ATTACHMENT 3 – COLLECTION PLAN FOR SW MISSOURI LEAD/ZINC PROJECT

M E M O R A N D U M

February 13, 2007

To: HSI FILE

From: Shawn Muenks

Re: Southwest Missouri Hyperspectral Imagery (HSI) Lead/Zinc Re-analysis Project

The following attachments provide a Scope of Work (SOW), related plans, and Standard Operating Procedures (SOPs) for the February 21 and 22, 2007 HSI project located in Southwest Missouri. The plan will be modified as the project develops and or to accommodate field conditions.

The purpose of this field analysis project is to collect surface data of lead and zinc concentrations for development of the Airborne Real-Time Cueing Hyperspectral Enhanced Reconaissance (ARCHER) system. The data from this field event will be used to calibrate previously acquired imagery for development of a "signature" for lead/zinc levels. Once a "signature" is developed for varying concentration levels, the HSI configured aircraft can be used to locate and analyze surface contamination over large areas within a short amount of time.

The surface concentrations will be recorded in-situ with a handheld X-ray Fluorescence (XRF) Spectrometer. The locations of the tests will be recorded with a handheld Global Positioning System (GPS) unit.

In summary, the objectives of the field analysis are as follows:

- Obtain ground truth data for use in development of an electronic "signature" for varying surface concentration levels of lead and zinc.
- Investigate mining areas to locate possible source areas or tailings piles.
- Investigate and collect data from mine shafts.
- Gather locational data of test locations and visual landmarks to use in rectifying imagery.

SM

Attachments: Scope of Work
Trimble Standard Operating Procedure
Standard Operating Procedure for Innov-X XRF Analyzer

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Scope of Work for
Southwest Missouri Hyperspectral Imagery (HSI) Lead/Zinc Re-analysis Project
Aurora and Wentworth, Missouri
Febuary 21 & 22, 2007

BACKGROUND

In December 2004, the department established a Cooperative Agreement (CA) with the University of Missouri Columbia (UMC) to support an Environmental Protection Agency (EPA) funded Pilot Project. The Pilot Project, Characterizing Chemical Contamination through Airborne Hyperspectral Imagery (HSI), evaluated applications of the Civil Air Patrol's (CAP) new Airborne Real-Time Cueing Hyperspectral Enhanced Reconnaissance (ARCHER) system to the department's Environmental Emergency Response (EER) and contamination characterization requirements. CAP deployed ARCHER to Jefferson City, August 7-9, 2005, and collected HSI of a variety of contaminated sites identified by department Project Managers (PM), including mining locations within the Aurora/Wentworth area. The UMC, through the Missouri Resource Assessment Partnership (MoRAP), analyzed the HSI of select sites, in concert with the sites' PMs, to provide a preliminary assessment of applications. There was not sufficient funding to conduct in-depth analysis of all sites or perform ground truth verification. However, preliminary analysis indicated several promising applications for both EER and contamination characterization.

PURPOSE

The purpose of this phase of the HSI project is to perform a field ground truth survey of the Aurora and Wentworth HSI imagery areas to confirm/disprove the ability of the ARCHER system to characterize lead contamination in surface soils and/or vegetation. Field screening data will be collected and compared to the imagery analyses previously provided by MoRAP. Lead and zinc concentration levels will be used to calibrate the spectral imagery to known in-situ ground conditions. The ARCHER system will then be adapted to conduct field screening for general distribution, and possibly concentration levels of mine waste and other contaminants with distinguishable spectral signatures.

SCOPE SUMMARY

TASK I: Conduct site visit planning meeting
TASK II: Develop field survey plan
TASK III: Collect field data
TASK IV: Data analyses and report generation

TASK I DESCRIPTION: CONDUCT SITE VISIT PLANNING MEETING

Federal Facilities Section (FFS) staff will meet with MoRAP to discuss re-analysis of imagery for Southwest Missouri mining area. MoRAP will be tasked with charting a map with varying levels of contamination in order to identify areas for field ground truth surveying. This information will be used to map out specific geographical locations to collect readings of lead and zinc for comparison to the spectral imagery. Areas of high, medium, and low lead concentrations will attempt to be identified for field surveying.

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TASK II DESCRIPTION: DEVELOP FIELD SURVEY PLAN

Information provided by MoRAP will be used by FFS staff to choose geographical locations for field data collection. Areas will be chosen with high, moderate, and low levels for the field survey. If time constraints are encountered, only the high levels will be surveyed. Areas to be surveyed will be located on a map using ArcView mapping software and imagery layers provided by MoRAP. Locational data will be recorded and downloaded into a handheld Trimble Geographical Positioning System (GPS). The GPS will be used to locate the survey points in the field.

TASK III: COLLECT FIELD DATA

The survey points will be located in the field and a handheld X-ray Fluorescence (XRF) Spectrometer will be used to record the in-situ surface soil concentrations for lead and zinc. The geographical location of each XRF test will also be recorded in the field using the same GPS unit. Vegetation within the area of contamination will also be analyzed with the XRF utilizing the thin-film analysis tool of the XRF. All test locations, mining features, and other landmarks will be recorded using the GPS unit. Standard Operating Procedures (SOPs) for these devices is included in the attachments.

The goal of the field survey is to obtain ground truth data for use in development of an electronic "signature" for varying surface concentration levels of lead and zinc. In addition, data from mining features such as shafts or tailings piles will be recorded for use in developing spectral signatures for the ARCHER system.

TASK IV: DATA ANALYSES AND REPORT GENERATION

Once the field survey is complete, all data will be downloaded and analyzed for any reoccurring trends that can be attributed to the output of the spectral imagery. The GPS locations of the XRF field tests will be plotted over the spectral imagery and compared with lead and zinc concentrations to identify areas of similar spectral signature. Surface metals data for designated areas and for non-contaminated areas will be plotted for analyses. Also, areas of lead and zinc contamination in vegetation will be plotted and compared with the spectral imagery to see if there are trends within the imagery that correlate to the contamination. Locations of mine features such as shafts and tailings piles will also be plotted to identify any characteristics that appear in the imagery. GPS coordinates of designated landmarks will also be given for geo-referencing of the imagery.

A final report will include all findings and present any recognizable signatures from the imagery. The metals data will be presented along with locational information for follow-on analysis. The results of the investigation will be used to gain confidence in the ARCHER system for use as a field screening tool in Southwest Missouri, and mine waste inventory applications in general.

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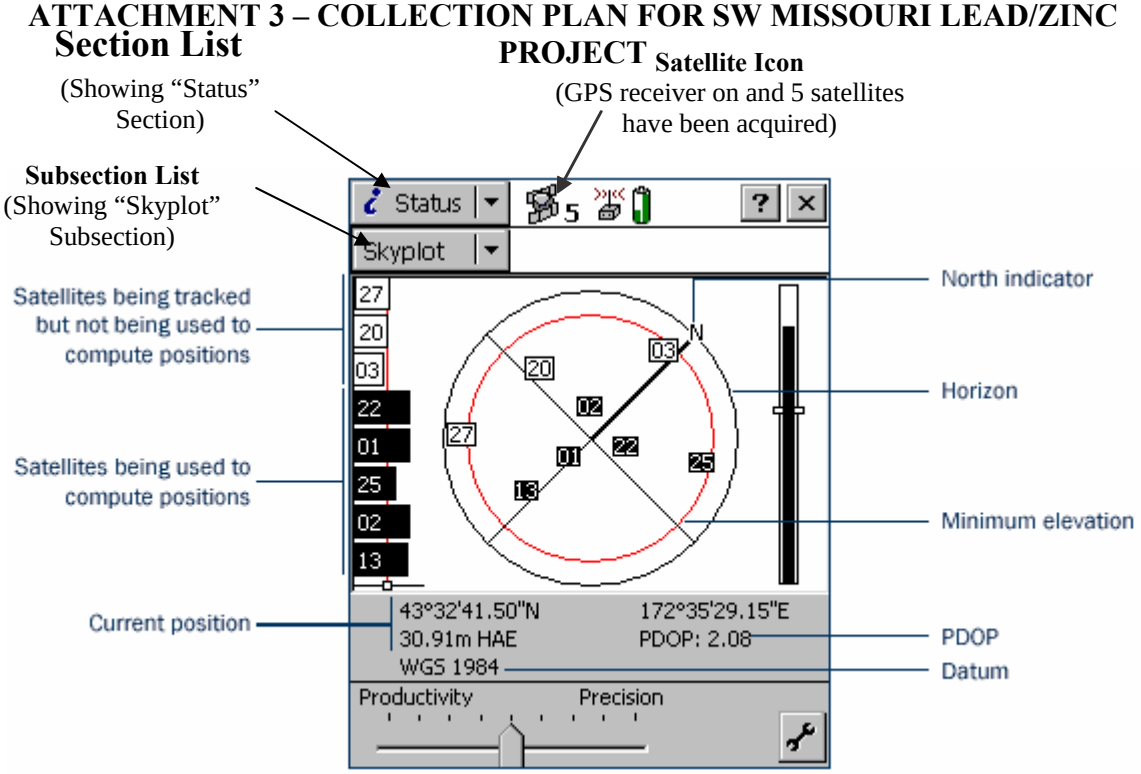
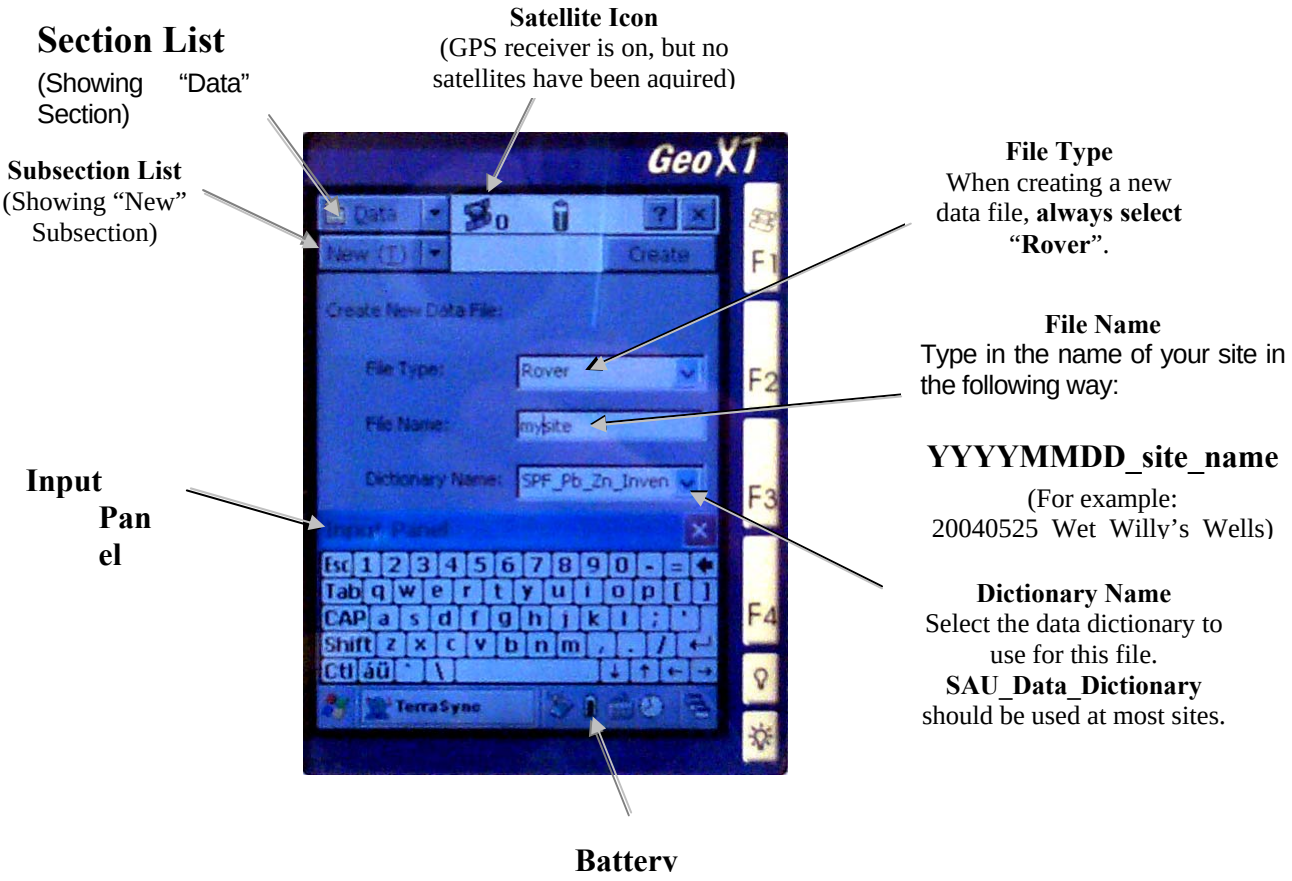
TRIMBLE STANDARD OPERATING PROCEDURE


Section List
(Showing "Status" Section)
Satellite Icon
(GPS receiver on and 5 satellites have been acquired)
Subsection List
(Showing "Skyplot" Subsection)
Satellites being tracked but not being used to compute positions
Satellites being used to compute positions
Current position
North indicator
Horizon
Minimum elevation
PDOP
Datum
Status
Skyplot
43°32'41.50"N
172°35'29.15"E
30.91m HAE
PDOP: 2.08
WGS 1984
Productivity
Precision


Section List
(Showing "Data" Section)
Satellite Icon
(GPS receiver is on, but no satellites have been aquired)
Subsection List
(Showing "New" Subsection)
Input Panel
Battery
File Type
When creating a new data file, always select "Rover".
File Name
Type in the name of your site in the following way:
YYYYMMDD_site_name
(For example: 20040525 Wet Willy's Wells)
Dictionary Name
Select the data dictionary to use for this file.
SAU_Data_Dictionary
should be used at most sites.
GeoXT
Data
New (1)
Create
Create New Data File:
File Type:
Rover
File Name:
mysite
Dictionary Name:
SPF_Pb_Zn_Inven
Input Panel
TerraSync

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Questions and Answers for the Basics

1. **How do I turn the Trimble handheld unit off and on?**
   To turn on, press the large button below the screen. Press and release, do not hold the button. To turn off, press and release the large button below the screen. (See cover page)

2. **How do I check the battery power?**
   Double click the battery icon on the lower right hand side of the screen.

3. **How do I recharge the unit?**
   Plug module into outlet, turn on the unit and place it into the black support module as shown and **leave unit turned on**:

4. **Why is the screen so dark?**
   The backlight may be turned off. Press the small button below the screen with the light bulb icon. If that doesn't work, press and hold the same button until the desired setting is reached. (See cover page)

5. **How do I access the keyboard on the Trimble?**
   Tap on the keyboard icon in the lower right hand portion of the screen. To close the keyboard, tap on the X on the top right portion of the "Input Panel." (See cover page and page 2)

6. **How do I open TerraSync software?**
   Double click the TerraSync icon on the desktop. The program loads slowly. Wait approximately five seconds for the program to load. (See cover page)

7. **How do I turn on the GPS receiver?**
   With TerraSync software open (see 6 above), tap the down arrow on the Section List (usually reads "Status"). Select "Setup." The Current Configuration screen is opened. On the top right of this screen is a button with "GPS" on it. Tap this button. A small satellite icon will appear to the right of the "Setup" menu. The GPS receiver is now on (see page 2).

8. **How do I turn off the GPS receiver?**
   With TerraSync software open, tap the down arrow on the Section List. Select "Setup." The Current Configuration screen is opened. On the top right of this screen is a button with "GPS" on it. Tap this button. A message window opens and asks you if "you are sure you want to disconnect from the GPS receiver?" Tap "Yes." The small satellite icon will disappear to the right of the "Setup" drop down menu. The GPS receiver is now off.

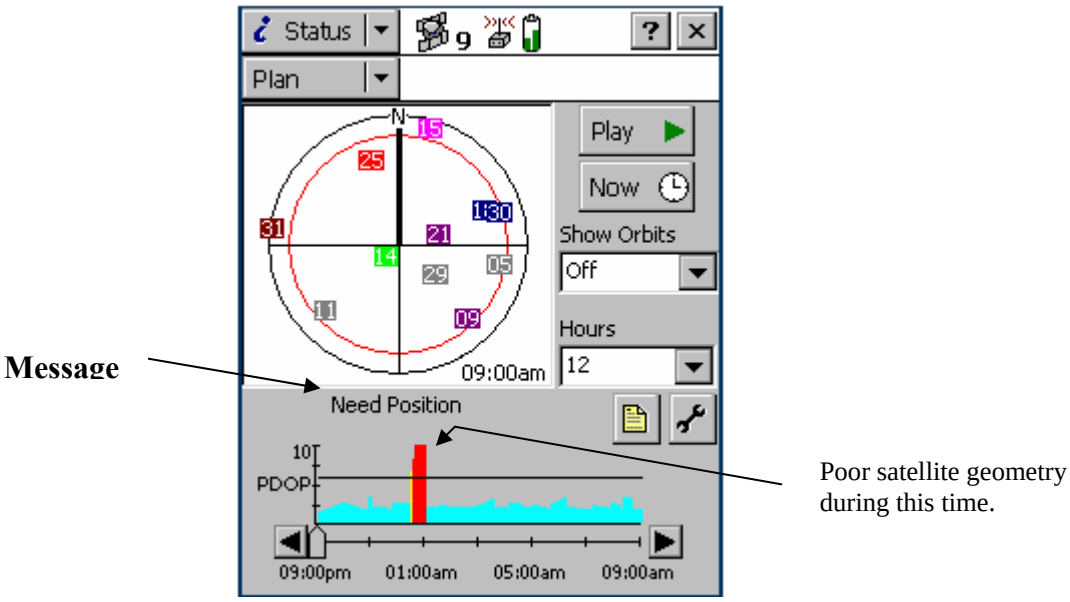
9. How do I know when poor satellite geometry will occur at my site?

Run Mission Planning when you arrive at your site (you only need to run this once per day). With TerraSync software open and the GPS receiver turned on, tap the down arrow of the Section List and select "Status". Select "Plan" from the Subsection List. This could take several minutes to complete. The Trimble has to figure out where it is and then (automatically) get information from the satellites in order to run the plan. You may see one of the following messages displayed during this time:

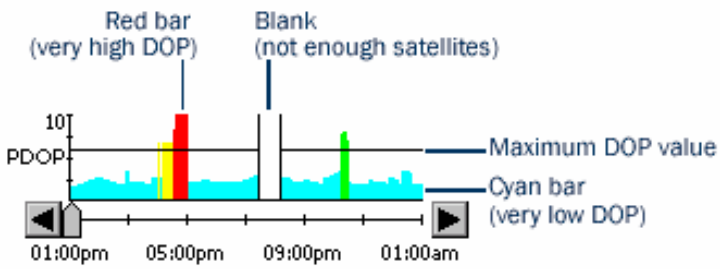
Plan screen: Messages

Message	Meaning
Recording almanac	TerraSync is downloading an almanac from the connected GPS receiver.
Need almanac	TerraSync does not have a current almanac of satellite locations.
Need position	The GPS receiver has stopped computing positions.
Heading locked	The GPS receiver is stationary or moving too slowly to calculate an accurate heading. The rotation of the planning skyplot does not reflect the current heading.

After the unit receives the information it needs, you will see something similar to the picture below.



At the bottom of the screen is a graph with PDOP values on the left and time on the bottom. **In the enlarged example below** you can see a yellow and red bar from 4pm to 5pm and a green bar around 10:30pm. The PDOP exceeds the maximum DOP value in these two instances and you would not be able to collect positions during these times. Around 8pm, there aren't enough satellites to collect positions and you would not be able to collect positions during this time. **Plan your data collection during the cyan colored portions of the graph.**



Standard Operating Procedure for Innov-X α 400sl XRF Analyzers

The guidance for safe instrument operation described in the manufacturer's manual will be followed. In addition, to ensure consistent use of the instrument among department personnel, the following protocol will be followed.

Note about trigger lock: If the analyzer is not used for a period of time, the trigger lock will automatically engage. To unlock, click on the lock icon in the lower right hand corner of the screen while in the "Ready to Test" screen.

Startup (handheld operation)

- Place a battery in the handle of the analyzer.
- Power up the analyzer (On/Off switch located on base of handle), then the iPAQ Pocket PC.
- Start the Innov-X software using the icon in the Start dropdown file on the iPAQ.
- A "NOTICE" screen will pop up warning about ionizing radiation, hit START.
- The Innov-X Main Menu screen appears, choose which mode you wish to test in. Available modes will be highlighted.
- The instrument will automatically perform a hardware initialization procedure, which lasts for 60 seconds.
- Following initialization, the software will prompt you for Standardization, place the stainless steel standardization clip over the nose of the analyzer.
- Tap the "Standardize" button on the iPAQ screen. The instrument will perform an internal 60-second standardization procedure. During standardization, and any other time the x-ray tube is on, the red light on the top of the analyzer will flash. When the x-ray tube is off, the red light will remain on solid. *Do not remove the probe end of the analyzer from the test surface when the light is flashing. It is not dangerous to do so, but it will prematurely stop the analysis.*
- Following standardization, a window will pop up displaying the analyzer resolution. Record the resolution if so desired, hit OK.
- The analyzer is now ready to analyze calibration check samples (NIST standards).

Calibration Check (handheld operation)

- The NIST Low (2709), NIST Medium (2711), NIST High (2710), or RCRA (408) soil calibration check samples will be analyzed at the beginning of each use (e.g. beginning of the day and at each start up), followed by the certified blank sand sample. Choose the standard which is closest to the anticipated range of the media to be tested.
- On the iPAQ screen, hit the "Info" button at the bottom of the screen. A data entry window will pop up allowing input of information about the next test.
- Fill in the appropriate information using the dropdown menus or type in information using the touch pad keyboard (use the keyboard icon at the bottom of the screen to toggle between the keyboard and input screen).
- Click OK

- Place a calibration check sample cup on a smooth surface with soil material facing up. Place the test window of the analyzer over the sample and pull the trigger or hit the "Start" button on the iPAQ screen.
- The screen will display the words "Test in progress" and the time elapsed. The word "Testing" will blink on and off in the low right hand corner of the screen and the red light will flash.
- Assess instrument calibration by comparing the measured values to the certified true values on the charts located in the analyzer carrying case. Measured values present above the instrument levels of detection must be within 20% of the true.
- If values above 20% of true are observed, re-analyze the calibration check sample. If the measured value still exceeds 20% of true, power the XRF off, close the iPAQ software and shut it down also, wait 10 seconds, and power them back up, and re-initialize and re-standardize as described above. Re-analyze the standards.
- A blank sand sample should be analyzed at least once per 20 samples, preferably following a high concentration sample.
- Re-standardize each instrument a minimum of once each 4 hours of operation or when there is an extreme change in ambient conditions such as temperature. Standardization can be accessed from "File" tab at the bottom of the screen.
- The calibration check standards will be analyzed approximately mid-way through sample analysis (e.g. mid-day), again at the end of sample analysis, and anytime the instrument is re-standardized.

In-Situ Sample Analysis

- Before taking an in-situ test with the analyzer, be sure to check the "Info" screen for information about the next test. This screen can be accessed by hitting the "Info" button on the Ready to Test screen or by hitting "Edit" at the bottom of the screen and choosing "Edit Test Information".
- Fill in the appropriate information using the dropdown menus or type in information using the touch pad keyboard (use the keyboard icon at the bottom of the screen to toggle between the keyboard and input screen).
- Click OK
- Next choose the length of testing time from the "Options" tab at the bottom of the screen.
- Choose "Set Testing Times" from the "Options" menu. Set the Maximum testing time for the Standard Test (The minimum testing time should be set for 10 seconds and a typical maximum testing time would be 30 or 60 seconds for a Standard Test. Longer testing times may be chosen, but will not improve results significantly. Do not change settings for Light Element Test).
- Click OK
- Point the analyzer to the surface to be tested. Any foreign objects should be cleared away and the analyzer should be held such that the front of the probe head is held flush to the surface.
- Pull the trigger or tap the "Start" button on the Ready to Test screen.

- The screen will display the words "Test in progress" and the time elapsed. The word "Testing" will blink on and off in the low right hand corner of the screen and the red light will flash. The test will continue for the amount of time specified.
- It is recommended that the window be carefully wiped clean after each analysis or clear plastic used to protect the test window. The window should also be checked periodically to ensure it is not ripped or punctured.
- The results of the analysis will be displayed on the screen after each test. If the results do not appear, tap the "View" tab at the bottom of the screen and choose "Results".
- If necessary, tap the X in the upper right hand corner of the Results screen to return to the Ready to Test screen at any time.
- Tests can be stopped by either pulling the trigger again, or tapping Stop on the iPAQ screen.
- When finished analyzing, exit out of the software by tapping on the "File" tab at the bottom of the screen and choosing "Exit". You may have to repeat this two times to exit the Innov-X software.

Basics

- Innov-X software uses three main screens: Main, Analysis and Results: Users select mode to use via the *Main* screen. Most edits to testing method are made via the *Analysis* screen, which typically says "Ready to Test". The *Results* screen shows all data. All data editing features are done from here.

- Always exit software completely when finished using the analyzer! It may be necessary to close all three screens. Use File ∏ Exit. Software sill prompt for confirmation before closing.

- Removing iPAQ: Slide iPAQ towards nose of analyzer to clear connector before lifting upwards.

Note: **For any operation that requests a password, the administrator password is lower case z, and the factory password is 1234.**

Downloading Data

Exported data is saved as comma delimited (.csv) files. These files can be opened and formatted in MS Excel, or any other spreadsheet program. To transfer data to a PC, ActiveSync must be installed on the PC.

- Insert iPAQ in cradle connected to PC. Choose "Guest" partnership.
- Open Innov-X software from the Start dropdown menu.
- Tap START on the "NOTICE!" screen.
- Choose View ∏ Results (at the bottom of the iPAQ screen).
- Choose File ∏ Export Results (at the bottom of the iPAQ screen).
- Select readings to be exported using the choices given. Tap OK.
- Input Filename, folder, tap OK.

The results file will be stored in the My Documents Folder on the iPAQ. It can be copied to the PC by using "My Computer" and navigating to the file by clicking on the "Mobile Device" icon.