

Proposal for Phase II Activities Paducah Data Warehouse and GIS

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Background

The Paducah Gaseous Diffusion Plant (PGDP) Data Warehouse and GIS Viewer (DWGIS) is a web accessible environmental data query and GIS viewer tool. It utilizes web technology to provide access to millions of environmental data and hundreds of GIS features for the PGDP.

A prototype DWGIS was developed for the Portsmouth Gaseous Diffusion Plant (PORTS). The PORTS system was developed and deployed in CY 2000 and has been in use since that time. The PGDP DWGIS was based upon the structure and functionality of the PORTS DWGIS. Statistical comparison of data and GIS features of the PORTS-DWGIS and PGDP-DWGIS is presented in Table 1. A comparison of the features of the “Phase I” PGDP DWGIS and PORTS DWGIS is provided in Table 2.

The main differences between the PORTS DWGIS and PGDP DWGIS are:

- 1) PORTS-DWGIS has not been updated from OREIS since 2003
- 2) PORTS-DWGIS does not have any OREIS field measurement data in data warehouse
- 3) PORTS-DWGIS has Geoscience data (modeling info) – PAD-DWGIS does not.
- 4) PAD-DWGIS has more standardized GIS features

Table 1. Environmental Data Warehouse Statistics:

	Paducah	Portsmouth
Environmental lab results	2,296,537	1,040,657
Groundwater Elevation	21,960	27,955
Environmental Sample Locations	10,262	6,950
Groundwater Wells	866	1,231
Field Measurements	95,600	0
Boring/Well Logs (PDF)	652	2,055
Geologic Stratigraphy/Lithology Picks	0	1,939
GeoScience	0	1,483
GeoScience Logs	0	264
Standardized GIS Features	140	80
Aerial Images	3	1
2 meter Digital Elevation Model	1	1

Table 2. PORTS & PGDP DWGIS Feature & Functionality Comparison

Y = attribute/tool/capability is part of system		
FEATURE	PORTS DWGIS	PGDP DWGIS
Web Accessibility	Y	Y
Security Features (multi-level)	Y	Y
Data Warehouse Web Page	Y	Y
Analytical Data & Plotting Page Link	Y	Y
Site GIS Viewer Page Link	Y	Y

Well and Borehole Information Page Link	Y	Y
Geoscience Page Link	Y	Y*
GIS Viewer Web Page	Y	Y
Feature Search by Name	Y	Y
Feature Search by Description	Y	Y
Query Samples by Media	Y	Y
View Legend	Y	Y
Set Media Result Layers	Y	Y
Set Non-Media Layers	Y	Y
Add and Delete Visible Layers	Y	Y
Set Visible Layers	Y	Y
Set Active Layer	Y	Y
Prioritize Layers	Y	Y
GIS Map-Viewer Functions	Y	Y
Auto Zoom to Original Extent	Y	Y
Auto Zoom In/Out	Y	Y
Zoom to Full Extent	Y	Y
Zoom to Active Layer	Y	Y
Zoom to Last Extent	Y	Y
Pan View	Y	Y
Select View by Rectangle	Y	Y
Hyperlink	Y	Y
Query	Y	Y
Measure	Y	Y
Data Query by Buffer	Y	Y
Data Query select by Rectangle	N	Y
Data Query select by Polygon	N	Y
Data Query select by Radius	N	Y
Clear	Y	Y
Print	Y	Y
Server Requirements		
Physical	Y	Y
Software	Y	Y
Desktop Workstation Requirements		
Physical	Y	Y
Software	Y	Y
Data Accessibility		
Analytical Data & Plotting Page Link	Y	Y
Query analytical data by location	Y	Y
Query analytical data by media	Y	Y
Query analytical data by analyte/location/depth	Y	Y
Screening results by detects & non-detects	Y	Y
Query analytical data by location/analyte/fraction	Y	Y
Query field measurements	N	Y
Query data by sampling event	Y	Y

Query analytical data by specified sample date range	Y	Y
Query submitted to table (screen view)	Y	Y
Query submitted to downloaded Excel Spreadsheet	Y	Y
To BE COMPLETED		
* Not populated as part of Phase I development Activities		

Development of the PGDP DWGIS began in April 2005 and Phase I DWGIS development activities continued through November 2005. The PGDP DWGIS was initially deployed for internal KRCEE beta-testing in August 2005. End-user beta-testing with PGDP site contractors was conducted from November through December 2005. Site beta-testers identified improvements and additional functional requirements to increase the utility of the PGDP DWGIS. The most critical improvements and functional requirements for the PGDP DWGIS are identified and discussed in this proposal.

General Scope

Seven (7) Phase II PGDP DWGIS development tasks are addressed in this proposal. The tasks are:

1. Document Indexing and Linkage Module
2. Risk Assessment Module
3. Training
4. On-Going Data Support and Integration
5. Development of Spatial Query Tools
6. Development of DWGIS Feature Extraction Tool
7. White Paper for 3-D Visualization Software

Section 1 of this proposal describes the steps to develop a standardized methodology to collect, index, link and then distribute technical PGDP documents to end users via the web based data warehouse. An integrated approach utilizing commercial web document indexing is described in this section.

Section 2 describes a Risk Assessment module that applies standardized statistical analysis of environmental data for comparison to human health risk-based standards. Traditionally this type of comparison is periodically conducted by scientists every time new data is added. Each scientist downloads the data, standardizes the data, compares the data and runs statistics on the data in a redundant process. This module will perform the process once and each scientist can access the risk-based comparisons from the web-based GIS.

Section 3 describes two types of training to be conducted for the Paducah Data Warehouse and GIS. The first training session will be targeted for general system use for

about 10-12 users. The other training session is for server configuration and installation limited to a smaller group of IT professionals.

Section 4 describes the activities to continue updating the data warehouse with additional data. The data will include newer OREIS data, newer or updated GIS features and geoscience data generated from on-going projects. The activation of web interfaces for geoscience data is also included in this section.

Section 5 describes the development and deployment of several geospatial query tools for the GIS Viewer Web Page. Four tools that will allow the end-users to spatially query data are described: 1) Select by Rectangle; 2) Select by Polygon; 3) Select by Radius; and 4) Select by Buffer.

Section 6 describes the development and deployment of a feature extraction tool for the DWGIS that would allow GIS analysts and end-users to download active GIS layers and data directly from the GIS Viewer Web Page. Once downloaded the GIS layers and data could be used for geospatial analysis in ARCGIS/ARCINFO and for production of presentation quality graphics. This tool allows for ready access to routinely updated GIS layers and data.

Section 7 briefly describes the development of a white paper to identify three-dimensional data visualization tools for the PGDP. The white paper, when completed, will define the specific software, software capabilities, and software applicability for 3-D visualization of various types of PGDP data. The white paper is being developed to serve as the basis for identifying the appropriate 3-D visualization software for use at the PGDP.

1.0 Document Indexing and Linkage Module

Estimated Subcontract Cost: \$30,000.00 (Cost to KRCEE)

Many PGDP technical environmental reports and geotechnical documents as well as supporting documents have been developed and stored in various electronic formats. KRCEE proposes to develop a standardized document linkage page and linkage tools for environmental reports for the PGDP DWGIS. KRCEE will develop and deploy document linkage functionality via implementation of methodology to collect, index, link and then distribute technical PGDP documents to end users via the web based DWGIS. An integrated approach utilizing commercial web-document indexing software will be utilized for this task.

The commonly used format for storage and distribution of electronic document files is Adobe Acrobat™ PDF. PDF documents may be simple images of documents that are not indexed or queryable or they may be indexed and queryable via commercially available software.

The KRCEE currently stores and distributes electronic PDF copies of PGDP environmental documents utilizing a web secure web accessible FTP site organized simply by project type. Most of the documents on the KRCEE ftp site are simple scanned images of documents and are not indexed or queryable PDF documents. They have not been through an optical character recognition (OCR) process.

PGDP currently has indexed and queryable PDF documents developed by site contractors for many environmental projects. These documents are currently stored electronically at the PGDP Document Center and are available electronically via Compact Disc upon request.

PGDP documents need to be universally accessible to end users in an indexed-retrievable web-based solution. The documents should be searchable for any combination of words. A Google™-like interface (similar to the well-known search engine) will be developed and deployed on the DWGIS for retrieval and query of PDF documents. All scanned documents will be OCR'd and fully searchable.

PGDP GIS features will be linked to the PDF documents and documents will be linked to PGDP GIS features. For example, if building C-333 is clicked on the GIS viewer for additional information; the document search engine is triggered with the "C-333" search term. The document search engine will return a list of hyperlinked documents matching the search term to the screen for review.

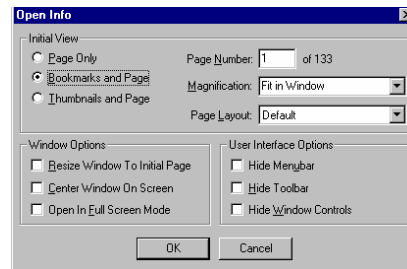
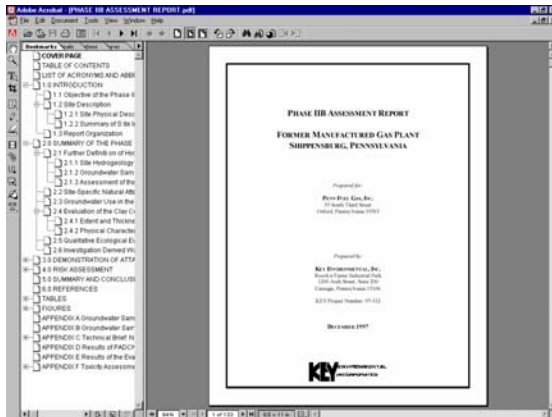
1.1 Environmental Reports

PGDP environmental reports are made up of text, graphics and tables published from different software programs.. Report text is generated with word processing software. Report maps and figures are generated with GIS and CAD software. Tables are generated with spreadsheet, word processing or database reporting tools.

The use of many different software programs creates information integration problems in the development of project reports. The goal for electronic report integration is to create a standardized format from each of the different software programs into a file that matches the hard copy report page for page. The standard electronic document format for environmental reports is Adobe Acrobat's Portable Document Format (PDF). It is desired that all reports be generated into a single PDF of all pages of the report.

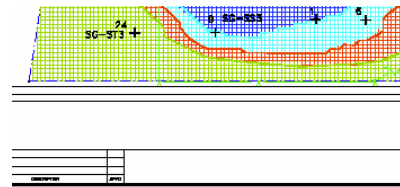
Initial Page and Bookmarks

The figure below is an example of what the initial view of an electronic PDF document will look like when it is opened. Document sections will have bookmarks and all subsections will have nested bookmarks. When a document is retrieved, the initial page will open to the cover page with magnification set to "Fit in Window" with the document indexing bookmarks on the left side of the window. Default settings are illustrated below.



Page Size and Large Format Figures

All tables and figures will be inserted into the electronic report PDF at the same scale and paper size as in the original document. For example, page 101 of 133 is an 11 x 17 figure in the Phase II Assessment Report. See the example to the right.



General Info

Report Title, Subject, Author and Keywords fields will be completed in the Adobe Acrobat General Info

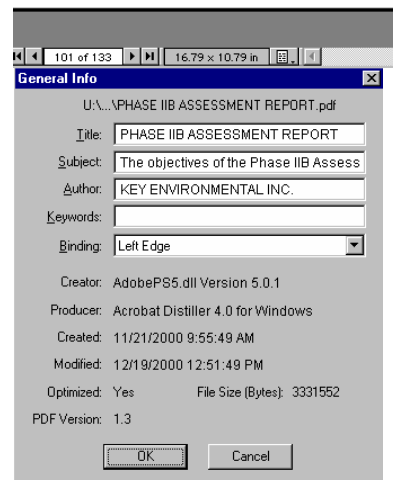


Figure 1 Document General Info

Use a combination of the options below to refine your search.

The image shows a search results page on the left and an advanced search form on the right. The search results page displays seven items related to benzene, including links to PDFs and Word documents, and brief descriptions of each. The advanced search form, titled 'Documents', allows users to refine their search using various criteria: 'should contain', 'must contain', and 'must not contain' (all with dropdown menus for 'in the body' and 'the words'); 'Document Type' (checkboxes for 'Search includes Home Pages only', 'Search includes Archived documents only', and 'Search excludes Archived documents only'); 'Last Updated' (radio buttons for 'Anytime', 'in the last week', 'on or after', and 'and on or before', with date pickers for month, day, and year); and '10 hits', 'sorted by relevance', and 'with summaries' (all with dropdown menus). A 'Search' button is located at the bottom of the form.

Search Results Found for: benzene [Show Recent Updates First](#)

- DisplayBoard1a.f [Adobe PDF]**
When considering the estimated cancer risk as a result of North Island's activities, it is important to put the numbers in perspective. Here are a few examples of our normal cancer risk, expressed as per ...
Page Last Updated: 01 Oct 01
- Supplemental Site Investigation and Groundwater Monitoring ChevronTexaco Point Wells Terminal Upper Bluff Property ...**
The PIE Contracts web site is the primary source of contract information for marketing and proposal preparation.
Page Last Updated: 02 Nov 05
- Site 20-9291 Design and Implement Excavation, Point Wells Terminal Upper Bluff Property, Snohomish County WA**
The PIE Contracts web site is the primary source of contract information for marketing and proposal preparation.
Page Last Updated: 02 Nov 05
- Conduct Site Visit, Characterize Contamination, Site Assessment and Temporary Groundwater Monitoring Well ...**
The PIE Contracts web site is the primary source of contract information for marketing and proposal preparation.
Page Last Updated: 02 Nov 05
- Iraq Reconstruction Business Development: IRAQ Reconstruction News Headlines January 26, 2004 [Word]**
Compilation of latest Iraq reconstruction news from key sources relevant to SAIC.
Page Last Updated: 20 Feb 04
- Underground Storage Tank (UST) Closure at Rocky Top #7 Site, Englewood, Tennessee**
The PIE Contracts web site is the primary source of contract information for marketing and proposal preparation.
Page Last Updated: 18 Nov 05
- Facility 43099: Ashburn, GA**
The PIE Contracts web site is the primary source of contract information for marketing and proposal preparation.

Documents

should contain in the body the words

and

must contain in the body the words

and

must not contain in the body the words

Search

Document Type

Search includes Home Pages only.

Search includes Archived documents only.

Search excludes Archived documents only.

Last Updated

Anytime

in the last week

on or after January 01, 2003

and on or before January 01, 2005

10 hits sorted by relevance with summaries

Search

With the Verity Ultraseek™ software all PGDP environmental documents resident on the DWGIS will be retrievable utilizing either a simple search term or a more advanced search. See the advanced search form above and to the right.

Assumptions :

- Up to 5 (five) significant (i.e. non-editorial) comments will be addressed for this module.
- Comments should be provided to KRCEE/SAIC within 1 week from this module installation.
- Comments will be consolidated and provided to KRCEE/SAIC in electronic format with all contradictory comments resolved prior to submission.
- The deliverable will be finalized per comments received. Finalization of this deliverable will constitute acceptance of the deliverable.
- SAIC, as a subcontractor to KRCEE, will not purchase Verity Ultraseek™ under this contract.
- SAIC will utilize their currently licensed copy of Verity Ultraseek™ while developing this module.

2.0 Risk Assessment Module

Estimated Subcontract Cost: \$33,000.00 (Cost to KRCEE)

2.1. Background

Currently the web data download interface extracts environmental data from the warehouse for various media, analytical parameters, concentrations/activities and units of measure. A comparison of these data to background and risk-based standards will be developed for access through the PGDP DWGIS. Background, regulatory, and risk/dose based standards will be updateable as they change over time.

In addition to risk and risk/dose-based standards KRCEE has developed a macro that generates qualitative statistical results about datasets downloaded from OREIS. This macro will be integrated into the PGDP–DWGIS. Standardized risk comparison reporting will be developed based on input from DOE risk assessors. Output generated from the risk assessment and qualitative statistical tool will be downloadable from the data DWGIS.

2.2 Specific Scope

The Risk Assessment Module will be developed to be compatible with the PGDP DWGIS. The DWGIS will use the current spatial visualization and data tools for data import into other software for printing or additional analysis where applicable. The Risk Assessment Module will be composed of four elements:

1. Risk Reduction Standard Management
2. Risk Assessment Data Comparison
3. GIS Viewer Risk Tool
4. Advanced Temporal Plotting

2.2.1 Risk Reduction Standard Management (RRSM)

A web-based data entry page (front end) for specific risk management users to update the tabular risk reduction values and other data elements will be developed for the DWGIS Risk Assessment Module. The tabular risk reduction value information for comparison includes:

- 1) Risk Reduction Standard 1 –Background or PQL for groundwater
- 2) Risk Reduction Standard 2 –Risk based values for comparison for the same media

Beta testing will be conducted for the RRSM front end data entry screens.

The tests will be conducted on the following functional requirements:

- Add a record
- Delete a record
- Edit a record

Assumptions:

- UK Paducah staff will provide prototype formats in Excel format to SAIC for the Risk Reduction Standard (RRS) management
- SAIC will develop the web-based front-end in java server page (JSP) format to be compatible with the Paducah Data Warehouse and GIS
- The database tables for the RR module will be maintained in the existing Paducah Data Warehouse schema
- Access to this module will be limited to specific users
- Up to 5 (five) significant (i.e. non-editorial) comments will be addressed for this module.

2.2.2 Risk Assessment Comparison and Reporting

The Risk Assessment Comparison and Reporting module will be a web-based report generated for the end-user for specific environmental locations and media.

The Risk Assessment Comparison and Reporting module will produce a statistical report of results of the chemical analyses. This report will indicate the following information at every sample location where temporal data exist for each analyte:

General Results
Sample Location
Analyte
Units
Proportion Detected
Proportion U
Proportion NULL
Proportion J

Detected Results	All Results
MDL Reported	MDL Reported
MDL Exceeded	MDL Exceeded
Minimum Detected Result	Minimum Record
Arithmetic Mean	Arithmetic Mean
Standard Deviation	Standard Deviation
Median Result	Median Result
Minimum MDL	Minimum MDL
Average MDL	Average MDL

Detected Results	All Results
Maximum MDL	Maximum MDL
Maximum Detect	Maximum Record
Standard	Standard
Standard Value	Standard Value
FOD Above Standard	FOR Above Standard
Action Value	Action Value
FOD Above Action	FOR Above Action
No Action Value	No Action Value
FOD Above No Action	FOR Above No Action
Background Value	Background Value
FOD Above Background	FOR Above Background
Dose Based Value	Dose Based Value
FOD Above Dose Based	FOR Above Dose Based

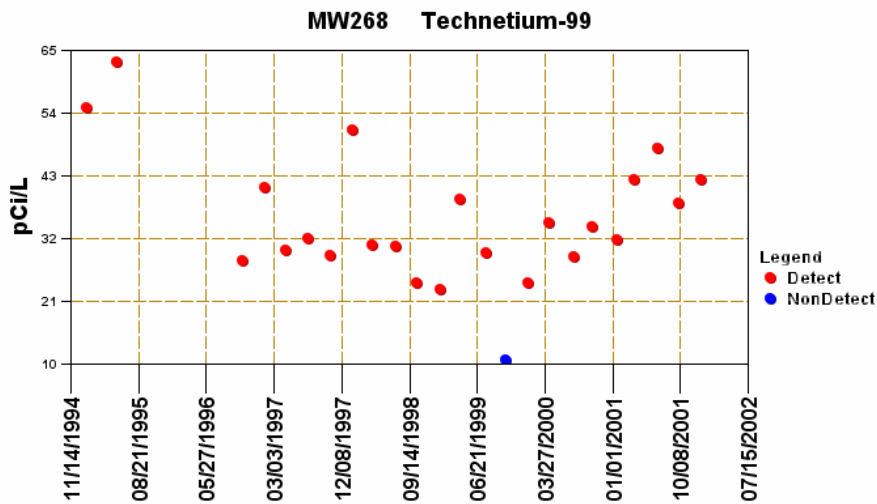
A new data warehouse table DW_RISK will contain the results of the statistics and comparison to the standards for each sample location and analyte. This table will be utilized for requests from the web based data warehouse and GIS Viewer for risk based comparison of analytical data.

2.2.3 GIS Viewer Risk Tool

A new Risk Report tool will be added to the GIS Viewer. The user will select a grouping of sample locations by drawing a box around them in the GIS Viewer. A Risk Report will be generated for the sample locations and displayed on the screen. The end-user will be provided the option to download the Risk Report in an MS Excel format.

2.2.4 Advanced Temporal Plotting

Temporal plotting of analytical results is currently done utilizing a commercially available Java Applet charting package. The current temporal plots look like the following example.



***The data displayed in the previous data table may have different units of measure for a analyte. The values displayed on the above graph have been standardized to the units of measure displayed on the left border of the chart.

The capability of the DWGIS to depict additional information about the data point on the temporal plots will be developed and deployed. The additional information includes:

- Data Validation Qualifier
- Detect or Non-detect
- Rad Error for Radiological Parameters
- Detection Limit
- Error Bar for Radiological Parameters

Data will be graphically displayed in the following manner:

Analytical Data

Diamond symbols with lines using the following color coded convention for data validation qualifiers

XV	Hollow Diamond	Not Validated
J	Yellow Diamond	Estimated activity or concentration per validation
=	Blue Diamond	Detected at reported activity or concentration per validation
U	Red Diamond	Not Detected per validation

Rad Error

Magenta square symbols with lines

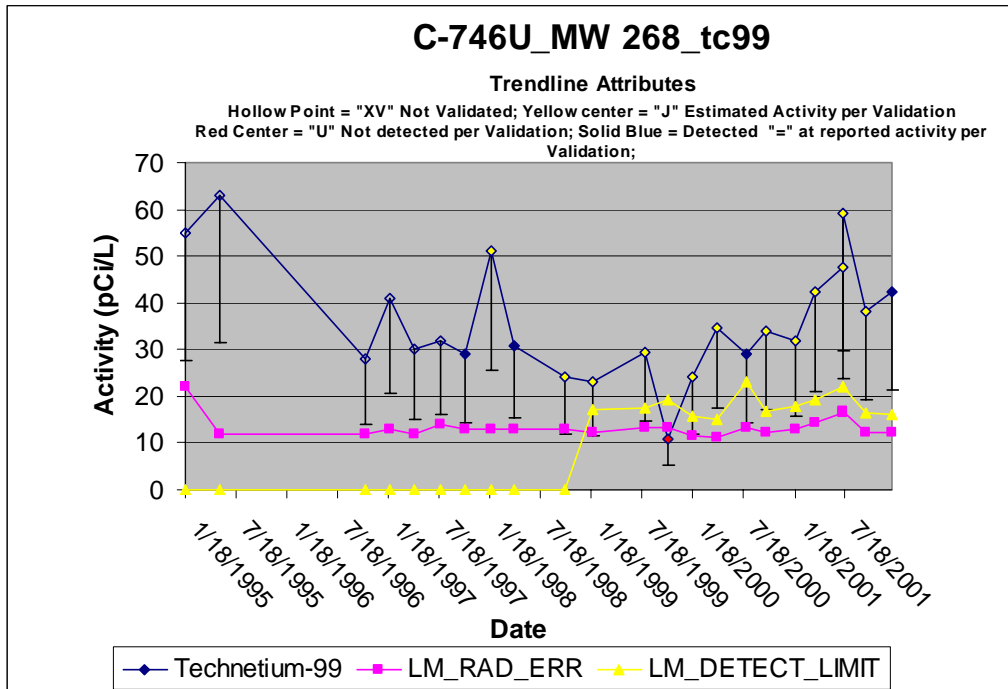
Detection Limit

Yellow triangles symbols with lines

Error Bar

Black bar set at -50% of radiological activity

The proposed temporal plots look like the following example.



Assumptions:

- Up to 5 (five) significant (i.e. non-editorial) comments will be addressed for this module.
- Comments should be provided to SAIC within 1 week from this module installation.
- Comments will be consolidated and provided to SAIC in electronic format with all contradictory comments resolved prior to submission to SAIC.
- The deliverable will be finalized per comments received. Finalization of this deliverable will constitute acceptance of the deliverable.

3.0 Training

Estimated Subcontract Cost: \$10,000.00 (Cost to KRCEE)

3.1 User Training

Training session will be provided to PGDP personnel on the operation of the PGDP DWGIS. Training will include GIS map display, data query, data export and map printing. Three half-day training sessions, each for no more than 4 trainees will be provided at the PGDP. Hands-on access will be available for no more than 4 users at one time during a training session.

3.2 Administrator Training

A one-day training session will be provided to specific personnel on the administration of the Paducah Data Warehouse and GIS application. Training will include server installation, configuration, administration and backup and restore procedures. Training will be for no more than 2 trainees.

4.0 On-Going Data Support & Integration

Estimated Subcontract Cost: \$25,000.00 (Cost to KRCEE)

There will be additional efforts in defining, collecting and organizing data for inclusion into the data warehouse. The data will include GIS, geoscience and environmental. As newer data types are located and loaded, additional data warehouse web access features will be activated.

4.1 GIS Features

Additional GIS features have been identified for inclusion into the GIS database. The preliminarily GIS features identified are:

- Watersheds
- WMUs
- AOCs
- DMSAs

Other features may be defined for inclusion into the data warehouse as well.

Assumptions:

- Up to 20 additional feature classes will be added to the DWGIS for the quoted price.
- The added features will be standardized into the SDSFIE format and the geodatabase portion of the DWGIS will be updated upon completion of each feature.

4.2 Geoscience Data

Additional geoscience data are being developed for eventual inclusion into the data warehouse. These data include but are not limited by the following data types:

- Original boring and well logs
- Seismic Transects and Seismic Profiles
- Geotechnical logs
- Lithology and stratigraphy data

Assumptions:

- The existing Portsmouth Geoscience data warehouse format will be used as a prototype.

- The geoscience data warehouse will be customized to fit the lithology and stratigraphy models provided by PGDP site personnel.
- Lithology and stratigraphy data will be loaded from data in the Rockware™ electronic format.
- A web export utility will be developed and deployed for the lithology and stratigraphy data.

4.3 Environmental Data

This task will include adding additional data to the data warehouse. These data include:

- Updated OREIS analytical data
- OREIS field measurements

Phase I PGDP DWGIS development only captured analytical laboratory data and groundwater elevation data extracted from OREIS. Field measurement data from OREIS will be downloaded, formatted and housed in the DWGIS. The following field parameters are proposed for inclusion into the data warehouse:

Field Parameter	Number of Records
pH	29122
Temperature	17910
Dissolved Oxygen	12559
Flow Rate	8161
Conductivity	8055
Barometric Pressure Reading	4584
Chlorine, Total Residual	3932
Redox	2371
Turbidity	1566
Specific Conductivity (PIP)	1198
Alkalinity	354
Iron (2+)	121
Salinity	120
Toxicity, Final Concentration	80
Total Coliform	63
Organic Vapor	48

Analytical and field measurements have been added to OREIS since the original 2005 data warehouse download. The most recent OREIS data will be requested, obtained and integrated into the DWGIS. A request for an OREIS update will be completed.

Assumptions:

- SAIC will request no more than two OREIS updates during the Phase II period of performance for this activity.

5. Development of Spatial Data Query Tools

Estimated Subcontract Cost: \$11,000.00 (Cost to KRCEE)

Several geospatial data query tools will be developed for the GIS Viewer Web Page to optimize end user ability to query and select data. Specifically, four (4) tools that will allow the end-users to spatially query data are included: 1) Select by Rectangle; 2) Select by Polygon; 3) Select by Radius; and 4) Select by Buffer

6. GIS Feature Extraction Tool

Estimated Subcontract Cost: \$9,500.00 (Cost to KRCEE)

Savvy GIS users require higher level geospatial analysis than that provided by the DWGIS. These users require the geospatial features as ESRI shape files and the imagery as geo-referenced image files locally on their desktop PC. These users typically have ArcGIS (ArcView or ArcInfo) on their desktop PC to perform advanced geospatial analyses and produce production quality graphics.

A feature extraction tool will be developed and deployed for the DWGIS that will allow GIS analysts and end-users to download active GIS layers and data directly from the GIS Viewer Web Page. Once downloaded, the GIS layers and data could be used for geospatial analysis in ARCGIS/ARCINFO and for production of presentation quality graphics. This tool allows for ready access to routinely updated GIS layers and data. This tool is very powerful and will benefit PGDP as well as PORTS for their future activities. Once developed this tool can be deployed at PGDP and PORTS.

This new extraction utility will allow the user to:

- 1) Window the area of interest (the extent) to extract geospatial data;
- 2) Select the specific geospatial features or images to be extracted from the windowed area; and
- 3) Download a compressed ZIP file that includes the specified features and images ready for import into ARC programs.

Assumptions

- Features can be extracted into ESRI shape files at any user extent (scale)
- Images can be extracted in no larger than 8095 x 8095 pixel resolution (or 65,529,025 total pixels) size
- Images will be created in JPEG format with an associated JPW world file
- Spatially-enabled environmental analytical data can be extracted and downloaded into ESRI shape files by media (i.e. groundwater, soil, surface water, etc.)

- Extracting and downloading large sets of spatially-enabled environmental analytical data require longer request cycles
- No other user requests on the data warehouse and GIS viewer can be made by the user during the extract and download session until the request is complete.

7. White Paper for 3-D Visualization Software

Estimated Subcontract Cost: \$4000.00 (Cost to KRCEE)

A white paper to identify three-dimensional data visualization tools for the PGDP will be developed by KRCEE and SAIC. The white paper, when completed, will define the specific software available, software costs, software capabilities, and software applicability for for 3-D visualization of various types of PGDP data.