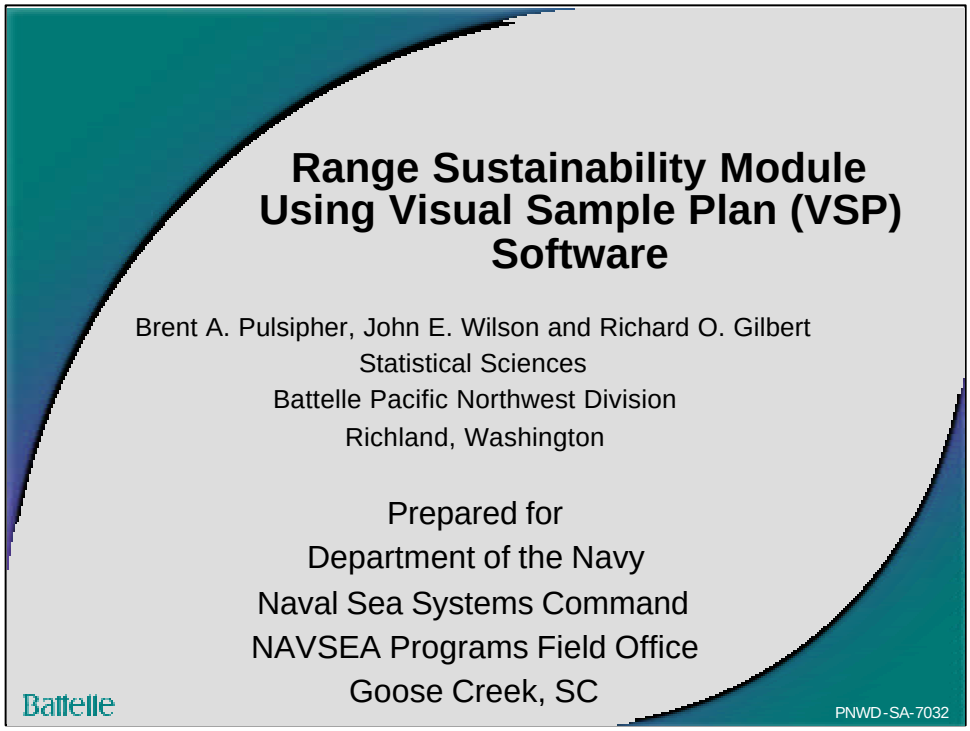
Range Sustainability Module
Using Visual Sample Plan (VSP)
Software
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Objective

- Learn how to use the Range Sustainability (RS) Module in the Visual Sample Plan (VSP) software
  - to determine if explosives constituents in surface soil may have migrated beyond the provisional boundary of an active training range, and if so,
  - to estimate the location of a new provisional boundary that may enclose the area where mean concentrations exceed action limits.

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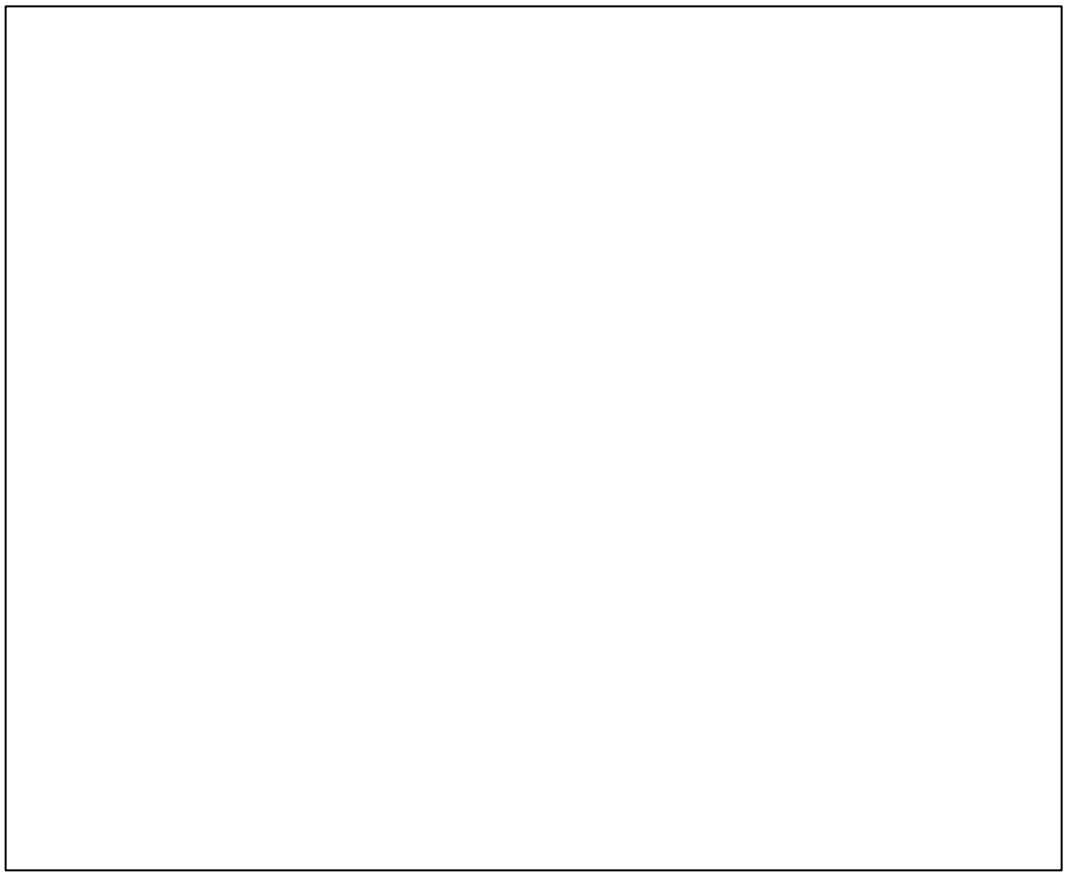

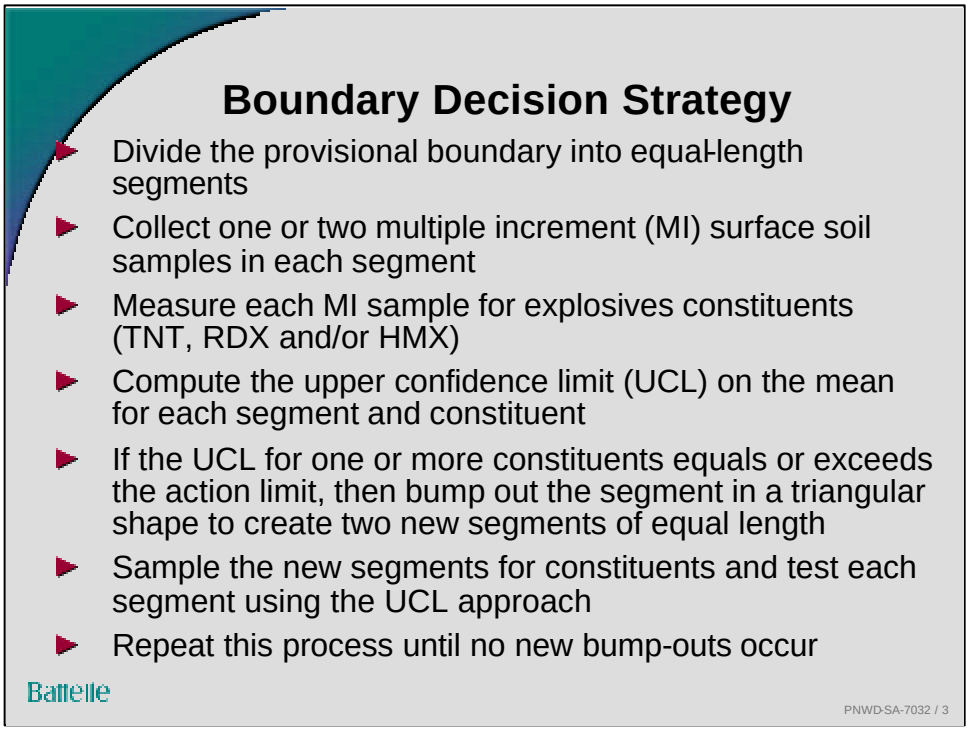

It is assumed that explosives constitutes in surface soil are not resuspended and transported through the air to distinct isolated hot spots outside the boundary. That is, it is assumed that explosives constituents in surface soil move as a plume across the boundary with no discontinuities over space.

Outline of This Training

- Introduce Visual Sample Plan (VSP) software
- Outline the steps in using the VSP-RS module
- Describe each step
  - Provide illustrations, screen shots, and a case study

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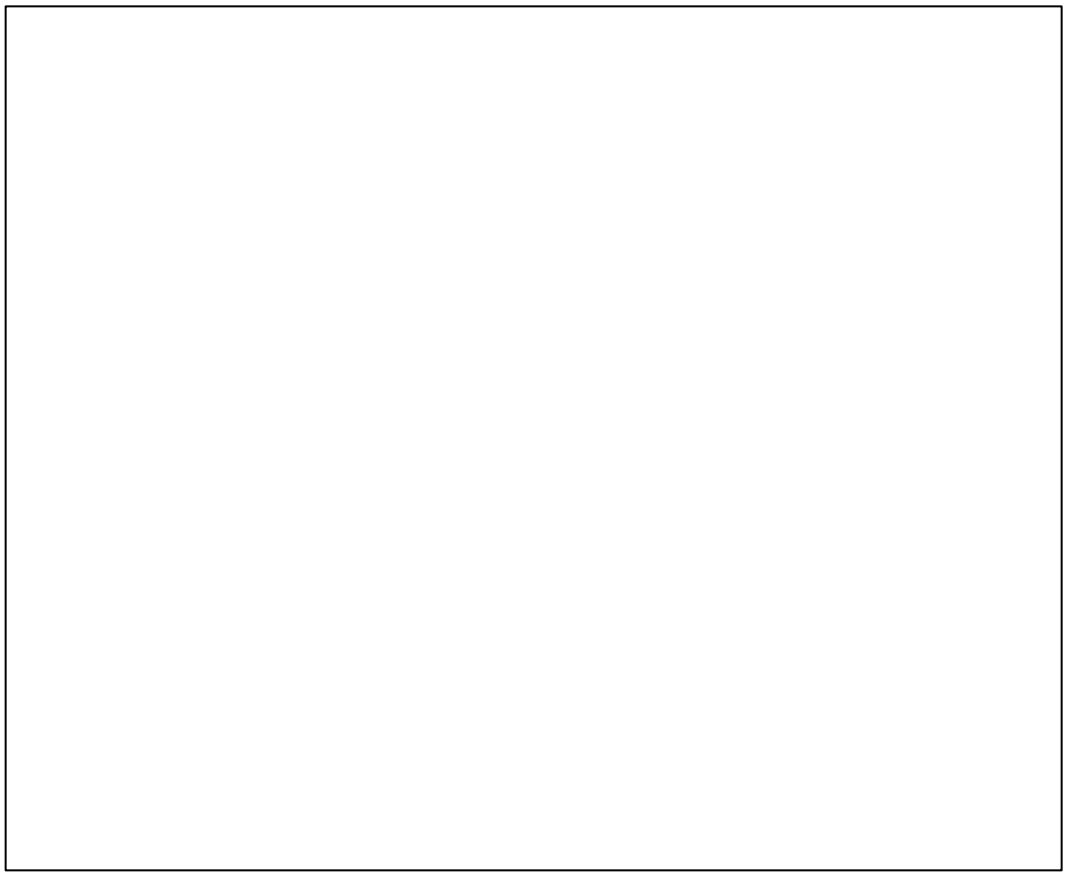
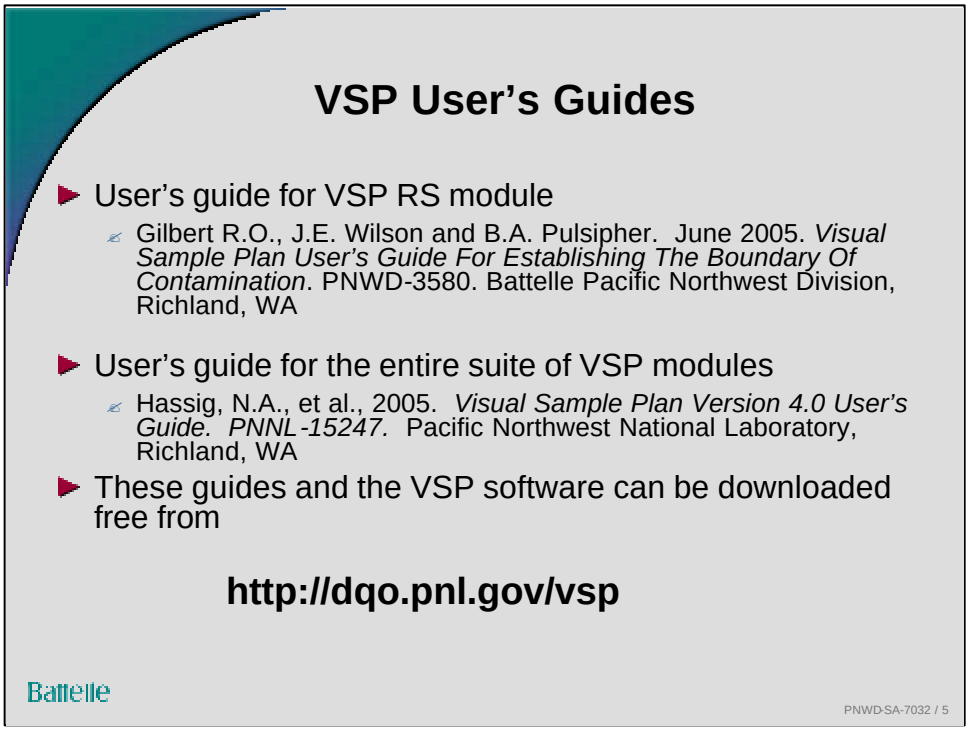
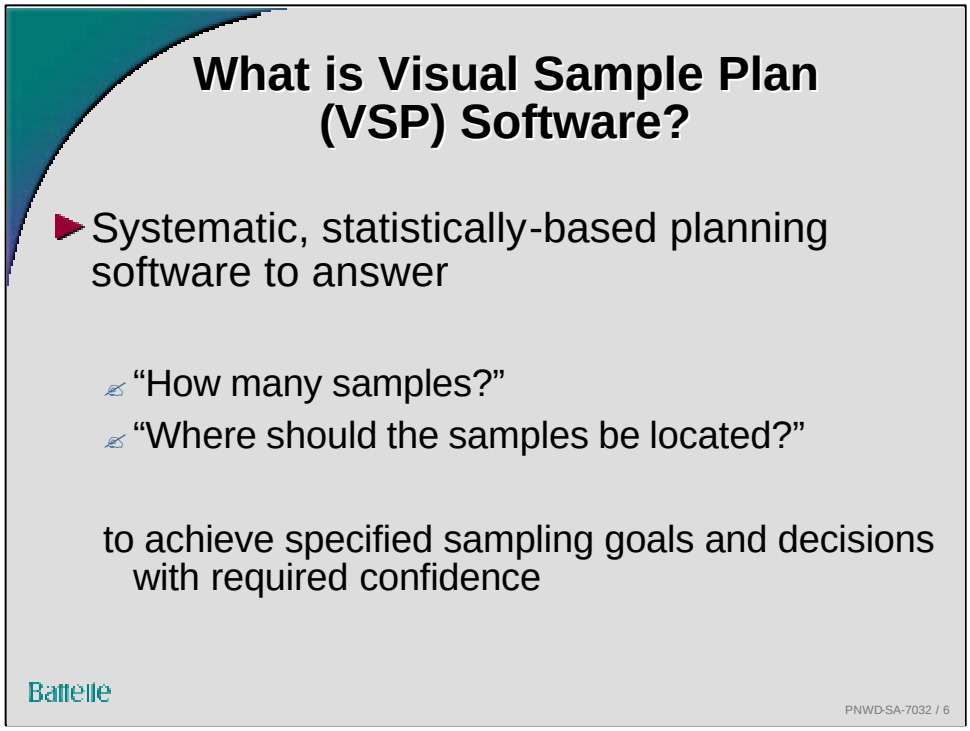
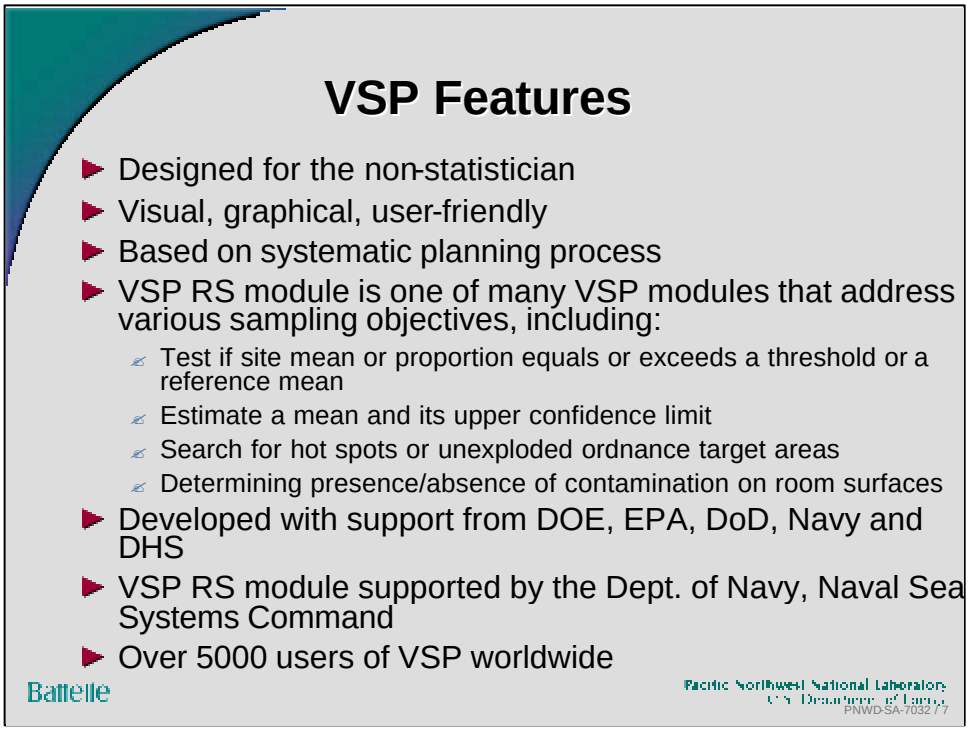




The Visual Sample Plan "Quick-Start Guide" that is automatically downloaded along with the VSP software provides very help instructions on use of basic VSP features.



The RS module of VSP differs from other VSP modules in that the number of samples per segment is fixed at 1 or 2. Other VSP modules compute the minimum number of samples on the basis of inputs (Data Quality Objectives) provided by the VSP user



VSP provides both well known and novel sampling approaches:

- Simple random sampling
- Systematic grid sampling
- Sequential sampling
- Collaborative sampling
- Stratified sampling
- Rand-Set sampling
- Adaptive cluster sampling
- Continuous transect sampling
- Judgmental sampling
- Composite sampling along boundaries

The VSP User's Guide (Hassig et al, 2005) provides full details.

What are the Steps in Using the VSP RS Module?

1. Download, install and open VSP
2. Define the provisional range boundary
3. Specify sampling design inputs and constituents of concern
4. VSP divides boundary into equal-length segments
5. Collect two multiple-increment (MI) soil samples in 5 or more segments or at least 10% of segments; collect one MI sample in remaining segments
6. Measure the MI soil samples for explosives contaminants of interest: TNT, RDX and/or HMS
7. Enter data into VSP

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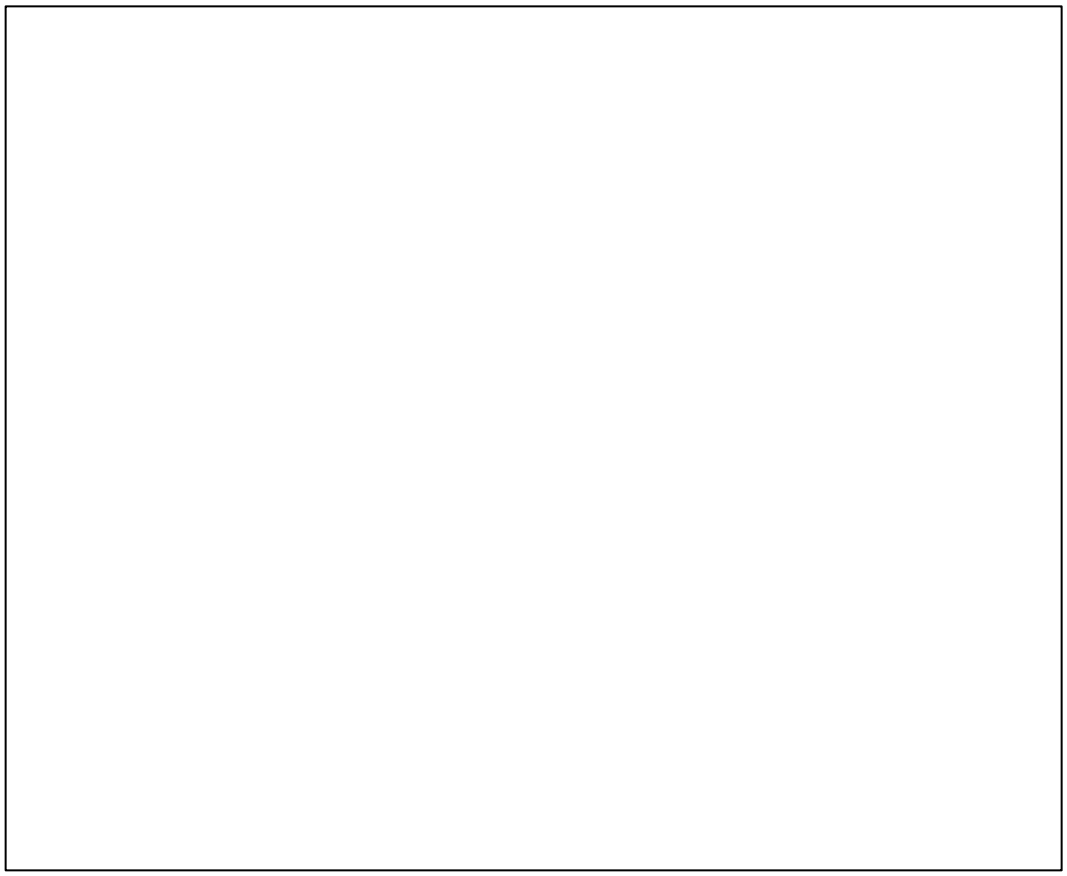

What are the Steps in Using the VSP-RS Module? (continued)

8. VSP computes for each segment the one-sided upper confidence limit (UCL) on the mean for each contaminant measured
9. If the UCL for a given segment for one or more contaminants equals or exceeds a specified action limit, then VSP bumps out that boundary segment in a triangular shape to create two new segments of same length
10. Each new segment is similarly sampled and tested using the UCL to see if it should be bumped out
11. VSP automatically prepares a summary report that includes a map of the final boundary, measurements obtained, statistical methods and assumptions

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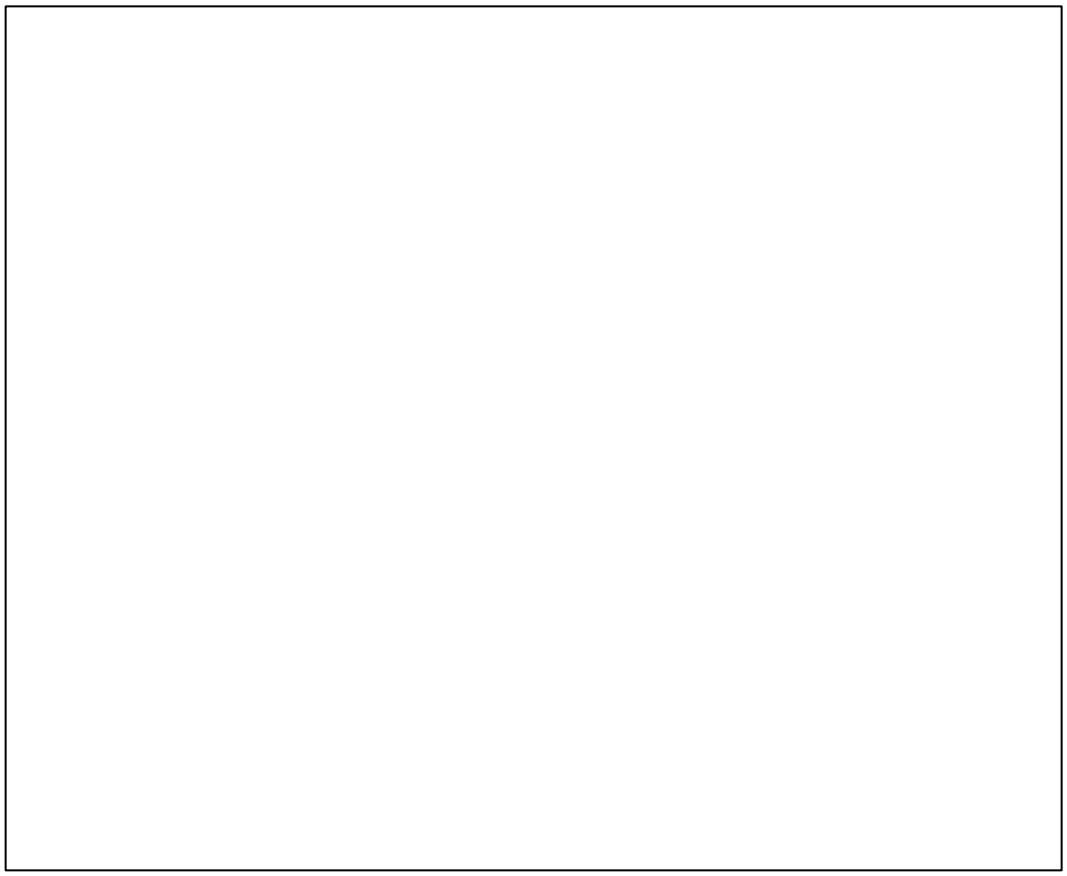
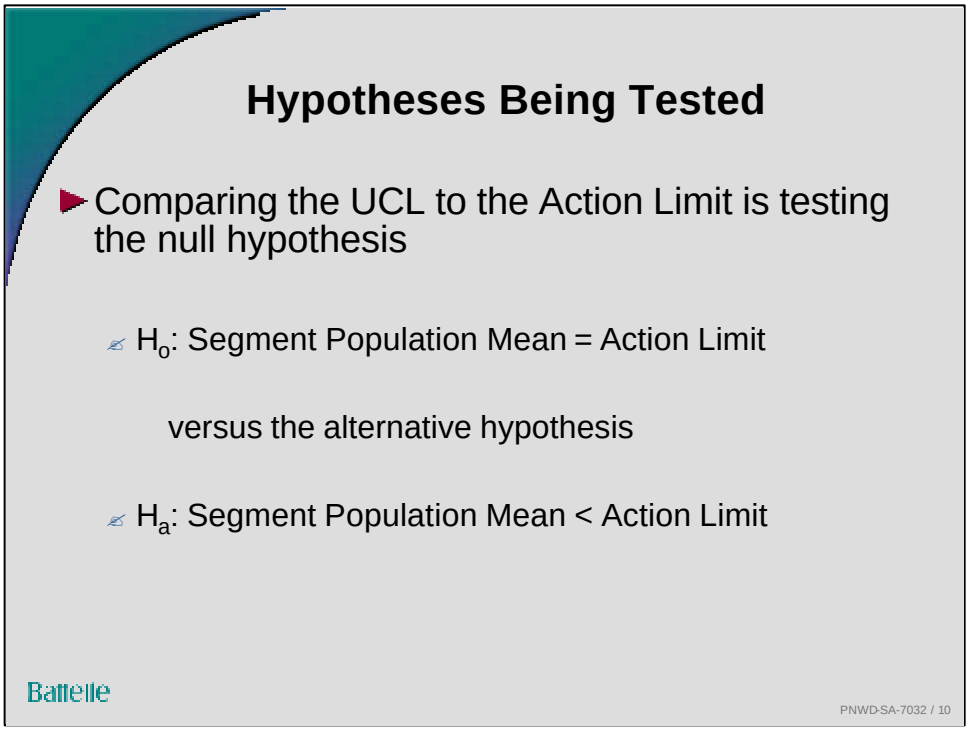
PNWD-SA-7032 / 9





The null hypothesis is accepted as being true unless the evidence (data) strongly indicate that it should be rejected in favor of the alternative hypothesis. The burden of proof is on showing that the null hypothesis is false., i.e., on showing that the segment does not need to be bumped out.

Step 1: Download, Install and Open VSP

- Download VSP and the VSP user's guides from http://dqo.pnl.gov/vsp
- Install VSP by double clicking on the downloaded VSample.exe file
- Start VSP by clicking
  Start>Programs>Visual Sample Plan>Visual Sample Plan
- In the "Select VSP Version" box that appears, click
  "Range Sustainability Application Version" or "General (all inclusive) VSP"
- In the "VSP Advisor" box that appears
  - Click on questions of interest about VSP to obtain answers
  - Close the box when finished
- On the "Welcome to Visual Sample Plan" screen
  - Click on questions of interest about VSP

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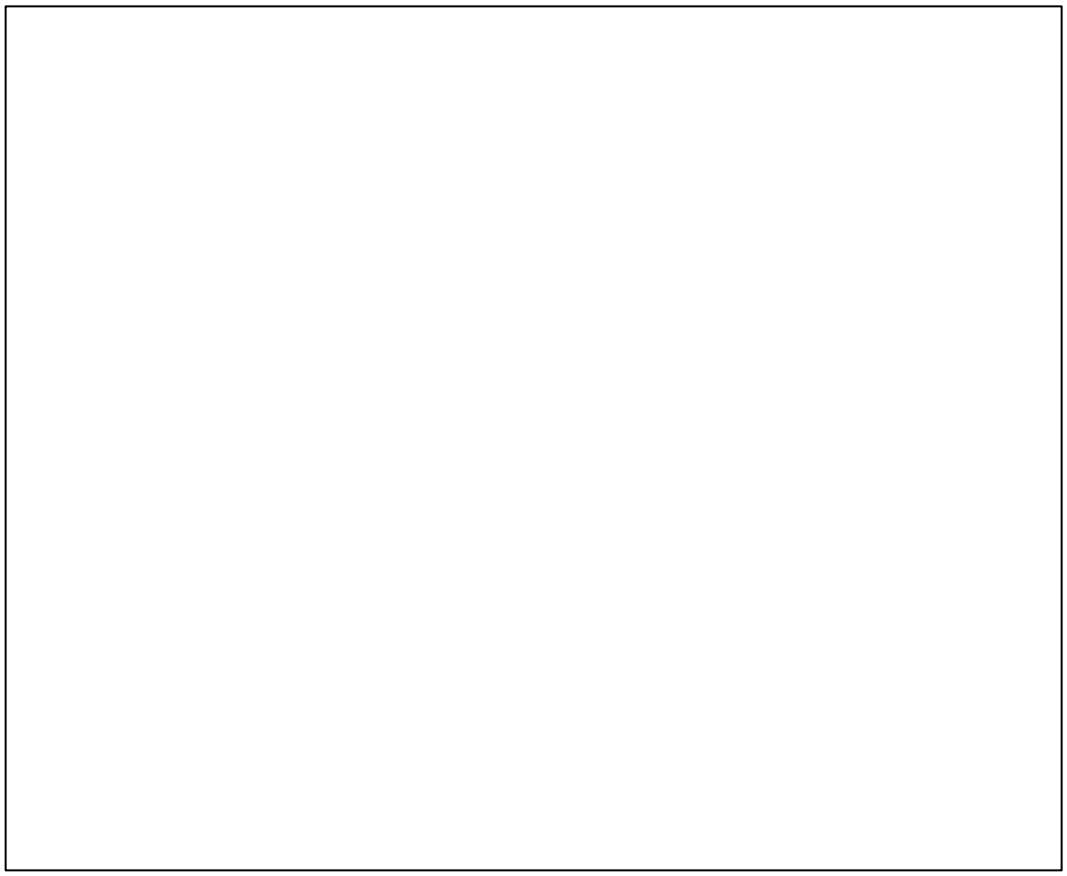
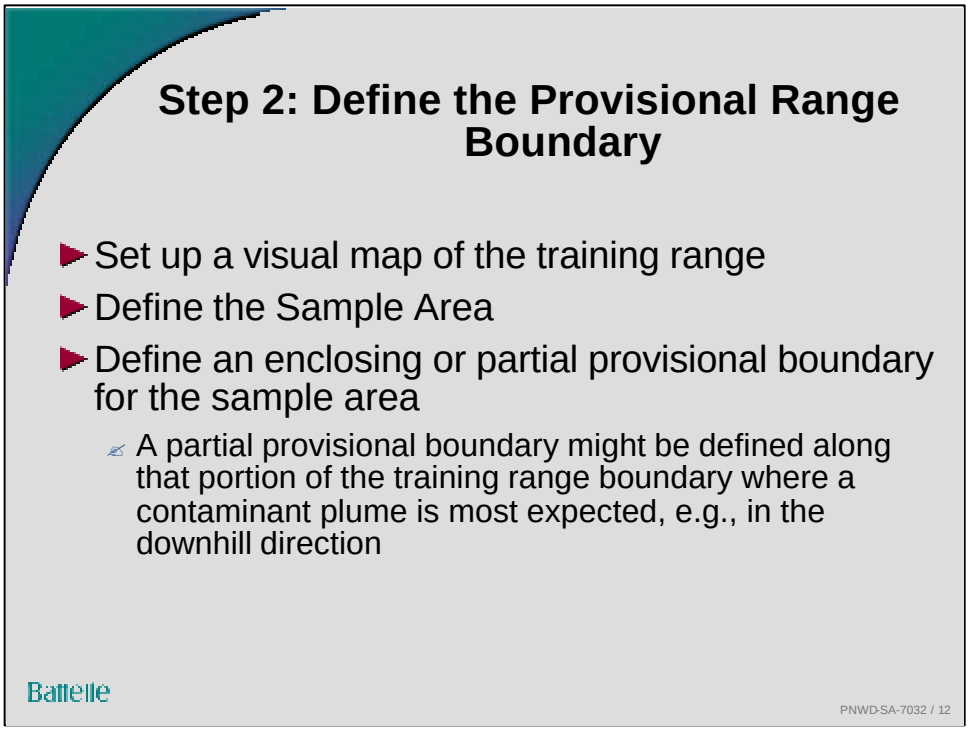
PNWD-SA-7032 / 11





A provisional partial boundary can be placed at any location on the map, not necessarily on the boundary of the sample area. The provisional partial boundary may be placed at the field location (boundary) such that the soil on one side of the boundary is expected to be contaminated and the soil on the other side is expected to be uncontaminated.

Set Up a Visual Map of the Range

- Save a Shape (SHP) or Data Exchange Format (DXF) file of the training range in the VSP folder (C:\Program Files\Visual Sample Plan)
- Load the SHP or DXF file into the current VSP project by
  - clicking **Map** on the menu bar
  - clicking **Load Map from File** on the **Map** drop-down menu
  - double clicking on the desired file
- If a SHP or DXF file of the training range is not available, VSP drawing tools can be used to draw the range map
- Examples of a loaded DXF file and a site map drawn using the VSP drawing tool “Draw Line or Polyline” are provided on the next two slides

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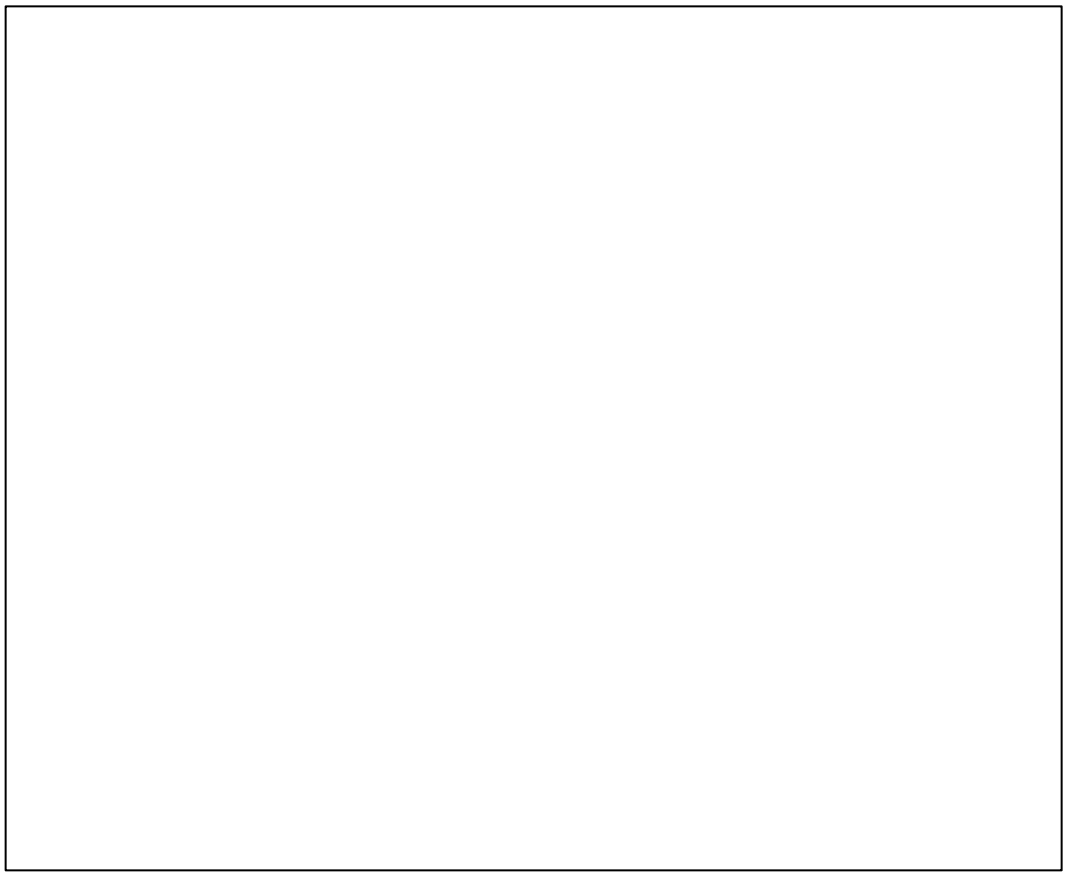
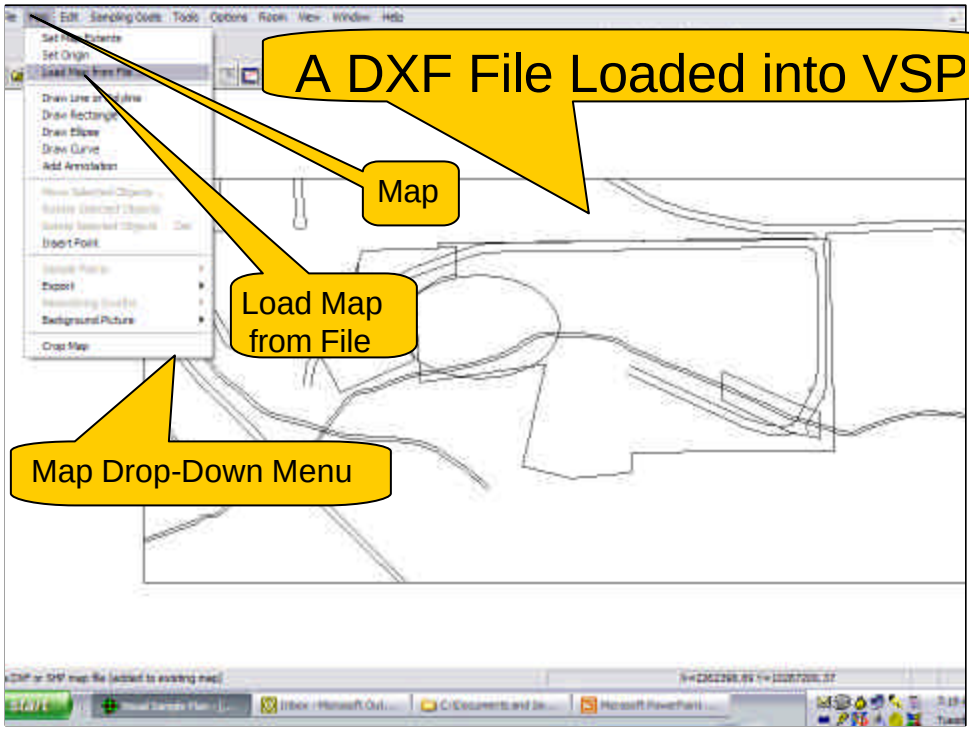
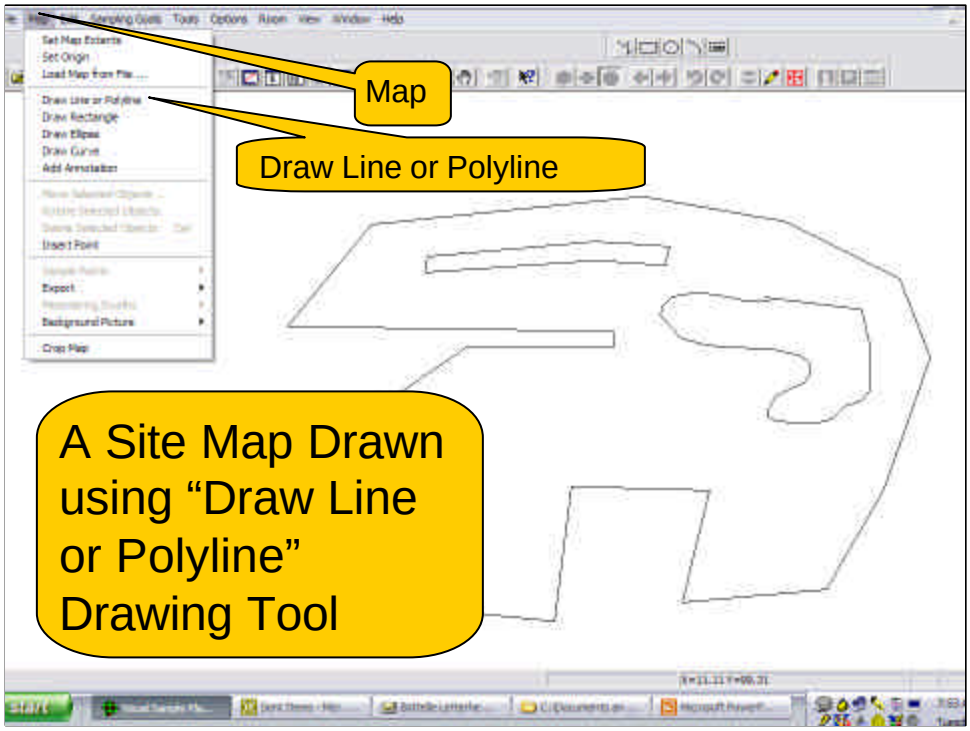
PNWD-SA-7032 / 13




A DXF File Loaded into VSP
Map
Load Map from File
Map Drop-Down Menu



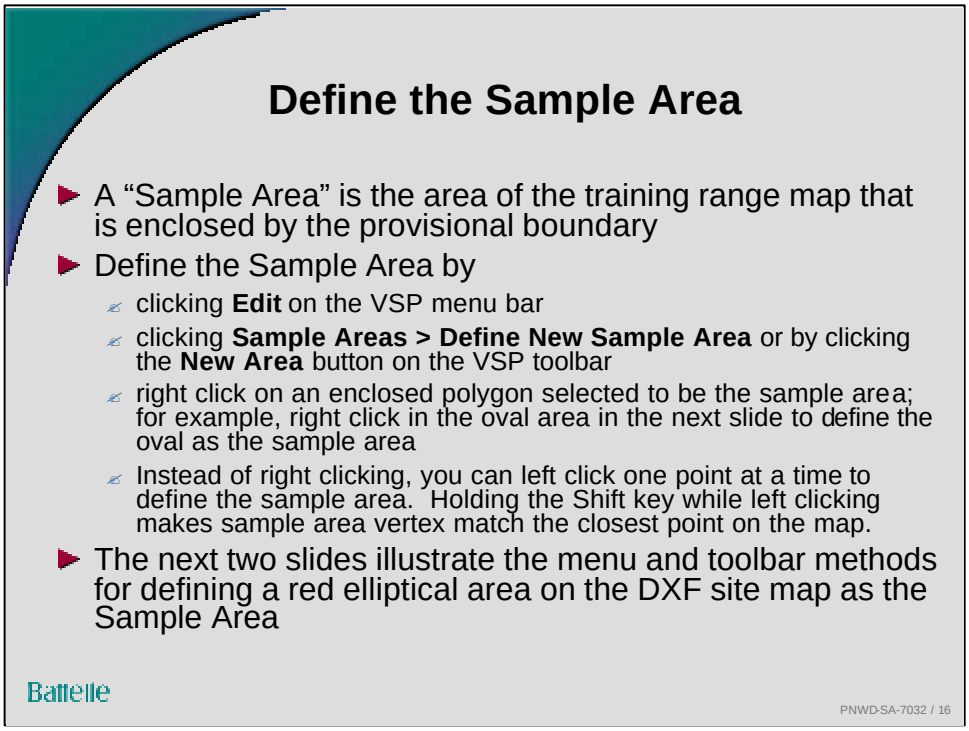
Other drawing tools on the MAP drop down menu are:

Draw Rectangle

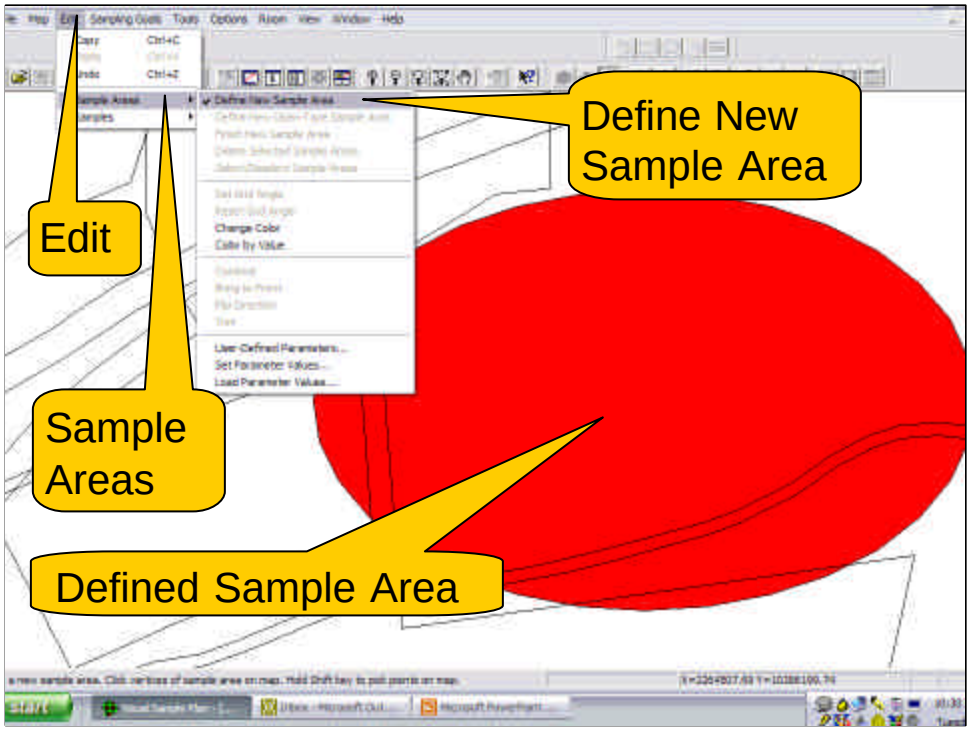
Draw Ellipse

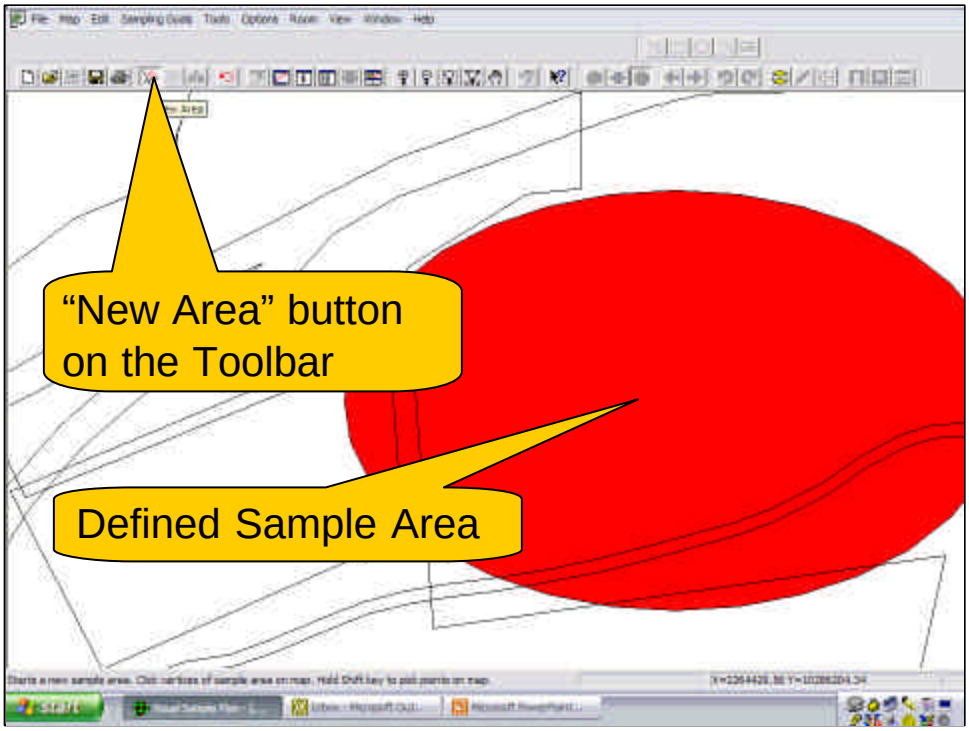
Draw Curve

The VSP User’s Guide (Hassig et al 2005) describes how to use these drawing tools.



The **New Area** button is the 6th button from the left on the VSP toolbar. Clicking this button or **Edit > Sample Areas > Define New Sample Area** brings up the **“Color Dialog Box**,” which permits selecting a preferred color to highlight the Sample Area. The **Sample Area** is created by positioning the cursor inside the desired enclosed area on the map and right-clicking the mouse. A dialog box appears that shows the size of the **Sample Area** in square meters, square feet or square inches, as selected. If the **Sample Area** is relative simple (a rectangle, square, circle, ellipse or simple polygon) it is not necessary to first load a map of the training range. Instead the **Sample Area** can be drawn using one of the drawing tools on the **MAP** drop-down bar. Other methods for creating the **Sample Area** are provided in the VSP User’s Guide by Hassig et al. (2005) that can be downloaded from http://dqo.pnl.gov/vsp.


Define New Sample Area
Edit
Sample Areas
Defined Sample Area


"New Area" button
on the Toolbar
Defined Sample Area

Define the Provisional Enclosing or Partial Boundary Segments

- Suppose an enclosing boundary is desired
- First click **Sampling Goals** on the VSP menu bar, then click

  Establish Boundary of Contamination > Enclosing Boundary

  to bring up a dialog box
- The next slide shows these steps and the dialog box that appears
- That slide is followed by a slide that shows the inputs to the dialog box
- When the **Apply** button at the bottom of the dialog box is clicked, VSP determines and displays the boundary segments
- Each segment shows 5 Primary Sampling Locations that are evenly spaced along the segment

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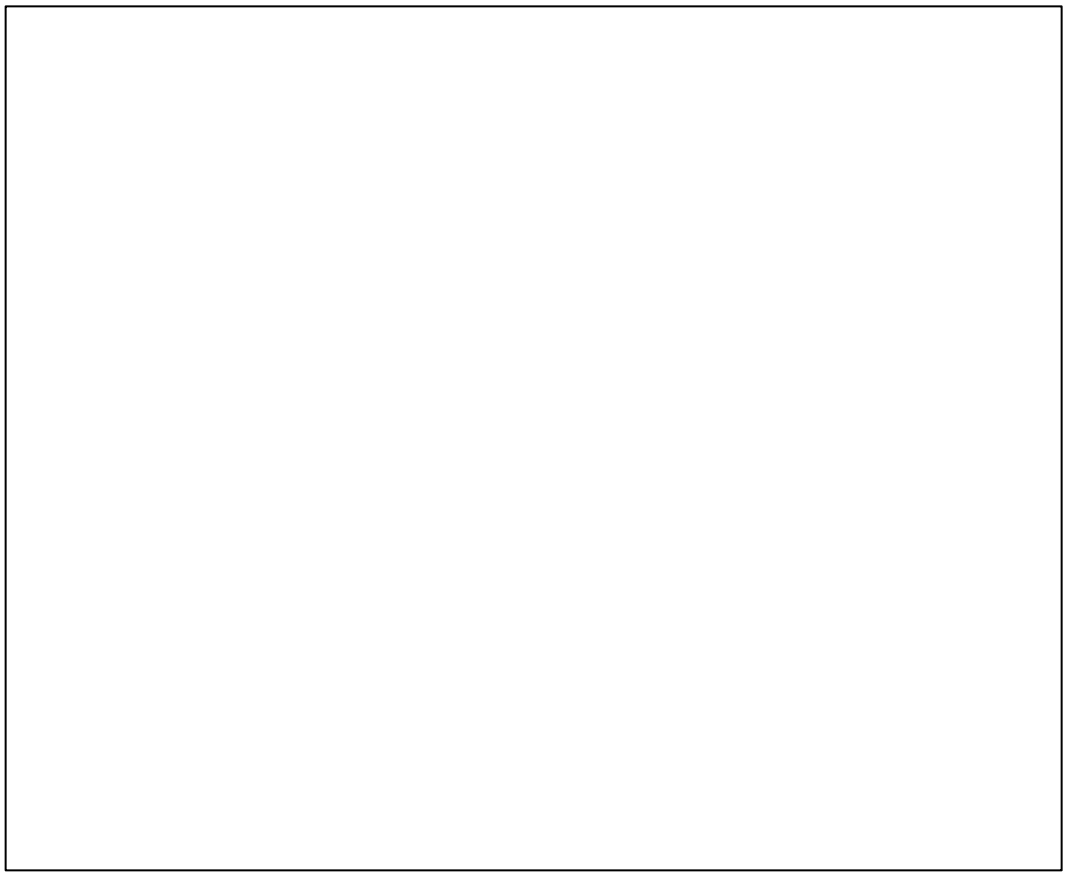
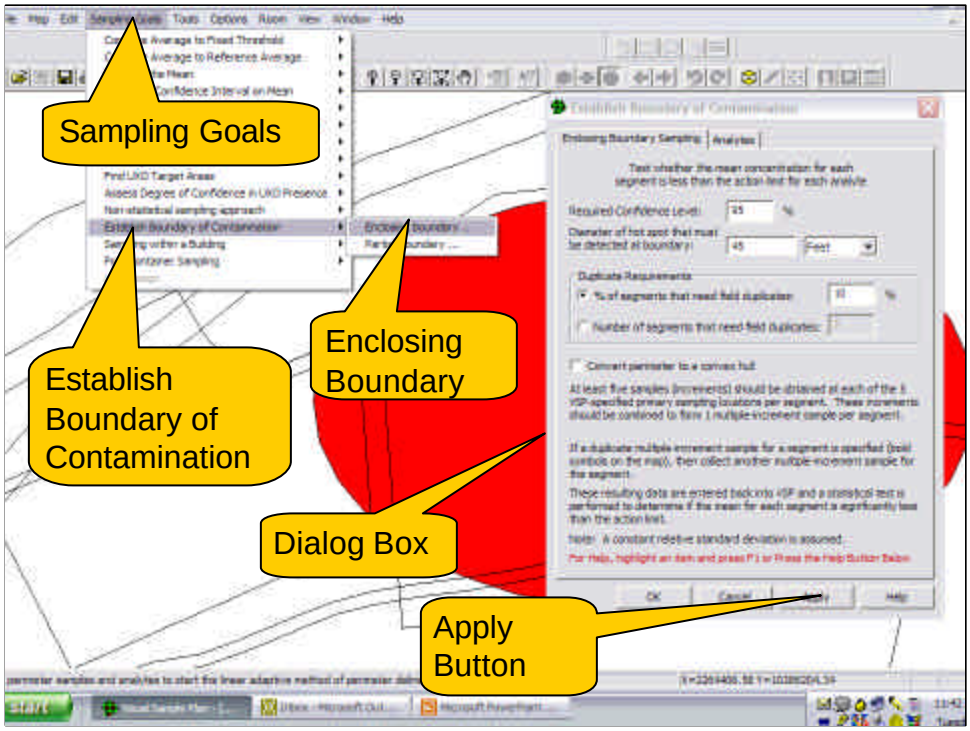
PNWD-SA-7032 / 19





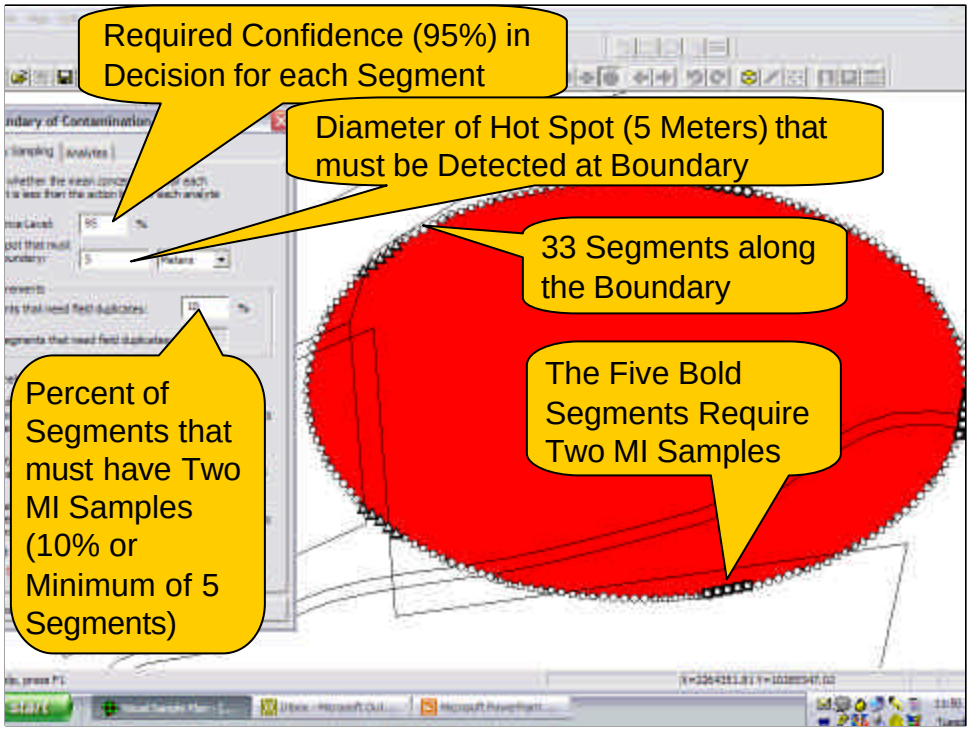
Definition of inputs in dialogue box:

Required Confidence Level: the required probability that the UCL for a segment actually exceeds the true mean for the segment.

Diameter of Hot Spot: the width of a contaminant plume or hot spot of concentrations that would be of concern if it existed at the perimeter boundary.

Percent or Number of Segments to need Field Duplicates: the VSP user can input into the dialogue box the percent or number of segments that should have two MI soil samples rather than one.

Convert the Boundary to a Convex Hull: If the boundary of the Sample Area is very irregular (has various indentations) the VSP user may specify that VSP should change the enclosing boundary to a convex hull. This smoothes out the boundary.



The number and length of segments are determined by VSP as follows:

- VSP computes the optimum segment length (OSL):

  OSL = 5 x (specified width of plume of concern)

where 5 is the number of Primary Sample Locations equally spaced along the length of each segment.

- VSP computes the number of segments along the boundary by dividing the total length of the boundary by the OSL and rounding up to the nearest whole number

- Length of Segment is computed by dividing the length of provisional boundary by the number of segments.

Define a Sample Area with a Provisional *Partial* Boundary

- If a provisional *partial* boundary is desired, first click **Edit** on the VSP menu bar, then click **Sample Areas > Define New Open-Type Sample Area**
- Then
  - Place the cursor at the starting location of the desired partial boundary and click each vertex along the desired boundary until the end of the partial boundary is reached
  - Then click the right mouse button
- The next slide shows an elliptical sample area with a provisional partial boundary on the downhill side of the Sample Area

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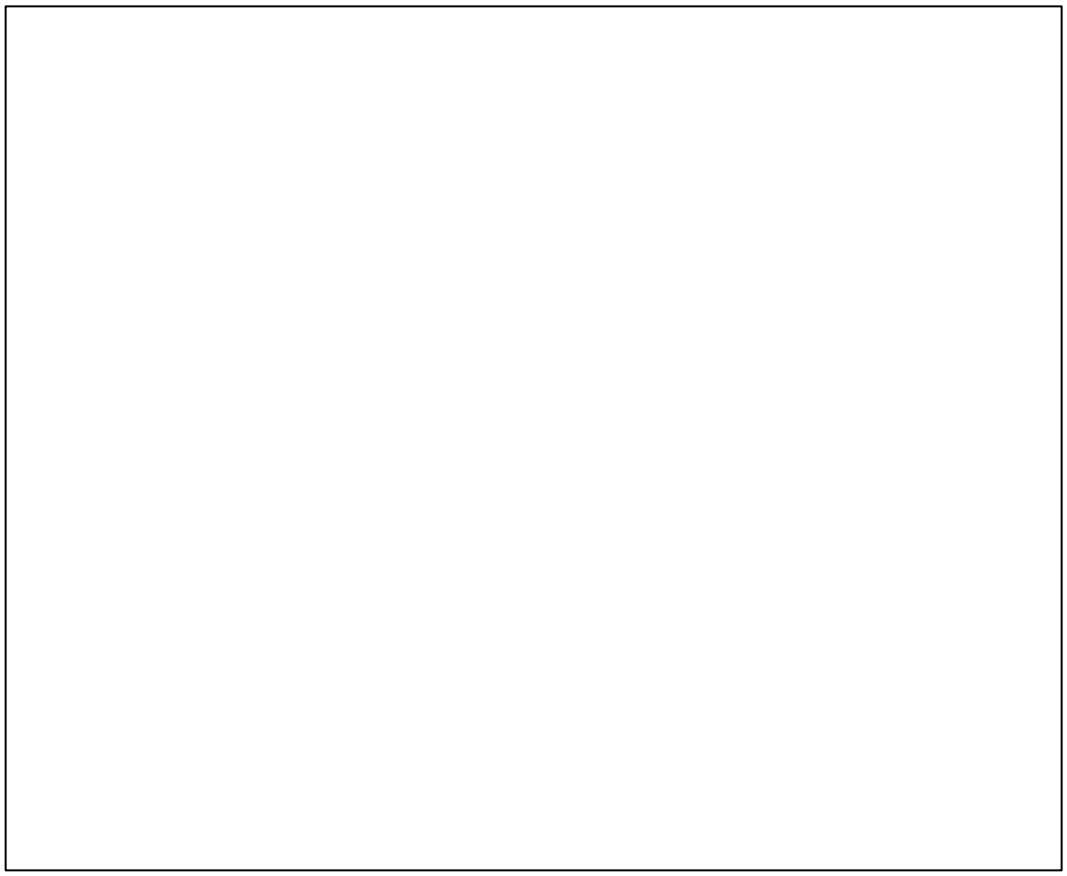
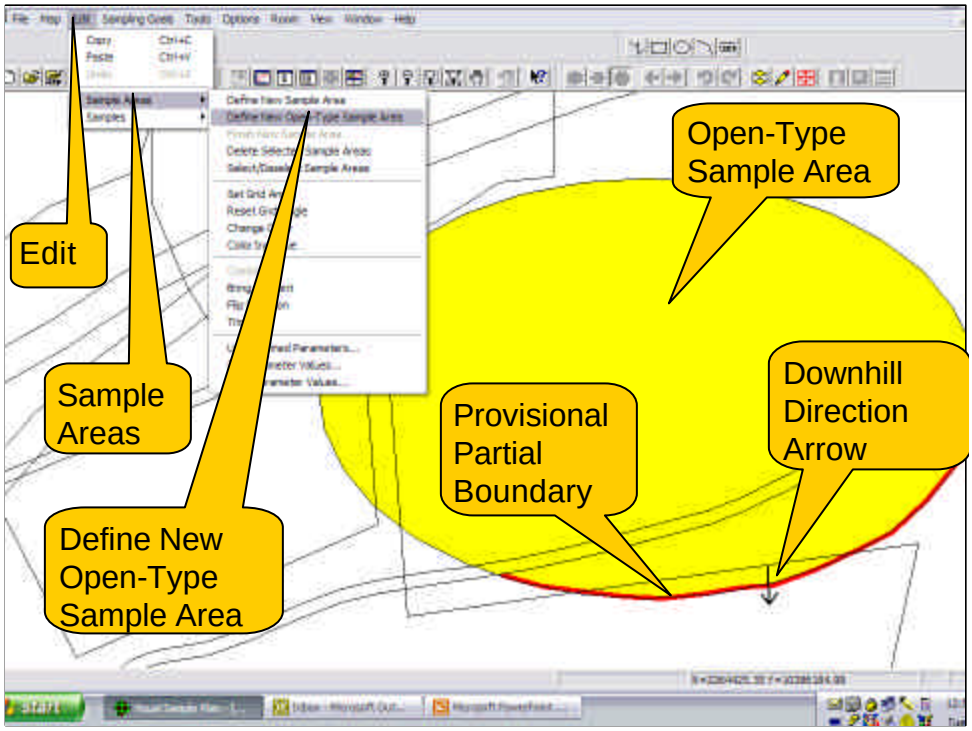
PNWD-SA-7032 / 22




Edit
Sample Areas
Define New Open-Type Sample Area
Open-Type Sample Area
Provisional Partial Boundary
Downhill Direction Arrow

Specify Sampling Design Inputs for Provisional Partial Boundary

- Supply VSP with inputs needed to compute the number of segments and identify which segments require two rather than one MI samples
- Inputs are entered into a dialog box, which is accessed by clicking **Sampling Goals** on the menu bar, then clicking

  Establish Boundary of Contamination > Partial Boundary

  as illustrated on the next two slides

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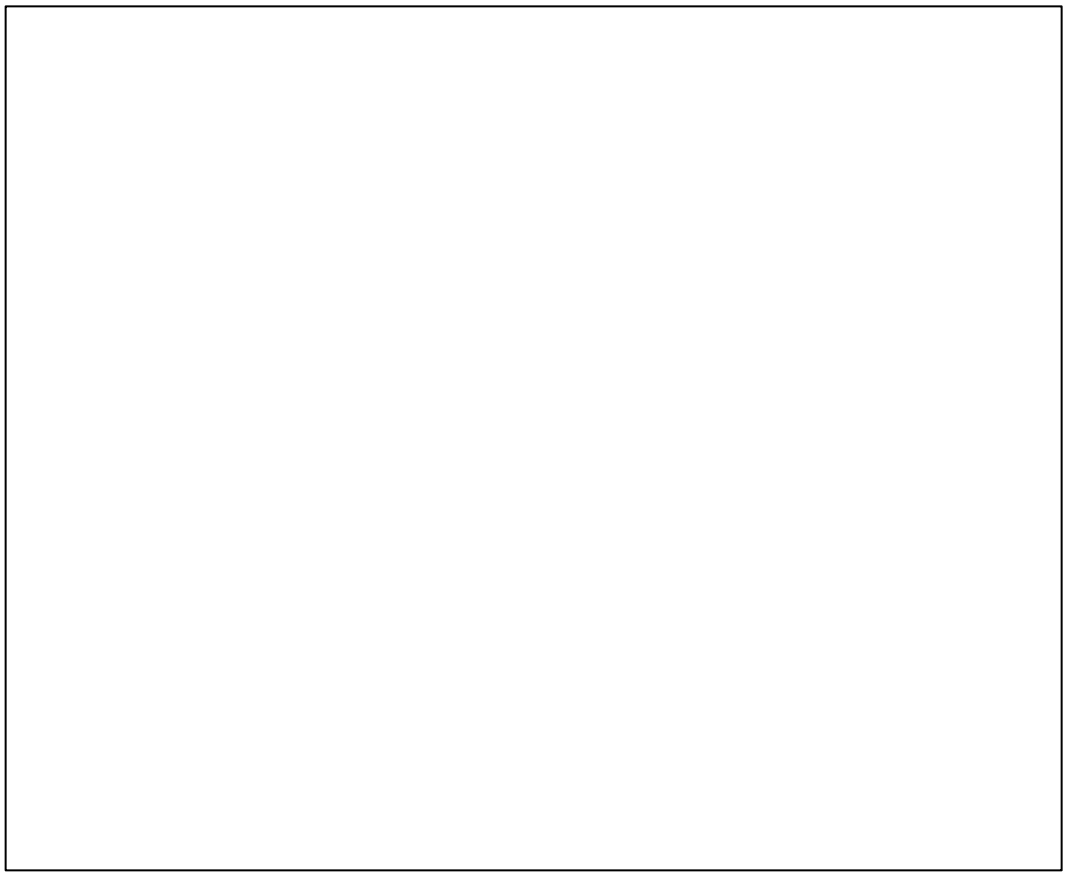
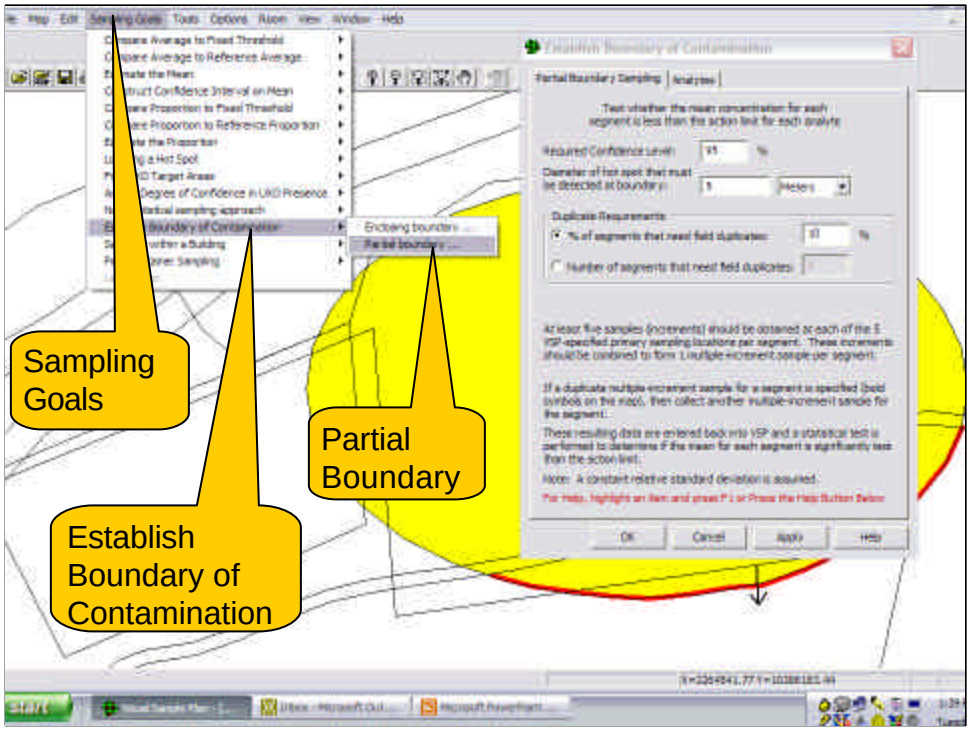
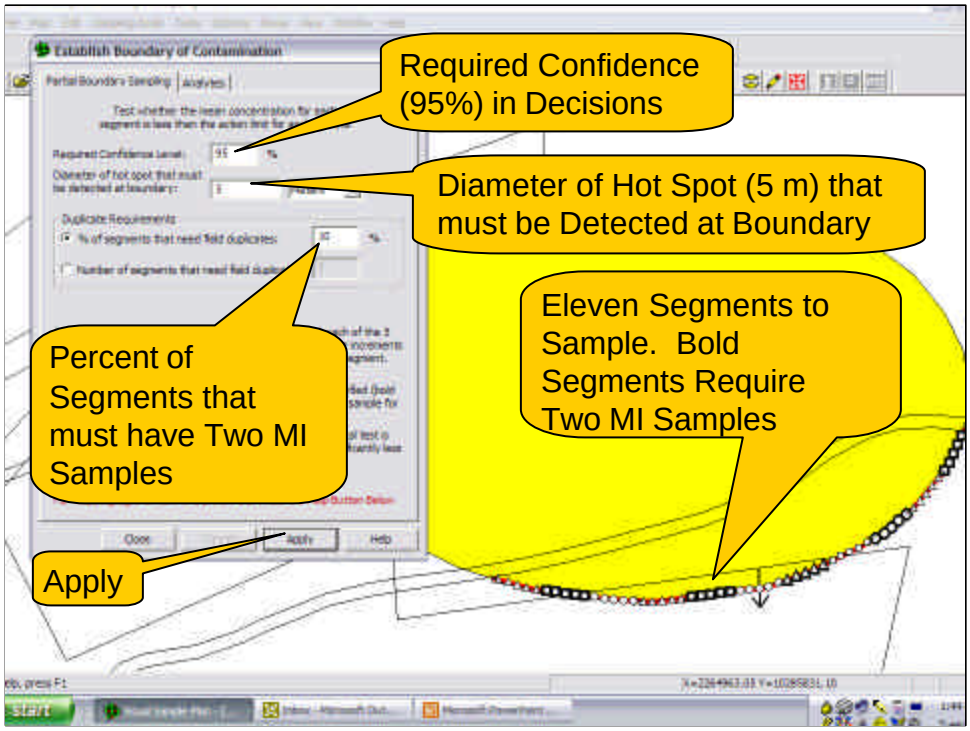
PNWD-SA-7032 / 24




Sampling Goals
Establish Boundary of Contamination
Partial Boundary


Establish Boundary of Contamination
Required Confidence (95%) in Decisions
Diameter of Hot Spot (5 m) that must be Detected at Boundary
Eleven Segments to Sample. Bold Segments Require Two MI Samples
Percent of Segments that must have Two MI Samples
Apply

Specify Constituents of Concern

- Click on the **Analytes** tab at the top of the dialog box.
- This brings up the default list of explosives constituents (TNT, RDX and HDX), their Action Limits and units of measurement (ppm)
- VSP user can change the list of constituents and the action limits

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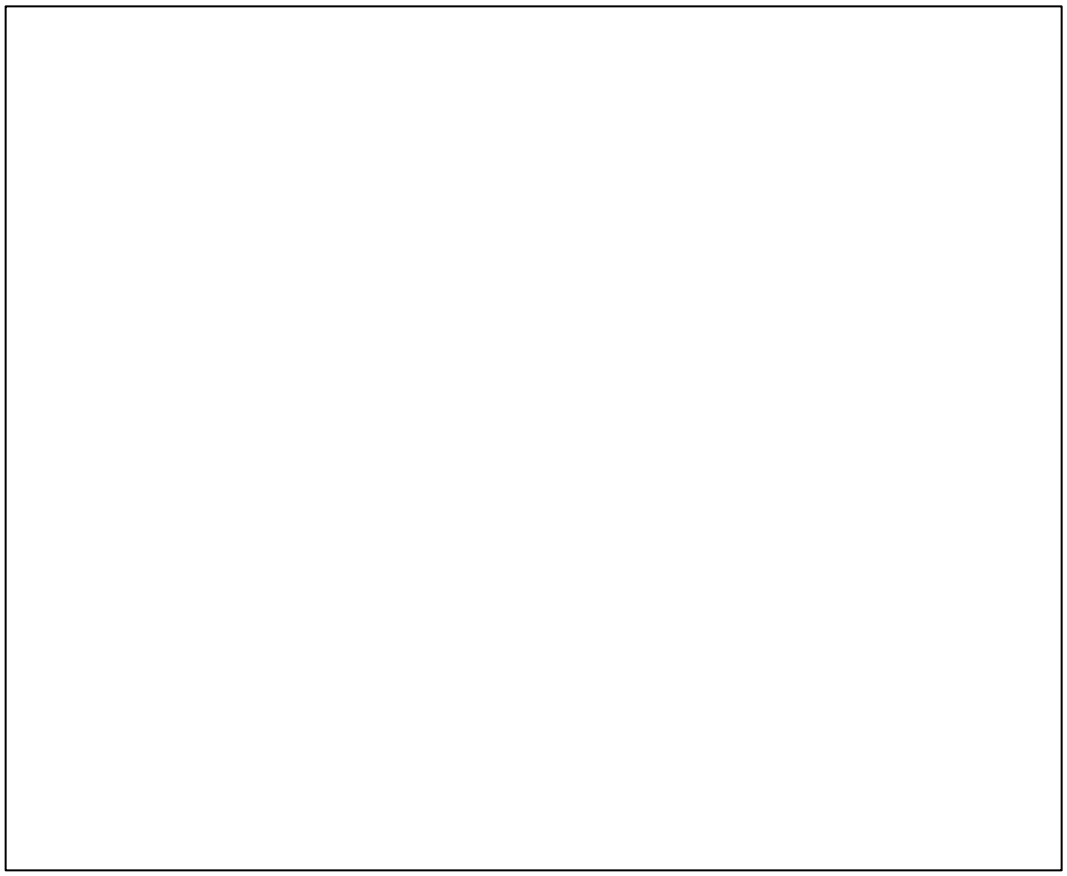
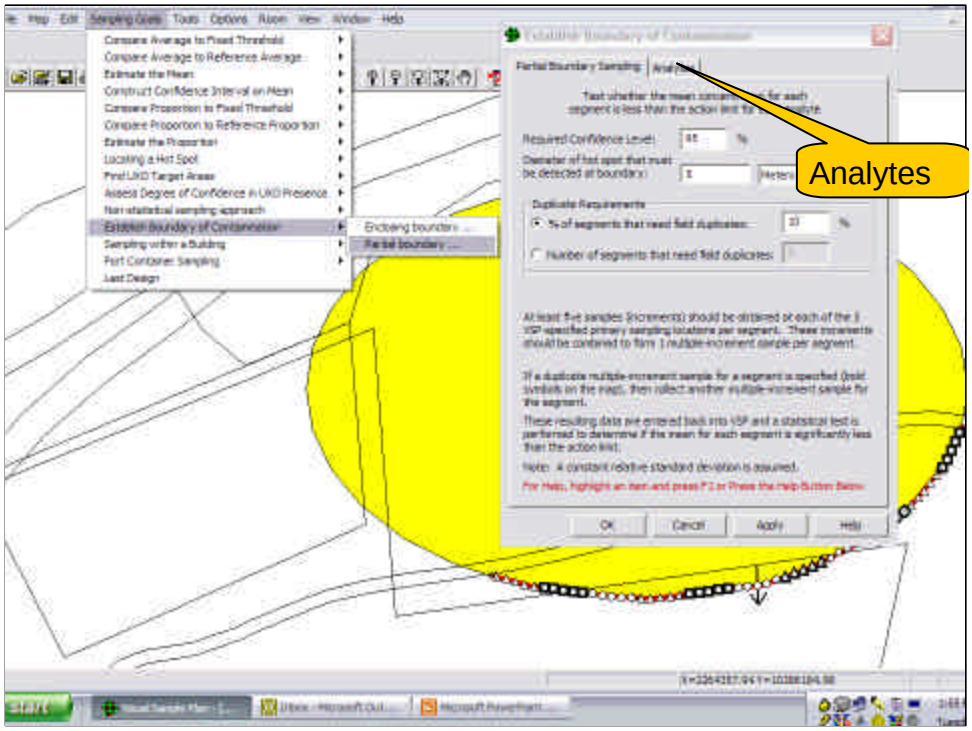
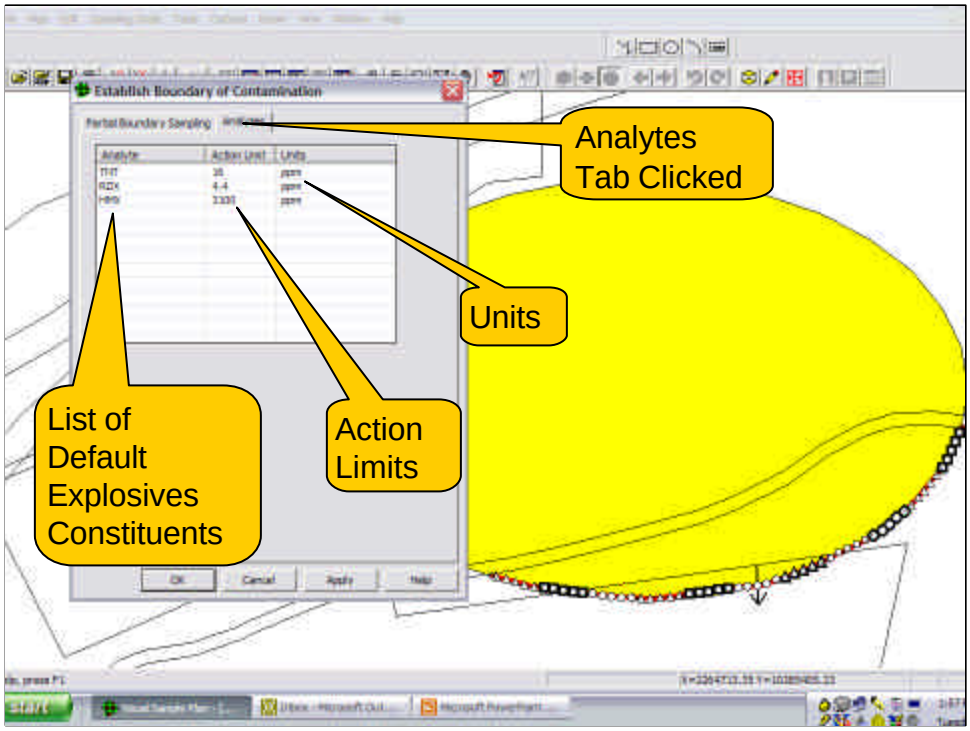
PNWD-SA-7032 / 27




Analytes


Establish Boundary of Contamination
Analytes Tab Clicked
Units
List of Default Explosives Constituents
Action Limits

Obtain MI Samples in each Segment

- Two MI samples must be collected in at least 5 or at least 10% of the segments
  - One MI sample is collected in other segments
  - Segments that require 2 MI samples are selected at random by VSP
  - The project planning team decides where in the segment to collect the second MI sample
- Each MI sample is formed by pooling and mixing at least 5 small soil samples (increments) collected in the vicinity of each of the 5 Primary Sample Locations in each segment
  - Hence, at least 25 soil increments are used to form each MI sample
  - Primary Sample Locations are evenly spaced along the segment
- The project planning team chooses the pattern of soil increment sampling locations around each Primary Sample Location

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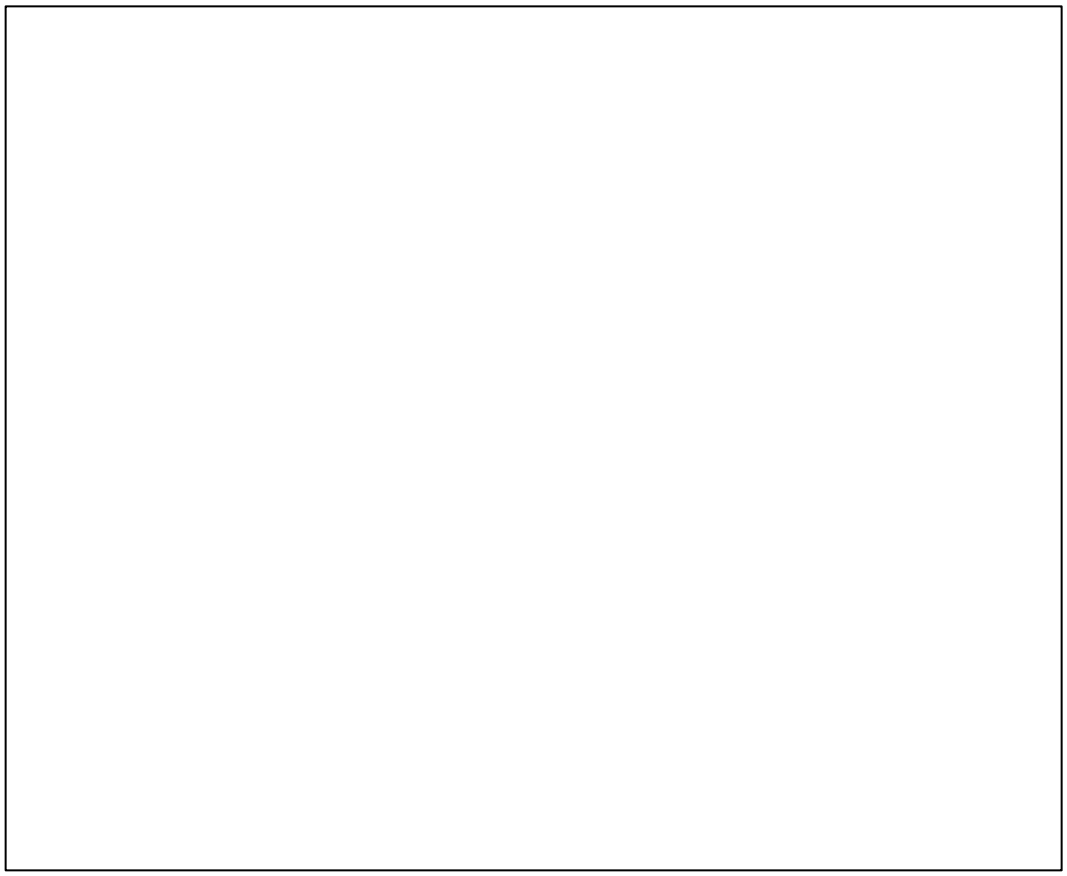
PNWD-SA-7032 / 30



Measure Each MI Sample for Explosives Constituents

- Measure each MI sample for TNT, RDX and/or MDX in the manner prescribed by the project planning team
- If more than one measurement for a constituent is obtained for a MI sample, then the average of the measurements for that MI sample and constituent should be entered into VSP

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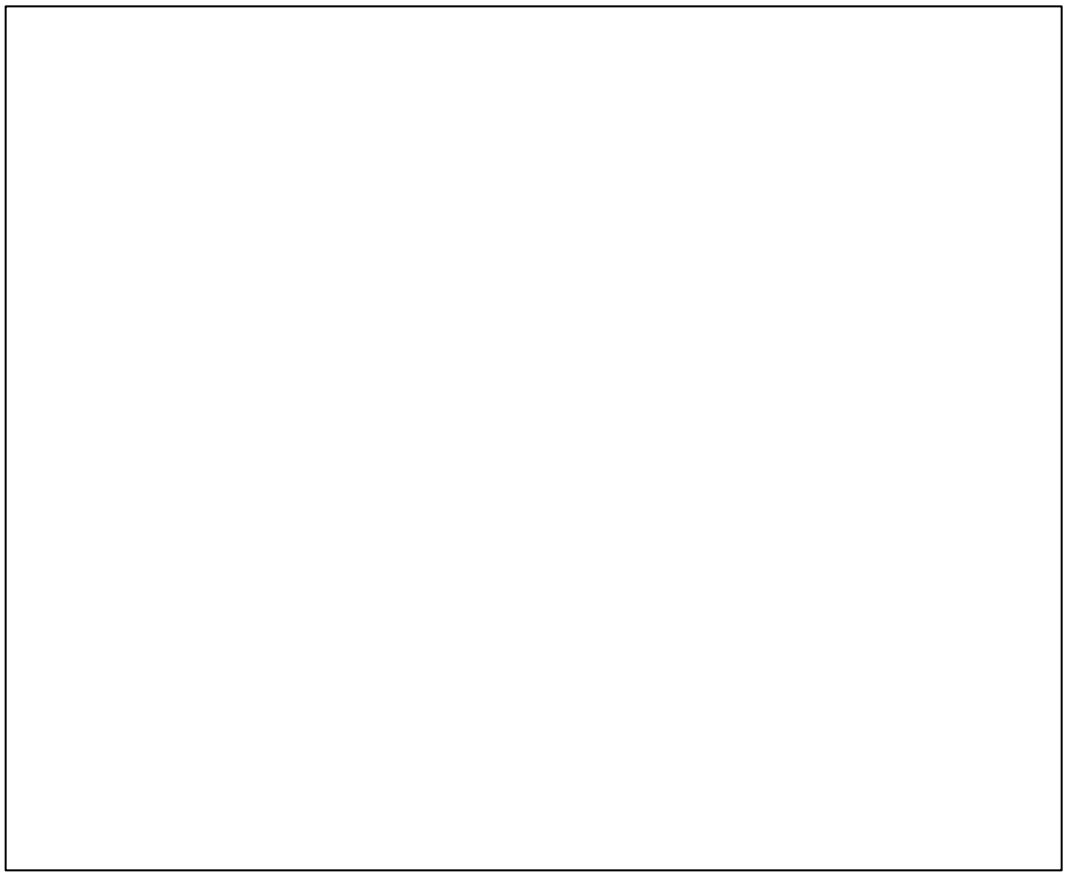
PNWD-SA-7032 / 31



Enter Measurements into VSP (Illustrated on Next Slide)

- First, open the VSP file where the **Sample Area** and boundary map are stored
- Click the **Map View** button on the VSP toolbar to display the **Sample Area** and boundary segments
- For each segment, place the cursor over the segment and click the right mouse button to bring up the **Sample Information** box
- Enter the explosives constituent measurements into the appropriate rows in the box
  - For segments with 2 MI samples, enter a measurement for both samples
- Click “OK” to close the box for that segment
- Repeat above process for each segment

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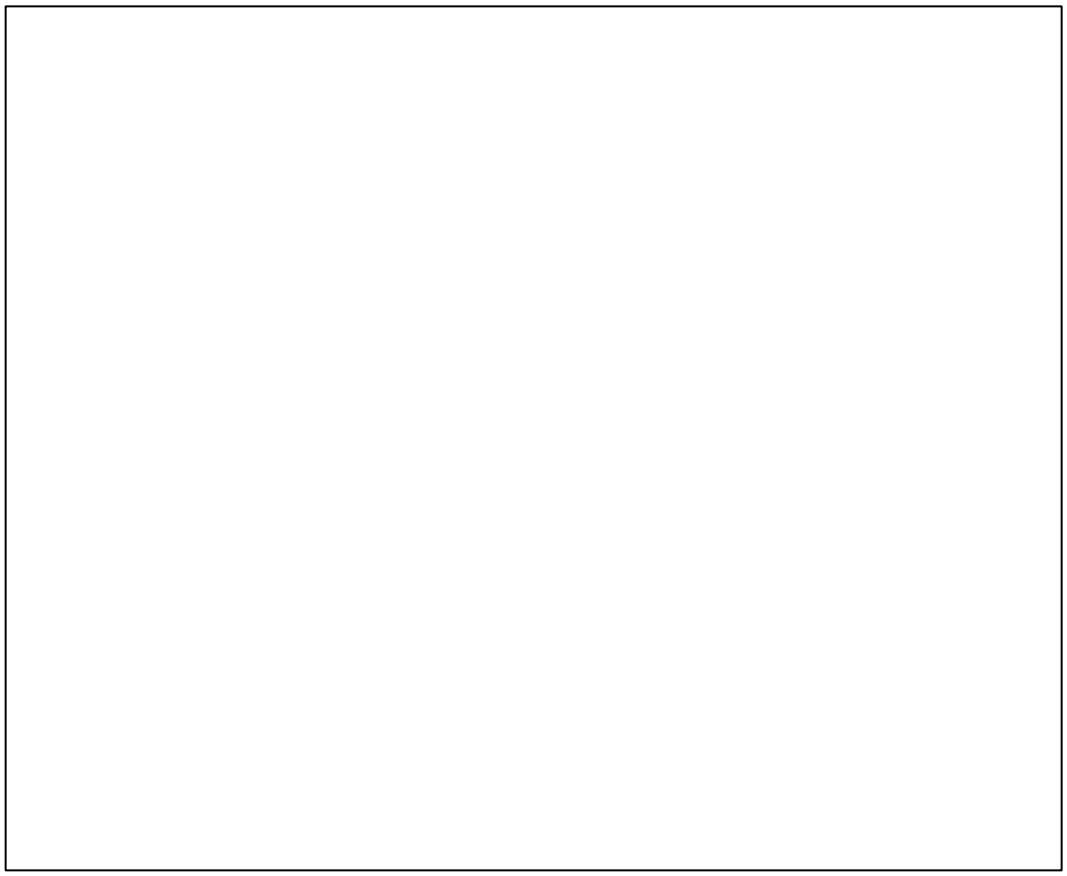
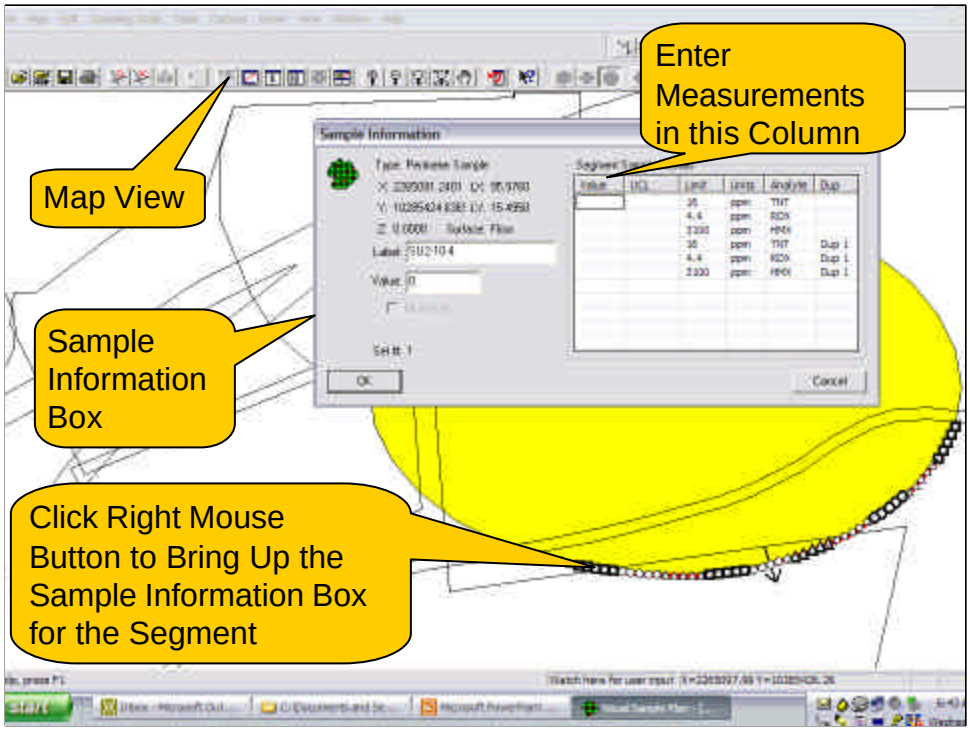
PNWD-SA-7032 / 32




Enter Measurements in this Column
Map View
Sample Information Box
Click Right Mouse Button to Bring Up the Sample Information Box for the Segment

Sample Information Box

- The next slide shows a close-up of the **Sample Information** box and the enclosed **Segment Sample Results** box.
- UCLs computed by VSP are placed in the UCL column

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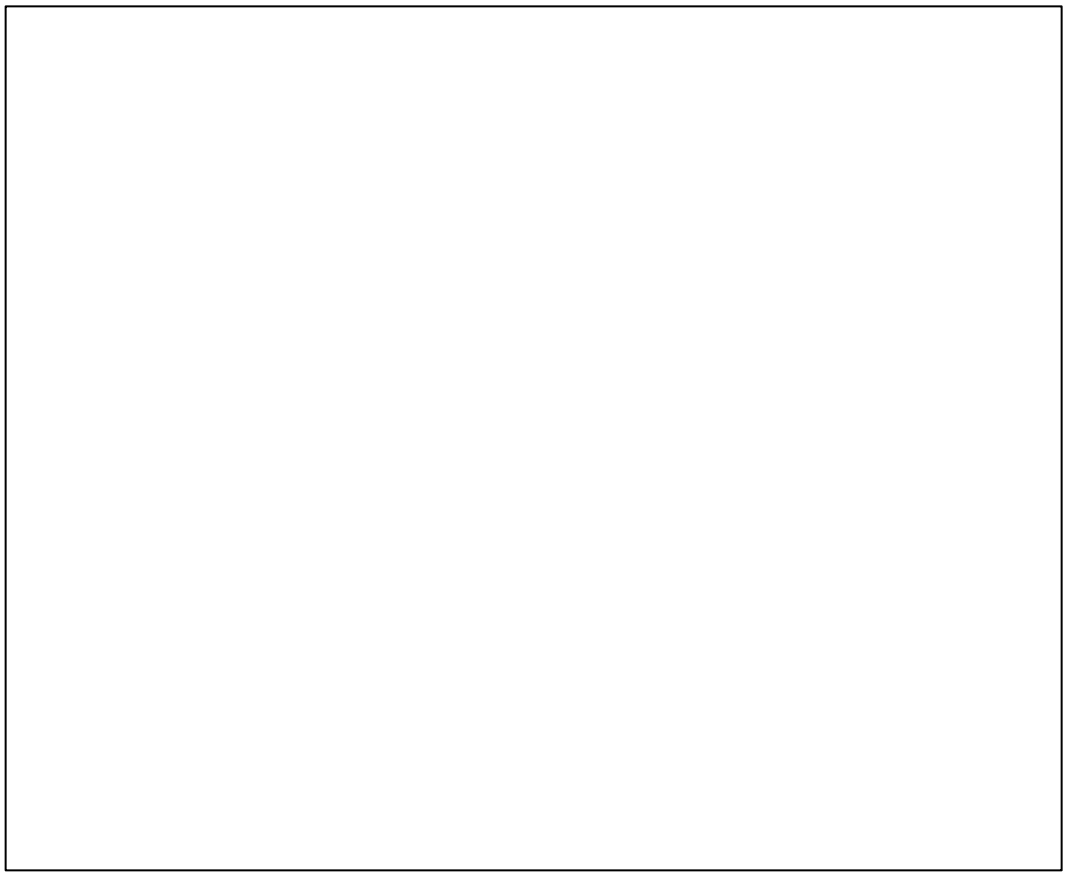
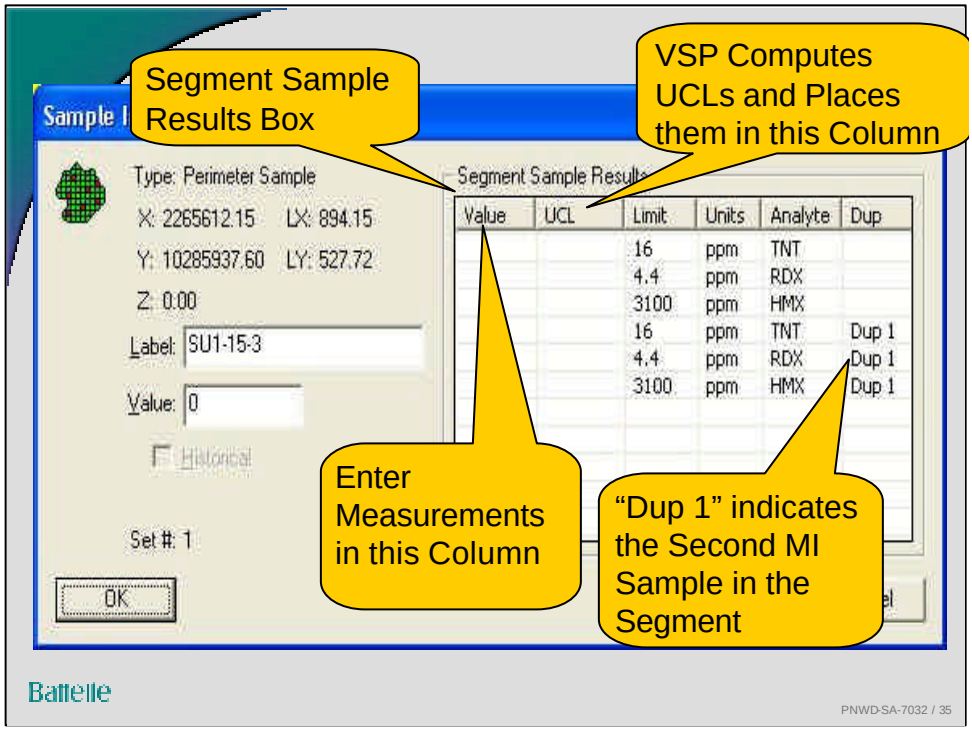
PNWD-SA-7032 / 34

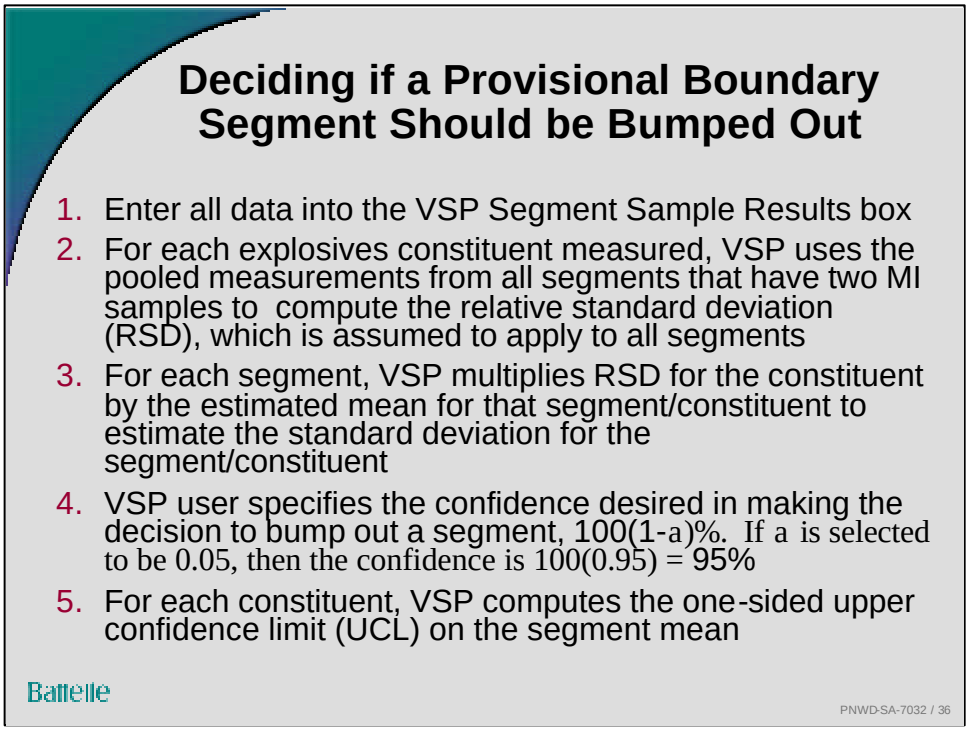




The Segment Sample Results box displays the geographical coordinates of the Primary Sample Locations for the segment that was clicked. It also display the "Label" for that location, which provides a unique number for the location. This label is assigned by VSP, but it can be changed by the VSP user. Directly below the Label box is a "Value" box. For the Primary Sampling Location clicked, the VSP user can enter an individual value if desired. VSP does not use that value.

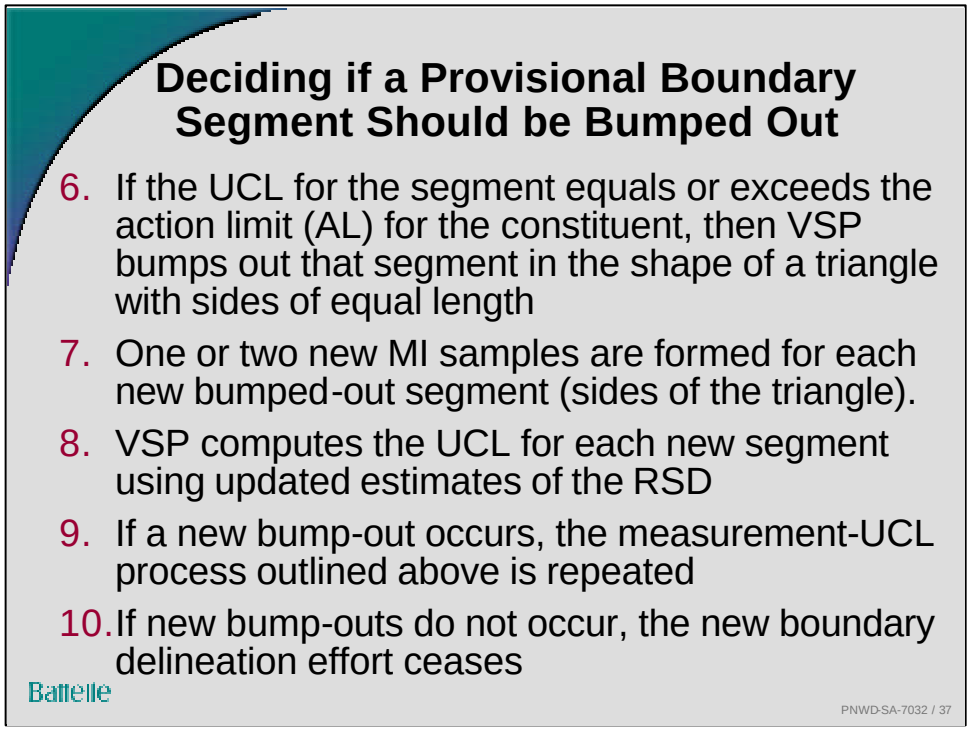
MI sample measurements can also be entered into VSP using a spreadsheet such as Excel. Details for doing this are in the VSP User's Guide for the RS module.

"Dup 1" in the Sample Information Box refers to the 2nd MI sample collected in that segment.



It is expected that 100a % of the statistical tests for the segments that compare the UCL to the action limit will incorrectly conclude that the segment does not need to be bumped out. In that case, the spread of contamination beyond the provisional boundary has not been detected by the test. However, the probability of this happening can be controlled to as small a value as required. The VSP user simply specifies a larger confidence level (smaller a value) for the UCL.

If the UCL test incorrectly indicates that the segment *should* be bumped out, then the UCL tests on the two new bumped out segments are expected to indicate that no further bump outs are required. Hence, the effects of that incorrect decision are minimized.



Depending on the shape of the enclosing boundary, the bump-out may not always be a triangle; sometimes it will fill an indentation when necessary to maintain a boundary that does not cross over itself.

The UCLs are not computed until data for all segments that have duplicate MI samples have been entered into the Segment Sample Results box.

There are two cases where VSP will bump out a triangle before the UCL is computed:

- when only one MI sample is collected in a segment and the measurement for that sample exceeds the AL
- when two MI samples are collected in a segment and the mean of those two samples exceeds the AL

If the VSP user specified that a percentage of the segments should have duplicate MI samples, then that percentage of the newly bumped-out segments will have duplicate MI samples

Method for Computing UCLs

1. First, compute the relative standard deviation (RSD) using measurements obtained for the initial set of n segments for which two MI samples were obtained:

$$RSD = \sqrt{\frac{1}{n}\sum_{i=1}^{n}\frac{s_i^2}{\bar{x}_i^2}}$$

where

$s_i^2 = \sum_{j=1}^{2}(x_{ij} - \bar{x}_i)^2$ = variance of the two MI sample measurements in the i^{th} segment

$\bar{x}_i = \frac{1}{2}\sum_{j=1}^{2} x_{ij}$ = mean of the two MI sample measurements in the i^{th} segment

n = number of segments for which two MI samples were obtained

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Method for Computing UCLs (continued)

2. Compute the standard deviation for each segment along the initial boundary, even those segments that had only one MI sample. The standard deviation for the i^{th} segments is computed as

$$SD_i = (RSD)(\bar{x}_i)$$

where

$\bar{x}_i = \frac{1}{m_i} \sum_{j=1}^{m_i} x_{ij}$ = mean of the MI sample measurements in the i^{th} segment

m_i = number of MI sample measurements (1 or 2) in the i^{th} segment

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PNWD-SA-7032 / 39

Method for Computing UCLs (continued)

3. Compute the 100(1-a)% UCL on the mean for each segment along the initial boundary. The UCL for the i^{th} segment is computed as

$$UCL_i = \bar{x}_i + t_{1-\alpha,n}\frac{SD_i}{\sqrt{m_i}}$$

where $\bar{x}_i = \frac{1}{m_i}\sum_{j=1}^{m_i} x_{ij}$ $\qquad SD_i = (RSD)(\bar{x}_i)$

$t_{1-\alpha,n}$ = 100(1-a) percentile of the t distribution with n degrees of freedom,

m_i = number of MI sample measurements (1 or 2) in the i^{th} segment

and $0 < a < 0.5$, where a is the selected probability that can be tolerated of falsely rejecting the null hypothesis that the segment needs to be bumped out.

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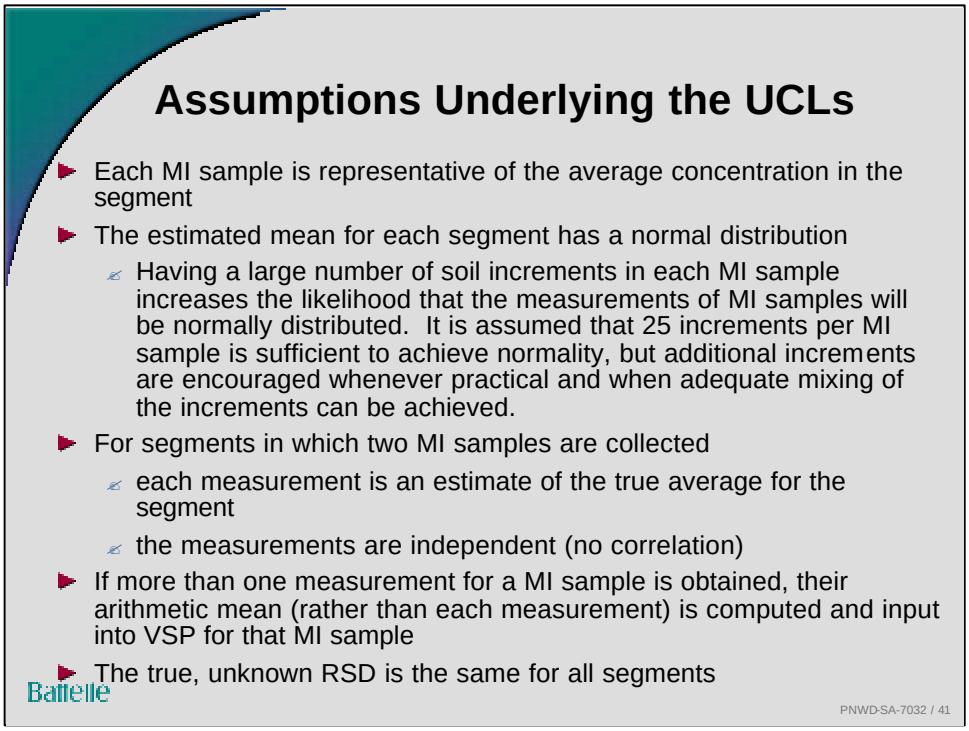
PNWD-SA-7032 / 40

The percentiles of the t distribution are tabulated in many statistics books, e.g., Gilbert, R.O. 1987. *Statistical Methods for Environmental Pollution Monitoring*, Wiley, NY.



It is also assumed that explosives constitutes in surface soil are not resuspended and transported through the air to distinct isolated hot spots outside the boundary. That is it is assumed that the only way surface soil explosives constituents will breach the boundary is as a continuous plume across the boundary.

Power of the UCL test depends on magnitude of the difference in the true mean for the segment and the action level, the number of soil increments per MI sample, and the variability among MI samples in each segment. In contrast to most all other VSP modules, the RS VSP module does not ask the VSP user to specify the required power of the test. Hence, VSP presumes the user has verified previously that the number of increments and MI samples used is sufficient to achieve a sufficiently high power for the UCL test to reject Ho when Ho is false.

Hypothetical Case Study

- Suppose that surface soil samples are to be collected along the current (provisional) boundary of an active training range to determine if mean concentrations of RDX at the boundary exceed the action limit (4.4 ppm).
- If so, it will be necessary to determine if true mean concentrations greater than 4.4 ppm extend beyond the boundary, and if so, where along the boundary such contamination may exist.
- The goal would be to establish a new boundary beyond which there is high confidence that the action limit for the RDX mean (4.4 ppm) is not exceeded.

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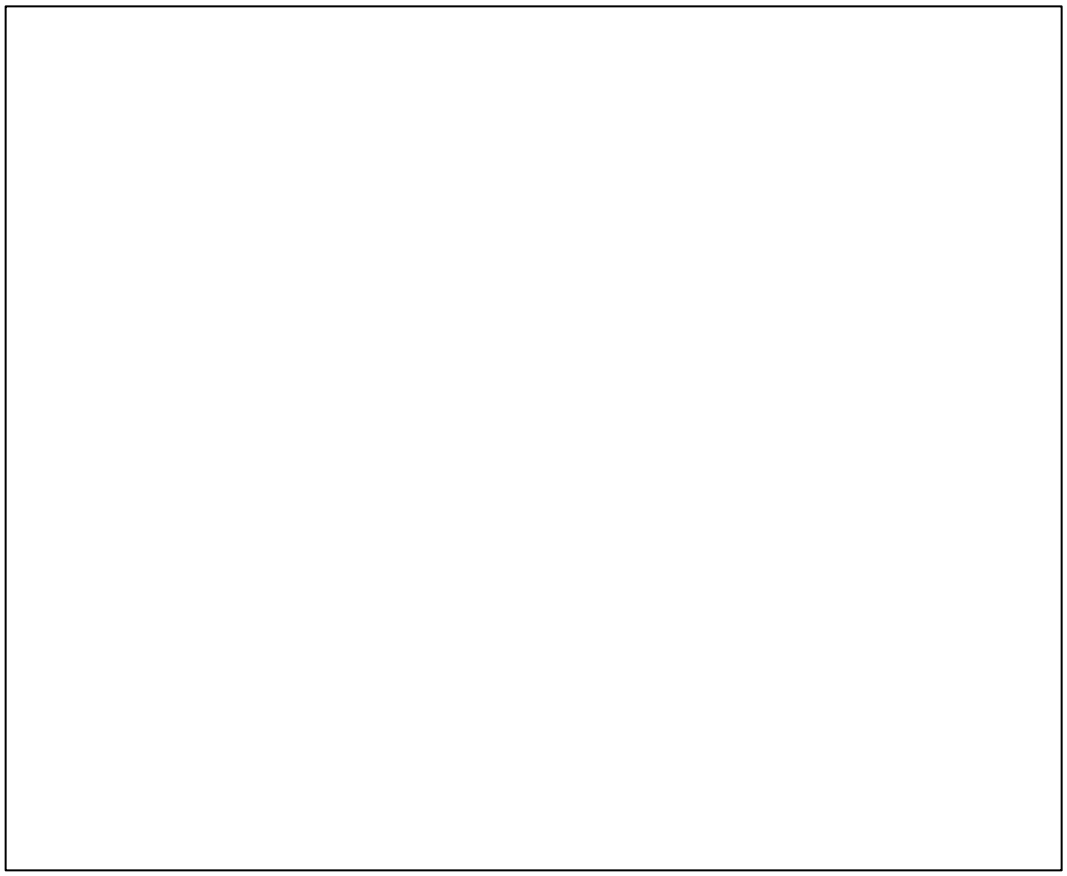
PNWD-SA-7032 / 42



Hypothetical Case Study (continued)

- Suppose that movement of RDX in surface soil to adjacent off-range areas would be most likely to occur on the downhill portion of the range
- Assuming that assumption to be true, the project planning team decides to sample only the current boundary on the downhill side of the training range
- Suppose a DXF file of the training range has been saved in the VSP folder
- The DXF file is loaded into VSP by clicking **Map** on the VSP menu bar, then clicking **Load Map from file**, and double clicking the appropriate DXF file

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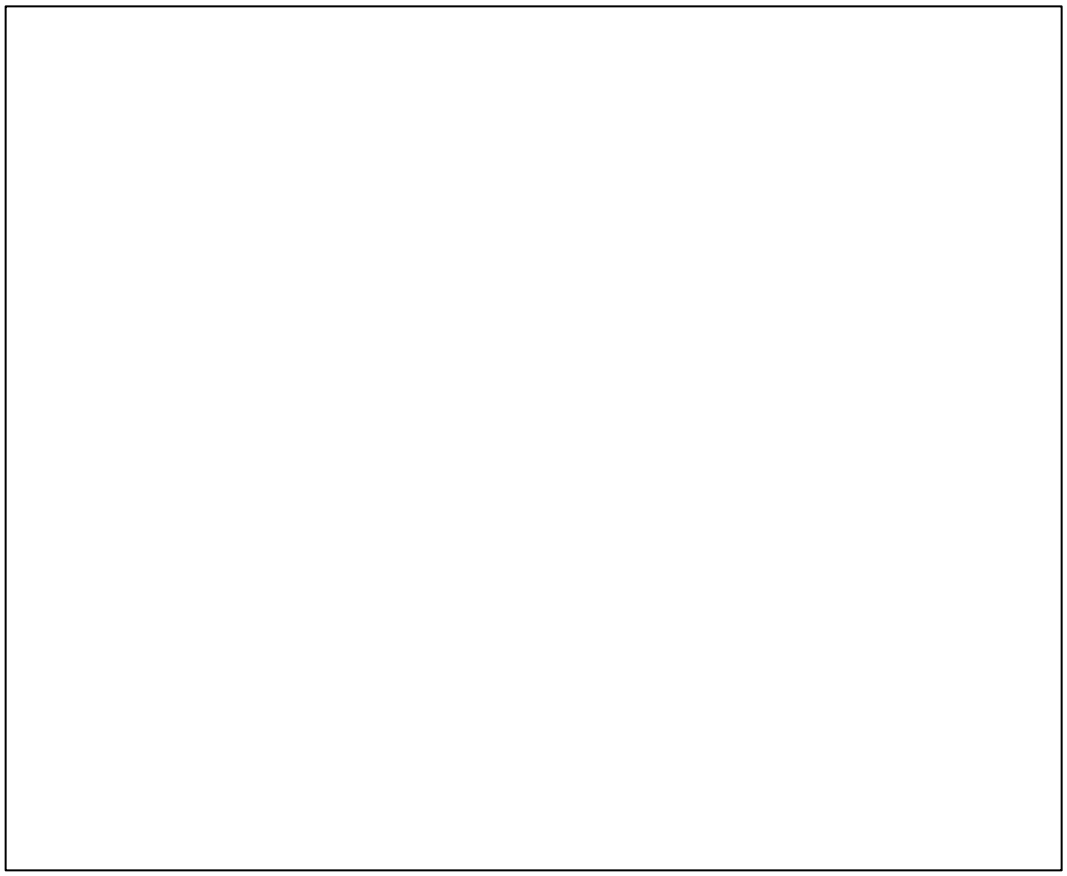
PNWD-SA-7032 / 43



Hypothetical Case Study (continued)

- The partial boundary is drawn on the map by
  - clicking **Edit** on the VSP menu bar
  - clicking **Sample Areas > Define New Open-Type Sample Area**
  - selecting a color (say, red) from the color box that appears
  - clicking the left mouse button at locations (the boundary beginning point, points of changing direction along the boundary, and the boundary end point) on the map to define the partial boundary
  - clicking the right mouse button to create the boundary, then
  - clicking **Edit** on the VSP menu bar
  - clicking **Sample Areas > Flip Direction** to reverse the arrow that VSP placed on the boundary to indicate the downhill direction

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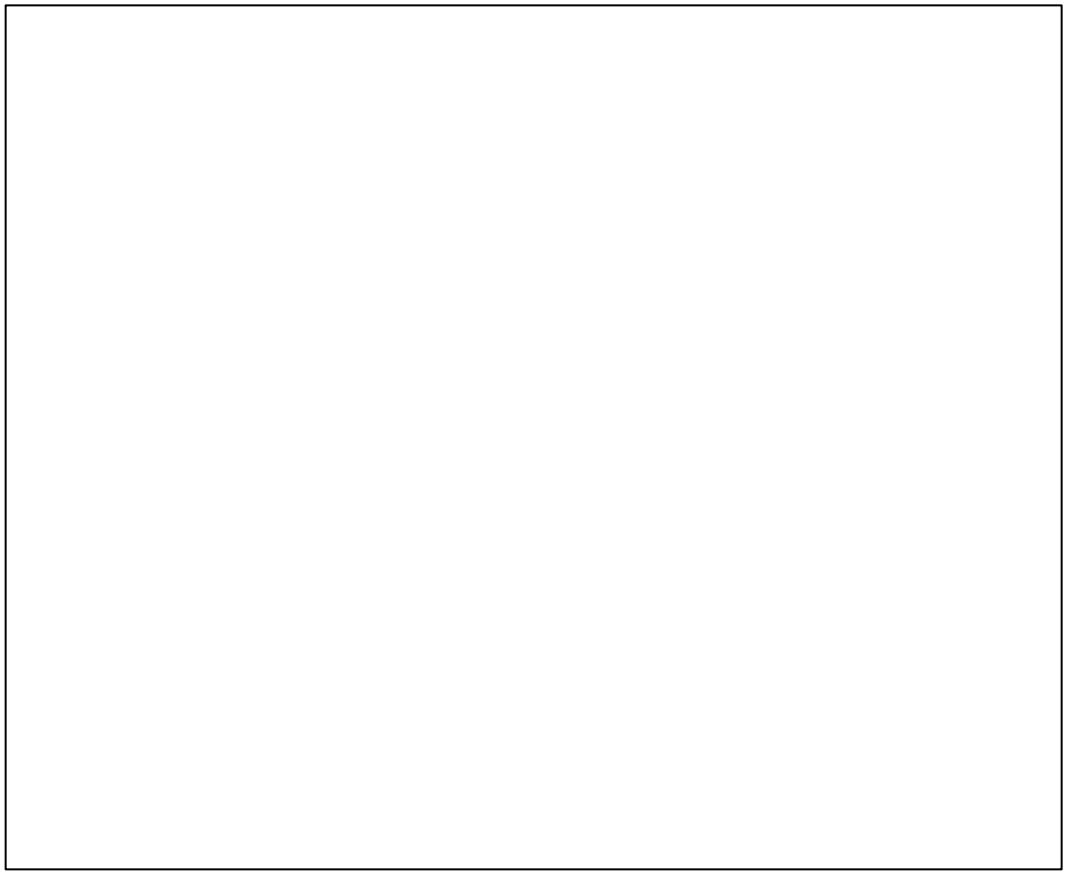
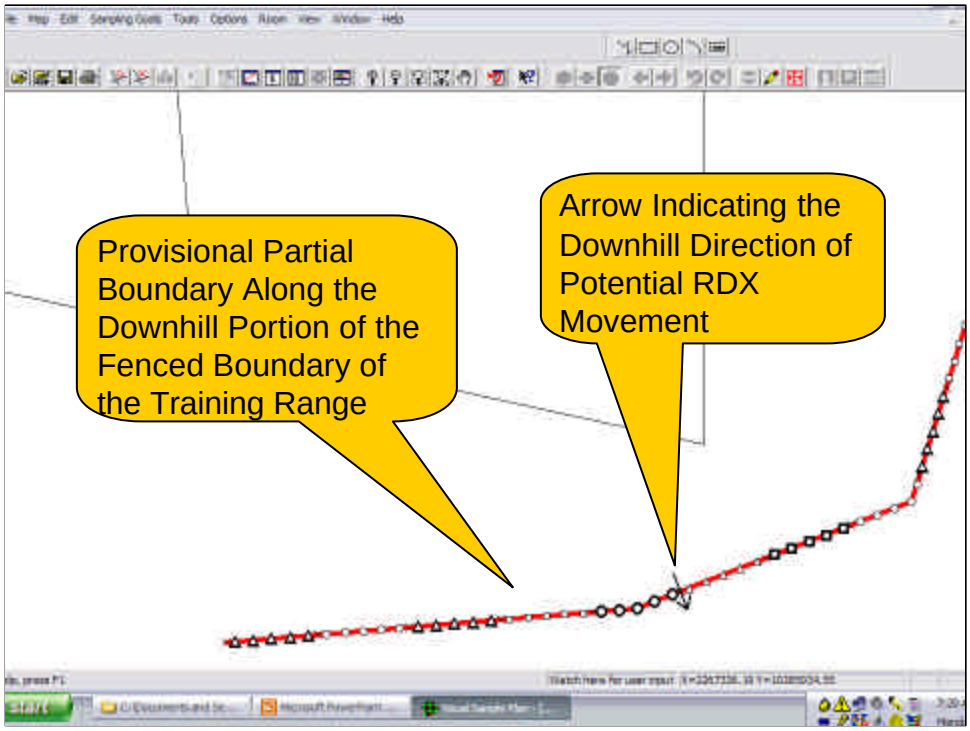
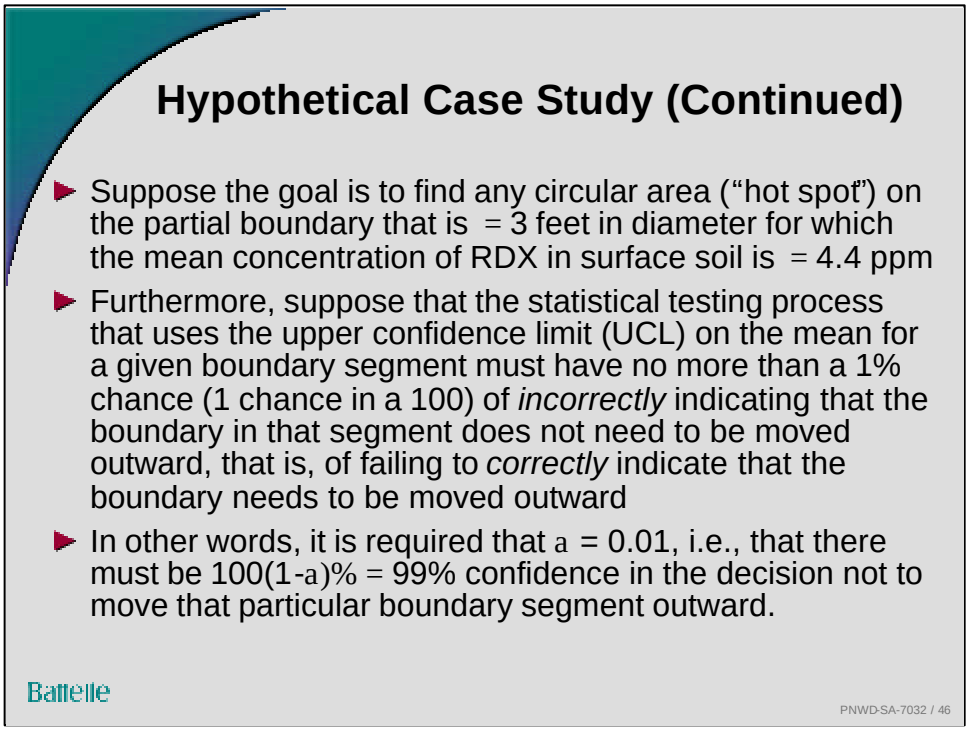
PNWD-SA-7032 / 44




Provisional Partial Boundary Along the Downhill Portion of the Fenced Boundary of the Training Range
Arrow Indicating the Downhill Direction of Potential RDX Movement



The 99% confidence statement applies to the decision made *separately* for each individual segment. If in truth none of the k segments along the boundary have hot spots, then the overall confidence that *all* the k UCL tests will correctly indicate that none of the k boundary segments should be moved outward will be (assuming the k tests are independent)

$$\text{Overall Confidence} = 100(1 - \alpha)^k$$

For example, if a = 0.01 for each of the k UCL tests, then

$$\text{Overall Confidence} = 100(1 - 0.01)^9 = 100(0.99)^9 = 91$$

that is, there is 91% confidence in the conclusion that none of the boundary segments need to be moved outward. Note that reducing a for each individual segment will increase the overall confidence level. For example, if a is set at 0.001 for each segment, then

$$\text{Overall Confidence} = 100(1 - 0.001)^9 = 100(0.999)^9 = 99$$

as desired. For additional discussion of this topic see page 305 in:

Millard, S.P. and N.K. Neerchal. 2001. *Environmental Statistics with S-Plus*, CRC Press, NY

Hypothetical Case Study (Continued)

- The requirements on the previous slide are entered into the VSP RS dialog box
- This box is accessed by clicking **Sampling Goals** on the VSP menu bar, then clicking

  Establish Boundary of Contamination > Partial Boundary

  as shown on the next slide.
- Click the **Apply** button after dialog box inputs are added.

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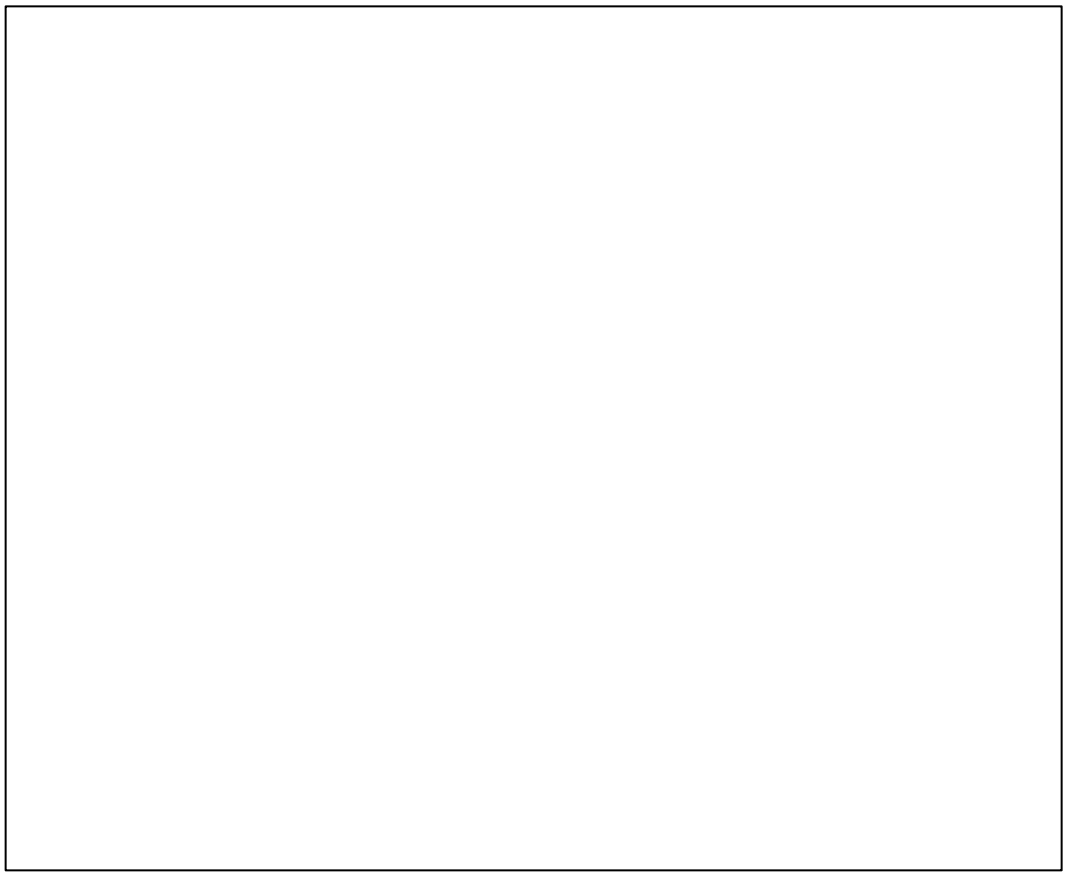
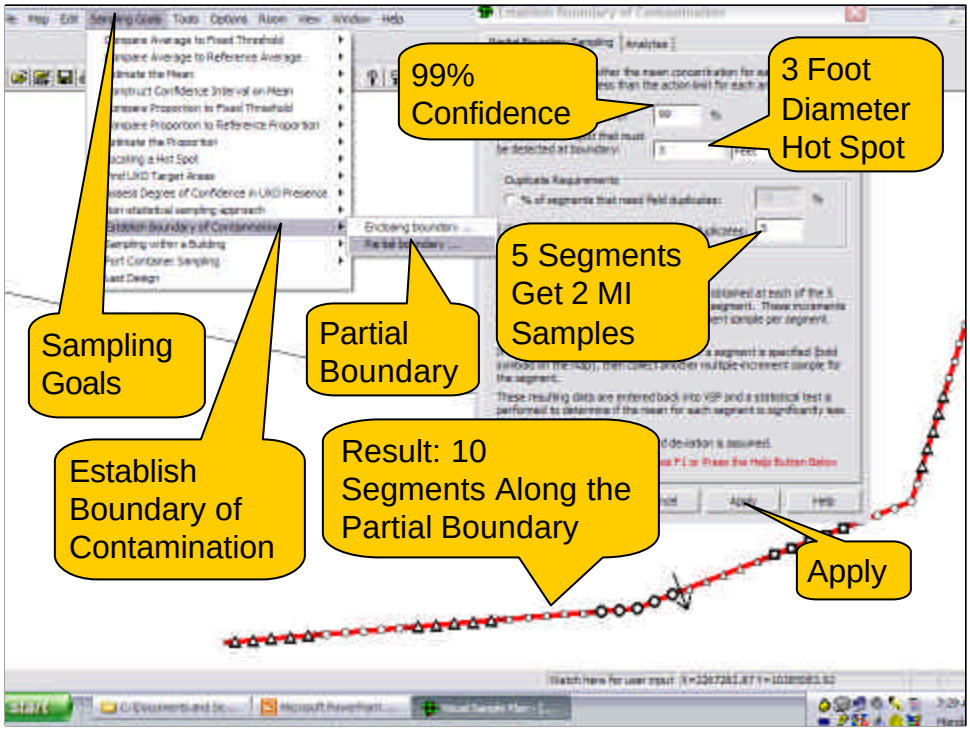
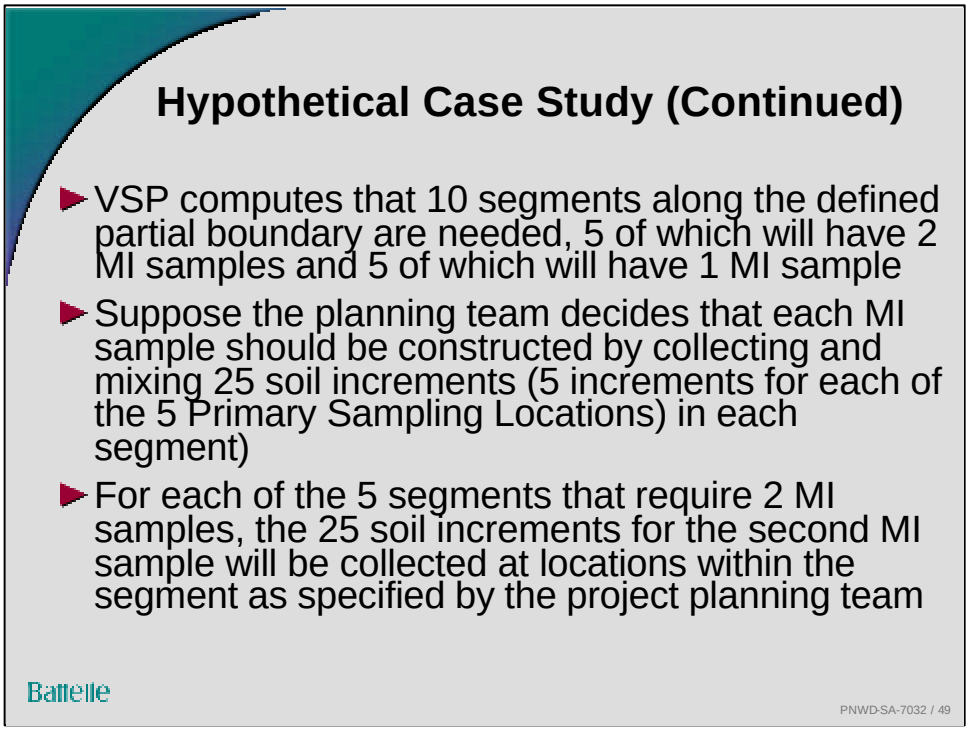
PNWD-SA-7032 / 47




99% Confidence
3 Foot Diameter Hot Spot
5 Segments Get 2 MI Samples
Sampling Goals
Partial Boundary
Establish Boundary of Contamination
Result: 10 Segments Along the Partial Boundary
Apply



The planning team assumes that 25 soil increments per MI sample are sufficient to achieve a normal distribution for the RDX measurements that are made on aliquots withdrawn from the MI samples. The team also assumes that the measurements from the two MI samples are not correlated (contain redundant information)

Hypothetical Case Study (Continued)

- VSP automatically determines the geographical locations of the Primary Sampling Locations in the segments along the boundary
- These locations are listed by VSP and can be seen by clicking on the **Coordinate View** button on the VSP toolbar as shown in the next slide
- These coordinates can be saved to a text file to use in a Geographical Positioning System (GPS) for finding locations in the field
  - Click **Map > Sample Points > Export**
  - Provide a name for the text file and click **Save**

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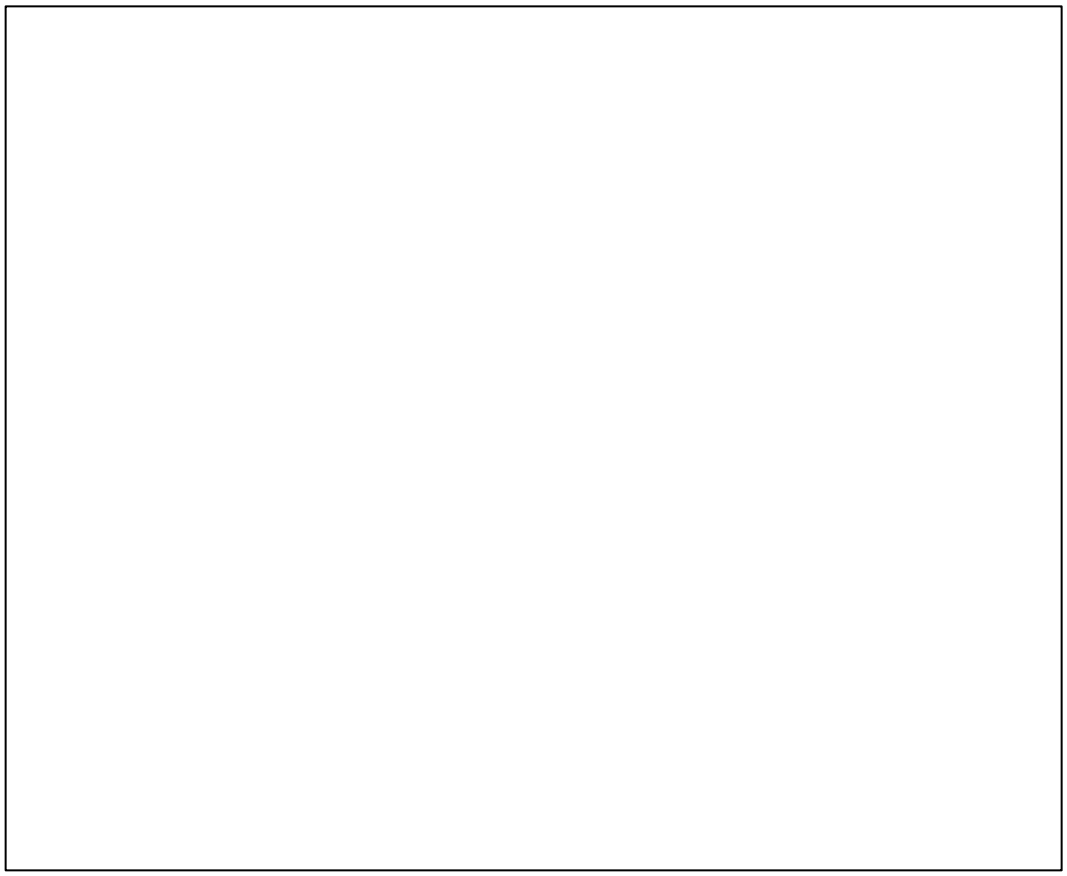
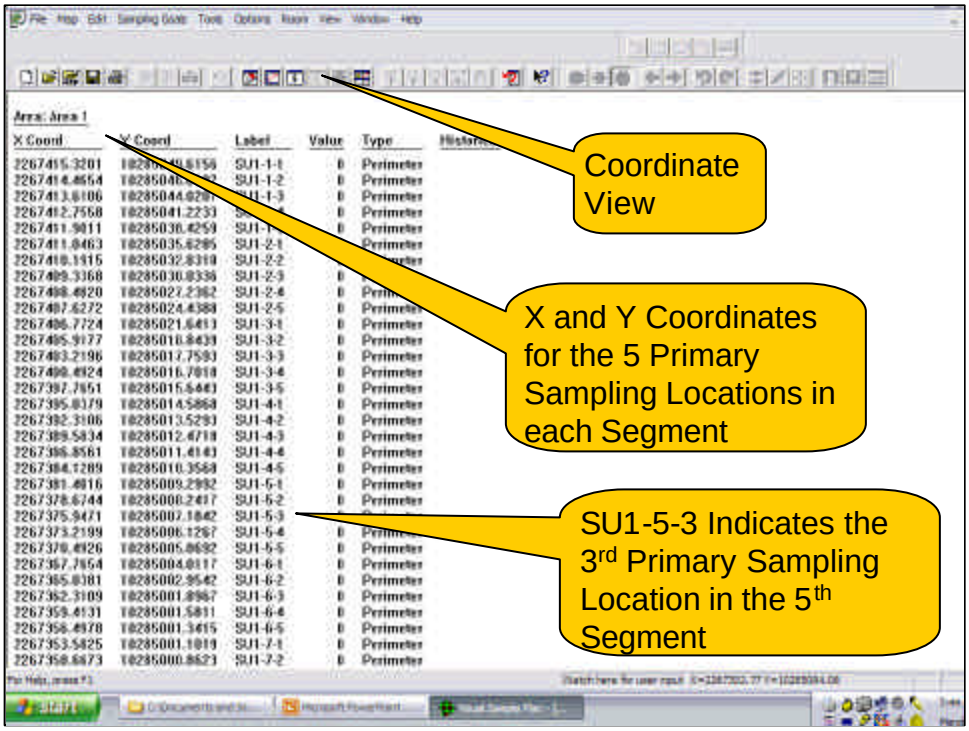
PNWD-SA-7032 / 50




Coordinate View
X and Y Coordinates for the 5 Primary Sampling Locations in each Segment
SU1-5-3 Indicates the 3rd Primary Sampling Location in the 5th Segment

Hypothetical Case Study (Continued)

- Clicking the **Graph View** button on the VSP toolbar brings up a graph that relates the hot spot diameter of interest at the boundary to the number of Primary Sampling Locations in the segments along the defined partial boundary (shown in the next slide).

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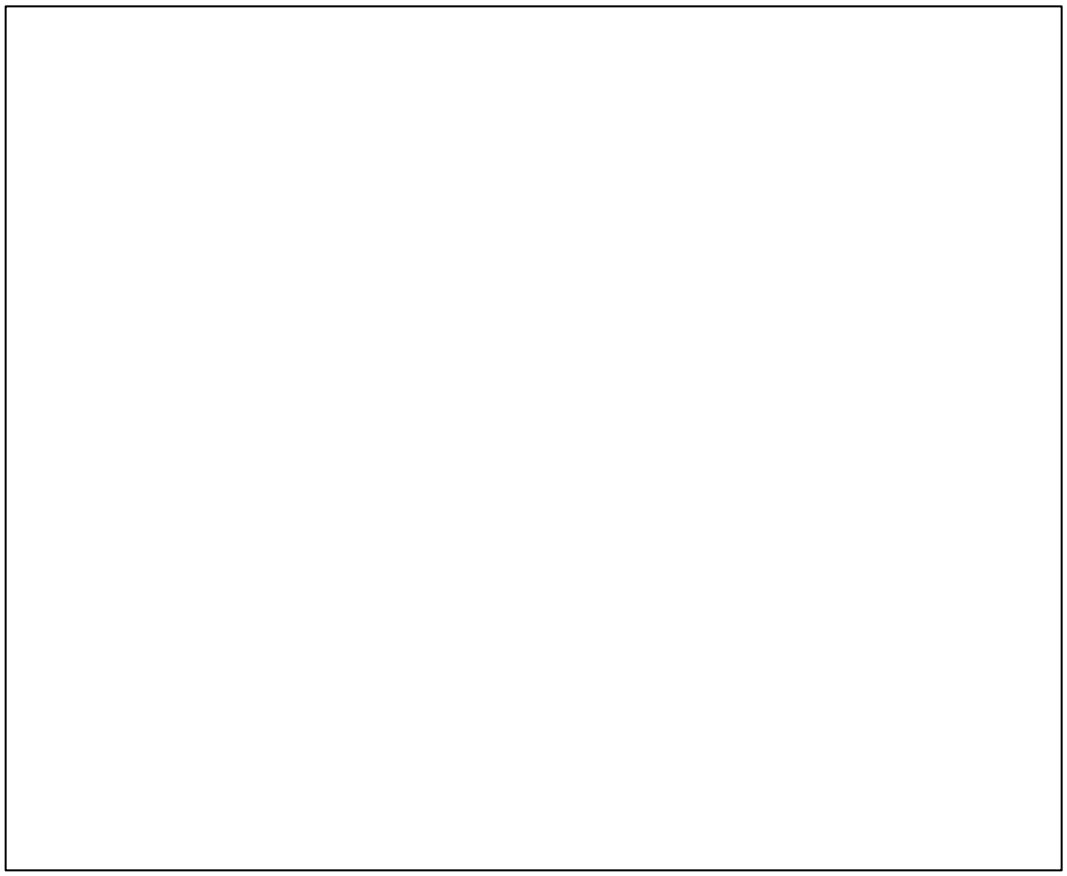
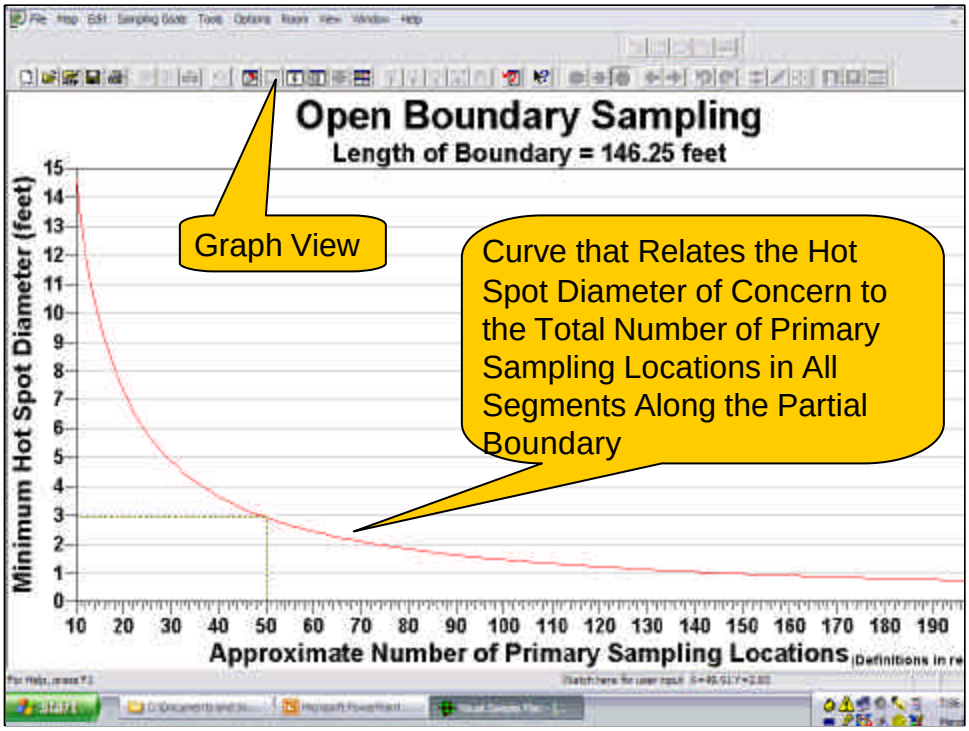
PNWD-SA-7032 / 52




Open Boundary Sampling
Length of Boundary = 146.25 feet
Minimum Hot Spot Diameter (feet)
Approximate Number of Primary Sampling Locations
Graph View
Curve that Relates the Hot Spot Diameter of Concern to the Total Number of Primary Sampling Locations in All Segments Along the Partial Boundary

Hypothetical Case Study (Continued)

- Once the design of the study in VSP is complete, save the project as a VSP file
  - Click **File** on the VSP menu
  - Click **Save Project As…** and provide a name for the project

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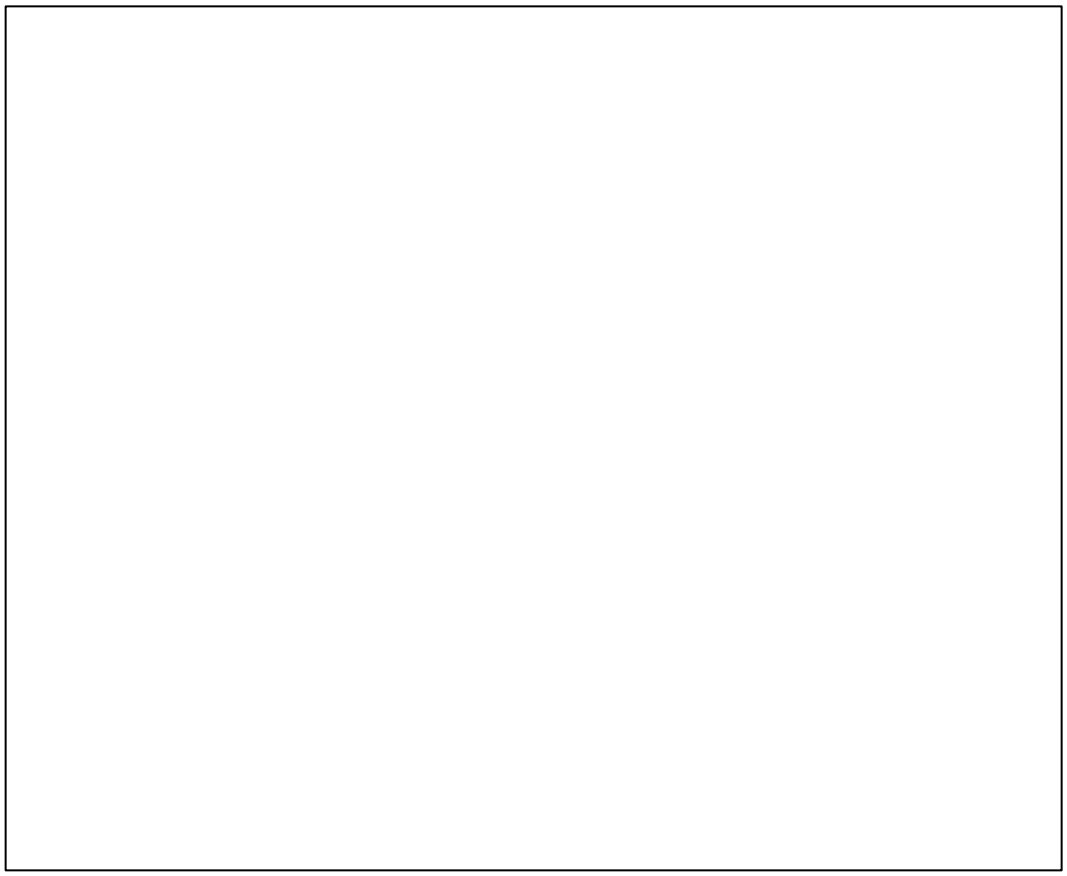
PNWD-SA-7032 / 54



Hypothetical Case Study (Continued)

- Once the MI samples have been collected, handled, and analyzed for RDX according to specified procedures the RDX measurements are entered into VSP as follows:
- Open the saved project file and display the range map with the partial boundary by clicking
  - **File** on the VSP menu, then
  - clicking **Open Project** and the project file name
- Next, for each segment in turn
  - click the right mouse button on one of the Primary Sampling Locations to bring up the **Sample Information Box** for the segment.
  - The RDX measurement(s) are entered into the box as illustrated on the next two slides

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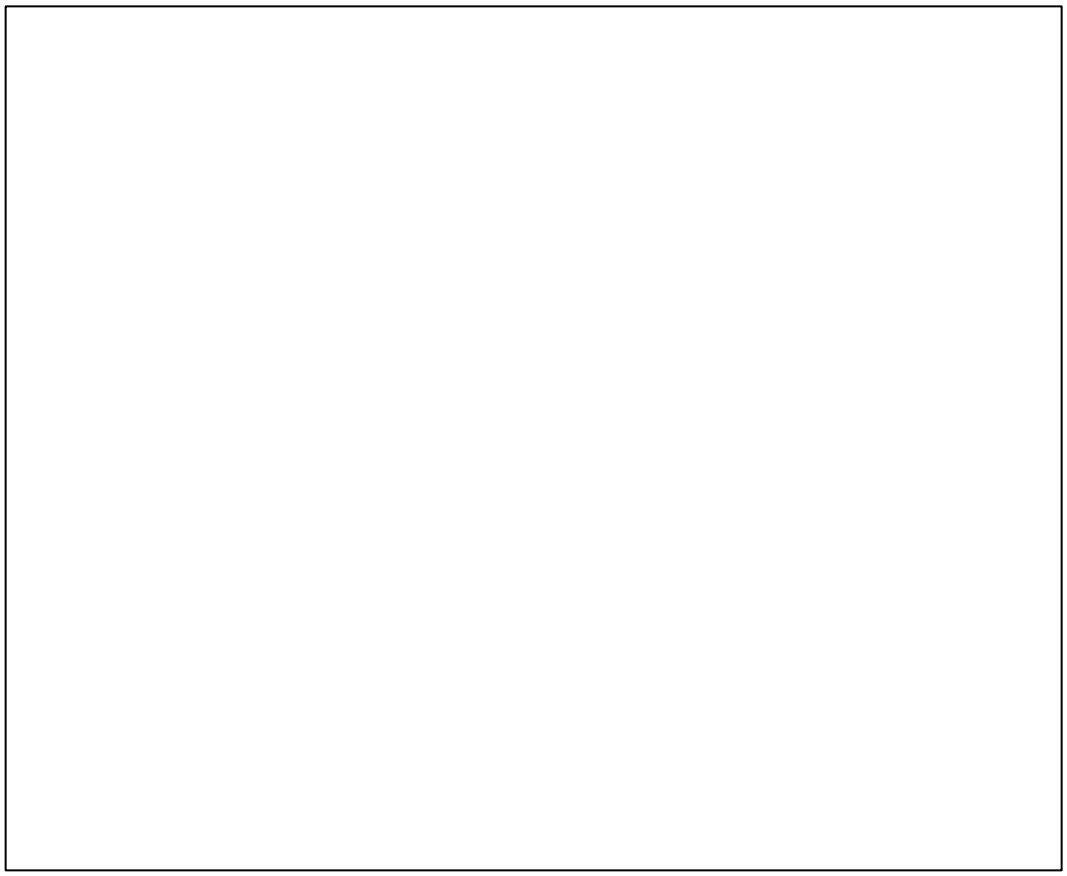
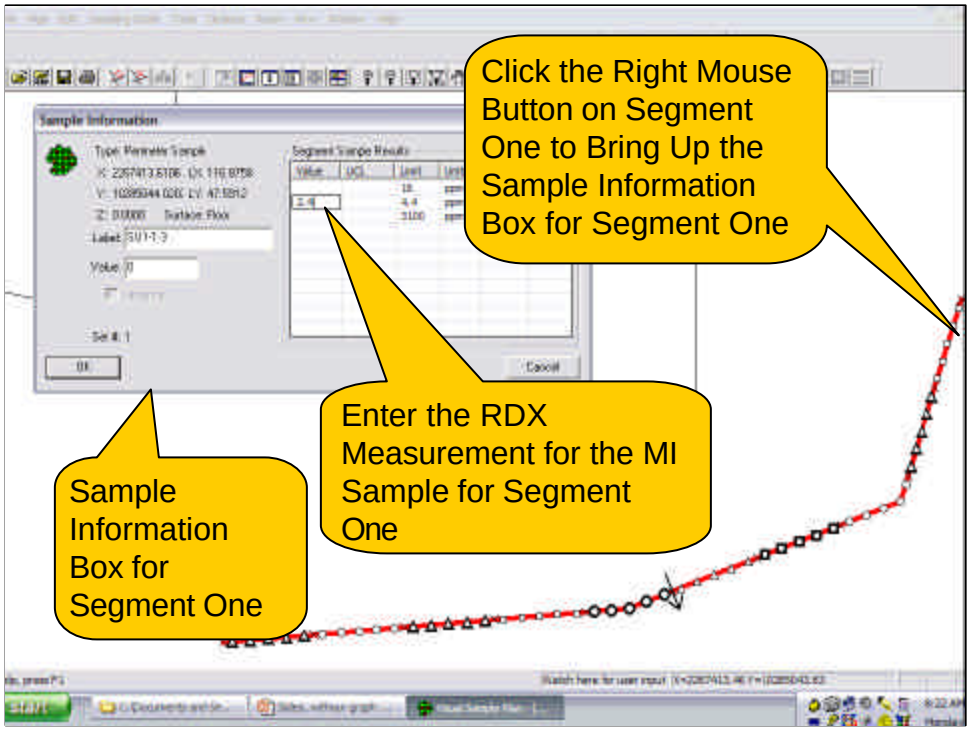
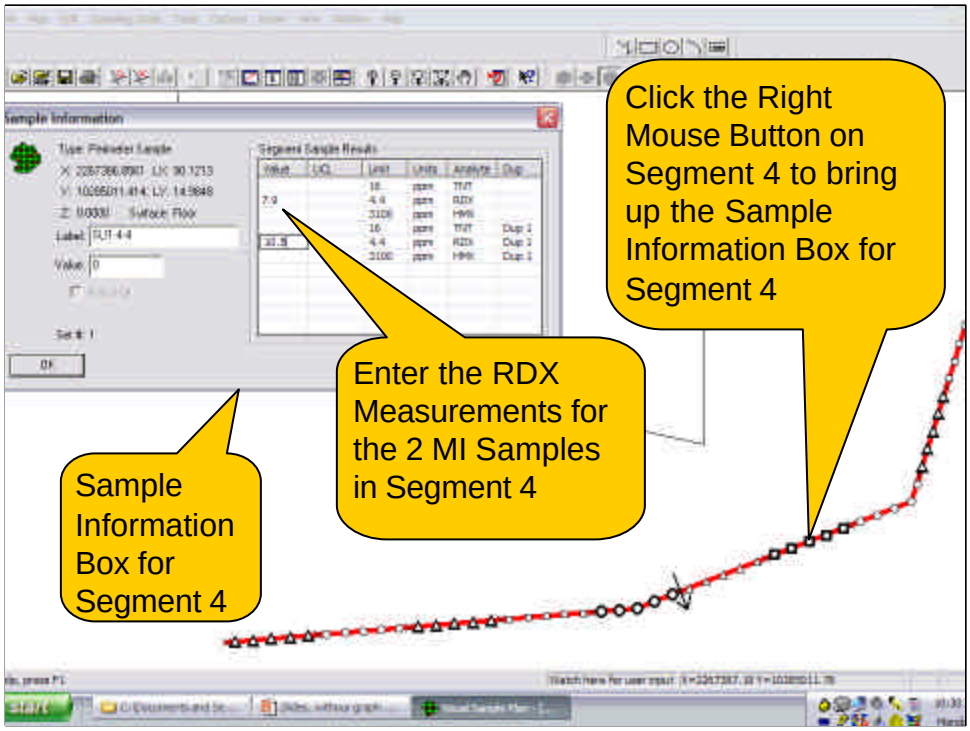
PNWD-SA-7032 / 55




Click the Right Mouse Button on Segment One to Bring Up the Sample Information Box for Segment One
Enter the RDX Measurement for the MI Sample for Segment One
Sample Information Box for Segment One


Click the Right Mouse Button on Segment 4 to bring up the Sample Information Box for Segment 4
Enter the RDX Measurements for the 2 MI Samples in Segment 4
Sample Information Box for Segment 4

Hypothetical Case Study (Continued)

- After the data for all segments have been entered into VSP, the UCLs are computed and compared to the RDX action limit (4.4 ppm) for each segment
- As shown on the next two slides, segments 2, 3, 4 and 7 were pushed outward because the UCL for those segments exceeded 4.4 ppm
  - 8 new segments were created that must now be sampled and tested against the action limit
- The following slide presents the RDX measurements, 99% UCLs and the decision (yes or no) whether the action limit for each segment was exceeded

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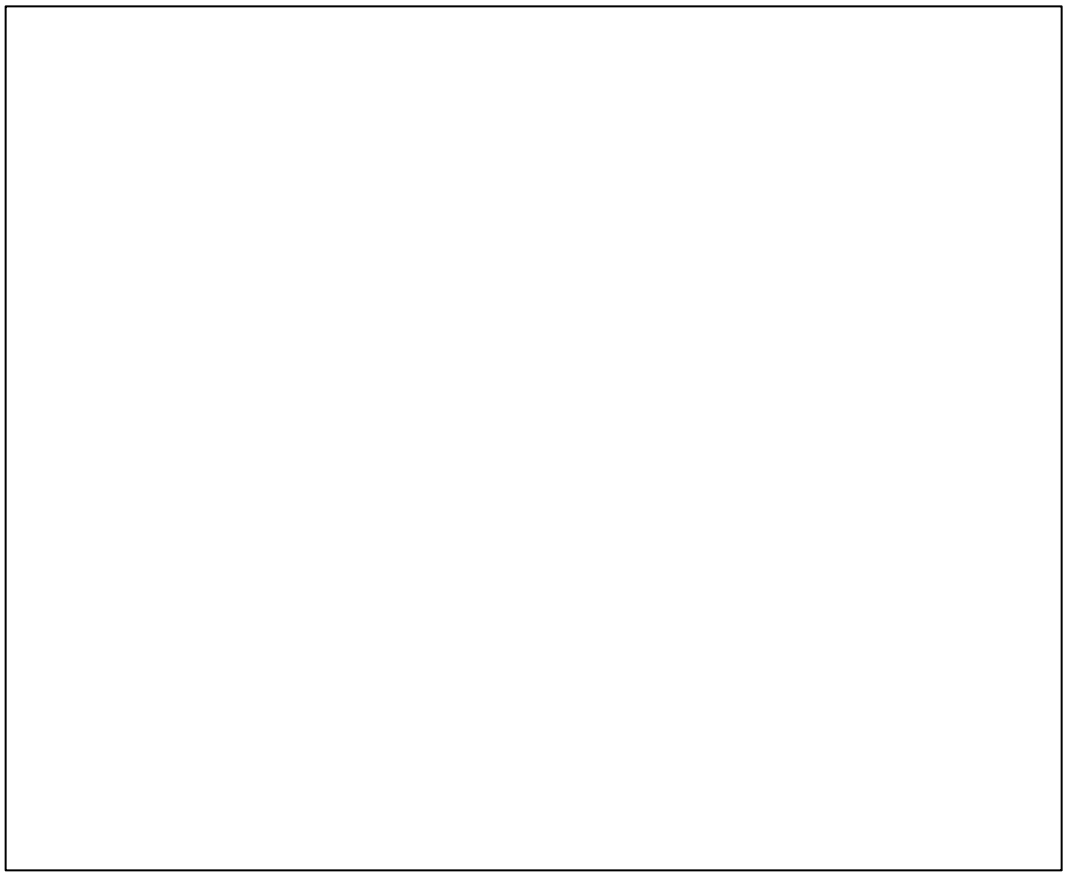
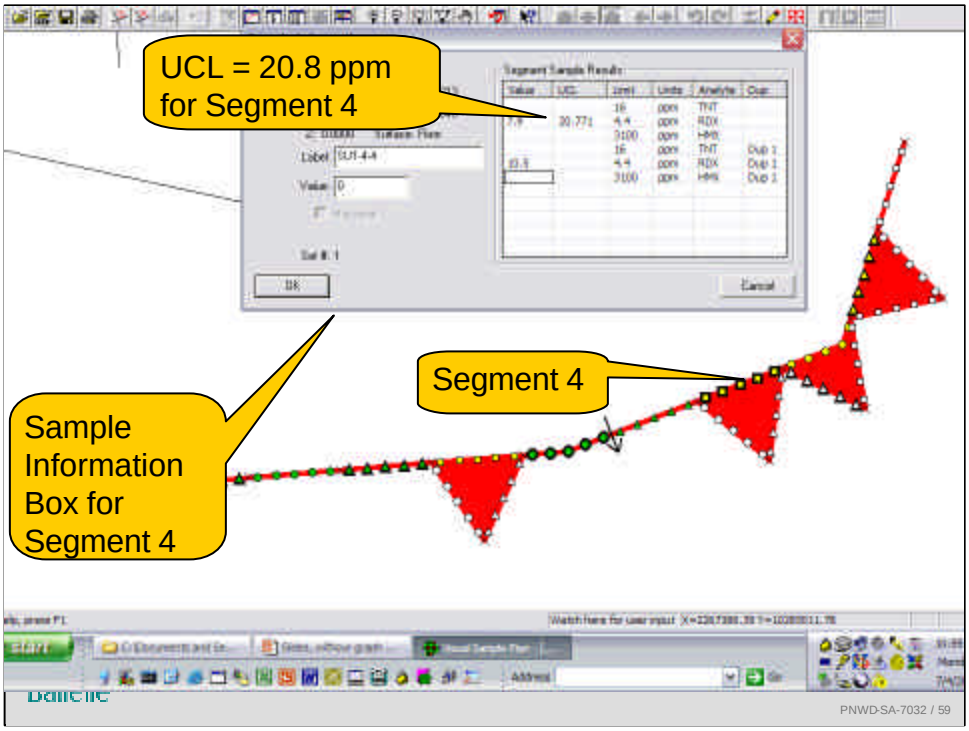
PNWD-SA-7032 / 58




UCL = 20.8 ppm for Segment 4
Segment 4
Sample Information Box for Segment 4
PNWD-SA-7032 / 59

Hypothetical Case Study (Continued)

Segment on Initial Provisional Boundary	RDX (ppm)	99% UCL	Exceed Action Limit?
1	0.5	1.4	No
2	2.1, 3.2	6.0	Yes
3	5.0	13.9	Yes
4	7.9, 10.5	20.8	Yes
5	1.4	3.9	NO
6	0.4, 0.9	1.5	No
7	2.1	5.8	Yes
8	0.9, 1.9	3.2	No
9	0.1	0.3	No
10	0.4, 0.1	0.6	No

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PNWD-SA-7032 / 60

Hypothetical Case Study (Continued)

- The 8 new segments must now be sampled and tested using the segment's 99% UCL in the same way as was done for the original 10 segments along the initial provisional boundary
- The final boundary that results from this iterative process is shown on the next slide.
- It appears that the true mean RDX concentrations in surface soil may exceed the action limit of 4.4 ppm in two places along the initial provisional boundary.

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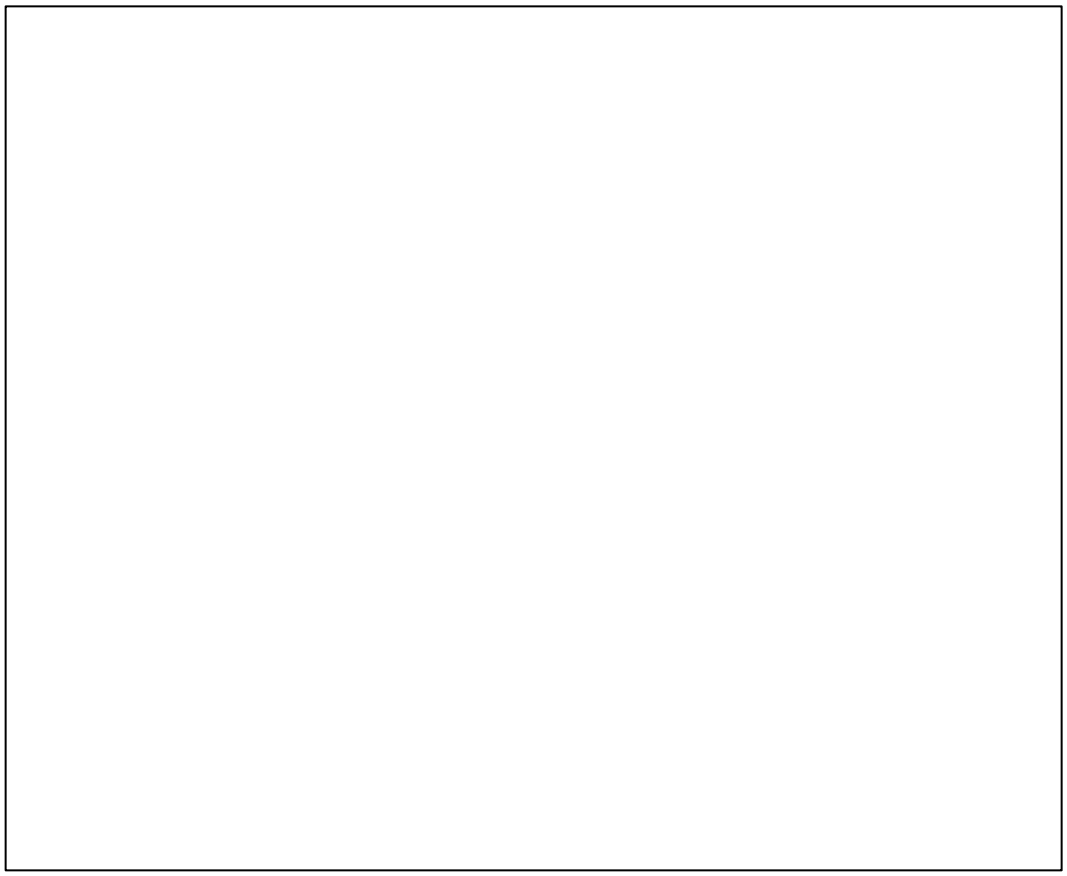
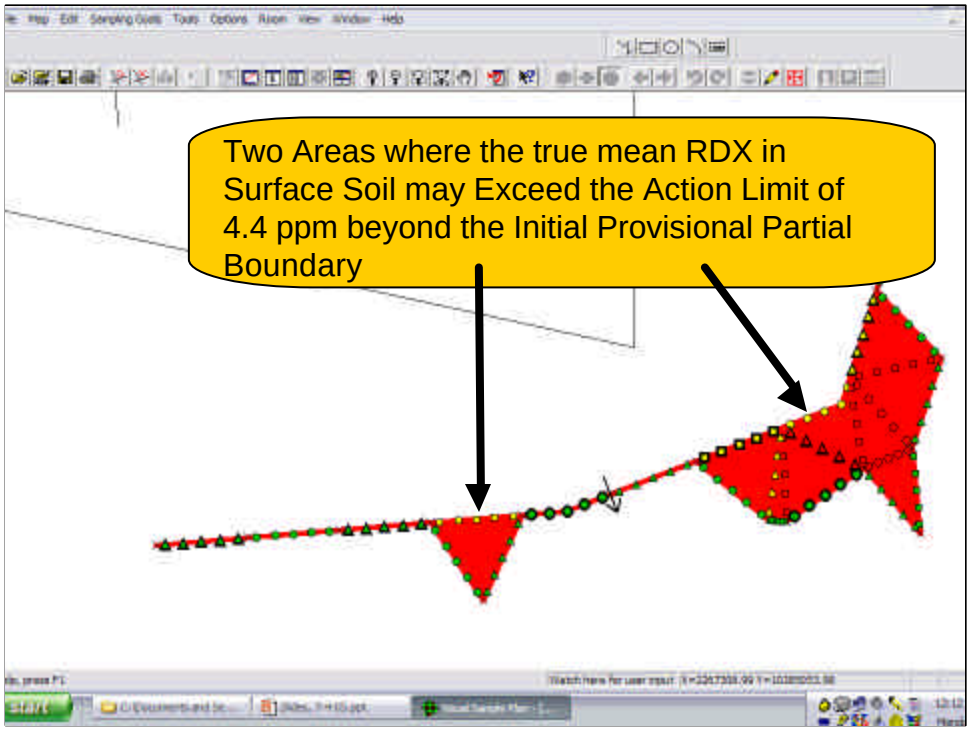
PNWD-SA-7032 / 61




Two Areas where the true mean RDX in Surface Soil may Exceed the Action Limit of 4.4 ppm beyond the Initial Provisional Partial Boundary

Hypothetical Case Study (Continued)

- VSP automatically prepares a summary report for the project
- View the report by clicking the **Report View** button on the VSP tool bar, as shown in the next slide.
- Some information contained in the report:
  - A table that summarizes the boundary design (number and length of segments, length of boundary, minimum size hot spot of concern, number of soil increments per MI sample, number of segments with 2 MI samples, whether contamination extends beyond the original boundary, etc)
  - **Map View** of the site showing the final boundary after data have been entered into VSP and the UCL tests applied
  - Listing of all measurements for all segments
  - Formulas and assumptions used to compute the UCLs
- The report can be copied and pasted into project documents

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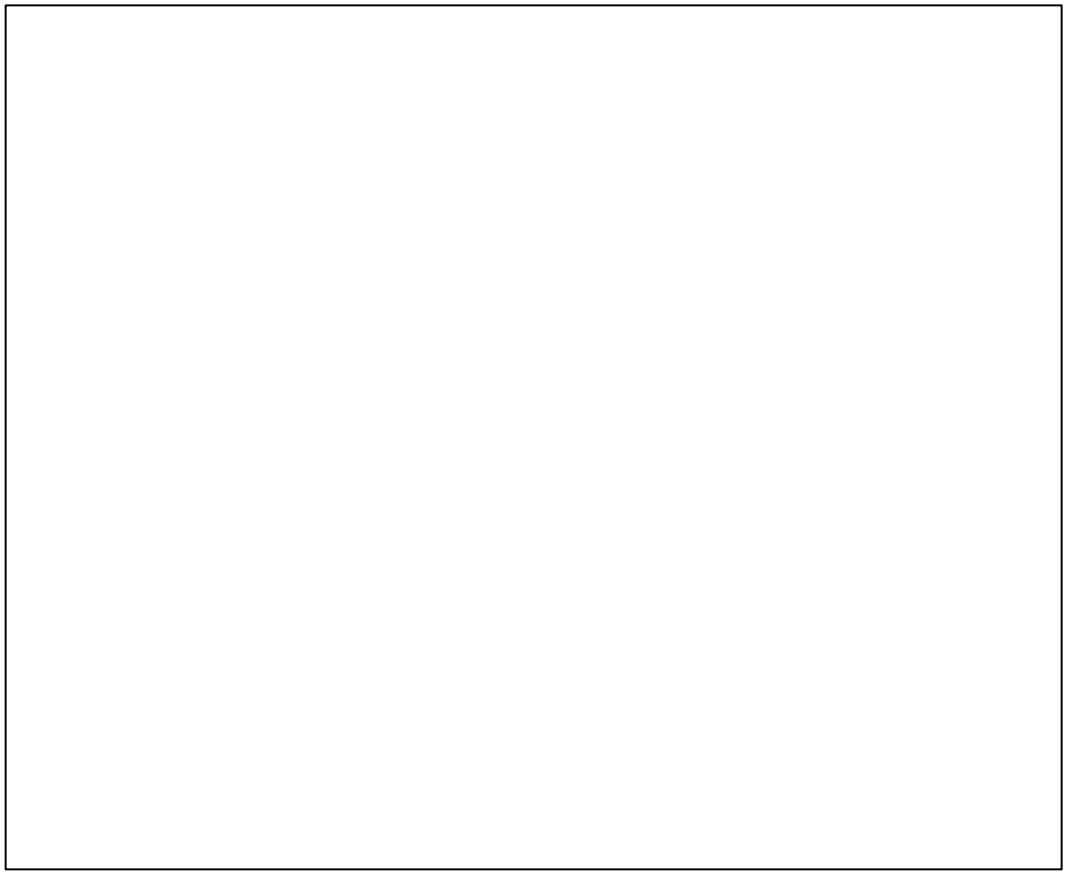
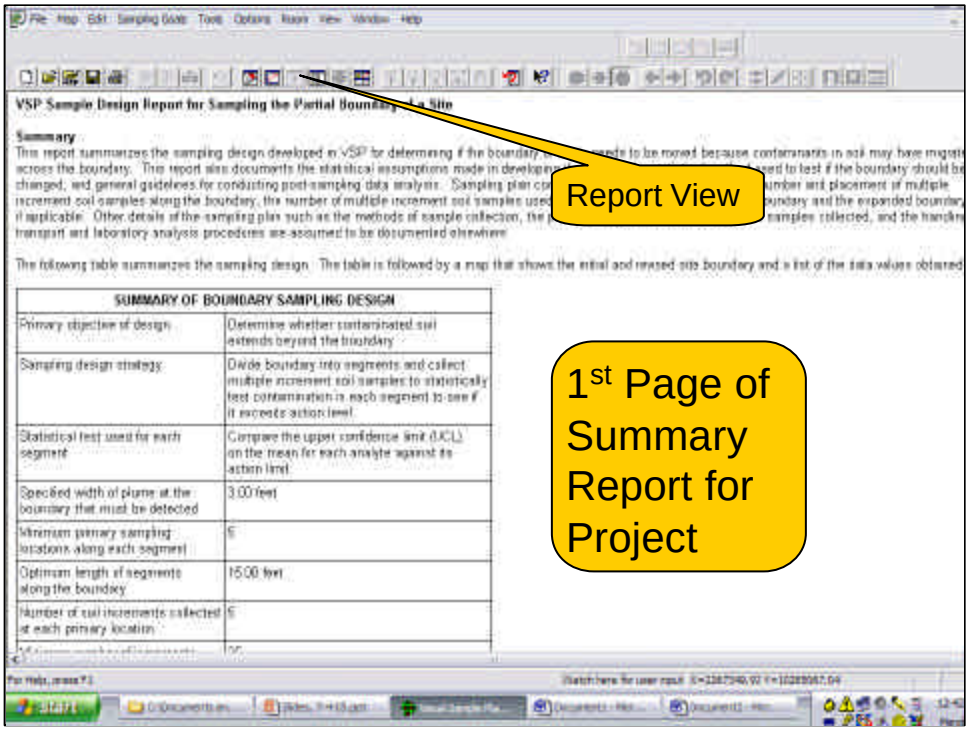
PNWD-SA-7032 / 63




Report View
1st Page of Summary Report for Project
SUMMARY OF BOUNDARY SAMPLING DESIGN
Primary objective of design
Determine whether contaminated soil extends beyond the boundary
Sampling design strategy
Divide boundary into segments and collect multiple increment soil samples to statistically test contamination in each segment to see if it exceeds action level
Statistical test used for each segment
Compare the upper confidence limit (UCL) on the mean for each analyte against its action limit
Specified width of plume at the boundary that must be detected
3.00 feet
Minimum primary sampling locations along each segment
5
Optimum length of segments along the boundary
15.00 feet
Number of soil increments collected at each primary location
5

Summary

- This training has been an introduction to how to use the VSP Range Sustainability module
  - to determine if explosives constituents in surface soil may have migrated beyond the provisional boundary of an active training range, and if so,
  - to estimate the location of a new provisional boundary that is expected to identify the area where true mean concentrations may exceed action limits
- Not all features in VSP-RS module have been illustrated in this training
  - Please refer to the VSP RS user's guide, the user's guide for the entire VSP software package, and the VSP Quick-Start Guide for further information on the use of VSP
  - Download these guides from http://dqo.pnl.gov/vsp

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PNWD-SA-7032 / 65