NO	No BG or RSL														
	Chromium	mg/kg	NC	12000	51.3	651	NO	MAX < RSL														
	Cobalt	mg/kg	NC	2.3	17.8	193	**YES**	**MAX > BG and RSL**	NO									58.96	25.63	**Site > BG**	**YES**	
	Copper	mg/kg	NC	310	49.65	181	NO	MAX < RSL														
	Iron	mg/kg	NC	5500	32400	90475	**YES**	**MAX > BG and RSL**	NO, but max was from removed sample	68056	**YES**	**MAX > BG and RSL**	NO					36159	6.57	**Site > BG**	**YES**	
	Lead	mg/kg	--	400	194	158	NO	MAX < BG and RSL														
	Magnesium	mg/kg		NS	6950	21639	**YES**	**MAX > BG**	NO									10876	No RSL	**Site > BG**	**YES**	
	Manganese	mg/kg	NC	180	968	3070	**YES**	**MAX > BG and RSL**	NO									859.2	4.77	**Site > BG**	**YES**	
	Mercury	mg/kg	NC	1	0.25	**9.74**	**YES**	**MAX > BG and RSL**	**YES, remove sample SV-AU-05**	**2.3**	**YES**	**MAX > BG and RSL**	**YES, remove sample SV-04**	1.7	**YES**	**MAX > BG and RSL**	NO	0.357	0.36	--	NO, risk ratio < 1	**SV-AU-05 and SV-04 are Outliers (see Table E.13)**
	Nickel	mg/kg	NC	150	33.5	176	**YES**	**MAX > BG and RSL**	NO									67.32	0.45	--	NO, risk ratio < 1	
	Phosphorous	mg/kg		NS	NA	198	NO	No BG or RSL														
	Potassium	mg/kg		NS	NA	9081	NO	No BG or RSL														
	Selenium	mg/kg	NC	39	1.2	1.41	NO	MAX < RSL														
	Silicon	mg/kg		NS	NA	2240	NO	No BG or RSL														
	Sodium	mg/kg		NS	NA	600	NO	No BG or RSL														
	Strontium	mg/kg	NC	4700	53	20.7	NO	MAX < BG and RSL														
	Sulfur	mg/kg		NS	NA	255	NO	MAX < BG and RSL														
	Thallium	mg/kg	NC	0.078	2.2	**28.6**	**YES**	**MAX > BG and RSL**	**YES, remove sample SV-AU-03**	4.73	**YES**	**MAX > BG and RSL**	NO					1.05	13.44	Site ≤ BG	NO	**(see Section 2.3.13)**
	Titanium	mg/kg		NS	2690	896	NO	MAX < BG														
	Vanadium	mg/kg	NC	39	75.5	627	**YES**	**MAX > BG and RSL**	NO, but max was from removed sample	293	**YES**	**MAX > BG and RSL**	NO					73.66	1.89	**Site > BG**	**YES**	
	Zinc	mg/kg	NC	2300	158	209	NO	MAX < RSL														
	Cyanide	mg/kg	NC	2.2	0.26	0.74	NO	MAX < RSL														
	Arochlor-1260	mg/kg	C	0.22	NA	1.3	**YES**	**MAX > RSL**	NO		NO. Max result excavated; remainder ND											
	Methylene Chloride	µg/kg	C	56000	18	68	NO	MAX < RSL														
	Anthracene	µg/kg	NC	1,700,000	510	181.25	NO	MAX < BG and RSL														
	Benzo(a)anthracene	µg/kg	C	150	357.5	**3800**	**YES**	**MAX > BG and RSL**	**YES, remove sample BAKER-03**	773	**YES**	**MAX > BG and RSL**	NO					150.9	1.01	Site ≤ BG	NO	**BAKER-03 is Outlier (see Table E.13)**
	Benzo(a)pyrene	µg/kg	C	15	375	2800	**YES**	**MAX > BG and RSL**	NO, but max was from removed sample	595	**YES**	**MAX > BG and RSL**	NO					215.5	14.37	Site ≤ BG	NO	
	Benzo(b)fluoranthene	µg/kg	C	150	365.7	**3400**	**YES**	**MAX > BG and RSL**	**YES, remove sample BAKER-03**	895	**YES**	**MAX > BG and RSL**	NO					173.3	1.16	Site ≤ BG	NO	**BAKER-03 is Outlier (see Table E.13)**
	Benzo(g,h,i)perylene	µg/kg		NS	331.5	244	NO	MAX < BG														
	Benzo(k)fluoranthene	µg/kg	C	1500	356.6	**2200**	**YES**	**MAX > BG and RSL**	**YES, remove sample SV-BAKER-03**	377	NO	MAX < RSL										**SV-BAKER-03 is Outlier (see Table E.13)**
	Benzoic Acid	µg/kg	NC	24000000	510	210	NO	MAX < BG and RSL														
	Bis(2-ethylhexyl) phthalate	µg/kg	C	35000	1479	131	NO	MAX < BG and RSL														
	Chrysene	µg/kg	C	15000	400.9	2700	NO	MAX < RSL														
	Dibenz(a,h)anthracene	µg/kg	C	15	510	1100	**YES**	**MAX > BG and RSL**	Remaining data all ND, but max was from removed sample	ND (DL=184-478)	NO	DL < BG										
	Diethyl Phthalate	µg/kg	NC	4900000	510	24	NO	MAX < BG and RSL														
	Fluoranthene	µg/kg	NC	230000	699.9	4200	NO	MAX < RSL														
	Indeno(1,2,3-c,d) Pyrene	µg/kg	C	150	334.7	**2000**	**YES**	**MAX > BG and RSL**	**YES, remove sample BAKER-03**	273	NO	MAX < BG										**BAKER-03 is Outlier (see Table E.13)**
	Phenanthrene	µg/kg		NS	407.4	**2000**	**YES**	**MAX > BG**	**YES, remove sample SV-BAKER-03**	327	NO	MAX < BG										**SV-BAKER-03 is Outlier (see Table E.13)**
	Pyrene	µg/kg	NC	170000	626.4	5500	NO	MAX < RSL														

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3. EPC divided by adjusted RSL; Drop out COPC if < or = 1. If insufficient sample number, then risk ratio is max value divided by adjusted RSL

4. Statistical background comparisons using ProUCL two-sample hypothesis test to determine if site results greater than background (minimum of 5 samples)

NA not applicable, NC non-carcinogen, C carcinogen, NS none specified

mg/kg milligrams per kilogram, µg/kg micrograms per kilogram

** If detected in the old risk assessment data set, but not a Provisional COPC (from Pre-2005 HHRA Review document), chemical is not shown on this table unless more recent sample also contains a detection of that chemical.*

APPENDIX B:
FIGURES

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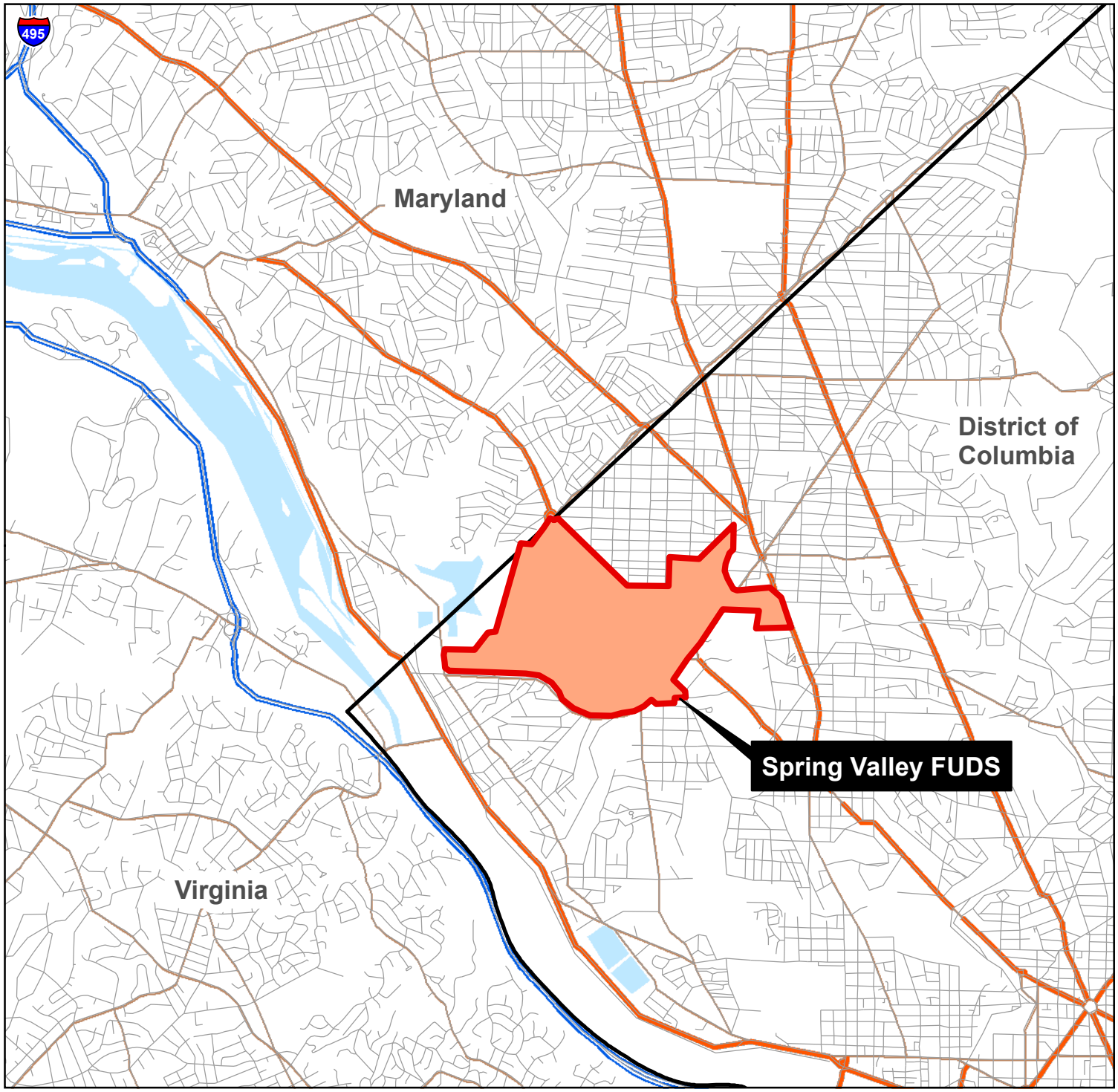


Figure 1
Site Location Map

Spring Valley FUDS
Washington, DC

Legend

- Spring Valley Site
- District of Columbia Boundary
- Urban Freeway
- Urban Interstate
- Local Streets
- Rivers and Lakes

FUDS - Formerly Used Defense Site

N
W E
S

0 0.25 0.5 1
Mile

ERT

August 2013

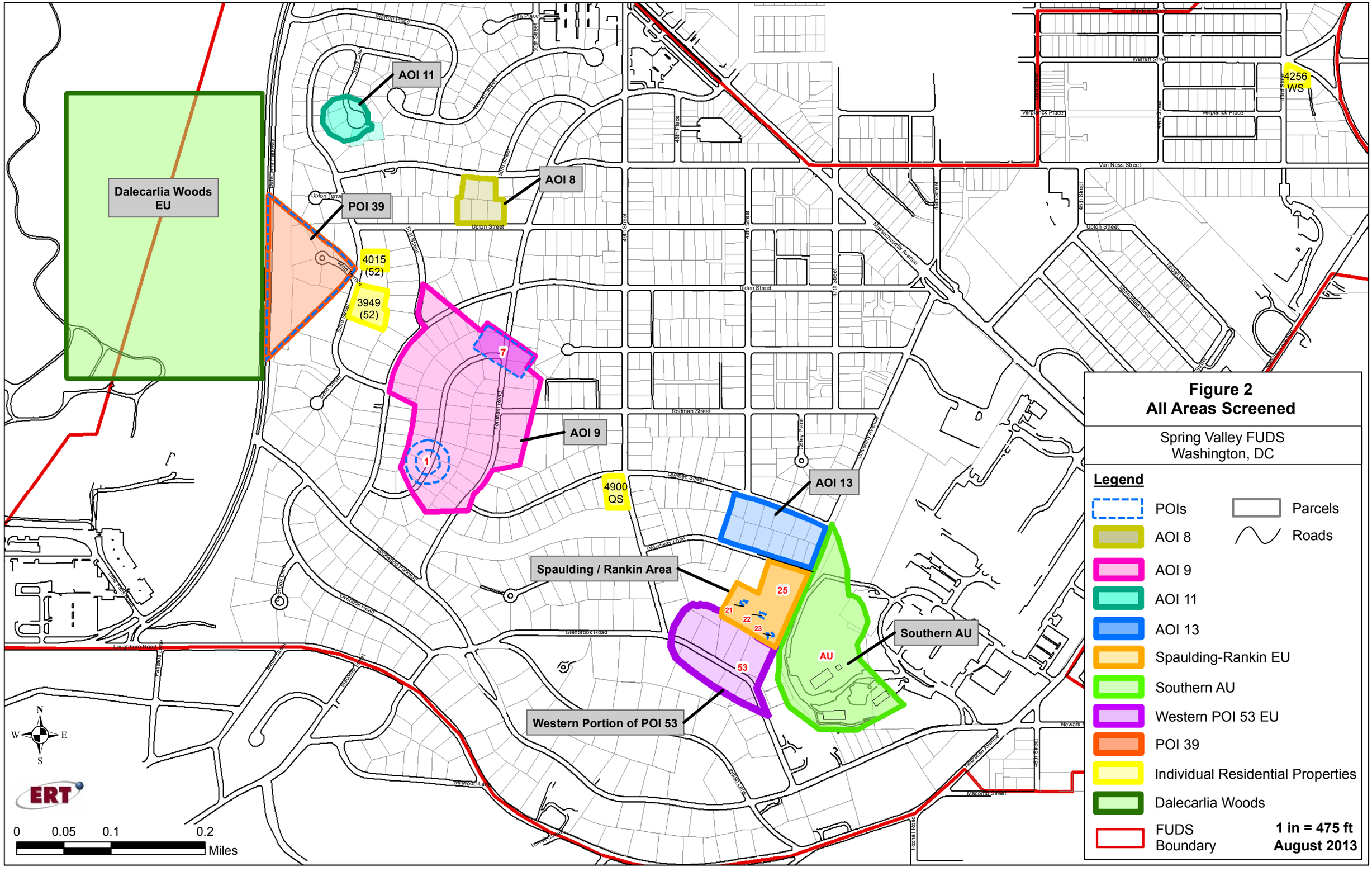


Figure 2
All Areas Screened

Spring Valley FUDS
Washington, DC

Legend

- POIs
- Parcels
- AOI 8
- Roads
- AOI 9
- AOI 11
- AOI 13
- Spaulding-Rankin EU
- Southern AU
- Western POI 53 EU
- POI 39
- Individual Residential Properties
- Dalecarlia Woods
- FUDS Boundary

1 in = 475 ft
August 2013

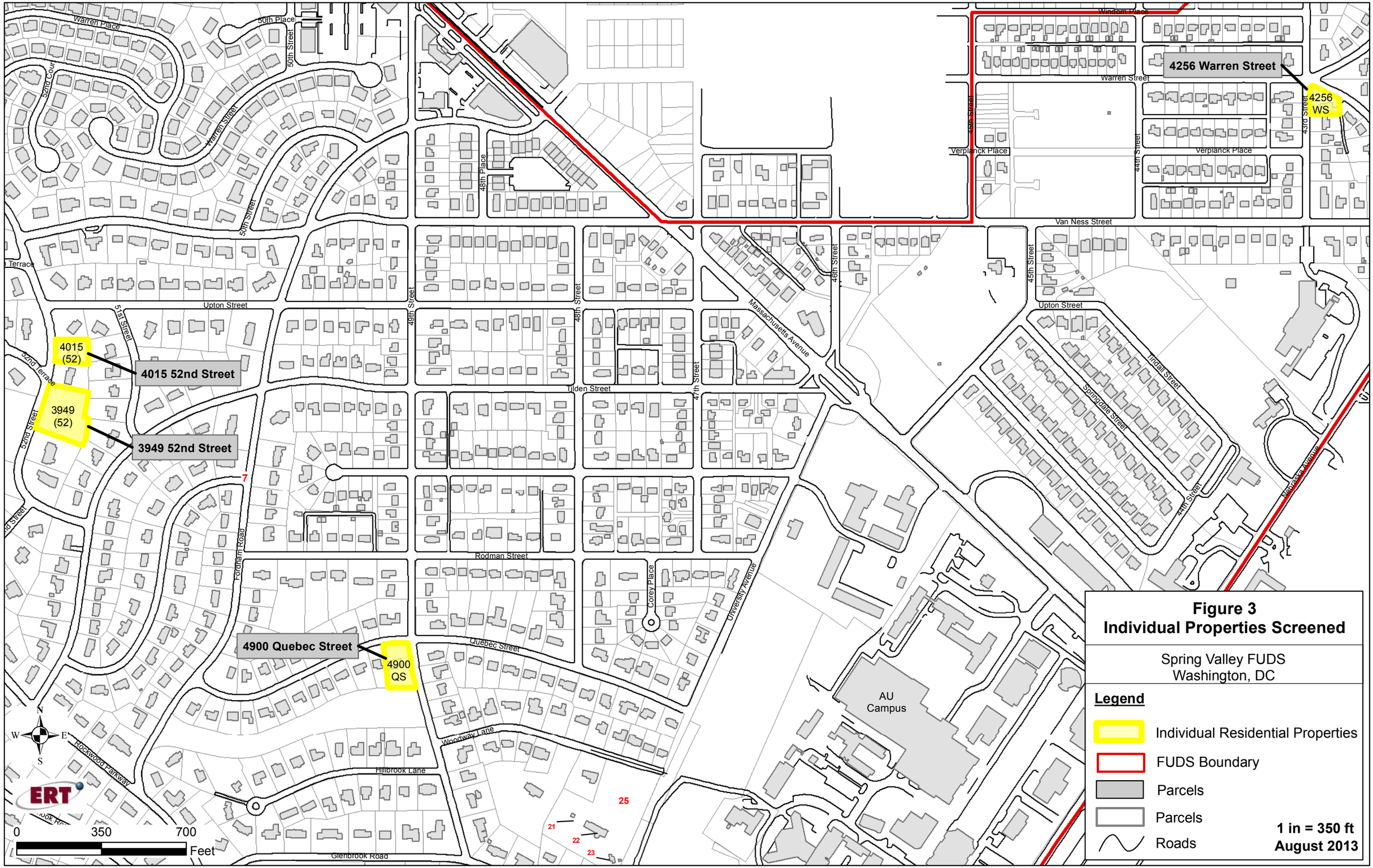


Figure 3
Individual Properties Screened

Spring Valley FUDS
Washington, DC

Legend

- Individual Residential Properties
- FUDS Boundary
- Parcels
- Parcels
- Roads

1 in = 350 ft
August 2013

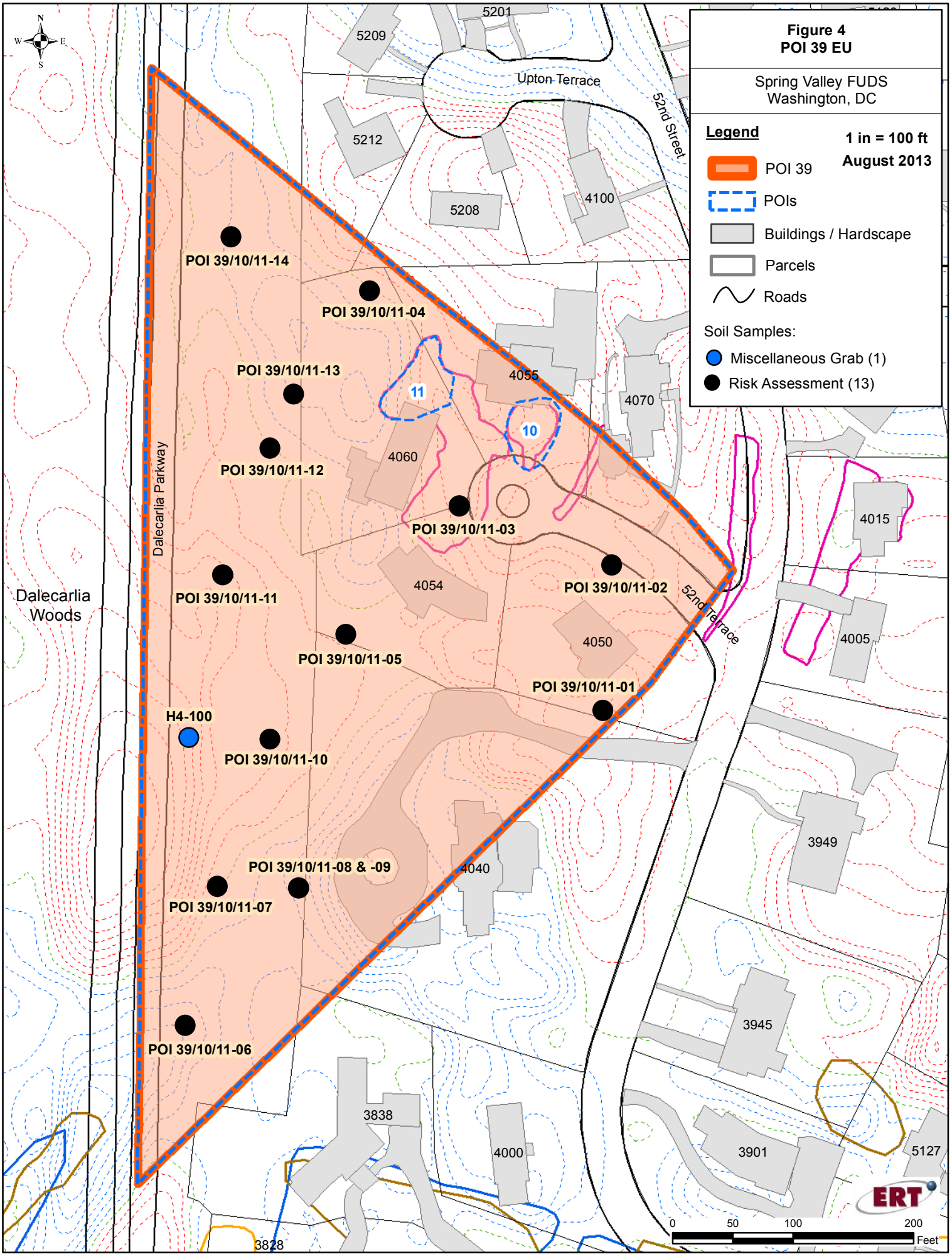


Figure 4
POI 39 EU
Spring Valley FUDS
Washington, DC
Legend
1 in = 100 ft
August 2013
POI 39
POIs
Buildings / Hardscape
Parcels
Roads
Soil Samples:
Miscellaneous Grab (1)
Risk Assessment (13)
POI 39/10/11-14
POI 39/10/11-04
POI 39/10/11-13
POI 39/10/11-12
POI 39/10/11-03
POI 39/10/11-02
POI 39/10/11-11
POI 39/10/11-05
POI 39/10/11-01
H4-100
POI 39/10/11-10
POI 39/10/11-08 & -09
POI 39/10/11-07
POI 39/10/11-06
11
10
Dalecarlia Parkway
Dalecarlia Woods
Upton Terrace
52nd Street
52nd Terrace
5201
5209
5212
5208
4100
4055
4070
4060
4054
4050
4040
4015
4005
3949
3945
3901
3838
4000
5127
3828
0
50
100
200
Feet
ERT

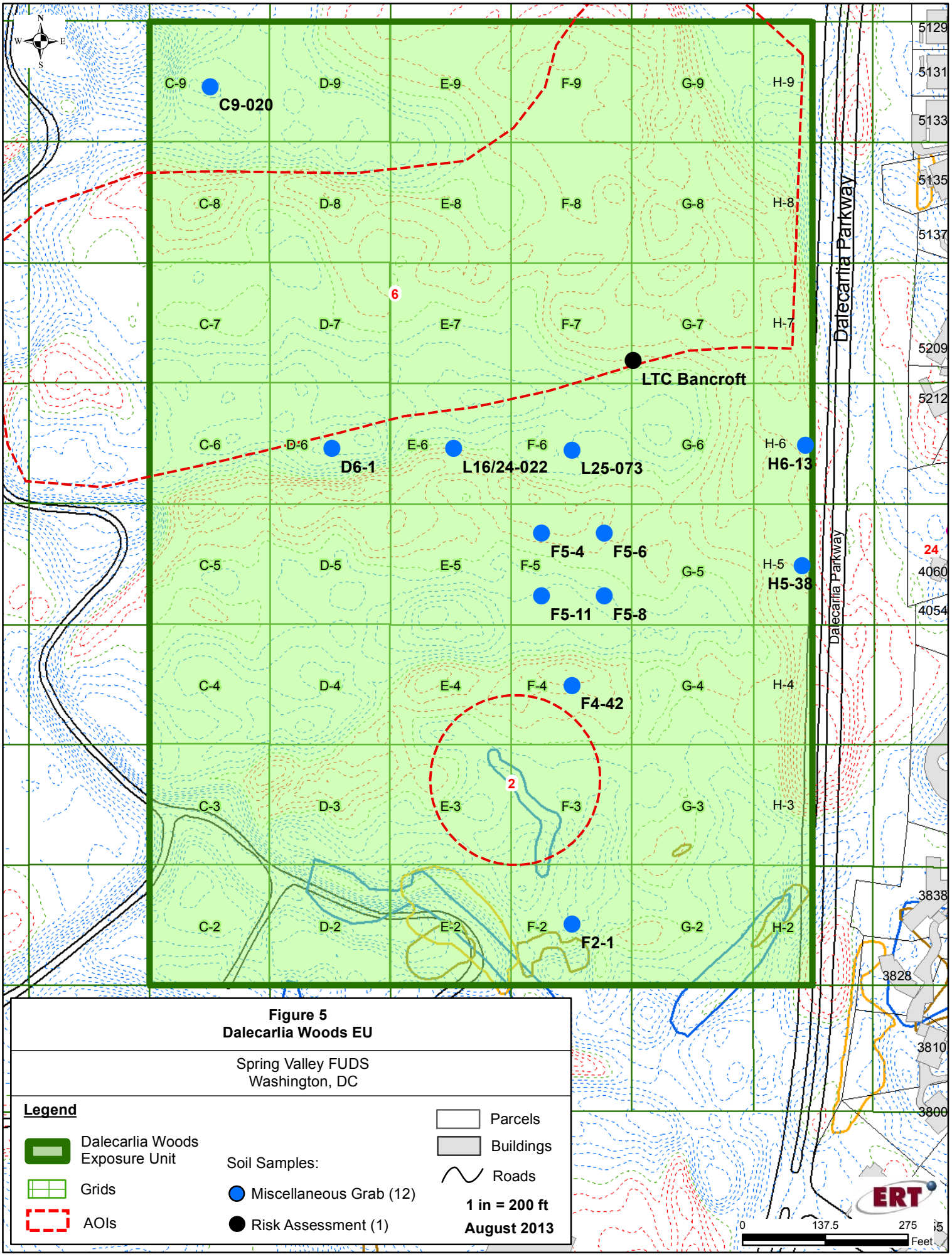


Figure 5
Dalecarlia Woods EU

Spring Valley FUDS
Washington, DC

Legend

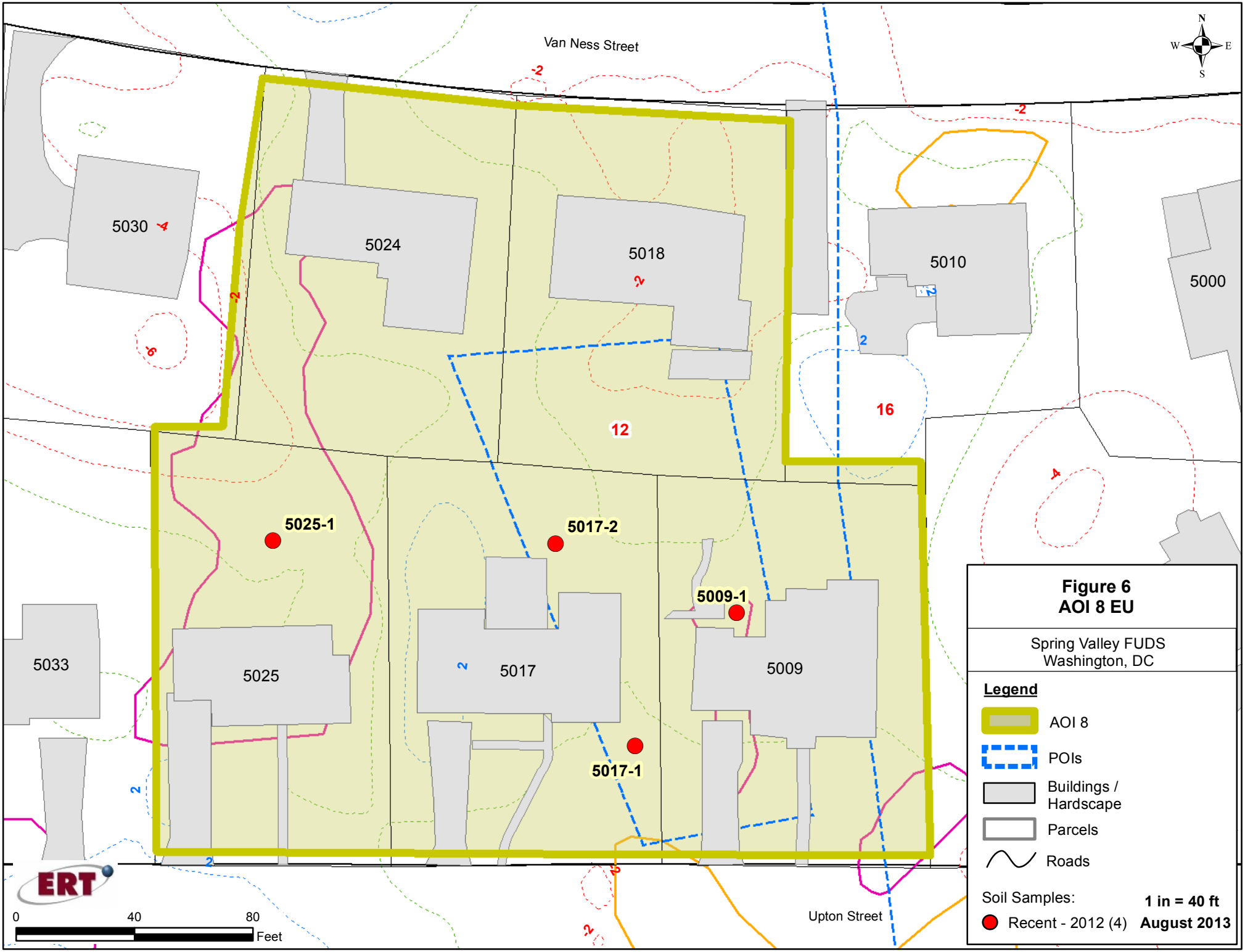
- Dalecarlia Woods Exposure Unit
- Grids
- AOIs

Soil Samples:

- Miscellaneous Grab (12)
- Risk Assessment (1)

- Parcels
- Buildings
- Roads

1 in = 200 ft
August 2013


Van Ness Street
N
W
E
S
5030
5024
5018
5010
5000
5033
5025
5017
5009
5025-1
5017-2
5009-1
5017-1
12
16
-2
-4
-6
2
4
Upton Street
ERT
0
40
80
Feet
Figure 6
AOI 8 EU
Spring Valley FUDS
Washington, DC
Legend
AOI 8
POIs
Buildings / Hardscape
Parcels
Roads
Soil Samples:
Recent - 2012 (4)
1 in = 40 ft
August 2013

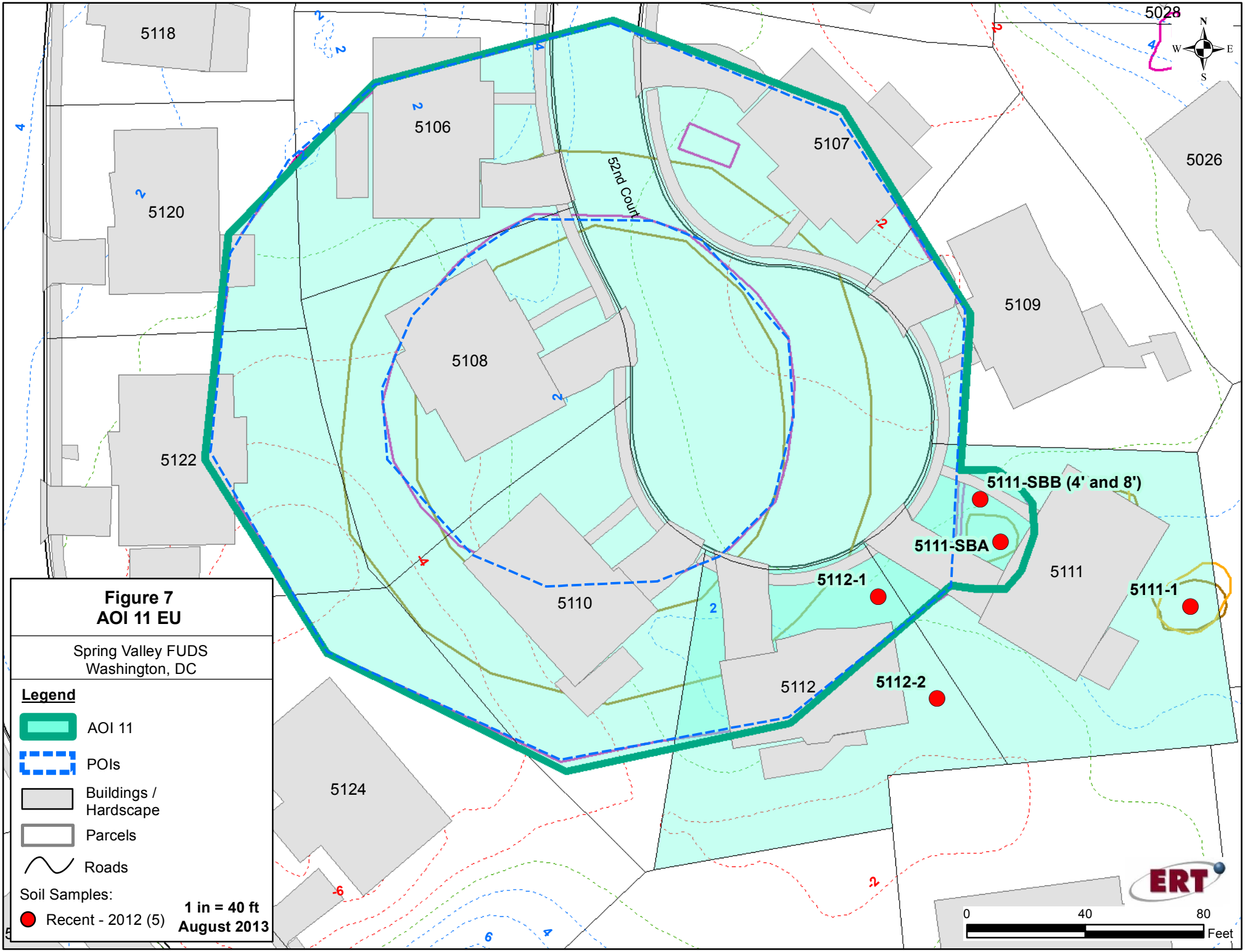


Figure 7
AOI 11 EU

Spring Valley FUDS
Washington, DC

Legend

- AOI 11
- POIs
- Buildings / Hardscape
- Parcels
- Roads

Soil Samples:

- Recent - 2012 (5)

1 in = 40 ft
August 2013

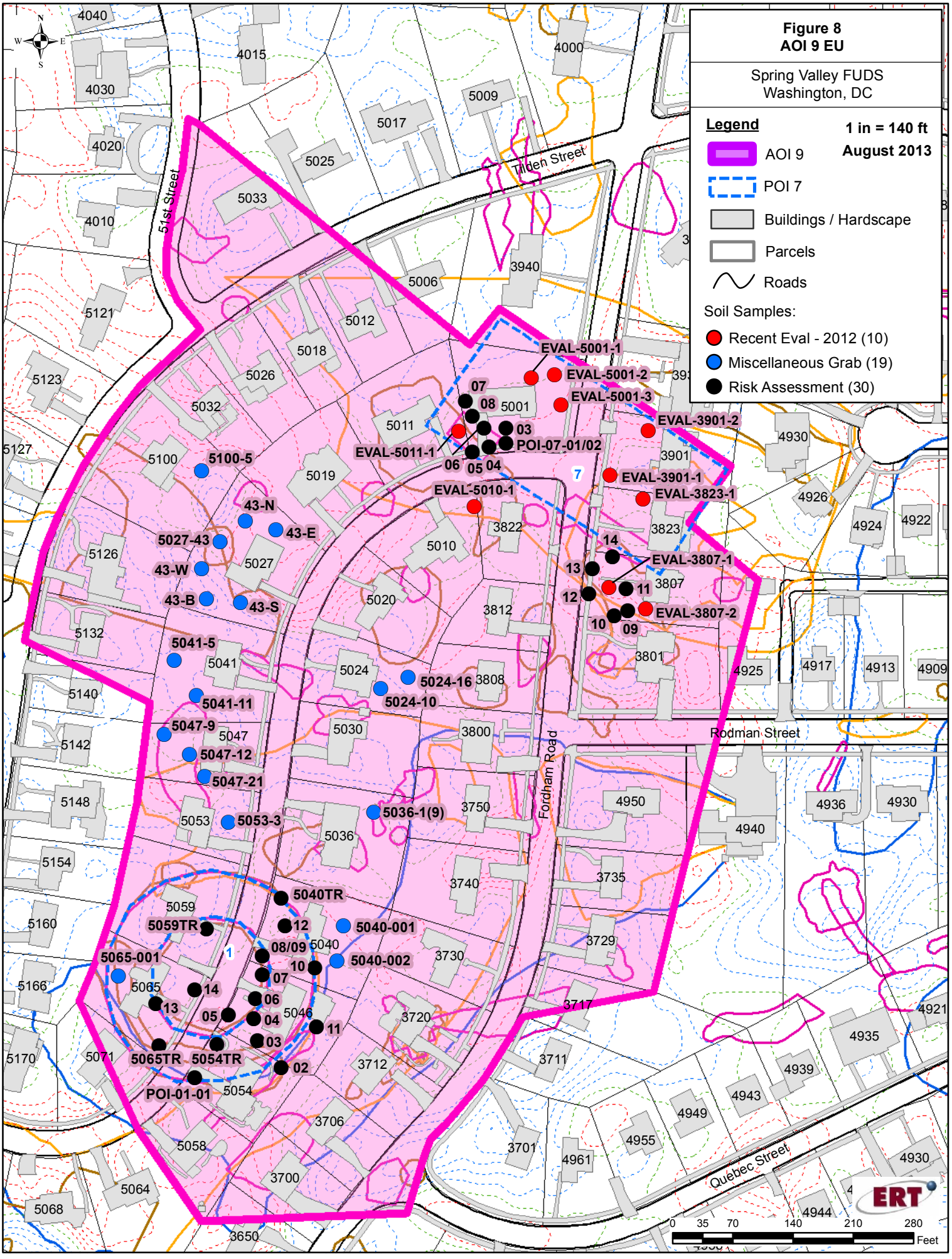


Figure 8
AOI 9 EU
Spring Valley FUDS
Washington, DC
Legend
1 in = 140 ft
August 2013
AOI 9
POI 7
Buildings / Hardscape
Parcels
Roads
Soil Samples:
Recent Eval - 2012 (10)
Miscellaneous Grab (19)
Risk Assessment (30)
EVAL-5001-1
EVAL-5001-2
EVAL-5001-3
EVAL-3901-2
EVAL-3901-1
EVAL-3823-1
EVAL-5011-1
EVAL-5010-1
EVAL-3807-1
EVAL-3807-2
POI-07-01/02
5100-5
43-N
43-E
5027-43
43-W
43-B
43-S
5041-5
5041-11
5047-9
5047-12
5047-21
5053-3
5024-16
5024-10
5036-1(9)
5040TR
5040-001
5040-002
5059TR
5065-001
5065TR
5054TR
POI-01-01
08/09
07
06
05
04
03
02
10
11
12
13
14
09
08
Tilden Street
51st Street
Fordham Road
Rodman Street
Québec Street
0 35 70 140 210 280
Feet
ERT

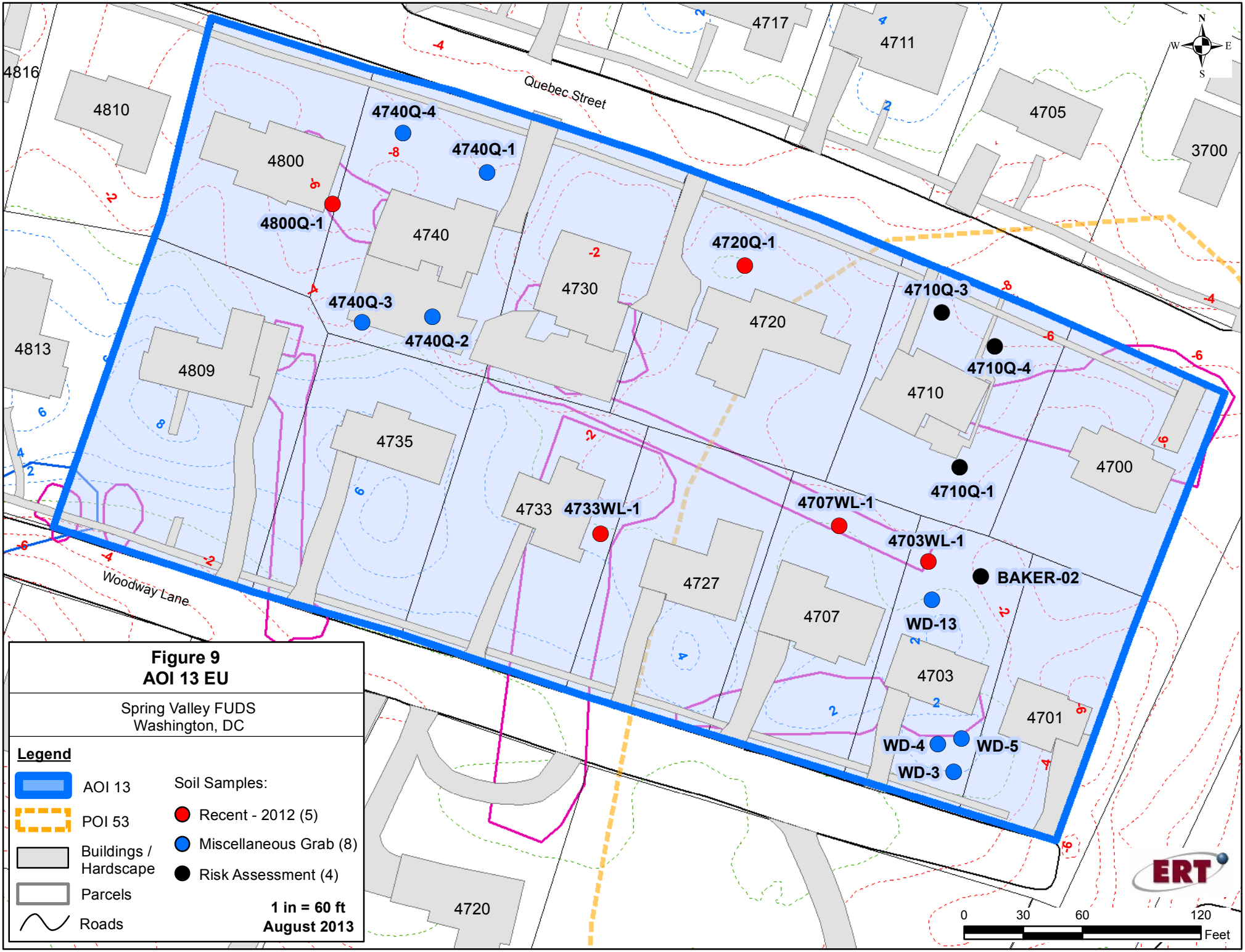


Figure 9
AOI 13 EU

Spring Valley FUDS
Washington, DC

Legend

- AOI 13
- POI 53
- Buildings / Hardscape
- Parcels
- Roads

Soil Samples:

- Recent - 2012 (5)
- Miscellaneous Grab (8)
- Risk Assessment (4)

1 in = 60 ft
August 2013

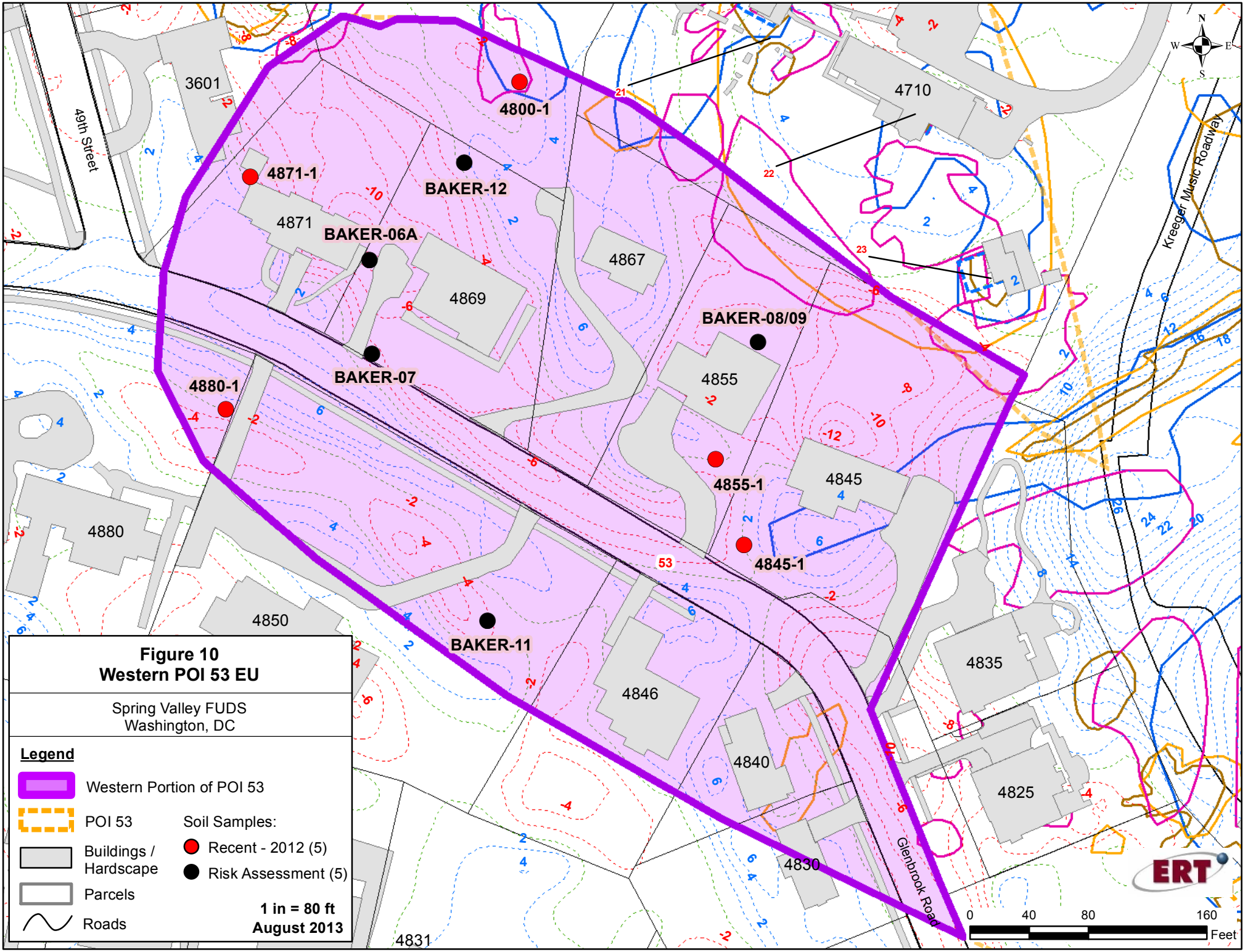


Figure 10
Western POI 53 EU

Spring Valley FUDS
Washington, DC

Legend

- Western Portion of POI 53
- POI 53
- Buildings / Hardscape
- Parcels
- Roads

Soil Samples:

- Recent - 2012 (5)
- Risk Assessment (5)

1 in = 80 ft
August 2013

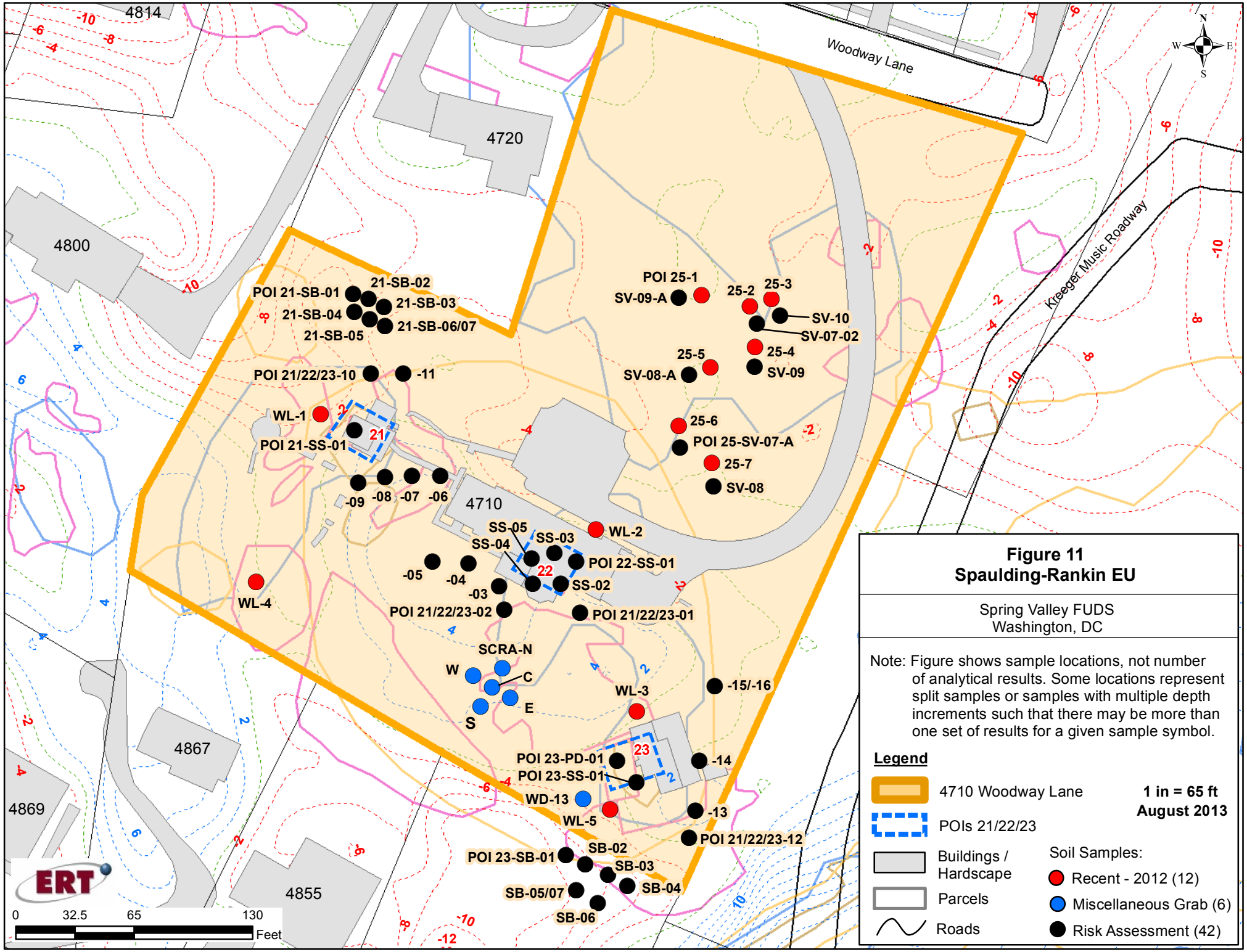


Figure 11
Spaulding-Rankin EU

Spring Valley FUDS
Washington, DC

Note: Figure shows sample locations, not number of analytical results. Some locations represent split samples or samples with multiple depth increments such that there may be more than one set of results for a given sample symbol.

Legend

- 4710 Woodway Lane
- POIs 21/22/23
- Buildings / Hardscape
- Parcels
- Roads

1 in = 65 ft
August 2013

Soil Samples:
- Recent - 2012 (12)
- Miscellaneous Grab (6)
- Risk Assessment (42)

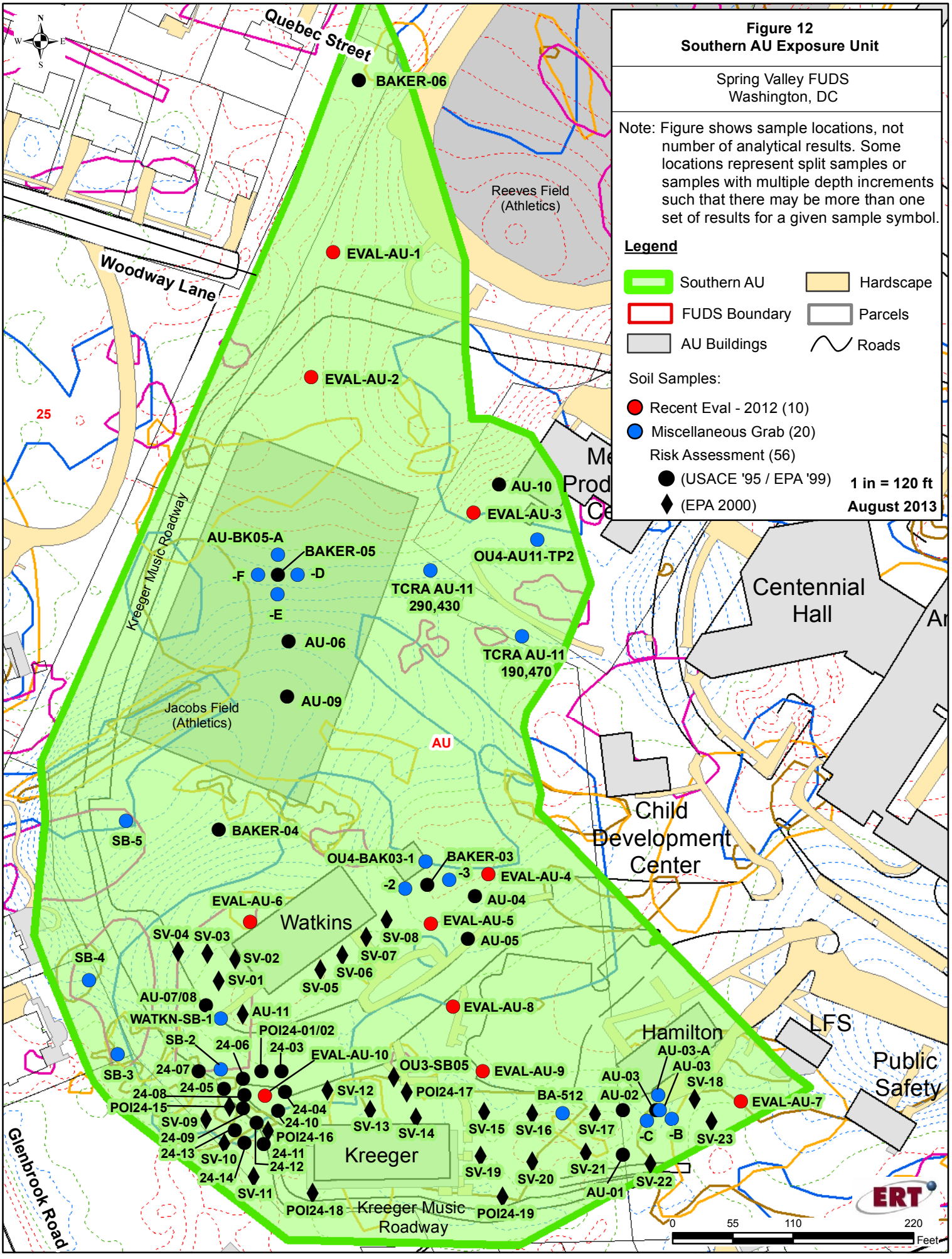


Figure 12
Southern AU Exposure Unit
Spring Valley FUDS
Washington, DC
Note: Figure shows sample locations, not number of analytical results. Some locations represent split samples or samples with multiple depth increments such that there may be more than one set of results for a given sample symbol.
Legend
Southern AU
FUDS Boundary
AU Buildings
Hardscape
Parcels
Roads
Soil Samples:
Recent Eval - 2012 (10)
Miscellaneous Grab (20)
Risk Assessment (56)
(USACE '95 / EPA '99)
(EPA 2000)
1 in = 120 ft
August 2013
Quebec Street
Woodway Lane
Reeves Field (Athletics)
Kreeger Music Roadway
Jacobs Field (Athletics)
Centennial Hall
Child Development Center
Watkins
Kreeger
Hamilton
LFS
Public Safety
Glenbrook Road
Kreeger Music Roadway
AU
25
BAKER-06
EVAL-AU-1
EVAL-AU-2
AU-10
EVAL-AU-3
AU-BK05-A
BAKER-05
-F
-D
-E
OU4-AU11-TP2
TCRA AU-11 290,430
TCRA AU-11 190,470
AU-06
AU-09
SB-5
BAKER-04
OU4-BAK03-1
BAKER-03
-3
-2
EVAL-AU-4
AU-04
EVAL-AU-6
EVAL-AU-5
AU-05
SV-04
SV-03
SV-02
SV-01
SV-08
SV-07
SV-06
SV-05
SB-4
AU-07/08
WATKN-SB-1
AU-11
EVAL-AU-8
SB-2
SB-3
POI24-01/02
24-06
24-03
24-07
24-05
24-08
POI24-15
EVAL-AU-10
OU3-SB05
EVAL-AU-9
SV-12
POI24-17
SV-09
24-09
24-13
SV-10
24-14
SV-11
24-04
24-10
POI24-16
24-11
24-12
SV-13
SV-14
SV-15
SV-16
BA-512
SV-17
AU-03
AU-02
AU-03-A
AU-03
SV-18
EVAL-AU-7
-C
-B
SV-23
SV-19
SV-20
SV-21
SV-22
AU-01
POI24-18
POI24-19
0
55
110
220
Feet
ERT

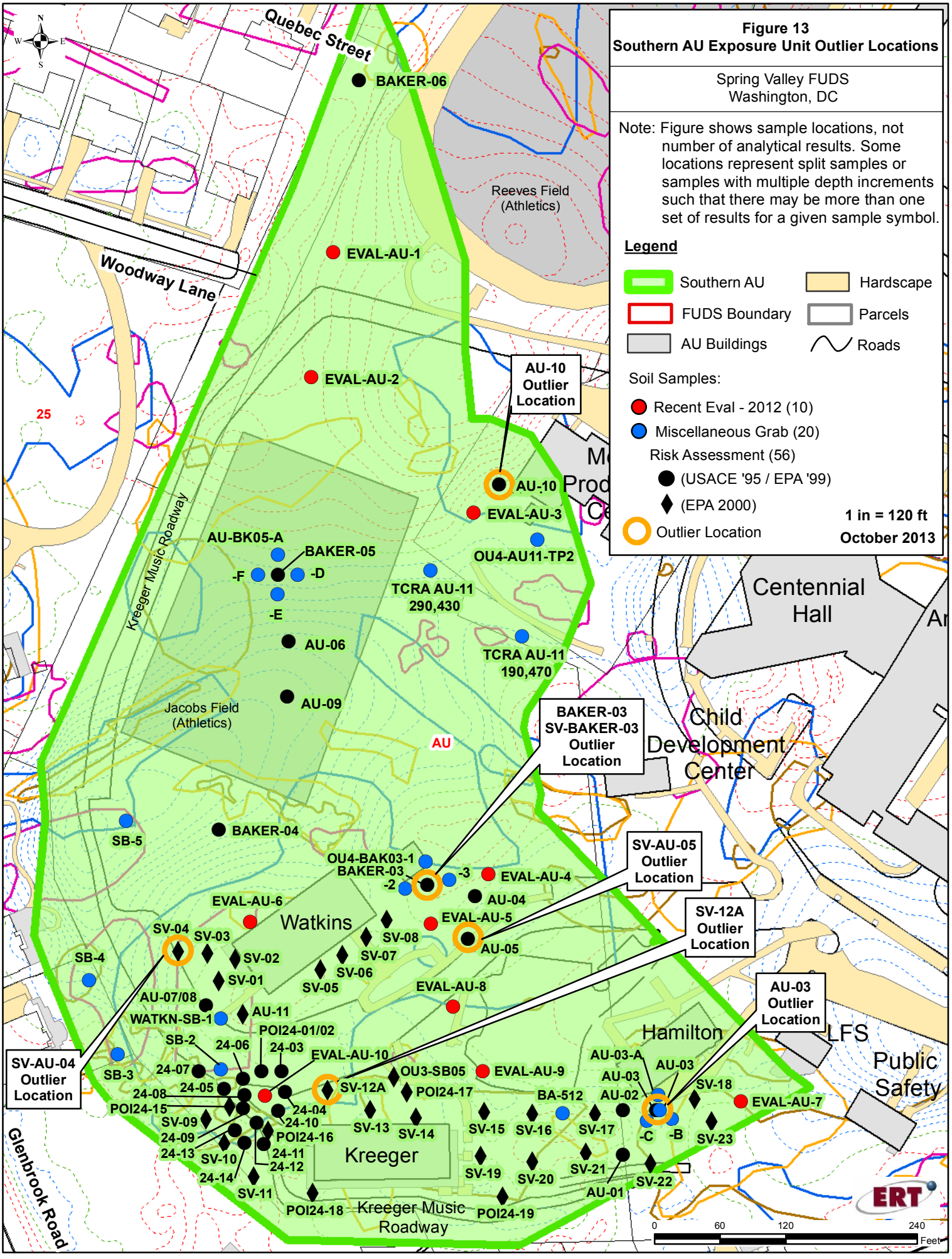


Figure 13
Southern AU Exposure Unit Outlier Locations
Spring Valley FUDS
Washington, DC
Note: Figure shows sample locations, not number of analytical results. Some locations represent split samples or samples with multiple depth increments such that there may be more than one set of results for a given sample symbol.
Legend
Southern AU
FUDS Boundary
AU Buildings
Hardscape
Parcels
Roads
Soil Samples:
Recent Eval - 2012 (10)
Miscellaneous Grab (20)
Risk Assessment (56)
(USACE '95 / EPA '99)
(EPA 2000)
Outlier Location
1 in = 120 ft
October 2013
Quebec Street
Woodway Lane
Reeves Field (Athletics)
Kreeger Music Roadway
Jacobs Field (Athletics)
Centennial Hall
Child Development Center
Watkins
Kreeger
Hamilton
LFS Public Safety
Glenbrook Road
Kreeger Music Roadway
AU-10 Outlier Location
BAKER-03 SV-BAKER-03 Outlier Location
SV-AU-05 Outlier Location
SV-12A Outlier Location
AU-03 Outlier Location
SV-AU-04 Outlier Location
BAKER-06
EVAL-AU-1
EVAL-AU-2
AU-10
EVAL-AU-3
OU4-AU11-TP2
AU-BK05-A
BAKER-05
-F
-D
-E
TCRA AU-11 290,430
TCRA AU-11 190,470
AU-06
AU-09
AU
SB-5
BAKER-04
OU4-BAK03-1
BAKER-03
-2
-3
EVAL-AU-4
AU-04
EVAL-AU-6
EVAL-AU-5
AU-05
SV-04
SV-03
SV-02
SV-01
SV-08
SV-07
SV-06
SV-05
SB-4
EVAL-AU-8
AU-07/08
WATKN-SB-1
AU-11
POI24-01/02
SB-2
24-06
24-03
EVAL-AU-10
SB-3
24-07
24-05
24-08
POI24-15
SV-09
24-09
24-13
SV-10
24-14
SV-11
24-04
24-10
POI24-16
24-11
24-12
POI24-18
SV-12A
OU3-SB05
EVAL-AU-9
POI24-17
SV-13
SV-14
SV-15
SV-16
BA-512
SV-17
SV-19
SV-20
SV-21
AU-01
POI24-19
AU-03-A
AU-03
AU-02
-C
-B
SV-18
EVAL-AU-7
SV-23
SV-22
ERT
0
60
120
240
Feet

AOI 9

Spaulding / Rankin Area

Southern AU

7

1

25

21

22

23

53

AU

0 0.05 0.1 0.2 Miles

N W E S

ERT

Figure 14
Areas Recommended for Human Health Risk Assessment

Spring Valley FUDS
Washington, DC

Legend

- POIs
- AOI 9
- Spaulding-Rankin EU
- Southern AU
- FUDS Boundary
- Parcels
- Roads

1 in = 475 ft
August 2013

APPENDIX C:
SCREENING STEPS PROCEDURE - MEMORANDUM

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APPENDIX C
Screening Procedure Memorandum

Screening of Exposure Units (EUs) for Addendum 1 Follow-on Screen

A. Initial Screen for all Detected Chemicals

Initial Screen: Compare to higher of RSL and Background

1. Compare the maximum detected concentration to the risk-based screening level (RSL) (adjusted down by 10 if based on non-cancer effects) and
2. For inorganics, compare the maximum detected concentrations to the 2008 background concentration

Initial Screen (for Sample Sets with All NDs)

1. Check the Detection Limit (DL). If the DL is greater than the screening level (SL), the analyte is selected as a Provisional COPC (whether DL is greater than or less than background). [Based on the concept that these chemicals with high DLs could exist on a site with concentrations greater than SLs.]

Conclusions of Initial Screen:

If the maximum detected concentration is greater than the higher of the current RSL or the 2008 background, or for data sets with all NDs the DL<SL, it is selected as a Provisional COPC.

B. Additional Screen for Provisional COPCs

Additional Screen Step 1: Calculate Risk Ratio:

1. Assuming sufficient quantity of samples (5 or greater),[1] ProUCL is used to calculate the exposure point concentration (EPC), which is the 95% upper confidence limit (UCL) of the mean.

    - If a data set consists of all ND results, the EPC is assumed to be ½ of the *average* DL.
    - If there is only one detect, the EPC is the detected value.
    - If a data set consists of fewer than 5 samples, the EPC is the maximum detected concentration.
    - If the ProUCL-calculated EPC is greater than the maximum detected value, then the maximum detected value is used as the EPC in the risk ratio.

[1] ProUCL will not compute any decision statistics such as UCLs and UPLs, UTLs for data sets of size less than 5 (without NDs). Moreover, for data sets with NDs of at least 5, no decision statistics will be computed when not more than one detected observation is present in the data set. For small data sets of size less than 5, ProUCL provides warning messages informing the user about the potential deficiencies present in the data set.

2. Calculate Risk Ratio: compare EPCs to the most current RSLs (adjusted down by 10 if based on non-cancer endpoint)[2]

Conclusions of Additional Screen Step 1:
If the risk ratio is less than or equal to one, EPC does not exceed RSL, and that COPC drops out.

If the risk ratio is greater than one, EPC exceeds the RSL, go to next step (statistical comparison to background).

Additional Screen Step 2. Background Comparison: Assuming sufficient quantity of samples (5 or greater),[3] a two-sample hypothesis test comparing site concentrations to background concentrations is done using ProUCL- recommended procedures:[4]

1. For sample sets without NDs (all results are detected values), use the Student's t (pooled test) (assumes equal variances), or the Welch-Satterthwaite (W-S) test (assumes unequal variances), as described below (ProUCL provides both).
   - Use Student's t (pooled test), which assumes equal variances, as long as this assumption is consistent with the Test of Equality of Variances.
   - When variances are found by the Test of Equality of Variances to be unequal, two things could occur:
     - The conclusions of the Student's t test and the W-S test are the same, and this conclusion is listed in the results.
     - The conclusions of the Student's t test and the W-S test are different. Then, if the Test of Equality of Variances shows that the data set has unequal variances, the W-S results are used.
2. For sample sets with any nondetects (either some or all non-detects), use the Wilcoxon-Mann-Whitney (WMW) test (ProUCL enters in the minimum detection limit and the maximum detection limit to do the comparison).
   - For data sets with all NDs and DL>SL, if the result of the statistical comparison to background is site<BG, this means that, even with the elevated detection limits, if this COPC was found on the site at these DL concentrations, the concentrations would be less than background, so the COPC drops out.

[2] Risk ratio defined as EPC/RSL (RSL adjusted down by 10 for non-cancer-based RSLs).
[3] ProUCL recommends a minimum data set of 8 to 10 samples, however, does perform background calculations for sample sets of as low as 5; reduced statistical power is associated with calculations based on the bare minimum number of samples. For locations with <5 samples, the background comparison is not done.
[4] These tests are appropriate for site-versus-background comparisons of the means, and compare: site parameters (e.g., mean, shape, distribution, variability) to background parameters (e.g., mean, shape, distribution, variability). According to ProUCL User's Guide, two-sample hypothesis tests are preferably used for site-versus-background comparisons.

Notes:
In some cases, the listed site mean and maximum concentrations are higher than the background mean and maximums, but the ProUCL tests still conclude that site < BG. This is because the mean, shape, distribution, and variability of the data, as well as the number of non-detects, are taken into account in the ProUCL statistical tests.[5] ProUCL concludes that the differences are consistent with the random variation observed (and expected) in the samples. Therefore the sample results do not constitute "statistically significant evidence of a difference." That is, this 'small' difference is thoroughly consistent with chance variations predicted by statistical theory and therefore it would be invalid to conclude there is any difference in means. In effect, ProUCL concludes that there is insufficient evidence that site is greater than BG.

Conclusions of Additional Screen Step 2:

<u>If ProUCL determines that Site concentrations are less than or equal to background, the COPC drops out.</u>

<u>If ProUCL determines that Site concentrations are greater than background, the COPC is retained.</u>

Excavated and Backfilled Areas:

The sub-steps of re-analyzing data after removing samples that represent excavated soil and then re-analyzing data after the backfill data have been included in the Step 1 and 2 analysis above. For details on those steps (previously Steps 3a and 3b) see Appendix C in the Final Pre-2005 document.

<u>EU Dilution – Outlier Testing</u>

The following approach is used to confirm that the EUs are appropriate with respect to the detected concentrations and that the identified EUs do not dilute higher concentrations over a too large area. (areas of higher concentrations within an EU may be considered outliers or hot spots).

This procedure is be to applied to an EU that consists of multiple individual properties. Individual residences are assumed to constitute an EU as it is impractical to further subdivide a property (yard) into multiple EUs.

[5] For the WMW test, the ProUCL Technical Guide states: "The WMW test does not place enough weight on the larger site and background measurements. This means, a WMW may lead to the conclusion that two populations are comparable even when the observations in the right tail of one distribution (e.g., site) are significantly larger than the right tail observations of other population (e.g., background)." For the t test, this may occur because the test is not robust to outliers because sample means and standard deviations are sensitive to outliers.

For an EU comprising multiple properties, check for outliers as follows:

1. Identify provisional COPCs (max > higher of RSL or BG) in that EU.
2. Check max for each COPC against the average of the rest of the sample points in the EU. Example: AOI-9 EU has 60 samples. Compare max aluminum concentration to the average of the other 59 aluminum data points.
    - If max is less than 10 times the average, it is not an outlier--proceed to next screening step
    - If max is more than 10 or more times the average, then aluminum in the max sample is an outlier. Then, the procedure must be repeated for the next highest aluminum data point, etc.—iterative process to identify outliers.
3. Remove the max aluminum sample from the data set and call this **Location A** (defined by that single sample). Continue the COPC screen for the AOI-9 EU with only 59 samples.
4. If another COPC (e.g., barium) is shown to be an outlier, remove the max barium sample from the data set and call this **Location B**; AOI-9 EU now only has 58 samples for the screen, and so on.
5. At the end of the screening step, COPCs are identified for AOI-9 EU and the additional separate locations of the outliers. For example, aluminum might be the only COPC at Location A and barium might be the only COPC at Location B.

Addressing the outliers

At the Follow-on screening stage, assess the outliers using the screening process above. If COPCs posing potential risk result, then the outlier area or location moves to the full Risk Assessment stage and the details will be provided for that particular HHRA.

APPENDIX D:
ProUCL STATISTICAL TESTING OUTPUT
(provided on CD only)

Note:
Output is organized by 'A' tables in Appendix A.

- 95%UCLs from Step 1 of the 'A' tables presented first
- Background testing from Step 2 of the 'A' tables presented next

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	General UCL Statistics for Full Data Sets
User Selected Options	
From File	ProUCL upload.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

BEGIN TABLE A.2

Mercury 4900 Quebec

General Statistics

Number of Valid Observations	13	Number of Distinct Observations	13

Raw Statistics		**Log-transformed Statistics**	
Minimum	0.0062	Minimum of Log Data	-5.083
Maximum	2.61	Maximum of Log Data	0.959
Mean	0.721	Mean of log Data	-1.129
Geometric Mean	0.323	SD of log Data	1.868
Median	0.66		
SD	0.687		
Std. Error of Mean	0.191		
Coefficient of Variation	0.954		
Skewness	1.761		

Relevant UCL Statistics

Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0.835	Shapiro Wilk Test Statistic	0.786
Shapiro Wilk Critical Value	0.866	Shapiro Wilk Critical Value	0.866
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	1.06	95% H-UCL	20.75
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	4.902
95% Adjusted-CLT UCL (Chen-1995)	1.134	97.5% Chebyshev (MVUE) UCL	6.419
95% Modified-t UCL (Johnson-1978)	1.076	99% Chebyshev (MVUE) UCL	9.398
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	0.626	Data appear Gamma Distributed at 5% Significance Level	
Theta Star	1.151		
MLE of Mean	0.721		
MLE of Standard Deviation	0.911		
nu star	16.28		
Approximate Chi Square Value (.05)	8.164	**Nonparametric Statistics**	
Adjusted Level of Significance	0.0301	95% CLT UCL	1.034
Adjusted Chi Square Value	7.358	95% Jackknife UCL	1.06
		95% Standard Bootstrap UCL	1.023
Anderson-Darling Test Statistic	0.61	95% Bootstrap-t UCL	1.195
Anderson-Darling 5% Critical Value	0.771	95% Hall's Bootstrap UCL	2.518
Kolmogorov-Smirnov Test Statistic	0.173	95% Percentile Bootstrap UCL	1.03
Kolmogorov-Smirnov 5% Critical Value	0.246	95% BCA Bootstrap UCL	1.103
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	1.552
		97.5% Chebyshev(Mean, Sd) UCL	1.911
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	2.617
95% Approximate Gamma UCL (Use when n >= 40)	1.438		
95% Adjusted Gamma UCL (Use when n < 40)	1.595		
Potential UCL to Use		Use 95% Approximate Gamma UCL 1.44	

	General UCL Statistics for Full Data Sets
User Selected Options	**BEGIN TABLE A.5**
From File	ProUCL upload.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Aluminum POI39

General Statistics

Number of Valid Observations	14	Number of Distinct Observations	14

Raw Statistics		**Log-transformed Statistics**	
Minimum	14400	Minimum of Log Data	9.575
Maximum	28400	Maximum of Log Data	10.25
Mean	22393	Mean of log Data	9.998
Geometric Mean	21976	SD of log Data	0.206
Median	22500		
SD	4319		
Std. Error of Mean	1154		
Coefficient of Variation	0.193		
Skewness	-0.412		

Relevant UCL Statistics

Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0.951	Shapiro Wilk Test Statistic	0.929
Shapiro Wilk Critical Value	0.874	Shapiro Wilk Critical Value	0.874
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	24437	95% H-UCL	24909
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	27818
95% Adjusted-CLT UCL (Chen-1995)	24156	97.5% Chebyshev (MVUE) UCL	30157
95% Modified-t UCL (Johnson-1978)	24416	99% Chebyshev (MVUE) UCL	34752
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	21.06	Data appear Normal at 5% Significance Level	
Theta Star	1063		
MLE of Mean	22393		
MLE of Standard Deviation	4879		
nu star	589.8		
Approximate Chi Square Value (.05)	534.4	**Nonparametric Statistics**	
Adjusted Level of Significance	0.0312	95% CLT UCL	24292
Adjusted Chi Square Value	527.5	95% Jackknife UCL	24437
		95% Standard Bootstrap UCL	24254
Anderson-Darling Test Statistic	0.355	95% Bootstrap-t UCL	24259
Anderson-Darling 5% Critical Value	0.734	95% Hall's Bootstrap UCL	24037
Kolmogorov-Smirnov Test Statistic	0.169	95% Percentile Bootstrap UCL	24186
Kolmogorov-Smirnov 5% Critical Value	0.228	95% BCA Bootstrap UCL	24100
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	27424
		97.5% Chebyshev(Mean, Sd) UCL	29602
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	33878
95% Approximate Gamma UCL (Use when n >= 40)	24711		
95% Adjusted Gamma UCL (Use when n < 40)	25039		
Potential UCL to Use		**Use 95% Student's-t UCL 24437**	

	General UCL Statistics for Data Sets with Non-Detects
From File	ProUCL upload.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Antimony POI39

General Statistics

Number of Valid Data	14	Number of Detected Data	3
Number of Distinct Detected Data	3	Number of Non-Detect Data	11
		Percent Non-Detects	78.57%
Raw Statistics		**Log-transformed Statistics**	
Minimum Detected	11.2	Minimum Detected	2.416
Maximum Detected	13.5	Maximum Detected	2.603
Mean of Detected	12.17	Mean of Detected	2.496
SD of Detected	1.193	SD of Detected	0.0964
Minimum Non-Detect	2.1	Minimum Non-Detect	0.742
Maximum Non-Detect	11.5	Maximum Non-Detect	2.442
Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	12
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	2
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	85.71%

UCL Statistics

Normal Distribution Test with Detected Values Only		**Lognormal Distribution Test with Detected Values Only**	
Shapiro Wilk Test Statistic	0.929	Shapiro Wilk Test Statistic	0.939
5% Shapiro Wilk Critical Value	0.767	5% Shapiro Wilk Critical Value	0.767
Data appear Normal at 5% Significance Level		**Data appear Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	6.5	Mean	1.735
SD	3.316	SD	0.599
95% DL/2 (t) UCL	8.07	95% H-Stat (DL/2) UCL	9.772
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	2.195
		SD in Log Scale	0.174
		Mean in Original Scale	9.113
		SD in Original Scale	1.764
		95% t UCL	9.947
		95% Percentile Bootstrap UCL	9.875
		95% BCA Bootstrap UCL	10.1
		95% H-UCL	9.94
Gamma Distribution Test with Detected Values Only		**Data Distribution Test with Detected Values Only**	
k star (bias corrected)	N/A	**Data appear Normal at 5% Significance Level**	
Theta Star	N/A		
nu star	N/A		
A-D Test Statistic	N/A	**Nonparametric Statistics**	
5% A-D Critical Value	N/A	Kaplan-Meier (KM) Method	
K-S Test Statistic	N/A	Mean	11.41
5% K-S Critical Value	N/A	SD	0.601
Data not Gamma Distributed at 5% Significance Level		SE of Mean	0.197
		95% KM (t) UCL	11.76
Assuming Gamma Distribution		95% KM (z) UCL	11.73
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	11.85
Minimum	N/A	95% KM (bootstrap t) UCL	11.8
Maximum	N/A	95% KM (BCA) UCL	13.5
Mean	N/A	95% KM (Percentile Bootstrap) UCL	13.5
Median	N/A	95% KM (Chebyshev) UCL	12.26
SD	N/A	97.5% KM (Chebyshev) UCL	12.63
k star	N/A	99% KM (Chebyshev) UCL	13.36
Theta star	N/A		
Nu star	N/A	**Potential UCLs to Use**	
AppChi2	N/A	**95% KM (t) UCL**	**11.8**
95% Gamma Approximate UCL (Use when n >= 40)	N/A	95% KM (Percentile Bootstrap) UCL	13.5
95% Adjusted Gamma UCL (Use when n < 40)	N/A		

	General UCL Statistics for Full Data Sets		
User Selected Options			
From File	ProUCL upload.wst		
Full Precision	OFF		
Confidence Coefficient	95%		
Number of Bootstrap Operations	2000		
Manganese POI39			
General Statistics			
Number of Valid Observations	13	Number of Distinct Observations	12
Number of Missing Values	1		
Raw Statistics		**Log-transformed Statistics**	
Minimum	233	Minimum of Log Data	5.451
Maximum	2580	Maximum of Log Data	7.856
Mean	845.5	Mean of log Data	6.539
Geometric Mean	691.8	SD of log Data	0.625
Median	551		
SD	649.7		
Std. Error of Mean	180.2		
Coefficient of Variation	0.768		
Skewness	2.025		
Relevant UCL Statistics			
Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0.741	Shapiro Wilk Test Statistic	0.932
Shapiro Wilk Critical Value	0.866	Shapiro Wilk Critical Value	0.866
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	1167	95% H-UCL	1266
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	1475
95% Adjusted-CLT UCL (Chen-1995)	1250	97.5% Chebyshev (MVUE) UCL	1755
95% Modified-t UCL (Johnson-1978)	1183	99% Chebyshev (MVUE) UCL	2306
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	2.087	Data Follow Appr. Gamma Distribution at 5% Significance Level	
Theta Star	405.1		
MLE of Mean	845.5		
MLE of Standard Deviation	585.2		
nu star	54.27		
Approximate Chi Square Value (.05)	38.34	**Nonparametric Statistics**	
Adjusted Level of Significance	0.0301	95% CLT UCL	1142
Adjusted Chi Square Value	36.44	95% Jackknife UCL	1167
		95% Standard Bootstrap UCL	1134
Anderson-Darling Test Statistic	0.759	95% Bootstrap-t UCL	1649
Anderson-Darling 5% Critical Value	0.741	95% Hall's Bootstrap UCL	2773
Kolmogorov-Smirnov Test Statistic	0.208	95% Percentile Bootstrap UCL	1147
Kolmogorov-Smirnov 5% Critical Value	0.239	95% BCA Bootstrap UCL	1251
Data follow Appr. Gamma Distribution at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	1631
		97.5% Chebyshev(Mean, Sd) UCL	1971
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	2638
95% Approximate Gamma UCL (Use when n >= 40)	1197		
95% Adjusted Gamma UCL (Use when n < 40)	1259		
Potential UCL to Use		**Use 95% Approximate Gamma UCL 1197**	

	General UCL Statistics for Full Data Sets			
User Selected Options				BEGIN TABLE A.8
From File	ProUCL Upload.wst			
Full Precision	OFF			
Confidence Coefficient	95%			
Number of Bootstrap Operations	2000			
Aluminum AOI 11				
General Statistics				
Number of Valid Observations	6		Number of Distinct Observations	6
Raw Statistics			Log-transformed Statistics	
Minimum	16300		Minimum of Log Data	9.699
Maximum	21000		Maximum of Log Data	9.952
Mean	18167		Mean of log Data	9.804
Geometric Mean	18112		SD of log Data	0.0842
Median	17850			
SD	1574			
Std. Error of Mean	642.7			
Coefficient of Variation	0.0867			
Skewness	1.215			
Relevant UCL Statistics				
Normal Distribution Test			Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.904		Shapiro Wilk Test Statistic	0.924
Shapiro Wilk Critical Value	0.788		Shapiro Wilk Critical Value	0.788
Data appear Normal at 5% Significance Level			Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution			Assuming Lognormal Distribution	
95% Student's-t UCL	19462		95% H-UCL	N/A
95% UCLs (Adjusted for Skewness)			95% Chebyshev (MVUE) UCL	20888
95% Adjusted-CLT UCL (Chen-1995)	19564		97.5% Chebyshev (MVUE) UCL	22066
95% Modified-t UCL (Johnson-1978)	19515		99% Chebyshev (MVUE) UCL	24379
Gamma Distribution Test			Data Distribution	
k star (bias corrected)	83.25		Data appear Normal at 5% Significance Level	
Theta Star	218.2			
MLE of Mean	18167			
MLE of Standard Deviation	1991			
nu star	999			
Approximate Chi Square Value (.05)	926.6		Nonparametric Statistics	
Adjusted Level of Significance	0.0122		95% CLT UCL	19224
Adjusted Chi Square Value	901.1		95% Jackknife UCL	19462
			95% Standard Bootstrap UCL	19133
Anderson-Darling Test Statistic	0.371		95% Bootstrap-t UCL	20119
Anderson-Darling 5% Critical Value	0.696		95% Hall's Bootstrap UCL	25881
Kolmogorov-Smirnov Test Statistic	0.23		95% Percentile Bootstrap UCL	19117
Kolmogorov-Smirnov 5% Critical Value	0.332		95% BCA Bootstrap UCL	19433
Data appear Gamma Distributed at 5% Significance Level			95% Chebyshev(Mean, Sd) UCL	20968
			97.5% Chebyshev(Mean, Sd) UCL	22181
Assuming Gamma Distribution			99% Chebyshev(Mean, Sd) UCL	24562
95% Approximate Gamma UCL (Use when n >= 40)	19585			
95% Adjusted Gamma UCL (Use when n < 40)	20140			
Potential UCL to Use			Use 95% Student's-t UCL 19462	

	General UCL Statistics for Full Data Sets
User Selected Options	
From File	ProUCL Upload.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Magnesium AOI 11

General Statistics

Number of Valid Observations	6	Number of Distinct Observations	6

Raw Statistics		**Log-transformed Statistics**	
Minimum	5350	Minimum of Log Data	8.585
Maximum	7060	Maximum of Log Data	8.862
Mean	5848	Mean of log Data	8.67
Geometric Mean	5823	SD of log Data	0.0996
Median	5690		
SD	619.6		
Std. Error of Mean	252.9		
Coefficient of Variation	0.106		
Skewness	2.003		

Relevant UCL Statistics

Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0.765	Shapiro Wilk Test Statistic	0.792
Shapiro Wilk Critical Value	0.788	Shapiro Wilk Critical Value	0.788
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	6358	95% H-UCL	N/A
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	6883
95% Adjusted-CLT UCL (Chen-1995)	6485	97.5% Chebyshev (MVUE) UCL	7331
95% Modified-t UCL (Johnson-1978)	6392	99% Chebyshev (MVUE) UCL	8212
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	58.27	Data Follow Appr. Gamma Distribution at 5% Significance Level	
Theta Star	100.4		
MLE of Mean	5848		
MLE of Standard Deviation	766.1		
nu star	699.3		
Approximate Chi Square Value (.05)	638.9	**Nonparametric Statistics**	
Adjusted Level of Significance	0.0122	95% CLT UCL	6264
Adjusted Chi Square Value	617.9	95% Jackknife UCL	6358
		95% Standard Bootstrap UCL	6221
Anderson-Darling Test Statistic	0.696	95% Bootstrap-t UCL	7058
Anderson-Darling 5% Critical Value	0.696	95% Hall's Bootstrap UCL	8146
Kolmogorov-Smirnov Test Statistic	0.327	95% Percentile Bootstrap UCL	6267
Kolmogorov-Smirnov 5% Critical Value	0.332	95% BCA Bootstrap UCL	6367
Data follow Appr. Gamma Distribution at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	6951
		97.5% Chebyshev(Mean, Sd) UCL	7428
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	8365
95% Approximate Gamma UCL (Use when n >= 40)	6401		
95% Adjusted Gamma UCL (Use when n < 40)	6619		
Potential UCL to Use		Use 95% Approximate Gamma UCL 6401	

	General UCL Statistics for Full Data Sets			
User Selected Options			BEGIN TABLE A.9	
From File	ProUCL Upload.wst			
Full Precision	OFF			
Confidence Coefficient	95%			
Number of Bootstrap Operations	2000			
Aluminum AOI 9				
General Statistics				
Number of Valid Observations	48		Number of Distinct Observations	44
Raw Statistics			Log-transformed Statistics	
Minimum	4007		Minimum of Log Data	8.296
Maximum	51900		Maximum of Log Data	10.86
Mean	18842		Mean of log Data	9.732
Geometric Mean	16842		SD of log Data	0.496
Median	18550			
SD	9152			
Std. Error of Mean	1321			
Coefficient of Variation	0.486			
Skewness	1.377			
Relevant UCL Statistics				
Normal Distribution Test			Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.902		Shapiro Wilk Test Statistic	0.949
Shapiro Wilk Critical Value	0.947		Shapiro Wilk Critical Value	0.947
Data not Normal at 5% Significance Level			Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution			Assuming Lognormal Distribution	
95% Student's-t UCL	21059		95% H-UCL	21821
95% UCLs (Adjusted for Skewness)			95% Chebyshev (MVUE) UCL	25200
95% Adjusted-CLT UCL (Chen-1995)	21296		97.5% Chebyshev (MVUE) UCL	27887
95% Modified-t UCL (Johnson-1978)	21103		99% Chebyshev (MVUE) UCL	33167
Gamma Distribution Test			Data Distribution	
k star (bias corrected)	4.34		Data appear Gamma Distributed at 5% Significance Level	
Theta Star	4341			
MLE of Mean	18842			
MLE of Standard Deviation	9044			
nu star	416.7			
Approximate Chi Square Value (.05)	370.3		Nonparametric Statistics	
Adjusted Level of Significance	0.045		95% CLT UCL	21015
Adjusted Chi Square Value	369		95% Jackknife UCL	21059
			95% Standard Bootstrap UCL	20996
Anderson-Darling Test Statistic	0.577		95% Bootstrap-t UCL	21531
Anderson-Darling 5% Critical Value	0.753		95% Hall's Bootstrap UCL	21484
Kolmogorov-Smirnov Test Statistic	0.102		95% Percentile Bootstrap UCL	21003
Kolmogorov-Smirnov 5% Critical Value	0.128		95% BCA Bootstrap UCL	21290
Data appear Gamma Distributed at 5% Significance Level			95% Chebyshev(Mean, Sd) UCL	24600
			97.5% Chebyshev(Mean, Sd) UCL	27092
Assuming Gamma Distribution			99% Chebyshev(Mean, Sd) UCL	31986
95% Approximate Gamma UCL (Use when n >= 40)	21199			
95% Adjusted Gamma UCL (Use when n < 40)	21276			
Potential UCL to Use			Use 95% Approximate Gamma UCL 21199	

	General UCL Statistics for Data Sets with Non-Detects
From File	ProUCL upload.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Antimony AOI 9

General Statistics

Number of Valid Data	58	Number of Detected Data	19
Number of Distinct Detected Data	19	Number of Non-Detect Data	39
		Percent Non-Detects	67.24%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	0.194	Minimum Detected	-1.64
Maximum Detected	44.2	Maximum Detected	3.789
Mean of Detected	13.06	Mean of Detected	1.616
SD of Detected	12.69	SD of Detected	1.874
Minimum Non-Detect	0.23	Minimum Non-Detect	-1.47
Maximum Non-Detect	10.9	Maximum Non-Detect	2.389
Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	49
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	9
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	84.48%

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.883	Shapiro Wilk Test Statistic	0.826
5% Shapiro Wilk Critical Value	0.901	5% Shapiro Wilk Critical Value	0.901
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	5.795	Mean	0.789
SD	8.918	SD	1.451
95% DL/2 (t) UCL	7.753	95% H-Stat (DL/2) UCL	11.38
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE yields a negative mean		Mean in Log Scale	-0.0812
		SD in Log Scale	1.702
		Mean in Original Scale	4.621
		SD in Original Scale	9.287
		95% t UCL	6.66
		95% Percentile Bootstrap UCL	6.797
		95% BCA Bootstrap UCL	7.121
		95% H-UCL	8.436
Gamma Distribution Test with Detected Values Only		**Data Distribution Test with Detected Values Only**	
k star (bias corrected)	0.575	Data do not follow a Discernable Distribution (0.05)	
Theta Star	22.71		
nu star	21.86		
A-D Test Statistic	0.862	**Nonparametric Statistics**	
5% A-D Critical Value	0.789	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.789	Mean	4.627
5% K-S Critical Value	0.208	SD	9.26
Data not Gamma Distributed at 5% Significance Level		SE of Mean	1.259
		95% KM (t) UCL	6.733
Assuming Gamma Distribution		95% KM (z) UCL	6.699
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	6.686
Minimum	0.000001	95% KM (bootstrap t) UCL	7.273
Maximum	44.2	95% KM (BCA) UCL	6.942
Mean	4.586	95% KM (Percentile Bootstrap) UCL	6.753
Median	0.000001	95% KM (Chebyshev) UCL	10.12
SD	9.355	97.5% KM (Chebyshev) UCL	12.49
k star	0.1	99% KM (Chebyshev) UCL	17.16
Theta star	45.81		
Nu star	11.61	Potential UCLs to Use	
AppChi2	4.974	95% KM (Chebyshev) UCL	10.12
95% Gamma Approximate UCL (Use when n >= 40)	10.71		
95% Adjusted Gamma UCL (Use when n < 40)	10.95		

	General UCL Statistics for Full Data Sets
User Selected Options	
From File	ProUCL Upload.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Cobalt AOI 9

General Statistics

Number of Valid Observations	24	Number of Distinct Observations	23

Raw Statistics		**Log-transformed Statistics**	
Minimum	4.33	Minimum of Log Data	1.466
Maximum	69.2	Maximum of Log Data	4.237
Mean	22.52	Mean of log Data	2.946
Geometric Mean	19.03	SD of log Data	0.619
Median	19.35		
SD	13.95		
Std. Error of Mean	2.847		
Coefficient of Variation	0.619		
Skewness	1.87		

Relevant UCL Statistics

Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0.829	Shapiro Wilk Test Statistic	0.917
Shapiro Wilk Critical Value	0.916	Shapiro Wilk Critical Value	0.916
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	27.4	95% H-UCL	30.2
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	36.17
95% Adjusted-CLT UCL (Chen-1995)	28.37	97.5% Chebyshev (MVUE) UCL	41.94
95% Modified-t UCL (Johnson-1978)	27.58	99% Chebyshev (MVUE) UCL	53.28
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	2.757	Data appear Gamma Distributed at 5% Significance Level	
Theta Star	8.17		
MLE of Mean	22.52		
MLE of Standard Deviation	13.57		
nu star	132.3		
Approximate Chi Square Value (.05)	106.8	**Nonparametric Statistics**	
Adjusted Level of Significance	0.0392	95% CLT UCL	27.21
Adjusted Chi Square Value	105.1	95% Jackknife UCL	27.4
		95% Standard Bootstrap UCL	27.06
Anderson-Darling Test Statistic	0.663	95% Bootstrap-t UCL	29.51
Anderson-Darling 5% Critical Value	0.751	95% Hall's Bootstrap UCL	32.82
Kolmogorov-Smirnov Test Statistic	0.17	95% Percentile Bootstrap UCL	27.29
Kolmogorov-Smirnov 5% Critical Value	0.179	95% BCA Bootstrap UCL	28.3
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	34.93
		97.5% Chebyshev(Mean, Sd) UCL	40.3
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	50.85
95% Approximate Gamma UCL (Use when n >= 40)	27.92		
95% Adjusted Gamma UCL (Use when n < 40)	28.35		
Potential UCL to Use		**Use 95% Approximate Gamma UCL 27.92**	

	General UCL Statistics for Full Data Sets
User Selected Options	
From File	ProUCL Upload.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Magnesium AOI 9

General Statistics

Number of Valid Observations	9	Number of Distinct Observations	8

Raw Statistics		**Log-transformed Statistics**	
Minimum	534.5	Minimum of Log Data	6.281
Maximum	7490	Maximum of Log Data	8.921
Mean	4888	Mean of log Data	8.162
Geometric Mean	3507	SD of log Data	1.084
Median	5020		
SD	2727		
Std. Error of Mean	908.9		
Coefficient of Variation	0.558		
Skewness	-0.893		

Relevant UCL Statistics

Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0.834	Shapiro Wilk Test Statistic	0.682
Shapiro Wilk Critical Value	0.829	Shapiro Wilk Critical Value	0.829
Data appear Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	6578	95% H-UCL	23492
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	15200
95% Adjusted-CLT UCL (Chen-1995)	6094	97.5% Chebyshev (MVUE) UCL	19280
95% Modified-t UCL (Johnson-1978)	6533	99% Chebyshev (MVUE) UCL	27295
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	1.176	Data appear Normal at 5% Significance Level	
Theta Star	4156		
MLE of Mean	4888		
MLE of Standard Deviation	4507		
nu star	21.17		
Approximate Chi Square Value (.05)	11.72	**Nonparametric Statistics**	
Adjusted Level of Significance	0.0231	95% CLT UCL	6383
Adjusted Chi Square Value	10.26	95% Jackknife UCL	6578
		95% Standard Bootstrap UCL	6316
Anderson-Darling Test Statistic	1.193	95% Bootstrap-t UCL	6321
Anderson-Darling 5% Critical Value	0.733	95% Hall's Bootstrap UCL	6101
Kolmogorov-Smirnov Test Statistic	0.328	95% Percentile Bootstrap UCL	6269
Kolmogorov-Smirnov 5% Critical Value	0.284	95% BCA Bootstrap UCL	6156
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	8850
		97.5% Chebyshev(Mean, Sd) UCL	10564
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	13931
95% Approximate Gamma UCL (Use when n >= 40)	8830		
95% Adjusted Gamma UCL (Use when n < 40)	10079		
Potential UCL to Use		**Use 95% Student's-t UCL 6578**	

	General UCL Statistics for Full Data Sets		
User Selected Options			
From File	ProUCL Upload.wst		
Full Precision	OFF		
Confidence Coefficient	95%		
Number of Bootstrap Operations	2000		
Manganese AOI 9			
General Statistics			
Number of Valid Observations	48	Number of Distinct Observations	46
Raw Statistics		**Log-transformed Statistics**	
Minimum	89	Minimum of Log Data	4.489
Maximum	2040	Maximum of Log Data	7.621
Mean	593.3	Mean of log Data	6.242
Geometric Mean	513.8	SD of log Data	0.569
Median	514		
SD	338.2		
Std. Error of Mean	48.82		
Coefficient of Variation	0.57		
Skewness	2.089		
Relevant UCL Statistics			
Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0.835	Shapiro Wilk Test Statistic	0.921
Shapiro Wilk Critical Value	0.947	Shapiro Wilk Critical Value	0.947
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	675.2	95% H-UCL	709.6
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	831.1
95% Adjusted-CLT UCL (Chen-1995)	689.4	97.5% Chebyshev (MVUE) UCL	930.3
95% Modified-t UCL (Johnson-1978)	677.7	99% Chebyshev (MVUE) UCL	1125
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	3.418	Data Follow Appr. Gamma Distribution at 5% Significance Level	
Theta Star	173.6		
MLE of Mean	593.3		
MLE of Standard Deviation	320.9		
nu star	328.1		
Approximate Chi Square Value (.05)	287.2	**Nonparametric Statistics**	
Adjusted Level of Significance	0.045	95% CLT UCL	673.6
Adjusted Chi Square Value	286	95% Jackknife UCL	675.2
		95% Standard Bootstrap UCL	672.8
Anderson-Darling Test Statistic	0.987	95% Bootstrap-t UCL	694.3
Anderson-Darling 5% Critical Value	0.754	95% Hall's Bootstrap UCL	722.4
Kolmogorov-Smirnov Test Statistic	0.128	95% Percentile Bootstrap UCL	676.6
Kolmogorov-Smirnov 5% Critical Value	0.129	95% BCA Bootstrap UCL	693.5
Data follow Appr. Gamma Distribution at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	806.1
		97.5% Chebyshev(Mean, Sd) UCL	898.2
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	1079
95% Approximate Gamma UCL (Use when n >= 40)	678		
95% Adjusted Gamma UCL (Use when n < 40)	680.8		
Potential UCL to Use		**Use 95% Approximate Gamma UCL 678**	

	General UCL Statistics for Full Data Sets		
User Selected Options			
From File	ProUCL Upload.wst		
Full Precision	OFF		
Confidence Coefficient	95%		
Number of Bootstrap Operations	2000		
Vanadium AOI 9			
General Statistics			
Number of Valid Observations	56	Number of Distinct Observations	53
Raw Statistics		**Log-transformed Statistics**	
Minimum	0.66	Minimum of Log Data	-0.416
Maximum	307	Maximum of Log Data	5.727
Mean	43.82	Mean of log Data	3.428
Geometric Mean	30.81	SD of log Data	0.948
Median	29.1		
SD	48.51		
Std. Error of Mean	6.483		
Coefficient of Variation	1.107		
Skewness	3.836		
Relevant UCL Statistics			
Normal Distribution Test		**Lognormal Distribution Test**	
Lilliefors Test Statistic	0.305	Lilliefors Test Statistic	0.267
Lilliefors Critical Value	0.118	Lilliefors Critical Value	0.118
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	54.67	95% H-UCL	64.57
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	78.48
95% Adjusted-CLT UCL (Chen-1995)	58.04	97.5% Chebyshev (MVUE) UCL	91.77
95% Modified-t UCL (Johnson-1978)	55.22	99% Chebyshev (MVUE) UCL	117.9
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	1.493	Data do not follow a Discernable Distribution (0.05)	
Theta Star	29.36		
MLE of Mean	43.82		
MLE of Standard Deviation	35.87		
nu star	167.2		
Approximate Chi Square Value (.05)	138.3	**Nonparametric Statistics**	
Adjusted Level of Significance	0.0457	95% CLT UCL	54.49
Adjusted Chi Square Value	137.6	95% Jackknife UCL	54.67
		95% Standard Bootstrap UCL	54.26
Anderson-Darling Test Statistic	3.956	95% Bootstrap-t UCL	63.52
Anderson-Darling 5% Critical Value	0.768	95% Hall's Bootstrap UCL	68.11
Kolmogorov-Smirnov Test Statistic	0.222	95% Percentile Bootstrap UCL	55.54
Kolmogorov-Smirnov 5% Critical Value	0.121	95% BCA Bootstrap UCL	58.35
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	72.08
		97.5% Chebyshev(Mean, Sd) UCL	84.31
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	108.3
95% Approximate Gamma UCL (Use when n >= 40)	52.98		
95% Adjusted Gamma UCL (Use when n < 40)	53.25		
Potential UCL to Use		**Use 95% Chebyshev (Mean, Sd) UCL**	**72.08**

	General UCL Statistics for Full Data Sets			
User Selected Options				BEGIN TABLE A.10
From File	ProUCL upload.wst			
Full Precision	OFF			
Confidence Coefficient	95%			
Number of Bootstrap Operations	2000			
Aluminum AOI 13				
General Statistics				
Number of Valid Observations	15		Number of Distinct Observations	14
Raw Statistics			Log-transformed Statistics	
Minimum	9260		Minimum of Log Data	9.133
Maximum	29700		Maximum of Log Data	10.3
Mean	17857		Mean of log Data	9.736
Geometric Mean	16910		SD of log Data	0.343
Median	16450			
SD	6112			
Std. Error of Mean	1578			
Coefficient of Variation	0.342			
Skewness	0.554			
Relevant UCL Statistics				
Normal Distribution Test			Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.949		Shapiro Wilk Test Statistic	0.976
Shapiro Wilk Critical Value	0.881		Shapiro Wilk Critical Value	0.881
Data appear Normal at 5% Significance Level			Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution			Assuming Lognormal Distribution	
95% Student's-t UCL	20637		95% H-UCL	21384
95% UCLs (Adjusted for Skewness)			95% Chebyshev (MVUE) UCL	24863
95% Adjusted-CLT UCL (Chen-1995)	20694		97.5% Chebyshev (MVUE) UCL	27892
95% Modified-t UCL (Johnson-1978)	20675		99% Chebyshev (MVUE) UCL	33842
Gamma Distribution Test			Data Distribution	
k star (bias corrected)	7.511		Data appear Normal at 5% Significance Level	
Theta Star	2377			
MLE of Mean	17857			
MLE of Standard Deviation	6516			
nu star	225.3			
Approximate Chi Square Value (.05)	191.6		Nonparametric Statistics	
Adjusted Level of Significance	0.0324		95% CLT UCL	20453
Adjusted Chi Square Value	187.8		95% Jackknife UCL	20637
			95% Standard Bootstrap UCL	20340
Anderson-Darling Test Statistic	0.215		95% Bootstrap-t UCL	20806
Anderson-Darling 5% Critical Value	0.738		95% Hall's Bootstrap UCL	20720
Kolmogorov-Smirnov Test Statistic	0.113		95% Percentile Bootstrap UCL	20510
Kolmogorov-Smirnov 5% Critical Value	0.222		95% BCA Bootstrap UCL	20600
Data appear Gamma Distributed at 5% Significance Level			95% Chebyshev(Mean, Sd) UCL	24736
			97.5% Chebyshev(Mean, Sd) UCL	27713
Assuming Gamma Distribution			99% Chebyshev(Mean, Sd) UCL	33559
95% Approximate Gamma UCL (Use when n >= 40)	21003			
95% Adjusted Gamma UCL (Use when n < 40)	21431			
Potential UCL to Use			Use 95% Student's-t UCL 20637	

	General UCL Statistics for Full Data Sets
User Selected Options	
From File	ProUCL upload.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Cobalt AOI 13

General Statistics

Number of Valid Observations	15	Number of Distinct Observations	14

Raw Statistics		**Log-transformed Statistics**	
Minimum	0.66	Minimum of Log Data	-0.416
Maximum	30.7	Maximum of Log Data	3.424
Mean	17.43	Mean of log Data	2.5
Geometric Mean	12.18	SD of log Data	1.222
Median	17.1		
SD	8.995		
Std. Error of Mean	2.323		
Coefficient of Variation	0.516		
Skewness	-0.528		

Relevant UCL Statistics

Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0.945	Shapiro Wilk Test Statistic	0.646
Shapiro Wilk Critical Value	0.881	Shapiro Wilk Critical Value	0.881
Data appear Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	21.53	95% H-UCL	71.03
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	60.35
95% Adjusted-CLT UCL (Chen-1995)	20.92	97.5% Chebyshev (MVUE) UCL	76.18
95% Modified-t UCL (Johnson-1978)	21.47	99% Chebyshev (MVUE) UCL	107.3
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	1.276	Data appear Normal at 5% Significance Level	
Theta Star	13.66		
MLE of Mean	17.43		
MLE of Standard Deviation	15.43		
nu star	38.28		
Approximate Chi Square Value (.05)	25.11	**Nonparametric Statistics**	
Adjusted Level of Significance	0.0324	95% CLT UCL	21.25
Adjusted Chi Square Value	23.8	95% Jackknife UCL	21.53
		95% Standard Bootstrap UCL	21.16
Anderson-Darling Test Statistic	1.586	95% Bootstrap-t UCL	21.15
Anderson-Darling 5% Critical Value	0.753	95% Hall's Bootstrap UCL	21.1
Kolmogorov-Smirnov Test Statistic	0.269	95% Percentile Bootstrap UCL	20.97
Kolmogorov-Smirnov 5% Critical Value	0.225	95% BCA Bootstrap UCL	20.77
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	27.56
		97.5% Chebyshev(Mean, Sd) UCL	31.94
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	40.54
95% Approximate Gamma UCL (Use when n >= 40)	26.58		
95% Adjusted Gamma UCL (Use when n < 40)	28.04		
Potential UCL to Use		Use 95% Student's-t UCL 21.53	

	General UCL Statistics for Full Data Sets		
User Selected Options			
From File	ProUCL upload.wst		
Full Precision	OFF		
Confidence Coefficient	95%		
Number of Bootstrap Operations	2000		
Iron AOI 13			
General Statistics			
Number of Valid Observations	7	Number of Distinct Observations	6
Raw Statistics		**Log-transformed Statistics**	
Minimum	26300	Minimum of Log Data	10.18
Maximum	38500	Maximum of Log Data	10.56
Mean	32733	Mean of log Data	10.39
Geometric Mean	32433	SD of log Data	0.147
Median	32500		
SD	4754		
Std. Error of Mean	1797		
Coefficient of Variation	0.145		
Skewness	-0.0695		
Relevant UCL Statistics			
Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0.908	Shapiro Wilk Test Statistic	0.909
Shapiro Wilk Critical Value	0.803	Shapiro Wilk Critical Value	0.803
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	36225	95% H-UCL	36801
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	40680
95% Adjusted-CLT UCL (Chen-1995)	35638	97.5% Chebyshev (MVUE) UCL	44118
95% Modified-t UCL (Johnson-1978)	36217	99% Chebyshev (MVUE) UCL	50870
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	31.23	Data appear Normal at 5% Significance Level	
Theta Star	1048		
MLE of Mean	32733		
MLE of Standard Deviation	5858		
nu star	437.2		
Approximate Chi Square Value (.05)	389.7	**Nonparametric Statistics**	
Adjusted Level of Significance	0.0158	95% CLT UCL	35689
Adjusted Chi Square Value	376.1	95% Jackknife UCL	36225
		95% Standard Bootstrap UCL	35386
Anderson-Darling Test Statistic	0.407	95% Bootstrap-t UCL	36505
Anderson-Darling 5% Critical Value	0.708	95% Hall's Bootstrap UCL	34906
Kolmogorov-Smirnov Test Statistic	0.24	95% Percentile Bootstrap UCL	35424
Kolmogorov-Smirnov 5% Critical Value	0.311	95% BCA Bootstrap UCL	35424
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	40566
		97.5% Chebyshev(Mean, Sd) UCL	43955
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	50612
95% Approximate Gamma UCL (Use when n >= 40)	36721		
95% Adjusted Gamma UCL (Use when n < 40)	38051		
Potential UCL to Use		**Use 95% Student's-t UCL 36225**	

	General UCL Statistics for Full Data Sets
User Selected Options	
From File	ProUCL upload.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Magnesium AOI 13

General Statistics

Number of Valid Observations	7	Number of Distinct Observations	6

Raw Statistics		**Log-transformed Statistics**	
Minimum	425.5	Minimum of Log Data	6.053
Maximum	13100	Maximum of Log Data	9.48
Mean	5867	Mean of log Data	8.118
Geometric Mean	3354	SD of log Data	1.437
Median	6630		
SD	4458		
Std. Error of Mean	1685		
Coefficient of Variation	0.76		
Skewness	0.187		

Relevant UCL Statistics

Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0.924	Shapiro Wilk Test Statistic	0.761
Shapiro Wilk Critical Value	0.803	Shapiro Wilk Critical Value	0.803
Data appear Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	9141	95% H-UCL	176170
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	24943
95% Adjusted-CLT UCL (Chen-1995)	8765	97.5% Chebyshev (MVUE) UCL	32488
95% Modified-t UCL (Johnson-1978)	9161	99% Chebyshev (MVUE) UCL	47310
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	0.683	Data appear Normal at 5% Significance Level	
Theta Star	8590		
MLE of Mean	5867		
MLE of Standard Deviation	7099		
nu star	9.563		
Approximate Chi Square Value (.05)	3.671	**Nonparametric Statistics**	
Adjusted Level of Significance	0.0158	95% CLT UCL	8639
Adjusted Chi Square Value	2.656	95% Jackknife UCL	9141
		95% Standard Bootstrap UCL	8381
Anderson-Darling Test Statistic	0.723	95% Bootstrap-t UCL	9238
Anderson-Darling 5% Critical Value	0.727	95% Hall's Bootstrap UCL	9044
Kolmogorov-Smirnov Test Statistic	0.307	95% Percentile Bootstrap UCL	8421
Kolmogorov-Smirnov 5% Critical Value	0.319	95% BCA Bootstrap UCL	8554
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	13211
		97.5% Chebyshev(Mean, Sd) UCL	16389
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	22631
95% Approximate Gamma UCL (Use when n >= 40)	15286		
95% Adjusted Gamma UCL (Use when n < 40)	21121		
Potential UCL to Use		Use 95% Student's-t UCL 9141	

	General UCL Statistics for Full Data Sets
User Selected Options	
From File	ProUCL upload.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Manganese AOI 13

General Statistics

Number of Valid Observations	16	Number of Distinct Observations	15

Raw Statistics		**Log-transformed Statistics**	
Minimum	9.637	Minimum of Log Data	2.266
Maximum	992	Maximum of Log Data	6.9
Mean	525	Mean of log Data	5.847
Geometric Mean	346.4	SD of log Data	1.422
Median	563.5		
SD	253.4		
Std. Error of Mean	63.36		
Coefficient of Variation	0.483		
Skewness	-0.707		

Relevant UCL Statistics

Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0.913	Shapiro Wilk Test Statistic	0.569
Shapiro Wilk Critical Value	0.887	Shapiro Wilk Critical Value	0.887
Data appear Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	636.1	95% H-UCL	3326
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	2370
95% Adjusted-CLT UCL (Chen-1995)	617.3	97.5% Chebyshev (MVUE) UCL	3027
95% Modified-t UCL (Johnson-1978)	634.2	99% Chebyshev (MVUE) UCL	4316
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	1.134	Data appear Normal at 5% Significance Level	
Theta Star	463		
MLE of Mean	525		
MLE of Standard Deviation	493		
nu star	36.29		
Approximate Chi Square Value (.05)	23.5	**Nonparametric Statistics**	
Adjusted Level of Significance	0.0335	95% CLT UCL	629.2
Adjusted Chi Square Value	22.33	95% Jackknife UCL	636.1
		95% Standard Bootstrap UCL	624.7
Anderson-Darling Test Statistic	2.478	95% Bootstrap-t UCL	625.2
Anderson-Darling 5% Critical Value	0.757	95% Hall's Bootstrap UCL	621.8
Kolmogorov-Smirnov Test Statistic	0.345	95% Percentile Bootstrap UCL	618.6
Kolmogorov-Smirnov 5% Critical Value	0.22	95% BCA Bootstrap UCL	617
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	801.2
		97.5% Chebyshev(Mean, Sd) UCL	920.7
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	1155
95% Approximate Gamma UCL (Use when n >= 40)	810.7		
95% Adjusted Gamma UCL (Use when n < 40)	853.1		
Potential UCL to Use		Use 95% Student's-t UCL 636.1	

	General UCL Statistics for Data Sets with Non-Detects
From File	ProUCL upload.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Thallium AOI 13

General Statistics

Number of Valid Data	15	Number of Detected Data	8
Number of Distinct Detected Data	7	Number of Non-Detect Data	7
		Percent Non-Detects	46.67%

Raw Statistics		**Log-transformed Statistics**	
Minimum Detected	0.17	Minimum Detected	-1.772
Maximum Detected	3.2	Maximum Detected	1.163
Mean of Detected	1.541	Mean of Detected	0.013
SD of Detected	1.131	SD of Detected	1.134
Minimum Non-Detect	0.11	Minimum Non-Detect	-2.207
Maximum Non-Detect	1.2	Maximum Non-Detect	0.182
Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	10
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	5
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	66.67%

UCL Statistics

Normal Distribution Test with Detected Values Only		**Lognormal Distribution Test with Detected Values Only**	
Shapiro Wilk Test Statistic	0.902	Shapiro Wilk Test Statistic	0.846
5% Shapiro Wilk Critical Value	0.818	5% Shapiro Wilk Critical Value	0.818
Data appear Normal at 5% Significance Level		**Data appear Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	0.956	Mean	-0.719
SD	1.037	SD	1.298
95% DL/2 (t) UCL	1.428	95% H-Stat (DL/2) UCL	3.491
Maximum Likelihood Estimate(MLE) Method		Log ROS Method	
Mean	2.323	Mean in Log Scale	-0.932
SD	0.53	SD in Log Scale	1.377
95% MLE (t) UCL	2.564	Mean in Original Scale	0.894
95% MLE (Tiku) UCL	2.738	SD in Original Scale	1.075
		95% t UCL	1.383
		95% Percentile Bootstrap UCL	1.358
		95% BCA Bootstrap UCL	1.431
		95% H UCL	3.535

Gamma Distribution Test with Detected Values Only		**Data Distribution Test with Detected Values Only**	
k star (bias corrected)	0.917	**Data appear Normal at 5% Significance Level**	
A-D Test Statistic	0.603	**Nonparametric Statistics**	
5% A-D Critical Value	0.731	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.731	Mean	0.925
5% K-S Critical Value	0.3	SD	1.017
Data appear Gamma Distributed at 5% Significance Level		SE of Mean	0.282
		95% KM (t) UCL	1.421
Assuming Gamma Distribution		95% KM (z) UCL	1.388
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	1.389
Minimum	0.000001	95% KM (bootstrap t) UCL	1.501
Maximum	3.2	95% KM (BCA) UCL	1.724
Mean	0.836	95% KM (Percentile Bootstrap) UCL	1.502
Median	0.213	95% KM (Chebyshev) UCL	2.153
SD	1.118	97.5% KM (Chebyshev) UCL	2.684
k star	0.158	99% KM (Chebyshev) UCL	3.727
Theta star	5.284		
Nu star	4.748	**Potential UCLs to Use**	
AppChi2	1.038	**95% KM (t) UCL**	**1.421**
95% Gamma Approximate UCL (Use when n >= 40)	3.826	95% KM (Percentile Bootstrap) UCL	1.502
95% Adjusted Gamma UCL (Use when n < 40)	4.704		

	General UCL Statistics for Full Data Sets
User Selected Options	
From File	ProUCL upload.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Vanadium AOI 13

General Statistics

Number of Valid Observations	15	Number of Distinct Observations	14

Raw Statistics		**Log-transformed Statistics**	
Minimum	32.2	Minimum of Log Data	3.472
Maximum	103	Maximum of Log Data	4.635
Mean	63.18	Mean of log Data	4.056
Geometric Mean	57.74	SD of log Data	0.444
Median	63.8		
SD	27.12		
Std. Error of Mean	7.002		
Coefficient of Variation	0.429		
Skewness	0.311		

Relevant UCL Statistics

Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0.865	Shapiro Wilk Test Statistic	0.88
Shapiro Wilk Critical Value	0.881	Shapiro Wilk Critical Value	0.881
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	75.52	95% H-UCL	80.88
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	95.64
95% Adjusted-CLT UCL (Chen-1995)	75.3	97.5% Chebyshev (MVUE) UCL	109.7
95% Modified-t UCL (Johnson-1978)	75.61	99% Chebyshev (MVUE) UCL	137.2
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	4.615	Data appear Gamma Distributed at 5% Significance Level	
Theta Star	13.69		
MLE of Mean	63.18		
MLE of Standard Deviation	29.41		
nu star	138.4		
Approximate Chi Square Value (.05)	112.3	**Nonparametric Statistics**	
Adjusted Level of Significance	0.0324	95% CLT UCL	74.7
Adjusted Chi Square Value	109.4	95% Jackknife UCL	75.52
		95% Standard Bootstrap UCL	74.15
Anderson-Darling Test Statistic	0.732	95% Bootstrap-t UCL	77.06
Anderson-Darling 5% Critical Value	0.738	95% Hall's Bootstrap UCL	73.86
Kolmogorov-Smirnov Test Statistic	0.185	95% Percentile Bootstrap UCL	74.11
Kolmogorov-Smirnov 5% Critical Value	0.222	95% BCA Bootstrap UCL	74.79
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	93.71
		97.5% Chebyshev(Mean, Sd) UCL	106.9
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	132.9
95% Approximate Gamma UCL (Use when n >= 40)	77.92		
95% Adjusted Gamma UCL (Use when n < 40)	79.99		
Potential UCL to Use		Use 95% Approximate Gamma UCL	77.92

	General UCL Statistics for Full Data Sets
User Selected Options	BEGIN TABLE A.11
From File	ProUCL upload.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Aluminum Western 53

General Statistics

Number of Valid Observations	5	Number of Distinct Observations	5

Raw Statistics		Log-transformed Statistics	
Minimum	11900	Minimum of Log Data	9.384
Maximum	26500	Maximum of Log Data	10.18
Mean	16560	Mean of log Data	9.675
Geometric Mean	15908	SD of log Data	0.303
Median	14900		
SD	5729		
Std. Error of Mean	2562		
Coefficient of Variation	0.346		
Skewness	1.899		

Relevant UCL Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.779	Shapiro Wilk Test Statistic	0.853
Shapiro Wilk Critical Value	0.762	Shapiro Wilk Critical Value	0.762
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	22022	95% H-UCL	23997
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	26220
95% Adjusted-CLT UCL (Chen-1995)	23098	97.5% Chebyshev (MVUE) UCL	30425
95% Modified-t UCL (Johnson-1978)	22384	99% Chebyshev (MVUE) UCL	38687
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	5.18	Data appear Normal at 5% Significance Level	
Theta Star	3197		
MLE of Mean	16560		
MLE of Standard Deviation	7276		
nu star	51.8		
Approximate Chi Square Value (.05)	36.27	**Nonparametric Statistics**	
Adjusted Level of Significance	0.0086	95% CLT UCL	20774
Adjusted Chi Square Value	30.69	95% Jackknife UCL	22022
		95% Standard Bootstrap UCL	20283
Anderson-Darling Test Statistic	0.563	95% Bootstrap-t UCL	31556
Anderson-Darling 5% Critical Value	0.679	95% Hall's Bootstrap UCL	43364
Kolmogorov-Smirnov Test Statistic	0.346	95% Percentile Bootstrap UCL	21060
Kolmogorov-Smirnov 5% Critical Value	0.357	95% BCA Bootstrap UCL	21800
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	27727
		97.5% Chebyshev(Mean, Sd) UCL	32559
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	42051
95% Approximate Gamma UCL (Use when n >= 40)	23650		
95% Adjusted Gamma UCL (Use when n < 40)	27950		
Potential UCL to Use		Use 95% Student's-t UCL 22022	

	General UCL Statistics for Full Data Sets
User Selected Options	
From File	ProUCL upload.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Manganese Western 53

General Statistics

Number of Valid Observations	5	Number of Distinct Observations	5

Raw Statistics		**Log-transformed Statistics**	
Minimum	128	Minimum of Log Data	4.852
Maximum	1380	Maximum of Log Data	7.23
Mean	604.8	Mean of log Data	5.895
Geometric Mean	363.3	SD of log Data	1.153
Median	206		
SD	612.9		
Std. Error of Mean	274.1		
Coefficient of Variation	1.013		
Skewness	0.672		

Relevant UCL Statistics

Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0.77	Shapiro Wilk Test Statistic	0.808
Shapiro Wilk Critical Value	0.762	Shapiro Wilk Critical Value	0.762
Data appear Normal at 5% Significance Level		**Data appear Lognormal at 5% Significance Level**	

Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	1189	95% H-UCL	17579
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	1854
95% Adjusted-CLT UCL (Chen-1995)	1144	97.5% Chebyshev (MVUE) UCL	2400
95% Modified-t UCL (Johnson-1978)	1203	99% Chebyshev (MVUE) UCL	3471

Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	0.581	**Data appear Normal at 5% Significance Level**	
Theta Star	1042		
MLE of Mean	604.8		
MLE of Standard Deviation	793.7		
nu star	5.807		
Approximate Chi Square Value (.05)	1.542	**Nonparametric Statistics**	
Adjusted Level of Significance	0.0086	95% CLT UCL	1056
Adjusted Chi Square Value	0.773	95% Jackknife UCL	1189
		95% Standard Bootstrap UCL	1010
Anderson-Darling Test Statistic	0.645	95% Bootstrap-t UCL	8076
Anderson-Darling 5% Critical Value	0.69	95% Hall's Bootstrap UCL	8629
Kolmogorov-Smirnov Test Statistic	0.335	95% Percentile Bootstrap UCL	1042
Kolmogorov-Smirnov 5% Critical Value	0.364	95% BCA Bootstrap UCL	1046
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	1799
		97.5% Chebyshev(Mean, Sd) UCL	2316
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	3332
95% Approximate Gamma UCL (Use when n >= 40)	2278		
95% Adjusted Gamma UCL (Use when n < 40)	4542		
Potential UCL to Use		**Use 95% Student's-t UCL 1189**	

	General UCL Statistics for Data Sets with Non-Detects
From File	ProUCL upload.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Thallium Western 53

General Statistics

Number of Valid Data	10	Number of Detected Data	5
Number of Distinct Detected Data	5	Number of Non-Detect Data	5
		Percent Non-Detects	50.00%

Raw Statistics		**Log-transformed Statistics**	
Minimum Detected	1.88	Minimum Detected	0.631
Maximum Detected	3.41	Maximum Detected	1.227
Mean of Detected	2.428	Mean of Detected	0.866
SD of Detected	0.586	SD of Detected	0.223
Minimum Non-Detect	0.85	Minimum Non-Detect	-0.163
Maximum Non-Detect	0.93	Maximum Non-Detect	-0.0726
Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	5
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	5
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	50.00%

UCL Statistics

Normal Distribution Test with Detected Values Only		**Lognormal Distribution Test with Detected Values Only**	
Shapiro Wilk Test Statistic	0.861	Shapiro Wilk Test Statistic	0.914
5% Shapiro Wilk Critical Value	0.762	5% Shapiro Wilk Critical Value	0.762
Data appear Normal at 5% Significance Level		**Data appear Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	1.436	Mean	0.0268
SD	1.116	SD	0.897
95% DL/2 (t) UCL	2.083	95% H-Stat (DL/2) UCL	3.655
Maximum Likelihood Estimate(MLE) Method		Log ROS Method	
Mean	1.114	Mean in Log Scale	0.536
SD	1.498	SD in Log Scale	0.378
95% MLE (t) UCL	1.982	Mean in Original Scale	1.828
95% MLE (Tiku) UCL	2.182	SD in Original Scale	0.743
		95% t UCL	2.259
		95% Percentile Bootstrap UCL	2.238
		95% BCA Bootstrap UCL	2.265
		95% H UCL	2.382

Gamma Distribution Test with Detected Values Only		**Data Distribution Test with Detected Values Only**	
k star (bias corrected)	9.746	**Data appear Normal at 5% Significance Level**	
A-D Test Statistic	0.39	**Nonparametric Statistics**	
5% A-D Critical Value	0.679	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.679	Mean	2.154
5% K-S Critical Value	0.357	SD	0.461
Data appear Gamma Distributed at 5% Significance Level		SE of Mean	0.163
		95% KM (t) UCL	2.453
Assuming Gamma Distribution		95% KM (z) UCL	2.422
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	2.424
Minimum	0.000001	95% KM (bootstrap t) UCL	2.619
Maximum	3.41	95% KM (BCA) UCL	2.656
Mean	1.214	95% KM (Percentile Bootstrap) UCL	2.536
Median	0.94	95% KM (Chebyshev) UCL	2.864
SD	1.338	97.5% KM (Chebyshev) UCL	3.171
k star	0.15	99% KM (Chebyshev) UCL	3.775
Theta star	8.093		
Nu star	3	**Potential UCLs to Use**	
AppChi2	0.372	95% KM (t) UCL	2.453
95% Gamma Approximate UCL (Use when n >= 40)	9.779	**95% KM (Percentile Bootstrap) UCL**	**2.54**
95% Adjusted Gamma UCL (Use when n < 40)	14.27		

	General UCL Statistics for Full Data Sets
User Selected Options	
From File	ProUCL upload.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Vanadium Western 53

General Statistics

Number of Valid Observations	10	Number of Distinct Observations	10

Raw Statistics		**Log-transformed Statistics**	
Minimum	45.1	Minimum of Log Data	3.809
Maximum	129	Maximum of Log Data	4.86
Mean	70.37	Mean of log Data	4.213
Geometric Mean	67.56	SD of log Data	0.289
Median	69.7		
SD	23.32		
Std. Error of Mean	7.374		
Coefficient of Variation	0.331		
Skewness	1.916		

Relevant UCL Statistics

Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0.805	Shapiro Wilk Test Statistic	0.913
Shapiro Wilk Critical Value	0.842	Shapiro Wilk Critical Value	0.842
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	83.89	95% H-UCL	85.14
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	98.28
95% Adjusted-CLT UCL (Chen-1995)	87.27	97.5% Chebyshev (MVUE) UCL	110.4
95% Modified-t UCL (Johnson-1978)	84.63	99% Chebyshev (MVUE) UCL	134.4
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	8.765	Data appear Gamma Distributed at 5% Significance Level	
Theta Star	8.028		
MLE of Mean	70.37		
MLE of Standard Deviation	23.77		
nu star	175.3		
Approximate Chi Square Value (.05)	145.7	**Nonparametric Statistics**	
Adjusted Level of Significance	0.0267	95% CLT UCL	82.5
Adjusted Chi Square Value	141	95% Jackknife UCL	83.89
		95% Standard Bootstrap UCL	81.93
Anderson-Darling Test Statistic	0.513	95% Bootstrap-t UCL	92.58
Anderson-Darling 5% Critical Value	0.725	95% Hall's Bootstrap UCL	139.8
Kolmogorov-Smirnov Test Statistic	0.205	95% Percentile Bootstrap UCL	82.06
Kolmogorov-Smirnov 5% Critical Value	0.267	95% BCA Bootstrap UCL	87.65
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	102.5
		97.5% Chebyshev(Mean, Sd) UCL	116.4
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	143.7
95% Approximate Gamma UCL (Use when n >= 40)	84.68		
95% Adjusted Gamma UCL (Use when n < 40)	87.5		
Potential UCL to Use		**Use 95% Approximate Gamma UCL 84.68**	

	General UCL Statistics for Full Data Sets			
User Selected Options				BEGIN TABLE A.12
From File	ProUCL upload.wst			
Full Precision	OFF			
Confidence Coefficient	95%			
Number of Bootstrap Operations	2000			
Aluminum Spaulding Rankin				
General Statistics				
Number of Valid Observations	66		Number of Distinct Observations	64
Raw Statistics			Log-transformed Statistics	
Minimum	2530		Minimum of Log Data	7.836
Maximum	37428		Maximum of Log Data	10.53
Mean	15639		Mean of log Data	9.57
Geometric Mean	14330		SD of log Data	0.454
Median	15248			
SD	6068			
Std. Error of Mean	746.9			
Coefficient of Variation	0.388			
Skewness	0.477			
Relevant UCL Statistics				
Normal Distribution Test			Lognormal Distribution Test	
Lilliefors Test Statistic	0.062		Lilliefors Test Statistic	0.102
Lilliefors Critical Value	0.109		Lilliefors Critical Value	0.109
Data appear Normal at 5% Significance Level			Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution			Assuming Lognormal Distribution	
95% Student's-t UCL	16885		95% H-UCL	17613
95% UCLs (Adjusted for Skewness)			95% Chebyshev (MVUE) UCL	19884
95% Adjusted-CLT UCL (Chen-1995)	16914		97.5% Chebyshev (MVUE) UCL	21627
95% Modified-t UCL (Johnson-1978)	16892		99% Chebyshev (MVUE) UCL	25051
Gamma Distribution Test			Data Distribution	
k star (bias corrected)	5.626		Data appear Normal at 5% Significance Level	
Theta Star	2780			
MLE of Mean	15639			
MLE of Standard Deviation	6593			
nu star	742.7			
Approximate Chi Square Value (.05)	680.4		Nonparametric Statistics	
Adjusted Level of Significance	0.0464		95% CLT UCL	16867
Adjusted Chi Square Value	679.1		95% Jackknife UCL	16885
			95% Standard Bootstrap UCL	16849
Anderson-Darling Test Statistic	0.727		95% Bootstrap-t UCL	16930
Anderson-Darling 5% Critical Value	0.753		95% Hall's Bootstrap UCL	16920
Kolmogorov-Smirnov Test Statistic	0.0855		95% Percentile Bootstrap UCL	16864
Kolmogorov-Smirnov 5% Critical Value	0.11		95% BCA Bootstrap UCL	16873
Data appear Gamma Distributed at 5% Significance Level			95% Chebyshev(Mean, Sd) UCL	18894
			97.5% Chebyshev(Mean, Sd) UCL	20303
Assuming Gamma Distribution			99% Chebyshev(Mean, Sd) UCL	23070
95% Approximate Gamma UCL (Use when n >= 40)	17069			
95% Adjusted Gamma UCL (Use when n < 40)	17102			
Potential UCL to Use			Use 95% Student's-t UCL 16885	

	General UCL Statistics for Data Sets with Non-Detects
User Selected Options	
From File	ProUCL upload.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Antimony Spaulding Rankin

General Statistics

Number of Valid Data	54	Number of Detected Data	27
Number of Distinct Detected Data	24	Number of Non-Detect Data	27
		Percent Non-Detects	50.00%

Raw Statistics		**Log-transformed Statistics**	
Minimum Detected	0.454	Minimum Detected	-0.79
Maximum Detected	18.5	Maximum Detected	2.918
Mean of Detected	4.947	Mean of Detected	1.076
SD of Detected	5.062	SD of Detected	1.06
Minimum Non-Detect	3.25	Minimum Non-Detect	1.179
Maximum Non-Detect	14.7	Maximum Non-Detect	2.688
Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	52
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	2
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	96.30%

UCL Statistics

Normal Distribution Test with Detected Values Only		**Lognormal Distribution Test with Detected Values Only**	
Shapiro Wilk Test Statistic	0.787	Shapiro Wilk Test Statistic	0.885
5% Shapiro Wilk Critical Value	0.923	5% Shapiro Wilk Critical Value	0.923
Data not Normal at 5% Significance Level		**Data not Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	4.205	Mean	1.108
SD	3.783	SD	0.813
95% DL/2 (t) UCL	5.067	95% H-Stat (DL/2) UCL	5.342
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	0.813
		SD in Log Scale	0.798
		Mean in Original Scale	3.355
		SD in Original Scale	3.9
		95% t UCL	4.243
		95% Percentile Bootstrap UCL	4.297
		95% BCA Bootstrap UCL	4.448
		95% H-UCL	3.911

Gamma Distribution Test with Detected Values Only		**Data Distribution Test with Detected Values Only**	
k star (bias corrected)	0.995	**Data do not follow a Discernable Distribution (0.05)**	
A-D Test Statistic	1.716	**Nonparametric Statistics**	
5% A-D Critical Value	0.771	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.771	Mean	3.425
5% K-S Critical Value	0.173	SD	4.03
Data not Gamma Distributed at 5% Significance Level		SE of Mean	0.593
		95% KM (t) UCL	4.418
Assuming Gamma Distribution		95% KM (z) UCL	4.4
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	4.412
Minimum	0.454	95% KM (bootstrap t) UCL	4.579
Maximum	18.5	95% KM (BCA) UCL	4.492
Mean	3.759	95% KM (Percentile Bootstrap) UCL	4.382
Median	2.268	95% KM (Chebyshev) UCL	6.009
SD	3.804	97.5% KM (Chebyshev) UCL	7.127
k star	1.48	99% KM (Chebyshev) UCL	9.324
Theta star	2.539		
Nu star	159.9	**Potential UCLs to Use**	
AppChi2	131.7	**95% KM (BCA) UCL**	**4.492**
95% Gamma Approximate UCL (Use when n >= 40)	4.566		
95% Adjusted Gamma UCL (Use when n < 40)	4.59		

	General UCL Statistics for Data Sets with Non-Detects		
From File	ProUCL upload.wst		
Full Precision	OFF		
Confidence Coefficient	95%		
Number of Bootstrap Operations	2000		
Arsenic Spaulding Rankin			
General Statistics			
Number of Valid Data	64	Number of Detected Data	56
Number of Distinct Detected Data	49	Number of Non-Detect Data	8
		Percent Non-Detects	12.50%
Raw Statistics		**Log-transformed Statistics**	
Minimum Detected	0.2	Minimum Detected	-1.609
Maximum Detected	131	Maximum Detected	4.875
Mean of Detected	7.35	Mean of Detected	0.942
SD of Detected	19.34	SD of Detected	1.207
Minimum Non-Detect	0.25	Minimum Non-Detect	-1.386
Maximum Non-Detect	2.1	Maximum Non-Detect	0.742
Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	34
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	30
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	53.13%
UCL Statistics			
Normal Distribution Test with Detected Values Only		**Lognormal Distribution Test with Detected Values Only**	
Lilliefors Test Statistic	0.356	Lilliefors Test Statistic	0.187
5% Lilliefors Critical Value	0.118	5% Lilliefors Critical Value	0.118
Data not Normal at 5% Significance Level		**Data not Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	6.526	Mean	0.766
SD	18.2	SD	1.248
95% DL/2 (t) UCL	10.32	95% H-Stat (DL/2) UCL	6.629
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE yields a negative mean		Mean in Log Scale	0.751
		SD in Log Scale	1.265
		Mean in Original Scale	6.52
		SD in Original Scale	18.2
		95% t UCL	10.32
		95% Percentile Bootstrap UCL	10.64
		95% BCA Bootstrap UCL	13.3
		95% H-UCL	6.706
Gamma Distribution Test with Detected Values Only		**Data Distribution Test with Detected Values Only**	
k star (bias corrected)	0.569	**Data do not follow a Discernable Distribution (0.05)**	
A-D Test Statistic	5.868	**Nonparametric Statistics**	
5% A-D Critical Value	0.807	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.807	Mean	6.531
5% K-S Critical Value	0.125	SD	18.06
Data not Gamma Distributed at 5% Significance Level		SE of Mean	2.278
		95% KM (t) UCL	10.33
Assuming Gamma Distribution		95% KM (z) UCL	10.28
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	10.33
Minimum	0.000001	95% KM (bootstrap t) UCL	17.8
Maximum	131	95% KM (BCA) UCL	11.06
Mean	6.434	95% KM (Percentile Bootstrap) UCL	10.59
Median	1.66	95% KM (Chebyshev) UCL	16.46
SD	18.23	97.5% KM (Chebyshev) UCL	20.75
k star	0.27	99% KM (Chebyshev) UCL	29.19
Theta star	23.83		
Nu star	34.56	**Potential UCLs to Use**	
AppChi2	22.11	**95% KM (Chebyshev) UCL**	**16.46**
95% Gamma Approximate UCL (Use when n >= 40)	10.06		
95% Adjusted Gamma UCL (Use when n < 40)	10.16		

	General UCL Statistics for Full Data Sets
User Selected Options	
From File	ProUCL upload.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Chromium Spaulding Rankin

General Statistics

Number of Valid Observations	55	Number of Distinct Observations	52

Raw Statistics		**Log-transformed Statistics**	
Minimum	49.3	Minimum of Log Data	3.898
Maximum	15867	Maximum of Log Data	9.672
Mean	907.7	Mean of log Data	6.313
Geometric Mean	551.5	SD of log Data	0.826
Median	544		
SD	2091		
Std. Error of Mean	281.9		
Coefficient of Variation	2.304		
Skewness	7.031		

Relevant UCL Statistics

Normal Distribution Test		**Lognormal Distribution Test**	
Lilliefors Test Statistic	0.353	Lilliefors Test Statistic	0.182
Lilliefors Critical Value	0.119	Lilliefors Critical Value	0.119
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	1380	95% H-UCL	987.3
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	1191
95% Adjusted-CLT UCL (Chen-1995)	1657	97.5% Chebyshev (MVUE) UCL	1374
95% Modified-t UCL (Johnson-1978)	1424	99% Chebyshev (MVUE) UCL	1733
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	1.091	Data do not follow a Discernable Distribution (0.05)	
Theta Star	831.9		
MLE of Mean	907.7		
MLE of Standard Deviation	869		
nu star	120		
Approximate Chi Square Value (.05)	95.72	**Nonparametric Statistics**	
Adjusted Level of Significance	0.0456	95% CLT UCL	1371
Adjusted Chi Square Value	95.14	95% Jackknife UCL	1380
		95% Standard Bootstrap UCL	1386
Anderson-Darling Test Statistic	4.627	95% Bootstrap-t UCL	3036
Anderson-Darling 5% Critical Value	0.776	95% Hall's Bootstrap UCL	3166
Kolmogorov-Smirnov Test Statistic	0.235	95% Percentile Bootstrap UCL	1468
Kolmogorov-Smirnov 5% Critical Value	0.123	95% BCA Bootstrap UCL	1817
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	2137
		97.5% Chebyshev(Mean, Sd) UCL	2668
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	3713
95% Approximate Gamma UCL (Use when n >= 40)	1138		
95% Adjusted Gamma UCL (Use when n < 40)	1145		
Potential UCL to Use		**Use 95% Chebyshev (Mean, Sd) UCL 2137**	

	General UCL Statistics for Full Data Sets		
User Selected Options			
From File	ProUCL upload.wst		
Full Precision	OFF		
Confidence Coefficient	95%		
Number of Bootstrap Operations	2000		

Cobalt Spaulding Rankin

General Statistics

Number of Valid Observations	37	Number of Distinct Observations	37

Raw Statistics		**Log-transformed Statistics**	
Minimum	11.96	Minimum of Log Data	2.482
Maximum	426.5	Maximum of Log Data	6.056
Mean	80.34	Mean of log Data	4.074
Geometric Mean	58.77	SD of log Data	0.737
Median	49.63		
SD	83.51		
Std. Error of Mean	13.73		
Coefficient of Variation	1.039		
Skewness	2.774		

Relevant UCL Statistics

Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0.646	Shapiro Wilk Test Statistic	0.943
Shapiro Wilk Critical Value	0.936	Shapiro Wilk Critical Value	0.936
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	103.5	95% H-UCL	99.95
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	120.6
95% Adjusted-CLT UCL (Chen-1995)	109.6	97.5% Chebyshev (MVUE) UCL	139.7
95% Modified-t UCL (Johnson-1978)	104.6	99% Chebyshev (MVUE) UCL	177.3
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	1.624	Data appear Lognormal at 5% Significance Level	
Theta Star	49.48		
MLE of Mean	80.34		
MLE of Standard Deviation	63.05		
nu star	120.2		
Approximate Chi Square Value (.05)	95.85	**Nonparametric Statistics**	
Adjusted Level of Significance	0.0431	95% CLT UCL	102.9
Adjusted Chi Square Value	94.91	95% Jackknife UCL	103.5
		95% Standard Bootstrap UCL	102.7
Anderson-Darling Test Statistic	2.017	95% Bootstrap-t UCL	120.5
Anderson-Darling 5% Critical Value	0.763	95% Hall's Bootstrap UCL	117.2
Kolmogorov-Smirnov Test Statistic	0.213	95% Percentile Bootstrap UCL	104.7
Kolmogorov-Smirnov 5% Critical Value	0.147	95% BCA Bootstrap UCL	110
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	140.2
		97.5% Chebyshev(Mean, Sd) UCL	166.1
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	216.9
95% Approximate Gamma UCL (Use when n >= 40)	100.7		
95% Adjusted Gamma UCL (Use when n < 40)	101.7		
Potential UCL to Use		Use 95% H-UCL 99.95	

	General UCL Statistics for Full Data Sets
User Selected Options	
From File	ProUCL upload.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Copper Spaulding Rankin

General Statistics

Number of Valid Observations	30	Number of Distinct Observations	29

Raw Statistics		**Log-transformed Statistics**	
Minimum	15.1	Minimum of Log Data	2.715
Maximum	481	Maximum of Log Data	6.176
Mean	58.32	Mean of log Data	3.618
Geometric Mean	37.27	SD of log Data	0.793
Median	30.7		
SD	89.44		
Std. Error of Mean	16.33		
Coefficient of Variation	1.534		
Skewness	4.034		

Relevant UCL Statistics

Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0.474	Shapiro Wilk Test Statistic	0.846
Shapiro Wilk Critical Value	0.927	Shapiro Wilk Critical Value	0.927
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	86.06	95% H-UCL	70.95
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	85.42
95% Adjusted-CLT UCL (Chen-1995)	98.03	97.5% Chebyshev (MVUE) UCL	100.6
95% Modified-t UCL (Johnson-1978)	88.07	99% Chebyshev (MVUE) UCL	130.4
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	1.154	Data do not follow a Discernable Distribution (0.05)	
Theta Star	50.55		
MLE of Mean	58.32		
MLE of Standard Deviation	54.29		
nu star	69.22		
Approximate Chi Square Value (.05)	51.07	**Nonparametric Statistics**	
Adjusted Level of Significance	0.041	95% CLT UCL	85.18
Adjusted Chi Square Value	50.17	95% Jackknife UCL	86.06
		95% Standard Bootstrap UCL	84.13
Anderson-Darling Test Statistic	2.874	95% Bootstrap-t UCL	130.3
Anderson-Darling 5% Critical Value	0.769	95% Hall's Bootstrap UCL	188.5
Kolmogorov-Smirnov Test Statistic	0.246	95% Percentile Bootstrap UCL	87.12
Kolmogorov-Smirnov 5% Critical Value	0.164	95% BCA Bootstrap UCL	105.4
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	129.5
		97.5% Chebyshev(Mean, Sd) UCL	160.3
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	220.8
95% Approximate Gamma UCL (Use when n >= 40)	79.05		
95% Adjusted Gamma UCL (Use when n < 40)	80.46		
Potential UCL to Use		Use 95% Chebyshev (Mean, Sd) UCL 129.5	

	General UCL Statistics for Full Data Sets		
User Selected Options			
From File	ProUCL upload.wst		
Full Precision	OFF		
Confidence Coefficient	95%		
Number of Bootstrap Operations	2000		
Iron Spaulding Rankin			
General Statistics			
Number of Valid Observations	29	Number of Distinct Observations	29
Raw Statistics		**Log-transformed Statistics**	
Minimum	26308	Minimum of Log Data	10.18
Maximum	140536	Maximum of Log Data	11.85
Mean	56232	Mean of log Data	10.87
Geometric Mean	52536	SD of log Data	0.367
Median	53391		
SD	22985		
Std. Error of Mean	4268		
Coefficient of Variation	0.409		
Skewness	1.826		
Relevant UCL Statistics			
Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0.863	Shapiro Wilk Test Statistic	0.981
Shapiro Wilk Critical Value	0.926	Shapiro Wilk Critical Value	0.926
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	63493	95% H-UCL	63864
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	73089
95% Adjusted-CLT UCL (Chen-1995)	64798	97.5% Chebyshev (MVUE) UCL	80461
95% Modified-t UCL (Johnson-1978)	63734	99% Chebyshev (MVUE) UCL	94942
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	6.763	Data appear Gamma Distributed at 5% Significance Level	
Theta Star	8315		
MLE of Mean	56232		
MLE of Standard Deviation	21623		
nu star	392.3		
Approximate Chi Square Value (.05)	347.4	**Nonparametric Statistics**	
Adjusted Level of Significance	0.0407	95% CLT UCL	63252
Adjusted Chi Square Value	344.8	95% Jackknife UCL	63493
		95% Standard Bootstrap UCL	63022
Anderson-Darling Test Statistic	0.299	95% Bootstrap-t UCL	65319
Anderson-Darling 5% Critical Value	0.747	95% Hall's Bootstrap UCL	67731
Kolmogorov-Smirnov Test Statistic	0.0977	95% Percentile Bootstrap UCL	63461
Kolmogorov-Smirnov 5% Critical Value	0.163	95% BCA Bootstrap UCL	64307
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	74837
		97.5% Chebyshev(Mean, Sd) UCL	82887
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	98700
95% Approximate Gamma UCL (Use when n >= 40)	63501		
95% Adjusted Gamma UCL (Use when n < 40)	63965		
Potential UCL to Use		**Use 95% Approximate Gamma UCL 63501**	

	General UCL Statistics for Full Data Sets
User Selected Options	
From File	ProUCL upload.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Lead Spaulding Rankin

General Statistics

Number of Valid Observations	60	Number of Distinct Observations	59

Raw Statistics		**Log-transformed Statistics**	
Minimum	0.82	Minimum of Log Data	-0.198
Maximum	868	Maximum of Log Data	6.766
Mean	53.08	Mean of log Data	3.083
Geometric Mean	21.82	SD of log Data	1.271
Median	19.45		
SD	119.5		
Std. Error of Mean	15.42		
Coefficient of Variation	2.251		
Skewness	5.776		

Relevant UCL Statistics

Normal Distribution Test		**Lognormal Distribution Test**	
Lilliefors Test Statistic	0.331	Lilliefors Test Statistic	0.0878
Lilliefors Critical Value	0.114	Lilliefors Critical Value	0.114
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	78.86	95% H-UCL	78.93
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	91.26
95% Adjusted-CLT UCL (Chen-1995)	90.74	97.5% Chebyshev (MVUE) UCL	110.1
95% Modified-t UCL (Johnson-1978)	80.77	99% Chebyshev (MVUE) UCL	147
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	0.659	Data appear Lognormal at 5% Significance Level	
Theta Star	80.51		
MLE of Mean	53.08		
MLE of Standard Deviation	65.37		
nu star	79.12		
Approximate Chi Square Value (.05)	59.63	**Nonparametric Statistics**	
Adjusted Level of Significance	0.046	95% CLT UCL	78.45
Adjusted Chi Square Value	59.21	95% Jackknife UCL	78.86
		95% Standard Bootstrap UCL	78.08
Anderson-Darling Test Statistic	2.282	95% Bootstrap-t UCL	118.8
Anderson-Darling 5% Critical Value	0.799	95% Hall's Bootstrap UCL	175
Kolmogorov-Smirnov Test Statistic	0.167	95% Percentile Bootstrap UCL	80.02
Kolmogorov-Smirnov 5% Critical Value	0.12	95% BCA Bootstrap UCL	96.48
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	120.3
		97.5% Chebyshev(Mean, Sd) UCL	149.4
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	206.5
95% Approximate Gamma UCL (Use when n >= 40)	70.44		
95% Adjusted Gamma UCL (Use when n < 40)	70.93		
Potential UCL to Use		Use 95% H-UCL	78.93

	General UCL Statistics for Full Data Sets		
User Selected Options			
From File	ProUCL upload.wst		
Full Precision	OFF		
Confidence Coefficient	95%		
Number of Bootstrap Operations	2000		
Magnesium Spaulding Rankin			
General Statistics			
Number of Valid Observations	30	Number of Distinct Observations	30
Raw Statistics		**Log-transformed Statistics**	
Minimum	1278	Minimum of Log Data	7.153
Maximum	14900	Maximum of Log Data	9.609
Mean	4600	Mean of log Data	8.239
Geometric Mean	3787	SD of log Data	0.649
Median	4291		
SD	3047		
Std. Error of Mean	556.4		
Coefficient of Variation	0.662		
Skewness	1.816		
Relevant UCL Statistics			
Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0.817	Shapiro Wilk Test Statistic	0.921
Shapiro Wilk Critical Value	0.927	Shapiro Wilk Critical Value	0.927
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	5545	95% H-UCL	6012
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	7203
95% Adjusted-CLT UCL (Chen-1995)	5712	97.5% Chebyshev (MVUE) UCL	8314
95% Modified-t UCL (Johnson-1978)	5576	99% Chebyshev (MVUE) UCL	10496
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	2.475	Data Follow Appr. Gamma Distribution at 5% Significance Level	
Theta Star	1858		
MLE of Mean	4600		
MLE of Standard Deviation	2924		
nu star	148.5		
Approximate Chi Square Value (.05)	121.3	**Nonparametric Statistics**	
Adjusted Level of Significance	0.041	95% CLT UCL	5515
Adjusted Chi Square Value	119.9	95% Jackknife UCL	5545
		95% Standard Bootstrap UCL	5480
Anderson-Darling Test Statistic	0.783	95% Bootstrap-t UCL	5929
Anderson-Darling 5% Critical Value	0.754	95% Hall's Bootstrap UCL	6725
Kolmogorov-Smirnov Test Statistic	0.139	95% Percentile Bootstrap UCL	5586
Kolmogorov-Smirnov 5% Critical Value	0.161	95% BCA Bootstrap UCL	5709
Data follow Appr. Gamma Distribution at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	7025
		97.5% Chebyshev(Mean, Sd) UCL	8074
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	10135
95% Approximate Gamma UCL (Use when n >= 40)	5630		
95% Adjusted Gamma UCL (Use when n < 40)	5696		
Potential UCL to Use		**Use 95% Approximate Gamma UCL 5630**	

	General UCL Statistics for Full Data Sets
User Selected Options	
From File	ProUCL upload.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Manganese Spaulding Rankin

General Statistics

Number of Valid Observations	66	Number of Distinct Observations	64

Raw Statistics		**Log-transformed Statistics**	
Minimum	222	Minimum of Log Data	5.403
Maximum	3248	Maximum of Log Data	8.086
Mean	1123	Mean of log Data	6.813
Geometric Mean	909.3	SD of log Data	0.66
Median	901		
SD	764.9		
Std. Error of Mean	94.15		
Coefficient of Variation	0.681		
Skewness	1.332		

Relevant UCL Statistics

Normal Distribution Test		**Lognormal Distribution Test**	
Lilliefors Test Statistic	0.215	Lilliefors Test Statistic	0.0946
Lilliefors Critical Value	0.109	Lilliefors Critical Value	0.109
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	1280	95% H-UCL	1330
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	1561
95% Adjusted-CLT UCL (Chen-1995)	1294	97.5% Chebyshev (MVUE) UCL	1749
95% Modified-t UCL (Johnson-1978)	1283	99% Chebyshev (MVUE) UCL	2119
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	2.419	Data Follow Appr. Gamma Distribution at 5% Significance Level	
Theta Star	464.2		
MLE of Mean	1123		
MLE of Standard Deviation	722		
nu star	319.3		
Approximate Chi Square Value (.05)	278.9	**Nonparametric Statistics**	
Adjusted Level of Significance	0.0464	95% CLT UCL	1278
Adjusted Chi Square Value	278.1	95% Jackknife UCL	1280
		95% Standard Bootstrap UCL	1274
Anderson-Darling Test Statistic	0.747	95% Bootstrap-t UCL	1306
Anderson-Darling 5% Critical Value	0.76	95% Hall's Bootstrap UCL	1295
Kolmogorov-Smirnov Test Statistic	0.131	95% Percentile Bootstrap UCL	1280
Kolmogorov-Smirnov 5% Critical Value	0.111	95% BCA Bootstrap UCL	1288
Data follow Appr. Gamma Distribution at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	1533
		97.5% Chebyshev(Mean, Sd) UCL	1711
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	2060
95% Approximate Gamma UCL (Use when n >= 40)	1286		
95% Adjusted Gamma UCL (Use when n < 40)	1289		
Potential UCL to Use		**Use 95% Approximate Gamma UCL**	**1286**

	General UCL Statistics for Data Sets with Non-Detects
From File	ProUCL upload.wst
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Mercury Spaulding Rankin

General Statistics

Number of Valid Data	45	Number of Detected Data	29
Number of Distinct Detected Data	19	Number of Non-Detect Data	16
		Percent Non-Detects	35.56%

Raw Statistics		**Log-transformed Statistics**	
Minimum Detected	0.03	Minimum Detected	-3.507
Maximum Detected	2.5	Maximum Detected	0.916
Mean of Detected	0.27	Mean of Detected	-1.927
SD of Detected	0.472	SD of Detected	1.01
Minimum Non-Detect	0.055	Minimum Non-Detect	-2.9
Maximum Non-Detect	0.13	Maximum Non-Detect	-2.04
Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	28
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	17
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	62.22%

UCL Statistics

Normal Distribution Test with Detected Values Only		**Lognormal Distribution Test with Detected Values Only**	
Shapiro Wilk Test Statistic	0.462	Shapiro Wilk Test Statistic	0.92
5% Shapiro Wilk Critical Value	0.926	5% Shapiro Wilk Critical Value	0.926
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	0.189	Mean	-2.391
SD	0.392	SD	1.05
95% DL/2 (t) UCL	0.287	95% H-Stat (DL/2) UCL	0.233
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE yields a negative mean		Mean in Log Scale	-2.417
		SD in Log Scale	1.081
		Mean in Original Scale	0.188
		SD in Original Scale	0.393
		95% t UCL	0.286
		95% Percentile Bootstrap UCL	0.296
		95% BCA Bootstrap UCL	0.349
		95% H-UCL	0.239

Gamma Distribution Test with Detected Values Only		**Data Distribution Test with Detected Values Only**	
k star (bias corrected)	0.869	Data do not follow a Discernable Distribution (0.05)	
Theta Star	0.31		
nu star	50.41		
A-D Test Statistic	1.993	**Nonparametric Statistics**	
5% A-D Critical Value	0.776	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.776	Mean	0.188
5% K-S Critical Value	0.168	SD	0.388
Data not Gamma Distributed at 5% Significance Level		SE of Mean	0.0589
		95% KM (t) UCL	0.287
Assuming Gamma Distribution		95% KM (z) UCL	0.285
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	0.287
Minimum	0.000001	95% KM (bootstrap t) UCL	0.467
Maximum	2.5	95% KM (BCA) UCL	0.309
Mean	0.176	95% KM (Percentile Bootstrap) UCL	0.293
Median	0.09	95% KM (Chebyshev) UCL	0.445
SD	0.398	97.5% KM (Chebyshev) UCL	0.556
k star	0.183	99% KM (Chebyshev) UCL	0.775
Theta star	0.966		
Nu star	16.44	Potential UCLs to Use	
AppChi2	8.275	95% KM (Chebyshev) UCL	0.445
95% Gamma Approximate UCL (Use when n >= 40)	0.351		
95% Adjusted Gamma UCL (Use when n < 40)	0.359		

	General UCL Statistics for Full Data Sets
User Selected Options	
From File	ProUCL upload.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Nickel Spaulding Rankin

General Statistics

Number of Valid Observations	64	Number of Distinct Observations	63

Raw Statistics		**Log-transformed Statistics**	
Minimum	35.9	Minimum of Log Data	3.581
Maximum	335	Maximum of Log Data	5.814
Mean	116.2	Mean of log Data	4.59
Geometric Mean	98.47	SD of log Data	0.567
Median	87.6		
SD	73.08		
Std. Error of Mean	9.135		
Coefficient of Variation	0.629		
Skewness	1.453		

Relevant UCL Statistics

Normal Distribution Test		**Lognormal Distribution Test**	
Lilliefors Test Statistic	0.191	Lilliefors Test Statistic	0.101
Lilliefors Critical Value	0.111	Lilliefors Critical Value	0.111
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	131.5	95% H-UCL	132.6
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	153.3
95% Adjusted-CLT UCL (Chen-1995)	133	97.5% Chebyshev (MVUE) UCL	169.8
95% Modified-t UCL (Johnson-1978)	131.7	99% Chebyshev (MVUE) UCL	202.1
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	3.037	Data appear Lognormal at 5% Significance Level	
Theta Star	38.27		
MLE of Mean	116.2		
MLE of Standard Deviation	66.69		
nu star	388.7		
Approximate Chi Square Value (.05)	344	**Nonparametric Statistics**	
Adjusted Level of Significance	0.0463	95% CLT UCL	131.2
Adjusted Chi Square Value	343	95% Jackknife UCL	131.5
		95% Standard Bootstrap UCL	131.6
Anderson-Darling Test Statistic	1.179	95% Bootstrap-t UCL	134.1
Anderson-Darling 5% Critical Value	0.757	95% Hall's Bootstrap UCL	133.6
Kolmogorov-Smirnov Test Statistic	0.136	95% Percentile Bootstrap UCL	131.6
Kolmogorov-Smirnov 5% Critical Value	0.112	95% BCA Bootstrap UCL	132.9
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	156
		97.5% Chebyshev(Mean, Sd) UCL	173.3
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	207.1
95% Approximate Gamma UCL (Use when n >= 40)	131.3		
95% Adjusted Gamma UCL (Use when n < 40)	131.7		
Potential UCL to Use		Use 95% H-UCL 132.6	

	General UCL Statistics for Data Sets with Non-Detects
User Selected Options	
From File	ProUCL upload.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Selenium Spaulding Rankin

General Statistics

Number of Valid Data	37	Number of Detected Data	22
Number of Distinct Detected Data	22	Number of Non-Detect Data	15
		Percent Non-Detects	40.54%

Raw Statistics		**Log-transformed Statistics**	
Minimum Detected	5.92	Minimum Detected	1.778
Maximum Detected	47.1	Maximum Detected	3.852
Mean of Detected	17.33	Mean of Detected	2.564
SD of Detected	13.97	SD of Detected	0.751
Minimum Non-Detect	6.74	Minimum Non-Detect	1.908
Maximum Non-Detect	18.73	Maximum Non-Detect	2.93
Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	30
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	7
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	81.08%

UCL Statistics

Normal Distribution Test with Detected Values Only		**Lognormal Distribution Test with Detected Values Only**	
Shapiro Wilk Test Statistic	0.737	Shapiro Wilk Test Statistic	0.776
5% Shapiro Wilk Critical Value	0.911	5% Shapiro Wilk Critical Value	0.911
Data not Normal at 5% Significance Level		**Data not Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	12.59	Mean	2.195
SD	12.23	SD	0.771
95% DL/2 (t) UCL	15.98	95% H-Stat (DL/2) UCL	15.93
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE yields a negative mean		Mean in Log Scale	2.262
		SD in Log Scale	0.7
		Mean in Original Scale	12.87
		SD in Original Scale	12.03
		95% t UCL	16.21
		95% Percentile Bootstrap UCL	16.13
		95% BCA Bootstrap UCL	16.62
		95% H-UCL	15.64

Gamma Distribution Test with Detected Values Only		**Data Distribution Test with Detected Values Only**	
k star (bias corrected)	1.657	**Data do not follow a Discernable Distribution (0.05)**	
A-D Test Statistic	2.564	**Nonparametric Statistics**	
5% A-D Critical Value	0.757	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.757	Mean	13.11
5% K-S Critical Value	0.188	SD	11.72
Data not Gamma Distributed at 5% Significance Level		SE of Mean	1.975
		95% KM (t) UCL	16.45
Assuming Gamma Distribution		95% KM (z) UCL	16.36
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	16.42
Minimum	0.000001	95% KM (bootstrap t) UCL	17.37
Maximum	47.1	95% KM (BCA) UCL	16.64
Mean	12.48	95% KM (Percentile Bootstrap) UCL	16.56
Median	8.5	95% KM (Chebyshev) UCL	21.72
SD	12.46	97.5% KM (Chebyshev) UCL	25.45
k star	0.401	99% KM (Chebyshev) UCL	32.77
Theta star	31.14		
Nu star	29.66	**Potential UCLs to Use**	
AppChi2	18.23	**95% KM (t) UCL**	**16.45**
95% Gamma Approximate UCL (Use when n >= 40)	20.31	95% KM (% Bootstrap) UCL	16.56
95% Adjusted Gamma UCL (Use when n < 40)	20.76		

	General UCL Statistics for Data Sets with Non-Detects
From File	ProUCL upload.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Thallium Spaulding Rankin

General Statistics

Number of Valid Data	70	Number of Detected Data	31
Number of Distinct Detected Data	30	Number of Non-Detect Data	39
Number of Missing Values	1	Percent Non-Detects	55.71%

Raw Statistics		**Log-transformed Statistics**	
Minimum Detected	0.25	Minimum Detected	-1.386
Maximum Detected	75.72	Maximum Detected	4.327
Mean of Detected	14.18	Mean of Detected	1.868
SD of Detected	19.26	SD of Detected	1.309
Minimum Non-Detect	0.22	Minimum Non-Detect	-1.514
Maximum Non-Detect	14.03	Maximum Non-Detect	2.641
Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	63
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	7
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	90.00%

UCL Statistics

Normal Distribution Test with Detected Values Only		**Lognormal Distribution Test with Detected Values Only**	
Shapiro Wilk Test Statistic	0.643	Shapiro Wilk Test Statistic	0.866
5% Shapiro Wilk Critical Value	0.929	5% Shapiro Wilk Critical Value	0.929
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	7.797	Mean	1.025
SD	14.04	SD	1.538
95% DL/2 (t) UCL	10.6	95% H-Stat (DL/2) UCL	14.05
Maximum Likelihood Estimate(MLE) Method		Log ROS Method	
Mean	1.145	Mean in Log Scale	0.747
SD	41.17	SD in Log Scale	1.419
95% MLE (t) UCL	9.349	Mean in Original Scale	6.865
95% MLE (Tiku) UCL	24.54	SD in Original Scale	14.31
		95% t UCL	9.716
		95% Percentile Bootstrap UCL	9.811
		95% BCA Bootstrap UCL	10.52
		95% H UCL	8.38
Gamma Distribution Test with Detected Values Only		**Data Distribution Test with Detected Values Only**	
k star (bias corrected)	0.71	Data do not follow a Discernable Distribution (0.05)	
A-D Test Statistic	2.947	**Nonparametric Statistics**	
5% A-D Critical Value	0.787	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.787	Mean	7.12
5% K-S Critical Value	0.164	SD	14.17
Data not Gamma Distributed at 5% Significance Level		SE of Mean	1.733
		95% KM (t) UCL	10.01
Assuming Gamma Distribution		95% KM (z) UCL	9.97
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	9.955
Minimum	0.000001	95% KM (bootstrap t) UCL	10.82
Maximum	75.72	95% KM (BCA) UCL	10.45
Mean	6.299	95% KM (Percentile Bootstrap) UCL	10.32
Median	0.000001	95% KM (Chebyshev) UCL	14.67
SD	14.54	97.5% KM (Chebyshev) UCL	17.94
k star	0.103	99% KM (Chebyshev) UCL	24.36
Theta star	61.13		
Nu star	14.43	**Potential UCLs to Use**	
AppChi2	6.864	**95% KM (BCA) UCL**	**10.45**
95% Gamma Approximate UCL (Use when n >= 40)	13.24		
95% Adjusted Gamma UCL (Use when n < 40)	13.45		

	General UCL Statistics for Full Data Sets
User Selected Options	
From File	ProUCL upload.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Vanadium Spaulding Rankin

General Statistics

Number of Valid Observations	71	Number of Distinct Observations	70

Raw Statistics		**Log-transformed Statistics**	
Minimum	24	Minimum of Log Data	3.178
Maximum	195	Maximum of Log Data	5.273
Mean	94.85	Mean of log Data	4.477
Geometric Mean	87.94	SD of log Data	0.404
Median	90.9		
SD	36.55		
Std. Error of Mean	4.338		
Coefficient of Variation	0.385		
Skewness	0.789		

Relevant UCL Statistics

Normal Distribution Test		**Lognormal Distribution Test**	
Lilliefors Test Statistic	0.101	Lilliefors Test Statistic	0.1
Lilliefors Critical Value	0.105	Lilliefors Critical Value	0.105
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	102.1	95% H-UCL	104
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	115.9
95% Adjusted-CLT UCL (Chen-1995)	102.4	97.5% Chebyshev (MVUE) UCL	124.8
95% Modified-t UCL (Johnson-1978)	102.1	99% Chebyshev (MVUE) UCL	142.3
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	6.497	Data appear Normal at 5% Significance Level	
Theta Star	14.6		
MLE of Mean	94.85		
MLE of Standard Deviation	37.21		
nu star	922.5		
Approximate Chi Square Value (.05)	853	**Nonparametric Statistics**	
Adjusted Level of Significance	0.0466	95% CLT UCL	102
Adjusted Chi Square Value	851.6	95% Jackknife UCL	102.1
		95% Standard Bootstrap UCL	102
Anderson-Darling Test Statistic	0.273	95% Bootstrap-t UCL	102.5
Anderson-Darling 5% Critical Value	0.753	95% Hall's Bootstrap UCL	102.4
Kolmogorov-Smirnov Test Statistic	0.0741	95% Percentile Bootstrap UCL	102
Kolmogorov-Smirnov 5% Critical Value	0.106	95% BCA Bootstrap UCL	102.4
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	113.8
		97.5% Chebyshev(Mean, Sd) UCL	121.9
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	138
95% Approximate Gamma UCL (Use when n >= 40)	102.6		
95% Adjusted Gamma UCL (Use when n < 40)	102.7		
Potential UCL to Use		Use 95% Student's-t UCL	102.1

	General UCL Statistics for Full Data Sets
User Selected Options	
From File	ProUCL upload.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Zinc Spaulding Rankin

General Statistics

Number of Valid Observations	30	Number of Distinct Observations	30

Raw Statistics		**Log-transformed Statistics**	
Minimum	42.17	Minimum of Log Data	3.742
Maximum	13600	Maximum of Log Data	9.518
Mean	537.2	Mean of log Data	4.557
Geometric Mean	95.28	SD of log Data	1.009
Median	78.25		
SD	2467		
Std. Error of Mean	450.5		
Coefficient of Variation	4.593		
Skewness	5.475		

Relevant UCL Statistics

Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0.198	Shapiro Wilk Test Statistic	0.523
Shapiro Wilk Critical Value	0.927	Shapiro Wilk Critical Value	0.927
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	1303	95% H-UCL	252.8
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	297.7
95% Adjusted-CLT UCL (Chen-1995)	1759	97.5% Chebyshev (MVUE) UCL	359.6
95% Modified-t UCL (Johnson-1978)	1378	99% Chebyshev (MVUE) UCL	481.1
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	0.367	Data do not follow a Discernable Distribution (0.05)	
Theta Star	1464		
MLE of Mean	537.2		
MLE of Standard Deviation	886.7		
nu star	22.02		
Approximate Chi Square Value (.05)	12.36	**Nonparametric Statistics**	
Adjusted Level of Significance	0.041	95% CLT UCL	1278
Adjusted Chi Square Value	11.94	95% Jackknife UCL	1303
		95% Standard Bootstrap UCL	1253
Anderson-Darling Test Statistic	8.959	95% Bootstrap-t UCL	43867
Anderson-Darling 5% Critical Value	0.835	95% Hall's Bootstrap UCL	17490
Kolmogorov-Smirnov Test Statistic	0.475	95% Percentile Bootstrap UCL	1436
Kolmogorov-Smirnov 5% Critical Value	0.172	95% BCA Bootstrap UCL	1894
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	2501
		97.5% Chebyshev(Mean, Sd) UCL	3351
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	5020
95% Approximate Gamma UCL (Use when n >= 40)	957.5		
95% Adjusted Gamma UCL (Use when n < 40)	991		
Potential UCL to Use		**Use 95% Chebyshev (Mean, Sd) UCL 2501**	

	General UCL Statistics for Full Data Sets		
User Selected Options			BEGIN TABLE A.13
From File	ProUCL upload.wst		
Full Precision	OFF		
Confidence Coefficient	95%		
Number of Bootstrap Operations	2000		

Aluminum Southern AU

General Statistics

Number of Valid Observations	74	Number of Distinct Observations	42

Raw Statistics		**Log-transformed Statistics**	
Minimum	3740	Minimum of Log Data	8.227
Maximum	56138	Maximum of Log Data	10.94
Mean	18932	Mean of log Data	9.741
Geometric Mean	16998	SD of log Data	0.473
Median	17653		
SD	9269		
Std. Error of Mean	1078		
Coefficient of Variation	0.49		
Skewness	1.541		

Relevant UCL Statistics

Normal Distribution Test		**Lognormal Distribution Test**	
Lilliefors Test Statistic	0.166	Lilliefors Test Statistic	0.101
Lilliefors Critical Value	0.103	Lilliefors Critical Value	0.103
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	20727	95% H-UCL	21045
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	23745
95% Adjusted-CLT UCL (Chen-1995)	20911	97.5% Chebyshev (MVUE) UCL	25808
95% Modified-t UCL (Johnson-1978)	20760	99% Chebyshev (MVUE) UCL	29860
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	4.614	Data appear Lognormal at 5% Significance Level	
Theta Star	4103		
MLE of Mean	18932		
MLE of Standard Deviation	8814		
nu star	682.8		
Approximate Chi Square Value (.05)	623.2	**Nonparametric Statistics**	
Adjusted Level of Significance	0.0468	95% CLT UCL	20705
Adjusted Chi Square Value	622.1	95% Jackknife UCL	20727
		95% Standard Bootstrap UCL	20679
Anderson-Darling Test Statistic	1.131	95% Bootstrap-t UCL	20869
Anderson-Darling 5% Critical Value	0.755	95% Hall's Bootstrap UCL	21011
Kolmogorov-Smirnov Test Statistic	0.109	95% Percentile Bootstrap UCL	20772
Kolmogorov-Smirnov 5% Critical Value	0.104	95% BCA Bootstrap UCL	20938
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	23629
		97.5% Chebyshev(Mean, Sd) UCL	25661
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	29653
95% Approximate Gamma UCL (Use when n >= 40)	20744		
95% Adjusted Gamma UCL (Use when n < 40)	20781		
Potential UCL to Use		Use 95% Student's-t UCL	20727

	General UCL Statistics for Data Sets with Non-Detects
From File	ProUCL upload.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Antimony Southern AU

General Statistics

Number of Valid Data	77	Number of Detected Data	41
Number of Distinct Detected Data	29	Number of Non-Detect Data	36
		Percent Non-Detects	46.75%
Raw Statistics		**Log-transformed Statistics**	
Minimum Detected	0.367	Minimum Detected	-1.002
Maximum Detected	19.1	Maximum Detected	2.95
Mean of Detected	2.781	Mean of Detected	0.166
SD of Detected	4.803	SD of Detected	1.108
Minimum Non-Detect	0.24	Minimum Non-Detect	-1.427
Maximum Non-Detect	16.88	Maximum Non-Detect	2.826
Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	76
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	1
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	98.70%

UCL Statistics

Normal Distribution Test with Detected Values Only		**Lognormal Distribution Test with Detected Values Only**	
Shapiro Wilk Test Statistic	0.526	Shapiro Wilk Test Statistic	0.707
5% Shapiro Wilk Critical Value	0.941	5% Shapiro Wilk Critical Value	0.941
Data not Normal at 5% Significance Level		**Data not Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	2.579	Mean	0.0629
SD	3.992	SD	1.289
95% DL/2 (t) UCL	3.337	95% H-Stat (DL/2) UCL	3.57
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	-0.307
		SD in Log Scale	1.095
		Mean in Original Scale	1.741
		SD in Original Scale	3.668
		95% t UCL	2.437
		95% Percentile Bootstrap UCL	2.485
		95% BCA Bootstrap UCL	2.616
		95% H-UCL	1.802
Gamma Distribution Test with Detected Values Only		**Data Distribution Test with Detected Values Only**	
k star (bias corrected)	0.669	**Data do not follow a Discernable Distribution (0.05)**	
Theta Star	4.155		
nu star	54.88		
A-D Test Statistic	7.191	**Nonparametric Statistics**	
5% A-D Critical Value	0.794	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.794	Mean	1.823
5% K-S Critical Value	0.144	SD	3.702
Data not Gamma Distributed at 5% Significance Level		SE of Mean	0.438
		95% KM (t) UCL	2.552
Assuming Gamma Distribution		95% KM (z) UCL	2.543
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	2.541
Minimum	0.000001	95% KM (bootstrap t) UCL	2.829
Maximum	19.1	95% KM (BCA) UCL	2.539
Mean	1.791	95% KM (Percentile Bootstrap) UCL	2.581
Median	0.657	95% KM (Chebyshev) UCL	3.732
SD	3.722	97.5% KM (Chebyshev) UCL	4.558
k star	0.213	99% KM (Chebyshev) UCL	6.18
Theta star	8.416		
Nu star	32.77	**Potential UCLs to Use**	
AppChi2	20.69	**95% KM (Chebyshev) UCL**	**3.732**
95% Gamma Approximate UCL (Use when n >= 40)	2.838		
95% Adjusted Gamma UCL (Use when n < 40)	2.863		

General UCL Statistics for Data Sets with Non-Detects	
From File	ProUCL upload.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Arsenic Southern AU

Number of Valid Data	74	Number of Detected Data	71
Number of Distinct Detected Data	41	Number of Non-Detect Data	3
		Percent Non-Detects	4.05%
Raw Statistics		**Log-transformed Statistics**	
Minimum Detected	0.64	Minimum Detected	-0.446
Maximum Detected	17.1	Maximum Detected	2.839
Mean of Detected	5.093	Mean of Detected	1.39
SD of Detected	3.493	SD of Detected	0.728
Minimum Non-Detect	0.1	Minimum Non-Detect	-2.303
Maximum Non-Detect	2.54	Maximum Non-Detect	0.932
Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	28
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	46
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	37.84%

UCL Statistics

Normal Distribution Test with Detected Values Only		**Lognormal Distribution Test with Detected Values Only**	
Lilliefors Test Statistic	0.133	Lilliefors Test Statistic	0.131
5% Lilliefors Critical Value	0.105	5% Lilliefors Critical Value	0.105
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	4.92	Mean	1.299
SD	3.525	SD	0.896
95% DL/2 (t) UCL	5.603	95% H-Stat (DL/2) UCL	6.862
Maximum Likelihood Estimate(MLE) Method		Log ROS Method	
Mean	3.969	Mean in Log Scale	1.344
SD	4.702	SD in Log Scale	0.756
95% MLE (t) UCL	4.879	Mean in Original Scale	4.946
95% MLE (Tiku) UCL	4.981	SD in Original Scale	3.497
		95% t UCL	5.624
		95% Percentile Bootstrap UCL	5.641
		95% BCA Bootstrap UCL	5.69
		95% H UCL	6.112
Gamma Distribution Test with Detected Values Only		**Data Distribution Test with Detected Values Only**	
k star (bias corrected)	2.17	Data do not follow a Discernable Distribution (0.05)	
A-D Test Statistic	0.988	**Nonparametric Statistics**	
5% A-D Critical Value	0.762	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.762	Mean	4.945
5% K-S Critical Value	0.107	SD	3.476
Data not Gamma Distributed at 5% Significance Level		SE of Mean	0.407
		95% KM (t) UCL	5.623
Assuming Gamma Distribution		95% KM (z) UCL	5.614
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	5.622
Minimum	0.000001	95% KM (bootstrap t) UCL	5.706
Maximum	17.1	95% KM (BCA) UCL	5.627
Mean	4.933	95% KM (Percentile Bootstrap) UCL	5.62
Median	4.2	95% KM (Chebyshev) UCL	6.719
SD	3.513	97.5% KM (Chebyshev) UCL	7.487
k star	1.249	99% KM (Chebyshev) UCL	8.996
Theta star	3.949		
Nu star	184.9	Potential UCLs to Use	
AppChi2	154.4	95% KM (BCA) UCL	5.63
95% Gamma Approximate UCL (Use when n >= 40)	5.905		
95% Adjusted Gamma UCL (Use when n < 40)	5.927		

	General UCL Statistics for Full Data Sets
User Selected Options	
From File	ProUCL upload.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Cobalt Southern AU

General Statistics

Number of Valid Observations	55	Number of Distinct Observations	40

Raw Statistics		**Log-transformed Statistics**	
Minimum	3.15	Minimum of Log Data	1.147
Maximum	193.1	Maximum of Log Data	5.263
Mean	37.62	Mean of log Data	3.29
Geometric Mean	26.83	SD of log Data	0.813
Median	19.1		
SD	36.3		
Std. Error of Mean	4.894		
Coefficient of Variation	0.965		
Skewness	2.259		

Relevant UCL Statistics

Normal Distribution Test		**Lognormal Distribution Test**	
Lilliefors Test Statistic	0.211	Lilliefors Test Statistic	0.178
Lilliefors Critical Value	0.119	Lilliefors Critical Value	0.119
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	45.81	95% H-UCL	47.3
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	57
95% Adjusted-CLT UCL (Chen-1995)	47.27	97.5% Chebyshev (MVUE) UCL	65.63
95% Modified-t UCL (Johnson-1978)	46.06	99% Chebyshev (MVUE) UCL	82.58
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	1.549	Data do not follow a Discernable Distribution (0.05)	
Theta Star	24.28		
MLE of Mean	37.62		
MLE of Standard Deviation	30.23		
nu star	170.4		
Approximate Chi Square Value (.05)	141.2	**Nonparametric Statistics**	
Adjusted Level of Significance	0.0456	95% CLT UCL	45.67
Adjusted Chi Square Value	140.5	95% Jackknife UCL	45.81
		95% Standard Bootstrap UCL	45.67
Anderson-Darling Test Statistic	2.712	95% Bootstrap-t UCL	48.34
Anderson-Darling 5% Critical Value	0.767	95% Hall's Bootstrap UCL	48.17
Kolmogorov-Smirnov Test Statistic	0.201	95% Percentile Bootstrap UCL	46.22
Kolmogorov-Smirnov 5% Critical Value	0.122	95% BCA Bootstrap UCL	47.11
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	58.96
		97.5% Chebyshev(Mean, Sd) UCL	68.19
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	86.32
95% Approximate Gamma UCL (Use when n >= 40)	45.4		
95% Adjusted Gamma UCL (Use when n < 40)	45.63		
Potential UCL to Use		**Use 95% Chebyshev (Mean, Sd) UCL 58.96**	

	General UCL Statistics for Full Data Sets
User Selected Options	
From File	ProUCL upload.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Iron Southern AU

General Statistics

Number of Valid Observations	55	Number of Distinct Observations	36

Raw Statistics		**Log-transformed Statistics**	
Minimum	13000	Minimum of Log Data	9.473
Maximum	68056	Maximum of Log Data	11.13
Mean	33509	Mean of log Data	10.36
Geometric Mean	31699	SD of log Data	0.335
Median	33900		
SD	11743		
Std. Error of Mean	1583		
Coefficient of Variation	0.35		
Skewness	1.268		

Relevant UCL Statistics

Normal Distribution Test		**Lognormal Distribution Test**	
Lilliefors Test Statistic	0.224	Lilliefors Test Statistic	0.162
Lilliefors Critical Value	0.119	Lilliefors Critical Value	0.119
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	36159	95% H-UCL	36283
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	40256
95% Adjusted-CLT UCL (Chen-1995)	36403	97.5% Chebyshev (MVUE) UCL	43180
95% Modified-t UCL (Johnson-1978)	36204	99% Chebyshev (MVUE) UCL	48925
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	8.68	Data do not follow a Discernable Distribution (0.05)	
Theta Star	3860		
MLE of Mean	33509		
MLE of Standard Deviation	11374		
nu star	954.8		
Approximate Chi Square Value (.05)	884.1	**Nonparametric Statistics**	
Adjusted Level of Significance	0.0456	95% CLT UCL	36114
Adjusted Chi Square Value	882.3	95% Jackknife UCL	36159
		95% Standard Bootstrap UCL	36063
Anderson-Darling Test Statistic	1.449	95% Bootstrap-t UCL	36525
Anderson-Darling 5% Critical Value	0.751	95% Hall's Bootstrap UCL	36425
Kolmogorov-Smirnov Test Statistic	0.179	95% Percentile Bootstrap UCL	36123
Kolmogorov-Smirnov 5% Critical Value	0.12	95% BCA Bootstrap UCL	36608
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	40411
		97.5% Chebyshev(Mean, Sd) UCL	43398
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	49264
95% Approximate Gamma UCL (Use when n >= 40)	36190		
95% Adjusted Gamma UCL (Use when n < 40)	36265		
Potential UCL to Use		**Use 95% Student's-t UCL**	**36159**
		or 95% Modified-t UCL	36204

	General UCL Statistics for Full Data Sets
User Selected Options	
From File	ProUCL upload.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Magnesium Southern AU

General Statistics

Number of Valid Observations	55	Number of Distinct Observations	40

Raw Statistics		**Log-transformed Statistics**	
Minimum	531.9	Minimum of Log Data	6.276
Maximum	21639	Maximum of Log Data	9.982
Mean	7914	Mean of log Data	8.704
Geometric Mean	6024	SD of log Data	0.835
Median	6590		
SD	5039		
Std. Error of Mean	679.5		
Coefficient of Variation	0.637		
Skewness	0.404		

Relevant UCL Statistics

Normal Distribution Test		**Lognormal Distribution Test**	
Lilliefors Test Statistic	0.208	Lilliefors Test Statistic	0.186
Lilliefors Critical Value	0.119	Lilliefors Critical Value	0.119
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	9051	95% H-UCL	10910
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	13176
95% Adjusted-CLT UCL (Chen-1995)	9071	97.5% Chebyshev (MVUE) UCL	15213
95% Modified-t UCL (Johnson-1978)	9057	99% Chebyshev (MVUE) UCL	19214
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	1.887	Data do not follow a Discernable Distribution (0.05)	
Theta Star	4194		
MLE of Mean	7914		
MLE of Standard Deviation	5762		
nu star	207.5		
Approximate Chi Square Value (.05)	175.2	**Nonparametric Statistics**	
Adjusted Level of Significance	0.0456	95% CLT UCL	9032
Adjusted Chi Square Value	174.4	95% Jackknife UCL	9051
		95% Standard Bootstrap UCL	9026
Anderson-Darling Test Statistic	1.499	95% Bootstrap-t UCL	9084
Anderson-Darling 5% Critical Value	0.763	95% Hall's Bootstrap UCL	9080
Kolmogorov-Smirnov Test Statistic	0.203	95% Percentile Bootstrap UCL	9070
Kolmogorov-Smirnov 5% Critical Value	0.122	95% BCA Bootstrap UCL	8985
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	10876
		97.5% Chebyshev(Mean, Sd) UCL	12158
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	14675
95% Approximate Gamma UCL (Use when n >= 40)	9375		
95% Adjusted Gamma UCL (Use when n < 40)	9418		
Potential UCL to Use		Use 95% Chebyshev (Mean, Sd) UCL	10876

	General UCL Statistics for Full Data Sets
User Selected Options	
From File	ProUCL upload.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Manganese Southern AU

General Statistics

Number of Valid Observations	74	Number of Distinct Observations	48

Raw Statistics		**Log-transformed Statistics**	
Minimum	23.9	Minimum of Log Data	3.174
Maximum	3070	Maximum of Log Data	8.029
Mean	584.8	Mean of log Data	6.006
Geometric Mean	406.1	SD of log Data	0.912
Median	439.8		
SD	541.6		
Std. Error of Mean	62.96		
Coefficient of Variation	0.926		
Skewness	2.409		

Relevant UCL Statistics

Normal Distribution Test		**Lognormal Distribution Test**	
Lilliefors Test Statistic	0.24	Lilliefors Test Statistic	0.132
Lilliefors Critical Value	0.103	Lilliefors Critical Value	0.103
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	689.7	95% H-UCL	776.2
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	938.9
95% Adjusted-CLT UCL (Chen-1995)	707.2	97.5% Chebyshev (MVUE) UCL	1081
95% Modified-t UCL (Johnson-1978)	692.6	99% Chebyshev (MVUE) UCL	1360
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	1.463	Data do not follow a Discernable Distribution (0.05)	
Theta Star	399.7		
MLE of Mean	584.8		
MLE of Standard Deviation	483.5		
nu star	216.6		
Approximate Chi Square Value (.05)	183.5	**Nonparametric Statistics**	
Adjusted Level of Significance	0.0468	95% CLT UCL	688.4
Adjusted Chi Square Value	182.9	95% Jackknife UCL	689.7
		95% Standard Bootstrap UCL	690.7
Anderson-Darling Test Statistic	0.885	95% Bootstrap-t UCL	713.8
Anderson-Darling 5% Critical Value	0.769	95% Hall's Bootstrap UCL	717.7
Kolmogorov-Smirnov Test Statistic	0.133	95% Percentile Bootstrap UCL	691.5
Kolmogorov-Smirnov 5% Critical Value	0.106	95% BCA Bootstrap UCL	718.2
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	859.2
		97.5% Chebyshev(Mean, Sd) UCL	978
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	1211
95% Approximate Gamma UCL (Use when n >= 40)	690.2		
95% Adjusted Gamma UCL (Use when n < 40)	692.4		
Potential UCL to Use		Use 95% Chebyshev (Mean, Sd) UCL	859.2

	General UCL Statistics for Data Sets with Non-Detects
From File	ProUCL upload.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Mercury Southern AU

General Statistics

Number of Valid Data	74	Number of Detected Data	66
Number of Distinct Detected Data	30	Number of Non-Detect Data	8
		Percent Non-Detects	10.81%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	0.0241	Minimum Detected	-3.727
Maximum Detected	1.7	Maximum Detected	0.531
Mean of Detected	0.216	Mean of Detected	-2.271
SD of Detected	0.329	SD of Detected	1.161
Minimum Non-Detect	0.05	Minimum Non-Detect	-2.996
Maximum Non-Detect	0.13	Maximum Non-Detect	-2.04
Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	48
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	26
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	64.86%

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Lilliefors Test Statistic	0.279	Lilliefors Test Statistic	0.136
5% Lilliefors Critical Value	0.109	5% Lilliefors Critical Value	0.109
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	0.198	Mean	-2.374
SD	0.315	SD	1.142
95% DL/2 (t) UCL	0.259	95% H-Stat (DL/2) UCL	0.246
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE yields a negative mean		Mean in Log Scale	-2.368
		SD in Log Scale	1.136
		Mean in Original Scale	0.198
		SD in Original Scale	0.315
		95% t UCL	0.259
		95% Percentile Bootstrap UCL	0.259
		95% BCA Bootstrap UCL	0.273
		95% H-UCL	0.245

Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only	
k star (bias corrected)	0.775	Data do not follow a Discernable Distribution (0.05)	
Theta Star	0.279		
nu star	102.3		
A-D Test Statistic	3.035	**Nonparametric Statistics**	
5% A-D Critical Value	0.79	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.79	Mean	0.197
5% K-S Critical Value	0.114	SD	0.313
Data not Gamma Distributed at 5% Significance Level		SE of Mean	0.0367
		95% KM (t) UCL	0.259
Assuming Gamma Distribution		95% KM (z) UCL	0.258
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	0.258
Minimum	0.000001	95% KM (bootstrap t) UCL	0.283
Maximum	1.7	95% KM (BCA) UCL	0.262
Mean	0.195	95% KM (Percentile Bootstrap) UCL	0.264
Median	0.0788	95% KM (Chebyshev) UCL	0.357
SD	0.316	97.5% KM (Chebyshev) UCL	0.426
k star	0.472	99% KM (Chebyshev) UCL	0.562
Theta star	0.413		
Nu star	69.91	**Potential UCLs to Use**	
AppChi2	51.66	**95% KM (Chebyshev) UCL**	**0.357**
95% Gamma Approximate UCL (Use when n >= 40)	0.264		
95% Adjusted Gamma UCL (Use when n < 40)	0.266		

	General UCL Statistics for Full Data Sets
User Selected Options	
From File	ProUCL upload.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Nickel Southern AU

General Statistics

Number of Valid Observations	74	Number of Distinct Observations	46

Raw Statistics		**Log-transformed Statistics**	
Minimum	0.08	Minimum of Log Data	-2.526
Maximum	176.5	Maximum of Log Data	5.173
Mean	44.35	Mean of log Data	3.017
Geometric Mean	20.43	SD of log Data	1.772
Median	36.5		
SD	45.32		
Std. Error of Mean	5.268		
Coefficient of Variation	1.022		
Skewness	1.568		

Relevant UCL Statistics

Normal Distribution Test		**Lognormal Distribution Test**	
Lilliefors Test Statistic	0.223	Lilliefors Test Statistic	0.202
Lilliefors Critical Value	0.103	Lilliefors Critical Value	0.103
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	53.13	95% H-UCL	187.9
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	215.5
95% Adjusted-CLT UCL (Chen-1995)	54.05	97.5% Chebyshev (MVUE) UCL	268.4
95% Modified-t UCL (Johnson-1978)	53.29	99% Chebyshev (MVUE) UCL	372.2
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	0.748	Data do not follow a Discernable Distribution (0.05)	
Theta Star	59.33		
MLE of Mean	44.35		
MLE of Standard Deviation	51.3		
nu star	110.6		
Approximate Chi Square Value (.05)	87.36	**Nonparametric Statistics**	
Adjusted Level of Significance	0.0468	95% CLT UCL	53.02
Adjusted Chi Square Value	86.95	95% Jackknife UCL	53.13
		95% Standard Bootstrap UCL	52.92
Anderson-Darling Test Statistic	1.393	95% Bootstrap-t UCL	54.69
Anderson-Darling 5% Critical Value	0.792	95% Hall's Bootstrap UCL	54.08
Kolmogorov-Smirnov Test Statistic	0.116	95% Percentile Bootstrap UCL	53.12
Kolmogorov-Smirnov 5% Critical Value	0.108	95% BCA Bootstrap UCL	54.54
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	67.32
		97.5% Chebyshev(Mean, Sd) UCL	77.25
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	96.77
95% Approximate Gamma UCL (Use when n >= 40)	56.17		
95% Adjusted Gamma UCL (Use when n < 40)	56.44		
Potential UCL to Use		**Use 95% Chebyshev (Mean, Sd) UCL**	**67.32**

	General UCL Statistics for Data Sets with Non-Detects
From File	ProUCL upload.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Thallium Southern AU

General Statistics

Number of Valid Data	95	Number of Detected Data	42
Number of Distinct Detected Data	23	Number of Non-Detect Data	53
		Percent Non-Detects	55.79%
Raw Statistics		**Log-transformed Statistics**	
Minimum Detected	0.12	Minimum Detected	-2.12
Maximum Detected	4.73	Maximum Detected	1.554
Mean of Detected	1.227	Mean of Detected	-0.0504
SD of Detected	0.857	SD of Detected	0.785
Minimum Non-Detect	0.15	Minimum Non-Detect	-1.897
Maximum Non-Detect	18.41	Maximum Non-Detect	2.913
Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	95
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	0
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	100.00%

UCL Statistics

Normal Distribution Test with Detected Values Only		**Lognormal Distribution Test with Detected Values Only**	
Shapiro Wilk Test Statistic	0.794	Shapiro Wilk Test Statistic	0.875
5% Shapiro Wilk Critical Value	0.942	5% Shapiro Wilk Critical Value	0.942
Data not Normal at 5% Significance Level		**Data not Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	1.456	Mean	-0.124
SD	1.753	SD	1.054
95% DL/2 (t) UCL	1.755	95% H-Stat (DL/2) UCL	1.977
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	-0.435
		SD in Log Scale	0.708
		Mean in Original Scale	0.833
		SD in Original Scale	0.685
		95% t UCL	0.95
		95% Percentile Bootstrap UCL	0.952
		95% BCA Bootstrap UCL	0.965
		95% H-UCL	0.964
Gamma Distribution Test with Detected Values Only		**Data Distribution Test with Detected Values Only**	
k star (bias corrected)	1.976	**Data do not follow a Discernable Distribution (0.05)**	
Theta Star	0.621		
nu star	166		
A-D Test Statistic	1.252	**Nonparametric Statistics**	
5% A-D Critical Value	0.759	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.759	Mean	0.889
5% K-S Critical Value	0.138	SD	0.776
Data not Gamma Distributed at 5% Significance Level		SE of Mean	0.0954
		95% KM (t) UCL	1.048
Assuming Gamma Distribution		95% KM (z) UCL	1.046
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	1.048
Minimum	0.000001	95% KM (bootstrap t) UCL	1.063
Maximum	4.73	95% KM (BCA) UCL	1.069
Mean	0.891	95% KM (Percentile Bootstrap) UCL	1.064
Median	0.878	95% KM (Chebyshev) UCL	1.305
SD	0.718	97.5% KM (Chebyshev) UCL	1.485
k star	0.445	99% KM (Chebyshev) UCL	1.838
Theta star	2.002		
Nu star	84.6	**Potential UCLs to Use**	
AppChi2	64.4	**95% KM (t) UCL**	**1.048**
95% Gamma Approximate UCL (Use when n >= 40)	1.171	95% KM (% Bootstrap) UCL	1.064
95% Adjusted Gamma UCL (Use when n < 40)	1.176		

	General UCL Statistics for Full Data Sets
User Selected Options	
From File	ProUCL upload.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Vanadium Southern AU

General Statistics

Number of Valid Observations	84	Number of Distinct Observations	56

Raw Statistics		**Log-transformed Statistics**	
Minimum	17.07	Minimum of Log Data	2.837
Maximum	293	Maximum of Log Data	5.68
Mean	66.08	Mean of log Data	4.058
Geometric Mean	57.87	SD of log Data	0.49
Median	55		
SD	41.79		
Std. Error of Mean	4.56		
Coefficient of Variation	0.633		
Skewness	2.944		

Relevant UCL Statistics

Normal Distribution Test		**Lognormal Distribution Test**	
Lilliefors Test Statistic	0.216	Lilliefors Test Statistic	0.114
Lilliefors Critical Value	0.0967	Lilliefors Critical Value	0.0967
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	73.66	95% H-UCL	72.05
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	81.15
95% Adjusted-CLT UCL (Chen-1995)	75.14	97.5% Chebyshev (MVUE) UCL	88.07
95% Modified-t UCL (Johnson-1978)	73.91	99% Chebyshev (MVUE) UCL	101.7
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	3.797	Data do not follow a Discernable Distribution (0.05)	
Theta Star	17.4		
MLE of Mean	66.08		
MLE of Standard Deviation	33.91		
nu star	637.9		
Approximate Chi Square Value (.05)	580.3	**Nonparametric Statistics**	
Adjusted Level of Significance	0.0471	95% CLT UCL	73.58
Adjusted Chi Square Value	579.3	95% Jackknife UCL	73.66
		95% Standard Bootstrap UCL	73.48
Anderson-Darling Test Statistic	2.036	95% Bootstrap-t UCL	75.67
Anderson-Darling 5% Critical Value	0.756	95% Hall's Bootstrap UCL	77.22
Kolmogorov-Smirnov Test Statistic	0.139	95% Percentile Bootstrap UCL	73.89
Kolmogorov-Smirnov 5% Critical Value	0.098	95% BCA Bootstrap UCL	75.46
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	85.95
		97.5% Chebyshev(Mean, Sd) UCL	94.55
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	111.4
95% Approximate Gamma UCL (Use when n >= 40)	72.63		
95% Adjusted Gamma UCL (Use when n < 40)	72.75		
Potential UCL to Use		**Use 95% Student's-t UCL**	**73.66**
		or 95% Modified-t UCL	73.91

	General UCL Statistics for Data Sets with Non-Detects
From File	ProUCL upload.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Benzo(a)anthracene Southern AU

General Statistics

Number of Valid Data	45	Number of Detected Data	20
Number of Distinct Detected Data	8	Number of Non-Detect Data	25
		Percent Non-Detects	55.56%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	11	Minimum Detected	2.398
Maximum Detected	773	Maximum Detected	6.65
Mean of Detected	179.7	Mean of Detected	4.8
SD of Detected	156.8	SD of Detected	1.079
Minimum Non-Detect	70	Minimum Non-Detect	4.248
Maximum Non-Detect	458	Maximum Non-Detect	6.127
Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	44
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	1
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	97.78%

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.589	Shapiro Wilk Test Statistic	0.731
5% Shapiro Wilk Critical Value	0.905	5% Shapiro Wilk Critical Value	0.905
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	151	Mean	4.72
SD	118.6	SD	0.875
95% DL/2 (t) UCL	180.7	95% H-Stat (DL/2) UCL	221.1
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	4.232
		SD in Log Scale	0.962
		Mean in Original Scale	107.8
		SD in Original Scale	123.8
		95% t UCL	138.8
		95% Percentile Bootstrap UCL	142
		95% BCA Bootstrap UCL	150.3
		95% H-UCL	153.2

Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only	
k star (bias corrected)	1.242	Data do not follow a Discernable Distribution (0.05)	
Theta Star	144.7		
nu star	49.67		
A-D Test Statistic	2.525	**Nonparametric Statistics**	
5% A-D Critical Value	0.759	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.759	Mean	112.7
5% K-S Critical Value	0.198	SD	128.8
Data not Gamma Distributed at 5% Significance Level		SE of Mean	21.47
		95% KM (t) UCL	148.8
Assuming Gamma Distribution		95% KM (z) UCL	148
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	148.7
Minimum	0.000001	95% KM (bootstrap t) UCL	157.3
Maximum	773	95% KM (BCA) UCL	150.9
Mean	116.6	95% KM (Percentile Bootstrap) UCL	150.3
Median	113.8	95% KM (Chebyshev) UCL	206.3
SD	126.6	97.5% KM (Chebyshev) UCL	246.8
k star	0.324	99% KM (Chebyshev) UCL	326.3
Theta star	359.5		
Nu star	29.19	**Potential UCLs to Use**	
AppChi2	17.86	**95% KM (BCA) UCL**	**150.9**
95% Gamma Approximate UCL (Use when n >= 40)	190.6		
95% Adjusted Gamma UCL (Use when n < 40)	193.8		

	General UCL Statistics for Data Sets with Non-Detects
From File	ProUCL upload.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Benzo(a)pyrene Southern AU

General Statistics

Number of Valid Data	37	Number of Detected Data	18
Number of Distinct Detected Data	7	Number of Non-Detect Data	19
		Percent Non-Detects	51.35%
Raw Statistics		**Log-transformed Statistics**	
Minimum Detected	23	Minimum Detected	3.135
Maximum Detected	595	Maximum Detected	6.389
Mean of Detected	205.4	Mean of Detected	5.165
SD of Detected	122.3	SD of Detected	0.642
Minimum Non-Detect	190	Minimum Non-Detect	5.247
Maximum Non-Detect	458	Maximum Non-Detect	6.127
Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	36
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	1
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	97.30%

UCL Statistics

Normal Distribution Test with Detected Values Only		**Lognormal Distribution Test with Detected Values Only**	
Shapiro Wilk Test Statistic	0.657	Shapiro Wilk Test Statistic	0.706
5% Shapiro Wilk Critical Value	0.897	5% Shapiro Wilk Critical Value	0.897
Data not Normal at 5% Significance Level		**Data not Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	180.9	Mean	5.078
SD	95.68	SD	0.523
95% DL/2 (t) UCL	207.5	95% H-Stat (DL/2) UCL	217.8
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	5.098
		SD in Log Scale	0.478
		Mean in Original Scale	181
		SD in Original Scale	91.45
		95% t UCL	206.3
		95% Percentile Bootstrap UCL	207
		95% BCA Bootstrap UCL	216.2
		95% H-UCL	213.4
Gamma Distribution Test with Detected Values Only		**Data Distribution Test with Detected Values Only**	
k star (bias corrected)	2.771	**Data do not follow a Discernable Distribution (0.05)**	
Theta Star	74.14		
nu star	99.75		
A-D Test Statistic	2.463	**Nonparametric Statistics**	
5% A-D Critical Value	0.745	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.745	Mean	185.5
5% K-S Critical Value	0.205	SD	92.01
Data not Gamma Distributed at 5% Significance Level		SE of Mean	17.76
		95% KM (t) UCL	215.5
Assuming Gamma Distribution		95% KM (z) UCL	214.7
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	215.5
Minimum	23	95% KM (bootstrap t) UCL	219.8
Maximum	595	95% KM (BCA) UCL	215.9
Mean	200.8	95% KM (Percentile Bootstrap) UCL	213.9
Median	185.8	95% KM (Chebyshev) UCL	262.9
SD	91.12	97.5% KM (Chebyshev) UCL	296.4
k star	4.846	99% KM (Chebyshev) UCL	362.2
Theta star	41.43		
Nu star	358.6	**Potential UCLs to Use**	
AppChi2	315.7	**95% KM (t) UCL**	**215.5**
95% Gamma Approximate UCL (Use when n >= 40)	228.1	95% KM (% Bootstrap) UCL	213.9
95% Adjusted Gamma UCL (Use when n < 40)	229.3		

	General UCL Statistics for Data Sets with Non-Detects
From File	ProUCL upload.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Benzo(b)fluoranthene Southern AU

General Statistics

Number of Valid Data	45	Number of Detected Data	18
Number of Distinct Detected Data	7	Number of Non-Detect Data	27
		Percent Non-Detects	60.00%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	15	Minimum Detected	2.708
Maximum Detected	895	Maximum Detected	6.797
Mean of Detected	224.7	Mean of Detected	5.135
SD of Detected	182.3	SD of Detected	0.884
Minimum Non-Detect	70	Minimum Non-Detect	4.248
Maximum Non-Detect	458	Maximum Non-Detect	6.127
Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	44
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	1
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	97.78%

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.563	Shapiro Wilk Test Statistic	0.701
5% Shapiro Wilk Critical Value	0.897	5% Shapiro Wilk Critical Value	0.897
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	166.6	Mean	4.843
SD	134.8	SD	0.807
95% DL/2 (t) UCL	200.4	95% H-Stat (DL/2) UCL	228.6
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	4.504
		SD in Log Scale	0.844
		Mean in Original Scale	129.8
		SD in Original Scale	140.3
		95% t UCL	164.9
		95% Percentile Bootstrap UCL	164.9
		95% BCA Bootstrap UCL	181.1
		95% H-UCL	170.8
Gamma Distribution Test with Detected Values Only		**Data Distribution Test with Detected Values Only**	
k star (bias corrected)	1.65	Data do not follow a Discernable Distribution (0.05)	
Theta Star	136.1		
nu star	59.42		
A-D Test Statistic	2.573	**Nonparametric Statistics**	
5% A-D Critical Value	0.753	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.753	Mean	130.9
5% K-S Critical Value	0.206	SD	149.3
Data not Gamma Distributed at 5% Significance Level		SE of Mean	25.26
		95% KM (t) UCL	173.3
Assuming Gamma Distribution		95% KM (z) UCL	172.4
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	173.4
Minimum	0.000001	95% KM (bootstrap t) UCL	184.5
Maximum	895	95% KM (BCA) UCL	216.5
Mean	131.6	95% KM (Percentile Bootstrap) UCL	192.8
Median	126.6	95% KM (Chebyshev) UCL	241
SD	148	97.5% KM (Chebyshev) UCL	288.6
k star	0.181	99% KM (Chebyshev) UCL	382.2
Theta star	727.3		
Nu star	16.28	**Potential UCLs to Use**	
AppChi2	8.161	**95% KM (t) UCL**	**173.3**
95% Gamma Approximate UCL (Use when n >= 40)	262.5	95% KM (% Bootstrap) UCL	192.8
95% Adjusted Gamma UCL (Use when n < 40)	268.8		

	t-Test Site vs Background Comparison for Full Data Sets without NDs
User Selected Options	BEGIN BACKGROUND TEST RESULTS
From File	ProUCL upload.wst
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference (S)	0
Selected Null Hypothesis	Site or AOC Mean Less Than or Equal to Background Mean (Form 1)
Alternative Hypothesis	Site or AOC Mean Greater Than the Background Mean

BEGIN TABLE A.2

Area of Concern Data: Mercury 4900 Quebec
Background Data: MercuryBG

Raw Statistics

	Site	Background
Number of Valid Observations	13	23
Number of Distinct Observations	13	21
Minimum	0.0062	0.0065
Maximum	2.61	0.29
Mean	0.721	0.0865
Median	0.66	0.065
SD	0.687	0.0679
SE of Mean	0.191	0.0142

Site vs Background Two-Sample t-Test

H0: Mu of Site - Mu of Background <= 0

		t-Test	Critical	
Method	DF	Value	t (0.050)	P-Value
Pooled (Equal Variance)	34	4.437	1.691	0
Welch-Satterthwaite (Unequal Varian	12.1	3.318	1.782	0.003

Pooled SD 0.412

Conclusion with Alpha = 0.050

*** Student t (Pooled) Test: Reject H0, Conclude Site > Background**

* Welch-Satterthwaite Test: Reject H0, Conclude Site > Background

Test of Equality of Variances

Variance of Site	0.472
Variance of Background	0.00461

Numerator DF	Denominator DF	F-Test Value	P-Value
12	22	102.479	0

Conclusion with Alpha = 0.05

* Two variances are not equal

	t-Test Site vs Background Comparison for Full Data Sets without NDs
User Selected Options	
From File	ProUCL upload.wst
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference (S)	0
Selected Null Hypothesis	Site or AOC Mean Less Than or Equal to Background Mean (Form 1)
Alternative Hypothesis	Site or AOC Mean Greater Than the Background Mean

BEGIN TABLE A.5

Area of Concern Data: Aluminum POI39

Background Data: AluminumBG

Raw Statistics

	Site	Background
Number of Valid Observations	14	23
Number of Distinct Observations	14	21
Minimum	14400	5940
Maximum	28400	16300
Mean	22393	11552
Median	22500	11500
SD	4319	3283
SE of Mean	1154	684.5

Site vs Background Two-Sample t-Test

H0: Mu of Site - Mu of Background <= 0

		t-Test	Critical	
Method	DF	Value	t (0.050)	P-Value
Pooled (Equal Variance)	35	8.639	1.69	0
Welch-Satterthwaite (Unequal Varian	22.1	8.078	1.717	0

Pooled SD 3701.664

Conclusion with Alpha = 0.050

*** Student t (Pooled) Test: Reject H0, Conclude Site > Background**

* Welch-Satterthwaite Test: Reject H0, Conclude Site > Background

Test of Equality of Variances

Variance of Site	18654560
Variance of Background	10775991

Numerator DF	Denominator DF	F-Test Value	P-Value
13	22	1.731	0.248

Conclusion with Alpha = 0.05

* Two variances appear to be equal

	Wilcoxon-Mann-Whitney Site vs Background Comparison Test for Data Sets with Non-Detects
User Selected Options	
From File	ProUCL upload.wst
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference (S)	0
Selected Null Hypothesis	Site or AOC Mean/Median Less Than or Equal to Background Mean/Median (Form 1)
Alternative Hypothesis	Site or AOC Mean/Median Greater Than Background Mean/Median

Area of Concern Data: Antimony POI39
Background Data: AntimonyBG

Raw Statistics

	Site	Background
Number of Valid Data	14	23
Number of Non-Detect Data	11	10
Number of Detect Data	3	13
Minimum Non-Detect	2.1	5
Maximum Non-Detect	11.5	7.4
Percent Non detects	78.57%	43.48%
Minimum Detected	11.2	0.36
Maximum Detected	13.5	2.3
Mean of Detected Data	12.17	0.808
Median of Detected Data	11.8	0.7
SD of Detected Data	1.193	0.502

Wilcoxon-Mann-Whitney Site vs Background Test

All observations <= 11.5 (Max DL) are ranked the same

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Site or AOC <= Mean/Median of Background

Site Rank Sum W-Stat	289
WMW Test U-Stat	0.705
WMW Critical Value (0.050)	1.645
P-Value	0.241

Conclusion with Alpha = 0.05

Do Not Reject H0, Conclude Site <= Background

P-Value >= alpha (0.05)

	t-Test Site vs Background Comparison for Full Data Sets without NDs
User Selected Options	
From File	ProUCL upload.wst
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference (S)	0
Selected Null Hypothesis	Site or AOC Mean Less Than or Equal to Background Mean (Form 1)
Alternative Hypothesis	Site or AOC Mean Greater Than the Background Mean

Area of Concern Data: Manganese POI39

Background Data: ManganeseBG

Raw Statistics

	Site	Background
Number of Valid Observations	13	23
Number of Missing Values	1	0
Number of Distinct Observations	12	23
Minimum	233	163
Maximum	2580	1000
Mean	845.5	453
Median	551	368
SD	649.7	229.3
SE of Mean	180.2	47.81

Site vs Background Two-Sample t-Test

H0: Mu of Site - Mu of Background <= 0

		t-Test	Critical	
Method	DF	Value	t (0.050)	P-Value
Pooled (Equal Variance)	34	2.644	1.691	0.006
Welch-Satterthwaite (Unequal Varian	13.7	2.105	1.761	0.027

Pooled SD 427.790

Conclusion with Alpha = 0.050

* Student t (Pooled) Test: Reject H0, Conclude Site > Background

*** Welch-Satterthwaite Test: Reject H0, Conclude Site > Background**

Test of Equality of Variances

Variance of Site	422109
Variance of Background	52583

Numerator DF	Denominator DF	F-Test Value	P-Value
12	22	8.027	0

Conclusion with Alpha = 0.05

* Two variances are not equal

	t-Test Site vs Background Comparison for Full Data Sets without NDs
User Selected Options	
From File	ProUCL Upload.wst
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference (S)	0
Selected Null Hypothesis	Site or AOC Mean Less Than or Equal to Background Mean (Form 1)
Alternative Hypothesis	Site or AOC Mean Greater Than the Background Mean

BEGIN TABLE A.8

Area of Concern Data: Aluminum AOI 11

Background Data: AluminumBG

Raw Statistics

	Site	Background
Number of Valid Observations	6	23
Number of Distinct Observations	6	21
Minimum	16300	5940
Maximum	21000	16300
Mean	18167	11552
Median	17850	11500
SD	1574	3283
SE of Mean	642.7	684.5

Site vs Background Two-Sample t-Test

H0: Mu of Site - Mu of Background <= 0

		t-Test	Critical	
Method	DF	Value	t (0.050)	P-Value
Pooled (Equal Variance)	27	4.747	1.703	0
Welch-Satterthwaite (Unequal Varian	17.6	7.045	1.734	0

Pooled SD 3039.646

Conclusion with Alpha = 0.050

*** Student t (Pooled) Test: Reject H0, Conclude Site > Background**

* Welch-Satterthwaite Test: Reject H0, Conclude Site > Background

Test of Equality of Variances

Variance of Site	2478667
Variance of Background	10775991

Numerator DF	Denominator DF	F-Test Value	P-Value
22	5	4.347	0.109

Conclusion with Alpha = 0.05

* Two variances appear to be equal

	t-Test Site vs Background Comparison for Full Data Sets without NDs
User Selected Options	
From File	ProUCL Upload.wst
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference (S)	0
Selected Null Hypothesis	Site or AOC Mean Less Than or Equal to Background Mean (Form 1)
Alternative Hypothesis	Site or AOC Mean Greater Than the Background Mean

Area of Concern Data: Magnesium AOI 11

Background Data: MagnesiumBG

Raw Statistics

	Site	Background
Number of Valid Observations	6	23
Number of Distinct Observations	6	23
Minimum	5350	1550
Maximum	7060	8600
Mean	5848	4340
Median	5690	4360
SD	619.6	1758
SE of Mean	252.9	366.5

Site vs Background Two-Sample t-Test

H0: Mu of Site - Mu of Background <= 0

		t-Test	Critical	
Method	DF	Value	t (0.050)	P-Value
Pooled (Equal Variance)	27	2.044	1.703	0.025
Welch-Satterthwaite (Unequal Varian	24	3.386	1.711	0.001

Pooled SD 1608.984

Conclusion with Alpha = 0.050

* Student t (Pooled) Test: Reject H0, Conclude Site > Background

*** Welch-Satterthwaite Test: Reject H0, Conclude Site > Background**

Test of Equality of Variances

Variance of Site	383857	
Variance of Background	3089959	

Numerator DF	Denominator DF	F-Test Value	P-Value
22	5	8.05	0.029

Conclusion with Alpha = 0.05

* Two variances are not equal

	Wilcoxon-Mann-Whitney Site vs Background Comparison Test for Data Sets with Non-Detects
User Selected Options	
From File	ProUCL Upload.wst
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference (S)	0
Selected Null Hypothesis	Site or AOC Mean/Median Less Than or Equal to Background Mean/Median (Form 1)
Alternative Hypothesis	Site or AOC Mean/Median Greater Than Background Mean/Median

Area of Concern Data: Thallium AOI 11

Background Data: ThalliumBG

Raw Statistics

	Site	Background
Number of Valid Data	6	23
Number of Non-Detect Data	6	22
Number of Detect Data	0	1
Minimum Non-Detect	4.1	2.1
Maximum Non-Detect	4.4	3.1
Percent Non detects	100.00%	95.65%
Minimum Detected	N/A	0.82
Maximum Detected	N/A	0.82
Mean of Detected Data	N/A	0.82
Median of Detected Data	N/A	0.82
SD of Detected Data	N/A	N/A

Wilcoxon-Mann-Whitney Site vs Background Test

All observations <= 4.4 (Max DL) are ranked the same

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Site or AOC <= Mean/Median of Background

Site Rank Sum W-Stat	90
WMW Test U-Stat	-0.0269
WMW Critical Value (0.050)	1.645
P-Value	0.511

Conclusion with Alpha = 0.05

Do Not Reject H0, Conclude Site <= Background

P-Value >= alpha (0.05)

	t-Test Site vs Background Comparison for Full Data Sets without NDs
User Selected Options	
From File	ProUCL Upload.wst
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference (S)	0
Selected Null Hypothesis	Site or AOC Mean Less Than or Equal to Background Mean (Form 1)
Alternative Hypothesis	Site or AOC Mean Greater Than the Background Mean

BEGIN TABLE A.9

Area of Concern Data: Aluminum AOI 9

Background Data: AluminumBG

Raw Statistics

	Site	Background
Number of Valid Observations	48	23
Number of Distinct Observations	44	21
Minimum	4007	5940
Maximum	51900	16300
Mean	18842	11552
Median	18550	11500
SD	9152	3283
SE of Mean	1321	684.5

Site vs Background Two-Sample t-Test

H0: Mu of Site - Mu of Background <= 0

Method	DF	t-Test Value	Critical t (0.050)	P-Value
Pooled (Equal Variance)	69	3.696	1.667	0
Welch-Satterthwaite (Unequal Variance	65.5	4.9	1.668	0

Pooled SD 7777.580

Conclusion with Alpha = 0.050

* Student t (Pooled) Test: Reject H0, Conclude Site > Background

*** Welch-Satterthwaite Test: Reject H0, Conclude Site > Background**

Test of Equality of Variances

Variance of Site	83761485
Variance of Background	10775991

Numerator DF	Denominator DF	F-Test Value	P-Value
47	22	7.773	0

Conclusion with Alpha = 0.05

* Two variances are not equal

	Wilcoxon-Mann-Whitney Site vs Background Comparison Test for Data Sets with Non-Detects
User Selected Options	
From File	ProUCL upload.wst
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference (S)	0
Selected Null Hypothesis	Site or AOC Mean/Median Less Than or Equal to Background Mean/Median (Form 1)
Alternative Hypothesis	Site or AOC Mean/Median Greater Than Background Mean/Median

Area of Concern Data: Antimony AOI 9
Background Data: AntimonyBG

Raw Statistics

	Site	Background
Number of Valid Data	58	23
Number of Non-Detect Data	39	10
Number of Detect Data	19	13
Minimum Non-Detect	0.23	5
Maximum Non-Detect	10.9	7.4
Percent Non detects	67.24%	43.48%
Minimum Detected	0.194	0.36
Maximum Detected	44.2	2.3
Mean of Detected Data	13.06	0.808
Median of Detected Data	10.7	0.7
SD of Detected Data	12.69	0.502

Wilcoxon-Mann-Whitney Site vs Background Test

All observations <= 10.9 (Max DL) are ranked the same

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Site or AOC <= Mean/Median of Background

Site Rank Sum W-Stat	2482
WMW Test U-Stat	1.079
WMW Critical Value (0.050)	1.645
P-Value	0.14

Conclusion with Alpha = 0.05

Do Not Reject H0, Conclude Site <= Background

P-Value >= alpha (0.05)

	t-Test Site vs Background Comparison for Full Data Sets without NDs
User Selected Options	
From File	ProUCL Upload.wst
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference (S)	0
Selected Null Hypothesis	Site or AOC Mean Less Than or Equal to Background Mean (Form 1)
Alternative Hypothesis	Site or AOC Mean Greater Than the Background Mean

Area of Concern Data: Cobalt AOI 9

Background Data: CobaltBG

Raw Statistics

	Site	Background
Number of Valid Observations	24	23
Number of Distinct Observations	23	23
Minimum	4.33	2.5
Maximum	69.2	20
Mean	22.52	10.17
Median	19.35	8.5
SD	13.95	5.323
SE of Mean	2.847	1.11

Site vs Background Two-Sample t-Test

H0: Mu of Site - Mu of Background <= 0

		t-Test	Critical	
Method	DF	Value	t (0.050)	P-Value
Pooled (Equal Variance)	45	3.978	1.679	0
Welch-Satterthwaite (Unequal Variance)	29.8	4.043	1.697	0

Pooled SD 10.642

Conclusion with Alpha = 0.050

* Student t (Pooled) Test: Reject H0, Conclude Site > Background

*** Welch-Satterthwaite Test: Reject H0, Conclude Site > Background**

Test of Equality of Variances

Variance of Site	194.5
Variance of Background	28.34

Numerator DF	Denominator DF	F-Test Value	P-Value
23	22	6.863	0

Conclusion with Alpha = 0.05

* Two variances are not equal

	t-Test Site vs Background Comparison for Full Data Sets without NDs
User Selected Options	
From File	ProUCL Upload.wst
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference (S)	0
Selected Null Hypothesis	Site or AOC Mean Less Than or Equal to Background Mean (Form 1)
Alternative Hypothesis	Site or AOC Mean Greater Than the Background Mean

Area of Concern Data: Magnesium AOI 9

Background Data: MagnesiumBG

Raw Statistics

	Site	Background
Number of Valid Observations	9	23
Number of Distinct Observations	8	23
Minimum	534.5	1550
Maximum	7490	8600
Mean	4888	4340
Median	5020	4360
SD	2727	1758
SE of Mean	908.9	366.5

Site vs Background Two-Sample t-Test

H0: Mu of Site - Mu of Background <= 0

		t-Test	Critical	
Method	DF	Value	t (0.050)	P-Value
Pooled (Equal Variance)	30	0.675	1.697	0.252
Welch-Satterthwaite (Unequal Variance)	10.7	0.558	1.796	0.294

Pooled SD 2061.250

Conclusion with Alpha = 0.050

*** Student t (Pooled) Test: Do Not Reject H0, Conclude Site <= Background**

* Welch-Satterthwaite Test: Do Not Reject H0, Conclude Site <= Background

Test of Equality of Variances

Variance of Site	7435426
Variance of Background	3089959

Numerator DF	Denominator DF	F-Test Value	P-Value
8	22	2.406	0.098

Conclusion with Alpha = 0.05

* Two variances appear to be equal

	t-Test Site vs Background Comparison for Full Data Sets without NDs
User Selected Options	
From File	ProUCL Upload.wst
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference (S)	0
Selected Null Hypothesis	Site or AOC Mean Less Than or Equal to Background Mean (Form 1)
Alternative Hypothesis	Site or AOC Mean Greater Than the Background Mean

Area of Concern Data: Manganese AOI 9

Background Data: ManganeseBG

Raw Statistics

	Site	Background
Number of Valid Observations	48	23
Number of Distinct Observations	46	23
Minimum	89	163
Maximum	2040	1000
Mean	593.3	453
Median	514	368
SD	338.2	229.3
SE of Mean	48.82	47.81

Site vs Background Two-Sample t-Test

H0: Mu of Site - Mu of Background <= 0

		t-Test	Critical	
Method	DF	Value	t (0.050)	P-Value
Pooled (Equal Variance)	69	1.799	1.667	0.038
Welch-Satterthwaite (Unequal Variance)	60.8	2.054	1.67	0.022

Pooled SD 307.709

Conclusion with Alpha = 0.050

*** Student t (Pooled) Test: Reject H0, Conclude Site > Background**

* Welch-Satterthwaite Test: Reject H0, Conclude Site > Background

Test of Equality of Variances

Variance of Site	114392
Variance of Background	52583

Numerator DF	Denominator DF	F-Test Value	P-Value
47	22	2.175	0.051

Conclusion with Alpha = 0.05

* Two variances appear to be equal

	t-Test Site vs Background Comparison for Full Data Sets without NDs
User Selected Options	
From File	ProUCL Upload.wst
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference (S)	0
Selected Null Hypothesis	Site or AOC Mean Less Than or Equal to Background Mean (Form 1)
Alternative Hypothesis	Site or AOC Mean Greater Than the Background Mean

Area of Concern Data: Vanadium AOI 9

Background Data: VanadiumBG

Raw Statistics

	Site	Background
Number of Valid Observations	56	23
Number of Distinct Observations	53	23
Minimum	0.66	27.6
Maximum	307	85
Mean	43.82	55.43
Median	29.1	54.1
SD	48.51	14.98
SE of Mean	6.483	3.123

Site vs Background Two-Sample t-Test

H0: Mu of Site - Mu of Background <= 0

		t-Test	Critical	
Method	DF	Value	t (0.050)	P-Value
Pooled (Equal Variance)	77	-1.122	1.665	0.867
Welch-Satterthwaite (Unequal Varian	73.6	-1.613	1.666	0.944

Pooled SD 41.776

Conclusion with Alpha = 0.050

* Student t (Pooled) Test: Do Not Reject H0, Conclude Site <= Background

*** Welch-Satterthwaite Test: Do Not Reject H0, Conclude Site <= Background**

Test of Equality of Variances

Variance of Site	2354
Variance of Background	224.3

Numerator DF	Denominator DF	F-Test Value	P-Value
55	22	10.494	0

Conclusion with Alpha = 0.05

* Two variances are not equal

	t-Test Site vs Background Comparison for Full Data Sets without NDs
User Selected Options	
From File	ProUCL upload.wst
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference (S)	0
Selected Null Hypothesis	Site or AOC Mean Less Than or Equal to Background Mean (Form 1)
Alternative Hypothesis	Site or AOC Mean Greater Than the Background Mean

BEGIN TABLE A.10

Area of Concern Data: Aluminum AOI 13

Background Data: AluminumBG

Raw Statistics

	Site	Background
Number of Valid Observations	15	23
Number of Distinct Observations	14	21
Minimum	9260	5940
Maximum	29700	16300
Mean	17857	11552
Median	16450	11500
SD	6112	3283
SE of Mean	1578	684.5

Site vs Background Two-Sample t-Test

H0: Mu of Site - Mu of Background <= 0

		t-Test	Critical	
Method	DF	Value	t (0.050)	P-Value
Pooled (Equal Variance)	36	4.135	1.688	0
Welch-Satterthwaite (Unequal Variance)	19.3	3.665	1.729	0.001

Pooled SD 4594.892

Conclusion with Alpha = 0.050

* Student t (Pooled) Test: Reject H0, Conclude Site > Background

*** Welch-Satterthwaite Test: Reject H0, Conclude Site > Background**

Test of Equality of Variances

Variance of Site	37356950
Variance of Background	10775991

Numerator DF	Denominator DF	F-Test Value	P-Value
14	22	3.467	0.009

Conclusion with Alpha = 0.05

* Two variances are not equal

	t-Test Site vs Background Comparison for Full Data Sets without NDs
User Selected Options	
From File	ProUCL upload.wst
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference (S)	0
Selected Null Hypothesis	Site or AOC Mean Less Than or Equal to Background Mean (Form 1)
Alternative Hypothesis	Site or AOC Mean Greater Than the Background Mean

Area of Concern Data: Cobalt AOI 13

Background Data: CobaltBG

Raw Statistics

	Site	Background
Number of Valid Observations	15	23
Number of Distinct Observations	14	23
Minimum	0.66	2.5
Maximum	30.7	20
Mean	17.43	10.17
Median	17.1	8.5
SD	8.995	5.323
SE of Mean	2.323	1.11

Site vs Background Two-Sample t-Test

H0: Mu of Site - Mu of Background <= 0

		t-Test	Critical	
Method	DF	Value	t (0.050)	P-Value
Pooled (Equal Variance)	36	3.134	1.688	0.002
Welch-Satterthwaite (Unequal Variance)	20.4	2.822	1.725	0.005

Pooled SD 6.985

Conclusion with Alpha = 0.050

* Student t (Pooled) Test: Reject H0, Conclude Site > Background

*** Welch-Satterthwaite Test: Reject H0, Conclude Site > Background**

Test of Equality of Variances

Variance of Site	80.92
Variance of Background	28.34

Numerator DF	Denominator DF	F-Test Value	P-Value
14	22	2.855	0.027

Conclusion with Alpha = 0.05

* Two variances are not equal

	t-Test Site vs Background Comparison for Full Data Sets without NDs
User Selected Options	
From File	ProUCL upload.wst
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference (S)	0
Selected Null Hypothesis	Site or AOC Mean Less Than or Equal to Background Mean (Form 1)
Alternative Hypothesis	Site or AOC Mean Greater Than the Background Mean

Area of Concern Data: Iron AOI 13

Background Data: IronBG

Raw Statistics

	Site	Background
Number of Valid Observations	7	23
Number of Distinct Observations	6	22
Minimum	26300	14000
Maximum	38500	36200
Mean	32733	24643
Median	32500	23100
SD	4754	6635
SE of Mean	1797	1383

Site vs Background Two-Sample t-Test

H0: Mu of Site - Mu of Background <= 0

Method	DF	t-Test Value	Critical t (0.050)	P-Value
Pooled (Equal Variance)	28	2.985	1.701	0.003
Welch-Satterthwaite (Unequal Variance	13.9	3.567	1.761	0.002

Pooled SD 6279.391

Conclusion with Alpha = 0.050

*** Student t (Pooled) Test: Reject H0, Conclude Site > Background**

* Welch-Satterthwaite Test: Reject H0, Conclude Site > Background

Test of Equality of Variances

Variance of Site	22600741
Variance of Background	44020751

Numerator DF	Denominator DF	F-Test Value	P-Value
22	6	1.948	0.417

Conclusion with Alpha = 0.05

* Two variances appear to be equal

	t-Test Site vs Background Comparison for Full Data Sets without NDs
User Selected Options	
From File	ProUCL upload.wst
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference (S)	0
Selected Null Hypothesis	Site or AOC Mean Less Than or Equal to Background Mean (Form 1)
Alternative Hypothesis	Site or AOC Mean Greater Than the Background Mean

Area of Concern Data: Magnesium AOI 13

Background Data: MagnesiumBG

Raw Statistics

	Site	Background
Number of Valid Observations	7	23
Number of Distinct Observations	6	23
Minimum	425.5	1550
Maximum	13100	8600
Mean	5867	4340
Median	6630	4360
SD	4458	1758
SE of Mean	1685	366.5

Site vs Background Two-Sample t-Test

H0: Mu of Site - Mu of Background <= 0

		t-Test	Critical	
Method	DF	Value	t (0.050)	P-Value
Pooled (Equal Variance)	28	1.368	1.701	0.091
Welch-Satterthwaite (Unequal Varian	6.6	0.886	1.895	0.204

Pooled SD 2585.656

Conclusion with Alpha = 0.050

* Student t (Pooled) Test: Do Not Reject H0, Conclude Site <= Background

*** Welch-Satterthwaite Test: Do Not Reject H0, Conclude Site <= Background**

Test of Equality of Variances

Variance of Site	19869701		
Variance of Background	3089959		

Numerator DF	Denominator DF	F-Test Value	P-Value
6	22	6.43	0.001

Conclusion with Alpha = 0.05

* Two variances are not equal

	t-Test Site vs Background Comparison for Full Data Sets without NDs
User Selected Options	
From File	ProUCL upload.wst
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference (S)	0
Selected Null Hypothesis	Site or AOC Mean Less Than or Equal to Background Mean (Form 1)
Alternative Hypothesis	Site or AOC Mean Greater Than the Background Mean

Area of Concern Data: Manganese AOI 13

Background Data: ManganeseBG

Raw Statistics

	Site	Background
Number of Valid Observations	16	23
Number of Distinct Observations	15	23
Minimum	9.637	163
Maximum	992	1000
Mean	525	453
Median	563.5	368
SD	253.4	229.3
SE of Mean	63.36	47.81

Site vs Background Two-Sample t-Test

H0: Mu of Site - Mu of Background <= 0

Method	DF	t-Test Value	Critical t (0.050)	P-Value
Pooled (Equal Variance)	37	0.925	1.687	0.181
Welch-Satterthwaite (Unequal Variance	30.3	0.908	1.697	0.186

Pooled SD 239.381

Conclusion with Alpha = 0.050

*** Student t (Pooled) Test: Do Not Reject H0, Conclude Site <= Background**

* Welch-Satterthwaite Test: Do Not Reject H0, Conclude Site <= Background

Test of Equality of Variances

Variance of Site	64227
Variance of Background	52583

Numerator DF	Denominator DF	F-Test Value	P-Value
15	22	1.221	0.653

Conclusion with Alpha = 0.05

* Two variances appear to be equal

	Wilcoxon-Mann-Whitney Site vs Background Comparison Test for Data Sets with Non-Detects
User Selected Options	
From File	ProUCL upload.wst
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference (S)	0
Selected Null Hypothesis	Site or AOC Mean/Median Less Than or Equal to Background Mean/Median (Form 1)
Alternative Hypothesis	Site or AOC Mean/Median Greater Than Background Mean/Median

Area of Concern Data: Thallium AOI 13

Background Data: ThalliumBG

Raw Statistics

	Site	Background
Number of Valid Data	15	23
Number of Non-Detect Data	7	22
Number of Detect Data	8	1
Minimum Non-Detect	0.11	2.1
Maximum Non-Detect	1.2	3.1
Percent Non detects	46.67%	95.65%
Minimum Detected	0.17	0.82
Maximum Detected	3.2	0.82
Mean of Detected Data	1.541	0.82
Median of Detected Data	1.79	0.82
SD of Detected Data	1.131	N/A

Wilcoxon-Mann-Whitney Site vs Background Test

All observations <= 3.1 (Max DL) are ranked the same

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Site or AOC <= Mean/Median of Background

Site Rank Sum W-Stat	304
WMW Test U-Stat	0.329
WMW Critical Value (0.050)	1.645
P-Value	0.371

Conclusion with Alpha = 0.05

Do Not Reject H0, Conclude Site <= Background

P-Value >= alpha (0.05)

	t-Test Site vs Background Comparison for Full Data Sets without NDs
User Selected Options	
From File	ProUCL upload.wst
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference (S)	0
Selected Null Hypothesis	Site or AOC Mean Less Than or Equal to Background Mean (Form 1)
Alternative Hypothesis	Site or AOC Mean Greater Than the Background Mean

Area of Concern Data: Vanadium AOI 13
Background Data: VanadiumBG

Raw Statistics

	Site	Background
Number of Valid Observations	15	23
Number of Distinct Observations	14	23
Minimum	32.2	27.6
Maximum	103	85
Mean	63.18	55.43
Median	63.8	54.1
SD	27.12	14.98
SE of Mean	7.002	3.123

Site vs Background Two-Sample t-Test

H0: Mu of Site - Mu of Background <= 0

		t-Test	Critical	
Method	DF	Value	t (0.050)	P-Value
Pooled (Equal Variance)	36	1.136	1.688	0.132
Welch-Satterthwaite (Unequal Varian	19.6	1.012	1.725	0.162

Pooled SD 20.569

Conclusion with Alpha = 0.050

* Student t (Pooled) Test: Do Not Reject H0, Conclude Site <= Background

*** Welch-Satterthwaite Test: Do Not Reject H0, Conclude Site <= Background**

Test of Equality of Variances

Variance of Site	735.5
Variance of Background	224.3

Numerator DF	Denominator DF	F-Test Value	P-Value
14	22	3.279	0.013

Conclusion with Alpha = 0.05

* Two variances are not equal

	t-Test Site vs Background Comparison for Full Data Sets without NDs
User Selected Options	
From File	ProUCL upload.wst
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference (S)	0
Selected Null Hypothesis	Site or AOC Mean Less Than or Equal to Background Mean (Form 1)
Alternative Hypothesis	Site or AOC Mean Greater Than the Background Mean

BEGIN TABLE A.11

Area of Concern Data: Aluminum Western 53

Background Data: AluminumBG

Raw Statistics

	Site	Background
Number of Valid Observations	5	23
Number of Distinct Observations	5	21
Minimum	11900	5940
Maximum	26500	16300
Mean	16560	11552
Median	14900	11500
SD	5729	3283
SE of Mean	2562	684.5

Site vs Background Two-Sample t-Test

H0: Mu of Site - Mu of Background <= 0

		t-Test	Critical	
Method	DF	Value	t (0.050)	P-Value
Pooled (Equal Variance)	26	2.696	1.706	0.006
Welch-Satterthwaite (Unequal Variance	4.6	1.888	2.015	0.061

Pooled SD 3763.917

Conclusion with Alpha = 0.050

*** Student t (Pooled) Test: Reject H0, Conclude Site > Background**

* Welch-Satterthwaite Test: Do Not Reject H0, Conclude Site <= Background

Test of Equality of Variances

Variance of Site	32818000
Variance of Background	10775991

Numerator DF	Denominator DF	F-Test Value	P-Value
4	22	3.045	0.077

Conclusion with Alpha = 0.05

* Two variances appear to be equal

	t-Test Site vs Background Comparison for Full Data Sets without NDs
User Selected Options	
From File	ProUCL upload.wst
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference (S)	0
Selected Null Hypothesis	Site or AOC Mean Less Than or Equal to Background Mean (Form 1)
Alternative Hypothesis	Site or AOC Mean Greater Than the Background Mean

Area of Concern Data: Manganese Western 53

Background Data: ManganeseBG

Raw Statistics

	Site	Background
Number of Valid Observations	5	23
Number of Distinct Observations	5	23
Minimum	128	163
Maximum	1380	1000
Mean	604.8	453
Median	206	368
SD	612.9	229.3
SE of Mean	274.1	47.81

Site vs Background Two-Sample t-Test

H0: Mu of Site - Mu of Background <= 0

		t-Test	Critical	
Method	DF	Value	t (0.050)	P-Value
Pooled (Equal Variance)	26	0.962	1.706	0.172
Welch-Satterthwaite (Unequal Varian	4.2	0.546	2.132	0.306

Pooled SD 319.809

Conclusion with Alpha = 0.050

* Student t (Pooled) Test: Do Not Reject H0, Conclude Site <= Background

*** Welch-Satterthwaite Test: Do Not Reject H0, Conclude Site <= Background**

Test of Equality of Variances

Variance of Site	375601
Variance of Background	52583

Numerator DF	Denominator DF	F-Test Value	P-Value
4	22	7.143	0.002

Conclusion with Alpha = 0.05

* Two variances are not equal

	Wilcoxon-Mann-Whitney Site vs Background Comparison Test for Data Sets with Non-Detects
User Selected Options	
From File	ProUCL upload.wst
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference (S)	0
Selected Null Hypothesis	Site or AOC Mean/Median Less Than or Equal to Background Mean/Median (Form 1)
Alternative Hypothesis	Site or AOC Mean/Median Greater Than Background Mean/Median

Area of Concern Data: Thallium Western 53

Background Data: ThalliumBG

Raw Statistics

	Site	Background
Number of Valid Data	10	23
Number of Non-Detect Data	5	22
Number of Detect Data	5	1
Minimum Non-Detect	0.85	2.1
Maximum Non-Detect	0.93	3.1
Percent Non detects	50.00%	95.65%
Minimum Detected	1.88	0.82
Maximum Detected	3.41	0.82
Mean of Detected Data	2.428	0.82
Median of Detected Data	2.32	0.82
SD of Detected Data	0.586	N/A

Wilcoxon-Mann-Whitney Site vs Background Test

All observations <= 3.1 (Max DL) are ranked the same

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Site or AOC <= Mean/Median of Background

Site Rank Sum W-Stat	181.5
WMW Test U-Stat	0.431
WMW Critical Value (0.050)	1.645
P-Value	0.333

Conclusion with Alpha = 0.05

Do Not Reject H0, Conclude Site <= Background

P-Value >= alpha (0.05)

	t-Test Site vs Background Comparison for Full Data Sets without NDs
User Selected Options	
From File	ProUCL upload.wst
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference (S)	0
Selected Null Hypothesis	Site or AOC Mean Less Than or Equal to Background Mean (Form 1)
Alternative Hypothesis	Site or AOC Mean Greater Than the Background Mean

Area of Concern Data: Vanadium Western 53

Background Data: VanadiumBG

Raw Statistics

	Site	Background
Number of Valid Observations	10	23
Number of Distinct Observations	10	23
Minimum	45.1	27.6
Maximum	129	85
Mean	70.37	55.43
Median	69.7	54.1
SD	23.32	14.98
SE of Mean	7.374	3.123

Site vs Background Two-Sample t-Test

H0: Mu of Site - Mu of Background <= 0

		t-Test	Critical	
Method	DF	Value	t (0.050)	P-Value
Pooled (Equal Variance)	31	2.216	1.696	0.017
Welch-Satterthwaite (Unequal Varian	12.4	1.866	1.782	0.043

Pooled SD 17.805

Conclusion with Alpha = 0.050

*** Student t (Pooled) Test: Reject H0, Conclude Site > Background**

* Welch-Satterthwaite Test: Reject H0, Conclude Site > Background

Test of Equality of Variances

Variance of Site	543.7
Variance of Background	224.3

Numerator DF	Denominator DF	F-Test Value	P-Value
9	22	2.424	0.087

Conclusion with Alpha = 0.05

* Two variances appear to be equal

	t-Test Site vs Background Comparison for Full Data Sets without NDs
User Selected Options	
From File	ProUCL upload.wst
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference (S)	0
Selected Null Hypothesis	Site or AOC Mean Less Than or Equal to Background Mean (Form 1)
Alternative Hypothesis	Site or AOC Mean Greater Than the Background Mean

BEGIN TABLE A.12

Area of Concern Data: Aluminum Spaulding Rankin

Background Data: AluminumBG

Raw Statistics

	Site	Background
Number of Valid Observations	66	23
Number of Distinct Observations	64	21
Minimum	2530	5940
Maximum	37428	16300
Mean	15639	11552
Median	15248	11500
SD	6068	3283
SE of Mean	746.9	684.5

Site vs Background Two-Sample t-Test

H0: Mu of Site - Mu of Background <= 0

		t-Test	Critical	
Method	DF	Value	t (0.050)	P-Value
Pooled (Equal Variance)	87	3.069	1.663	0.001
Welch-Satterthwaite (Unequal Varian	71.3	4.034	1.667	0

Pooled SD 5498.519

Conclusion with Alpha = 0.050

* Student t (Pooled) Test: Reject H0, Conclude Site > Background

*** Welch-Satterthwaite Test: Reject H0, Conclude Site > Background**

Test of Equality of Variances

Variance of Site	36819403
Variance of Background	10775991

Numerator DF	Denominator DF	F-Test Value	P-Value
65	22	3.417	0.002

Conclusion with Alpha = 0.05

* Two variances are not equal

	Wilcoxon-Mann-Whitney Site vs Background Comparison Test for Data Sets with Non-Detects
User Selected Options	
From File	ProUCL upload.wst
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference (S)	0
Selected Null Hypothesis	Site or AOC Mean/Median Less Than or Equal to Background Mean/Median (Form 1)
Alternative Hypothesis	Site or AOC Mean/Median Greater Than Background Mean/Median

Area of Concern Data: Antimony Spaulding Rankin

Background Data: AntimonyBG

Raw Statistics

	Site	Background
Number of Valid Data	54	23
Number of Non-Detect Data	27	10
Number of Detect Data	27	13
Minimum Non-Detect	3.25	5
Maximum Non-Detect	14.7	7.4
Percent Non detects	50.00%	43.48%
Minimum Detected	0.454	0.36
Maximum Detected	18.5	2.3
Mean of Detected Data	4.947	0.808
Median of Detected Data	1.47	0.7
SD of Detected Data	5.062	0.502

Wilcoxon-Mann-Whitney Site vs Background Test

All observations <= 14.7 (Max DL) are ranked the same

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Site or AOC <= Mean/Median of Background

Site Rank Sum W-Stat	2129
WMW Test U-Stat	0.25
WMW Critical Value (0.050)	1.645
P-Value	0.401

Conclusion with Alpha = 0.05

Do Not Reject H0, Conclude Site <= Background

P-Value >= alpha (0.05)

	Wilcoxon-Mann-Whitney Site vs Background Comparison Test for Data Sets with Non-Detects
User Selected Options	
From File	ProUCL upload.wst
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference (S)	0
Selected Null Hypothesis	Site or AOC Mean/Median Less Than or Equal to Background Mean/Median (Form 1)
Alternative Hypothesis	Site or AOC Mean/Median Greater Than Background Mean/Median

Area of Concern Data: Arsenic Spaulding Rankin

Background Data: ArsenicBG

Raw Statistics

	Site	Background
Number of Valid Data	64	23
Number of Non-Detect Data	8	0
Number of Detect Data	56	23
Minimum Non-Detect	0.25	N/A
Maximum Non-Detect	2.1	N/A
Percent Non detects	12.50%	0.00%
Minimum Detected	0.2	2.1
Maximum Detected	131	8.2
Mean of Detected Data	7.35	4.683
Median of Detected Data	2.225	4.6
SD of Detected Data	19.34	1.555

Wilcoxon-Mann-Whitney Site vs Background Test

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Site or AOC <= Mean/Median of Background

Site Rank Sum W-Stat	2414
WMW Test U-Stat	-3.874
WMW Critical Value (0.050)	1.645
P-Value	1

Conclusion with Alpha = 0.05

Do Not Reject H0, Conclude Site <= Background

P-Value >= alpha (0.05)

	t-Test Site vs Background Comparison for Full Data Sets without NDs
User Selected Options	
From File	ProUCL upload.wst
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference (S)	0
Selected Null Hypothesis	Site or AOC Mean Less Than or Equal to Background Mean (Form 1)
Alternative Hypothesis	Site or AOC Mean Greater Than the Background Mean

Area of Concern Data: Cobalt Spaulding Rankin

Background Data: CobaltBG

Raw Statistics

	Site	Background
Number of Valid Observations	38	23
Number of Distinct Observations	38	23
Minimum	11.96	2.5
Maximum	426.5	20
Mean	79.17	10.17
Median	49.32	8.5
SD	82.68	5.323
SE of Mean	13.41	1.11

Site vs Background Two-Sample t-Test

H0: Mu of Site - Mu of Background <= 0

		t-Test	Critical	
Method	DF	Value	t (0.050)	P-Value
Pooled (Equal Variance)	59	3.984	1.671	0
Welch-Satterthwaite (Unequal Varian	37.5	5.127	1.686	0

Pooled SD 65.558

Conclusion with Alpha = 0.050

* Student t (Pooled) Test: Reject H0, Conclude Site > Background

*** Welch-Satterthwaite Test: Reject H0, Conclude Site > Background**

Test of Equality of Variances

Variance of Site	6837
Variance of Background	28.34

Numerator DF	Denominator DF	F-Test Value	P-Value
37	22	241.26	0

Conclusion with Alpha = 0.05

* Two variances are not equal

	t-Test Site vs Background Comparison for Full Data Sets without NDs
User Selected Options	
From File	ProUCL upload.wst
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference (S)	0
Selected Null Hypothesis	Site or AOC Mean Less Than or Equal to Background Mean (Form 1)
Alternative Hypothesis	Site or AOC Mean Greater Than the Background Mean

Area of Concern Data: Iron Spaulding Rankin

Background Data: IronBG

Raw Statistics

	Site	Background
Number of Valid Observations	30	23
Number of Distinct Observations	30	22
Minimum	26308	14000
Maximum	140536	36200
Mean	56729	24643
Median	54545	23100
SD	22749	6635
SE of Mean	4153	1383

Site vs Background Two-Sample t-Test

H0: Mu of Site - Mu of Background <= 0

		t-Test	Critical	
Method	DF	Value	t (0.050)	P-Value
Pooled (Equal Variance)	51	6.541	1.675	0
Welch-Satterthwaite (Unequal Varian	35.2	7.329	1.69	0

Pooled SD 17699.597

Conclusion with Alpha = 0.050

* Student t (Pooled) Test: Reject H0, Conclude Site > Background

*** Welch-Satterthwaite Test: Reject H0, Conclude Site > Background**

Test of Equality of Variances

Variance of Site	517500000
Variance of Background	44020751

Numerator DF	Denominator DF	F-Test Value	P-Value
29	22	11.757	0

Conclusion with Alpha = 0.05

* Two variances are not equal

	t-Test Site vs Background Comparison for Full Data Sets without NDs
User Selected Options	
From File	ProUCL upload.wst
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference (S)	0
Selected Null Hypothesis	Site or AOC Mean Less Than or Equal to Background Mean (Form 1)
Alternative Hypothesis	Site or AOC Mean Greater Than the Background Mean

Area of Concern Data: Magnesium Spaulding Rankin

Background Data: MagnesiumBG

Raw Statistics

	Site	Background
Number of Valid Observations	30	23
Number of Distinct Observations	30	23
Minimum	1278	1550
Maximum	14900	8600
Mean	4600	4340
Median	4291	4360
SD	3047	1758
SE of Mean	556.4	366.5

Site vs Background Two-Sample t-Test

H0: Mu of Site - Mu of Background <= 0

Method	DF	t-Test Value	Critical t (0.050)	P-Value
Pooled (Equal Variance)	51	0.364	1.675	0.359
Welch-Satterthwaite (Unequal Varian	47.8	0.389	1.677	0.349

Pooled SD 2571.611

Conclusion with Alpha = 0.050

* Student t (Pooled) Test: Do Not Reject H0, Conclude Site <= Background

*** Welch-Satterthwaite Test: Do Not Reject H0, Conclude Site <= Background**

Test of Equality of Variances

Variance of Site	9285972
Variance of Background	3089959

Numerator DF	Denominator DF	F-Test Value	P-Value
29	22	3.005	0.01

Conclusion with Alpha = 0.05

* Two variances are not equal

t-Test Site vs Background Comparison for Full Data Sets without NDs

User Selected Options	
From File	ProUCL upload.wst
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference (S)	0
Selected Null Hypothesis	Site or AOC Mean Less Than or Equal to Background Mean (Form 1)
Alternative Hypothesis	Site or AOC Mean Greater Than the Background Mean

Area of Concern Data: Manganese Spaulding Rankin

Background Data: ManganeseBG

Raw Statistics

	Site	Background
Number of Valid Observations	66	23
Number of Distinct Observations	64	23
Minimum	222	163
Maximum	3248	1000
Mean	1123	453
Median	901	368
SD	764.9	229.3
SE of Mean	94.15	47.81

Site vs Background Two-Sample t-Test

H0: Mu of Site - Mu of Background <= 0

		t-Test	Critical	
Method	DF	Value	t (0.050)	P-Value
Pooled (Equal Variance)	87	4.123	1.663	0
Welch-Satterthwaite (Unequal Varian	86	6.345	1.663	0

Pooled SD 671.097

Conclusion with Alpha = 0.050

* Student t (Pooled) Test: Reject H0, Conclude Site > Background

*** Welch-Satterthwaite Test: Reject H0, Conclude Site > Background**

Test of Equality of Variances

Variance of Site	585007
Variance of Background	52583

Numerator DF	Denominator DF	F-Test Value	P-Value
65	22	11.125	0

Conclusion with Alpha = 0.05

* Two variances are not equal

	Wilcoxon-Mann-Whitney Site vs Background Comparison Test for Data Sets with Non-Detects
User Selected Options	
From File	ProUCL upload.wst
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference (S)	0
Selected Null Hypothesis	Site or AOC Mean/Median Less Than or Equal to Background Mean/Median (Form 1)
Alternative Hypothesis	Site or AOC Mean/Median Greater Than Background Mean/Median

Area of Concern Data: Thallium Spaulding Rankin

Background Data: ThalliumBG

Raw Statistics

	Site	Background
Number of Valid Data	70	23
Number of Missing Values	1	0
Number of Non-Detect Data	39	22
Number of Detect Data	31	1
Minimum Non-Detect	0.22	2.1
Maximum Non-Detect	14.03	3.1
Percent Non detects	55.71%	95.65%
Minimum Detected	0.25	0.82
Maximum Detected	75.72	0.82
Mean of Detected Data	14.18	0.82
Median of Detected Data	4.89	0.82
SD of Detected Data	19.26	N/A

Wilcoxon-Mann-Whitney Site vs Background Test

All observations <= 14.03 (Max DL) are ranked the same

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Site or AOC <= Mean/Median of Background

Site Rank Sum W-Stat	3371
WMW Test U-Stat	0.712
WMW Critical Value (0.050)	1.645
P-Value	0.238

Conclusion with Alpha = 0.05

Do Not Reject H0, Conclude Site <= Background

P-Value >= alpha (0.05)

	t-Test Site vs Background Comparison for Full Data Sets without NDs
User Selected Options	
From File	ProUCL upload.wst
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference (S)	0
Selected Null Hypothesis	Site or AOC Mean Less Than or Equal to Background Mean (Form 1)
Alternative Hypothesis	Site or AOC Mean Greater Than the Background Mean

Area of Concern Data: Vanadium Spaulding Rankin

Background Data: VanadiumBG

Raw Statistics

	Site	Background
Number of Valid Observations	71	23
Number of Distinct Observations	70	23
Minimum	24	27.6
Maximum	195	85
Mean	94.85	55.43
Median	90.9	54.1
SD	36.55	14.98
SE of Mean	4.338	3.123

Site vs Background Two-Sample t-Test

H0: Mu of Site - Mu of Background <= 0

		t-Test	Critical	
Method	DF	Value	t (0.050)	P-Value
Pooled (Equal Variance)	92	5.023	1.662	0
Welch-Satterthwaite (Unequal Varian	87	7.375	1.663	0

Pooled SD 32.715

Conclusion with Alpha = 0.050

* Student t (Pooled) Test: Reject H0, Conclude Site > Background

*** Welch-Satterthwaite Test: Reject H0, Conclude Site > Background**

Test of Equality of Variances

Variance of Site	1336
Variance of Background	224.3

Numerator DF	Denominator DF	F-Test Value	P-Value
70	22	5.958	0

Conclusion with Alpha = 0.05

* Two variances are not equal

	t-Test Site vs Background Comparison for Full Data Sets without NDs
User Selected Options	
From File	ProUCL upload.wst
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference (S)	0
Selected Null Hypothesis	Site or AOC Mean Less Than or Equal to Background Mean (Form 1)
Alternative Hypothesis	Site or AOC Mean Greater Than the Background Mean

Area of Concern Data: Zinc Spaulding Rankin

Background Data: ZincBG

Raw Statistics

	Site	Background
Number of Valid Observations	30	23
Number of Distinct Observations	30	22
Minimum	42.17	39.1
Maximum	13600	283
Mean	537.2	113.2
Median	78.25	90.7
SD	2467	64.03
SE of Mean	450.5	13.35

Site vs Background Two-Sample t-Test

H0: Mu of Site - Mu of Background <= 0

		t-Test	Critical	
Method	DF	Value	t (0.050)	P-Value
Pooled (Equal Variance)	51	0.822	1.675	0.207
Welch-Satterthwaite (Unequal Variance)	29.1	0.941	1.699	0.177

Pooled SD 1861.137

Conclusion with Alpha = 0.050

* Student t (Pooled) Test: Do Not Reject H0, Conclude Site <= Background

*** Welch-Satterthwaite Test: Do Not Reject H0, Conclude Site <= Background**

Test of Equality of Variances

Variance of Site	6088451
Variance of Background	4100

Numerator DF	Denominator DF	F-Test Value	P-Value
29	22	1484.969	0

Conclusion with Alpha = 0.05

* Two variances are not equal

BEGIN TABLE A.13

	t-Test Site vs Background Comparison for Full Data Sets without NDs
User Selected Options	
From File	ProUCL upload.wst
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference (S)	0
Selected Null Hypothesis	Site or AOC Mean Less Than or Equal to Background Mean (Form 1)
Alternative Hypothesis	Site or AOC Mean Greater Than the Background Mean

Area of Concern Data: Aluminum Southern AU
Background Data: AluminumBG

Raw Statistics

	Site	Background
Number of Valid Observations	74	23
Number of Distinct Observations	42	21
Minimum	3740	5940
Maximum	56138	16300
Mean	18932	11552
Median	17653	11500
SD	9269	3283
SE of Mean	1078	684.5

Site vs Background Two-Sample t-Test

H0: Mu of Site - Mu of Background <= 0

Method	DF	t-Test Value	Critical t (0.050)	P-Value
Pooled (Equal Variance)	95	3.735	1.661	0
Welch-Satterthwaite (Unequal Varian	93.4	5.781	1.661	0

Pooled SD 8277.363

Conclusion with Alpha = 0.050

* Student t (Pooled) Test: Reject H0, Conclude Site > Background

*** Welch-Satterthwaite Test: Reject H0, Conclude Site > Background**

Test of Equality of Variances

Variance of Site	85915448
Variance of Background	10775991

Numerator DF	Denominator DF	F-Test Value	P-Value
73	22	7.973	0

Conclusion with Alpha = 0.05

* Two variances are not equal

	Wilcoxon-Mann-Whitney Site vs Background Comparison Test for Data Sets with Non-Detects
User Selected Options	
From File	ProUCL upload.wst
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference (S)	0
Selected Null Hypothesis	Site or AOC Mean/Median Less Than or Equal to Background Mean/Median (Form 1)
Alternative Hypothesis	Site or AOC Mean/Median Greater Than Background Mean/Median

Area of Concern Data: Antimony Southern AU
Background Data: AntimonyBG

Raw Statistics

	Site	Background
Number of Valid Data	77	23
Number of Non-Detect Data	36	10
Number of Detect Data	41	13
Minimum Non-Detect	0.24	5
Maximum Non-Detect	16.88	7.4
Percent Non detects	46.75%	43.48%
Minimum Detected	0.367	0.36
Maximum Detected	19.1	2.3
Mean of Detected Data	2.781	0.808
Median of Detected Data	0.76	0.7
SD of Detected Data	4.803	0.502

Wilcoxon-Mann-Whitney Site vs Background Test

All observations <= 16.88 (Max DL) are ranked the same

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Site or AOC <= Mean/Median of Background

Site Rank Sum W-Stat	3900
WMW Test U-Stat	0.0901
WMW Critical Value (0.050)	1.645
P-Value	0.464

Conclusion with Alpha = 0.05

Do Not Reject H0, Conclude Site <= Background

P-Value >= alpha (0.05)

	Wilcoxon-Mann-Whitney Site vs Background Comparison Test for Data Sets with Non-Detects
User Selected Options	
From File	ProUCL upload.wst
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference (S)	0
Selected Null Hypothesis	Site or AOC Mean/Median Less Than or Equal to Background Mean/Median (Form 1)
Alternative Hypothesis	Site or AOC Mean/Median Greater Than Background Mean/Median

Area of Concern Data: Arsenic Southern AU
Background Data: ArsenicBG

Raw Statistics

	Site	Background
Number of Valid Data	74	23
Number of Non-Detect Data	3	0
Number of Detect Data	71	23
Minimum Non-Detect	0.1	N/A
Maximum Non-Detect	2.54	N/A
Percent Non detects	4.05%	0.00%
Minimum Detected	0.64	2.1
Maximum Detected	17.1	8.2
Mean of Detected Data	5.093	4.683
Median of Detected Data	4.6	4.6
SD of Detected Data	3.493	1.555

Wilcoxon-Mann-Whitney Site vs Background Test

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Site or AOC <= Mean/Median of Background

Site Rank Sum W-Stat	3568
WMW Test U-Stat	-0.496
WMW Critical Value (0.050)	1.645
P-Value	0.69

Conclusion with Alpha = 0.05

Do Not Reject H0, Conclude Site <= Background

P-Value >= alpha (0.05)

	t-Test Site vs Background Comparison for Full Data Sets without NDs
User Selected Options	
From File	ProUCL upload.wst
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference (S)	0
Selected Null Hypothesis	Site or AOC Mean Less Than or Equal to Background Mean (Form 1)
Alternative Hypothesis	Site or AOC Mean Greater Than the Background Mean

Area of Concern Data: Cobalt Southern AU
Background Data: CobaltBG

Raw Statistics

	Site	Background
Number of Valid Observations	55	23
Number of Distinct Observations	40	23
Minimum	3.15	2.5
Maximum	193.1	20
Mean	37.62	10.17
Median	19.1	8.5
SD	36.3	5.323
SE of Mean	4.894	1.11

Site vs Background Two-Sample t-Test

H0: Mu of Site - Mu of Background <= 0

		t-Test	Critical	
Method	DF	Value	t (0.050)	P-Value
Pooled (Equal Variance)	76	3.598	1.665	0
Welch-Satterthwaite (Unequal Varian	59.3	5.47	1.671	0

Pooled SD 30.730

Conclusion with Alpha = 0.050

* Student t (Pooled) Test: Reject H0, Conclude Site > Background

*** Welch-Satterthwaite Test: Reject H0, Conclude Site > Background**

Test of Equality of Variances

Variance of Site	1318
Variance of Background	28.34

Numerator DF	Denominator DF	F-Test Value	P-Value
54	22	46.494	0

Conclusion with Alpha = 0.05

* Two variances are not equal

	t-Test Site vs Background Comparison for Full Data Sets without NDs
User Selected Options	
From File	ProUCL upload.wst
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference (S)	0
Selected Null Hypothesis	Site or AOC Mean Less Than or Equal to Background Mean (Form 1)
Alternative Hypothesis	Site or AOC Mean Greater Than the Background Mean

Area of Concern Data: Iron Southern AU
Background Data: IronBG

Raw Statistics

	Site	Background
Number of Valid Observations	55	23
Number of Distinct Observations	36	22
Minimum	13000	14000
Maximum	68056	36200
Mean	33509	24643
Median	33900	23100
SD	11743	6635
SE of Mean	1583	1383

Site vs Background Two-Sample t-Test

H0: Mu of Site - Mu of Background <= 0

		t-Test	Critical	
Method	DF	Value	t (0.050)	P-Value
Pooled (Equal Variance)	76	3.393	1.665	0.001
Welch-Satterthwaite (Unequal Varian	69.1	4.217	1.667	0

Pooled SD 10522.243

Conclusion with Alpha = 0.050

* Student t (Pooled) Test: Reject H0, Conclude Site > Background

*** Welch-Satterthwaite Test: Reject H0, Conclude Site > Background**

Test of Equality of Variances

Variance of Site	137900000
Variance of Background	44020751

Numerator DF	Denominator DF	F-Test Value	P-Value
54	22	3.132	0.005

Conclusion with Alpha = 0.05

* Two variances are not equal

	t-Test Site vs Background Comparison for Full Data Sets without NDs
User Selected Options	
From File	ProUCL upload.wst
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference (S)	0
Selected Null Hypothesis	Site or AOC Mean Less Than or Equal to Background Mean (Form 1)
Alternative Hypothesis	Site or AOC Mean Greater Than the Background Mean

Area of Concern Data: Magnesium Southern AU
Background Data: MagnesiumBG

Raw Statistics

	Site	Background
Number of Valid Observations	55	23
Number of Distinct Observations	40	23
Minimum	531.9	1550
Maximum	21639	8600
Mean	7914	4340
Median	6590	4360
SD	5039	1758
SE of Mean	679.5	366.5

Site vs Background Two-Sample t-Test

H0: Mu of Site - Mu of Background <= 0

		t-Test	Critical	
Method	DF	Value	t (0.050)	P-Value
Pooled (Equal Variance)	76	3.307	1.665	0.001
Welch-Satterthwaite (Unequal Varian	74.5	4.629	1.665	0

Pooled SD 4351.799

Conclusion with Alpha = 0.050

* Student t (Pooled) Test: Reject H0, Conclude Site > Background

*** Welch-Satterthwaite Test: Reject H0, Conclude Site > Background**

Test of Equality of Variances

Variance of Site	25394833
Variance of Background	3089959

Numerator DF	Denominator DF	F-Test Value	P-Value
54	22	8.219	0

Conclusion with Alpha = 0.05

* Two variances are not equal

	t-Test Site vs Background Comparison for Full Data Sets without NDs
User Selected Options	
From File	ProUCL upload.wst
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference (S)	0
Selected Null Hypothesis	Site or AOC Mean Less Than or Equal to Background Mean (Form 1)
Alternative Hypothesis	Site or AOC Mean Greater Than the Background Mean

Area of Concern Data: Manganese Southern AU
Background Data: ManganeseBG

Raw Statistics

	Site	Background
Number of Valid Observations	74	23
Number of Distinct Observations	48	23
Minimum	23.9	163
Maximum	3070	1000
Mean	584.8	453
Median	439.8	368
SD	541.6	229.3
SE of Mean	62.96	47.81

Site vs Background Two-Sample t-Test

H0: Mu of Site - Mu of Background <= 0

		t-Test	Critical	
Method	DF	Value	t (0.050)	P-Value
Pooled (Equal Variance)	95	1.133	1.661	0.13
Welch-Satterthwaite (Unequal Varian	86.3	1.668	1.663	0.049

Pooled SD 487.389

Conclusion with Alpha = 0.050

* Student t (Pooled) Test: Do Not Reject H0, Conclude Site <= Background

*** Welch-Satterthwaite Test: Reject H0, Conclude Site > Background**

Test of Equality of Variances

Variance of Site	293292
Variance of Background	52583

Numerator DF	Denominator DF	F-Test Value	P-Value
73	22	5.578	0

Conclusion with Alpha = 0.05

* Two variances are not equal

	Wilcoxon-Mann-Whitney Site vs Background Comparison Test for Data Sets with Non-Detects
User Selected Options	
From File	ProUCL upload.wst
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference (S)	0
Selected Null Hypothesis	Site or AOC Mean/Median Less Than or Equal to Background Mean/Median (Form 1)
Alternative Hypothesis	Site or AOC Mean/Median Greater Than Background Mean/Median

Area of Concern Data: Thallium Southern AU
Background Data: ThalliumBG

Raw Statistics

	Site	Background
Number of Valid Data	95	23
Number of Non-Detect Data	53	22
Number of Detect Data	42	1
Minimum Non-Detect	0.15	2.1
Maximum Non-Detect	18.41	3.1
Percent Non detects	55.79%	95.65%
Minimum Detected	0.12	0.82
Maximum Detected	4.73	0.82
Mean of Detected Data	1.227	0.82
Median of Detected Data	1.02	0.82
SD of Detected Data	0.857	N/A

Wilcoxon-Mann-Whitney Site vs Background Test

All observations <= 18.41 (Max DL) are ranked the same

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Site or AOC <= Mean/Median of Background

Site Rank Sum W-Stat	5653
WMW Test U-Stat	-0.0034
WMW Critical Value (0.050)	1.645
P-Value	0.501

Conclusion with Alpha = 0.05

Do Not Reject H0, Conclude Site <= Background

P-Value >= alpha (0.05)

	t-Test Site vs Background Comparison for Full Data Sets without NDs
User Selected Options	
From File	ProUCL upload.wst
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference (S)	0
Selected Null Hypothesis	Site or AOC Mean Less Than or Equal to Background Mean (Form 1)
Alternative Hypothesis	Site or AOC Mean Greater Than the Background Mean

Area of Concern Data: Vanadium Southern AU
Background Data: VanadiumBG

Raw Statistics

	Site	Background
Number of Valid Observations	84	23
Number of Distinct Observations	56	23
Minimum	17.07	27.6
Maximum	293	85
Mean	66.08	55.43
Median	55	54.1
SD	41.79	14.98
SE of Mean	4.56	3.123

Site vs Background Two-Sample t-Test

H0: Mu of Site - Mu of Background <= 0

		t-Test	Critical	
Method	DF	Value	t (0.050)	P-Value
Pooled (Equal Variance)	105	1.198	1.659	0.117
Welch-Satterthwaite (Unequal Varian	97.9	1.927	1.661	0.028

Pooled SD 37.786

Conclusion with Alpha = 0.050

* Student t (Pooled) Test: Do Not Reject H0, Conclude Site <= Background

*** Welch-Satterthwaite Test: Reject H0, Conclude Site > Background**

Test of Equality of Variances

Variance of Site	1747
Variance of Background	224.3

Numerator DF	Denominator DF	F-Test Value	P-Value
83	22	7.789	0

Conclusion with Alpha = 0.05

* Two variances are not equal

	Wilcoxon-Mann-Whitney Site vs Background Comparison Test for Data Sets with Non-Detects
User Selected Options	
From File	ProUCL upload.wst
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference (S)	0
Selected Null Hypothesis	Site or AOC Mean/Median Less Than or Equal to Background Mean/Median (Form 1)
Alternative Hypothesis	Site or AOC Mean/Median Greater Than Background Mean/Median

Area of Concern Data: Benzo(a)anthracene Southern AU
Background Data: Benzo(a)anthraceneBG

Raw Statistics

	Site	Background
Number of Valid Data	45	23
Number of Non-Detect Data	25	8
Number of Detect Data	20	15
Minimum Non-Detect	70	360
Maximum Non-Detect	458	430
Percent Non detects	55.56%	34.78%
Minimum Detected	11	43
Maximum Detected	773	590
Mean of Detected Data	179.7	213
Median of Detected Data	191.9	190
SD of Detected Data	156.8	132.5

Wilcoxon-Mann-Whitney Site vs Background Test

All observations <= 458 (Max DL) are ranked the same

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Site or AOC <= Mean/Median of Background

Site Rank Sum W-Stat	1542
WMW Test U-Stat	-0.143
WMW Critical Value (0.050)	1.645
P-Value	0.557

Conclusion with Alpha = 0.05

Do Not Reject H0, Conclude Site <= Background

P-Value >= alpha (0.05)

	Wilcoxon-Mann-Whitney Site vs Background Comparison Test for Data Sets with Non-Detects
User Selected Options	
From File	ProUCL upload.wst
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference (S)	0
Selected Null Hypothesis	Site or AOC Mean/Median Less Than or Equal to Background Mean/Median (Form 1)
Alternative Hypothesis	Site or AOC Mean/Median Greater Than Background Mean/Median

Area of Concern Data: Benzo(a)pyrene Southern AU
Background Data: Benzo(a)pyreneBG

Raw Statistics

	Site	Background
Number of Valid Data	37	23
Number of Non-Detect Data	19	7
Number of Detect Data	18	16
Minimum Non-Detect	190	360
Maximum Non-Detect	458	510
Percent Non detects	51.35%	30.43%
Minimum Detected	23	40
Maximum Detected	595	530
Mean of Detected Data	205.4	202.4
Median of Detected Data	185.8	180
SD of Detected Data	122.3	126.7

Wilcoxon-Mann-Whitney Site vs Background Test

All observations <= 510 (Max DL) are ranked the same

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Site or AOC <= Mean/Median of Background

Site Rank Sum W-Stat	1122
WMW Test U-Stat	-0.106
WMW Critical Value (0.050)	1.645
P-Value	0.542

Conclusion with Alpha = 0.05

Do Not Reject H0, Conclude Site <= Background

P-Value >= alpha (0.05)

	Wilcoxon-Mann-Whitney Site vs Background Comparison Test for Data Sets with Non-Detects
User Selected Options	
From File	ProUCL upload.wst
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference (S)	0
Selected Null Hypothesis	Site or AOC Mean/Median Less Than or Equal to Background Mean/Median (Form 1)
Alternative Hypothesis	Site or AOC Mean/Median Greater Than Background Mean/Median

Area of Concern Data: Benzo(b)fluoranthene Southern AU
Background Data: Benzo(b)fluorantheneBG

Raw Statistics

	Site	Background
Number of Valid Data	45	23
Number of Non-Detect Data	27	5
Number of Detect Data	18	18
Minimum Non-Detect	70	360
Maximum Non-Detect	458	430
Percent Non detects	60.00%	21.74%
Minimum Detected	15	40
Maximum Detected	895	620
Mean of Detected Data	224.7	184.4
Median of Detected Data	210.1	155
SD of Detected Data	182.3	144.1

Wilcoxon-Mann-Whitney Site vs Background Test

All observations <= 458 (Max DL) are ranked the same

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Site or AOC <= Mean/Median of Background

Site Rank Sum W-Stat	1542
WMW Test U-Stat	-0.143
WMW Critical Value (0.050)	1.645
P-Value	0.557

Conclusion with Alpha = 0.05

Do Not Reject H0, Conclude Site <= Background

P-Value >= alpha (0.05)

APPENDIX E:
RISK CALCULATIONS

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Table E.1
Calculation of Non-Cancer Hazard Quotients for Remaining COPCs
4256 Warren (one sample)

Non-Cancer Hazard Quotient Calculation - **Resident Child**						
Chemical of Potential Concern	Exposure Point Concentration (2) (mg/kg)	Chronic RfD (3) (mg/kg-day)	RME Chronic Daily Intake (CDI) (mg/kg-day)	**Non-Cancer Hazard Quotients**	RME Chronic Daily Intake (CDI) (mg/kg-day)	**Non-Cancer Hazard Quotients**
			Incidental Ingestion (1)		*Dermal Exposure* (1)	
Aluminum	25,500	1.00E+00	3.26E-01	**0.3**	NA	NA
Arsenic	14	3.00E-04	1.83E-04	**0.6**	2.01E-04	**0.0003**
Cobalt	19.6	3.00E-04	2.51E-04	**0.8**	NA	NA
Iron	67,600	7.00E-01	8.64E-01	**1.2**	NA	NA
Magnesium	7,430	NA	--	--	--	--
Vanadium	83.2	5.00E-03	1.06E-03	**0.2**	NA	NA

Non-Cancer Hazard Quotient Calculation - **Resident Adult**						
Chemical of Potential Concern	Exposure Point Concentration (2) (mg/kg)	Chronic RfD (3) (mg/kg-day)	RME Chronic Daily Intake (CDI) (mg/kg-day)	**Non-Cancer Hazard Quotients**	RME Chronic Daily Intake (CDI) (mg/kg-day)	**Non-Cancer Hazard Quotients**
			Incidental Ingestion (1)		*Dermal Exposure* (1)	
Aluminum	25,500	1.00E+00	3.49E-02	**0.03**	NA	NA
Arsenic	14	3.00E-04	1.96E-05	**0.07**	2.30E-04	**0.004**
Cobalt	19.6	3.00E-04	2.68E-05	**0.09**	NA	NA
Iron	67,600	7.00E-01	9.26E-02	**0.1**	NA	NA
Magnesium	7,430	NA	--	--	--	--
Vanadium	83.2	5.00E-03	1.14E-04	**0.02**	NA	NA

Notes:

1. Risks for a residential receptor were evaluated for the incidental soil ingestion route using the assumptions and equations shown below **(these also apply to Tables E.2 through E.13)**. Dermal pathway only quantified for those COPCs with EPA-recommended dermal absorption fractions. Currently, USEPA (2004) provides recommended dermal absorption factors for ten chemicals in soil, including only the inorganics arsenic (0.03) and cadmium (0.001).

	Acronym	Definition	Value Used
Incidental Ingestion CDI (mg/kg/day) = CS x IR x FI x EF x ED x CF / (BW x AT) [4]	CS	Chemical Concentration in Soil	mg/kg in soil
Dermal Contact CDI (mg/kg/day) = (CS x SA x AF x DA x EF x ED x CF) / (BW x AT)	IR	Incidental Soil Ingestion Rate	200 mg/day for child, 100 mg/day for adult
	FI	Fraction Ingested from Site	100%
To estimate non-cancer risks:	EF	Exposure Frequency	350 days/year
HQ = CDI/RfD	ED	Exposure Duration	33 years for adult, 6 years for child
HQ = Hazard Quotient	BW	Body Weight	70 kg for adult, 15 kg for child
CDI = Chronic Daily Intake	AT	Averaging Time	12,045 days for adult, 2,190 for child
RfD = Reference Dose (toxicity value)	CF	Conversion Factor	0.000001 kg/mg

Conclusion: Individual HQs are equal to or less than one, with all different target organs. Iron HQ slightly greater than one, but it is essential nutrient. Magnesium is essential nutrient.
Therefore, site does not require further evaluation.

2. Using the single available data point.

3. The toxicity values for aluminum, cobalt, iron, thallium, and vanadium are provisional peer-reviewed toxicity reference values (PPRTV) (EPA RSL Table May 2013).

4. Applies the “high end” incidental soil ingestion rates previously recommended by EPA to the screening calculations of non-cancer hazard quotients HQs associated with a “reasonable maximum scenario. The use of the high end soil ingestion rates at this screening level is appropriate because the purpose of conducting the HQ calculations was to identify chemicals in soil that were detected at concentrations that may be of human health concern to carry through to a full HHRA.

Table E.2
Calculation of Non-Cancer Hazard Quotients for Remaining COPCs
4900 Quebec (13 samples)

Non-Cancer Hazard Quotient Calculation - **Resident Child**				
Chemical of Potential Concern	Exposure Concentration (2) (mg/kg)	Chronic RfD (3) (mg/kg-day)	RME Chronic Daily Intake (CDI) (mg/kg-day)	**Non-Cancer Hazard Quotients**
			Incidental Ingestion (1)	
Mercury	1.44	3.00E-04	1.84E-05	**0.06**

Non-Cancer Hazard Quotient Calculation - **Resident Adult**				
Chemical of Potential Concern	Exposure Concentration (2) (mg/kg)	Chronic RfD (3) (mg/kg-day)	RME Chronic Daily Intake (CDI) (mg/kg-day)	**Non-Cancer Hazard Quotients**
			Incidental Ingestion (1)	
Mercury	1.44	3.00E-04	1.97E-06	**0.007**

Notes:

1. Risks for a residential receptor were evaluated for the incidental soil ingestion route using the assumptions and equations shown in Table E.1. Dermal pathway not quantified, since only those COPCs with EPA-recommended dermal absorption fractions are quantified. Currently, USEPA (2004) provides recommended dermal absorption factors for ten chemicals in soil, including only the inorganics arsenic (0.03) and cadmium (0.001).

2. Using the 95% UCL of the mean concentration.

3. The toxicity values for aluminum, cobalt, iron, thallium, and vanadium are provisional peer-reviewed toxicity reference values (PPRTV) (EPA RSL Table May 2013).

Since an oral RfD is not published for elemental mercury, the oral RfD for mercuric chloride was used

Conclusion: Individual HQ is less than one. **Therefore, site does not require further evaluation.**

Table E.3
Calculation of Non-Cancer Hazard Quotients for Remaining COPCs
3949 52nd (2 samples)

Non-Cancer Hazard Quotient Calculation - **Resident Child**				
Chemical of Potential Concern	Exposure Point Concentration (2) (mg/kg)	Chronic RfD (3) (mg/kg-day)	RME Chronic Daily Intake (CDI) (mg/kg-day)	**Non-Cancer Hazard Quotients**
			Incidental Ingestion (1)	
Cobalt	19.7	3.00E-04	2.52E-04	**0.8**

Non-Cancer Hazard Quotient Calculation - **Resident Adult**				
Chemical of Potential Concern	Exposure Point Concentration (2) (mg/kg)	Chronic RfD (3) (mg/kg-day)	RME Chronic Daily Intake (CDI) (mg/kg-day)	**Non-Cancer Hazard Quotients**
			Incidental Ingestion (1)	
Cobalt	19.7	3.00E-04	2.70E-05	**0.09**

Notes:

1. Risks for a residential receptor were evaluated for the incidental soil ingestion route using the assumptions and equations shown in Table E.1. Dermal pathway not quantified, since only those COPCs with EPA-recommended dermal absorption fractions are quantified. Currently, USEPA (2004) provides recommended dermal absorption factors for ten chemicals in soil, including only the inorganics arsenic (0.03) and cadmium (0.001).

2. Using the maximum of the two available data points.

3. The toxicity values for aluminum, cobalt, iron, thallium, and vanadium are provisional peer-reviewed toxicity reference values (PPRTV) (EPA RSL Table May 2013).

Conclusion: Individual HQ is less than one. **Therefore, site does not require further evaluation.**

Table E.4
Calculation of Non-Cancer Hazard Quotients for Remaining COPCs
4015 52nd (one sample)

Non-Cancer Hazard Quotient Calculation - **Resident Child**				
Chemical of Potential Concern	Exposure Point Concentration (2) (mg/kg)	Chronic RfD (3) (mg/kg-day)	RME Chronic Daily Intake (CDI) (mg/kg-day)	**Non-Cancer Hazard Quotients**
			Incidental Ingestion (1)	
Aluminum	28,000	1.00E+00	3.58E-01	**0.4**
Cobalt	22.8	3.00E-04	2.92E-04	**0.97**
Iron	38,300	7.00E-01	4.90E-01	**0.7**
Magnesium	7,160	NA	--	--

Non-Cancer Hazard Quotient Calculation - **Resident Adult**				
Chemical of Potential Concern	Exposure Point Concentration (2) (mg/kg)	Chronic RfD (3) (mg/kg-day)	RME Chronic Daily Intake (CDI) (mg/kg-day)	**Non-Cancer Hazard Quotients**
			Incidental Ingestion (1)	
Aluminum	28,000	1.00E+00	3.84E-02	**0.04**
Cobalt	22.8	3.00E-04	3.12E-05	**0.1**
Iron	38,300	7.00E-01	5.25E-02	**0.07**
Magnesium	7,160	NA	--	--

Notes:

1. Risks for a residential receptor were evaluated for the incidental soil ingestion route using the assumptions and equations shown in Table E.1. Dermal pathway not quantified, since only those COPCs with EPA-recommended dermal absorption fractions are quantified. Currently, USEPA (2004) provides recommended dermal absorption factors for ten chemicals in soil, including only the inorganics arsenic (0.03) and cadmium (0.001).

2. Using the single available data point.

3. The toxicity values for aluminum, cobalt, iron, thallium, and vanadium are provisional peer-reviewed toxicity reference values (PPRTV) (EPA RSL Table May 2013).

Conclusion: Individual HQs are equal to or less than one, with all different target organs. Magnesium is essential nutrient. **Therefore, site does not require further evaluation.**

Table E.5
Calculation of Non-Cancer Hazard Quotients for Remaining COPCs
POI 39 (14 samples)

Non-Cancer Hazard Quotient Calculation - **Resident Child**				
Chemical of Potential Concern	Exposure Point Concentration (2) (mg/kg)	Chronic RfD (3) (mg/kg-day)	RME Chronic Daily Intake (CDI) (mg/kg-day)	**Non-Cancer Hazard Quotients**
			Incidental Ingestion (1)	
Aluminum	24,437	1.00E+00	3.12E-01	**0.3**
Manganese	1,197	1.40E-01	1.53E-02	**0.1**

Non-Cancer Hazard Quotient Calculation - **Resident Adult**				
Chemical of Potential Concern	Exposure Point Concentration (2) (mg/kg)	Chronic RfD (3) (mg/kg-day)	RME Chronic Daily Intake (CDI) (mg/kg-day)	**Non-Cancer Hazard Quotients**
			Incidental Ingestion (1)	
Aluminum	24,437	1.00E+00	3.35E-02	**0.03**
Manganese	1,197	1.40E-01	1.64E-03	**0.01**

Notes:

1. Risks for a residential receptor were evaluated for the incidental soil ingestion route using the assumptions and equations shown in Table E.1. Dermal pathway not quantified, since only those COPCs with EPA-recommended dermal absorption fractions are quantified. Currently, USEPA (2004) provides recommended dermal absorption factors for ten chemicals in soil, including only the inorganics arsenic (0.03) and cadmium (0.001).

2. Using the 95% UCL of the mean.

3. The toxicity values for aluminum, cobalt, iron, thallium, and vanadium are provisional peer-reviewed toxicity reference values (PPRTV) (EPA RSL Table May 2013).

Conclusion: Individual HQs are less than one; even with same target organs, HQ combined still less than one. **Therefore, site does not require further evaluation.**

Table E.6
Calculation of Non-Cancer Hazard Quotients for Remaining COPCs
Dalecarlia Woods (13 samples)

There were no COPCs. However, zinc was an outlier in one sample (SVZONE9-A1, LTC Bancroft). That sample was screened separately and aluminum, cadmium, and zinc were determined to be COPCs.

Non-Cancer Hazard Quotient Calculation - **Resident Child**

Chemical of Potential Concern	Exposure Point Concentration (2) (mg/kg)	Chronic RfD (mg/kg-day)	RME Chronic Daily Intake (CDI) (mg/kg-day)	**Non-Cancer Hazard Quotients**
			Incidental Ingestion (1)	
Aluminum	27,783	1.00E+00	3.55E-01	**0.4**
Cadmium	29	1.00E-03	3.71E-04	**0.4**
Zinc	2,548	3.00E-01	3.26E-02	**0.1**

Non-Cancer Hazard Quotient Calculation - **Resident Adult**

Chemical of Potential Concern	Exposure Point Concentration (2) (mg/kg)	Chronic RfD (mg/kg-day)	RME Chronic Daily Intake (CDI) (mg/kg-day)	**Non-Cancer Hazard Quotients**
			Incidental Ingestion (1)	
Aluminum	27,783	1.00E+00	3.81E-02	**0.04**
Cadmium	29	1.00E-03	3.97E-05	**0.04**
Zinc	2,548	3.00E-01	3.49E-03	**0.01**

Notes:

1. Risks for a residential receptor were evaluated for the incidental soil ingestion route using the assumptions and equations shown in Table E.1. Dermal pathway not quantified, since only those COPCs with EPA-recommended dermal absorption fractions are quantified. Currently, USEPA (2004) provides recommended dermal absorption factors for ten chemicals in soil, including only the inorganics arsenic (0.03) and cadmium (0.001).

2. Using the maximum of the detected concentrations.

Conclusion: Individual HQ of outlier is less than one. **Therefore, site does not require further evaluation.**

Table E.7
Calculation of Non-Cancer Hazard Quotients for Remaining COPCs
AOI 8 (4 samples)

Non-Cancer Hazard Quotient Calculation - **Resident Child**				
Chemical of Potential Concern	Exposure Point Concentration (2) (mg/kg)	Chronic RfD (3) (mg/kg-day)	RME Chronic Daily Intake (CDI) (mg/kg-day)	**Non-Cancer Hazard Quotients**
			Incidental Ingestion (1)	
Manganese	1,130	1.40E-01	1.44E-02	**0.1**
Non-Cancer Hazard Quotient Calculation - **Resident Adult**				
Chemical of Potential Concern	Exposure Point Concentration (2) (mg/kg)	Chronic RfD (3) (mg/kg-day)	RME Chronic Daily Intake (CDI) (mg/kg-day)	**Non-Cancer Hazard Quotients**
			Incidental Ingestion (1)	
Manganese	1,130	1.40E-01	1.55E-03	**0.01**

Notes:

1. Risks for a residential receptor were evaluated for the incidental soil ingestion route using the assumptions and equations shown in Table E.1. Dermal pathway not quantified, since only those COPCs with EPA-recommended dermal absorption fractions are quantified. Currently, USEPA (2004) provides recommended dermal absorption factors for ten chemicals in soil, including only the inorganics arsenic (0.03) and cadmium (0.001).

2. Using the maximum of the detected concentrations.

3. The toxicity values for aluminum, cobalt, iron, thallium, and vanadium are provisional peer-reviewed toxicity reference values (PPRTV) (EPA RSL Table May 2013).

Conclusion: Individual HQ is less than one. **Therefore, site does not require further evaluation.**

Table E.8
Calculation of Non-Cancer Hazard Quotients for Remaining COPCs
AOI 11 (6 samples)

Non-Cancer Hazard Quotient Calculation - **Resident Child**				
Chemical of Potential Concern	Exposure Point Concentration (2) (mg/kg)	Chronic RfD (3) (mg/kg-day)	RME Chronic Daily Intake (CDI) (mg/kg-day)	**Non-Cancer Hazard Quotients**
			Incidental Ingestion (1)	
Aluminum	19,462	1.00E+00	2.49E-01	**0.2**
Magnesium	6,401	NA	--	--
Non-Cancer Hazard Quotient Calculation - **Resident Adult**				
Chemical of Potential Concern	Exposure Point Concentration (2) (mg/kg)	Chronic RfD (3) (mg/kg-day)	RME Chronic Daily Intake (CDI) (mg/kg-day)	**Non-Cancer Hazard Quotients**
			Incidental Ingestion (1)	
Aluminum	19,462	1.00E+00	2.67E-02	**0.03**
Magnesium	6,401	NA	--	--

Notes:

1. Risks for a residential receptor were evaluated for the incidental soil ingestion route using the assumptions and equations shown in Table E.1. Dermal pathway not quantified, since only those COPCs with EPA-recommended dermal absorption fractions are quantified. Currently, USEPA (2004) provides recommended dermal absorption factors for ten chemicals in soil, including only the inorganics arsenic (0.03) and cadmium (0.001).

2. Using the 95% UCL of the mean concentration.

3. The toxicity values for aluminum, cobalt, iron, thallium, and vanadium are provisional peer-reviewed toxicity reference values (PPRTV) (EPA RSL Table May 2013).

Conclusion: Aluminum HQ is less than one; magnesium is essential nutrient. **Therefore, site does not require further evaluation.**

Table E.9
Calculation of Non-Cancer Hazard Quotients for Remaining COPCs
AOI 9 (59 samples)

Non-Cancer Hazard Quotient Calculation - **Resident Child**				
Chemical of Potential Concern	Exposure Point Concentration (2) (mg/kg)	Chronic RfD (3) (mg/kg-day)	RME Chronic Daily Intake (CDI) (mg/kg-day)	**Non-Cancer Hazard Quotients**
			Incidental Ingestion (1)	
Aluminum	21,199	1.00E+00	2.71E-01	**0.3**
Cobalt	27.92	3.00E-04	3.57E-04	**1.2**
Manganese	678	1.40E-01	8.67E-03	**0.1**
Non-Cancer Hazard Quotient Calculation - **Resident Adult**				
Chemical of Potential Concern	Exposure Point Concentration (2) (mg/kg)	Chronic RfD (3) (mg/kg-day)	RME Chronic Daily Intake (CDI) (mg/kg-day)	**Non-Cancer Hazard Quotients**
			Incidental Ingestion (1)	
Aluminum	21,199	1.00E+00	2.90E-02	**0.03**
Cobalt	27.92	3.00E-04	3.82E-05	**0.1**
Manganese	678	1.40E-01	9.29E-04	**0.01**

Notes:

1. Risks for a residential receptor were evaluated for the incidental soil ingestion route using the assumptions and equations shown in Table E.1. Dermal pathway not quantified, since only those COPCs with EPA-recommended dermal absorption fractions are quantified. Currently, USEPA (2004) provides recommended dermal absorption factors for ten chemicals in soil, including only the inorganics arsenic (0.03) and cadmium (0.001).

2. Using the 95% UCL of the mean.

3. The toxicity values for aluminum, cobalt, iron, thallium, and vanadium are provisional peer-reviewed toxicity reference values (PPRTV) (EPA RSL Table May 2013).

Conclusion: Cobalt HQ is greater than one.
Site requires further evaluation.

Table E.10
Calculation of Non-Cancer Hazard Quotients for Remaining COPCs
AOI 13 (17 samples)

Non-Cancer Hazard Quotient Calculation - **Resident Child**				
Chemical of Potential Concern	Exposure Point Concentration (2) (mg/kg)	Chronic RfD (3) (mg/kg-day)	RME Chronic Daily Intake (CDI) (mg/kg-day)	**Non-Cancer Hazard Quotients**
			Incidental Ingestion (1)	
Aluminum	20,637	1.00E+00	2.64E-01	**0.3**
Cobalt	21.53	3.00E-04	2.75E-04	**0.9**
Iron	36,225	7.00E-01	4.63E-01	**0.7**

Non-Cancer Hazard Quotient Calculation - **Resident Adult**				
Chemical of Potential Concern	Exposure Point Concentration (2) (mg/kg)	Chronic RfD (3) (mg/kg-day)	RME Chronic Daily Intake (CDI) (mg/kg-day)	**Non-Cancer Hazard Quotients**
			Incidental Ingestion (1)	
Aluminum	20,637	1.00E+00	2.83E-02	**0.03**
Cobalt	21.53	3.00E-04	2.95E-05	**0.10**
Iron	36,225	7.00E-01	4.96E-02	**0.07**

Mercury was an outlier in one sample (4707WL-1); that sample was screened separately and mercury and cobalt were determined to be COPCs.

Non-Cancer Hazard Quotient Calculation - **Resident Child**				
Chemical of Potential Concern	Exposure Point Concentration (4) (mg/kg)	Chronic RfD (3) (mg/kg-day)	RME Chronic Daily Intake (CDI) (mg/kg-day)	**Non-Cancer Hazard Quotients**
			Incidental Ingestion (1)	
Cobalt	19.4	3.00E-04	2.48E-04	**0.8**
Mercury	2.3	3.00E-04	2.94E-05	**0.1**

Non-Cancer Hazard Quotient Calculation - **Resident Adult**				
Chemical of Potential Concern	Exposure Point Concentration (4) (mg/kg)	Chronic RfD (3) (mg/kg-day)	RME Chronic Daily Intake (CDI) (mg/kg-day)	**Non-Cancer Hazard Quotients**
			Incidental Ingestion (1)	
Cobalt	19.4	3.00E-04	2.66E-05	**0.09**
Mercury	2.3	3.00E-04	3.15E-06	**0.01**

Notes:

1. Risks for a residential receptor were evaluated for the incidental soil ingestion route using the assumptions and equations shown in Table E.1. Dermal pathway not quantified, since only those COPCs with EPA-recommended dermal absorption fractions are quantified. Currently, USEPA (2004) provides recommended dermal absorption factors for ten chemicals in soil, including only the inorganics arsenic (0.03) and cadmium (0.001).

2. Using the 95% UCL of the mean concentration.

3. The toxicity values for aluminum, cobalt, iron, thallium, and vanadium are provisional peer-reviewed toxicity reference values (PPRTV) (EPA RSL Table May 2013).

4. Concentration of outlier (maximum detected concentration within EU)

Since an oral RfD is not published for elemental mercury, the oral RfD for mercuric chloride was used

Conclusion: Individual HQs are less than one, with all different target organs. Mercury outlier HQ is less than one; Cobalt from that outlier sample has an HQ<1. **Therefore, site does not require further evaluation.**

Table E.11
Calculation of Non-Cancer Hazard Quotients for Remaining COPCs
Western POI 53 (10 samples)

Non-Cancer Hazard Quotient Calculation - **Resident Child**				
Chemical of Potential Concern	Exposure Point Concentration (2) (mg/kg)	Chronic RfD (3) (mg/kg-day)	RME Chronic Daily Intake (CDI) (mg/kg-day)	**Non-Cancer Hazard Quotients**
			Incidental Ingestion (1)	
Aluminum	22,022	1.00E+00	2.82E-01	**0.3**
Vanadium	85	5.00E-03	1.08E-03	**0.2**
Non-Cancer Hazard Quotient Calculation - **Resident Adult**				
Chemical of Potential Concern	Exposure Point Concentration (2) (mg/kg)	Chronic RfD (3) (mg/kg-day)	RME Chronic Daily Intake (CDI) (mg/kg-day)	**Non-Cancer Hazard Quotients**
			Incidental Ingestion (1)	
Aluminum	22,022	1.00E+00	3.02E-02	**0.03**
Vanadium	85	5.00E-03	1.16E-04	**0.02**

Notes:

1. Risks for a residential receptor were evaluated for the incidental soil ingestion route using the assumptions and equations shown in Table E.1. Dermal pathway not quantified, since only those COPCs with EPA-recommended dermal absorption fractions are quantified. Currently, USEPA (2004) provides recommended dermal absorption factors for ten chemicals in soil, including only the inorganics arsenic (0.03) and cadmium (0.001).

2. Using the 95% UCL of the mean concentration.

3. The toxicity values for aluminum, cobalt, iron, thallium, and vanadium are provisional peer-reviewed toxicity reference values (PPRTV) (EPA RSL Table May 2013).

Conclusion: Individual HQs are equal to or less than one, with all different target organs. **Therefore, site does not require further evaluation.**

Table E.12
Calculation of Non-Cancer Hazard Quotients for Remaining COPCs
Spaulding-Rankin (60 samples)

Non-Cancer Hazard Quotient Calculation - **Resident Child**				
Chemical of Potential Concern	Exposure Point Concentration (2) (mg/kg)	Chronic RfD (3) (mg/kg-day)	RME Chronic Daily Intake (CDI) (mg/kg-day)	**Non-Cancer Hazard Quotients**
			Incidental Ingestion (1)	
Aluminum	16,602	1.00E+00	2.12E-01	**0.2**
Cobalt	100	3.00E-04	1.28E-03	**4.3**
Iron	63,501	7.00E-01	8.12E-01	**1.2**
Manganese	1,286	1.40E-01	1.64E-02	**0.1**
Vanadium	99	5.00E-03	1.26E-03	**0.3**
Non-Cancer Hazard Quotient Calculation - **Resident Adult**				
Chemical of Potential Concern	Exposure Point Concentration (2) (mg/kg)	Chronic RfD (3) (mg/kg-day)	RME Chronic Daily Intake (CDI) (mg/kg-day)	**Non-Cancer Hazard Quotients**
			Incidental Ingestion (1)	
Aluminum	16,602	1.00E+00	2.27E-02	**0.02**
Cobalt	100	3.00E-04	1.37E-04	**0.5**
Iron	63,501	7.00E-01	8.70E-02	**0.1**
Manganese	1,286	1.40E-01	1.76E-03	**0.01**
Vanadium	99	5.00E-03	1.35E-04	**0.03**

Notes:

1. Risks for a residential receptor were evaluated for the incidental soil ingestion route using the assumptions and equations shown in Table E.1. Dermal pathway not quantified, since only those COPCs with EPA-recommended dermal absorption fractions are quantified. Currently, USEPA (2004) provides recommended dermal absorption factors for ten chemicals in soil, including only the inorganics arsenic (0.03) and cadmium (0.001).

2. Using the 95% UCL of the mean concentration.

3. The toxicity values for aluminum, cobalt, iron, thallium, and vanadium are provisional peer-reviewed toxicity reference values (PPRTV) (EPA RSL Table May 2013).

Conclusion: Iron HQ slightly greater than one, but it is essential nutrient. Cobalt HQ is greater than one; **therefore, site requires further evaluation.**

Table E.13
Calculation of Non-Cancer Hazard Quotients for Remaining COPCs
Southern AU (contained 86 total samples, including the 6 discrete sample locations that had outlier concentrations)

Calculations for COPCs with outliers removed

Non-Cancer Hazard Quotient Calculation - **Resident Child**

Chemical of Potential Concern	Exposure Point Concentration (2) (mg/kg)	Chronic RfD (3) (mg/kg-day)	RME Chronic Daily Intake (CDI) (mg/kg-day)	**Non-Cancer Hazard Quotients**	**Conclusions**
			Incidental Ingestion (1)		
Aluminum	20,727	1.00E+00	2.65E-01	**0.3**	
Cobalt	58.96	3.00E-04	7.54E-04	**2.5**	Cobalt HQ greater than one; **EU requires further evaluation.**
Iron	36,159	7.00E-01	4.62E-01	**0.7**	
Magnesium	10,876	NA	--	**--**	
Manganese	859	1.40E-01	1.10E-02	**0.08**	
Vanadium	74	5.00E-03	9.42E-04	**0.188**	

Non-Cancer Hazard Quotient Calculation - **Resident Adult**

Chemical of Potential Concern	Exposure Point Concentration (2) (mg/kg)	Chronic RfD (3) (mg/kg-day)	RME Chronic Daily Intake (CDI) (mg/kg-day)	**Non-Cancer Hazard Quotients**
			Incidental Ingestion (1)	
Aluminum	20,727	1.00E+00	2.84E-02	**0.03**
Cobalt	58.96	3.00E-04	8.08E-05	**0.3**
Iron	36,159	7.00E-01	4.95E-02	**0.07**
Magnesium	10,876	NA	--	**--**
Manganese	859	1.40E-01	1.18E-03	**0.008**
Vanadium	74	5.00E-03	1.01E-04	**0.0202**

Note: this table presents Final COPCs (i.e., not eliminated through screening steps) after all outliers removed.

Table E.13
Calculation of Non-Cancer Hazard Quotients for Remaining COPCs
Southern AU (contained 86 total samples, including the 6 discrete sample locations that had outlier concentrations)

Calculations for Highest Value from Outlier Test 1 (green)

Non-Cancer Hazard Quotient Calculation - **Resident Child**

Chemical of Potential Concern and Outlier Sample	Exposure Point Concentration (4) (mg/kg)	Chronic RfD (3) (mg/kg-day)	RME Chronic Daily Intake (CDI) (mg/kg-day)	**Non-Cancer Hazard Quotients**	**Conclusions**
			Incidental Ingestion (1)		
Antimony (AU-03)	40	4.00E-04	5.17E-04	**1.3**	Antimony at outlier location AU-03 could be associated with risk; **outlier location requires further evaluation.**
Beryllium (SV-12A)	19	2.00E-03	2.43E-04	**0.1**	
Mercury (SV-AU-05)	9.74	3.00E-04	1.25E-04	**0.4**	
Cancer Risk Calculation - **Resident Child**		Slope Factor (mg/kg-day)-1	RME Chronic Daily Intake (CDI) (mg/kg-day)	**Incremental Cancer Risk**	
Benzo(a)anthracene (BAKER-03)	3800	7.30E-01	4.16E-03	**3E-03**	Estimated incremental cancer risks are greater than the EPA acceptable range; **outlier locations BAKER-03 and SV-BAKER-03 require further evaluation.**
Benzo(b)fluoranthene (BAKER-03)	3400	7.30E-01	3.73E-03	**3E-03**	
Benzo(k)fluoranthene (SV-BAKER-03)	2200	7.30E-02	2.41E-03	**2E-04**	
Indeno(1,2,3-c,d) Pyrene (BAKER-03)	2000	7.30E-01	2.19E-03	**2E-03**	
Phenanthrene (SV-BAKER-03)	2000	NA	2.19E-03	**NA**	No tox value published; however, if the slope factor was 7.3E-1 (like the other PAHs), the conclusion would be the same as above.

Non-Cancer Hazard Quotient Calculation - **Resident Adult**

Chemical of Potential Concern and Outlier Sample	Exposure Point Concentration (4) (mg/kg)	Chronic RfD (3) (mg/kg-day)	RME Chronic Daily Intake (CDI) (mg/kg-day)	**Non-Cancer Hazard Quotients**	
			Incidental Ingestion (1)		
Antimony (AU-03)	40	4.00E-04	5.53E-05	**0.1**	
Beryllium (SV-12A)	19	2.00E-03	2.60E-05	**0.01**	
Mercury (SV-AU-05)	9.74	3.00E-04	1.33E-05	**0.04**	
Cancer Risk Calculation - **Resident Adult**		Slope Factor (mg/kg-day)-1	RME Chronic Daily Intake (CDI) (mg/kg-day)	**Incremental Cancer Risk**	
Benzo(a)anthracene (BAKER-03)	3800	7.30E-01	2.45E-03	**2E-03**	Estimated incremental cancer risks are greater than the EPA acceptable range; **outlier locations BAKER-03 and SV-BAKER-03 require further evaluation.**
Benzo(b)fluoranthene (BAKER-03)	3400	7.30E-01	2.20E-03	**2E-03**	
Benzo(k)fluoranthene (SV-BAKER-03)	2200	7.30E-02	1.42E-03	**1E-04**	
Indeno(1,2,3-c,d) Pyrene (BAKER-03)	2000	7.30E-01	1.29E-03	**9E-04**	
Phenanthrene (SV-BAKER-03)	2000	NA	1.29E-03	**NA**	No tox value published; however, if the slope factor was 7.3E-1 (like the other PAHs), the conclusion would be the same as above.

Note: this table shows 8 outlier chemicals from 4 sample locations resulting from Outlier Test 1. Cancer and non-cancer risks were evaluated for the detected concentrations of these 8 chemicals at the outliers.

Table E.13
Calculation of Non-Cancer Hazard Quotients for Remaining COPCs
Southern AU (contained 86 total samples, including the 6 discrete sample locations that had outlier concentrations)

Calculations for Highest Value from Outlier Test 2 (blue)

Non-Cancer Hazard Quotient Calculation - **Resident Child**

Chemical of Potential Concern and Outlier Sample	Exposure Point Concentration (4) (mg/kg)	Chronic RfD (3) (mg/kg-day)	RME Chronic Daily Intake (CDI) (mg/kg-day)	**Non-Cancer Hazard Quotients**	**Conclusions**
			Incidental Ingestion (1)		
Antimony (AU-10)	36.3	4.00E-04	4.64E-04	**1.2**	Antimony at outlier location AU-10 could be associated with risk; **outlier location requires further evaluation.**
Mercury (SV-04)	2.3	3.00E-04	2.94E-05	**0.1**	

Non-Cancer Hazard Quotient Calculation - **Resident Adult**

Chemical of Potential Concern and Outlier Sample	Exposure Point Concentration (4) (mg/kg)	Chronic RfD (3) (mg/kg-day)	RME Chronic Daily Intake (CDI) (mg/kg-day)	**Non-Cancer Hazard Quotients**
			Incidental Ingestion (1)	
Antimony (AU-10)	36.3	4.00E-04	4.97E-05	**0.1**
Mercury (SV-04)	2.3	3.00E-04	3.15E-06	**0.01**

Note: this table shows 2 outlier chemicals from 2 sample locations resulting from Outlier Test 2. Cancer and non-cancer risks were evaluated for the detected concentrations of these 2 chemicals at the outliers.

Notes:

1. Risks for a residential receptor were evaluated for the incidental soil ingestion route using the assumptions and equations shown in Table E.1. Dermal pathway not quantified, since only those COPCs with EPA-recommended dermal absorption fractions are quantified. Currently, USEPA (2004) provides recommended dermal absorption factors for ten chemicals in soil, including only the inorganics arsenic (0.03) and cadmium (0.001).

2. Using the 95% UCL of the mean with outliers removed.

3. The toxicity values for aluminum, cobalt, iron, thallium, and vanadium are provisional peer-reviewed toxicity reference values (PPRTV) (EPA RSL Table May 2013).

4. Concentration of outlier (maximum or next detected concentration within EU).

Since an oral RfD is not published for elemental mercury, the oral RfD for mercuric chloride was used