The Interagency Appalachian Coal Mining Geographic Information System (GeoMine) Pilot Project Report

GeoMine Interagency Team

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TABLE OF ACRONYMS

Acronym	Definition
ADS	authoritative data source
AMI	Amazon Machine Image
eAMLIS	Abandoned Mine Land Inventory System
ArcSDE	ESRI's Spatial Database Engine
ASTM	American Society for Testing and Materials
AWS	Amazon Web Services
BIM	Bond increment maps
CAD	computer-aided design
CHIA	cumulative hydrologic impact analysis
CIO	Chief Information Officer
COOP	continuity of operations
CSP	Cloud Service Provider
CWA	Clean Water Act
DMME	Virginia Department of Mines, Minerals and Energy
DOI	Department of the Interior
DMRE	Kentucky Division of Mine Reclamation and Enforcement
EBS	Amazon Elastic Block Storage
EC2	Amazon Elastic Compute Cloud
EPA	U.S. Environmental Protection Agency
ESRI	Environmental Systems Research Institute (GIS software vendor)
ETL	extract, transform, and load
FGDC	Federal Geographic Data Committee
FISMA	Federal Information Security Management Act
FME	feature manipulation engine
FTE	full-time employee
FWS	U.S. Fish and Wildlife Service
FY	fiscal year
GDB	geodatabase
GIO	Geospatial Information Officer
GIS	geographic information systems
HUC	hydrologic unit code
IaaS	Infrastructure-as-a-Service
IAM	Amazon Identity Access Management
IAP	interagency action plan
ISO	International Standards Organization
IT	information technology
IMCC	Interstate Mining Compact Commission
INDUS	INDUS Corporation, Vienna, Virginia (EPA IT services)
KFO	OSMRE Knoxville Field Office
KML	Keyhole Markup Language
LFO	OSMRE Lexington Field Office
MOU	memorandum of understanding
NHD	National Hydrography Dataset
NWI	National Wetlands Inventory

Acronym	Definition
NWIS	U.S. Geological Survey National Water Information System
NWP	U.S. Army Corps of Engineers Nationwide Permit
OGC	Open Geospatial Consortium
OMB	Office of Management and Budget
OSMRE	U.S. Office of Surface Mining Reclamation and Enforcement
RA	regulatory authority
RDP	Remote desktop protocol
REST	Representational State Transfer
S3	Amazon Simple Storage Service
SQL	Structured Query Language
STORET	EPA STOrage and RETrieval repository and framework for sharing water monitoring data
TAGIS	Technical Applications and Geographical Information Systems
TIPS	OSMRE Technical Innovation and Professional Services
TDS	total dissolved solids
URL	uniform resource locator
USACE	U.S. Army Corps of Engineers
USGS	U.S. Geological Survey
WVDEP	West Virginia Department of Environmental Protection
XML	Extensible Markup Language

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Note

External websites referenced in this report are hyperlinked in the text by the specific URL; internal documents referenced in this report are hyperlinked by here to an OSM-maintained webpage containing multiple referenced documents.

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I. Introduction

The GeoMine Pilot Project (Pilot Project) was established to investigate new technologies to share the geospatial data collected and used by individual agencies involved in regulation of coal mining. The technical decisions required under the Surface Mining Control and Reclamation Act of 1977 (SMCRA) and the Clean Water Act of 1972 (CWA) permitting processes, and decisions and consultations involving the Endangered Species Act of 1973 (ESA) are based on the best available scientific data, and geo-spatially enabled data provide opportunity for more effective and efficient decision-making. The GeoMine Interagency Team represented the state and Federal agencies involved in the regulation of coal-mining related activities:

- The Pilot Project states of Kentucky, Virginia, and West Virginia are SMCRA-primacy programs where administration of SMCRA has been delegated to the states by OSMRE. Tennessee is a Federal program where the SMCRA authority is retained by OSMRE.
- The U.S. Army Corps of Engineers administers the Clean Water Act Section 404 permitting program in Appalachia.
- The Pilot Project states administer Sections 401 and 402 of the Clean Water Act. Under Section 402 the EPA retains oversight authority.

<u>Geographic Information Systems and Coal-Mining Related Spatial Data</u>
Geographic Information Systems (GIS) are recognized as adding place-based value to organizational processes and decisions. As Roger Tomlinson, the "father of GIS" states, "Geographic Information Systems integrate seemingly disparate information quickly and visually, which facilitates communication, collaboration and decision making. Through GIS, geography is actually becoming an organizing tool." Geospatial data are used to locate natural or man-made features on, below, or even above the earth's surface.

The administration and jurisdiction over coal-mining related GIS data are often divided between separate divisions within a State or Federal agency. For example, SMCRA states may have surface coal mining boundaries tracked in the regulatory agency (RA) GIS, underground mine boundaries in the mine safety division GIS, abandoned mine land (AML) sites in the AML division GIS, minesite hydrologic data in the water quality division GIS database, and coal production in the revenue department GIS. Because these GIS were established to serve business needs specific to each division, they often have evolved in isolation from other departments as GIS "stovepipes". These stovepipe GIS, although functioning well to support decisions within a department, may lack the connectivity to other related GIS data needed to serve the collaborative decisions required by SMCRA, CWA, and ESA. Many organizations have recognized these isolated stovepipe GIS and are progressing in creating "federated" or integrated enterprise GIS that are capable of sharing geospatial data across internal organizational boundaries.

Although agencies have successfully secured access to internal GIS data through their collaboration with business units within their organizations, needed external GIS data sources are often difficult to discover and access. Internal agency GIS data have not been available to the community of practice across agency boundaries, creating agency-centric stovepipe GIS. Discovery and download of GIS data from multiple state, Federal and non-governmental

organizations for use in technical and analytical applications is critical to a collaborative approach to environmental protection and restoration. The process of finding and using needed external geospatial data for technical analyses can cause delays or complicate permit decisions for both SMCRA, CWA, and ESA agencies.

Increasingly, agencies that administer SMCRA and the CWA, and participate in consultations under the ESA are using on-line portals to Internet services that make their GIS data viewable by the public. The progress in Internet and computing technologies has made the discovery and access to these previously inaccessible data possible only recently. An Internet services-orientation for access, increasing bandwidth and the advent of Cloud computing are creating opportunities for organizations to be more open and transparent with geospatial data obtained through government regulatory activities. The transparent access and availability of data has become a priority for the Federal government in particular. Federal agencies have been challenged by the administration to make their data, consistent with law and policy, readily discoverable and accessible to the public.

Section 201 of SMCRA (30 U.S.C. 1211; "Creation of the Office") requires OSMRE to develop, maintain, and provide data to the public in support of its programs. Specifically, it requires "[t]he Secretary [of the Interior], acting through the Office," to: "develop and maintain an Information and data Center on Surface Coal Mining, Reclamation, and Surface Impacts of Underground Mining, which will make such data available to the public and the Federal, regional, State, and local agencies conducting or concerned with land use planning and agencies concerned with surface and underground mining and reclamation operations" [SMCRA, sec. 201 (c)(8)]. GeoMine will help OSMRE better meet this mandate. GeoMine implementation will also facilitate the DOI Interagency participant's compliance with Executive Order 13642 (Project Open Data) of May 9, 2013 "Making Open and Machine Readable the New Default for Government Information", by making coal-mining related geospatial "…. information resources easy to find, accessible, and usable…".

The confluence of services-oriented state and Federal GIS, and the new technological ability to integrate various GIS services and datasets have created an opportunity for SMCRA, CWA, and ESA agencies to collaborate through an Internet-based GIS portal concept. A portal is a shared geospatial platform or "one-stop shop" that can serve as a broker for needed geospatial information. The Pilot Project platform creates the ability for users to not only discover geospatial data from state and Federal agencies, but to download data needed for analysis by geographic area of interest and map layer. The Pilot Project created an Internet site that all partnering agencies could access for sharing pertinent geospatial data.

II. Collaborative – Based Planning Model

The collaborative-based project planning model adopted for the Pilot Project is similar to that used for the OSMRE-led Appalachian Regional Reforestation Initiative. In using this model, also referred to as a concentric management approach[1], OSMRE led the effort to engage partners from the potentially affected State and Federal agencies and to solicit their input into shaping the GeoMine project mission and vision; the intention was to develop a consensus around the strategic approach for the Pilot Project.

The initial impetus for the Pilot Project was the November 2009 meeting of Federal agency executives and staff to discuss implementation of an Interagency Action Plan (IAP) that resulted from a Federal interagency Memorandum of Understanding (MOU)[2]. One of the topics on which participants reached a consensus was the need for accurate and available data. A key action item discussed during the meeting was that the "…. agencies should explore the development of a common geo-referenced GIS database." The four Federal agencies continued a dialog through meetings and teleconferences to work out a cooperative approach to building an Appalachian coal mining GIS through the development of a GIS Pilot Project, including assigning agency representatives.

The Federal Interagency Appalachian coal mining GIS (GeoMine) Pilot Project participants met at EPA West, in Washington, DC, on April 14, 2010, to begin work in earnest. Discussion topics included:

- critical geospatial data themes,
- data inventory and needs,
- partnering strategies with respect to State regulatory authorities (RAs),
- potential GIS system considerations,
- possible funding scenarios, and
- geographic scope.

The tentative decision was made to limit the Pilot Project geographic scope to the States of Kentucky, Tennessee, Virginia, and West Virginia**.**

On August 3 and 4, 2010, the first Federal/State interagency meeting regarding the proposed GeoMine Pilot Project was held in Charleston, West Virginia, among 31 attendees representing IMCC, OSMRE, EPA, USACE, FWS, and the States of Kentucky, Virginia, and West Virginia. The purpose of this 2-day meeting was to develop a Federal/State consensus around the GeoMine Pilot Project concept. A consensus was achieved after very frank discussions. The agencies then discussed how best to proceed. Major decisions reached were:

- to form a GeoMine Pilot Project Team to guide the project;

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[1]See the "Collaborative-Based Program Planning Model: Office of Surface Mining Reclamation and Enforcement, Appalachian Regional Reforestation Initiative" section (beginning on page 4) of the DOI OIG "U.S. Department of the Interior Program Startup Evaluation."

[2]See the "Memorandum of Understanding among the U.S. Department of the Army, the U.S. Department of the Interior, and the U.S. Environmental Protection Agency Implementing the Interagency Action Plan on Appalachian Surface Coal Mining," June 11, 2009; commonly called the interagency action plan (or IAP).

- to draft definitions of the data and technology phases of the Pilot Project;
- project management and administrative support provided by OSMRE;
- functional workgroups were assigned responsibility for specific tasks (e.g., data and technology phases) of the Pilot Project
- OSMRE and the States compiled information regarding additional funding needs to start-up the Pilot Project; and
- EPA participation in the American Society for Testing and Materials (ASTM) coal mining data standards team.

The Pilot Project Team was thereby formed, consisting of members representing eight Federal and State organizations. These partners all shared the mission and vision of the Pilot Project. A variety of management and subject-matter experts in a range of disciplines were engaged in the project since its inception, and the project leads reached out to incorporate additional expertise as the project developed.

The challenging dynamic of fostering collaboration among Federal agencies and State agencies subject to oversight by their Federal counterparts made relationship-building at a personal level critical to the success of the Pilot Project. The important principle that each agency is the authoritative data source (ADS) for its data was a trust-building component. Also, the *quid pro quo* expectation that all participating parties seeking geospatial data would contribute their own data to the effort opened lines of communication between the participants and introduced an element of trust that had been lacking in previous Federal-State interactions.

The decision-making mechanism employed on the team was decision by consensus of the primary representatives. Participation in the Pilot Project was considered voluntary, and any party could withdraw at any time. Changes in the scope or goals of the project were expected, subject to team discussion. As the project was not intended to create a final GIS system with attendant operations and maintenance functions, there was no need for a formal change review board. Decisions that needed to be made at an executive level were communicated by the primary representatives upward through their appropriate management sponsor.

III. Project Scope

The scope of the GeoMine Pilot Project was limited to coal-mining geospatial and related data within the States of Virginia, West Virginia, Kentucky, and Tennessee. The project utilized digital map layers from a variety of Federal and State sources including SMCRA and CWA regulatory programs and national datasets such as the National Hydrography Dataset (NHD) and the National Wetlands Inventory (NWI). Additional geospatial records were identified and incorporated into the Pilot Project as additional resources and funding became available. For example, FY-2011 funds were awarded in the form of cooperative-agreement grants from OSMRE to the Pilot Project States to promote the creation of digital geospatial data from hardcopy media for Title IV (abandoned) and Title V (currently permitted) minesites.

IV. Participants and Roles

<u>GeoMine Pilot Project Interagency Team</u>

OSMRE members:

Bill Clark, OSMRE Geographic Information Officer* and Executive Sponsor
Robert Welsh, Western Region, Project Manager
Bill Winters, Knoxville Field Office - Tennessee SMCRA program
Dave Hartos, Appalachian Region
Greg Morlock, Western Region
Chris Benson, Western Region
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FWS members:

Christy Johnson-Hughes, Branch of Conservation Planning Assistance*
Jose Barrios, GeoFin Administrator**

EPA members:

Brian Topping, EPA Headquarters, Office of Wetlands, Oceans, and Watersheds*, **
Ross Geredien, Ross Geredien, ORISE Internship/Research Participation Program at EPA Headquarters, Office of Wetlands, Oceans, and Watersheds

USACE members:

William James, USACE, Great Lakes & Ohio River Division
Desiree Morningstar, USACE Headquarters*
Joel Schlagel, USACE Headquarters, Institute for Water Resources**

IMCC member:

Greg Conrad, IMCC*

Kentucky Division of Mine Reclamation and Enforcement members:

Daryl Hines*, **
Jeff Laird

Virginia Department of Mines, Minerals and Energy member:

Daniel Kestner*, **

West Virginia Department of Environmental Protection members:

Michael Shank*, **
Charles Sturey

* GeoMine Primary Representative, ** GeoMine Data Steward

Regulatory Agency Authority

Activities in association with coal mining and reclamation are subject to regulation under federal laws including the Surface Mining Control and Reclamation Act and the Clean Water Act. In general, one of the objectives of SMCRA is to ensure that the surface coal mine activity is conducted in an environmentally responsible manner and that the land disturbed by mining is adequately reclaimed. In contrast, review under the Clean Water Act is focused specifically on effects to waters of the United States and the Corps, EPA and the states have different roles and responsibilities to ensure that the physical, chemical, and biological integrity of the Nation's waters is restored and maintained. Details of the regulatory agencies' authority under these Acts are as follows:

- Administration of the SMCRA authority has been delegated by OSMRE to all states, except in Tennessee and Washington, where the authority is retained by OSMRE. Under this authority, OSMRE or the states have authority and responsibility to evaluate any disturbance of the hydrologic balance within the permit and adjacent areas, and must determine whether material damage to the hydrologic balance would occur outside the permit area. Under SMCRA, evaluation includes pre- and post-mining land uses, backfilling and grading activities, disposal of excess spoil, and the protection or replacement of water supplies.

- Administration of the Clean Water Act Section 404 permitting program in Appalachia is carried out by the U.S. Army Corps of Engineers. Under Section 404, the Corps regulates the discharge of dredged or fill material into waters of the United States, including wetlands. The focus of the CWA is on the protection of physical, chemical and biological integrity of waters of the United States and the Corps evaluation focuses on identifying the least environmentally damaging practicable alternative, ensuring it does not violate specific standards and evaluating whether it would result in significant degradation of the waters of the US. With respect to addressing the required mitigation sequence, it must first be demonstrated that impacts to waters of the United States have been avoided to the maximum extent practicable and then minimized, and finally compensatory mitigation may be used to offset impacts that cannot be avoided or minimized. When evaluating proposals, a variety of factors are considered to the extent appropriate based on project-specific circumstances, including effects to substrate; suspended particulates/turbidity; water circulation; normal water fluctuations; threatened and endangered species; fish, crustaceans, mollusks, and other aquatic organisms in the food web; other wildlife; wetlands; riffle and pool complexes; municipal and private water supplies; recreational and commercial fisheries; water-related recreation; and aesthetics.

- Clean Water Act Section 404 also encourages the minimization of delays in the permit process through formal interagency review and coordination on proposed projects under 404(q). Additionally, Section 404(c) authorizes EPA to restrict, prohibit, deny, or withdraw the use of an area as a disposal site for dredged or fill material if the discharge will have unacceptable adverse effects on municipal water supplies, shellfish beds and fishery areas, wildlife, or recreational areas.

- Administration of Section 401 of the Clean Water Act is carried out by the States in Appalachia. Any applicant for a Federal license or permit to conduct any activity

including, but not limited to, the construction or operation of facilities, which may result in any discharge into the navigable waters, shall provide the licensing or permitting agency a certification from the State in which the discharge originates. The certification indicates that the state has determined the proposed discharge will not violate state water quality standards or other appropriate requirements of state law. No license or permit shall be granted until the certification required by this section has been obtained or has been waived as provided in the preceding sentence. No license or permit shall be granted if certification has been denied by the State, interstate agency, or the Administrator, as the case may be.

- Administration of Section 402 of the Clean Water Act has been delegated to the Appalachian states by U.S. EPA, and under this authority, the states are responsible for administering the permit program, which authorizes point source discharges of pollutants to surface waters of the United States. The Clean Water Act requires that those permits include appropriate treatment technology based limits as well as any additional limits needed to protect water quality.

- Under Section 402 the EPA retains the authority to oversee state-run programs. All permits for primary industries, which include coal mines, are required to be submitted to the Agency for review. In its oversight role, the EPA reviews certain permits and can object when their conditions are not consistent with the requirements of the Clean Water Act. When the EPA objects to a permit the state must makes the required changes. If the issues on which the objection is based are not resolved within the timeframes under the regulations, the authority to issue the permit moves to the EPA.

Because statutory roles and responsibilities of different state and federal agencies differ, the data made available in GeoMine will be utilized in different ways to inform each agency's respective decision-making. Further, other data from other sources may be used to inform substantive decisions made by each agency. In addition to the substantive statutory requirements of SMCRA and the CWA, federal agencies also have a requirement to comply with the National Environmental Policy Act (NEPA). Under NEPA, federal agencies are required to evaluate cumulative effects of an action when added to other actions in the relevant study area, regardless of what agency or person undertakes those actions. GeoMine only provides data for coal mine sites, and the responsibility for federal agencies to evaluate cumulative effects under NEPA is broader. Therefore, when disclosing cumulative effects, other data and tools will be used by Federal agencies to the extent available and appropriate, while also taking into consideration information regarding other land use impacts, like roads and development, on the resources being evaluated.

V. Primary Objectives

The Federal team representatives from OSMRE, FWS, EPA, and USACE worked closely with State regulatory authority (RA) team members regulating SMCRA, CWA, and other applicable statutes to:

1) Create a GeoMine Pilot Project collaborative model for discovering, collecting, harmonizing, managing, and serving map layers pertinent to SMCRA and Clean Water Act (CWA) regulation of coal mining and reclamation activities located in the States of Virginia, West Virginia, Kentucky, and Tennessee;
2) Recognize the agencies as ADSs for data under their control and establish data stewards.
3) Develop a shared, Cloud-based GIS platform for Appalachian coal mining geospatial layers available to the Federal interagency MOU participants (OSMRE, EPA, USACE, and FWS) and the State RAs users.
4) Provide a GeoMine internet application with simple tools to allow search and download capabilities; and
5) Provide resources through OSMRE-sponsored Federal Cooperative Agreement grants for SMCRA RAs to convert data to digital GIS data and create services sharable through the GeoMine platform.

If GeoMine is implemented as an OSMRE function, public access to the map layers through www.data.gov or other government-hosted websites will be explored in keeping with the guidance provided through President Obama's January 21, 2009, memorandum for the heads of executive departments and agencies regarding "Transparency and Open Government." With this in mind, the geospatial data exchanges will be designed to enable future expansion of reporting and analytical services for clients at all levels.

VI. Methodology (Phased-Approach)

The GeoMine Pilot Project participants agreed with the approach proposed by the IMCC and partner States to proceed in two concurrent phases; a data phase to discover and provide geospatial layers, and a technology phase to advance the data sharing platform design and implementation.

Even though the Pilot Project timeframe was initially planned for two years, key data were sourced and provided by data stewards within the first year. Tomlinson (2007) defines information products (this report uses the term "geospatial layers") as desired outputs from a GIS that are wanted or needed by the business user. GeoMine Pilot Project geospatial layers are those digital geospatial data themes that pertain to SMCRA and CWA permitting activities and ESA decisions, and include currently permitted and abandoned minesites and related hydrologic and environmental data.

To help complete tasks identified during the data and technology phases of the Pilot Project, members of the GeoMine team participated, on the basis of their individual expertise, in one or both of two workgroups, called informally the "data-phase workgroup" and the "technology-phase workgroup."

VII. Data-Phase Approach and Map Layers

The data phase of the project started with the drafting of a project plan (link here) by the cooperating agencies (OSMRE, including the OSMRE Federal program in Tennessee administered by the Knoxville, TN Field Office, FWS, USACE, EPA, Kentucky, Virginia, and West Virginia) to clearly articulate the purpose, goals, objectives, and methodology for the Pilot Project. Each agency data steward investigated and evaluated existing geospatial layers for potential use by the Pilot Project. Informal geospatial layer sharing agreements and policies were developed through collaboration with data stewards on an as-needed basis.

During the data phase of the Pilot Project, key foundational tasks were accomplished, including:

- assignment of data stewards for each participating organization;
- investigation of a wide range of potential candidate geospatial layers for each agency (Appendix A);
- prioritizing available geospatial layers and services that could be readily provided to the shared platform;
- aligning geospatial layers through use of data standards; and
- creating hydrologic geospatial layers and services that were usable by typical GIS software/tools and analytical software.

ASTM Standards and Pilot Project Schema Development

Standardizing the way coal-mining geospatial data is expressed enables Federal, state and Tribal agencies to share data more efficiently and accurately. These data standards will allow for better cooperation between the different enforcement agencies involved in regulating coal mining and reclamation. If there is a coalfield that crosses over state boundaries, for example, the adjacent states can better collaborate to reduce environmental impacts within and without the coalfield boundaries since both parties are working with compatible data.

A common schema for SMCRA-program geospatial layers has been developed by the SMCRA GeoMine agencies, using draft ASTM standards developed by the OSMRE-sponsored Coal Mining Spatial Data Standards ASTM Task Group (Appendix B). The purpose of these voluntary standards is to facilitate the exchange of surface and underground coal mine geospatial data within the coal mining and reclamation community in a standardized format. The standards were developed using the procedures developed by the American Society of Testing Materials (ASTM) International, an organization that develops and provides voluntary consensus standards covering a wide range of technical applications.

A draft of the ASTM standard that resulted from the Task Group efforts, "Standard Practice for Geospatial Data for Representing Coal Mining Features[3]", was used as a basis to construct the geodatabase schema for each of the Pilot Project map layers. This schema is provisional for the pilot project, and was not modified for the duration of the project to correspond with new revisions made to the ASTM standards. The schema for individual map layers was slightly modified for the project and used to align the attributes from the SMCRA-derived geospatial

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[3] See Standard Practice for Geospatial Data for Representing Coal Mining Features; Designation: D7780 – 12; ASTM International, Feb, 2012.

data for visualization and delivery in GeoMine. If GeoMine becomes an operational system, the provisional schema will be updated to correspond to the latest ASTM D7780 – 12 standards. Appendix B provides more detail on the creation of the geodatabase schema and associated coded value domains.

GeoMine Geospatial Map Layers

The current layer list is derived from a much larger list of 77 geospatial data layer needs identified by the GeoMine partners during initial formative meetings (see Appendix A). The online web application currently hosts 25 layers and 2 tools (widgets) representing 665,000 features. Data is derived from each of the pilot project States, the four Federal pilot project partners, and publically available data from the USGS. Seven geospatial layers were created for the pilot project States as determined by the results of the ASTM workgroup's efforts to identify the most important information necessary to "define the accurate location and description of geospatial data for coal mining operations"[5]. Within GeoMine, these layers are referred to as 'SMCRA' map layers to indicate that they pertain directly to the administration of SMCRA regulations. Additional SMCRA and other non-ADS agency State data layers are currently in development, and may be considered for inclusion in GeoMine in the future (see Appendix C). Additional SMCRA layers that were considered for GeoMine and included in early versions of the GeoMine Viewer, but later determined to be non-viable by the interagency team due to data and/or organizational limitations are described in Appendix D. The Federal partners have contributed 11 layers and one combined widget, including 3 from OSMRE, 2 from FWS, 4 from ACE, 2 layers and a widget from EPA, and while not a partner in GeoMine, the USGS provided 3 layers which are publically available static data, and contributed to a widget.

GeoMine attributes are the non-spatial data associated with a coal-mining location (e.g., Permit ID #, Company Name, MSHA #, etc.). This attribute data is visible and downloadable through the GeoMine Viewer. The levels of attribution for each map layer have been determined and tracked on a quarterly basis since August, 2011. The latest quarterly attribution results and discussion of the benefits and limits of this metric are presented in Appendix F.

Following this section are brief descriptions of each geospatial layer, including the purpose of the layer, what type of data is presented (points, lines polygons, raster data, etc.), who created it, what kind of service is provided to GeoMine, and what the layer represents. The layer title indicates the spatial extent of the layer by listing state abbreviations or if national in extent (which is most of the Federal layers); the term 'national dataset' is used. Additional information is provided, where available, that covers specific issues or missing data so users are aware of data capabilities and limitations. In certain cases, States have provided their own detailed descriptions or definitions of each data set, and these are listed in Appendix F.

A. SMCRA Map Layers

The following seven layers and one widget represent data provided, vetted, and approved by each Pilot Project State ADS. State data sources, services, and refresh publication dates are common to the first seven layers. They are:
source: State or OSMRE (TN) Authoritative Data Source;
service: KY-shapefile, TN-geodatabase, VA-replicated web service, WV-live web service;
refresh publication date: KY-ad hoc, TN-ad hoc, VA-Saturdays, WV-daily update M-F.

Coal mine permit or operation boundaries are polygons of various operational or bond status. Note that while most of the polygons in the currently permitted, released, and legacy pre-SMCRA surface coal mine boundary layers are permit boundaries, a few represent pre-SMCRA non-permitted mines.

1. Currently Permitted Surface Coal Mine Permit Boundaries KY-TN-VA-WV

Purpose: To display SMCRA permitted surface coal mining areas that may be actively mining coal, Inactive (under temporary cessation), permitted but abandoned (30 CFR 840.11 (g)(1-2) sites), interim (initial) program sites, or in various stages of reclamation.

Data type: polygon;
Description: This layer represents those permit boundary polygons in KY, TN, VA, and WV with an 'active', inactive, or interim (initial) program coal mine operation status. Queryable attributes include Permittee, Mine Name, Permit ID, National Permit ID, Post-SMCRA mining (Y/N), calculated and reported area, the state edit date, and the authoritative data source (ADS) contact. Permit mining types represented include area mining, contour mining, mountaintop mining, steep slope mining, auger mining, underground mining with a surface face, refuse disposal sites, load outs, preparation plants, and haul roads. Note that there may be: 1) many records/polygons for a single permit ID due for example to multiple surface features associated with a single underground operation, or 2) multiple permit polygons for a single operation due to transfers of ownership. The currently permitted surface coal mine permit boundaries layer is meant to be synonymous with ASTM coal mining and reclamation standard D7780-12 - Coal Mine Operations.

2. Released Surface Coal Mine Permit Boundaries KY-TN-WV

Purpose: To show the location of surface coal mining permits in which the permittee has met all SMCRA reclamation requirements and the performance bond has been released or the regulatory authority has made a decision to revoke the permit.
Data type: polygon;
Description: This layer represents those surface coal mine permit boundaries in which the coal mine operations status (coalmine_ops_status) attribute is listed as 'Released'.

3. Legacy pre-SMCRA Coal Mining Operation Boundaries KY-TN-VA-WV

Purpose: To display all surface coal mine operation boundaries that are from pre-SMCRA State regulatory programs.
Data: type: polygon;
Description: This layer was constructed by querying Surface Coal Mine Permit Boundaries for coal mine operations status equal to Not Applicable (pre-SMCRA boundaries) and

Unknown. Many of the records in this layer may have very limited attribution due to the age of the data.

4. Coal Refuse Disposal Sites KY-TN-WV
Purpose: To display the location of proposed, in-process, and completed coal refuse impoundments and coal refuse placement sites.
Data type: polygon;
Description: This layer includes all proposed coal refuse sites; those in some phase of construction, and completed coal refuse impoundments and placement sites. The distinction between impounding and non-impounding refuse placement sites is an attribute within the layer. Note that this layer does NOT necessarily represent disturbance on the land; some of these polygons represent proposals to build disposal sites only. The 'feature placement status' attribute distinguishes proposed sites from in-process or completed sites. Note that this attribute has not yet been fully populated. Some coal refuse sites in KY and WV may be pre-SMCRA abandoned mine land refuse.

5. Environmental Resource Monitoring Locations KY-TN-VA-WV
Purpose: To display environmental monitoring locations in the coal mining areas of KY, TN, VA and WV.
Data type: points;
Description: This point dataset depicts environmental monitoring location sites and can include geologic, groundwater, National Pollutant Discharge Elimination System (NPDES), rain gauge, subsidence, surface water, topsoil sampling, topsoil substitute, trend station, and other monitoring sites. Kentucky provides groundwater, surface water, and NPDES monitoring sites. Tennessee has contributed geologic, surface water, groundwater, and trend station data. Virginia has ground water, surface water, NPDES, geologic, and rain gauge monitoring locations associated with coal mining operations. West Virginia's monitoring locations consist of NPDES, surface water, and trend station sites.

6. Bond Status KY-TN-VA
Purpose: To display the reclamation bond status within surface coal mining permits.
Data type: polygons;
Description: This polygon layer shows the bond status in two formats; for specific portions of a single surface coal mine permit area (detailed) in TN and VA, and bond status for the entire permit area (general) in KY and WV. For the former, a single surface coal mining permit area may contain several bond status polygons in different stages of bond release. For the latter, the status reflects the minimum phase of bond release present over the entire permit area. In other words, the status may not advance from phase I to phase II until all acres under phase I have been released throughout the permit.
Bond Status levels include:
Phase I Release - completion of backfill/grading, and drainage control.
Phase II Release - establishment of vegetation on the graded mined lands.
Phase III Release - completion of all reclamation and hydrologic requirements fully met.
Forfeited - Default of the performance bond resulting in revocation of the permit.
Bonded - Fully bonded by the permittee to conduct surface coal mining and reclamation.
Not Bonded - Approved for surface coal mining and reclamation. Performance bond not yet submitted.

Termination of Jurisdiction - RA has released jurisdiction as defined under 30 CFR 700.11(d)(1)(i and ii).

7. Coal Preparation Plants – KY-TN-WV
Purpose: To show the location of coal preparation facilities, which clean, sort, resize and blend coal.
Data type: point;
Description: This layer shows point locations for coal preparation plants. These facilities produce coal refuse as a byproduct. Note that this layer does not include load outs, tipples, or other coal transport-related facilities. Significant attributes for this layer are coarse_refuse and fine_refuse, which simply indicates whether coarse or fine refuse byproducts are present or absent. Position of the point locations falls into two categories; actual plant location (detailed) in KY, and a point representing the centroid of the permit polygon (calculated in GeoMine) that indicates the presence of a plant somewhere within the permit (general) in TN and WV.

W1. HydrologicTrend Stations Widget - WV
Purpose: Visualization of long-term water quality parameters in mining regions.
Data type: widget with point data sources;
source: WVDEP;
service: tightly integrated web service, AMF format;
refresh publication date: real-time database query, quarterly sampling interval.
Description: Rather than a data layer, this is a tool that provides users with time series graphics for a whole host of chemical and physical measurements taken at fixed locations over time within State water courses. The widget can be accessed from the toolbar at the top of the GeoMine Viewer as a yellow highlighted water droplet icon. Note that sample detection limits for different samples may not be the same; users are cautioned to examine units of measure before comparing sample results for a given analyte. West Virginia is currently the only State providing a trend station widget. KY and TN are both collecting trend station data, and a draft of TN trend station data has been appended to the developmental layers group until a data standards architecture can be developed as a foundation for the construction of all future trend station widgets.

B. <u>Federal Map layers</u>

***U.S. Office of Surface Mining Reclamation and Enforcement* eAMLIS – National Dataset**
Purpose: To provide a national map of abandoned mine land problem areas, as well as cumulative documentation of locations where mine reclamation activities have been completed. Another feature is to provide users with a map of the highest reclamation priority level of the various problem types at each problem area site in order to assess the relative level of reclamation urgency for public health and safety and environmental protection.
Data type: points;
source: OSMRE;
service: replicated database;
refresh publication date: ad hoc updates.
Description: The Abandoned Mine Land Inventory System (eAMLIS) is a computer system used to store, manage, and report on OSMRE's Inventory of Abandoned Mine Land Problems. This includes both problems in need of reclamation and a cumulative listing of those that have been reclaimed.

In general, abandoned mine lands are lands and waters adversely impacted by inadequately reclaimed surface coal mining operations on lands that were not subject to the reclamation requirements of the Surface Mining Law. Environmental problems associated with abandoned mine lands include surface and ground water pollution, entrances to open mines, water-filled pits, unreclaimed or inadequately reclaimed refuse piles and mine sites (including some with dangerous highwalls), sediment-clogged streams, damage from landslides, and fumes and surface instability resulting from mine fires and burning coal refuse. Environmental restoration activities under the abandoned mine reclamation program correct or mitigate these problems. Two layers are provided:

1. Abandoned Mine Reclamation Project Status. This layer displays abandoned mine land reclamation problem areas, and is color coded to differentiate problem areas in which all reclamation projects have been completed from those with outstanding inventoried reclamation problems.
2. Abandoned Mine Reclamation Priority Level. This layer shows the highest reclamation priority level among all of the inventoried problem types present at a given problem area. So for example, if a problem area has clogged streams, industrial/residential waste, and dangerous highwalls, the safety factor for the dangerous highwalls is the highest (1), and this priority is assigned to the entire problem area. Note that current legislation only permits reclamation of problems with priorities 1, 2, or 3. See Appendix F for detailed priority level definitions and caveats.

Part of the cooperative grant funding provided to pilot project states by OSMRE has resulted in scanning, digitizing, georeferencing, and attributing of thousands of hard-copy AML problem areas. Future goals include the digitization by the States of legacy hard-copy problem area reports, and development of points, lines, and polygons corresponding to individual problem types, such as highwalls, seeps, etc. These will be incorporated into a new AML planning unit/problem area/problem types layer, currently in development.

3. National Mine Map Repository – National Dataset
Purpose: To show the location of scanned historic mine maps stored in the National Mine Map Repository.
Data type: points;
source: OSMRE;
service: static download;
refresh publication date: ad hoc updates.
Description: The National Mine Map repository collects and maintains mine map information and images for coal, metal, and non-metal mining for the entire country. The repository contains maps from the 1860s to the present day. It serves as a point of reference for mine maps and other information for both surface and underground mines. Many of the maps in the repository are currently available in digital format and the repository is in the process of scanning all the maps in the continually-growing collection; they are not available via this service at this time. This geospatial dataset shows the location of each of the maps stored in the repository. Attributes for each point display such things as the year the map was created, whether the map has been scanned into an image, commodity, type of mine (surface or underground), and detailed location information.

U.S. Fish and Wildlife Service

4. Wetlands – National Dataset

Purpose: To provide the citizens of the United States and its Trust Territories with current geospatially referenced information on the status, extent, characteristics and functions of wetlands, riparian, deep-water and related aquatic habitats in priority areas to promote the understanding and conservation of these resources.

Data type: polygons;

source: U.S. FWS;

service: web map service;

refresh publication date: updated in continuous increments.

Description: This data set represents the extent, approximate location and type of wetlands and deep-water habitats in the conterminous United States. These data delineate the areal extent of wetlands and surface waters[4]. To access a fact sheet describing this layer, go to: http://www.fws.gov/wetlands/Documents/National-Spatial-Data-Infrastructure-Wetlands-Layer-Fact-Sheet.pdf. Metadata is located at: http://www.fws.gov/wetlands/Data/metadata/conus_wet_poly.htm. Remember that if this layer is grayed out in the layer list, you will need to zoom in to a more local area to activate it.

5. Critical Habitats - National Dataset

Purpose: To display the locations of designated critical habitats.

Data type: lines and polygons;

source: U.S. FWS;

service: shapefile;

refresh publication date: automatic download weekly.

Description: Designated critical habitats are specific geographic areas that contain features essential for the conservation of a threatened or endangered species and that may require special management and protection. Federal agencies are required to consult with the U.S. Fish and Wildlife Service on actions they carry out, fund, or authorize to ensure that their actions will not destroy or adversely modify critical habitat. In this way, a critical habitat designation protects areas that are necessary for the conservation of the species. Remember that if this layer is grayed out in the layer list, you will need to zoom in to a more local area to activate it.

U.S. Environmental Protection Agency

6. 303(d) Listed Impaired Waters National Hydrologic Dataset (NHD) Indexed Dataset – National Dataset

Purpose: To provide a method within GeoMine to review watershed impairments in the context of coal mine permitting and reclamation activities.

Data: type: point, line, and polygon;

source: EPA;

service: imported from EPA;

refresh publication date: static layer updated by EPA semi-annually.

Description: Under Section 303(d) of the CWA, states, territories, and authorized tribes are required to develop lists of impaired waters. These are waters that are too polluted or

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[4] Cowardin et al. 1979. Classification of Wetlands and Deepwater Habitats of the United States. Diane Publishing Co. 103p.

otherwise degraded to meet the state water quality standards. This dataset contains geospatial information for 303(d) listed waters approved by EPA, which is indexed to the 1:100,000 National Hydrography Dataset (NHD).

Note that this layer does not represent: 1) waters that are impaired and have an EPA-approved Total Maximum Daily Load (TMDL) established (some waters with TMDLs are still included if additional impairments on the same water do not yet have a TMDL),, 2) impaired waters for which other pollution control mechanisms are in place and expected to attain water quality standards, or 3) waters with impairments such as flow alteration that are not caused by a pollutant.

The Clean Water Act requires all states to submit for EPA approval an impaired water list on April 1 every two years (even-numbered years) and the list submission year is the cycle year, however the submittal of GIS layers typically lags behind the formal impaired waters list. The state data in the national or state downloads are not all from the same reporting year nationally. Generally, what is available for each state represents their most recent GIS submittal. In 2002, EPA established a national baseline for impaired waters; some states have not updated their lists since that time. The attribute called "Cycle_Year" represents the year that the data was collected. A State by State list of the data availability can be obtained by going to http://epamap32.epa.gov/radims/ and selecting data availability under Water Program Features, then selecting "Available 303(d) Impaired Waters."

This spatial data has been joined with EPA's Assessment and TMDL Tracking and Implementation System (ATTAINS) to display more detailed attribute information about the pollutant type, name, and cause. In addition, simply click on the 'Details Link' attribute hyperlink which is found using the ID tool for a particular feature to view ATTAINS data directly. After following the details link look to the lower left hand side of the map to see what other years also have data, some of which may be newer. For more information see http://www.epa.gov/waters/data/downloads.html section on 303(d) Listed Impaired Waters NHD Indexed Dataset.

7. 303(d) Listed Impaired Waters with TMDLs NHD Indexed Dataset – National Dataset
Purpose: To provide a method within GeoMine to review impairments and recovery plans within watersheds in the context of coal mine permitting and reclamation activities.
Data: type: point, line, and polygon;
source: EPA;
service: imported from EPA;
refresh publication date: static layer updated by EPA semi-annually.
Description: This dataset contains geospatial information for 303(d) listed impaired waters for which a Total Maximum Daily Load (TMDL) has been developed. Where the geospatial information for the 303(d) listed waters with a TMDL is available it has been indexed to the 1:100,000 National Hydrography Dataset (NHD).

Note that this layer represents waters that are impaired but have an EPA-approved Total Maximum Daily Load (TMDL) established. It is possible to have overlapping 303(d) features and TMDL features for the same water body, since TMDLs are established for each pollutant and other pollutants may exist without corresponding TMDLs on a single water body. Generally, what is available for each state represents their most recent GIS submittal. The

attribute called “Cycle_Year” represents the most recent year’s status that is geo-referenced in ATTAINS.

The Clean Water Act requires all states to submit for EPA approval an impaired water list on April 1 every two years (even-numbered years) and the list submission year is the cycle year, however the submittal of GIS layers typically lags behind the formal impaired waters list. The state data in the national or state downloads are not all from the same reporting year nationally. Generally, what is available for each state represents their most recent GIS submittal. In 2002, EPA established a national baseline for impaired waters; some states have not updated their lists since that time. The attribute called “Cycle_Year” represents the year that the data was collected.

Simply click on the ‘featuredetailurl’ attribute hyperlink which is found using the ID tool for a particular feature. After following the feature details link look to the lower left hand side of the map to see what other years also have data, which may be newer. For more information see http://www.epa.gov/waters/data/downloads.html section on Impaired Waters with TMDLs NHD Indexed Dataset.

This spatial data has been joined with EPA's Assessment and TMDL Tracking and Implementation System (ATTAINS) to display more detailed attribute information about the cause(s) of impairment and the TMDL(s) that apply to the water body. In addition, simply click on the ‘featuredetailurl’ attribute hyperlink which is found using the ID tool for a particular feature to view ATTAINS data directly. After following the details link look to the lower left hand side of the map to see what other years also have data, some of which may be newer. For more information see http://www.epa.gov/waters/data/downloads.html section on Impaired Waters with TMDLs NHD Indexed Dataset.

W1a. STORET Water Monitoring Widget – National
Purpose: To allow GeoMine users to access national water quality information in the context of coal mine permitting and reclamation activities.
Data: type: water monitoring sample tool with data download capability;
source: EPA;
service: live web service;
refresh publication date: weekly.
Description: The STORET and NWIS widgets have been combined into a single widget located on the GeoMine Viewer toolbar at the top of the screen as a blue highlighted water droplet.

The STORET Data Warehouse is EPA's repository of the water quality monitoring data collected by water resource management groups across the country. These organizations include states, tribes, watershed groups, other federal agencies, volunteer groups and universities that submit data to the STORET Warehouse in order to make their data publically accessible.

In order to provide direct access to STORET and NWIS data through GeoMine, EPA created a widget for the Pilot Project that accesses an EPA portal serving out STORET and NWIS water quality data. The widget was first released to the GeoMine Viewer in August, 2011. The USGS National Water Information System (NWIS) stations were added to GeoMine and

became accessible through the same widget in February, 2012. The sample locations are selectable by point location, and HUC8 and HUC12 watershed boundaries.

Rather than a layer, this is a tool or "widget" developed specifically for GeoMine that produces downloadable analytical results for water monitoring sites nationwide. When the widget is activated by clicking on the blue water droplet icon on the main GeoMine tool bar, the user will see a series of magenta polygons drawn on the map representing a hierarchical set of watershed boundaries known as HUC boundaries. In order to see the STORET monitoring points, zoom in until blue water droplets appear on the map. Click on a point to see basic information about it and to bring up the download data tools. Monitoring data can also be downloaded by HUC. Monitoring information for all locations within a HUC 8 or HUC 12 can be obtained by selecting the "8" or "12" from "Water Monitoring Stations" widget toolbar. This will show the corresponding HUC 8 or 12s on the map. Click on one of the HUCs to select it and bring up the download tools in the widget. By selecting the download data for 'All Analytes', users can download an Excel spreadsheet file that will provide water quality data such as the concentration of iron, sulfur, or phosphate for a selected monitoring site. Users can also download a Google Earth mapping service kml file to automatically view the point location on a high resolution 2D or 3D image.

***U.S. Army Corps of Engineers* Nationwide Permit Locations KY-TN-VA-WV**
Purpose: To allow GeoMine users to access available information on discharges of dredged or fill material in waters of the United States in association with coal mine and reclamation activities within the States of KY, TN, VA, and WV.
Data type: point;
source: USACE;
service: static download;
refresh publication date: ad hoc updates.
Description: A project location may be entered as county, state, latitude/longitude, or address, and points represent nationwide permit numbers 21, 49, and 50. NWP 21 verifies activities in waters of the United States in association with surface coal mining and reclamation activities, NWP 49 verifies activities in waters of the United States in association with coal remining activities, and NWP 50 verifies activities in waters of the United States in association with underground coal mining and reclamation operations. NWP 21 authorizes discharges of dredged or fill material into waters of the United States associated with surface coal mining and reclamation operations provided the activities are already authorized, or are currently being processed as part of an integrated permit processing procedure, by OSMRE, or by states with approved programs under Title V of the Surface Mining Control and Reclamation Act of 1977. NWP 21 was suspended in Appalachia by USACE on June 18, 2010, and new permits after that date required authorization under Section 404 of the Clean Water Act using the individual permit process. In the reissued NWP 21 (effective date March 19, 2012), valley fills are prohibited and there are new threshold limits on stream impacts. For a detailed description of layer caveats, please see Appendix F. This layer includes four sub-layers:
8. NWP 21, 49, and 50 Permits. Provides information, where available, regarding the location of NWP 21, 49, and 50 permits.
9. NWP 21, 49, and 50 Impacts. Provides information, where available, regarding **i**mpacts to waters of the U.S. that have been permitted to be impacted by a discharge of dredged and/or fill material.

10. NWP 21, 49, and 50 Jurisdictional Determinations. Provides information, where available, regarding waters of the United States on a parcel. A jurisdictional determination is a Corps determination related to the presence or absence of waters of the United States on a parcel. An approved jurisdictional determination means: "… a Corps document stating the presence or absence of waters of the U.S. on a parcel or a written statement and map identifying the limits of waters of the U.S. on a parcel." Preliminary jurisdictional determinations are "… written indications that there may be waters of the U.S. on a parcel or indications of the approximate location(s) of waters of the U.S. on a parcel."
11. NWP 21, 49, and 50 Mitigation Projects. Provides information, where available, regarding area or linear value of compensatory mitigation. Compensatory mitigation may be permittee-responsible on or off-site, or may be third party compensation through the purchase of credits from a mitigation bank or in-lieu fee program. The purpose of compensatory mitigation is to offset unavoidable adverse impacts which remain after all appropriate and practicable avoidance and minimization has been achieved. Types of compensatory mitigation projects include the restoration, enhancement, preservation or creation of aquatic resources, including streams and wetlands.

U.S. Geological Survey
12. Coal Fields of the United States – National Dataset
Purpose: To display national level geologic coal provinces and coal ranking within each province.
Data type: polygon;
source: USGS;
service: downloadable shapefile;
refresh publication date: August, 2001.
Description: This National Atlas map layer was compiled by the USGS Eastern Energy Resources Science Center (EERSC). It shows the coal fields of Alaska and the conterminous United States. Most of the material for the conterminous United States was collected from James Trumbull's "Coal Fields of the United States, Conterminous United States" map (sheet 1, 1960). The Gulf Coast region was updated using generalized, coal-bearing geology obtained from State geologic maps. The Alaska coal fields were collected from Farrell Barnes's "Coal Fields of the United States, Alaska" map (sheet 2, 1961). These data are intended for geographic display and analysis at the National level, and for large regional areas. Attribution includes the coal province, a ranking system for each coal province based on the maximum quality of potential coal production, and a description of the maximum rank, denoting potential minability and other potential uses in the province.

13. National Hydrography Dataset (NHD) – Hydrography – National Dataset
Purpose: To display hydrographic data such as streams, lakes, canals, ditches, and springs, as well as water flow directions for the United States.
Data type: point, lines, polygons;
source: USGS National Map;
service: Live web service;
refresh publication date: ad hoc (?).
Description: The USGS National Hydrography Dataset (NHD) service from The National Map is a comprehensive set of digital spatial data that encodes information about naturally occurring and constructed bodies of surface water (lakes, ponds, and reservoirs), paths through which water flows (canals, ditches, streams, and rivers), and related entities such as

point features (springs, wells, stream gages, and dams). The information encoded about these features includes classification and other characteristics, delineation, geographic name, position and related measures, a "reach code" through which other information can be related to the NHD, and the direction of water flow. The network of reach codes delineating water and transported material flow allows users to trace movement in upstream and downstream directions. In addition to this geographic information, the dataset contains metadata that supports the exchange of future updates and improvements to the data. The NHD is available nationwide in two seamless datasets, one based on 1:24,000-scale maps and referred to as high resolution NHD, and the other based on 1:100,000-scale maps and referred to as medium resolution NHD. Additional selected areas in the United States are available based on larger scales, such as 1:5,000-scale or greater, and referred to as local resolution NHD. The NHD from The National Map supports many applications, such as making maps, geocoding observations, flow modeling, data maintenance, and stewardship. For additional information, go to http://nhd.usgs.gov/index.html.

14. National Hydrography Dataset (NHD) – HUC Watershed Boundaries – National Dataset

Purpose: To display nation-wide hierarchical hydrologic unit (HUC) watershed boundaries.
Data type: nested polygons;
source: USGS National Map;
service: Live web service;
refresh publication date: ad hoc.
Description: This file contains Hydrologic Unit boundaries and codes for the United States. The data is a seamless National representation of Hydrologic Unit Code (HUC) boundaries at HUC2 to HUC12 levels compiled from U.S. Geological Survey (USGS) National Hydrography Dataset (NHD) and U.S. Department of Agricultural (USDA) National Resources Conservation Services (NRCS) Watershed Boundary Dataset (WBD) sources. This data is intended primarily for geographic display and analysis of regional and national data, and can also be used for illustration purposes at intermediate or small scales (1:250,000 to 1:2,000,000). For more information go to http://nhd.usgs.gov/index.html.

W1b. National Water Information System (NWIS) Water Monitoring Site Widget - National

Purpose: To allow GeoMine users to access national water quality information in the context of coal mine permitting and reclamation activities.
Data type: water monitoring tool with data download capability;
source: USGS;
service: Live web service;
refresh publication date: unknown.
Description: Rather than a layer, this is a tool or “widget” working in concert with the EPA STORET widget, and produces downloadable analytical results for water monitoring sites nationwide. When the widget is activated by clicking on the blue water droplet icon on the main GeoMine tool bar, the user will see a series of purple polygons drawn on the map representing a hierarchical set of watershed boundaries known as HUC boundaries. In order to see the NWIS monitoring points, zoom in until black water droplets appear on the map. Click on a point to see basic information about it and to download data. By selecting the download data for ‘All Analytes’, users can download an Excel spreadsheet file that will provide water quality data such as the concentration of iron, sulfur, or phosphate for a selected

monitoring site. Users can also download a kml file to automatically view the point location on a high resolution 2D or 3D image.

The USGS collects and analyzes chemical, physical, and biological properties of water, sediment and tissue samples from across the Nation. The Water Data for the Nation discrete sample data base is a compilation of over 4.4 million historical water quality analyses in the USGS district data bases through September 2005. The discrete sample data is a large and complex set of data that has been collected by a variety of projects ranging from national programs to studies in small watersheds. Users should review the help notes and particularly the data retrieval precautions before beginning any retrieval or analysis of data from this data set. Additions of more current data, modifications to ancillary information, and enhanced retrieval options to help users find and appropriately use the data they need are planned for a future release of Water Data for the Nation.

VIII. Map Layer Metadata

Pilot Project Metadata Creation and Standards

The technology phase workgroup has tried to create the most comprehensive metadata possible. The workgroup included metadata for feature datasets, feature classes, and all of our web service types. Using the ISO metadata standards, the team has been unsuccessful in developing metadata for individual attributes. However, schema attributes are documented in Appendix C and a full explanation of the attribute values are to be found in “ASTM D7780-12, Standard Practice for Geospatial Data for Representing Coal Mining Features. If GeoMine is extended beyond a pilot project, the metadata will be published to Data.gov, the government-wide metadata service. For more details on metadata creation, and the editors and standards that were investigated, see Appendix G.

IX. Technology-Phase Approach

The technology phase workgroup investigated the efficacy of using Amazon web services (AWS) cloud computing (referred to in this report as the Cloud approach) to host geospatial layers and applications developed in the data phase. The Cloud approach offers potential IT infrastructure savings in making server and storage investment unnecessary. Alternative GIS services using Environmental Systems Research Institute (ESRI) server technology and federally-hosted servers such as OSMRE servers, USACE's CorpsMap, EPA's Exchange Network, or the FWS's Wetlands Mapper were potential options available to limit technology risk if the cloud solution had limitations.

The experimentation determined that a cloud-based solution was appropriate, reliable, and cost-effective for the purposes of the Pilot Project. The results for GeoMine include increased bandwidth, performance, and flexibility and scalability advantages. The neutral site cloud-hosting location was preferred by the IMCC and States. Alternative platforms for hosting and sharing of priority geoservices and geodata were therefore not needed.

The GeoMine Pilot Project team encountered significant technological challenges to acquire, transform and load coal-mining related data into a coherent and common form that can be easily maintained and accessed by interested parties. The technology phase workgroup met those challenges by using ASTM-developed standards and innovative technology.

Methodology

The concept of GeoMine is to provide GIS web services to support mapping and data distribution and to develop a web mapping application for users that do not have the capability to utilize the services directly. Toward those ends, the technology phase team decided to use ESRI's ArcGIS Server to serve the GIS web Services and ESRI's Spatial Database Engine (ArcSDE) in conjunction with a relational database to manage the GIS data. Additionally, the technology phase workgroup decided to use Safe Software's Feature Manipulation Engine (FME) to read, transform and load data from our various sources into the GeoMine geodatabases. FME Server required another AWS machine. One last machine image was set up to house the Open Source (developed by ESRI) GeoPortal for managing metadata. Appendix H explains the conceptual design, virtual computer interconnections and configuration details for the virtual computers.

The GeoMine web mapping application was developed using ArcGIS application programming interface (API) for Adobe's Flex web application environment, and housed on the ArcGIS Server. Flex is an open source application framework for building expressive web applications that work consistently on all major browsers. Contractor services obtained through the USGS provided the highly specialized and unique Flex application programming expertise that has developed, designed and maintained the GeoMine web application in the Cloud. This also included extensive programming in the JavaScript language for creating functionality in the Flex framework of the GeoMine web-mapping application.

Data Acquisition and Loading

The coal-mining related data available from the authoritative data sources (ADS); namely the SMCRA state regulatory authorities in Kentucky, Tennessee, Virginia and West Virginia; have various data available that can more or less be loaded into the GeoMine schema. The

GeoMine project wanted to pose the least burden possible to the ADS when it comes to giving the data to the project. To that end, the technology phase workgroup wanted to be able to take the data in whatever form the ADS had. That form took several shapes including ESRI shape files, ESRI geodatabases and WFS feature services. In addition, there were ancillary data available on HTML web pages. The shape files were available in some cases from FTP servers. Shape files were periodically updated or only made available on an *ad hoc* basis.

Data read, transform and load functions for GeoMine are performed using Safe Software's Feature Manipulation Engine (FME). Using FME enables GeoMine to acquire data from many locations in many formats and homogenize them into a single coherent GIS dataset (geodatabase) that is used to create web-based GIS services that power web-mapping applications.

The FME server enables automatic connection to all of the different data sources and performs the conversion and re-projection necessary to transform the original data into our common schemas. Some of these transformations are quite elaborate since the original data are much different from the end schema and projection. In some cases, we use FME to join attributes from different sources. For instance, one set of data we use obtains shape files from a zipped set of shape files automatically maintained on an FTP server. The FME job then extracts the shape files, reads them, and then joins them to more data obtained from HTML web pages referred to in one of the shape file attributes. Since there are tens of thousands of records in these particular datasets, the FME job also checks for changes from our current data and only reads and adds or replaces new or updated data, which saves thousands of round trips to the web server. The details for the data access, reading, transformation and loading into the GeoMine platform is provided in Appendix I.

GeoMine Cloud Computing

During the planning phase of GeoMine there was much discussion about where to host the computing infrastructure so that it would be flexible and be available to all parties developing resources for the project. There were offers from different agencies to host the GeoMine Viewer prototype but in the end there were always security and network constraints that made access to all challenging. After several discussions with workgroup members it was decided to investigate using a Cloud approach for a development environment because of the following factors.

The Cloud approach selected allows significant flexibility in setting up machines and networking environments and easily supports experimentation – essential for a prototype. The interconnected data centers available through the Cloud create services that are robust and highly available. Another significant factor in using AWS as opposed to other cloud computing platforms was their relationship with ESRI. ESRI had developed ready-made machine images for their essential GIS services that could be made operational within minutes and were fully supported by the Department of Interior's enterprise licensing agreement with ESRI. Further details regarding Cloud computing concepts and challenges are in Appendix J.

GeoCloud II

GeoCloud II is the second generation of proof-of-concept GIS in the cloud projects sponsored by the Federal Geographic Data Committee (FGDC). In the fall of 2011, the FGDC solicited proposals from across the Federal Government for GIS Projects that might be ported to the cloud. Selected projects would be funded – including cloud computing costs and technical support – for one year. The GeoMine project team submitted a proposal and was selected for inclusion in GeoCloud II with several other projects from around the Government.

The purpose of GeoCloud II was to develop standard and repeatable techniques for agencies to support their GIS services in a cloud environment. Also, the flexibility and cost effectiveness of cloud platforms for Government GIS systems was to be determined. Finally, and perhaps the most important goal, was to develop a standard platform that can be certified and authorized and can be reused by many for their own purposes without having to go through a costly and lengthy single-purpose Certification & Accreditation (C&A) process on their own.

GeoCloud II operated on the Amazon Web Services (AWS) cloud, the same platform that was used for the Pilot Project. That facilitated porting GeoMine applications since they already were running on AWS. GeoCloud II employed two types of platforms, ArcGIS Server and GeoMedia – the Pilot Project uses ArcGIS Server. One of the techniques being used to create standard platforms was to create machine images with all required software installed with appropriate Government-required security settings pre-set. The machine images included a separate image with a data drive (a D: drive on a Windows machine). The idea was that when there is a significant software update, the main machine image can be replaced with a new approved image and the old data drive can be re-attached with minimal interruption of service.

The main outcome from the GeoCloud II work for GeoMine was the knowledge of how to create a standard, secured GIS system in the AWS cloud that can easily be certified through the Federal C&A requirements. GeoMine participation in GeoCloud II concluded in May 2013 with the advent of the Federal Risk and Authorization Management Program (FedRAMP) accreditation and certification of GeoMine's Cloud Service Provider, Amazon Web Service. FedRAMP is a government-wide program that provides a standardized approach to security, and the FedRAMP accreditation of AWS should solve any GeoMine Cloud security issues related to provisioning Cloud services for GeoMine.

GeoMine Computer Security

GeoMine security is comprised of two parts: the first part is data security risk classification, and the second is cloud computing security. Security assessment for the Pilot Project was initiated by surveying each ADS for data level risk sensitivity for their GeoMine geospatial layer(s). User authentication to control user access to the GeoMine Viewer was established soon after version 2.0 was deployed in February, 2012. The May 2013 FedRAMP accreditation and certification of the GeoMine Cloud service provider for Low to Moderate data risk data, Amazon Web Services, will facilitate the compliance certification of the Pilot Project Cloud solution. Based on our review, the GeoMine Viewer prototype was classified as a Moderate risk. The FedRAMP accreditation of the Amazon Cloud Service Provider (CSP) will further assist OSMRE with applicable guidance on the proper security controls that apply to the GeoMine Project. As the program continues more detailed guidance for Virtual System Security Plans will be available. In the meantime, Western Region (WR) has started categorization and is working to define the controls that will be needed.

Data Security Classification
The Federal Information Processing Standards Publications 199 (FIPS 199) Workbook, Data Classification Questionnaire, and Privacy Impact Analysis (PIA) has been used to address the classification of the data maintained on GeoMine; both the dataset that is contributed and data that is produced by the GeoMine services.

A security categorization assigned to a system based on the FIPS 199 Workbook would be one of three security levels; Low, Moderate or High. This security categorization is then used with the National Institute of Standards and Technology Publication 800-53 (NIST 800-53 rev3) to assign the proper security controls necessary to secure a system. The Data Classification Questionnaire ensures that the confidentiality, integrity, and availability of the dataset are not compromised and that there is no privacy or individual data in the dataset. Data Classification along with the FIPS 199 was used to determine the overall categorization level. GeoMine is classified at the moderate level due to the fact that it would potentially provide information to citizens and requires moderate availability. The FIPS199 Workbook for GeoMine can be found here.

The Privacy Impact Assessment (PIA) is used to assess a system for any kind of private and/or personal identifiable information. Due to the E-Government Act of 2002, all government systems must complete a PIA to discover whether the system does or doesn't contain privacy/personal identifiable information. GeoMine does not contain any privacy or personal identifiable information.

Cloud Computing Security
The second part of GeoMine security has to do with cloud security. Appendix K, The GeoMine Concept of Operations for IT Security, provides an overview of the operating model and key processes for GeoMine, and describes roles and responsibilities in relation to system security and risk. In the case of GeoMine, controls like Amazon Identity Access Management (IAM) are used to limit access to the Amazon Machine Instance (AMI) and Amazon Network and Security control that serves as a firewall to the AMI. These are controls that are set in place to protect the GeoMine Viewer prototype from potential threats. Details on the controls can be found in Appendix K.

As a way to systematically address security concerns of Cloud implementation, the administration has drafted a standard approach to cloud security called FedRAMP, which stands for Federal Risk and Authorization Management Program. FedRAMP has been established to provide a standard approach to assessing and authorizing cloud computing services and products. FedRAMP allows joint authorizations and continuous security monitoring services for Government and Commercial cloud computing systems intended for multi-agency use. Joint authorization of cloud provider's results in a common security risk model that can be leveraged across the Federal Government, and provides a consistent baseline for Cloud based technologies. This common baseline ensures that the benefits of cloud-based technologies are effectively integrated across the various cloud computing solutions currently proposed within the government. The risk model will also enable the government to "approve once, and use often" by ensuring multiple agencies gain the benefit and insight of the FedRAMP's authorization and access to service provider's authorization packages.

FedRAMP will provide Federal agencies with specifications for cloud vendors. The goal is to establish a checklist for authorizing cloud products intended for multiple agencies. Departments deploying the same tools won't have to conduct duplicative security reviews, which should expedite the shift to Cloud use. The GeoMine operational model will ensure thorough reviews of applicable security requirements for FedRAMP, NARA compliance, COOP considerations, and the impacts of service outages, with the necessary security, compliance, and service reliability controls implemented.

X. Funding and Personnel Resources

The majority of funding for the Pilot Project has been used to cover two broad categories of expenditure: computing infrastructure costs, including computer hardware, software and contracted services; and OSMRE grants to the states for digital geospatial layer development. Appendix L breaks down the funding amounts and categories from FY10 through FY12 expenditures, both as direct OSMRE funding and Federal cooperative agreement grant funding. The Federal and State agencies have also dedicated significant personnel time for data support and report preparation and review totaling hundreds of hours for each Pilot Project agency. Specifically, OSMRE furnished a project manager, data- and technology-phase leads, and GIS support personnel in its Denver, Pittsburgh, and Knoxville offices. EPA, FWS, and USACE had team members in both headquarters and regional offices represented. The other Federal and State agencies also committed staff time and expertise to development of GeoMine, as reflected in the team membership listed in this project plan.

OSMRE allocated a total of $203,550 for GeoMine in FY-2010: $64,350 of this funded hardware and software acquisition to facilitate State digital data creation and storage, along with data-phase data interoperability, and $139,200 in OSMRE-directed software and programming services, including technology-phase funding for cloud-computing experimentation. EPA has committed more than $13,000 to provide contract IT and GIS programming services. OSMRE‘s TIPS program committed $10,100 in FY-2011 to the Pilot Project. This money was used to cover software maintenance costs for software procured in FY-2010 and State travel to GeoMine working sessions. FWS and USACE have not provided direct funding support.

Using FY2011 funding, OSMRE committed a total of $714,264 in Cooperative Agreements for GeoMine digital data support to the SMCRA pilot-project States, including $480,661 in direct and indirect personnel costs to generate digital mine-map data and $233,603 in computing infrastructure, including computer hardware and software. In addition, OSMRE provided two GIS interns under the AmeriCorps program to assist in GIS data digitization. In FY2012, OSMRE provided Cooperative Agreements totaling $407,000 to assist the Pilot Project states.

The Pilot Project states shared data to GeoMine through both transfer of existing data and the creation of new digital data through the scanning, digitizing and georeferencing of permit maps. The costs involved in transferring data are lower on a unit basis than the process of creating digital data. The table below details the costs associated with transferred vs. digitized data and the number of GeoMine features generated by each.

Table 1. Costs Associated with Data Creation vs. Data Transfers from Pilot Project States (as of 5/17/13)

State	Regulatory Site Polygons and Point Features				AML Site Polygons and Point Features				Total	Total
	Digitized	Cost	Transferred	Cost	Digitized	Cost	Transferred	Cost	Features	Cost
KY	51,643	$217,902	97,641	$156,000	9,727	$65,610	0	$0	159,011	$439,512
TN	568	$25,000	6,717	$4,825	0	$0	2,350	$8,175	9,635	$38,000
VA	10,796	$166,326	18,710	$19,680	0	$0	7,427	$10,400	29,089	$196,406
WV	6,456	$122,010	72,122	$29,008	16,013	$268,417	3,157	$0	97,748	$419,435
Total	69,642	$531,238	195,190	$209,513	25,740	$334,027	12,934	$18,575	295,483	$1,093,353

XI. Pilot Project Milestones and Scheduling

The Pilot Project relied on internal coordination, communications, and made external outreach efforts where appropriate. All Federal and state executives have been briefed on the Pilot Project purpose, goals, status and accomplishments to cultivate support for the project. Demonstrations of the GeoMine Viewer and its geospatial discovery and download capability were critical in communicating the value of the application. The Pilot Project engaged State and Federal users and executive management. The individual agencies began the communication process to the business user community early in the Pilot Project by means of internal surveys of permit reviewer geospatial needs by the data stewards. These business users were invited to participate in the testing of GeoMine services to provide valuable feedback on the geospatial layers delivered. The IT departments of each agency have been consulted early in the GeoMine process to enlist the necessary resources and expertise needed to facilitate digital storage, acquisition of GIS software and hardware and the transfer of digital data. Technology-transfer of lessons learned from GeoMine has already occurred at various technology and business meetings. Table 2 details the remaining schedule of project report completion.

Table 2. Pilot Project Milestones and Proposed Schedule (as of 1/23/2014)

#	Milestones	Estimated Completion Date	Completion Date	Assigned To
1	Email Draft Project Coordination Schedule -- to Interagency Team Members for review/comment	7/31/2012	7/20/2012	OSMRE-Clark
2	Teleconference with Interagency Team-- finalize draft Project Coordination Schedule and review updated GeoMine Viewer	8/1/2012 and 8/6/2012	8/6/2012	OSMRE-Welsh and Interagency Team
3	DRAFT #1 Pilot Project Report Produced-- distributed for Interagency Team and GeoCommittee review	8/10/2012	8/10/2012	OSMRE-Welsh
4	Interagency Team Teleconference--discuss plans for review Draft #1 review including areas that team should focus on	8/14/2012	8/14/2012	OSMRE-Welsh and Interagency Team
5	DRAFT #1 Comments Due from Interagency Team and GeoCommittee	9/14/2012	10/2/2012	Interagency Team
6	INTERAGENCY TEAM MEETING #1-- finalize facts and findings and tentative agreement on recommendations. Produce Draft # 2. Location: WV State Office Charleston.	10/2 & 3/2012	10/3/2012	Interagency Team
7	**DRAFT #2 Pilot Project Report Produced**--distributed for Interagency Team, SMCRA GeoCommittee, and Interagency Executive review/comment	11/28/2012	11/28/12	OSMRE-Welsh
8	**INTERAGENCY TEAM MEETING #2**-- secure comments on Draft #2 to revise into Draft #3. Location: KY DMP Office, Frankfort, KY.	12/4 & 5/2012	12/5/12	Interagency Team
9	**DRAFT #3 Pilot Project Report and Executive Summary Distributed to IA Team and Executives for Review and Comment.**	1/31/2013	1/28/2013	OSMRE-Welsh, Benson
10	**Key Agency Executives Briefed--**by each Interagency Federal and State primary team representative. Objective of these separate sessions is to brief & secure comments/input from State/Fed Execs including DOI GIO that will allow team to complete Draft #3.	1/25/2012	2/11/13	Individual Interagency Team Members
11	**INTERAGENCY TEAM MEETING #3** -- discuss draft #3 report and secure IA team executive comments and IMCC input to revise into Draft #4. Location: Charleston, WV - OSMRE Office	2/14-15/2013	2/15/2013	Interagency Team

#	Milestones	Estimated Completion Date	Completion Date	Assigned To
12	**Interagency Team -- revisions due on Draft #3 Pilot Project Report and Executive Summary**	2/25/2013	4/15/13	Interagency Team
13	**DRAFT #4 Pilot Project Report and Executive Summary Distributed to IA Team and Executives, and SMCRA GeoCommittee for Review and Comment**, including Deployment Plan for Nationwide GeoMine deployment to SMCRA, CWA, and ESA users only - not the public.	6/20/2013	6/20/13	OSMRE-Welsh, Benson
14	**DRAFT #4 Pilot Project Report and Executive Summary Comments Due.**	8/9/2013	08/21/2013	IA Team and SMCRA GeoCommittee
15	**Briefing to Agency Executives and Executive Approval to Publish Final Report**-- via web meetings and/or face-to-face briefings (OSMRE will brief Director and other appropriate DOI executives).	10/1/2013	9/16/13	OSMRE-Welsh and Interagency Team
16	**Final Report Published for SMCRA, CWA and ESA and Federal Agency Comment**	12/13/2013		OSMRE-Welsh and Interagency Team
17	**SMCRA, CWA and ESA Communities' and Federal Agency Input Due.**	1/31/2014		Interagency Team

Legend: Blue--milestones require action/participation by all Interagency team members. Red--draft reports produced for review/finalization. Green--Interagency Face-to-Face Team Meetings.

XII. Objectives and Findings

The Pilot Project has met the five major objectives established by the team[5]:

Objective 1 - Create a GeoMine Pilot Project collaborative model for discovering, collecting, harmonizing, managing, and serving map layers pertinent to SMCRA and Clean Water Act (CWA) regulation of coal mining and reclamation activities located in the States of Virginia, West Virginia, Kentucky, and Tennessee.

Before GeoMine, valuable GIS data existed in each agency administering SMCRA and the CWA; however this data was not readily available to other agencies, or in a form that is useful to assist in regulatory decision-making.

[6] ***Objective 6. Align with Federal agency geospatial plans and guidance*** (e.g., Federal Geospatial Platform, Department of Interior Geospatial Guidance and the SMCRA GeoPlan) was removed as an Interagency objective of the Pilot Project. The GeoMine Viewer will meet all applicable Federal mandates and guidance and findings in this report are not germane.

SMCRA states now manage, maintain, and contribute seven geospatial mining and reclamation-related layers to GeoMine. Four additional layers are under development. The eleven Federal agency geospatial layers contributed to GeoMine provide a seamless hydrological, biological and historical mining context to the SMCRA state coal mining and reclamation activity that allows a deeper understanding of potential issues and concerns related to new or existing coal permitting and mining.

GeoMine has brought together in one website for the first time, over 713,000 coal mining-related geospatial sites and surface coal mine operation boundaries covering 3.5 million acres in the Pilot Project states. Tables 3, 4 and 5 and Figures 1 and 2 summarize the number of SMCRA agency (including OSMRE TN data) and Federal Agency geospatial sites available in the GeoMine Viewer as of May, 2013. SMCRA states' resource and database considerations have resulted in convergence on a core set of geospatial layers that can be updated and maintained on a regular basis and provided to GeoMine in a regular refresh cycle. Additional geospatial sites will be added through 2014 through work performed by the Pilot Project states using OSMRE grants awarded in 2011 and 2012.

<u>Finding A: Use of common formats and tools for sharing coal mining geospatial data has allowed increased collaboration between state and Federal SMCRA and CWA programs operating across the Pilot Project region.</u>

GeoMine has leveraged the ASTM standards for coal mining to create a common geospatial language that interprets data from different sources and organizations. Collaboration has created new tools, including a GIS geodatabase format, that have been shared with the Pilot Project partners. GeoMine Viewer tools for hydrology have increased the access to databases of analytes of interest to the regulatory community.

<u>Finding B: SMCRA states now share seven key geospatial layers for coal mining and reclamation activities with four additional layers in development (shown in Tables 3 and 4 and Figures 1 and 2):</u>

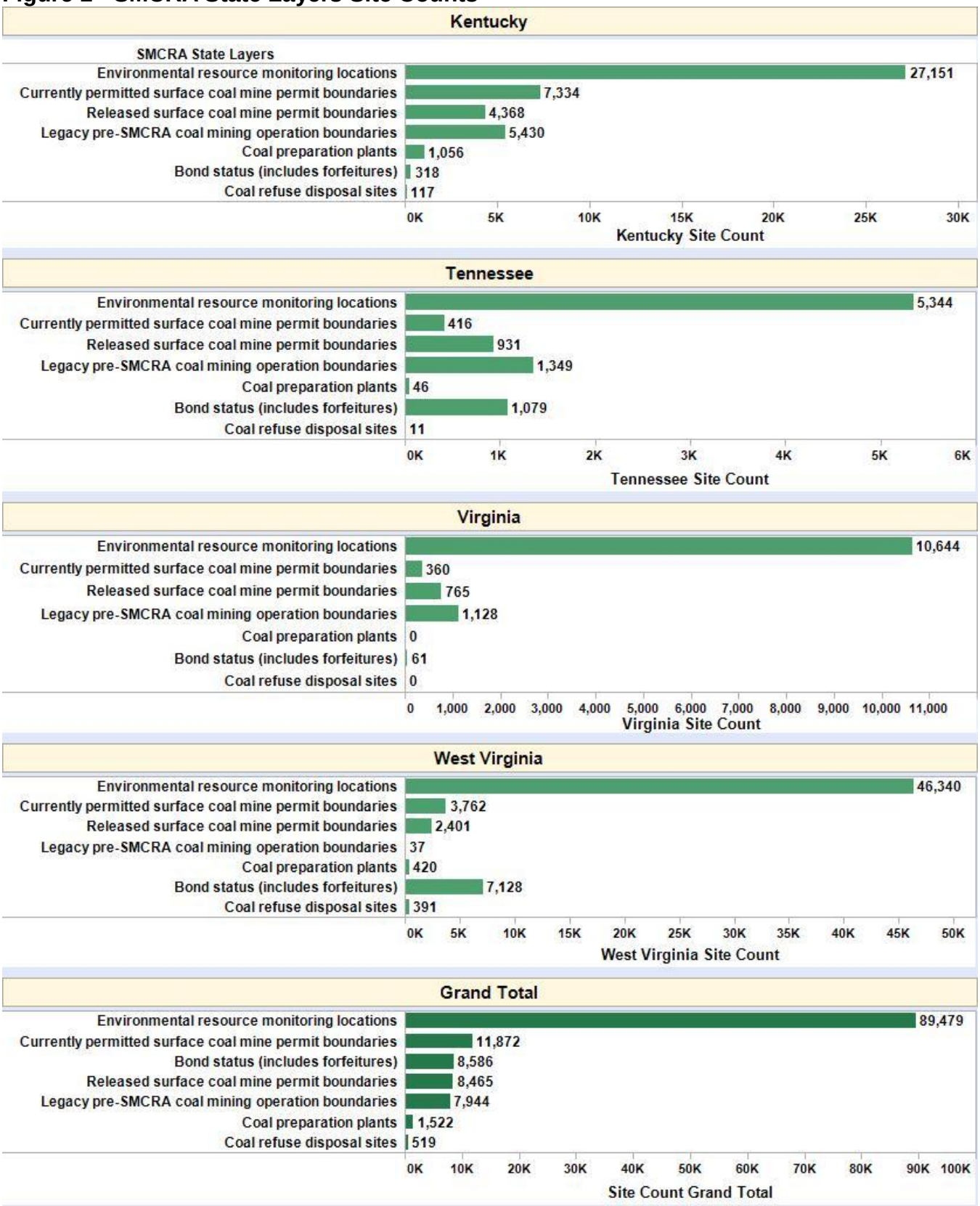
The SMCRA states committed to maintaining, and providing to GeoMine, seven key coal mining geospatial data layers. The state SMCRA agencies were of the opinion that these layers were either currently available or would soon be added. Most of this state data is being made available through state-sponsored public-facing websites already.

Table 3. SMCRA State Layers Site Counts

#	SMCRA Geospatial Layers	KY Site Count and (Acres)	TN Site Count and (Acres)	VA Site Count and (Acres)	WV Site Count and (Acres)	Total Site Count and (Acres) by layer
1	Currently permitted surface coal mine permit boundaries	7,334 (2,047,826)	416 (45,003)	360 (78,818)	3,762 (321,172)	11,872 (2,492,819)
2	Released surface coal mine permit	4,368 (568,926)	931 (48,772)	765 (23,901)	2,401 (95,545)	8,465 (737,144)
3	Legacy surface coal mining	5,430 (206,261)	1,349 (53,246)	1,128 (67,136)	37 (7,489)	7,944 (334,132)
4	Coal refuse disposal sites	117 (6,092)	11 (542)	TBP	391 (14,779)	519 (21,413)
5	Environmental resource monitoring	27,151	5,344	10,644	46,340	89,479
6	Bond status (includes forfeitures)	318 (80,348)	1,079 (81,023)	61 (10,579)	7,128 (458,169)	8,586 (630,119)
7	Coal preparation plants	1,056	46	NC	420	1,522
Total SMCRA Site Counts and (Acres) by State		**45,774 (2,909,453)**	**9,176 (228,586)**	**12,958 (180,434)**	**60,479 (897,154)**	**128,387 (4,215,627)**

Figure 1 is a graphical representation of the site counts for the seven GeoMine SMCRA layers.

Figure 1 - SMCRA State Layers Site Counts



Four SMCRA state coal mining geospatial layers are under development for potential inclusion into GeoMine in the future (see Table 4 and Figure 2). These layers include the # 8 Underground Mine Extent layer, which has been provided to GeoMine by the SMCRA partners as brokers of this data that are generated by other state agencies. The GeoMine SMCRA state partners are not the ADS for these data and for this reason are challenged to provide adequate quality analysis or the creation of services for GeoMine use. Future development of this layer will be explored through the Mine Safety and Health Administration or directly with the state agencies compiling these data.

The #9 Fills layer is problematic in the sense that fill boundaries depicted in permit applications and provided to GeoMine often have a larger footprint than the as-built fill. Future GeoMine efforts with the states could explore remote sensing or GPS collection of as-built fill boundaries to more accurately depict this layer.

The # 10 AML Problem Area/Planning Units layer is being populated in KY and WV through OSMRE grants. TN and VA have focused on currently permitted and released surface mining boundaries with their recent data collection.

Due to current database limitations, # 11 Post-mining land-use can only be associated with the entire permit boundary in KY and WV, making this data an over-generalized view of post-mining land-use. In the future, subdividing the permit into land-use sub-sections with their own associated post-mining land-use would allow an accurate rendering of the land-use on a GeoMine layer, as VA has done.

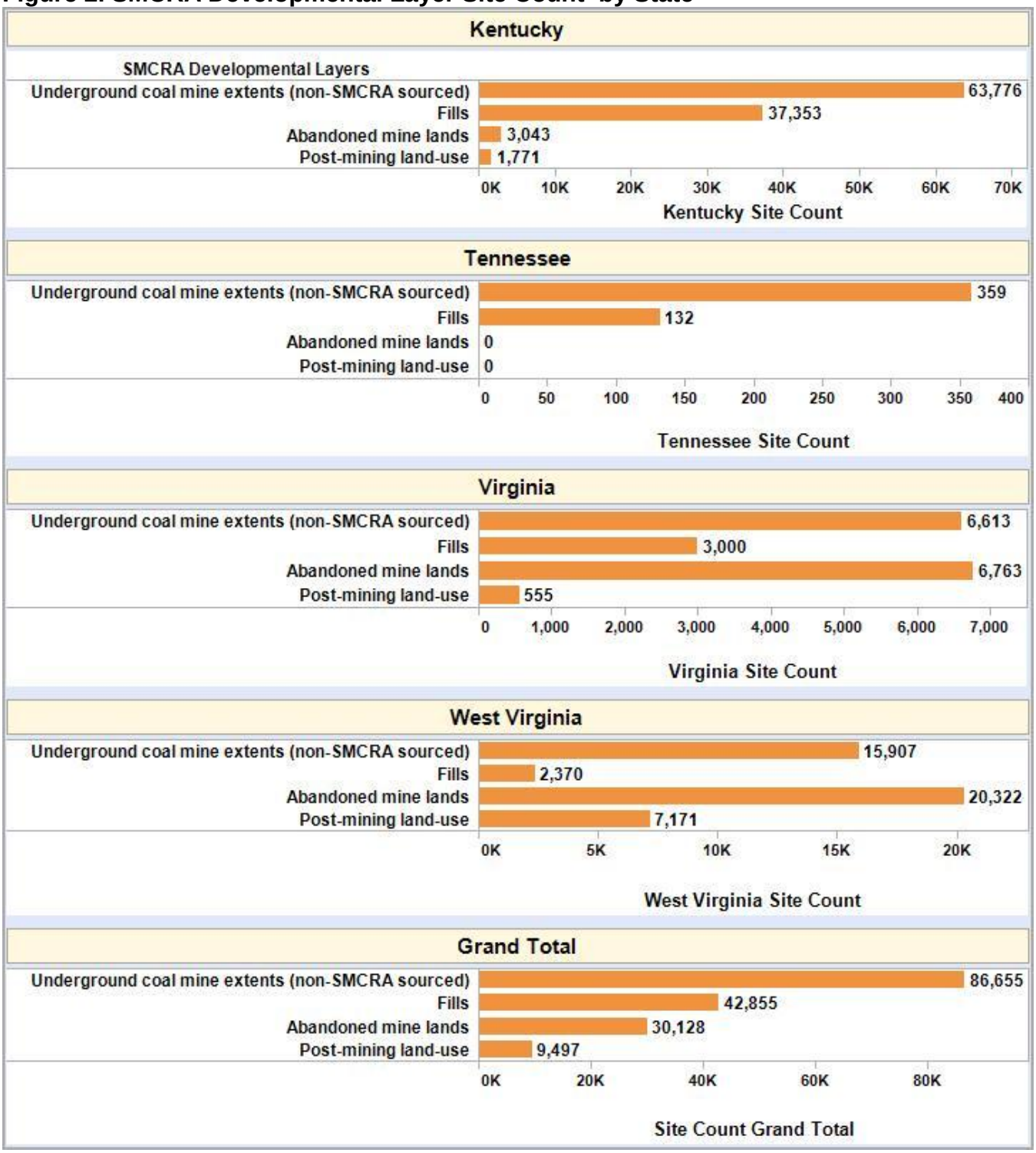
Table 4. SMCRA Developmental Layer Site Count by State

Layer #	Development Geospatial Layers (SMCRA and other State Data)	KY Site Count (Acres)	TN Site Count (Acres)	VA Site Count (Acres)	WV Site Count (Acres)	Total Site Count per layer (Acres)
8	Underground coal mine extents (non-SMCRA sourced)	63,776 (2,274,309)	30 (17,082)	6,613 (496,728)	15,907 (2,240,257)	86,314 (5,028,377)
9	Fills	37,353 (290,971)	132 (1,516)	601 (10,007)	2,326 (59,568)	40,414 (362,062)
10	Abandoned Mine Lands	3,043	0	6,763	19,170	21,616
11	Post-mining land-use	1,771 (636,827)	0	547 (66,137)	7,148 (452,561)	9,466 (518,895)

Blue shading indicates OSMRE grants were used to convert sites to digital formats.

Figure 2 is a graphical representation of the site counts for the four SMCRA layers under development for GeoMine.

Figure 2. SMCRA Developmental Layer Site Count by State



Finding C: Federal agencies now contribute 11 geospatial layers with two hydrologic databases linked to sampling locations (STORET and NWIS) (shown in Table 5 and Figures 3 and 4);

Table 5. Federal Agency Layers and Geospatial Site Count in GeoMine as of 5/8/13

Layer #	Federal Agency Geospatial Layers	KY Site Count	TN Site Count	VA Site Count	WV Site Count	Total Site Count per layer
1	OSMRE Abandoned Mine Land Information System (eAMLIS) Project Status					
2	OSMRE Abandoned Mine Land Information System (eAMLIS) Priority	2,308	278	513	4,291	7,390
3	OSMRE Mine Map Repository (MMR)	5,477	1,467	6,327	36,884	50,155
4	FWS National Wetlands Inventory	105,163	99,596	31,422	38,022	274,203
5	FWS Critical Habitats	3	25	7	1	36
6	EPA 303d Listed Impaired Waters	1,060	1,028	2,534	906	5,528
7	EPA 303d Listed Impaired Waters with TMDLs	39	116	954	2382	3,491
8	Corps of Engineers NWP 21, 49, and 50 permits	72	8	36	65	181
9	Corps of Engineers NWP 21, 49, and 50 impacts	237	50	155	173	615
10	Corps of Engineers NWP 21, 49, and 50 mitigation	141	38	81	127	387
11	Corps of Engineers NWP 21, 49, and 50 jurisdictional determinations	210	41	148	353	752
12	EPA STORET water sampling locations	1,950	6,374	4,580	5,134	18,038
13	National Water Information System (NWIS) water sampling locations	14,711	12,862	10,517	16,918	55,008
Total Federal Agency Site Count by Pilot Project State		131,371	121,883	57,274	105,256	**415,784**

Figures 3 and 4 are graphical representations of the GeoMine Viewer Federal layer site counts within the Appalachian coal field in the Pilot Project states.

Figure 3. Federal Layer Site Count by Pilot Project State

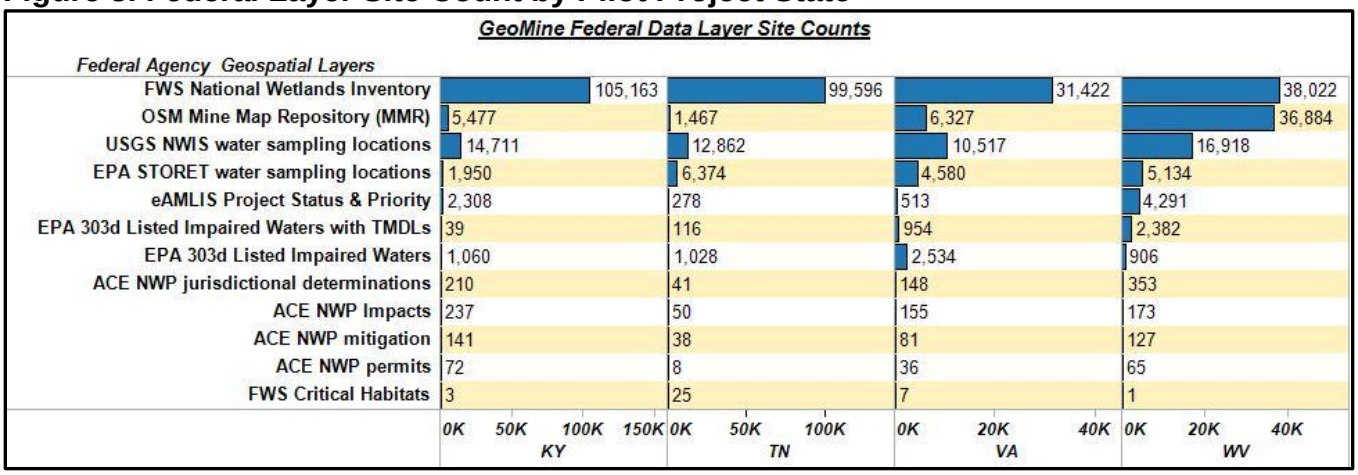
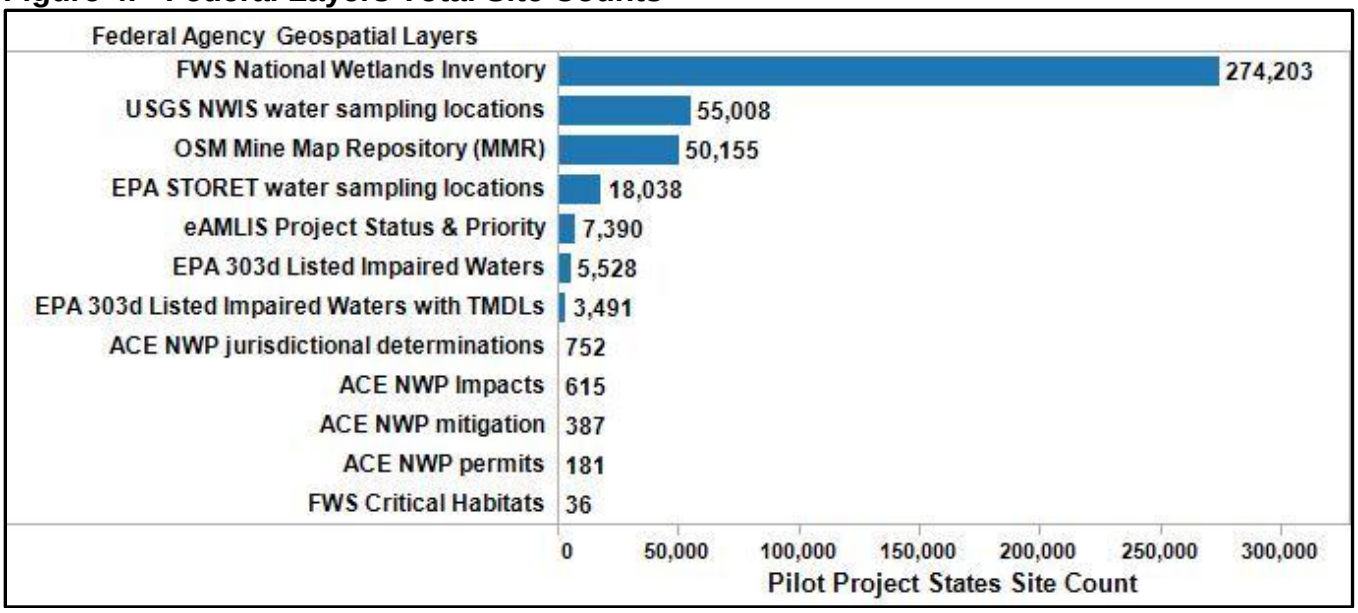


Figure 4. - Federal Layers Total Site Counts



<u>Finding D: Attribute data provided for SMCRA layers are completed by SMCRA state ADSs to the level that state databases have these data available.</u>

Since September 2011, OSMRE has conducted a quarterly inventory of the level of attribution of the SMCRA geospatial layers provided by each of the four Pilot Project states and entered into the database. The purpose of this exercise was to facilitate a clear understanding of the level of progress attained by state authoritative data sources in meeting the objectives established in the Pilot Project Plan. This data also aids in mapping strategies to determine the best areas to concentrate future efforts, and to provide a system of metrics for tracking progress in carrying out work assignments outlined in the GeoMine Project MOU implementation plans. The most recent inventory is presented in Appendix I.

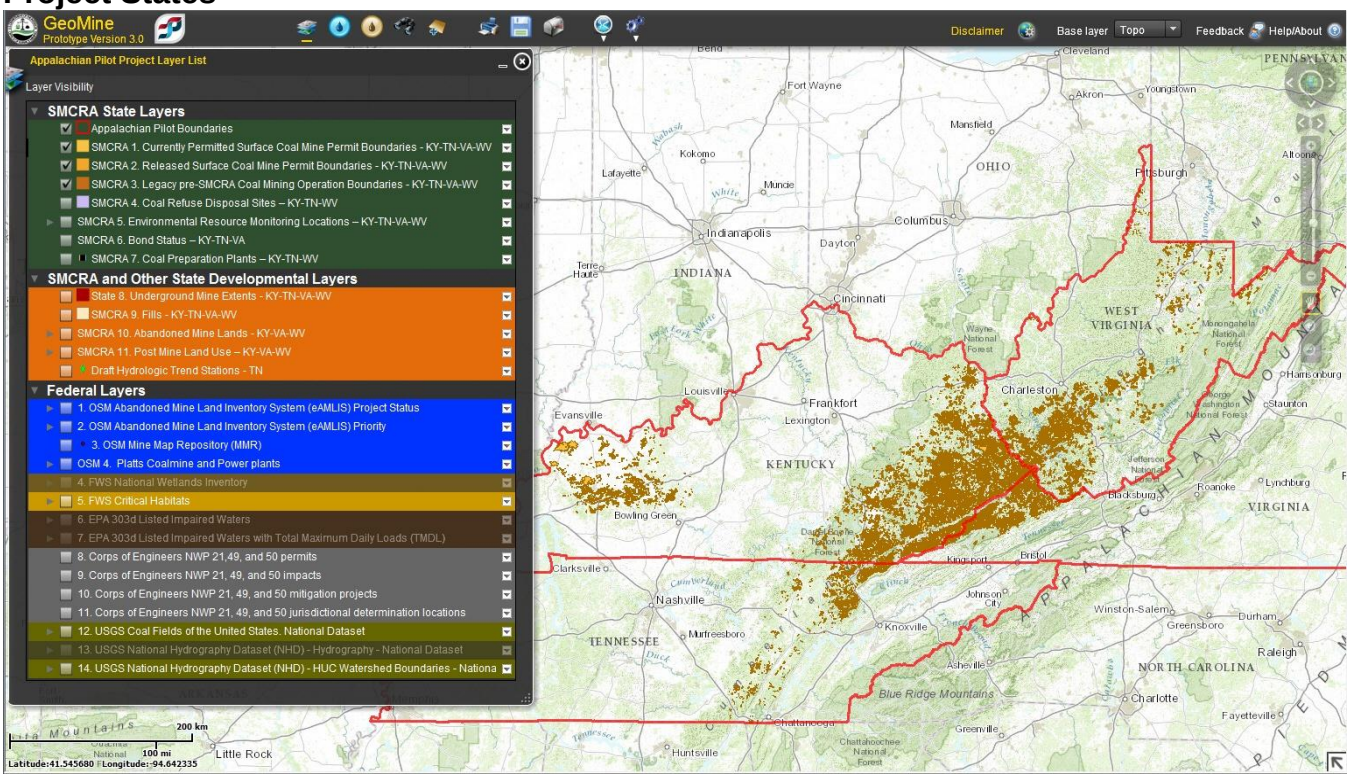
Finding E: The GeoMine model merges data from multiple sources into seamless geospatial layers extending across the Pilot Project extent.

The GeoMine Viewer displays geospatial data as continuous, seamless layers extending beyond state boundaries to provide a comprehensive regional perspective that recognizes that hydrologic systems, geology, and ecosystems have a wider extent than a single state. Although the Pilot Project states host website portals to coal mining data that are open and transparent to the public on an individual state basis, the GeoMine Viewer promotes openness and transparency of coal mining geospatial data across a regional extent. This regional data availability could facilitate or eliminate data calls from a variety of external sources, including FOIA requests, to individual states. GIS data that is shared has value that escalates with an increasing number of users. Shared data also gains in value and authority. Translation from paper maps into digital formats allows easy use and reuse of geospatial data. Digital data can better withstand the ravages of time and circumstance and are highly portable.

The Pilot Project online web application hosts 25 geospatial layers and 2 widget tools with data sources from each of the pilot project States and each of the four Federal pilot project partners (Figure 1). The geospatial layers created for the pilot project States used the ASTM workgroup's efforts to "define the accurate location and description of geospatial data for coal mining operations"[6]. Within GeoMine, these geospatial layers and any derivatives are referred to as 'SMCRA' layers to indicate that they pertain directly to the administration of SMCRA regulations.

[6] Standard Practice for Geospatial Data for Representing Coal Mining Features; Designation: D7780 – 12; ASTM International, Feb. 2012.

Figure 5. GeoMine Viewer v. 3.0 Showing Surface Coal Mining Boundaries in the Pilot Project States



<u>Objective 2 - Recognize the agencies as Authoritative Data Sources (ADS) for geospatial layers under their control and establish data stewards for the geospatial layers.</u>

<u>Finding A. Each of the state and Federal agencies has designated a data steward as the point of contact for GeoMine.</u>

Each participating agency has successfully accepted the ADS role for their geospatial layers, and has developed internal processes to validate their layers. Agencies have committed FTE resources, most importantly the assignment of a consistent data steward who has served as the point of contact for the Pilot Project. This consistency has been a major positive factor in promoting geospatial layer services and data. The data stewards have been responsible for the clear and unambiguous definition of their geospatial layers and the alignment with ASTM data standards. Using existing ASTM data standards developed for coal mining helps in understanding each organization's data. Several of the GeoMine team members have helped develop the ASTM coal mining standards.

Data stewards also have provided data dictionaries detailing the attributes for their geospatial layers. Stewards have been responsible for the quality and accuracy validation for their ADS geospatial layers. Metadata for the agency geospatial layers has been generated by each ADS, describing the lineage, quality and currency of their geospatial data or services. These efforts by each ADS have promoted trust, consistency, reliability and certainty in their data, benefitting their organizations as well as providing confidence in analyses performed using ADS data.

Finding B. Each agency has remained engaged in maintaining, updating and enhancing their contributed geospatial services and data.
Existing digital geospatial services and data have been incorporated into the platform on update cycle schedules negotiated with each data steward. New digital geospatial data created under OSMRE grants to the SMCRA states will be added to SMCRA state geospatial layer collections as updates to the Pilot Project platform. Geospatial layer services have been relatively stable – where internal server or organizational IT changes have caused a loss of connectivity to the GeoMine platform, requests made to the data steward have been effective in re-establishing those services. The GeoMine concept has recognized that each Pilot Project state has a different level of maturity in creating the priority geospatial data services for contribution to GeoMine, and the Pilot Project provided technical support to states needing development help.

Objective 3 - Developing a shared, Cloud-based GIS platform for Appalachian coal mining geospatial layers available to the SMCRA state and Federal users.

Finding A. The Cloud-based platform has proved capable of sharing all seven agencies' geospatial layers and attribute data.
The GeoMine cloud-based platform allows us to easily configure GIS components to fit our need and to adjust those components as necessary. Because the Cloud is easily accessible by all GeoMine partners via the Internet and the GeoMine team has control over access, we have been able to easily connect to all partner data sources and in turn, provide robust services and applications. The GeoMine platform is flexible enough to accept state and Federal data in various GIS file formats including Shapefiles, geodatabase files and kml files. ESRI and Open Geospatial Consortium (OGC) Web Map Services and Web Feature Services are also supported.

Finding B. The GeoMine platform is open and accessible to all the Interagency team and is not resident on Federal servers to satisfy the preferred solution offered by the IMCC and SMCRA states.
The IMCC and SMCRA state partners preferred a neutral ground to house GeoMine to avoid the appearance that any single Federal Agency exclusively controlled GeoMine. The Cloud provides just such a solution since it is provided by a private company and the GeoMine virtual computers we developed were easily accessible by the entire interagency team.

Finding C. The Cloud has high-capacity networks that make accessing web-based applications and data very easy from any Internet connected location.
The Cloud provider we use for GeoMine has a very high-capacity network connected to the Internet and is readily accessible by users. Performance through the Cloud is actually not the limiting factor – we found that limitations in office bandwidth and data flows are more of a constraint.

Objective 4. - Provide resources through OSMRE-sponsored Federal Cooperative Agreement grants for SMCRA RAs to convert data to digital GIS data and create services sharable through the GeoMine platform.

The OSMRE approved and fully funded GeoMine digital data proposals submitted by each Pilot Project State RA in 2011 under Federal cooperative agreements. Also, another round of

funding was approved by the OSMRE Director in May 2012 to support further data creation work in the Pilot Project States. Each RA prioritized the digital conversion of currently permitted Title V mining and reclamation data and AML project data not currently available in digital form. Business process enhancements were made to facilitate the creation of future digital geospatial data through RA permitting and data translation procedures. To aid in business process enhancement, the GeoMine Team developed a common element to these agreements; tasking the joint OSMRE/States GIS team to create a GIS personal geodatabase as a XML workspace document (here) optimized for interchange of ASTM-approved Title V geospatial layers with core attributes that could be used in Electronic Coal Mining Data Submittal workflows for receipt of data from industry into ESRI's GIS formats.

Developing standard GIS geodatabase schema helps new developers collect, format, and share their data. GeoMine can automatically transform attributes and disparate geographic projections into a standardized schema in a common projection. The GIS geodatabase is a reusable format for these data that can be modified for individual states' use. Users of ArcGIS GIS software can re-create the GeoMine schema by importing the XML workspace document into ArcCatalog. This will create a new geodatabase in Arc Catalog with a new set of feature classes, data elements and coded value domains. These classes will be an exact replica of the GeoMine schema and can be a good starting point for those with less developed GIS for working with coalmine permitting data.

Finding: The Pilot Project states created additional geospatial site layers, map locations and attribution for GeoMine under the OSMRE grants:

West Virginia Department of Environmental Protection

Progress made in creating geospatial data under the grant funding through 3/31/13:

- 3,517 currently permitted surface coal mining boundaries, including 571 from annual progress maps extending back to 2005;
- 46,334 environmental resource monitoring locations;
- 140 preparation plants on permits
- 2,939 Post Mining Land-use; and
- Scanned 3,400 of 4,000 AML Problem Areas to be georeferenced and digitized.

Kentucky Division of Mine Reclamation and Enforcement

Progress made in creating geospatial data under the grant through 3/31/13:

- 51,643 digitized surface coal mining boundaries and related features;
- 27,151 environmental resource monitoring locations; and
- 9,727 AML Problem Areas/Planning Units and AML problems.

Virginia Department of Mines, Minerals and Energy

Progress made in creating geospatial data under the grant through 3/31/13:

- 3,447 released surface coal mining boundaries;
- 365 active permits;
- 10,612 environmental resource monitoring locations; and
- 6,763 AML Problem Areas/Planning Units and problems.

The OSMRE Director approved additional GeoMine cooperative agreement grant funding for 2012 for the Pilot Project states. This continuation of grant funding will facilitate creation of additional geospatial coal mining data for GeoMine. Memoranda of Understanding were prepared detailing the geospatial data priorities for the 2013 work for each state.

OSMRE Tennessee Knoxville Field Office

The KFO GeoMine emphasis has been updating the status of permits entered in their Field Office Comprehensive Information System (FOCIS) database and adding permit revisions to their GIS. An AmeriCorps intern has updated status for over 1,200 legacy permit records by entering missing data such as permit issuance dates, expiration dates, coal seam data, and reclamation status if it could be determined. A two-year-old backlog of Federal program permit revisions was added to the KFO GIS, comprising 40 revisions on 22 permits. The AML Program Specialist for KFO has geo-referenced and digitized AML features from 81 paper maps. The recent work through 3/31/13 for KFO has resulted in:

- 288 digital currently permitted surface coal mining boundaries created;
- 280 released surface coal mining boundaries created;
- 2,732 total surface coal mining boundaries have been verified for TN;
- 2,128 digital AML features (point, lines, polygons) created; and
- 98 AML planning units and 311 AML problem areas digitized.

Objective 5. - Provide a GeoMine internet application with simple tools to allow search and download capabilities to permit reviewers and inspectors.

The GeoMine Viewer serves users by providing, for the first time, a single website that allows discovery of mining and reclamation geospatial data that is authoritative, trusted and available for users to both investigate an area of interest such as a watershed, and to download mine site boundaries and associated data in digital formats. The seven SMCRA state and 13 Federal layers can be displayed in any combination, allowing quick visual comparisons of mining sites and the surrounding hydrologic and environmental context. Previously, permit reviewers or inspectors would have to search paper permit files or visit multiple Federal and state websites to assemble this data in a piece-mill fashion. GeoMine serves as a "One-Stop-Shop" for the unique collection of nationwide coal map layers provided by partnering agencies.

Finding A. The GeoMine Viewer has tools to discover and download key geospatial layers related to coal mining and reclamation activities.

For discovery, the GeoMine Viewer has a search "widget". This widget allows the discovery of data by performing keyword searches on various data attributes. The features that are found are highlighted on the map. A user can automatically zoom to selected features and can find information about all of the feature's attributes.

Any feature on the GeoMine map can be queried by performing a mouse click on the feature on the map. All of the attribute data for the selected feature will be displayed.

Users can download subsets of the underlying data used to produce the GeoMine map. By using the download widget, an area can be drawn on the map and all of the data that intersect the area in selected layers will be downloaded in user selectable formats and in a choice of geographic projections.

The GeoMine Viewer also has a widget for downloading water quality data from the EPA STORET system. This widget will display water monitoring points on the map and will allow the user to select the points and download the data to a spreadsheet for external analysis.

Finding B. The GeoMine Viewer provides discovery and access to geospatial data, including specialized widgets to download hydrologic data in user-friendly formats – it does not incorporate analytic or modeling tools.

By design and team consensus, the GeoMine Viewer was developed to find and explore geospatial mining and reclamation data for an area of interest, and then download this data for further analysis if desired. Tools were developed for access to the STORET and NWIS hydrologic data. The widget for STORET and NWIS allows download of this data into user-friendly formats that can then be used in commercial off-the-shelf (COTS) or open source software. These COTS and open source software are readily available and have been refined to provide hydrologic and other modeling tools by expert developers. Also, agencies have invested significant resources in developing in-house tools for analysis; GeoMine is not intended to replace or duplicate these efforts.

Finding C. The GeoMine Viewer provides users with disabilities discovery and access to geospatial data.

Discovery and access to geospatial data in the GeoMine Viewer by individuals with disabilities under Section 508 was analyzed for Section 508 compliance on June 12, 2012. Section 508 is an Amendment to the Rehabilitation Act of 1973 that requires Federal agencies to make their electronic and information technology accessible to people with disabilities. A scan of the site was conducted using the on-line software compliance tool Cynthia Says – Web Content Accessibility Report by HiSoftware®.

The overall finding of the compliance report resulting from the site scan was that the GeoMine Viewer was 508 compliant, but certain enhancements would be desirable if approved for public use (Appendix M). The GeoMine Team has already implemented measures to facilitate access by individuals with disabilities that were recommended in the scan report:

- Provide a disclaimer concerning selecting a link in the two EPA 303d layers that advises the user that they are departing the existing web location in GeoMine and are following an external link to the EPA 303d website for additional information; and
- To better accommodate red/green color-blindness issues, the symbology for eAMLIS Outstanding/Completed Reclamation Projects has been changed from the existing red/green legend color scheme to an enhanced-contrast color scheme that addresses the red/green perception issue.

Finding D. Making Federal agency geospatial data available through a Federal Viewer Prototype allows discovery and access to a wide range of geospatial data layers pertinent to SMCRA, CWA, and ESA regulatory programs.

The Pilot Project has demonstrated that nationwide Federal geospatial and hydrologic data shared through the ongoing Pilot Project can immediately be made available to State, Tribal and Federal agency personnel that have responsibilities in their various programs. The data provided by the Federal agencies cover the entire country—not just the four Appalachian pilot project states[7]. The personnel that can take immediate advantage of this data include SMCRA technical staff and management in both the regulatory and AML programs; CWA staff and management in EPA and ACE; and FWS staff and management in administering the Endangered Species Act (ESA).

The Federal Viewer Prototype was deployed for a feedback testing campaign to several target groups:

I. **Alpha Testing--The GeoMine Interagency Team and SMCRA GeoCommittee (completed May 17, 2013).**
II. **Beta Testing--SMCRA Data Stewards** (including 42 SMCRA Data Stewards, 31 OSMRE-TIPS Steering Committee members and OSMRE-TIPS Team) **(completed May 31, 2013).**

The findings from the feedback campaign were complied, classified and prioritized to make impactful improvements in the
Federal Viewer Prototype user experience. These improvements are summarized as follows:

1) Functionality and usability enhancements – tailoring controls and widgets to create an easy-to-use user interface.
2) Additional geospatial layer creation – creating a prime farmland layer extracted from Natural Resources Conservation Service Soil Survey Geographic Database (SSurgo) soils data.
3) Making 508 compliance and other changes to accommodate special user needs where possible.
4) Bug fixes and performance enhancements.

The Version 3.0 Federal Viewer Prototype is planned for public release upon approval by the Interagency Team executives. This Federal Viewer Prototype will provide public access to SMCRA, CWA and ESA – related geospatial data layers in keeping the with new Executive Order 13642 of May 9, 2013 “Making Open and Machine Readable the New Default for Government Information”.

XIII. Alternatives and Recommended Alternative

Three scenarios were developed to aid executive decision-making in determining future GeoMine activities. The Executive Summary (Appendix Q of this report) and the GeoMine Viewer and Federal Viewer Prototype Factsheet (Appendix R) are intended to be used as

[7] The USACE will share data for when it is made publically available through its ORM2 public interface.

communication tools to agency executives to illustrate the benefits of GeoMine and summarize the alternatives.

Alternative 1: <u>Deploy the Federal Viewer Prototype for all Nationally-Available Federal Data Layers[8]; Discontinue the GeoMine Viewer.</u> Allow all contracts, grants, and support services and data sharing for the GeoMine Viewer to expire at the end of FY13. This includes discontinuing the GeoMine Viewer cloud web application. Upon acceptance of the GeoMine Pilot Project Report by agency executives, the Federal Viewer Prototype will be released to the public. Implications of this course of action, both positive and negative, are as follows:	
PROS	CONS
• Limited resources needed to deploy Federal Viewer Prototype. • State GIS data created through the Pilot Project will be usable by the State Regulatory Authorities in their own programs. • Over 63% of the currently permitted inspectable mine site boundaries in the U.S. already have been rendered digitally by the Pilot Project. • Lessons learned will be transferred via the Pilot Project report. • Access to Federal Viewer data by agencies, academics and the public will be available.	• No single-source access to SMCRA coal mining map data. • Ability to upload to or download from GeoMine Viewer eliminated. • Continued risk of data gaps in coal mining-related mapping data. Lack of ready access to coal permit and geospatial data. • States may abandon voluntary compliance with geospatial data standards for their own proprietary formats. • Due to costs and technical issues, states may decide not to share their data with other states or Federal regulatory authorities.

[8] The USACE will share data when it is made publically available through its ORM2 public interface.

Alternative 2: (Recommended by Interagency Team) ***<u>Deploy the Federal Viewer Prototype for all Nationally-Available Federal Data Layers[9] as Soon as Possible; GeoMine Viewer Deployed Nationwide with Public Access at Version 4.0 in early 2014.</u>*** The Federal Viewer would be deployed as a prototype until the GeoMine Viewer 4.0 is operational. Nationwide deployment of the GeoMine Viewer to the remaining SMCRA State, Federal and Indian Programs would be staged over a five-year period. As data is incorporated into GeoMine it would be made available to the agencies and the public. Implications of this course of action, both positive and negative, are as follows:	
PROS	CONS
• Voluntary participation by all SMCRA states in GeoMine will result in a "One-Stop-Shop" for national coal mining data. • Access and use of GeoMine for analysis by agencies, academics and the public immediately available. • GIS data created through the Pilot Project will be usable by all agencies. • Over 63% of the currently permitted inspectable mine site boundaries in the U.S. already have been rendered digitally by the Pilot Project. • Pilot Project states support GeoMine implementation for this alternative. • Public availability of data may reduce FOIA requests for these data.	• Deployment nationwide will require new Federal funding and assistance to SMCRA states.

[9] The USACE will share data when it is made publically available through its ORM2 public interface.

Alternative 3: <u>Deploy the Federal Viewer Prototype for all Nationally-Available Federal Data Layers[10] as soon as possible; GeoMine Viewer Deployed Nationwide with Immediate State/Federal/Tribal Access; Public Access Delayed.</u> Nationwide deployment to remaining SMCRA State, Federal and Indian Programs would be staged over a five-year period. As data is incorporated into GeoMine, it would be made immediately available to State, Federal and Tribal agencies only. Access to the public would be delayed until state and federal programs are more comfortable with public access.	
PROS	CONS
• Voluntary participation by all SMCRA states in GeoMine will result in a "One-Stop-Shop" for the unique collection of national coal mining data provided by partnering agencies. • Access and use of GeoMine for analysis made available immediately to <u>only</u> the agencies. • GIS data created through the Pilot Project will be usable by all agencies. • Over 63% of the currently permitted inspectable mine site boundaries in the U.S. already have been rendered digitally by the Pilot Project.	• Deployment nationwide will require new Federal funding and assistance to SMCRA states and tribes. • Public access to the GeoMine Viewer would be delayed. • Public and academic access to the data for study and public engagement not available in the near term. • While the GeoMine Viewer is not publically available there may be an increase in FOIA requests for these data.

After thorough discussion and deliberation by the Interagency Team, Alternative 2 was selected as superior and is recommended. Alternative 1, terminating the GeoMine Pilot Project services and not extending GeoMine nationally, was considered to have little merit as the Interagency Team realized the following benefits of extending GeoMine to additional partners nationally:

- The two-year project demonstrated the feasibility and value of sharing mapping data among the eight partners, thus reducing duplication of effort and improving efficiencies;
- It can add value by improving regional-level decision-making--critical coal mining-related data extending beyond individual state boundaries, including hydrologic and geologic data, will be more accessible to technical staff in multiple agencies, resulting in more-informed technical reports;
- The GeoMine Viewer is practical--it has easy to use tools that allows data search and download capabilities for permit reviewers, inspectors, scientists/engineers and program managers/executives;
- The project was technically successful: coal mining map layers and data are being shared routinely among all the partners and the innovative Amazon-Esri Cloud solution worked; and

[10] The USACE will share data when it is made publically available through its ORM2 public interface.

- Greater transparency of regional data shared between Federal, State and Tribal agencies will result in more responsible stewardship, improved customer service, increased productivity, and greater efficiency as it relates to the public interest.

Alternative 2 was preferred over Alternative 3 to maximize availability of data to SMCRA state and Federal agencies, as well as the public. This alternative also demonstrates governmental transparency and will likely reduce the number of FOIA requests.

XIV. GeoMine Deployment 5-Year Schedule and Cost Estimation

Goal: To carry out the Interagency Team Pilot Project recommendations through deploying GeoMine coal-mining data-sharing nationwide to all participating state, Tribal and OSMRE SMCRA Regulatory Authorities (RA) in sequential fiscal-year phases over a five-year period, including deployment of the GeoMine Viewer and Federal Viewer Prototype to SMCRA, CWA and ESA agencies and the public.

Organization and Governance: The deployment of the GeoMine Viewer and Federal Viewer Prototype will be guided via the established SMCRA GeoCommittee. The GeoCommittee was "created and chartered to discover, review, and promote geospatial technologies that increase the effectiveness and efficiencies of SMCRA organizations." The GeoCommittee members consist of representatives from the Interstate Mining Compact Commission (IMCC), the National Association of Abandoned Mine Land Programs (NAAMLP), the Western Interstate Energy Board (WIEB), the three OSMRE regions, and OSMRE Headquarters. Additional information on the GeoCommittee is on the TIPS website at http://www.tips.osmre.gov/Geospatial/Geocommittee.shtml. These activities will be coordinated with the other Federal agencies sharing data in GeoMine including USACE, EPA and FWS.

OSMRE's TIPS program will serve as the project lead and provide the web-based Cloud data sharing solution to accept geospatial coal-mining data from existing SMCRA RA GISs and CAD systems. As in the pilot project, the RAs will serve as GeoMine's authoritative data sources for coal mining activities under their SMCRA programs. RA data stewards will be the point of contact with GeoMine. The GeoCommittee, including IMCC, WIEB, and NAAMLP, will be enlisted to help facilitate outreach, state and Tribal participation, and to conduct workshops and training sessions.

Establishment of the National Coal–mining GIS (NCG): OSMRE will support the design, development and deployment of a new GIS application—the National Coal Mining GIS (NCG)—that can be used by RAs that do not have the necessary GIS technology expertise and IT systems.

The RAs for the four states involved in the Pilot Project had their own robust in-house GIS solutions that they had developed and maintained over the years that successfully provided GeoMine with needed data. It was recognized during the Pilot Project that some states and tribes do not have these capabilities to develop and maintain a GIS that can provide the necessary data to GeoMine; hence, they will need assistance. They are primarily expected to be states/tribes with a small and limited technical staff and/or a small number of active mines. These RAs will be provided access to NCG so that they can upload and maintain their own GIS data. The NCG is the vehicle to provide SMCRA RA data to GeoMine. Participation in

the NCG will be voluntary and will be decided on a case-by-case basis. During the review of this draft report the Interagency Team is seeking input from the states and tribes on the need for the NCG. It is envisioned that, as with GeoMine, NCG will be cloud-based.

The NCG will be designed, developed and tested during the first year of the 5-year phased schedule of GeoMine. NCG will then be deployed to the states/tribes that need it beginning in the second year. An IMCC survey in May of 2013 indicated that at least five RAs would utilize the NCG capabilities to house their coal mining geospatial data. For further details see the GeoMine Nationwide Deployment 5-Year Schedule and Cost Estimation sections below.

GeoMine Nationwide Deployment 5-Year Schedule: GeoMine will house, at a minimum, the seven nationwide coal-mining map layers using RA-contributed data. GeoMine will use and expand the existing Cloud computing capability for flexibility and functionality, and will deploy and maintain multiple web-based Viewers for users. GeoMine will either employ the current Amazon-Esri Cloud-based solution that has now achieved FedRAMP security accreditation, or one of the other DOI-approved cloud vendor solutions. The GeoMine Viewer Cloud solution will be upgraded to include the “lessons learned” and best practices from the Pilot Project, and be structured to operate in a standard GIS operations and maintenance mode. A Federal Viewer Prototype will be deployed at the onset to SMCRA, CWA and ESA agencies and the public. Once the infrastructure components (servers, cloud services, security, etc.) of GeoMine are built up to full operations specifications, the GeoMine Viewer 4.0 will be ready for public access. When the GeoMine Viewer 4.0 is released in early 2014, the Federal Viewer Prototype will be discontinued, as it will be redundant (see Table 6. GeoMine Nationwide Deployment 5-Year Schedule).

The GeoMine nationwide deployment is projected to occur in five fiscal-year based phases, with anticipated completion by the end of year five. However, implementation goals will be dependent on the funding and resources made available to the project. The team fully expects SMCRA RAs to volunteer to join GeoMine, as several have already expressed interest through their SMCRA data stewards.

The major milestones for the GeoMine Phase I deployment in the first year will involve the first cohort of volunteer SMCRA states/tribes. Phase I will focus on obtaining Federal cooperative agreement grants for these states/tribes to digitize map data, develop and deploy an upgraded GeoMine Viewer v.4.0 and implement regular operations and maintenance, and development of the NCG for SMCRA RAs needing GIS capability. The Phase I practices and procedures will be applied to subsequent fiscal year phases II-V, with appropriate modifications.

The GeoMine Nationwide Deployment Schedule below provides additional details and estimated completion dates for key deployment tasks. If Alternative 2 is approved, a detailed project plan for the 5-year project would be developed.

Table 6. GeoMine Nationwide Deployment 5-Year Schedule

PHASE I			
#	Milestones	Target Start/End Dates	Assigned To
1	**Deploy GeoMine Federal Viewer Prototype** for use by partner agencies and the public	As soon as possible	OSMRE-GeoMine Team
2	**Recruit SMCRA RA Volunteers** to participate and share data with GeoMine**.**	9/1/13-1/1/14	OSMRE-GeoMine Team, GeoCommittee, IMCC, WEIB and NAAMLP
3	**Develop GeoMine Deployment Project Plan**	10/1/13-2/1/14	OSMRE-GeoMine Team
4	**Award OSMRE Federal Cooperative Agreements** to SMCRA RA volunteers to digitize their coal mining geospatial data for their GISs and GeoMine sharing.	3/1/14	RAs and OSMRE-GeoMine Team
5	**Deploy an upgraded GeoMine Viewer v.4.0** and develop infrastructure to support regular operations and maintenance (including appropriate enhancements in Appendix O).	9/1/13-2/15/14	Morlock, Hale
6	**Discontinue the Federal Viewer Prototype** and its infrastructure**.**	2/15/13	Morlock, Hale
7	**NCG Developed, Tested and Deployed**	10/1/13-10/1/14	OSMRE-GeoMine Team and RAs
8	**RA Digital Data Created and Shared to GeoMine.** RAs create digital data by scanning and digitizing permit files as necessary for the Phase I volunteers.	1/31/14-9/31/14	SMCRA RAs
9	**GeoMine Viewer Deployment to SMCRA, CWA, and ESA Users with Phase I Participant Data Added**	2/1/14-10/1/14	GeoMine Team
PHASES II-V			
10	**Phase II - Deployment of GeoMine to the next cohort of remaining SMCRA states Nationwide** using methodologies developed in Phase I (similar milestones as Phase I)	10/1/14-9/30/15	GeoMine Team
11	**Phase III - Deployment of GeoMine to the next cohort of remaining SMCRA states Nationwide** using methodologies developed in previous phases (similar milestones as Phase I)	10/1/15-9/30/16	GeoMine Team
12	**Phase IV - Deployment of GeoMine to the next cohort of remaining SMCRA states Nationwide** using methodologies developed in previous phases (similar milestones as Phase I)	10/1/16-9/30/17	GeoMine Team
13	**Phase V - Deployment of GeoMine to the next cohort of remaining SMCRA states Nationwide** using methodologies developed in previous phases (similar milestones as Phase I)	10/1/17-9/30/18	GeoMine Team

Cost Estimation:
Projected costs for carrying out the GeoMine Pilot Project report recommendations have been categorized in the following discussion, and are focused on the seven key regulatory SMCRA layers that were approved as foundational to the project by the Interagency Team. In the future, AML layers may be included in GeoMine at minimal cost, as many AML programs have established GIS for their AML projects.

1. Federal Cooperative Agreements with States - SMCRA RA Data Acquisition/Transfer to GeoMine
In calculating costs for states/tribes to digitize permit data using cooperative agreement grants, three factors were considered: 1) the total number of active permits in each state, 2) a feature multiplier to account for all of the data associated each permit boundary and, 3) the unit cost to digitize individual features. The following paragraphs detail each of these factors.

Based on Evaluation Year (EY) 2012 REG8 data provided to OSMRE by all the States and Tribes, there are 7,440 active coal-mining permits nationwide. To date, the GeoMine Pilot Project has received digital permit boundaries for 4,682 (63%) of this total that are located in the four Pilot Project states. The remaining 2,758 active coal-mining permits are located in 23 states and 4 Tribal lands nationwide. The number of permit boundaries that would be digitized in Phase I of the Pilot Project is estimated at one-fifth of this remaining total, or about 552 permit boundaries.

Experience with the Pilot Project states indicates that, for Title V permits, there are many additional features and attributes associated with each permit boundary, such as coal refuse disposal sites, coal preparation plants, bond status, etc., that are collected during the digitization process. To account for the time and cost of adding these additional data elements, an active permit multiplier factor was calculated using the actual number of features digitized by Pilot Project states during cooperative agreement grant work. In calculating the average ratio of features per active permit, ERMLs and underground coal mine extents were not counted since they are derived from non-ADS sources, and are not digitized in association with active permit boundaries by SMCRA RAs. The calculated average active permit multiplier is 16, so for example, if a State has 100 active permits, the expected maximum number of features to digitize would be 1,600.

For phase I of the GeoMine deployment, a cost of $56.34 per digitized spatial feature, was determined, based on the grant funding drawdowns under the FY11-12 Pilot Project cooperative agreements (see Appendix N). Unit costs for the four pilot project States range from $4.22 to $56.34 (the interagency team is still discussing costs associated with digitizing, thus these costs may change somewhat). The lowest unit costs are associated with Kentucky and West Virginia, which coincidentally have the highest number of active permits in the U.S. This is likely the result of these states developing economies of scale for digitizing data. Once a digitizing system is developed, the cost per unit should decrease as operators become more experienced and efficient. The highest unit cost of the Pilot Project states was chosen because this figure better accommodates the remaining states/tribes by considering their smaller numbers of active permits, and high project initiation costs.

The costs for Phase I Federal cooperative agreement funding needs were derived by use of a formula that multiplies the anticipated number of permits to be digitized in Phase I, the feature

multiplier for each permitted boundary, and the unit cost per boundary to arrive at a maximum estimated cost[11] for the initial phase of OSMRE Federal cooperative agreement grants. Therefore the formula to derive the Phase I cost to produce at least 20% percent of the remaining actively-permitting mine boundaries is:

> 552 (Phase I active permits) X 16 (feature multiplier) X $56.34 (cost per digitized feature) = $497,595.

2. GeoMine OSMRE Operations and Maintenance

As an operating GIS project, GeoMine will require a dedicated OSMRE personnel commitment to manage and support the deployment and upgrade of the GeoMine Viewer 3.0, and the day-to-day back-office operations such as GIS database administration. The deployment of the new GeoMine Viewer from Pilot Project status to operations status will incorporate bug fixes and user suggestions from feedback testing and the appropriate enhancements listed in Appendix O that have been collected during the Pilot Project.

The estimated OSMRE level of effort for GeoMine operations and maintenance is three FTE:

- one Project Manager,
- one GIS System Administrator, and
- one GIS/Data Analyst.

Program funding through the GeoMine account will be necessary for GeoMine computing and database support, maintenance, and appropriate expansion. These annual recurring costs are mainly for the staffing, Cloud infrastructure services contract and the GeoMine Viewer development and maintenance (currently through an Interagency Agreement with the USGS).

Costs associated with a Federal Viewer Prototype have been minimal, as Federal data has been provided through existing Federal agency services, and the primary cost has been establishing and maintaining a separate virtual GIS Server instance in the Cloud.

Software

As described in Chapter X, and detailed in Appendix I, the data processing for GeoMine is performed using Safe Software's Feature Manipulation Engine (FME). Using FME enables GeoMine to acquire data from many locations in many formats and homogenize them into individual map layers that are displayed on the GeoMine Viewer.

The FME server enables automatic connection to all of the different data sources and performs the conversion and re-projection necessary to transform the original data into our common map layers. FME also checks for changes from our current data and only reads and adds or replaces new or updated data, which saves thousands of round trips to the web server. A single copy of this software is sufficient to perform the GeoMine data processing.

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[11] These costs are estimated as "worst case", because some of the remaining SMCRA RAs already maintain digital permit boundaries in their GIS or CAD systems. These digital boundaries could be transferred to GeoMine from SMCRA RA GIS or CAD systems for much less than the cost of digitizing paper data ($1.07 per permit and associated features vs. $56.34 ; based on Pilot Project states, the ratio of transferred to digitized features is about 8:1.

The Secure Socket Layer (SSL) Certificates are software that are used to encrypt communication over the Internet, and are used to provide security for these communications. The SSL software is used on each computer server.

The Camtasia Studio software is used to produce marketing and outreach media about GeoMine. The software is easy to use and allows operations in the GeoMine Viewer to be demonstrated through screen-capturing GeoMine functions.

Cloud and Web-Based Viewer Services

As described in Chapter X, and detailed in Appendix J, the ESRI Amazon Cloud services allow several important advantages over traditional computer technology:

- the Cloud is a neutral ground for storage and integration of GIS data from all member sources (a key consideration for the SMCRA state partners);
- development of databases and web-based GIS tools are greatly aided by the ability to quickly test new configurations without the need to change physical computer systems; and
- the Cloud has high capacity networks that make accessing web-based applications and data very easy from any Internet connected location.

The existing Cloud capability will be expanded to provide sufficient capacity for nationwide SMCRA GIS data, over and above the four-state Pilot Project extent.

The GeoMine Viewer serves as the access point to GeoMine from any Internet-connected device. As described in Chapter X, and in technical detail in Appendix I, the GeoMine web mapping application was developed using ArcGIS application programming interface (API) for Adobe's Flex web application environment, and housed on the Cloud-based ArcGIS Server. Flex is an open source application framework for building web applications that work consistently on all major Internet browsers. Contractor services obtained through the USGS provided the highly specialized and unique Flex application programming expertise that has developed, designed and maintained the GeoMine web application in the Cloud. This also included extensive programming for creating functionality in the Flex framework of the GeoMine web-mapping application. It is anticipated that the need to maintain and enhance multiple viewers will require additional programming support over the current Pilot Project level of effort.

3. GeoMine SMCRA States Operations and Maintenance for GIS Data

In order to update permit boundaries and status, and to maintain GIS data for active permits in the four Pilot Project states and for each of the new SMCRA RA participants, resources will be needed, as indicated in Table 7 below.

To arrive at an estimate of SMCRA RA operations and maintenance (O&M) costs for participating SMCRA RAs in GeoMine, the cumulative total Federal cooperative agreement funds needed to complete the digitization of all coal mining permits nationwide was first estimated. For the four Pilot Project states, total Federal cooperative agreement funds awarded for FY11-12 were $1,121,264. Projected cooperative agreement funding to digitize remaining SMCRA RA data over the five-year nationwide GeoMine deployment is estimated at $2,589,505. Total Federal cooperative agreement funds would therefore be about $3,710,769.

To estimate the level of effort needed for each RA to handle their SMCRA data O&M costs, the REG8 percentage change in permit number between Evaluation Year (EY) 2011 and 2012 was calculated. This percentage should reflect a level of effort to keep SMCRA RA updates of permit boundaries and status current after they have digitized their active permits. Looking at the REG8 data for 2012, the total number of new permits issued and phase III bond releases for each RA were summed to obtain a sense for workloads required of SMCRA RA GIS personnel to process permit data on an annual basis. The average change in number of permits within the Pilot Project states from 2011 to 2012 is 5.0 percent of the total active permits present in 2012. This percentage was used to estimate the annual SMCRA RA costs for O&M. Minor costs associated with permit revisions and attribute changes were not considered in this calculation. If only the Pilot Project states were considered, the 5% value would amount to about $14,000 a year for O&M, which is roughly 292 hours of work by a GIS professional per year.

To arrive at an annual estimate of O&M costs as new RAs are added, we multiplied the cumulative total of MOU funds awarded for each year by the 5 percent permit change factor. For example, in 2014, cooperative agreement funding is estimated at $497,595. This is added to the $1,121,264 FY11-12 Pilot Project funding to equal $1,618,859 in total cumulative grants (see Table 7 below). Multiplying this by the 5% of average permit change, results in an annual SMCRA RA O&M cost of $80,943 for those RAs that have completed development (which is the Pilot Project states plus 20 percent of the remaining RAs that need to be added). Out-years FY15-18 reflect the addition of new participating SMCRA RAs and the on-going O&M of previously added RAs. In FY19, nationwide O&M should reach a steady state, in which the FY18 cost is increased only by the inflation factor (1.02).

Therefore, the formula to derive the Phase I cost to update and maintain the actively-permitted mine boundaries is:

$1,618,859 (anticipated cooperative agreement funding through Phase I) x .05 (average percentage of permit change) = $80,943.

4. <u>NCG Design, Development and Deployment</u>

NCG development will provide a common GIS for SMCRA RAs that do not plan to establish their own organizational GIS. The states/tribes using the NCG will be responsible for compiling and preparing their coal mining map data into GIS-ready formats. One common virtual GIS server in the Amazon/ESRI Cloud will be dedicated to the NCG. Funding for two additional OSMRE regional GIS data analysts will be needed to assist and train states/tribes that have minimal GIS capability in GIS data preparation techniques and how to transfer their data to GeoMine. Travel funding for the regional GIS staff will be necessary to work with and train the states/tribes. Table 7 provides detailed cost breakdowns for each of the four cost categories described in the above discussion.

Table 7. Estimated Costs for the GeoMine Project FY14-18

Category	Description	FY14 Funds	FY15 Funds	FY16 Funds	FY17 Funds	FY18 Funds	Total FY14-18	Out Year Annual Operations and Maintenance (beginning in FY19)
1. Federal Cooperative Agreements - data acquisition/transfer to GeoMine								
OSMRE Federal Cooperative Agreement	Funds to SMCRA States/Tribes	$497,595	$507,547	$517,698	$528,052	$538,613	$2,589,505	
2. GeoMine OSMRE Operations and Maintenance								
Software	Feature Manipulation Engine (FME) Software Maintenance	$5,000	$5,100	$5,202	$5,306	$5,412	$26,020	$5,520
	Security Software--Secure Socket Layer (SSL) Certificates (4) for OSMRE	$860	$877	$895	$913	$931	$4,476	$950
	Camtasia Software Maintenance	$900	$918	$936	$955	$974	$4,683	$993
Cloud and Viewer Services	Contract for ESRI Amazon Cloud Services	$50,000	$51,000	$52,020	$53,060	$54,122	$260,202	$55,204
	Viewer Developmen t Services (IAG with USGS)	$150,000	$153,000	$156,060	$159,181	$162,364	$780,605	$165,611
	Federal GIS Server Instance	$4,200	$4,284	$4,370	$4,457	$4,546	$21,857	$4,637
OSMRE Personnel	3 FTE	$300,000	$306,000	$312,120	$318,362	$324,730	$1,561,212	$331,225
Subtotal-GeoMine O & M Costs		$510,960	$521,179	$531,603	$542,234	$553,079	$2,659,055	$564,140
3. GeoMine SMCRA State Operations and Maintenance (O&M) for GIS Data								
SMCRA State O&M		$80,943	$106,320	$132,205	$158,608	$185,538	$663,615	$189,249
4. GeoMine NCG Design, Development and Deployment costs								
OSMRE Personnel	2 FTE	$200,000	$204,000	$208,080	$212,242	$216,486	$1,040,808	$220,815
Contract for ESRI Amazon Cloud Services (DLT, Inc.)	Cost to stand-up one common NCG Server Instance	$4,200	$4,284	$4,370	$4,457	$4,546	$21,857	$4,637
OSMRE Travel Support	Support to State/Tribal offices and briefing travel	$10,000	$10,200	$10,404	$10,612	$10,824	$52,040	$0
Subtotal - NCG		$214,200	$218,484	$222,854	$227,311	$231,856	$1,114,705	$225,452
Summary By Personnel and Non-Personnel								
OSMRE Personnel - 5 FTE		$500,000	$510,000	$520,200	$530,604	$541,216	$2,602,020	$552,040
OSMRE Non - Personnel Costs		$722,755	$737,210	$751,955	$766,993	$782,332	$3,761,245	$237,552
Summary								
Grand Total FY14-18		$1,303,698	$1,353,530	$1,404,360	$1,456,205	$1,509,086	$7,026,880	
Annual Operations and Maintenance, beginning FY19								$978,841

Appendices

Appendix A: Agency Geospatial Datasets Considered for GeoMine

#	Geodata Layer	Agency	ADS	Web Service or Digital Data Format	Geometry	Comments
1	**Proposed Permit Boundaries**	KY DMP	KY DMP	Local	Polygons	
2	**Proposed Coal Mining Permit Boundaries**	OSMRE-TN	KFO GIS	ArcSDE Geodatabase	Polygons	
3	**Application Permit Boundaries**	VA DMME	DMME GIO	Potential Webservice (ArcSDE Enterprise GDB)	Polygon	Proposed boundaries are not included until an application has been submitted and appears no additional boundary adjustment will be made
4	**Pending Permit**	KY DMP	KY DMP	local\web	Point	
5	**Currently permitted Permits**	KY DMP	KY DMP	local\web	Point	
6	**Currently permitted Coal Mining Permit Boundaries**	OSMRE-TN	KFO GIS	ArcSDE Geodatabase	Polygons	
7	**Permit Boundary**	KY DMP	KY DMP	Local	Polygons	
8	**Permit Boundaries**	WV-DEP	TAGIS	Webservice (ArcSDE Geodatabase)	Polygons	
9	**Permit Boundaries**	VA DMME	DMME GIO	Potential Webservice (ArcSDE Enterprise GDB)	Polygon	All existing permits with "Currently permitted", "Completion Letter" or "Completion Report" status
10	**Released Permit Boundaries**	VA DMME	DMME GIO	Potential Webservice (ArcSDE Enterprise GDB)	Polygon	Released permit boundaries 1996-Current
11	**Reclaimed Coal Mining Boundaries**	OSMRE-TN	KFO GIS	ArcSDE Geodatabase	Polygons	
12	**Released Permit Locations**	VA DMME	DMME GIO	Potential Webservice (ArcSDE Enterprise GDB)	Point	Locations of released permits
13	**Released Permits**	KY DMP	KY DMP	local\web	Point	
14	**Permit Boundary Haul Roads**	KY DMP	KGS	Local	Polygons	
15	**Permits (All Grouped)**	KY DMP	KY DMP	local\web	Points	
16	**Mined Out Areas**	KY DMP	Office of Mine Safety and License\ Revenue	local\web	Polygons	

#	Geodata Layer	Agency	ADS	Web Service or Digital Data Format	Geometry	Comments
17	**Currently permitted Mine License**	VA DMME	DMME GIO	Potential Webservice (ArcSDE Enterprise GDB)	Point	locations of mine health and safety licenses
18	**Reclamation Status**	VA DMME	DMME GIO	Potential Webservice (ArcSDE Enterprise GDB)	Polygon	Permit area classified as disturbed, regraded, vegetated
19	**Bonding Status**	VA DMME	DMME GIO	Potential Webservice (ArcSDE Enterprise GDB)	Polygon	Permit area in phase bond release process - I,TECHNOLOGY PHASE,TECHNOLOGY PHASEI
20	**Post-mining Land Use**	VA DMME	DMME GIO	Potential Webservice (ArcSDE Enterprise GDB)	Polygon	Permit area approved Post-mining Land Use classifications
21	**Application Post-mining Land Use**	VA DMME	DMME GIO	Potential Webservice (ArcSDE Enterprise GDB)	Polygon	Proposed Mining Underground/Unit - underground mine limits in applications
22	**Permitted Post Mining Land Use**	VA DMME	DMME GIO	Potential Webservice (ArcSDE Enterprise GDB)	Polygon	Permitted - Proposed Mining Underground/Unit - underground mine limits in applications
23	**Released Post Mining Land Use boundaries**	VA DMME	DMME GIO	Potential Webservice (ArcSDE Enterprise GDB)	Polygon	Boundaries of released post-mining land use types
24	**Hollow fills**	KY DMP	Division of Mine Permits (KY DMP)	Local	Polygons	
25	**Hollow fills**	WV-DEP	TAGIS	Webservice (ArcSDE Geodatabase)	Polygons	
26	**Fills**	OSMRE-TN	KFO GIS	ArcSDE Geodatabase	Polygons	
27	**Application Fills**	VA DMME	DMME GIO	Potential Webservice (ArcSDE Enterprise GDB)	Polygon	Fill footprints proposed in permit applications
28	**Permitted Fills**	VA DMME	DMME GIO	Potential Webservice (ArcSDE Enterprise GDB)	Polygon	Permitted Excess Spoil Material Disposal - Fill Footprint
29	**Released Fills**	VA DMME	DMME GIO	Potential Webservice (ArcSDE Enterprise GDB)	Polygon	Permanent fills that have been released by permit
30	**Impoundments**	KY DMP	Mining	Local	Point	
31	**Active In stream Monitoring**	VA DMME	DMME GIO	Potential Webservice (ArcSDE Enterprise GDB)	Point	Currently being monitored as part of permit requirements - compliance monitoring
32	**Inactive In stream Monitoring**	VA DMME	DMME GIO	Potential Webservice (ArcSDE Enterprise GDB)	Point	Previously monitored - permit released or monitoring terminated - compliance monitoring

#	Geodata Layer	Agency	ADS	Web Service or Digital Data Format	Geometry	Comments
33	**Active NPDES Monitoring**	VA DMME	DMME GIO	Potential Webservice (ArcSDE Enterprise GDB)	Point	Currently being monitored as part of permit requirements - compliance monitoring
34	**Inactive NPDES Monitoring**	VA DMME	DMME GIO	Potential Webservice (ArcSDE Enterprise GDB)	Point	Previously monitored - permit released or monitoring terminated - compliance monitoring
35	**Active Rainfall Monitoring**	VA DMME	DMME GIO	Potential Webservice (ArcSDE Enterprise GDB)	Point	Currently being monitored as part of permit requirements - compliance monitoring
36	**Active Groundwater Monitoring**	VA DMME	DMME GIO	Potential Webservice (ArcSDE Enterprise GDB)	Point	Currently being monitored as part of permit requirements - compliance monitoring
37	**Inactive Groundwater Monitoring**	VA DMME	DMME GIO	Potential Webservice (ArcSDE Enterprise GDB)	Point	Previously monitored - permit released or monitoring terminated - compliance monitoring
38	**Inactive Rainfall Monitoring**	VA DMME	DMME GIO	Potential Webservice (ArcSDE Enterprise GDB)	Point	Previously monitored - permit released or monitoring terminated - compliance monitoring
39	**Mine maps Index (yearly deep mine maps)**	KY DMP	Office of Mine Safety and License\ Revenue	local\web	Polygons	
40	**Mine maps Index(KY DMP)**	KY DMP	KY DMP	local\web	Polygons	
41	**Underground Mining Extent**	WV-DEP	TAGIS	Webservice (ArcSDE Geodatabase)	Polygons	
42	**Underground Mine Extents**	VA DMME	DMME GIO	Potential Webservice (ArcSDE Enterprise GDB)	Polygon	Underground mine extents
43	**Abandoned Mine Land Features**	VA DMME	DMME GIO	Potential Webservice (ArcSDE Enterprise GDB)	Point, Line, Polygon	Abandoned Mine land features - AMLIS categories
44	**Abandoned Mine Land Administrative Boundaries**	VA DMME	DMME GIO	Potential Webservice (ArcSDE Enterprise GDB)	Polygon	AML - Planning Units, Problem Areas, Project Sites
45	**Abandoned Mine Licenses**	VA DMME	DMME GIO	Potential Webservice (ArcSDE Enterprise GDB)	Point	locations of mine health and safety licenses
46	**Coal Exploration Permits**	VA DMME	DMME GIO	Potential Webservice (ArcSDE Enterprise GDB)	Polygon	Coal Exploration Notices and permits
47	**Geologic Sample Points**	VA DMME	DMME GIO	Potential Webservice (ArcSDE Enterprise GDB)	Points	Geologic Sample locations submitted with a permit application

#	Geodata Layer	Agency	ADS	Web Service or Digital Data Format	Geometry	Comments
48	**Lineaments**	VA DMME	DMME GIO	Potential Webservice (ArcSDE Enterprise GDB)	Line	geologic lineaments - Faults
49	**Coal Outcrops**	VA DMME	DMME GIO	Potential Webservice (ArcSDE Enterprise GDB)	Line	coal outcrops
50	**Active Gas Wells**	VA DMME	DMME GIO	Potential Webservice (ArcSDE Enterprise GDB)	Point	Gas Well locations
51	**Pending Gas Wells**	VA DMME	DMME GIO	Potential Webservice (ArcSDE Enterprise GDB)	Point	Gas Well locations
52	**Permitted Gas Wells/Undrilled**	VA DMME	DMME GIO	Potential Webservice (ArcSDE Enterprise GDB)	Point	Gas Well locations
53	**Slope**	VA DMME	DMME GIO	Potential Webservice (ArcSDE Enterprise GDB)	Polygon	Degree Slope elevation
54	**Contour**	VA DMME	DMME GIO	Potential Webservice (ArcSDE Enterprise GDB)	Line	5ft contours generated from DTM's
55	**Historic Geologic Maps**	VA DMME	DMME GIO	Potential Webservice (ArcSDE Enterprise GDB)	Raster	Raster - Scanned georeferenced images
56	**Technical Investigations**	VA DMME	DMME GIO	Potential Webservice (ArcSDE Enterprise GDB)	Point	locations of technical investigations and associated attribution
57	**Wetlands**	US FWS	NWI Madison office - Tom Dahl	WMS	Polygon	
58	**Threatened & Endangered Species**	US FWS	iPaC/US EPA MIRA/ or USFWS Ecological Services - Herb Bergquist	Possible Web service/ or Geodatabase	Polygon	Data "resolution or scale" may be dependent on the selected source agency or program.
59	**Candidate Species**	US FWS	iPaC/US EPA MIRA/ or USFWS Ecological Services - Herb Bergquist	Possible Web service/ or Geodatabase	Polygon	Data "resolution or scale" may be dependent on the selected source agency or program.

#	Geodata Layer	Agency	ADS	Web Service or Digital Data Format	Geometry	Comments
60	**Species of Special Concern**	US FWS	iPaC/US EPA MIRA/ or USFWS Ecological Services - Herb Bergquist	Possible Web service/ or Geodatabase	Polygon	Data "resolution or scale" may be dependent on the selected source agency or program.
61	**Critical Habitat**	US FWS	iPaC/US EPA MIRA/ or Ecological Services Field Offices/Regional Offices	Possible Web service/ or Geodatabase	Polygon	Data "resolution or scale" may be dependent on the selected source agency or program.
62	**Watershed Boundary Data (WBD)**	USEPA	US EPA Office of Water	ArcGIS Server Webservice (WATERSGEO)	Polygon	current watersheds
63	**Legacy Hydrologic Units**	US EPA	US EPA Office of Water - ATTAINS program	ArcGIS Server Webservice (WATERSGEO)	Polygons	Includes polygon boundaries for HUC 2 through HUC 8 level watersheds
64	**NHD-Plus 1:100k**	USEPA / USGS	US EPA Office of Water	ArcGIS Server Webservice (Multiple)	Points, Lines, Polygons	Includes catchments, flow lines, hydrography, etc.
65	**Total Maximum Daily Loads (TMDL's)**	USEPA	US EPA Office of Water	Spatial - ArcGIS Server Webservice (WATERSGEO) ; Attributes - separate database connection	Points, Lines, Polygons	Attributes example - http://www.epa.gov/waters/tmdl/expert_query.html
66	**STORET/NWIS Water Monitoring Locations**	USEPA/USGS	US EPA Office of Water/USGS Water Resources Division	ArcGIS Server Webservice (WATERSGEO)	Points	
67	**305(B) Assessed Waters**	USEPA	US EPA Office of Water	Spatial - ArcGIS Server Webservice (WATERSGEO) Attributes separate database connection	Points, Lines, Polygons	Attributes example - http://www.epa.gov/waters/data/attributes.html
68	**Permit Locations**	USACE	ORM	Webservice (ArcSDE Geodatabase)	Shapefiles	
69	**Mitigation project Locations**	USACE	ORM	Webservice (ArcSDE Geodatabase)	Shapefiles	
70	**Jurisdictional Determinations**	USACE	ORM	Webservice (ArcSDE Geodatabase)	Shapefiles	

#	Geodata Layer	Agency	ADS	Web Service or Digital Data Format	Geometry	Comments
71	**National Hydrography Dataset HUC 12 Watershed Boundaries**	USGS	National Geospatial Program	Webservice (ArcSDE Geodatabase)		
72	**National Hydrography Dataset Surface Waters Dataset**	USGS	National Geospatial Program	Webservice (ArcSDE Geodatabase)		
73	**National Land Cover Database**	USGS	National Geospatial Program	Webservice (ArcSDE Geodatabase)		
74	**National Transportation Dataset**	USGS	National Geospatial Program	Webservice (ArcSDE Geodatabase)		
75	**National Orthoimagery Data**	USGS	National Geospatial Program	Webservice (ArcSDE Geodatabase)		
76	**National Elevation Dataset**	USGS	National Geospatial Program	Webservice (ArcSDE Geodatabase)		

Appendix B: Pilot Project Schema and Coded Value Domains Derived from ASTM D7780 – 12 Standards

The Pilot Project geodatabase schema was designed for Internet access. After some experimentation, the workgroup decided that it would be best to use a single database table to store attributes for each geodatabase feature class instead of having related tables. For most of the standard representations, this did not present a problem since there was a one-to-one relationship between attributes and a particular feature. However, there were a few feature types in the ASTM standard that had one-to-many relationships. For instance, the standard allows for several mining types, e.g., contour, underground, auger, etc., to be present within one permit. For mining type, the workgroup decided to add Boolean columns to the table for each mining type so that a particular mining type could either be present (true) or absent (false). In some cases, especially for pre-SMCRA mines, the mining type might not be known so the mine types are unknown (null).

In designing the database, the workgroup wanted the end user to know what the column names really mean without having to use some lookup table that gives the definition of the column name. When creating a geodatabase in ArcGIS, there is the capability to assign aliases to the column names. These aliases show up in the subsequent web services and make it much easier for the user to understand the data.

The following schema and coded domain diagrams show the logical data structure of the GeoMine key layers that were derived from the ASTM coal mining operations standards.

Coal Refuse

Simple feature class
geomine.sde.coal_refuse

Geometry Polygon
Contains M values No
Contains Z values No

Field name	Data type	Allow nulls	Default value	Domain	Precision	Scale	Length	Aliases
objectid	Object ID							
permittee	String	No					60	Permittee
permit_status	Short integer	No		CoalmineOPStatus	5			Permit Status
permit_id	String	No					40	Permit ID
national_id	String	No					40	National Permit ID
msha_id	String	Yes					40	MSHA ID
impounding_feature	Short integer	Yes		YesNo	5			Impounding Feature (Y/N)
design_refuse_volume	Double	Yes			38	8		Design Refuse Impounding Volume (cubic yards)
reported_refuse_volume	Double	Yes			38	8		Reported Refuse Impounded Volume (cubic yards)
normal_pool_elevation	Double	Yes			38	8		Normal Pool Elevation (feet)
refuse_placement_status	Short integer	Yes		PlacementStatus	5			Coal Refuse Feature Placement Status
calculated_area	Double	No			38	8		Calculated Area (acres)
reported_area	Double	Yes			38	8		Reported Area (acres)
edit_date	Date	No			0	0	36	State/Tribe Defined Edit Date
information_link	String	Yes					128	Information Hyperlink
contact	Short integer	No		Contact	5			Contact
comment	String	Yes					256	Comment
shape	Geometry	Yes						
st_area(shape)	Double	No			0	0		st_area(shape)
st_length(shape)	Double	No			0	0		st_length(shape)

Coded value domain
CoalmineOPStatus

Description Domain Definitions for coalmine_op_status
Field type Short integer
Split policy Default value
Merge policy Default value

Code	Description
0	Unknown
1	Active
2	Pending
3	Inactive
5	Revoked
6	Initial (Interim) Program
4	Not Applicable
7	Released

Coded value domain
YesNo

Description Domain Definition for Y/N attributes
Field type Short integer
Split policy Default value
Merge policy Default value

Code	Description
0	N
1	Y

Coded value domain
PlacementStatus

Description Domain Definition for placement_status
Field type Short integer
Split policy Default value
Merge policy Default value

Code	Description
0	Unknown
1	Proposed
2	Active (ongoing placement)
3	Inactive (placement has ceased)
4	Complete

Coded value domain
Contact

Description Domain Definitions for contact
Field type Short integer
Split policy Default value
Merge policy Default value

Code	Description
1	Virginia Dept. of Mines, Minerals and Energy; Big Stone Gap, VA; +1.276.523.8193
2	West Virginia Department of Environmental Protection, Division of Mining and Reclamation; Charleston, WV; +1.304.926.0490
3	Kentucky Energy and Environment Cabinet, Department of Natural Resources, Division of Mine Permits; Frankfort, KY; +1.502.564.6940
4	US Office of Surface Mining, Tennessee Field Office; Knoxville, TN; +1.865.545.4103

Coal Preparation Plant

Simple feature class
geomine.sde.coal_preparation_plant

Geometry Point
Contains M values No
Contains Z values No

Field name	Data type	Allow nulls	Default value	Domain	Prec-ision	Scale	Length	Aliases
objectid	Object ID							
permittee	String	No					60	Permittee
permit_status	Short integer	No		CoalmineOPStatus	5			Permit Status
permit_id	String	No					40	Permit ID
national_id	String	No					40	National Permit ID
coarse_refuse	Short integer	Yes		YesNo	5			Coarse Refuse (Y/N)
fine_refuse	Short integer	Yes		YesNo	5			Fine Refuse (Y/N)
edit_date	Date	No			0	0	36	State/Tribe Defined Edit Date
information_link	String	Yes					128	Information Hyperlink
contact	Short integer	No		Contact	5			Contact
comment	String	Yes					256	Comment
shape	Geometry	Yes						

Coded value domain
CoalmineOPStatus

Description Domain Definitions for coalmine_op_status
Field type Short integer
Split policy Default value
Merge policy Default value

Code	Description
0	Unknown
1	Active
2	Pending
3	Inactive
5	Revoked
6	Initial (Interim) Program
4	Not Applicable
7	Released

Coded value domain
YesNo

Description Domain Definition for Y/N attributes
Field type Short integer
Split policy Default value
Merge policy Default value

Code	Description
0	N
1	Y

Coded value domain
Contact

Description Domain Definitions for contact
Field type Short integer
Split policy Default value
Merge policy Default value

Code	Description
1	Virginia Dept. of Mines, Minerals and Energy; Big Stone Gap, VA; +1.276.523.8193
2	West Virginia Department of Environmental Protection, Division of Mining and Reclamation; Charleston, WV; +1.304.926.0490
3	Kentucky Energy and Environment Cabinet, Department of Natural Resources, Division of Mine Permits; Frankfort, KY; +1.502.564.6940
4	US Office of Surface Mining, Tennessee Field Office; Knoxville, TN; +1.865.545.4103

Environmental Resource Monitoring Locations

Simple feature class
geomine.sde.enviro_resource_monitoring_loc

Geometry Point
Contains M values No
Contains Z values No

Field name	Data type	Allow nulls	Default value	Domain	Prec-ision	Scale	Length	Aliases
objectid	Object ID							
permittee	String	No					60	Permittee
permit_id	String	No					40	Permit ID
monitoring_site_id	String	Yes					40	Monitoring Site ID
erml_type	Short integer	No		ERMLType	5			ERML Monitoring Type
elevation	Double	Yes			38	8		Elevation (feet)
edit_date	Date	No			0	0	36	State/Tribe Defined Edit Date
information_link	String	Yes					128	Information Hyperlink
contact	Short integer	No		Contact	5			Contact
comment	String	Yes					256	Comment
shape	Geometry	Yes						

Coded value domain
ERMLType

Description Domain Definition for erml_type
Field type Short integer
Split policy Default value
Merge policy Default value

Code	Description
1	Groundwater
2	Surface Water
3	Geologic
4	Rain Gage
5	Trend Station
6	NPDES
7	Subsidence
8	Topsoil Samples
9	Topsoil Substitute
10	Other (see metadata)

Coded value domain
Contact

Description Domain Definitions for contact
Field type Short integer
Split policy Default value
Merge policy Default value

Code	Description
1	Virginia Dept. of Mines, Minerals and Energy; Big Stone Gap, VA; +1.276.523.8193
2	West Virginia Department of Environmental Protection, Division of Mining and Reclamation; Charleston, WV; +1.304.926.0490
3	Kentucky Energy and Environment Cabinet, Department of Natural Resources, Division of Mine Permits; Frankfort, KY; +1.502.564.6940
4	US Office of Surface Mining, Tennessee Field Office; Knoxville, TN; +1.865.545.4103

Post Mining Land Use

Simple feature class
geomine.sde.postmining_land_use

Geometry Polygon
Contains M values No
Contains Z values No

Field name	Data type	Allow nulls	Default value	Domain	Prec-ision	Scale	Length	Aliases
objectid	Object ID							
permittee	String	No					60	Permittee
permit_id	String	No					40	Permit ID
national_id	String	No					40	National Permit ID
land_use_type	Short integer	No		LandUseType	5			Land Use Type
calculated_area	Double	No			38	8		Calculated Area (acres)
reported_area	Double	Yes			38	8		Reported Area (acres)
information_link	String	Yes					128	Information Hyperlink
contact	Short integer	Yes		Contact	5			Contact
comment	String	Yes					256	Comment
shape	Geometry	Yes						
st_area(shape)	Double	No			0	0		st_area(shape)
st_length(shape)	Double	No			0	0		st_length(shape)

Coded value domain

LandUseType

Description Domain Definition for land_use_type
Field type Short integer
Split policy Default value
Merge policy Default value

Code	Description
1	Pasture/Hayland
2	Grazingland
3	Forestry
4	Residential
5	Fish and Wildlife Habitat
6	Developed Water Resources (Impoundments of Water)
7	Public Utilities/Facilities
8	Recreation
9	Undeveloped Land or No Current Use or Land Management
10	Cropland

Coded value domain

Contact

Description Domain Definitions for contact
Field type Short integer
Split policy Default value
Merge policy Default value

Code	Description
1	Virginia Dept. of Mines, Minerals and Energy; Big Stone Gap, VA; +1.276.523.8193
2	West Virginia Department of Environmental Protection, Division of Mining and Reclamation; Charleston, WV; +1.304.926.0490
3	Kentucky Energy and Environment Cabinet, Department of Natural Resources, Division of Mine Permits; Frankfort, KY; +1.502.564.6940
4	US Office of Surface Mining, Tennessee Field Office; Knoxville, TN; +1.865.545.4103

The workgroup wanted the end user to understand the individual values that are stored in the rows of a table. This is accomplished by using a feature of ArcGIS geodatabases referred to as coded value domains. For example, a column that stores the value of 0 or 1 (false or true) would show the English value of No or Yes. A number of coded value domains are used in the schema developed for GeoMine

Following are the coded domain values for each of the 10 layers within the GeoMine geodatabase schema. Coded value domains are numeric values used to represent a short list of possible options available for each record in the database. The advantage to using coded values is that they are a vehicle for standardizing the variety of input terminologies submitted by each State. The italicized text beneath each layer name is the attribute name for which code values have been established.

In most instances, the coded value 'Unknown' (code value = 0) represents a record for which insufficient information is available to enter a status code value. Not Applicable (code value = 4) refers to a record for which the particular permit or operations status in question does not apply. This situation typically applies to pre-SMCRA surface coal mining permits.

GEOMINE CODE DOMAIN VALUES

COAL PREPARATION PLANT

permit_status

0	Unknown
1	Active
2	Pending
3	Inactive
5	Revoked
6	Initial (Interim) Program
4	Not Applicable
7	Released

COAL DISPOSAL SITES

permit_status

0	Unknown
1	Active
2	Pending
3	Inactive
5	Revoked
6	Initial (Interim) Program
4	Not Applicable
7	Released

refuse_placement_status

0	Unknown
1	Proposed
2	Active (ongoing placement)
3	Inactive (placement has ceased)
4	Complete

ENVIRONMENTAL RESOURCE MONITORING LOCATIONS

erml_type

1 Groundwater
2 Surface Water
3 Geologic
4 Rain Gage
5 Trend Station
6 NPDES
7 Subsidence
8 Topsoil Samples
9 Topsoil Substitute
10 Other (see metadata)

EXCESS SPOIL

placement_status

0 Unknown
1 Proposed
2 Active (ongoing placement)
3 Inactive (placement has ceased)
4 Complete

LAND RECLAMATION STATUS

land_reclamation_status

0 Unknown
1 Backfilled
2 Disturbed
3 Not Disturbed
4 Regraded
5 Revegetated
6 Topsoiled

release_eligibility

1 Phase I Eligible
2 Phase II Eligible
3 Phase III Eligible

LUMP

lump_basis

1 Incompatible
2 Fragile or Historic
3 Renewable Resource
4 Hazardous

lump_status

1 Under Review
2 Frivolous
3 Accepted for Study
4 Incomplete
5 Lands Designated as Unsuitable for Mining

Postmine Land Use

land_use_type

1 Pasture/Hayland

2 Grazing land
3 Forestry
4 Residential
5 Fish and Wildlife Habitat
6 Developed Water Resources (Impoundments of Water)
7 Public Utilities/Facilities
8 Recreation
9 Undeveloped Land or No Current Use or Land Management
10 Cropland

RECLAMATION BOND STATUS

reclamation_bond_status

1 Phase I Release
2 Phase II Release
3 Phase III Release
4 Forfeited
5 Bonded
6 Not Bonded
7 Termination of Jurisdiction

SURFACE COAL MINE PERMIT BOUNDARIES

coalmine_op_status

0 Unknown
1 Active
2 Pending
3 Inactive
5 Revoked
6 Initial (Interim) Program
4 Not Applicable
7 Released

inspectable_unit_status

0 Unknown
1 Active
3 Inactive
4 Abandoned (30 CFR 840.11.g1-2
5 Unpermitted or Illegal

UNDERGROUND MINE EXTENT

underground_mine_status

0 Unknown
1 Active
2 Inactive
3 Abandoned
4 Temporary Cessation

General Information Coded Values

Contact

1 Virginia Dept. of Mines, Minerals and Energy; Big Stone Gap, VA; +1.276.523.8193
2 West Virginia Department of Environmental Protection, Division of Mining and Reclamation; Charleston, WV; +1.304.926.0490

3 Kentucky Energy and Environment Cabinet, Department of Natural Resources, Division of Mine Permits; Frankfort, KY; +1.502.564.6940
4 US Office of Surface Mining Reclamation and Enforcement, Tennessee Field Office; Knoxville, TN; +1.865.545.4103

Boolean (Yes/No)
0 No
1 Yes

Appendix C. GeoMine Development Layers

The following four layers are in development. These are all candidates for future release in GeoMine, however their level of completion has not reached a point sufficient for the interagency team to attain consensus on their inclusion in the current release.

All of these layers share common sources, services, and refresh publication dates, as follows:
source: State or OSMRE (TN) Authoritative Data Source;
service: KY-shapefile, TN-geodatabase, VA-replicated webservice, WV-live web service;
refresh publication date: KY-ad hoc, TN-ad hoc, VA-Saturdays, WV-daily update M-F.

1. Underground Mine Extents - KY-TN-VA-WV

Purpose: To display the extent of underground coal mines projected to the surface in KY, TN, VA, and WV.
Data type: polygon;
Description: This polygon layer defines the extent of an underground coal mining operation. Currently many polygons may represent a single mine area for a variety of reasons. In some cases (e.g., eastern KY), multiple coincident polygons representing individual coal seams in a single underground mine may be present, but not obvious, until the user ID's a particular polygon and several results appear (e.g., upper, middle, and lower Elkhorn seams). This is in part due to the primary data source, which in KY is the Department of Revenue. Since taxes are based on an individual coal seam, the Department requires separate polygons for each, and these have all been digitized. Another principal cause for multiple polygons is transfer of ownership. A single link to a particular mine through time and ownership polygons has not been established yet, but this is a future goal. There are currently over 86,000 records in this layer. Data may be sourced from a number of State agencies, which are not GeoMine team members; thus GeoMine team agencies may not be the authoritative data sources for this layer.

TN – For the state of TN, the Underground Coal Mine Extents data layer contains extents for underground mining areas. The extents may or may not represent the complete underground mining extent as the maps they are displayed on may or may not be the final map required by MSHA once the mining is finished. These extents are acquired by digitizing hard copy mining operations maps, scanned and georeferenced historical maps or extracted from AutoCAD drawing files submitted by permittees to OSMRE.

VA – The purpose of this data set is to provide a geographic representation of the location and configuration of proposed underground mining in the various coal seams in the Southwest Virginia Coalfield. This data set is not intended to be used to make site specific decisions. Consulting the coal surface permit applications and field investigations are recommended for site specific decisions or actions. Outlines representing the Probable Mining Units/Mining Limits (PMU) of underground coal mining for currently permitted mines with an active status. These mining limits are derived from mapping and information supplied in the coal surface permit applications.

WV – Features are produced by the mineral lands mapping project at the West Virginia Geologic and Economic Survey, which initially was created to assist tax assessment of coal properties. Polygons typically represent a single mine within a single coal bed, with multiple

overlapping coal beds producing overlapping mine polygons for a given area. In WV, state law prevents active underground mine mapping from being released publicly, so mapping data is limited to completed underground mines in WV.

2. Fills KY-TN-VA-WV

Purpose: To display the extent of excess spoil structures in KY, TN, VA, and WV.
Data type: polygon;
Description: This layer shows the extent of proposed, under construction, or completed structures built to deposit spoil material in excess of that required to reclaim the mined area or return it to the approximate original contour. This includes bench fills, head-of-hollow fills, side-hill fills, slurry impoundments, valley fills, and other (durable rock, excess spoil, etc.). Note that this layer does NOT necessarily represent disturbance on the ground, as many of these polygons are proposals to build rather than as-built locations. Also, fills polygons may be stacked one on top of another. This duplication may be due to permit transfers or shared facilities. Currency of fills mapping is variable based on individual State programs.

KY – Kentucky's fill layer is a mix of proposed, in-construction and as-built footprints. Often fills are stacked one on top of another. This duplication is partly due to permit transfers and perhaps shared facilities.

TN **–** The TN Fills data layer contains boundaries for the footprint of fills which include bench fills, head-of-hollow fills, side-hill fills, slurry impoundments, valley fills, and other (durable rock, excess spoil, etc.). These boundaries were acquired by digitizing hard copy mining operations maps or extracted from AutoCAD drawing files of the mining operations map submitted by the permittees. The collection of fills data in Tennessee does not include design or reported volumes of fill. Due to an infrequent update process on fills data, placement status is limited to built or not built.

VA – The purpose of this data set is to provide a geographic representation of the location and configuration of proposed excess material disposal fills associated with mining operations in the Southwest Virginia Coalfield. This data set is not intended to be used to make site specific decisions. Consulting the coal surface permit applications and field investigations are recommended for site specific decisions or actions. Outlines representing the proposed or as-built footprint of excess material disposal fills associated with coal mining operations in Virginia. These outlines are derived from mapping and information supplied in the coal surface permit applications and Engineering certifications for as-built fills.

WV – Data is current to 2009, based on analysis of LIDAR, IFSAR, and historical contour data, along with satellite and aerial photography source dating from 1980-2009. Update of fill status based on 2011 aerial photography is anticipated soon.

3. Abandoned Mine Lands KY-VA-WV

Purpose: To display detailed Abandoned Mine Land Inventory geospatial data including planning unit polygons, problem area polygons, and points, lines, and polygons representing the locations of specific abandoned mine land problem types (keyword features) within each problem area.
Data: type: point, line, and polygon;
source: State Authoritative Data Source;

service: KY-shapefile, VA-replicated web service, WV-live web service;
refresh publication date: KY-ad hoc, VA-Saturdays, WV-daily update M-F.
Description: Part of the cooperative grant funding provided to pilot project states by OSMRE has resulted in scanning, digitizing, georeferencing, and attributing of thousands of hard-copy AML problem areas. States are digitizing legacy hard-copy problem area reports, and developing polygons for each planning unit watershed of problem areas, the problem area polygons within each planning unit, and points, lines, and polygons corresponding to individual problem types (keyword features) such as highwalls, seeps, etc. TN is in the process of preparing a dataset for consumption by GeoMine.

4. Post Mine Land Use – KY-VA-WV
Purpose: To display proposed post-mining land use for reclaimed mines.
Data: type: polygon;
source: State Authoritative Data Source;
service: KY-shapefile, VA-replicated web service, WV-live web service;
refresh publication date: KY-ad hoc, VA-Saturdays, WV-daily update M-F.
Description: This layer shows the types of land use allocated to reclaimed mine lands. Polygons are colored based on their land use description. This includes croplands, developed water resources (water impoundments), fish and wildlife habitat, forestry, grazing, pasture/hayland, public utilities/facilities, recreation, residential, and undeveloped/no current use or land management. There are two types of data present in this layer – detailed sub-permit level polygons included in the permittees reclamation plan (VA), and general permit-level data which shows the dominant proposed land use category within a permit area (WV and KY). TN does not currently have a corresponding data layer.

VA – The purpose of this data set is to provide a geographic representation of the location and configuration of Post Mining Land Use (PMLU) areas within a currently permitted surface permit mining operations in the Southwest Virginia Coalfield. This data set is not intended to be used to make site specific decisions. Consulting the coal surface permit applications and field investigations are recommended for site specific decisions or actions. Outlines representing the Post Mining Land Use areas associated with coal mining operations in Virginia. Each reclamation plan contains a detailed description of the proposed use, following reclamation, of the land within the permit area, including a discussion of the utility and capacity of the reclaimed land to support a variety of alternative uses, and the relationship of the proposed use of existing land use policies. These outlines are derived from mapping and information supplied in the coal surface permit applications.

Appendix D. Data Descriptions for Non-Viable SMCRA Map Layers

The following four layers were initially added to early version of the GeoMine Viewer, but were later deemed to be non-viable by the interagency team due to data or organizational limitations. Data descriptions are provided here to record their levels of development prior to removal.

1. Pending Permits – KY-TN

Purpose: To show the location of surface coal mining permits submitted to the State ADS, but not yet approved for mining and reclamation activities.
Data type: polygon;
source: State or OSMRE (TN) Authoritative Data Source;
service: KY-shapefile, TN-geodatabase;
refresh publication date: KY-ad hoc, TN-ad hoc;
Description: This sub-layer represents only those permit boundary polygons in KY and TN with a 'pending' coal mine operation status.

TN - For the state of TN, the Pending Surface Coal Mining data layer contains proposed mining area boundaries submitted in applications to OSMRE KFO by the permittees. When/if the application is approved the boundary is removed from the Pending Surface Coal Mining layer and goes into the Active and Footprint Surface Coal Mining Permit data layers. These pending boundaries are extracted from an AutoCAD drawing file of the mining operations map submitted by the permittees.

2. Land Reclamation Status – VA

Purpose: To display the status of reclamation within surface coal mining permits.
Data type: polygons;
source: VA DMME;
service: replicated web service (VA);
refresh publication date: updated every Saturday (VA);
Description: This polygon layer breaks out the various stages of reclamation conducted at a coal mine site. Many polygons with different levels of reclamation may be present within a single permit. The most salient information for this layer is the land_reclamation_status attribute. Following are brief definitions of each of status type:

Backfilled – Where material has been placed back into an excavated area.
Disturbed – All areas affected to facilitate mining operations.
Not Disturbed – An area approved for surface mining which is still in its pre-mining state.
Graded/Regraded – The contours of a surface have been changed to achieve the approved post-mining grade within a surface coal mining and reclamation operation.
Revegetated – Where the permittee has seeded or planted vegetative cover that is in accordance with the approved reclamation plan.
Topsoiled – Where the redistribution of topsoil or suitable substitute soil has been completed.

WV does not expect to have this layer available for use by GeoMine during the Pilot Project. Data from TN was not available due to difficulties in connecting to and parsing the database. KY expects to be able to provide this data sometime in the future; however it will be at the permit polygon level rather than a more detailed depiction.

TN – In the state of TN, the Land Reclamation Status data layer contains surface coal mining boundaries of permits and the reclamation status of each permitted area if the information is available. If no information is available (as is often the case for legacy permits) the status field contains the value “unknown”. The permit boundaries were acquired by digitizing hard copy mining operations maps, boundaries extracted from AutoCAD drawing files of the mining operations map submitted by the permittees, boundaries obtained from permit files located in the TN state office, hand-drawn boundaries on USGS 7.5 minute topographic maps and historical collections of maps where found.

VA – The purpose of this data set is to provide a geographic representation of the location and configuration of Reclamation Status areas within a currently permitted surface permit mining operations in the Southwest Virginia Coalfield. This data set is not intended to be used to make site specific decisions. Consulting the coal surface permit applications and field investigations are recommended for site specific decisions or actions. Outlines representing the Reclamation Status areas associated with coal mining operations in Virginia. Each Applicant submits a revegetation and regrading plan which describes method and sequence of excavation, backfilling, and regrading operations along with methods used in planting, seeding, and mulching. These outlines represent a Reclamation Status of either “Disturbed”, “Regraded”, or “Vegetated” and are derived from mapping and information supplied in the coal surface permit applications.

3. Lands Unsuitable for Mining Petition (LUMP)
Purpose: To depict polygonal areas that have been petitioned to be designated as unsuitable for mining.
Data type: polygon;
source:
service:
refresh publication date:
Description: Polygons in this layer represent areas that have been petitioned to be considered unsuitable for coal mining based on petition rationales that include incompatibility with current land use plans, damage to historic or fragile lands, reduction in quality of future renewable resources such as water and crops, and exacerbation of existing hazardous areas such as flood-prone areas or unstable geology. LUMP status is an important attribute for this layer. Status attribution options are: under review, frivolous, accepted for study, incomplete, and designated unsuitable for mining. Currently none of the States except TN have provided any LUMP data. WV has reported that it will not be able to provide this data during the Pilot Project.

TN – For the state of TN, the LUMP data layer contains boundaries of areas that have been submitted to OSMRE by petitioners asking that the submitted petition area be designated as unsuitable for surface coal mining operations. The LUMP boundaries were acquired by digitizing hard copy maps or from shape files submitted to OSMRE by the petitioner(s).

4. Lands Unsuitable for Mining Designated Areas
Purpose: To depict areas designated as unsuitable for coal mining.
Data type: polygon;
source:
service:

refresh publication date:

Description: Polygons in this layer represent areas that have been designated unsuitable for coal mining. Polygons can be designated as unsuitable, suitable with exceptions, or unsuitable with exceptions. Currently only TN has provided any LUM-designated area data.

TN – For the state of TN, the LUM designated areas data layer depicts the designated status of the areas of the petition after OSMRE has completed a review and analyses of the petition and it is finalized. The LUMP boundaries were acquired by digitizing hard copy maps or from shape files submitted to OSMRE by the petitioner(s). The LUM boundaries may be the entire boundary of the area as submitted by the petitioner if the entire area is designated as unsuitable for mining or it may be modified by OSMRE to depict the final designated (or not designated) areas from the finalized review and analyses.

Appendix E. SMCRA Layer Attribute Inventory Statistics (3/1/2013)

Quarterly Attribute Inventory

Since September 2011, OSMRE has conducted a quarterly inventory of the level of attribution of the SMCRA geospatial layers provided by each of the four Pilot Project states and entered into the database. The purpose of this exercise was to facilitate a clear understanding of the level of progress attained by state authoritative data sources in meeting the goals established in the Pilot Project Plan. This data also aids in mapping strategies to determine the best areas to concentrate future efforts, and to provide a system of metrics for tracking progress in carrying out work assignments outlined in the GeoMine Project MOU implementation plans. The most recent inventory was processed on March 1, 2013.

The inventory examined ten attribute tables associated with the SMCRA geospatial layers present in the GeoMine geodatabase. These tables are: from those layers accepted by the interagency team, Currently Permitted Surface Coal Mine Permit Boundaries, Released Surface Coal Mine Permit Boundaries, Legacy pre-SMCRA Surface Coal Mine Operations Boundaries, Coal Refuse, Environmental Resource Monitoring Locations, Bond Status, and Coal Preparation Plants; from the developmental layers, Underground Mine Extents, Fills, and Post Mine Land Use. For each table, two queries were developed that were designed to answer for each attribute: 1) how many records are represented by Null values or zero-length strings, and 2) how many records are represented by values of “Unknown”, “N/A”, or “NA”? Based on these results, statistics were generated that illustrate the percentage of records by attribute that contain data, i.e., are not null, as well as the percentage of records by attribute that contain useable data. Useable data is defined as any record entry that has no null or zero-length string values and no “Unknown”, “N/A”, or “NA” values. All Unknowns and NAs are considered to have no useful value, even in situations where a coded value domain might list “Unknown” as a valid code definition. So for example, a given attribute such as “Mine Name” may have no Null values or zero-length strings, yet only 70 percent of the data is useable because 30 percent of the records are filled with “Unknown”. Table results presented in the final inventory spreadsheets are the percentage of records for a given attribute that are useable.

Some attributes are grouped because of their aggregate nature (see Surface Coal Mine Permit Boundaries spreadsheet). This includes Surface Mine Boundary Mining Type and Underground Mine Extents Mining Type. For these attribute groups, statistics were calculated on the group as a whole, and sub-tables were created to present meaningful Boolean statistics that clarify whether data was entered or not. Another unique feature of the inventory is the Surface Mine Boundary Coal Mine Operation Status attribute. Since this single attribute is responsible for the first three GeoMine geospatial layers, and thus of great importance, a sub-table was constructed which displays how attributes were populated as record counts by state for each of the operational status categories. Total records entered into the database by state are recorded in the top portion of each table to enhance understanding of results. Color coding of percent useable attributes has been added to enable a more visual sense of where to focus future efforts.

The first inventories polled every attribute in each layer using a Visual Basic script in Microsoft Access. In April, 2012, an improvement was made to result quality by removing those attributes that are either optional (comment, information link), or they are populated by the GeoMine database manager. The inventory did not involve any formal QA/QC of data, thus

any errors in attribution of records in the GeoMine geodatabase would be reported by the individual state data stewards after review of the inventory spreadsheets.

Attribute Inventory Results

The average percent of attributes populated for all SMCRA layer attribute tables' ranges from 20 to 100 percent for all pertinent attribute fields (see table following). Pertinent refers to fields that the ADS is responsible for populating (e.g., operations status), as opposed to the ones GeoMine creates such as 'contact' and 'edit_date', or optional fields such as 'comment' and 'information link'. As expected, legacy surface coal mine boundary attribute data is poorly attributed (36 to 63 percent) due to its age and inherent lack of information, whereas the currently permitted surface coal mine permit boundary layer is well attributed, with approximately 80 percent of attributes populated. The underground mine extents layer is also particularly lacking attribution, partially because much of this data is also legacy data, and partly due to the source of the data, which is in most cases an agency not directly influenced by the State ADS. One hundred percent attribution can never be achieved, due to the fact that the gargantuan effort required to acquire and link attribute information (if it's even available) to legacy data digitized from hard copy maps, prints, and mylars, is simply not justified by the benefits. On the other hand, modern permit data collection is comprehensive, largely digital, and at least marginally tied to current ASTM standards. Thus, future permit features are most likely to approach full attribution.

Summary of GeoMine SMCRA Layer Attribute Inventory Results

Detail by State	**Kentucky**		**Tennessee**		**Virginia**		**West Virginia**	
Table	Total Records	Avg. % of Attributes Populated	Total Records	Avg. % of Attributes Populated	Total Records	Avg. % of Attributes Populated	Total Records	Avg. % of Attributes Populated
Currently Permitted Coal Mine Permit	6,692	82.7	505	80.7	366	79.2	3,822	73.8
Released	5,417	69.1	807	71.8	1,738	45.2	2,338	61.7
Legacy pre-SMCRA	5,463	39.6	1,378	63.0	1,106	36.3	34	57.5
Coal Refuse Impoundments	117	62.9	11	42.1	NA		250	38.9
Environmental Resource Monitoring Locations	27,151	81	3,298	77.7	10,653	70.7	46,334	33.9
Bond Status	318	100	1,079	96.6	48	83.9	NC	NC
Coal Preparation Plants	1,056	65.2	45	65.9	NC	NC	419	50.0
Underground Coal Mine Extents	63,776	19.9	30	33.3	6,601	24.6	15,907	29.4
Fills	37,353	39.4	132	63.0	603	48.9	2,326	42.1
Post-Mining Land Use	1,771	80.0	NC	NC	547	98.0	9,466	94.9
Total Records by State	149,114		7,285		21,662		80,896	

NC=Not Collected, NA=Not Available to GeoMine as of 3/1/2013.

Each successive quarterly inventory documented significant improvements to the database due to State ADS data clean-up efforts, such as the conversion of several thousand records in the surface coal mine permit boundary layer in Kentucky from unknown operations status to active, released, initial program, or pre-SMCRA. West Virginia removed of a few hundred records in that were erroneously grouped with coal mines, but which are actually industrial mineral quarries.

The following tables show attribution results for the seven Interagency Team-approved layers (the first three are represented by the surface coal mine permit boundary source layer), as well as the four developmental data layers currently under consideration for GeoMine.

SMCRA Map Layers

Geomine Geodatabase Surface Coalmine Boundary Table Progress Status

Table	Percent Useable Attributes			
Surface Coal Mine Boundary	KY	TN	VA	WV
Info Products # 1 to 5	n=17593	n=2732	n=375	n=7227
Permittee	68.73	99.05	95.47	98.51
Coal Mine Operation Status	53.36	10.32	95.47	83.4
Mine Name	8.11	98.5	95.47	47.1
Permit ID	97.57	100	100	99.94
MSHA ID	99.72	0	0	0
State Tribe Mine ID	0	0	0	0
National ID	0.32	99.67	100	100
Inspectable Unit Status	10.17	9.99	95.47	0
Post SMCRA	100	99.67	0	100
Calculated Area	100	100	100	100
Reported Area	59.65	94.55	95.47	98.37
Mining type				
Area Mining				
Contour Mining				
Mountaintop Mining				
Steep Slope Mining				
Auger Mining	49.04	97.11	66.93	0
Underground w/Surface Face				
Refuse Disp				
Load Out				
Preparation Plant				
Haul Road				
Report generated: 9/20/2012	60	91	70	69

	Total
	27927

	Counts			
Sub-Table	KY	TN	VA	WV
Coal Mine Operations Status	n=17593	n=2732	n=375	n=7227
Pending	49	9		
Active	1722	156	351	3517
Released	2567			2213
*Inactive	59		7	297
*Initial (Interim) Program	4991	117		
*Revoked				
*Not Applicable	1644			943
*Unknown	6561	2450	17	257
* "Other"	13255	2567	24	1497

Key	
	100 % attributed
	50 - 99 % attributed
	10 - 49 % attributed
	<10 % attributed
	Not Collected by ADS

Sub-Table	Counts			
Mining type	KY	TN	VA	WV
Is any mining type entered?	n=17593	n=2732	n=375	n=7227
No	8966	79	124	7227
Yes	8627	2653	251	0

Average % useable attributes

Surface Coal Mine Permit Boundaries

Geomine Geodatabase Coal Refuse Table Progress Status

Table	Percent Useable Attributes				
Coal Refuse	KY	TN	VA	WV	Total
	n=117	n=11		n=250	378
Permittee	100	100		95.2	96.83
Permit Status	100	90.91		0	33.6
Permit ID	100	100		96	97.35
National ID	100	100		100	100
MSHA ID	96.58	0		36.8	54.23
Impounding Feature	100	0		100	97.09
Design Refuse Volume	0	0		0	0
Reported Refuse Volume	0	0		0	0
Normal Pool Elevation	0	0		0	0
Refuse Placement Status	95.73	72.73		0	31.75
Reported Area	0	0		0	0
Report generated: 3/6/2013					

Key	
	100 % attributed
	50 - 99 % attributed
	10 - 49 % attributed
	<10 % attributed

Coal Refuse Impoundments and Refuse Placement Sites

Geomine Geodatabase Enviro Resource Monitoring Loc Table Progress Status					
Table	Percent Useable Attributes				
enviro_resource_monitoring_loc	KY	TN	VA	WV	Total
	n=27151	n=3298	n=10653	n=46334	87436
Permittee	99.58	93.36	100	17.42	55.86
Permit ID	99.58	94.15	100	17.43	55.9
monitoring_site_id	100	99.94	53.56	17.43	50.59
erml_type	100	100	100	100	100
elevation	5.65	1	0	17.31	10.97
Report generated: 3/6/2013					

Key
100 % attributed
50 - 99 % attributed
10 - 49 % attributed
<10 % attributed

Environmental Resource Monitoring Locations

Geomine Geodatabase Bond Status Table Progress Status					
Table	Percent Useable Attributes				
bond_status	KY	TN	VA	WV	Total
	n=318	n=1079	n=48		1445
Permittee	100	96.01	95.83		96.89
Permit ID	100	100	95.83		99.86
National ID	100	100	100		100
increment_area_id	100	79.89	0		81.66
reclamation_bond_status	100	100	100		100
bond_amount	100	100	100		100
Reported Area	100	100	95.83		99.86
Report generated: 3/6/2013					

Key
100 % attributed
50 - 99 % attributed
10 - 49 % attributed
<10 % attributed

Bond Status

Geomine Geodatabase Coal Preparation Plant Table Progress Status					
Table	Percent Useable Attributes				
coal_preparation_plant	KY	TN	VA	WV	Total
	n=1056	n=45		n=419	1520
Permittee	100	100		100	100
Permit Status	91.19	95.56		0	66.18
Permit ID	100	100		100	100
National ID	100	100		100	100
coarse_refuse	0	0		0	0
fine_refuse	0	0		0	0
Report generated: 3/6/2013					

Key
100 % attributed
50 - 99 % attributed
10 - 49 % attributed
<10 % attributed

Coal Preparation Plants

Developmental Layers

Geomine Geodatabase Underground Coalmine Extent Table Progress Status					
Table	Percent Useable Attributes				
Underground Coal Mine Extent	KY	TN	VA	WV	Total
	n=63776	n=30	n=6601	n=15907	86314
Permittee	0	66.67	0	0	0.02
Company	57.46	0	64.7	34.95	53.85
Mine Name	0	66.67	55.42	39.34	11.51
Permit ID	0	100	0	6.05	1.15
MSHA ID	44.76	0	0	0	33.07
State Tribe Mine ID	61.68	0	0	56.11	55.91
National ID	0	0	0	100	18.43
Mine Map Repository ID	0	3.33	0	0	0
Coal Bed Names	57	46.67	0	100	60.56
Map Date	0	50	0	45.98	8.49
Mine Status	38.2	0	100	0	35.87
Mining type					
Longwall					
Room and Pillar	0	100	99.98	0	7.68
Breast and pillar					
Highwall					
Reported Area	0	0	0	0	0
Report generated: 3/6/2013					

Key
100 % attributed
50 - 99 % attributed
10 - 49 % attributed
<10 % attributed

Sub-Table	Counts			
Mining type	KY	TN	VA	WV
Is any mining type entered?	n=63776	n=30	n=6601	n=15907
No	63776	0	1	15907
Yes	0	30	6600	0

Underground Mine Extents

Geomine Geodatabase Fills Table Progress Status					
Table	Percent Useable Attributes				
Fills	KY	TN	VA	WV	Total
	n=37,353	n=132	n=604	n=2,288	40,377
Permittee	83.1	100	91.06	0	
Permit Status	3.77	100	91.06	0	
Permit ID	96.82	100	91.06	78.5	
National ID	96.84	100	100	78.5	
Feauture ID	4.04	99.24	0	63.16	
Permanent	100	100	0	100	
Design Volume	4.01	0	0	0	
Reported Volume	5.69	0	0	0	
Placement Status	0	43.94	0	99.96	
Calculated Area	100	100	100	100	
Reported Area	0.02	0	91.06	0	
Report generated: 9/20/2012	45	83	51	47	Average % useable attributes

Key
100 % attributed
50 - 99 % attributed
10 - 49 % attributed
<10 % attributed
Not Collected by ADS

Fills

Geomine Geodatabase Postmining Land Use Table Progress Status					
Table	Percent Useable Attributes				
postmining_land_use	KY	TN	VA	WV	Total
	n=1771		n=547	n=7148	9466
Permittee	100		96.71	100	99.81
Permit ID	100		96.71	100	99.81
National ID	100		100	100	100
land_use_type	100		100	100	100
Reported Area	0		96.71	91.72	74.85
Report generated: 3/6/2013					

Key
100 % attributed
50 - 99 % attributed
10 - 49 % attributed

Post Mine Land Use

Appendix F. Detailed State and Federal Layer Descriptions

This appendix contains detailed descriptions optionally provided by each State ADS for SMCRA layers in GeoMine, as well as more detailed descriptions for some of the Federal layers.

SMCRA Layer Detailed State Descriptions

Currently Permitted Surface Coal Mine Permit Boundaries KY-TN-VA-WV
TN - For the state of TN, this data layer contains the permitted boundary for surface coal mining areas that may be actively mining coal or in various stages of reclamation. These permits are regularly inspected and are under a performance bond (a surety bond, collateral bond or self-bond, or a combination thereof) submitted by the permittees to ensure faithful performance of all the requirements of SMCRA. The permit boundaries were acquired by digitizing hard copy mining operations maps or extracted from an AutoCAD drawing file of the mining operations map submitted by the permittees.

VA - The purpose of this data set is to provide a geographic representation of the location of Virginia Division of Mined Land Reclamation (VA DMLR) coal surface permits. It is intended to provide general locations of currently permitted surface permits as provided in DMLR coal surface permit applications. This data displays outlines of the areas for VA DMLR surface permits for Buchanan, Dickenson, Lee, Russell, Scott, Tazewell and Wise counties, Virginia. Original application maps should be consulted when making site-specific decisions.

Released Surface Coal Mine Permit Boundaries – KY-TN-WV
TN - For the state of TN, the Released Surface Coal Mining Permit Boundaries data layer contains permits that are no longer in any active stage of surface coal mining activity and no longer inspected. The permits have been reclaimed to SMCRA standards and the performance bond released. The permit boundaries were acquired by digitizing hard copy mining operations maps, boundaries extracted from AutoCAD drawing files of the mining operations map submitted by the permittees, boundaries obtained from permit files located in the TN state office, hand-drawn boundaries on USGS 7.5 minute topographic maps and historical collections of maps where found.

VA - The purpose of this data set is to provide a geographic representation of the location of Virginia Division of Mined Land Reclamation (VA DMLR) coal surface permits. It is intended to provide general locations of currently permitted surface permits as provided in DMLR coal surface permit applications. This data displays outlines of the areas for VA DMLR surface permits for Buchanan, Dickenson, Lee, Russell, Scott, Tazewell and Wise counties, Virginia. Original application maps should be consulted when making site-specific decisions.

WV publishes all permit boundaries as an integrated layer, where released permits are identified by a PSTATUS (permit status) attribute value of ‘RC’ (completely released).

Legacy pre-SMCRA Surface Coal Mine Boundaries KY-TN-VA-WV
No additional information.

Coal Refuse Impoundments and Refuse Placement Sites KY-TN-WV
TN – As a part of the Fills data layer, this layer contains boundaries for the footprint of fills which include refuse piles. These boundaries were acquired by digitizing hard copy mining operations maps or extracted from AutoCAD drawing files of the mining operations map submitted by the permittees.

Environmental Resource Monitoring Locations KY-TN-VA-WV
KY – Kentucky provides groundwater, surface water, and NPDES monitoring sites.
TN - For the state of TN, the ERML data layer contains monitoring location points for surface and ground water and geologic drill hole points submitted as baseline data by the permittees in applications for surface coal mining permits. The baseline data shows the condition of surface and ground water at the time the permit application is being reviewed. These ERML points were acquired by digitizing hard copy mining operations maps or extracted from AutoCAD drawing files of the mining operations map submitted by the permittees. Also contained in the ERML data layer are trend station location points. These points were developed by KFO's hydrologists to collect long-term water quality and quantity data for use in the cumulative hydrologic impact area analysis for the watersheds in which proposed surface coal mining permits are located.
VA Summary - The purpose of this data set is to provide a geographic representation of the point locations for hydrologic, geologic, and climatological monitoring locations associated with mining operations in the southwest Virginia coalfield. This data set is not intended to be used to make site specific decisions. Consulting the coal surface permit applications and field investigations are recommended for site specific decisions or actions.
VA Description - Points representing the ground water, surface water, national pollution discharge elimination system (NPDES), geologic, and rain gauge monitoring locations associated with coal mining operations in Virginia. These monitoring point locations are derived from mapping and information supplied in the coal surface permit applications.
WV – ERML data consists of trend station locations for 235 long-term water sampling locations, as well as surface water and NPDES monitoring locations.

Bond Status KY-TN-VA-WV
TN - In the state of TN, the Bond Status data layer contains boundaries for permits currently under bond (active) and permits that have met the reclamation standards set forth in SMCRA and the bond has been released to the permittee. A permit may be under a standard or cumulative bond which means that the entire permit area is under one bond, or it may be bonded in increments, meaning that there are two or more areas under different bonds in the permitted area. The bonded areas are acquired from AutoCAD drawing files of bond increment maps (BIM) or, if no BIM is available, from mining operations or post mining land use maps submitted to OSMRE by the permittee.
VA Summary - The purpose of this data set is to provide a geographic representation of the location and configuration of Bonding Phase areas within a currently permitted surface permit mining operations in the Southwest Virginia Coalfield. This data set is not intended to be used to make site specific decisions. Consulting the coal surface permit applications and field investigations are recommended for site specific decisions or actions.
VA Description - Outlines representing the Bonding Phase areas associated with coal mining operations in Virginia. Each Applicant submits a bonding plan which includes calculations, maps, cross-sections, and other information necessary to support the cost estimates for

reclamation. Upon completion of reclamation, the Applicants will submit Completion Reports detailing which phase of reclamation has been finalized. These outlines represent a Bonding Status of either “Phase I - Regraded”, “Phase II - Vegetated”, or “Phase III – Total Bond Release” and are derived from mapping and information supplied in the coal surface permit applications.

Coal Preparation Plants – KY-TN-WV
No additional information.

Hydrologic Trend Station Widget – WV
WV - Water sample data for 235 long-term surface water sample locations located in the coal mining regions of West Virginia. Data for 20 analytes dating to 2002 is visualized via a custom client widget written in flash with supporting web data services. The trend station data provides water quality data, a time analysis and graphs of the water quality data. Sample results, thresholds, and change detection are all graphically depicted for such properties as total dissolved solids, total suspended solids, specific conductance, alkalinity, acidity, metal cation concentration (e.g. Fe, Al, Mg), and anion concentration (e.g. SO4, Cl).

<u>Federal Layer Detailed Descriptions</u>

Abandoned Mine Reclamation Project Status
No additional information.

Abandoned Mine Reclamation Priority Level
Priority level definitions:
1. Extreme danger or expected to cause substantial physical harm to persons or property.
2. Threatening people but is not an extreme danger.
3. Condition causing degradation of soil, water, woodland, fish, wildlife, recreational resources, or agriculture.
4. Repair damage to facilities caused by coal mining and after certification, non-coal mining. This priority was eliminated by Congress in 2006 amendments to SMCRA, thus it represents legacy reclamation projects only.
5. Repair recreation and historic lands affected by coal mining and after certification, non-coal mining. This priority was eliminated by Congress in 2006 amendments to SMCRA, thus it represents legacy reclamation projects only.

B. A pseudo priority created to allow work completed under Section 403(b) of SMCRA to be entered into the e-AMLIS database. There is no priority actually associated with these projects. This priority is for reclamation projects designed to protect, repair, replace, construct, or enhance facilities related to water supply, including water distribution facilities and treatment plants, in order to replace water supplies adversely affected by coal mining practices.

F. A pseudo priority created to allow work completed under Section 411(f) of SMCRA to be entered into the e-AMLIS database. There is no priority actually associated with these projects. This priority is associated with non-coal public facilities problem types. These areas were reclaimed or facilities were constructed by States/Indian tribes that have "Certified" that they have addressed all known eligible coal related problems.

Caveats. Note that coordinate positions for some older records are based on the southeast corner of USGS 7.5’ quadrangle maps rather than the central location or “centroid” of a given

problem area. Problem area spatial coordinates are entered in units of decimal degrees, and some of these have been entered to only one decimal point of precision (e.g. in portions of Wyoming). A small percentage of points have been removed due to erroneous coordinate positions.

Corps of Engineers NWP 21, 49, and 50 layers

The Corps Regulatory program currently tracks application/permit data through the second version of the OMBIL Regulatory Module (ORM2), a national database which was deployed in June 2007. Prior to that, permitting data was collected and stored at the district level to meet their specific requirements and at the districts' discretion. Quarterly totals were provided by Districts to Corps Headquarters. These data were then compiled and annual summaries were reported.

Caveats. As districts began converting their historic data into the current centralized version of the database, some districts had better success in converting legacy data. As a result, data prior to mid-2007 are considered incomplete for many data elements. Further, Nationwide Permit number was not a mandatory field until late 2008, so some records may not contain this information, and impact and mitigation data entry was not mandatory until October 2010. Activities in waters of the United States in association with coal mining activities that are regulated under Section 404 of the Clean Water Act may be authorized in some instances by standard individual permit rather than verified under general permits including NWP 21, 49 or 50. Data for these authorizations is not readily available for consumption into GeoMine.

Activities in waters of the United States in association with coal mining activities that are regulated under Section 404 of the Clean Water Act may be authorized in some instances by standard individual permit rather than verified under general permits including NWP 21, 49 or 50. Data for these authorizations is not readily available for consumption into GeoMine; however information on pending individual permit applications and final actions on these applications may be found at: http://geo.usace.army.mil/egis/f?p=340:1:0:::::

Appendix G. GeoMine Metadata Standards and Editor Testing

Creating good metadata for the GeoMine data layers has been a challenge. The standards for metadata in the United States are in flux. Until recently, all federally funded GIS systems were required to use Federal Geographic Data Committee (FGDC), the Content Standard for Digital Geospatial Metadata (CSDGM) – see: http://www.fgdc.gov/metadata/geospatial-metadata-standards#csdgm. However, FGDC recently endorsed several International Organization for Standardization (ISO) metadata standards – see: http://www.fgdc.gov/standards/fgdc-endorsed-external-standards/index_html. FGDC states that all federal systems will eventually move to the ISO standards and that if a new system is being developed, it would be advisable to use the ISO standards now instead of having to convert later. Because GeoMine would be a new GIS, the team selected the ISO standard. Also, ISO 10139 is specific for data services and therefore superior to CSDGM. ISO has several applicable standards including 19115 (including the 19115 North American Profile) and 19119. Another problem with using the ISO metadata standards is that the editors to create the metadata are not mature and are somewhat difficult to use. In addition, the ISO standards themselves are in a state of flux. Although the ISO standards allow hierarchical metadata describing attributes of features, implementing the standard has been confusing. New standards are forthcoming to address these shortcomings but are not currently available.

Creating and maintaining metadata for datasets and feature classes takes several steps. First, a template was created and exported from the ArcCatalog metadata editor. The exported XML metadata was then imported into the GeoNetwork editor for enhancement. After a few back and forth iterations, the final metadata is re-imported into ArcCatalog and also published to the GeoPortal. Having the metadata in ArcCatalog allows automatic updates of certain features such as feature count. In a production environment, the metadata would be refreshed after each data load and then republished to the GeoPortal.

Creating metadata for the GeoMine web services including ArcGIS map services, OGC WMS, and OGC WFS services is not straightforward. Some of the service metadata (that which appears on the service web endpoint) comes from comments and descriptions that are included in the underlying map document (mxd) file that is used to publish the web service. There are locations in the map document to include a description of the entire map and individual layers. Some of the metadata for the services must be manually created in forms when creating the OGC services. The OGC services can use an external capabilities file to get more information for metadata – these external capability files are described in OGC documentation. Documentation about creating metadata for ESRI web services can be found using ESRI's on-line documentation or ArcGIS.

Editor Selection

The technology phase workgroup tested three metadata editors:

- the built-in editor in ArcGIS;
- ESRI's GeoPortal ; and
- GeoNetwork.

The ArcGIS built-in editor works with geodatabases and source data but does not work with web services. The workgroup also had considerable difficulty creating proper ISO metadata with this editor. It is not clear when using the editor whether items are required by the

standard or not and since this editor works with many types of metadata, there is much information that can be added in the editor that does not belong in the ISO standard. A final problem was that exporting data from this editor and trying to load it into ESRI's own GeoPortal (a metadata search system) did not work without editing the underlying metadata XML document manually.

ESRI's GeoPortal comes with a metadata editor which can produce ISO metadata using the standards mentioned above. This editor works well but only includes the minimal amount of information required by the standard. This editor does not allow for expanded metadata descriptions. The technology phase workgroup created basic metadata with this editor, loading it into ArcCatalog, adding more information, and then reloading it into the GeoPortal – a tedious and cumbersome process.

The last metadata editor tested was through GeoNetwork – yet another metadata portal. This editor proved to be the most robust, handling all of the different fields of the ISO standards and having templates for simple as well as more detailed metadata. Metadata produced with this editor could generally be loaded back into ArcCatalog and could be loaded into ESRI's GeoPortal. With the current incomplete state of the ISO standards, the technology phase workgroup is not able to adequately describe the individual attributes in our geodatabase schema or our services.

Despite the drawbacks of the built-in ArcGIS editor, the technology workgroup adopted use of the built-in ArcGIS editor as the best of a set of imperfect options to generate metadata. It is hoped that future metadata tools should come into existence that will prove to better support metadata generation for GeoMine.

Appendix H. – Cloud Computing Virtual Server Instances, Connectivity and Server Installation Details

Setting up the ArcGIS Server and the ArcSDE server were simple. The workgroup contacted ESRI customer support and requested access to their AWS AMIs for ArcGIS Server and ArcSDE. These AMI's were preconfigured with everything we needed to run those two systems. The technology phase workgroup instantiated the images on AWS, set up network connection rules and performed a few other simple steps outlined in ESRI's instructions at: http://resources.arcgis.com/content/arcgisserver/10.0/arcgis-server-amazon. The ArcGIS Server came with the ArcGIS Server and ArcGIS Desktop software installed. There were scripts installed to help set up licensing – the technology phase workgroup used our DOI enterprise licenses. The ArcSDE image included ArcSDE and the open source database, PostGreSQL.

These ESRI images are Windows Server 2008 R2 and require the same administration as any Windows Server. Ancillary software can be installed and users can be managed. Patches have to be applied. Additional disk drives (virtual) can be added, etc.
Here is a list of items that were added or modified for the ArcGIS Server:

1. C: drive increased from 35GB to 100 GB to facilitate larger logs, more TEMP space, allow more user data storage, and to allow more software to be installed;
2. Changed Administrator password;
3. Changed ArcGIS service passwords;
4. Installed Adobe Reader to facilitate reading documentation; and
5. Installed FME Workbench to facilitate creating extract, transform and load jobs.

The ArcSDE Server only required changing service account names for the PostGreSQL database server and the database users' passwords along with changing the Windows Administrator password.

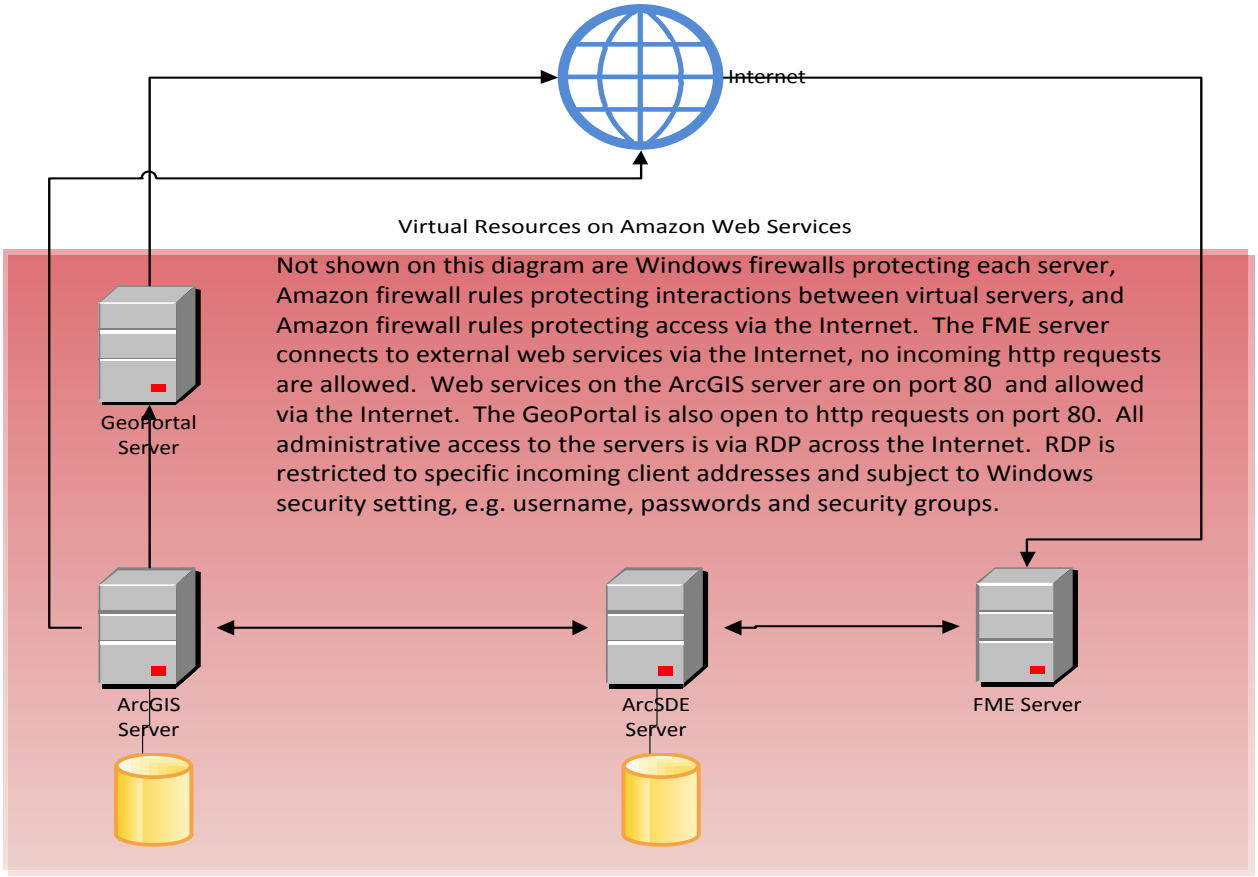
Initially, Safe Software did not have an AWS AMI for FME Server. The technology phase workgroup set up a Windows Server using an Amazon supplied AMI and installed FME Server following the directions from Safe. With the introduction of the latest version of FME Server 2012, Safe now has a FME Server AMI. The technology phase workgroup simply instantiates that instance, points to the license server, changes the Windows Administrator password and the computer server is ready.

The GeoPortal AWS server completes the GeoMine infrastructure. The GeoPortal was manually installed on an Amazon supplied AMI following the instructions at: http://sourceforge.net/apps/mediawiki/geoportal. Connections to these machine instances are made using various TCP/IP protocols. When an AMI is instantiated, it is assigned an external (connected to the Internet) and internal (connected to Amazon's internal network) IP address and Domain Name Service (DNS) name. All machine instances must be assigned to a security group by which the GeoMine administrators control access via the external and internal networks. By default the machines are only accessible via the external network using RDP. Although a running machine's security group cannot be changed, the configuration of these security groups can be changed on-the-fly.

Another key component of connecting to these machines is what Amazon calls elastic IP addresses. Despite their name, they are semi-permanent external IP addresses and DNS names that can be dynamically assigned to running AWS machine instances. The technology phase workgroup used them to assign addresses to the Internet accessible systems such as the ArcGIS Server. This makes things much easier if the workgroup terminates a machine and starts a new machine in its place. Starting a new machine means that it will be assigned an IP address/DNS name from the pool. However with elastic IP addresses, the technology phase workgroup can assign the new machine to that address and nobody will have to change shortcuts to access the new machine.

Although AWS provides a very robust and stable environment, the technology phase workgroup needed to have backups in case of AWS problems or user mistakes that would necessitate reinitializing a server to a previous state. AWS provides a simple method to make a complete backup so that they can be restarted exactly as they were at the time of the backup. This method involves making a new machine AMI. The process just takes a couple of button clicks in the AWS web-based console. The new AMI is just a pointer file with instructions how to create a virtual machine from something called snapshots. Snapshots are essentially backups of the virtual disk drives used in the instance. The nice thing about snapshots is that they are incremental meaning that an initial snapshot of a virtual disk contains all of the information on the disk but subsequent snapshots contain only the changes from the previous version. This method significantly reduces storage requirements and costs. The entire string of snapshots for a volume does not need to be saved. Older snapshots can be deleted when they are no longer needed.

The technology phase workgroup created new AMI's for the machine instances whenever there were significant changes to a virtual machine either in installed software or data. Maintenance of the created AMIs and snapshots is a manual process managed through the AWS Management Console. Care must be taken to give the various AMIs, snapshots, and volume images proper names for identification purposes. Of course, the more instances created, the higher the cost for services so it is prudent to get rid of old items that are no longer needed. The figure below depicts the conceptual AWS virtual machines and connectivity described above.



ArcGIS Server Installation Details

The GeoMine ArcGIS Server instance on AWS started with an AMI created by ESRI. The preconfigured AMI included ArcGIS Server ver. 10.0 SP3 and ArcGIS Desktop ver. 10.0 SP3 installed on a Microsoft Windows Server 2008 R2 Data Center Edition. The initial AMI creates a machine with a 35GB C: drive and a 100GB D: drive for data and for the ArcGIS Server virtual directories. After working with this configuration for some time, the technology phase workgroup decided that the size of the C: drive was inadequate since it didn't allow enough space for logs, installing new software and for user data. To allow for more capacity, the workgroup expanded the C: drive using the AWS command line API as described here: http://blog.jayway.com/2010/03/31/how-to-get-a-large-c-drive-for-windows-on-amazon/.

Ancillary software such as Adobe Reader was installed manually on the ESRI ArcGIS Server AMI. The technology phase workgroup also installed Safe Software's FME Workbench version 2012 SP2 installed for extract, load and translate operations.

Instead of having all developers log into the server using the administrator account, the workgroup set up individual accounts for each user and added them to appropriate security groups (local Windows accounts). This is more secure and allows each user to have a clearly defined set of personal data stored on the server that would interfere with others. In general, the technology phase workgroup followed ESRI's guidance as described at: http://links.esri.com/arcgisserver/10.0/amazon.

After the basic setup and software licensing, the technology phase workgroup were ready to set up connections to our data stores on the ArcSDE Server. After making sure that the new

ArcGIS Server worked with the demo data installed and could indeed produce web maps, the workgroup deleted those demo services and data. The workgroup then, using ArcCatalog, created connections to our ArcSDE server and put some demo data there and created some test map services. Once verified, the workgroup was ready to start loading GeoMine data and creating GeoMine services. Of course connections between two servers – ArcGIS Server and ArcSDE – require appropriate firewall rules for the AWS security groups.

Although the ArcGIS Server does not contain much of our data, it does house all of our map definitions that create our map and other GIS services. It also contains all of our SDE connection files and specialized ArcGIS toolboxes. All of these data are accessible by the ArcGIS server and are located in D:\GIS Data. The server also contains the virtual directories for our web mapping applications. The root of that directory structure is at D:\html.

Another major component of this server is FME Workbench. All of our ETL jobs are created with FME and the job definition files are stored in the individual developer's personal directory space. Since most of these jobs are also run via our FME Server, most of the jobs are published to and stored on the FME Server.

ArcSDE Server Installation Details

The GeoMine ArcSDE Server instance on AWS started with an AMI created by ESRI. The preconfigured AMI included ArcSDE Server ver. 10.0 SP3 installed on a Microsoft Windows Server 2008 R2 Data Center Edition. The underlying database is PostgreSQL version 8.3. When instantiating the AMI, the workgroup placed it in a security group which allowed access from our other machines – namely the ArcGIS Server and the FME Server – and of course access via RDP from the administrator's workstations.

Instead of having all developers log into the server using the administrator account, the technology phase workgroup set up individual accounts for each user and added them to appropriate security groups (local Windows accounts). This is more secure and allows each user to have a clearly defined set of personal data stored on the server that would not interfere with others. In general, the technology phase workgroup followed ESRI's guidance as described at: http://links.esri.com/arcgisserver/10.0/amazon.

The AMI came with a pre-configured database called ArcSDE owned by a user called sde. The technology phase workgroup changed the password of this user and of the database administrator. At this point, the machine was ready for use. A pre-installed script was used to create additional geodatabases.

FME Server Installation Details

At the beginning of the project, the technology phase workgroup installed FME server on a clean Windows Server 2008 R2 AMI supplied by Amazon following the standard installation instructions from Safe Software. Manual installation was tough, involving many steps and requiring editing of many configuration files. In early 2012, Safe came out with FME 2012 which included a much streamlined installation procedure. Shortly after FME 2012's introduction, Safe came out with a pre-configured Amazon AMI with FME Server 2012 installed. The technology phase workgroup tried that and found that it worked fine after changing some passwords as described for the other servers and changing the FME passwords for the pre-installed FME users. Again, the server was added to an Amazon

security group which allowed access on all TCP/IP ports from the ArcGIS Server and RDP connections from the administrators.

GeoPortal Server Installation Details

The GeoPortal Server uses the open source GeoPortal software developed by ESRI and maintained at: http://sourceforge.net/apps/mediawiki/geoportal/index.php?title=Main_Page. Esri Geoportal Server, an open source product that enables discovery and use of geospatial resources including datasets, rasters, and Web services. It helps manage and publish metadata for geospatial resources to let users discover and connect to those resources. The Geoportal Server supports standards-based clearinghouse and metadata discovery applications.

The technology phase workgroup installed GeoPortal Server on a clean Windows Server 2008 R2 Data Center Edition AMI supplied by Amazon. GeoPortal has a complicated installation procedure and the instructions included with the software must be followed carefully. Since GeoPortal is a JAVA application, there are prerequisites that must be installed including a JAVA servlet engine – the workgroup used the recommended Apache Tomcat. The workgroup found it much easier to not activate the Windows IIS web server and to only use the Tomcat servlet engine. Using the method, no interconnection between IIS and Tomcat were needed and since this was a single purpose system, with did not need IIS for any other purpose. Again, this system was put into its own security group so that RDP access is granted to the administrators.

Appendix I. GeoMine Access, Read, Transform and Load Procedures

Shape Files

For ad hoc shape file access, the technology phase workgroup manually downloaded the files from a FTP server. This is not the preferred method but since the files are not created on a routine production basis by the ADS and the schema tends to change from time-to-time, it is difficult to automate this process. Most data from Kentucky comes this way. Other shape files are updated on a routine basis and placed on an FTP server at a predictable location. This facilitates creating jobs that can automatically download and process the information. Data about Kentucky's underground mines is in this form. Additionally, many of the mines have additional information associated with HTML web pages which, using FME, the technology phase workgroup are able to parse and glean more information.

WFS Services

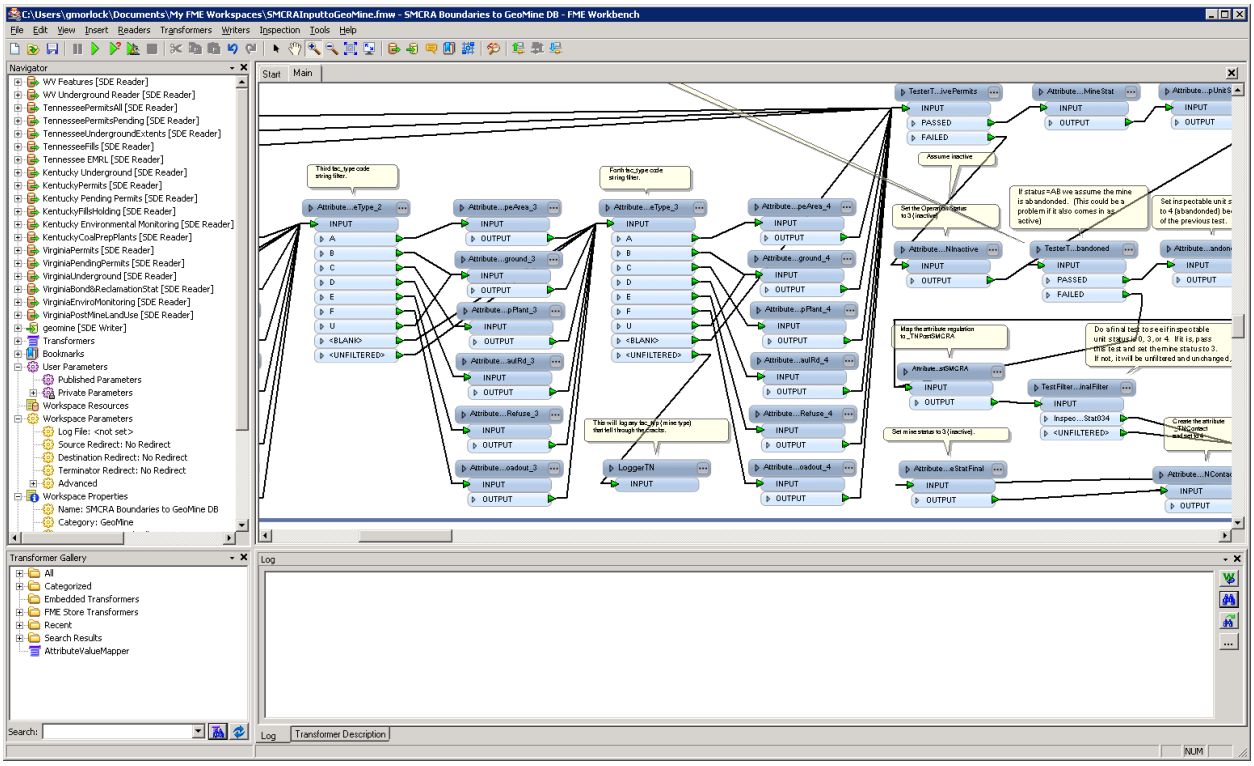
Some of the ADS owners had their data available via OGC Web Feature Services exposed to the Internet. Using our FME Server, the technology phase workgroup was able to connect to these services automatically to download and process data and described below. The data the technology phase workgroup get from West Virginia and Tennessee come this way. In the case of Tennessee (even though the ADS for Tennessee is part of OSMRE), getting the data proved difficult. OSMRE only has one ArcGIS Server in Denver exposed to the Internet for publishing web services from internal data. The Tennessee office does not have direct access to the server and internal network bandwidth problems were significant. Eventually, the technology phase workgroup was able to publish a WFS service of Tennessee's data by connecting directly to Tennessee's geodatabase from Denver. The service is extremely slow but is adequate enough for FME to connect and copy the data to our cloud-based computers.

Geodatabase Replication

The final method the technology phase workgroup use to obtain data for GeoMine is geodatabase replication. The technology phase workgroup used this technique with Virginia. Virginia has a geodata service accessible via the Internet that the technology phase workgroup can connect to using tools in ArcGIS and then replicates the pertinent parts of Virginia's geodatabase to our cloud platform.

FME Transformation and Loading

FME is the workhorse of the data transformation and loading. The technology phase workgroup developed elaborate "workbenches" to read, transform and re-project the data the technology phase workgroup obtained from the ADS. The wire diagram below is a small portion of the graphical representation of one of the FME workbench models the technology phase workgroup uses to read, transform, and load data into GeoMine.



Details for loading shape files

In general, this is the process for loading and processing shape files using FME Server: An HTTP (and FTP) reader is used to download zipped (a shape file consists of several separate files on the file system) shape file to a temporary folder on the FME Server. That download job then spawns another job to upload the zip file to a location where a processing job can unzip and use the shape file for input into the main transformation job. The main transformation job aligns the incoming attributes with the appropriate GeoMine geodatabase schema attributes. The job also re-projects the geometry objects to the final GeoMine projection (Web Mercator, Auxiliary Sphere 1984).

Details for loading WFS Services

The technology phase workgroup manages WFS services in a two-step process. First, a job reads the WFS service and then writes it, unchanged, into a geodatabase in the GeoMine SDE. It is loaded into SDE to avoid delays in processing of the large job to process information from all sources. If it was read and processed live, the entire processing job could fail if one of the WFS services were unavailable.

If possible, the schema for the underlying geodatabase is obtained – the geodatabase the WFS service is based upon – using an ESRI XML Workspace Document. Using a Workspace Document, the technology phase workgroup can create a schema that is identical to the incoming data. If a workspace document is not available, the technology phase workgroup must manually create a holding geodatabase using the information from the WFS "getcapabilities" document. Once the data is available in the holding geodatabase in the GeoMine SDE Server, it is processed by reading the holding geodatabase, aligning the attributes with the output schema and then writing to the output schema after re-projecting if necessary.

The FME Workbench models used by the technology phase workgroup, their sequence, and whether they run manually or automatically on a schedule are provided in the following table:

Workbench Name	Scheduled	Sequence	Description
KYUndergroundZIPUpload.fmw	Yes	1	This workspace downloads a zip file containing a shape file of the Kentucky underground mine works and places the contents of the zip file in a temporary file on the FME server. The workspace then copies the temporary zip file to the work area of the job that submits the data to holding database. Finally, the shape to holding database job is spawned.
KYUndergroundMineExtentsWithChangeDetector.fmw	Spawned from job above	2	Reads the Kentucky Underground Mine Extents shape file and stores the data in a holding SDE geodatabase. After completion the change detector job is spawned.
KYUndergroundMineExtentsShapeToHoldingDBWithChangeDetectorJobSubmitter.fmw	Spawned from job above	3	This workspace compares the new incoming underground works information from Kentucky to that which is already in the feature class. If there is a change, the record is updated, added or deleted as appropriate. In addition, this workspace tries to get additional information about mine status from Kentucky's mine map web site. If the data is available, it is used to supplement the attributes from the shape files.
FWSCritialHabitatZIPShapesToSDE.fmw	Yes	4	This workspace takes zip files of the Fish and Wildlife Service's Critical Habitat shape file data and loads it to the GeoMine holding geodatabase for subsequent processing.

FWSCriticalHabitatShapeToSDE.fmw	Spawned from job above	5	After the Fish and Wildlife Service's Critical Habitat data is uploaded with FWSCriticalHabitatZIPshapeToSDE, this job (which is run from the previously mentioned job) loads the data into the GeoMine SDE geodatabase. This data is not loaded into the general GeoMine schema but is loaded into a schema similar to the WFS service we read with the exception that the attributes are given descriptive aliases.
KFO_WFS_To_Geodatabase.fmw	Yes	6	This workspace reads a WFS service of four Tennessee layers and puts them into the tennessee_data geodatabase for further processing by the SMCRA layers workspace.
USACEPermitsWFStoSDE.fmw	Yes	7	This workspace reads a WFS service from the US Army Corps of Engineers concerning the locations of mining-related Nationwide Permit 21. The data are transformed and loaded into GeoMine. This data is not loaded into the general GeoMine schema but is loaded into a schema similar to the WFS service we read with the exception that the attributes are given descriptive aliases.

SMCRAInputtoGeoMine.fmw	Yes	8	This workspace transforms data from several SMCRA data sources and puts them in the appropriate GeoMine schema. The data are read from holding geodatabases housed in the GeoMine SDE server. The holding geodatabases hold the SMCRA data in its original form (schema and projection unchanged from original) – the data is just converted from its original shape or WFS to an enterprise geodatabase. The purpose getting the data from the holding geodatabase instead of the original source is speed and to avert problems with the temporary unavailability of the true source. In other words if a shape file of data is unavailable for download from a data provider we do not want the entire transformation job to fail – it will still work because a recent copy of the data is still available in our holding environment.
Various *ad hoc* workbenches	No	As needed	Various *ad hoc* workbenches are created and run manually as needed to transform manually downloaded shape files. Since these shape files tend to change often, we have not been able to make standard models to read them.

ArcGIS Map Document

All web services created in GeoMine start with an ArcGIS map document created in ArcMap. The map document controls many aspects of the subsequent map service including layers, description, display scales, extents, and service metadata. Table II shows a list of the map documents used to create GeoMine web services.

Table II
GeoMine Map Documents

Map Document Name	Description
SMCRACoalMineBoundaries.mxd	This map service displays 10 feature classes of coalmining related data. These data are gathered in automated processes from participating coalmining regulatory authorities, generally states. The data from the various sources are transformed into common schemas as described by the ASTM Standard Practice, Geospatial Data for Representing Coal Mining Features. The resultant feature classes represent seamless information covering the coal producing areas of the United States. Development of these data is ongoing and will become more complete as more cooperating regulatory authorities are added to GeoMine.
USACE-NWP21.mxd	The Operations and Maintenance Business Information Link - Regulatory Module (ORM2) automated information system provides detailed information on Army Corps of Engineers Regulatory Permits. This dataset contains feature classes that provide location information for Appalachian Surface Mining Actions from 2007 through the present. This dataset and associated feature classes are derived from a WFS service maintained by the U.S. Army Engineer Institute for Water Resources, Alexandria, VA
FWSCriticalHabitats.mxd	Information from the US Fish and Wildlife Service regarding Threatened and Endangered Species final Critical Habitat designation across the United States.

ArcGIS Map Service Documents and Standard Services

The mxd files listed in Table II above are optimized and saved at ESRI Map Service Documents – msd files. The msd files are then published as ArcGIS map services. The technology phase workgroup publishes a standard set of services including ArcGIS Map service, OGC WMS, and OGC WFS. KML web services were created as a test, but are not created routinely. All of the services support REST and SOAP end points that are freely accessible via the Internet so that end users can utilize these services in their own applications.

Web Mapping Application

In addition to the GeoMine web services, the technology phase workgroup created a web mapping application that uses the GeoMine services and other externally provided services from partners such as the US Fish and Wildlife Service, the US Environmental Protection Agency, and the US Geological Survey. The web application is available at http://geomine.osmre.gov (it is currently password protected). The application allows display and download of the GeoMine data. The application uses ESRI's Flex API which is freely available and was based upon the ESRI Flex Mapping Application. GeoMine developers and others customized the interface to perform specific functions.

Appendix J. Cloud Computing Concepts and Challenges

AWS has many cloud-based resources available but the technology phase workgroup was primarily interested in their Elastic Compute Cloud (EC2). EC2 allows us to quickly deploy virtual servers of varying power and virtual storage capacity. With AWS, you only pay for what you use. More powerful virtual machines cost more per hour to operate. More attached storage costs more per hour too. If the workgroup terminates a machine or deletes a virtual storage device, there are no more charges. Temporary increases in compute power or storage capacity are added as needed. AWS even supports load balancing across multiple computers that can be located in different data centers throughout the world.

AWS supports Microsoft Windows-based machine images and multiple versions of the LINUX operating system. Since the main developers of this prototype are from OSMRE – a Windows Shop – and the ESRI machine images are for Windows-based services, the technology phase workgroup used Windows virtual machines. To instantiate a virtual machine is simple. From a web-based application, one simply chooses an existing machine image – Amazon calls them Amazon Machine Images or AMIs – gives the interface a few parameters such as the data center and firewall rules before starting the image instance. Within a few minutes the virtual machine will be running and can be accessed via the Internet using Microsoft's Remote Desktop Protocol (RDP). Using RDP, the user experience is that of working directly on a Windows-based server. The images created for GeoMine are Windows Server 2008 R2 Data Center Edition.

Three major challenges hampered the AWS deployment. First was the procurement process. Since cloud-computing is relatively new concept, it was difficult to procure the cloud services. Our contracting people were unfamiliar with the concept and the Federal Acquisition Rules are vague about these types of contracts. Security was another problem that had to be addressed. First, the workgroup had to obtain permission to run this prototype from our Bureau security office. After that, the Department of Interior internal network did not allow RDP to be routed to Internet-based systems. The workgroup submitted change requests to allow access from certain internal computers to the AWS machine images – this took months. Finally, network bandwidth is an issue. RDP needs good band width between the client machine and the server on AWS. It turned out that OSMRE's Internet access speed was not up to the task – many times a person could type faster than the RDP display could display. Because increasing the internal agency bandwidth is a long term project out of the workgroup's control, it was decided to allow the OSMRE system developers to telework. The developer's home Internet access was more than adequate to work with RDP to AWS.

Appendix K. – GeoMine Concept of Operations for IT Security

GeoMine
Concept of Operations
1999 Broadway Suite 3320
Denver, CO 80202

Revision History

Version	Date	Author	Comments
1	4/15/2012	Orsain Larrahondo	Initial Creation
2	5/21/2013	Robert Welsh	Update to reflect Amazon Web Services certification under the FedRAMP

Project Summary
The Interagency Appalachian Coal Mining GIS Pilot Project (GeoMine Pilot Project) is the initial implementation of the GeoPlan for both State and federally sourced geospatial coal mining data limited in geographic scope to the States of Kentucky, Virginia, and West Virginia, as well as to OSMRE's federally administered program for the State of Tennessee. A GIS transparently integrates multiple geospatial layers; the Pilot Project will create a single digital platform that is ideally capable of delivering GIS data through an internet-accessible service.

On August 3 and 4, 2010, in Charleston, West Virginia, the first Federal/State interagency meeting regarding the proposed Pilot Project was held among 31 representatives of the Interstate Mining Compact Commission (IMCC), OSMRE, the U.S. Environmental Protection Agency (EPA), the U.S. Army Corps of Engineers (USACE), the U.S. Fish and Wildlife Service (FWS), and the States of Kentucky, Virginia, and West Virginia; the purpose of this 2-day meeting was to develop a Federal/State consensus around the Pilot Project concept. The discussion revealed common interests, and the parties agreed to proceed in two phases:

Data phase.—The Pilot Project partners will inventory their geospatial data holdings and prioritize available information layers that can be used by permit reviewers in their respective agencies. The information layers will be made consumable and usable by typical GIS software/tools. Each Pilot Project participating agency will assign a data steward and contribute their information layers of common interest.

Technology phase.—In harmony with the "cloud first" approach promoted by the Office of Management and Budget (OMB) for fiscal-year (FY) 2012, the Pilot Project would explore the development and implementation of cloud computing solutions for GeoMine. The idea is to have a platform operating as soon as practical with easily available data shared among all seven parties that will have tangible short-term positive results on the various permitting processes and on-going coordination needs. This neutral site cloud-hosting location is preferred by the IMCC and States to control costs and avoid IT issues.

The common GIS that is envisioned would incorporate geospatial and associated data from a variety of sources, but primarily those from Federal and State agencies that are involved in administering SMCRA and the Clean Water Act (CWA). Additionally, as a long-term goal and where appropriate, the common GIS and information exchanged between agencies will be shared more broadly with the general public towards the end of the Pilot Project. With this in mind the geospatial data exchanges will be designed to enable future expansion of reporting and analytical services for clients at all levels.

PURPOSE
The GeoMine Pilot Project is the first implementation of OSMRE's Geospatial Strategic Plan (GeoPlan), which is designed to expand and modernize OSMRE's use of geospatial technologies to meet current and future needs, while maintaining consistency with the goals of the DOI and the government-wide Geospatial Platform.

The purpose of GeoMine is to implement geospatial technologies at the enterprise level that will allow OSMRE and our SMCRA partners to realize significant operational efficiencies, make better decisions, and more effectively inform and involve the public in SMCRA-related

decisions. Effective oversight of coal mining and reclamation requires the regular collection and analysis of pertinent, accurate, and usable data. OSMRE, States, Tribes, and the public need real-time information in an easy-to-use, technology based format. Improved data collection and analysis has significant benefits by making it easier to evaluate performance, spot trends, increase productivity of oversight staff, direct limited resources, and keep staff and the public better informed. OSMRE is pursuing development of a national GIS to store, maintain, and analyze data and to report on the status of coal mining and reclamation activities. A well-designed and maintained surface mining GIS will provide both regulators and the public with valuable information for administering regulatory programs. Annual status reports from permittees would provide basic information for this GIS.

ORGANIZATIONAL ROLES AND RESPONSIBILITIES

GeoMine has defined owner, administrator and user roles and responsibilities as they relate to OSMRE and DOI policies. The identification of roles and responsibilities are best defined within the context of a General Support System (GSS). This section presents a breakdown of responsibilities and authorities within the GSS context that will allow for the operational success and security of GeoMine.

Owner

The GeoMine System Owner provides functional oversight and direction. The system owner is responsible and accountable for defining the goals of the GeoMine system, the overall requirements to be satisfied, and for providing direction to OSMRE management. Technology Management Division Chief is the System Owner for the GeoMine system. Consequently, he/she is responsible for the combined functions of the GeoMine system.

Manager

The GeoMine System Manager ensures that day to day operations and content is kept current. The GeoMine Manager is responsible for the content that is loaded and public accessibility. WR GeoMine Project Leader is the official that will coordinate with the other workgroup members to make GeoMine operational.

Administrator

The GeoMine Administrator is responsible for the personnel tasked to develop, manage and maintain GeoMine. WR staff will serve as primary contacts for the overall technical functions of GeoMine. Western Region Physical Scientists, IT Specialists, and Geographers are the officials that organize, manage and maintain the operational aspects of GeoMine.

Database Administrator

The Database Administrator is responsible for establishing the security safeguards for GeoMine and ensuring that all users of the databases have appropriate authorized access. Western Region Physical Scientists, IT Specialists, are the Database Administrators of GeoMine.

Users

GeoMine users are any individuals that have a need or wish to utilize GeoMine. Users are only allowed to view that data is uploaded by the System Administrators of GeoMine. If the users download that dataset, according to the disclaimer, OSMRE is not responsible once the data is downloaded.

OPERATIONS AND CONFIGURATIONS

Operation

The GeoMine infrastructure is an Infrastructure-as-a-Service (IaaS) hosted by Amazon Web Services. This allows OSMRE to only pay for what is required to keep GeoMine operational. An Amazon AWS (Amazon Web Service) account is issued; from there the user can provision the servers to run a system or application. The AWS account contains access to the Amazon Elastic Compute Cloud (EC2) dashboard for managing the Amazon Machine Instance (AMI- the virtual machines that are created in the Amazon environment) and all the following services: Amazon Elastic Block Storage (EBS) additional hard drives that can be connected to AMIs, Amazon Simple Storage Service (S3) storage used to upload information from your network to the Amazon Cloud Environment, and Identity Access Management (IAM) used to control access to the Amazon cloud environment and AMIs.

GeoMine is an ArcGIS Flex API (application programming interface). WR is currently using a pre-configured ArcGIS AMIs from ESRI, ESRI works together with Amazon to provide the users instances with ESRI software to host GIS services such as GeoMine. Amazon also provides instances of Microsoft SQL 2008 which is the database backend that connects to ArcGIS. FME (Feature Manipulation Engine) is the software that converts dataset into various formats, this allows GeoMine to receive dataset from other sources and manipulate it to a format that can be read by GeoMine. Currently WR has an ArcGIS Server instance; FME Server Instance and Arc SDE (Spatial Data Engine) instance running on the Amazon cloud environment together the instance allow GeoMine to function.

Security

GeoMine is hosted by a contractor providing Amazon Web Services (AWS). AWS was certified for FISMA moderate impact level by FedRAMP in May 2013 to meet the requirements as a Cloud Service Provider (CSP) see GSA link here. Once certified, government agencies will be able to leverage the certification and use the CSP to host their own services.

GeoMine relies totally on data provided by other federal agencies and local state government. All dataset provided are all copies of original datasets produced by originating agencies and states. All federal agencies have Memorandums of Understanding (MOU) that state what data is given and how it will be used. States and local government were given a questionnaire to complete to determine the data classification, and to ensure that the proper security data level is established for GeoMine. Currently there are also disclaimers in place to ensure that there is not misuse of the data that GeoMine displays.

Logical access to the cloud environment that host GeoMine is managed through the Amazon IAM and Network and Security options. IAM serves as a group-based control that allows the Administrator access to the console to manage the AMIs currently only the Administrators have access to this console. Network and Security options serves as a firewall that controls which machines can remote into the AMIs, only the Administrator machines have remote access to the GeoMine instances.

GeoMine is accessed as via most browsers, the information can only be viewed and cannot be altered. A reverse proxy is in place between the Amazon cloud environment and the internet.

All request to the Amazon hosted GeoMine services are handle by the reverse proxy to provide an additional level of security. All servers and AMI are routinely updated to ensure software is up to date.

Technical Operations and Configuration Management
The Western Region will be responsible for any technical issues related to GeoMine. All computer configuration settings will be controlled by personnel in WR. WR will maintain backups required to carry out the continuity of operation for GeoMine. WR GeoMine Team will be responsible for handling all issues related to the proper function, and maintenance of GeoMine. Functional issues that arise will be addressed by the WR on a prioritized basis. After GeoMine is assigned as a fully operational system, any application-specific issues will be addressed by the WR.

Configuration/Change Management processes are handled by the WR System Administrators. Should any major changes such as configuration, modifications, major upgrades, etc. occur to GeoMine, they will be reviewed and processed by the WR System Administrators. GeoMine is currently hosted on Amazon's Cloud Services. Images of the GeoMine servers are routinely made and new instances are created from the images to ensure that the images are correctly backing up.

ROLES AND RESPONSIBILITY MATRIX

There are certain maintenance and support requirements that must be managed to ensure overall effectiveness and acceptable operation. The management of these requirements is critical for the overall success of GeoMine in terms of availability and reliability. Included within these managerial areas are:

- Security Management and its component parts (e.g., Policies and Procedures, Physical Security, Personnel Security, Network Perimeter Security, Logical Access, etc.)
- Backup and Recovery
- Service Continuity

The following matrix identifies the scope and assignment of these responsibilities:

Area of Responsibility	**OSMRE (IRO)**	**WR (System Administrator)**	**Clients and Users**
Security Management			
Policies and Procedures	Issuance and maintenance of Overall Security Policies and Procedures	Assure that Cloud Service Provider (CSP) Service Agreement (SA) complies with Policy set forth.	Recognition and adherence to Security Policy in each of the areas.
Physical Security	Identification and documentation of DOI-wide Physical Security	Set Service Agreements that will ensure CSP will meet all Physical Security requirements.	Identification, justification, and submission of requests for

Area of Responsibility	OSMRE (IRO)	WR (System Administrator)	Clients and Users
	requirements.		employees who need regular or recurrent access into the building and/or processing center.
Network Perimeter Security	Identification and documentation of DOI-wide Network Perimeter Security requirements.	Implementation of DOI Network Perimeter Security requirements and management of associated devices within the processing center. These would include perimeter routers, switches, firewalls, and internal IDS system.	Implementation of DOI Network Perimeter Security requirements and management of associated devices within Client/User-managed areas of the network.
Logical Access	Identification and documentation of DOI-wide Logical Access requirements.	Implementation of DOI-wide Logical Access requirements and management of associated control and monitoring processes and equipment for the processing center.	Adherence to DOI and site logical access policies and procedures, identification of access requirements for systems, working with site operations support staff to identify, implement, and test a mutually acceptable logical access solution.
Backup and Recovery	Identification and documentation of DOI-wide Backup and Recovery requirements.	Provision and management of an overall site backup and recovery capability for all installed servers and data storage devices, including backup devices, management software, and support staff, and performance of regular disaster recovery backup activities.	Identification of backup and recovery requirements for Client/User servers and applications. Scheduling with Site Operator for appropriate time for accomplishing regular disaster recovery backups and performance of other backups, as needed, for processing or data integrity purposes.

Area of Responsibility	OSMRE (IRO)	WR (System Administrator)	Clients and Users
Service Continuity	Identification and documentation of DOI-wide Service Continuity requirements. Review and approval of Installation Business Continuity Plans, including Facility Business Recovery Plan and processing site Continuity of Operations Plans.	Development, maintenance, and coordination of processing site Continuity of Operations Plan; coordination and documentation of results of regularly scheduled disaster recovery exercises; coordination and participation in Business Recovery exercises.	Identification of system and application disaster recovery requirements; coordination and participation in processing site disaster recovery exercises; and provision of feedback on system/application disaster recovery exercise results.

End of Appendix K.

Appendix L: GeoMine Pilot Project Funding FY10-12 (Including OSMRE Infrastructure Costs and OSMRE Federal Cooperative Agreement Grants to the SMCRA Pilot Project States)

Funding Sources	Category	Description	FY10 Funding	FY11 Funding	FY12-13 Funding
OSMRE Direct Funding	Software for OSMRE GeoMine Development	Feature Manipulation Engine (FME) Software	$28,785	$4,963	$10,080
		Security Software--Secure Socket Layer (SSL) Certificates for OSMRE	$200	$215	$430
		Camtasia Studio 7 Software to produce Pilot Project briefing media	NA	NA	$897
	Cloud Contract and Contractor Services for OSMRE GeoMine Web Development	Apptis Inc. Amazon Cloud Services	$15,000	$25,000	$50,000
		Contractor for Internet Viewer Development Services Interagency Agreement via USGS Interagency Agreement	$96,364	$100,000	$200,000
	OSMRE Travel Support for OSMRE/State Project Personnel	State travel to Lexington, KY Pilot Project geodatadesign meeting (FY 10), Knoxville Data Design (2 trips), Abington, VA Engineers presentation, Pittsburgh Data Steward meeting,	$624	NA	$36,000

Funding Sources	Category	Description	FY10 Funding	FY11 Funding	FY12-13 Funding
		Briefing travel (FY 12)			
	OSMRE Personnel FTE	FTE Assigned to Support Pilot Project	2	3	3
OSMRE-Sponsored State Funding	TIPS-Funded Kentucky Hardware Support	Computer Storage and Color Scanner	$34,500	NA	NA
	TIPS-Funded Kentucky Software Support	Software-Adobe Flex 4 Development Environment and Photoshop (4 Copies)	$3,800	NA	NA
	Kentucky OSMRE Cooperative Grant Funding in FY11	Hardware ($23,500) and Interns ($192,660)	NA	$216,160	NA
	Kentucky OSMRE Cooperative Grant Funding in FY12-13	Hardware and Interns	NA	NA	$192,000
	TIPS-Funded Virginia Software Support	Security Software--Secure Socket Layer Certificates for VA	$200	$215	NA
	Virginia OSMRE Cooperative Grant Funding in FY10	VA upgrade of their Mobile GIS application to support field collection of GeoMine-ready data	$25,000	NA	NA
	Virginia OSMRE Cooperative Grant Funding in FY11	Computer Hardware ($39,000), Contract programming ($25,000) and	NA	$100,000	NA

Funding Sources	Category	Description	FY10 Funding	FY11 Funding	FY12-13 Funding
		Interns ($36,000)			
	Virginia OSMRE Cooperative Grant Funding in FY12-13	Contract programming and Interns	NA	NA	$100,000
	OSMRE-Funded West Virginia Software Support	Windows 7 Server Operating System (FY10) and Web Publishing Software (FY12)	$650	NA	$2,233
	West Virginia OSMRE Cooperative Grant Funding in FY11	Computer Hardware ($146,100) and Interns ($252,000)	NA	$398,100	NA
	West Virginia OSMRE Cooperative Grant Funding in FY12-13		NA	NA	$115,000
Sub Totals			$205,124	$851,156	$415,733
				Grand total	$1,677,137

Appendix M - Section 508 Compliance Analysis

Reviewed by: Delva Martinez

Date of scan: June 12, 2012

Name of Product: GeoMine Pilot Project

Purpose of 508 Compliance Review:
The purpose of Section 508 is to allow individuals with disabilities to be able to use an application or website with ease. Obviously, there are limitations on what can be provided for all disabilities, therefore, the focus of this has been on color blindness and the use of a keyboard.

Summary of Review Findings:
The GeoMine Team requested that we conduct an evaluation of the GeoMine Pilot Project for Section 508 compliance. A scan of the site was conducted using the tool named Cynthia Says – Web Content Accessibility Report by HiSoftware®. The results of the scan are found on Attachment A and the overall finding is that the site is currently 508 compliant.

Details of Analysis:
The following Technical Standards are not applicable to the current stage of the web-based application called GeoMine Pilot Project:

Section 1194.21 Software Applications and Operating Systems;
Section 1194.23 Telecommunications Products;
Section 1194.24 Video or Multimedia Products;
Section 1194.25 Self Contained, Closed Products; and
Section 1194.26 Desktop and Portable Computers.

Once the web-based application has reached the final stage a review will be conducted for the following Subparts: Subpart C Functional Performance Criteria; and Subpart D Information, Documentation, and Support. Should any of the components mentioned above as not applicable to the current state of the site, an additional review will be conducted to ensure they meet the standards.

At this stage, the evaluations focused on Web-based Intranet and Internet Information and Applications, Technical Standards, Section 1194.22. This section has sixteen requirements. The findings are that the web-based application met four; three (3) required attention; and nine (9) were not applicable. The nine not applicable could change as the development process continues to completion. At this current stage of development, the web-based application GeoMine Pilot Project passes with meeting thirteen out of sixteen requirements.

Recommendations:
The following are suggestions provided to the programmer of the Pilot Project:

- The Pilot Project requires the use of mouse in order to navigate and select sections or areas on a map for execution. For keyboard usage, the “TAB” key, the “ENTER” key

and a combination of keys called short-cuts should be implemented to allow easy navigation and execution.

For example, to open the Help window, the short-cut could be “ALT-H”. The “ENTER” key should be enabled to execute a request. There should be a short-cut to close windows that are open using as an example “ALT-C”. When using the “TAB” key to navigate, the location of where the “TAB” key moved on the site should be visible. Currently, the “TAB” key is a faded outline.

- For color blindness, there should be an ability to allow a person to change the color and change the light contrast to either dark or light. Maps, charts, and all other displays using color should also display the same information using black and white.

Additional Suggestion for Ease of Navigation and to meet DOJ requirement:
We also suggest that when a link is provided to another website or PDF (etc.), the site should allow another window to be opened to display the related site or information rather than occupying the same window where the web-based application resides.

The Department of Justice requires websites to provide a statement indicating the departure from the existing location to another. Although the requirement is for websites, this can easily be implemented with a statement prior to the execution of the link. Statement wording can be provided upon request.

Supporting documents:
The supporting documents of this review will follow under Attachment A and include:

- 508 Compliance Elements under Subpart B – Technical Standards, and
- HiSoftware® Cynthia Says™ - Web Content Accessibility Report

Section 508 §1194.22 Compliance Statement		
Criteria	Supporting Features	Remarks and explanations
Section 1194.21_Software Applications and Operating Systems Most of the specifications for software pertain to usability for people with vision impairments. For example, one provision requires alternative keyboard navigation, which is essential for people with vision impairments who cannot rely on pointing devices, such as a mouse. Other provisions address animated displays, color and contrast settings, flash rate, and electronic forms, among others.-1	Could not evaluate.	Evaluation will occur at final stage.
Section 1194.22 Web-based Internet Information and Applications	Conforms to 13 of 16	Please refer to SECTION 1194.22 Web-based Internet

The criteria for web-based technology and information are based on access guidelines developed by the Web Accessibility Initiative of the World Wide Web Consortium. Many of these provisions ensure access for people with vision impairments who rely on various assistive products to access computer-based information, such as screen readers, which translate what's on a computer screen into automated audible output, and refreshable Braille displays. Certain conventions, such as verbal tags or identification of graphics and format devices, like frames, are necessary so that these devices can "read" them for the user in a sensible way. The standards do not prohibit the use of web site graphics or animation. Instead, the standards aim to ensure that such information is also available in an accessible format. Generally, this means use of text labels or descriptors for graphics and certain format elements. (HTML code already provides an "Alt Text" tag for graphics which can serve as a verbal descriptor for graphics). This section also addresses the usability of multimedia presentations, image maps, style sheets, scripting languages, applets and plug-ins, and electronic forms. The standards apply to Federal web sites but not to private sector web sites (unless a site is provided under contract to a Federal agency, in which case only that web site or portion covered by the contract would have to comply). Accessible sites offer significant advantages that go beyond access. For example, those with "text-only" options provide a faster downloading alternative and can facilitate transmission of web-based data to cell phones and personal digital assistants. -1	standards	Information and Applications for detailed explanations.
Section 1194.23 Telecommunications Products The criteria of this section are designed primarily to ensure access to people who are deaf or hard of hearing. This includes compatibility with hearing aids, cochlear implants, assistive listening devices, and TTYs. TTYs are devices that enable people with hearing or speech impairments to communicate over the telephone; they typically include an acoustic coupler for the	Not Applicable	Pilot Project is not a telecommunications product.

telephone handset, a simplified keyboard, and a visible message display. One requirement calls for a standard non-acoustic TTY connection point for telecommunication products that allow voice communication but that do provide TTY functionality. Other specifications address adjustable volume controls for output, product interface with hearing technologies, and the usability of keys and controls by people who may have impaired vision or limited dexterity or motor control.-1		
Section 1194.24 Video and Multi-media Products Multimedia products involve more than one media and include, but are not limited to, video programs, narrated slide production, and computer generated presentations. Provisions address caption decoder circuitry (for any system with a screen larger than 13 inches) and secondary audio channels for television tuners, including tuner cards for use in computers. The standards also require captioning and audio description for certain training and informational multimedia productions developed or procured by Federal agencies. The standards also provide that viewers be able to turn captioning or video description features on or off.-1	Not Applicable	Pilot Project is not a video or multimedia product.
Section 1194.25 Self-Contained, Closed Products This section covers products that generally have imbedded software but are often designed in such a way that a user cannot easily attach or install assistive technology. Examples include information kiosks, information transaction machines, copiers, printers, calculators, fax machines, and similar types of products. The standards require that access features be built into the system so users do not have to attach an assistive device to it. Other specifications address mechanisms for private listening (handset or a standard headphone jack), touch screens, auditory output and adjustable volume controls, and location of controls in accessible reach ranges.-1	Not Applicable	Pilot Project is not a self-contained, closed product.

Section 1194.26 Desktop and Portable Computers This section focuses on keyboards and other mechanically operated controls, touch screens, use of biometric form of identification, and ports and connectors. -1	Not Applicable	Pilot Project is not a desktop or portable computer.
Section 1194.31 Functional Performance Criteria The performance requirements of this section are intended for overall product evaluation and for technologies or components for which there is no specific requirement under the technical standards in Subpart B. These criteria are designed to ensure that the individual accessible components work together to create an accessible product. They cover operation, including input and control functions, operation of mechanical mechanisms, and access to visual and audible information. These provisions are structured to allow people with sensory or physical disabilities to locate, identify, and operate input, control and mechanical functions and to access the information provided, including text, static or dynamic images, icons, labels, sounds or incidental operating cues. For example, one provision requires that at least one mode allow operation by people with low vision (visual acuity between 20/70 and 20/200) without relying on audio input since many people with low vision may also have a hearing loss.-1	Could not evaluate.	Evaluation will occur at final stage.
Section 1194.41 Information, Documentation and Support The standards also address access to all information, documentation, and support provided to end users (e.g., Federal employees) of covered technologies. This includes user guides, installation guides for end-user installable devices, and customer support and technical support communications. Such information must be available in alternate formats upon request at no additional charge. Alternate formats or methods of communication, can include Braille, cassette recordings, large print, electronic text, Internet postings, TTY	Could not evaluate.	Evaluation will occur at final stage.

access, and captioning and audio description for video materials. -1		

Note: -1 – from Section508.gov; Section 508 Standards Summary
Link: http://www.section508.gov/summary-section508-standards

Section 1194.22 Web-based Internet Information and Applications		
Criteria	Supporting Features	Remarks and explanations
(a) A text equivalent for every non-text element shall be provided (e.g., via “alt”, ”longdesc”, or in element content).	Supported	This requirement is met. In the Pilot Project a text equivalent is provided for all non-text elements.
(b) Equivalent alternatives for any multimedia presentation shall be synchronized with the presentation.	Not all was met. Requires attention.	This requirement is met with only a few minor corrections required. The Pilot Project contains no multimedia presentations.
(c) Web pages shall be designed so that all information conveyed with color is also available without color, for example from context or markup.	Requires attention.	This requirement is not met. The Pilot Project programmer has been informed of this requirement.
(d) Documents shall be organized so they are readable without requiring an associated style sheet.	Requires attention.	This point is it unknown if online documentation uses style sheets.
(e) Redundant text links shall be provided for each active region of a server-side image map.	Not Applicable	This requirement is not applicable.
(f) Client-side image maps shall be provided instead of server-side image maps except where the regions cannot be defined with an available geometric shape.	Not Applicable	At this early stage, this requirement is not applicable.
(g) Row and column headers shall be identified for data tables.	Not Applicable	At this early stage, this requirement is not applicable.
(h) Markup shall be used to associate data cells and header cells for data tables that have two or more logical levels of row or column headers.	Not Applicable	At this early stage, this requirement is not applicable.
(i) Frames shall be titled with text that facilitates frame identification and navigation	Not Applicable	This requirement is not applicable.
(j) Pages shall be designed to avoid causing the screen to flicker with a frequency greater than 2 Hz and lower than 55 Hz.	Supported	This requirement is fully met. All refreshable content in the Pilot Project has been verified to fall within the allowed range.

(k) A text-only page, with equivalent information or functionality, shall be provided to make a web site comply with the provisions of this part, when compliance cannot be accomplished in any other way. The content of the text-only page shall be updated whenever the primary page changes.	Not Applicable	This requirement is not applicable. At this early stage, a text only page was not necessary to provide an accessible experience since all data results are done by the user of the Pilot Project.
(l) When pages utilize scripting languages to display content, or to create interface elements, the information provided by the script shall be identified with functional text that can be read by Assistive Technology.	Supported	This requirement is fully met.
(m) When a web page requires that an applet, plug-in or other application be present on the client system to interpret page content, the page must provide a link to a plug-in or applet that complies with §1194.21(a) through (l).	Supported	This requirement is fully met.
(n) When electronic forms are designed to be completed on-line, the form shall allow people using Assistive Technology to access the information, field elements, and functionality required for completion and submission of the form, including all directions and cues.	Not Applicable	This requirement is not applicable. At this early stage, there are no forms to fill out for the Pilot Project.
(o) A method shall be provided that permits users to skip repetitive navigation links.	Not Applicable	This requirement is not applicable this early stage, the Pilot Project does not provide a skip navigation link.
(p) When a timed response is required, the user shall be alerted and given sufficient time to indicate more time is required.	Not Applicable	This requirement is not applicable. At this early stage, the Pilot Project does not have any features that require a timed response.

The level of detail setting for the report is to show all detail.

Verification Checklist

Checkpoints	Passed		
508 Standards, Section 1194.22	**Yes**	**No**	**Other**
A. 508 Standards, Section 1194.22, (a) A text equivalent for every non-text element shall be provided (e.g., via "alt", "longdesc", or in element content). ○ Rule: 1.1.1 - All IMG elements are required to contain either the alt or the longdesc attribute. ○ No invalid IMG elements found in document body. ○ Rule: 1.1.2 - All INPUT elements are required to contain the alt attribute or use a LABEL. ○ No INPUT Elements found within document ○ Rule: 1.1.3 - All OBJECT elements are required to contain element content. ○ No invalid OBJECT elements found in document body. ○ Rule: 1.1.4 - All APPLET elements are required to contain both element content and the alt attribute. ○ No APPLET elements found in document body. ○ Rule: 1.1.6 - All IFRAME elements are required to contain element content. ○ No IFRAME elements found in document body. ○ Rule: 1.1.7 - All Anchor elements found within MAP elements are required to contain the alt attribute. ○ No MAP elements found in document body. ○ Rule: 1.1.8 - All AREA elements are required to contain the alt attribute. ○ No AREA elements found in document body. ○ Rule: 1.1.9 - When EMBED Elements are used, the NOEMBED element is required in the document. ○ No EMBED elements found in document body.	Yes		
B. 508 Standards, Section 1194.22, (b) Equivalent alternatives for any multimedia presentation shall be synchronized with the presentation. ○ Rule: 1.4.1 - Identify all OBJECT Elements that have a multimedia MIME type as the type attribute value.			

○ No OBJECT elements found in document body that have multimedia MIME type as the 'type' attribute value. ○ Rule: 1.4.2 - Identify all OBJECT Elements that have a 'data' attribute value with a multimedia file extension. ○ Note: OBJECT Element found at Line: 140, Column: 17 appears to have '.swf' as a file extension in the 'data' attribute. ○ Rule: 1.4.3 - Identify all EMBED Elements that have a 'src' attribute value with a multimedia file extension. ○ No EMBED elements found in document body.			
C. 508 Standards, Section 1194.22, (c) Web pages shall be designed so that all information conveyed with color is also available without color, for example from context or markup.			
D. 508 Standards, Section 1194.22, (d) Documents shall be organized so they are readable without requiring an associated style sheet. ○ Note: Document uses external stylesheets, inline style information, or header style information.			
E. 508 Standards, Section 1194.22, (e) Redundant text links shall be provided for each active region of a server-side image map. ○ Rule: 1.2.1 - Locate any IMG element that contains the 'ismap' attribute. ○ No IMG elements found in document body that contain the 'ismap' attribute. ○ Rule: 1.2.2 - Locate any INPUT element that contains the 'ismap' attribute. ○ No INPUT elements found in document body.			N/A
F. 508 Standards, Section 1194.22, (f) Client-side image maps shall be provided instead of server-side image maps except where the regions cannot be defined with an available geometric shape. ○ Rule: 9.1.1 - No IMG element should contain the 'ismap' attribute. ○ No server-side image map IMG elements found in document body. ○ Rule: 9.1.2 - No INPUT element should contain the 'ismap' attribute. ○ No INPUT elements found in document body.			N/A
G. 508 Standards, Section 1194.22, (g) Row and column headers shall be identified for data tables. ○ Rule: 5.1.1 - Identify all Data TABLE elements. ○ No TABLE elements found in document body.			N/A
H. 508 Standards, Section 1194.22, (h) Markup shall be used to associate data cells and header cells for data tables that have two or more logical levels of row or column headers. ○ Rule: 5.2.1 - Identify all Data TABLE elements. ○ No TABLE elements found in document body.			N/A
I. 508 Standards, Section 1194.22, (i) Frames shall be titled with text that facilitates frame identification and navigation. ○ Document is not a FRAMESET Page.			N/A
J. 508 Standards, Section 1194.22, (j) Pages shall be designed to avoid causing the screen to flicker with a frequency greater than 2 Hz and lower than 55 Hz. ○ Rule: 7.1.1 - Documents are required not to contain the BLINK element. ○ No BLINK elements found in document body. ○ Rule: 7.1.2 - Documents are required not to contain the MARQUEE element. ○ No MARQUEE elements found in document body. ○ Note: SCRIPT element(s) found in document body, a visual verification must be done to ensure the script does not cause the screen to flicker.			

K. 508 Standards, Section 1194.22, (k) a text-only page, with equivalent information or functionality, shall be provided to make a web site comply with the provisions of this part, when compliance cannot be accomplished in any other way. The content of the text-only page shall be updated whenever the primary page changes.			
(k) Option A - Check for the string 'Text Version' within the document.			N/V
(k) Option B - Check for a Global Text Version Link within the document.			N/V
(k) Option C - Check for an Accessibility Policy Link within the document.			N/V
L. 508 Standards, Section 1194.22, (l) When pages utilize scripting languages to display content, or to create interface elements, the information provided by the script shall be identified with functional text that can be read by assistive technology. ○ Rule: 6.3.1 - Anchor elements are required not to use javascript for the link target when the NOSCRIPT element is not present in the document. These elements will not cause a failure of the checkpoint if the NOSCRIPT element is found; however, they will be identified. ○ No Anchor elements that use javascript for the link target were found in document body. ○ Rule: 6.3.2 - AREA elements are required not to use javascript for the link target when the NOSCRIPT element is not present in the document. These elements will not cause a failure of the checkpoint if the NOSCRIPT element is found; however, they will be identified. ○ No AREA Elements found in document body. ○ Rule: 6.3.3 - Locate elements that use HTML event handlers. ○ Note: This rule has not been selected to be verified for this checkpoint. ○ Rule: 6.3.4 - When SCRIPT Elements are used, the NOSCRIPT element is required in the document. ○ The SCRIPT element is used and the NOSCRIPT element was found in document.	Yes		
M. 508 Standards, Section 1194.22, (m) When a web page requires that an applet, plug-in or other application be present on the client system to interpret page content, the page must provide a link to a plug-in or applet that complies with §1194.21(a) through (l). ○ Rule: 6.3.5 - All OBJECT elements are required to contain element content. ○ No invalid OBJECT elements found in document body. ○ Rule: 6.3.6 - All APPLET elements are required to contain both element content and the alt attribute. ○ No APPLET elements found in document body. ○ Rule: 6.3.7 - When EMBED Elements are used, the NOEMBED element is required in the document. ○ No EMBED elements found in document body. ○ Rule: 6.3.8 - All pages that have links to files that require a special reader or plug-in are required to contain the specified text indicating a link to the reader or plug-in. ○ Note: This rule has not been selected to be verified for this checkpoint.	Yes		
N. 508 Standards, Section 1194.22, (n) When electronic forms are designed to be completed on-line, the form shall allow people using assistive technology to access the information, field elements, and functionality required for completion and submission of the form, including all directions and cues.			N/A
O. 508 Standards, Section 1194.22, (o) A method shall be provided that permits users to skip repetitive navigation links. ○ Rule: (o).1 - All pages are required to contain a bookmark link to skip navigation that has the specified text in either the link text or the 'title' attribute value. Skip Navigation Text: ○ Note: This rule has not been selected to be verified for this checkpoint.			
P. 508 Standards, Section 1194.22, (p) When a timed response is required, the user shall be alerted and given sufficient time to indicate more time is required.			

*Checkpoint Result Legend: **Yes** = Passed Automated Verification, **No** = Failed Automated Verification, **Warning** = Failed Automated*

Verification, however, configured not to cause page to fail (Priority 2 or 3 only), ***N/V*** *= Not selected for verification,* ***N/A*** *= No related elements were found in document (Visual only), No Value = Visual Checkpoint*

HiSoftware Alt Text Quality Report

Verified File Name: http://107.22.233.192/viewer/?config=pilot/pilot.xml.
Date and Time: 6/12/2012 6:43:36 PM
Passed Automated Verification

Verification Checklist

Checkpoints	Passed		
	Yes	No	Other
1.1 Validate that the alt text does not use the word image When users add alternative text to an image they tend to add the word "Image" when it really says nothing about the image, but describes the object versus the meaning of the object. This check will fail a page for the use of the word image in the alternative text. Image alternative text does not contain the word "Image"	Yes		
1.2 Validate that the alt text does not contain the text: .jpg, .gif, .bmp, .jpeg Many content creation tools will automatically add alternative text when you add an image to your content. The text is generally the image name. Validate that: .jpg, .gif, .bmp, .jpeg, are not found in the alt text. Image Alternative Text does not contain: .jpg, .gif, .bmp, .jpeg	Yes		
1.6 Validate that the alt text does not contain the text "image" Many content creation tools will automatically add alternative text when you add an image to your content. The text is generally the image name or the word image with a number associated, like image001. This checkpoint will fail a page if the string image is found in the alternative text. Image Alternative Text does not contain the text "image"	Yes		
2.1 Validate that Alternative Text is greater than 7 and less than 81 characters in length Short alternative text may not be valid, warn the report user if alternative text was found that is less than seven characters in length. Additionally alternative text should not be larger than 80 characters, if the alt text is greater the long description attribute should be used. This check validates that the alt attribute does not exceed 80 characters in length. The alternative text passed the minimum/maximum allowed characters check	Yes		
2.2 Validate that Alternative Text is not used to repeat words Alternative text should not be used to simply hide words with the hope of increasing your ranking on search engines. If you repeat a word more than 5 times your page may not be indexed. The alternative text passed the maximum allowed repeated words check	Yes		

*Checkpoint Result Legend: **Yes** = Passed Automated Verification, **No** = Failed Automated Verification, **Warning** = Automated*
*Verification Warning, **N/V** = Not Verified, **N/A** = No related elements were found in document, No Value = Visual Checkpoint*

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Appendix N. – Unit Costs for SMCRA States to Digitize/Transfer Coal Mine Boundaries and Associated Data Under the Federal Cooperative Agreements

West Virginia

Funding Source	Description expense	infrastructure/labor/equipment	FY10 cost Regulatory	FY10 cost AML	FY11 cost Regulatory	FY11 cost AML	FY12 cost Regulatory	FY12 cost AML
State Expense			$ -	$ -	$ -	$ -	$ 29,008	$ -
OSM Federal grant			$ -	$ -	$ 115,420	$ 268,417	$ 6,590	$ -
		sub Total cost:	$ -	$ -	$ 115,420	$ 268,417	$ 35,598	$ -

	MOU Digitized Regulatory	MOU Digitized AML	MOU Digitized Total	State Transfer Regulatory	State Transfer AML	State Transfer Total	Grand Total
Units produced:	6,456	16,013	22,469	72,122	3,157	75,279	97,748
Total Cost:	$ 122,010	$ 268,417	$ 390,427	$29,008	$0	$29,008	$419,435
Average Unit Cost:	$ 18.90	$ 16.76		$ 0.40	$ -		

Virginia

Funding Source	Description expense	Infrastructure/labor/equipment	FY10 cost Regulatory	FY10 cost AML	FY11 cost Regulatory	FY11 cost AML	FY12 cost Regulatory	FY12 cost AML
State Expense	Computer	$138/month X 2	$ -	$ -	$ 4,140	$ -	$ 4,140	$ -
State Expense	FTE Admin	% of salary	$ -	$ -	$ 5,200	$ 5,200	$ 5,200	$ 5,200
State Expense	Data Storage	$ 2.58/gb/month ~		$ -	$ 500	$ -	$ 500	$ -
State Expense	Peripheral (Scanners)	Fixed	$ -	$ -	$ -	$ -	$ -	$ -
State Expense	software	Fixed	$ -	$ -	$ -	$ -	$ -	$ -
OSM Federal grant			$ -	$ -	$ 100,000	$ -	$ 66,326	$ -
		sub Total cost:	$ -	$ -	$ 109,840	$ 5,200	$ 76,166	$ 5,200

	MOU Digitized Regulatory	MOU Digitized AML	MOU Digitized Total	State Transfer Regulatory	State Transfer AML	Total Units	Grand Total
Units produced:	2,952	0	2,952	18,710	7,427	26,137	29,089
Total Cost:	$ 166,326	$ -	$ 166,326	$19,680	$10,400	$30,080	$196,406
Average Unit Cost:	$ 56.34	#DIV/0!		$ 1.05	$ 1.40		

Kentucky

Funding Source	Description expense	infrastructure/labor/equipment	FY10 cost Regulatory	FY10 cost AML	FY11 cost Regulatory	FY11 cost AML	FY12 cost Regulatory	FY12 cost AML
State Expense	management		$ 52,000	$ -	$ 52,000	$ -	$ 52,000	$ -
State Expense	4.5 interns	$24,000 + 31% ovrhd	$ -	$ -	$ -	$ -	$ -	$ -
OSM Federal grant			$ -	$ -	$ 149,702	$ 54,915	$ 44,395	$ -
OSM TIPS Funded Equipment			$ -	$ -	$ 23,805	$ 10,695	$ -	$ -
		sub Total cost:	$ 52,000	$ -	$ 225,507	$ 65,610	$ 96,395	$ -

	MOU Digitized Regulatory	MOU Digitized AML	MOU Digitized Total	State Transfer Regulatory	State Transfer AML	Total Units	Grand Total
Units produced:	51,643	9,727	61,370	97,641	0	97,641	159,011
Total Cost:	$ 217,902	$ 65,610	$ 283,512	$156,000	$0	$156,000	$439,512
Average Unit Cost:	$ 4.22	$ 6.75		$ 1.60	#DIV/0!		

Tennessee OSM Knoxville Field Office

Funding Source	Description expense	infrastructure/labor/equipment	FY10 cost Regulatory	FY10 cost AML	FY11 cost Regulatory	FY11 cost AML	FY12 cost Regulatory	FY12 cost AML
State Expense - filling outside data requests			$ -	$ -	$ -	$ -	$ 800	$ -
State Expense - J. Middleton 160 hours			$ -	$ -	$ -	$ -	$ 4,025	$ -
State Expense - AML data digitization			$ -	$ -	$ -	$ -	$ -	$ 8,175
OSM Federal grant			$ -	$ -	$ -	$ -	$ 25,000	$ -
		sub Total cost:	$ -	$ -	$ -	$ -	$ 29,825	$ 8,175

	MOU Digitized Regulatory	MOU Digitized AML	MOU Digitized Total	State Transfer Regulatory	State Transfer AML	Total Units	Grand Total
Units produced:	568	0	568	6,717	2,350	9,067	9,635
Total Cost:	$ 25,000	$ -	$ 25,000	$4,825	$8,175	$13,000	$38,000
Average Unit Cost:	$ 44.01	#DIV/0!		$ 0.72	$ 3.48		

All Pilot Project States

Funding Source	Description expense	infrastructure/labor/equipment	FY10 cost Regulatory	FY10 cost AML	FY11 cost Regulatory	FY11 cost AML	FY12 cost Regulatory	FY12 cost AML
State Expense			$ 52,000	$ -	$ 61,840	$ 5,200	$ 95,673	$ 13,375
OSM Federal grant			$ -	$ -	$ 365,122	$ 323,332	$ 142,311	$ -
OSM TIPS Funded Equipment			$ -	$ -	$ 23,805	$ 10,695	$ -	$ -
		sub Total cost:	$ 52,000	$ -	$ 450,767	$ 339,227	$ 237,984	$ 13,375

	MOU Digitized Regulatory	MOU Digitized AML	MOU Digitized Total	State Transfer Regulatory	State Transfer AML	Total Units	Grand Total
Units produced:	61,619	25,740	87,359	195,190	12,934	208,124	295,483
Total Cost:	$ 531,238	$ 334,027	$ 865,265	$209,513	$18,575	$228,088	$1,093,353
Average Unit Cost:	$ 8.62	$ 12.98		$ 1.07	$ 1.44		

Appendix O. – GeoMine Implementation Enhancement Ideas

In no particular order of priority, the enhancement ideas below have been collected from project partners:

- Microsoft SQL Server service could be used to house the GeoMine ArcSDE database instead of instantiating a whole Windows computer image running a relational database. The advantage of using the SQL service is that there is no computer to manage; Amazon manages the system and keeps the software up-to-date;
- As the GeoMine Viewer/download portal is rolled out, performance metrics will be developed to measure user acceptance and utilization in SMCRA and CWA permit reviews. Portal usage can be tracked by measuring the number of site visits and, particularly, data downloads;
- Apollo image server implementation through GeoMine would allow OSMRE-stored imagery catalog research and discovery by imagery footprints;
- Mobile device implementation of GeoMine will allow geospatial layer portability to the field. Geospatial layer and attribution updating in the field will be a further elaboration to facilitate updating of geospatial data in state GIS and the GeoMine platform;
- Add the ability to upload minesite photos;
- Produce three versions or levels of GeoMine: Public, Regulator and Special Tools;
- Establish regular refresh cycles with RAs;
- Enable crowd-sourcing area for public comment and participation;
- Add coal bed polygon data for underground mine workings;
- AML areas and historical mining areas as polygons;
- Delineate all actual historical surface mining disturbance areas rather than or in addition to just permit boundaries;
- Land use/land cover information;
- Seamless STATSGO and SSURGO soil data across counties and state lines;
- NPDES discharge points, permit numbers and monitoring reports;
- Additional download or data extraction options;
- Other state CHIA evaluation points;
- Make layer colors and symbol types selectable; and
- Provide more extraction and download tools for GIS and attribute data to be used at local machine level.
- Add additional attributes (AMLs, edit date, PMLU Y/N field, etc.) to layers;
- Align all GeoMine schema with approved ASTM standards;
- Create a CAD-to-GIS template drawing file optimized for interchange of ASTM-approved Title V data layers to allow permittees to submit CAD layers and associated attributes into ESRI's formats;

- Inquire whether layers can be added to GeoMine from an external map services (like ArcOnline) such as the BLM national Federal land map (surface management agency SMA through Geocommunicator;
- Underground Mine Discharge locations are not being systematically collected over the Appalachian region, and represent a major data gap that the Interagency Team recommends as future area of investigation;
- Explore partnering adding state and federal data layers for oil and gas wells.
- Investigate using GeoMine Cloud resources to provide storage/backup of SMCRA state coal mining data;
- Deploy VA underground mine map inventory system (search system for mine maps) as a cloud instance as a test to determine effectiveness. VA will conduct cost comparison analysis to determine cost savings;
- Seek out more data sharing to eliminate duplication of efforts.
- After the first year of GeoMine operations and maintenance, perform an ROI analysis to test the time/cost avoidance in Appendix P;
- Provide outreach NAAMLP Annual Conference, September 22-25 in Daniels, WV; and
- Inventory SMCRA RA CAD/GIS data holdings and identify needs to digitize their coal mining data and assess their digital coal mining data for sharing to GeoMine.

Appendix P. GIS Project Benefit/Cost Examples

A comprehensive cost/benefit analysis of a GIS project must provide for a sufficient time horizon to allow for the organizational benefits to accrue. A six-year period has been suggested as "reasonable"[12]. As the GeoMine Viewer is not in operations and maintenance mode as of yet, and has only been in existence as a prototype for two years, it is not prudent to attempt a cost/benefit analysis for GeoMine across the three state and four Federal agencies participating in the project. However, the geospatial body of knowledge has examples of GIS projects similar to GeoMine that show a positive benefit/cost return. The three examples that follow have organizational and technical similarities to the GeoMine pilot project, and serve as guides to expected returns from deployment and operation of GeoMine.

<u>OSMRE Lexington Field Office Example #1: Oversight File Reviews</u>
In Kentucky each OSMRE inspector conducts 52 random oversight inspections per year. Currently there are six OSMRE inspectors for a total of 312 inspections per year. Each inspector conducts a file review of each one of their permits. All file reviews require downloading a Mine Reclamation Plan Map from a Kentucky State ftp site that can take on average one hour. GeoMine can answer many of the questions without downloading the MRP Map. However, there is information on the MRP map that cannot be obtained through GeoMine. Below is an estimate of how much time an inspector could save if he/she were using GeoMine.

A file review begins by locating the permit and determining a convenient place to meet with the State RA on the day of the inspection. Using the current tools provided to the OSMRE inspector, this process can take up to 0.5 hour. With GeoMine the Inspector can have directions to the permit or an idea of a meeting place within 10 minutes.

During the review process it is nice to be able to analyze an aerial image with the permit boundary. Being able to do this in GeoMine helps to give an idea of what the permit may look like and areas that may be of special concern. With GeoMine analyzing the permit boundary overlaid onto an aerial can take roughly 30 minutes. With the current tools provided to OSMRE inspectors this process can take up to 1 hour or more.

Finding adjacent permit numbers and boundaries with GeoMine can take about 5 minutes. Currently OSMRE inspectors have no easy way to be able to conduct this type of review. A conservative estimate of 3 hours was assigned which would encompass making a few phone calls to the RA and having to download multiple maps. If the permit in question was in the middle of a large mining complex figuring out where the boundaries lined up and downloading all the maps could take days. As of right now most the inspectors do not go out of the way to obtain this information but it can be very

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[12] Best Practice in Software Engineering and Methodologies for Developing GIS Applications, Geographical Information System International Group, Chapter 9 Cost-Benefit Analysis of GIS at http://www.gisig.it/best-gis/

valuable information. GeoMine provides this information in a very fast and usable format.

Water monitoring locations can be identified on the MRP Map that was downloaded fairly easily unless the scanned map is unreadable. Using this method the OSMRE inspector can locate these locations in about 30min. Using GeoMine water monitoring locations can be obtained in about 5 minutes.

Hourly savings an inspector may realize by using GeoMine to download and use a digital MRP map

Activity	Without GeoMine	With GeoMine	Savings/inspection	Savings/ inspector/year	Office Savings/yr in hours
Location	0:30	0:10	0:20	17:20	104
Aerial w/ Boundary	1:00	0:30	0:30	26:00	156
Water Monitoring	0:30	0:05	0:25	21:40	130
		Total	**1:15**	**65:00**	**390**
Adjacent permits	3:00	0:05	2:55	151:40	910
		Total	**4:10**	**216:40**	**1300**

<u>OSMRE Lexington Field Office Example 2: Information Request from OSMRE Appalachian Region Technical Support Division (AR-TSD)</u>

The OSMRE AR-TSD sent a request to OSMRE Lexington Field Office (LFO) to narrow a partial list of active slurry impoundments of MSHA class structures from (55) down to ten in order to conduct a special study. OSMRE LFO used GeoMine in order to efficiently and effectively filter the list down to a diverse sampling. OSMRE LFO was able to quickly identify each slurry impoundment for a given permit number using the transparent permit overlay. Also, OSMRE identified which impoundments appeared to have most recently pumped coal slurry and identify the larger impoundments for a given county. Additionally, GeoMine was used to provide the precise grid coordinates for the slurry impoundment vice a general grid coordinate listed on the permit. Using GeoMine this task took roughly 8 hours to complete.

Without the use of GeoMine the task of condensing the list of permits would have taken a significant amount of time. First the locations would have been obtained from the SMIS database and plotted using Google Earth. Next the aerial would have been examined for an impounding feature. If there was an impoundment adjacent to the permit location one could assume that the impoundment was the one that belonged to the permit number. However, this would have to be verified. Verification would be completed by downloading all the MRP maps from an FTP site and verify the locations. Downloading these maps takes roughly one hour per map. Without GeoMine this

process would have taken more than 60 hours, instead of the 8 hours using GeoMine. Therefore, the time savings realized from using GeoMine for this business activity totaled about 52 hours.

Improving the OSMRE Western Region Data Discovery Process for Section 7 Threatened and Endangered Species Consultation

GeoMine was used to conduct data discovery project scoping for a Section 7 threatened and endangered species consultation. The standard approach to request an official T&E species list for a mine area is for users to access the Fish and Wildlife Service IPAC website. There, one can launch a query to create a list of T&E species for a drawn search area or within a county. Often this results in a simplified habitat map covering multiple states that does not specify the detailed locations where T&E species may be impacted relative to a mine. GeoMine is a powerful visual tool to identify quickly where impacts could exist, such as specific streams where aquatic T&E species reside.

Investigation of the species that could potentially be impacted by mining, and the spatial locations of their critical habitats relative to the mine are quickly determined though GeoMine. This saves valuable time in the process of data discovery, improves understanding of critical spatial relationships, and enhances awareness of features or situations that may not have been previously considered. Without GeoMine the Section 7 discovery process required about 19 hours of work to gather the necessary information and create reports for a mine site. Using GeoMine, the same process took about half the time. The WR processes about ten of these Section 7 actions per year. Cumulative time savings realized over a year is estimated at 95 hours.

Iowa Geospatial Infrastructure GIS Benefit/Cost Analysis

The Iowa Geographic Information Council reports a 1.88/1 benefit to cost ratio over the six year period of 2007-2012 for a statewide GIS implementation of the Iowa Geospatial Infrastructure at the county level[13]. Similar to the GeoMine concept of focusing on key coal-mining-related layers, Iowa focused on development, maintenance, and delivery of nine framework map and image layers. Counties that employed GIS saw an average payback period of one year for their investment in GIS, with an annualized return of 188%. This study has been promoted by the Federal Geographic Data Committee and the Geospatial Information Technology Association as an example of a rigorous benefit cost analysis.

State of Washington Transportation Framework for GIS (WA-Trans)

The WA-Trans project included the Washington State Department of Transportation (DOT) and 18 other state agencies and counties that partnered to create a seamless, statewide transportation location-based dataset that included roads, railroads, airports, ferry terminals and routes, port facilities and non-motorized routes such as bike paths[14].

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[13] The Iowa Geospatial Infrastructure Return on Investment Studies at http://www.iowagic.org/projects/iowa-geospatial-infrastructure/documents/

[14] Building a Business Case for Shared Geospatial Data and Services (paste this link into a browser) http://www.fgdc.gov/policyandplanning/50states/ROI%20presentation%20NSGIC%20Mid%20Year.ppt

The cost/benefit analysis of the project found an overall annualized return on investment (ROI) of 10.9%. If the DOT had conducted and participated in the project alone, the ROI dropped to only an annualized 0.17%. The inclusion of the other participating agencies created an order of magnitude increase in the ROI and a payback period of only 4 years vs. a payback period of 18 years for a standalone DOT GIS. This example illustrates the intrinsic value of the GeoMine approach in sharing geospatial data across agencies with a business need for the geospatial data.

King County, Washington Geographic Information Systems Analysis of Benefits
After an 18-year implementation of a county-wide GIS, the benefits of GIS use in county agencies was estimated at a benefit to cost ratio of between 6.98:1 and 13.36:1[15]. The county estimated that as many as 1,000 county employees used GIS data and applications in their daily business tasks. The analysis methodology employed with-and-without surveys to assess how GIS altered agency output and effort and to estimate benefits associated with efficiency and production gains across five major County agencies, including the Department of Natural Resources and Parks, the Department of Transportation, and the Wastewater Treatment Division.

[15] An Analysis of Benefits from Use of Geographic Information Systems by King County, Washington at http://www.in.gov/gis/files/KCGIS_ROI_Report.pdf

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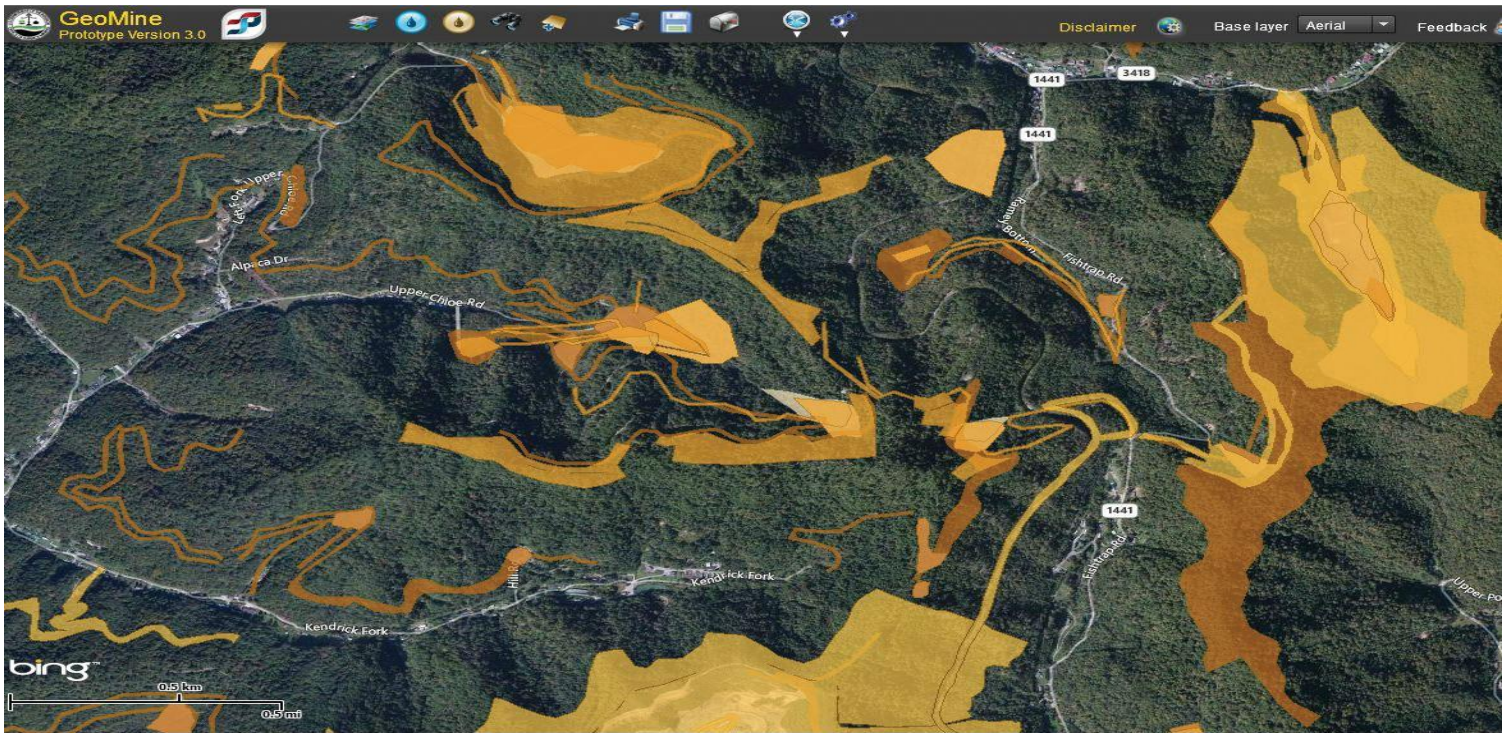
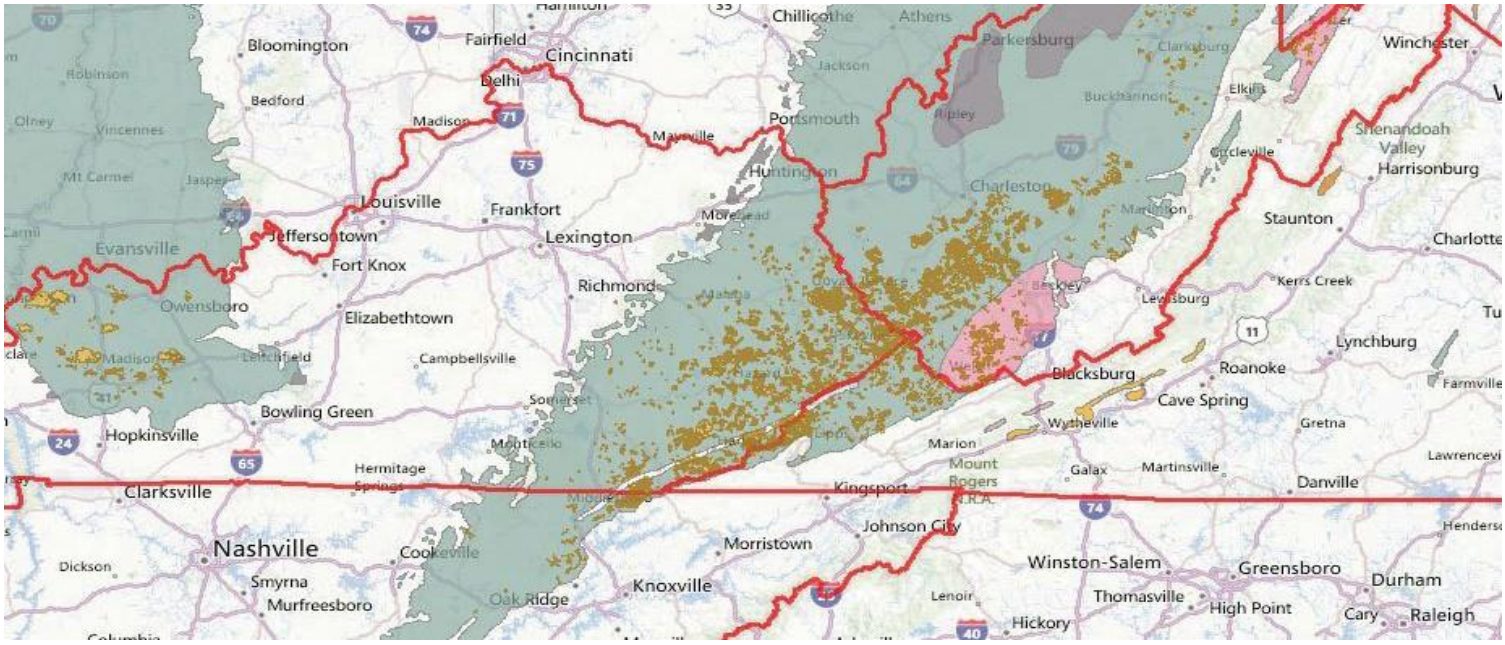
APPENDIX Q. EXECUTIVE SUMMARY



Interagency Appalachian GeoMine Pilot Project

Executive Summary 1/23/14



Preface

This executive summary provides an overview of the results of the Interagency Appalachian Coal Mining Geographic Information System (GeoMine) Pilot Project Report, dated 1/23/2014. This summary was developed as a stand-alone briefing tool for interagency team executives and illustrates the utility of the GeoMine Viewer to SMCRA, CWA and ESA community practitioners through seven use cases. The use case graphics are screen captures from the GeoMine Viewer v. 3.0.

Billie Clark
Appalachian GeoMine Pilot Project Sponsor
OSMRE Geospatial Information Officer

Credit: Stephanie Cain, AmeriCorps Web Design Intern, designed the executive summary.

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1: What is GeoMine and what is the Interagency Appalachian GeoMine Pilot Project?

GeoMine is envisioned to be an interactive web-based digital map of coal mining and reclamation activities in the United States.

GeoMine is a web-based Viewer (GeoMine Viewer) developed by the Office Surface Mining Reclamation and Enforcement (OSMRE) in collaboration with the Fish and Wildlife Service (FWS), Environmental Protection Agency (EPA), U.S. Army Corps of Engineers (USACE), and mining agencies from Kentucky, Tennessee, Virginia and West Virginia. GeoMine supports the decision-making processes associated with surface coal mining activities by improving accessibility to data, improving the timely delivery of authoritative information, and enhances understanding of geospatial data at various scales.

GeoMine creates seamless map layers of coal mining and reclamation activities across state boundaries. The map layers created by GeoMine include authoritative associated data, and for the seven SMCRA state layers and eleven Federal agency layers the GeoMine Viewer is a “one-stop-shop” for this unique collection of coal-mining-related data. GeoMine contributes coal mining-related data, but does not serve as the sole source of the host of data needed for CWA, SMCRA, and ESA determinations and decisions by the state and Federal agencies tasked with these responsibilities.

The Interagency Appalachian GeoMine Pilot Project (Pilot Project) was initiated among State and Federal regulatory agencies who administer the Surface Mining Control and Reclamation Act of 1977 (SMCRA), the Clean Water Act of 1972 (CWA), and the Endangered Species Act (ESA) of 1973. An Interagency Team was formed in 2009 to address the need to better understand the various permitting processes and mapping capabilities of agencies involved with surface coal mining permits.

The purpose of the Pilot Project is to demonstrate the value and utility of sharing the key data from each agency’s permit review process by using a shared web-based viewer.

2: What challenges does the GeoMine Pilot Project help to address?

- The data and systems that are maintained by Federal and State agencies are stove-piped, that is, although the data may be “accessible” it is not systematically available, easily accessible, or routinely shared.
- Some of the data that is housed in state files are not digitized or available in automated systems.
- Federal personnel needing information must forage multiple systems and various office files to find the data needed to make required SMCRA and CWA permitting decisions; and meet the mandates of the Endangered Species Act.
- State and Federal authorities need a better way to share data along state boundaries. Proposed and ongoing coal mining and reclamation activities and non-coal activities continue to have conflicts that need to be addressed for safety and better land management reasons.

3: What benefits could GeoMine offer?

- Reduce the time spent searching for information relevant to decision-making by sharing digital data on-line.
- Eliminate redundant data requests by having data on-hand for repeatable and authoritative reporting.
- Provide an easy-to-use source for unique coal-mining related maps and data to aid in high-level, landscape level, or focused cumulative-effect watershed analyses of mining impacts and mitigation opportunities.
- Map mining issues along common state borders to aid field studies and achieve mutually beneficial land management decisions.

4: Who are the GeoMine partners?

Federal Agencies:

- Office of Surface Mining Reclamation and Enforcement (OSMRE) including Knoxville, TN field office and OSMRE's national Technical Innovation and Professional Services (TIPS) program
- Fish and Wildlife Services (FWS)
- Army Corps of Engineers (USACE)
- Environmental Protection Agency (EPA)

State Agencies:

- Kentucky
- Virginia
- West Virginia
- Interstate Mining Compact Commission (IMCC)

5: What are examples of GeoMine use in support of SMCRA, CWA, and ESA regulation?

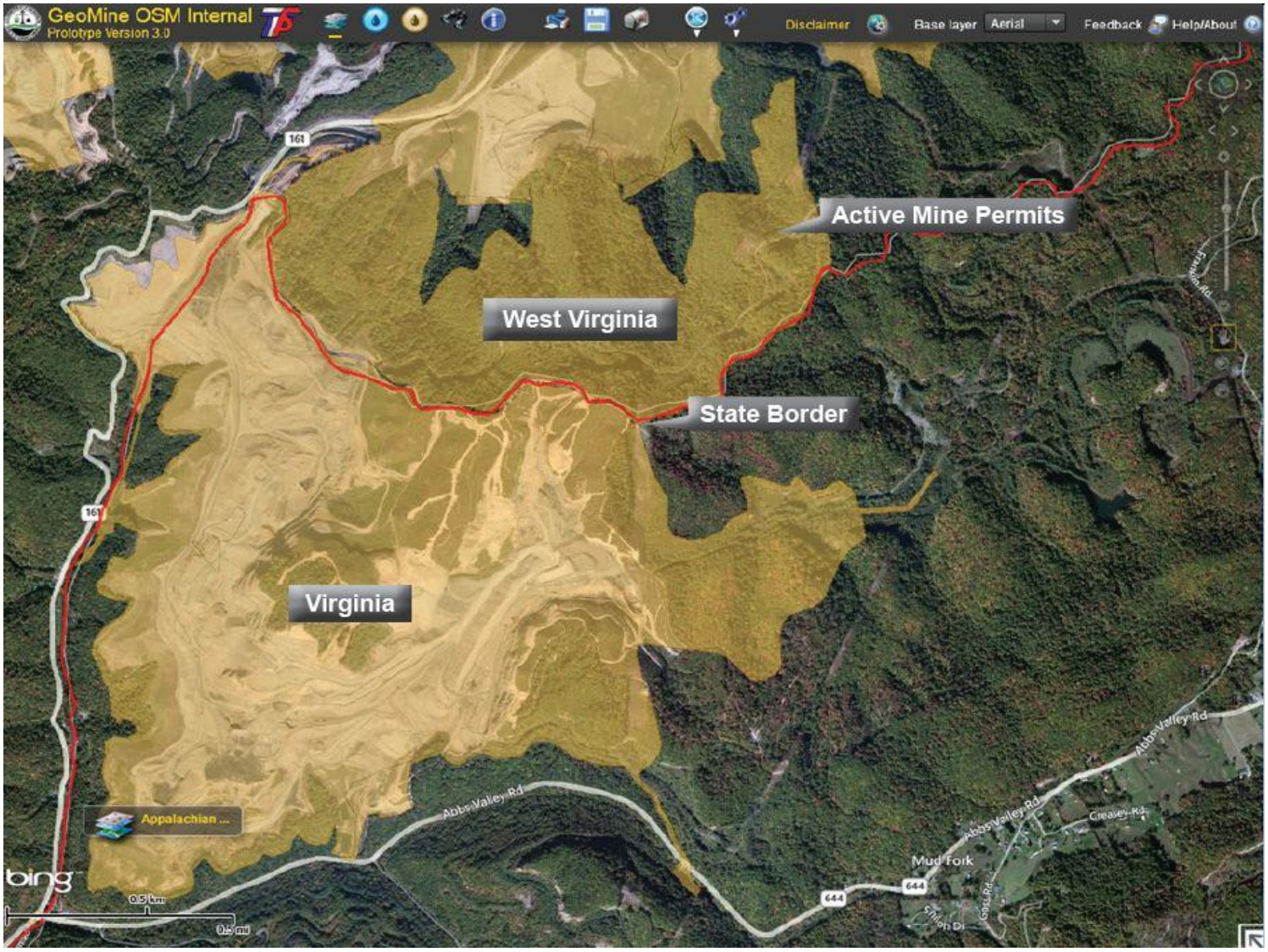
The following use cases demonstrate the value of the Pilot Project Map Layers.

Use Case A: The GeoMine Viewer is a "one-stop-shop" for the unique collection of coal mining-related map layers from the partner agencies.

The screen-view from GeoMine shows the Tennessee-Kentucky border. The data shown includes active, released, and legacy coal mine boundaries (shades of orange), underground coal mine extents (dark-brown), fills (tan), environmental resource monitoring locations (colored triangles), eAMLIS abandoned mine land problem areas (small colored points), national mine map repository locations (larger red points), FWS wetlands (green and blue polygons) and critical habitats (coarse red line), EPA 303D impaired waters (thin red lines), watershed boundaries (heavy purple line), and STORET water monitoring stations (blue water droplets). These are all available in standardized formats that aren't limited by State boundaries.

"The data extraction tool has multiple geospatial reference options, which is helpful in using this map data in analysis software. The AML priority location map layer could aid in identification of unknown underground mine entries or areas of instability. The FWS wetlands and critical habitat layers are useful with the classifications on GeoMine, and can be readily loaded into a GIS for analysis. The multi-state extent of the EPA 303d layers are convenient. Location information along the Tennessee state line would be useful for CHIA development." **- OSMRE Knoxville Field Office Hydrologist**

Use Case B: Common mining and reclamation issues along state boundaries should be easy to map and visualize.



GeoMine view along the Virginia-West Virginia border showing the State line (red), and active surface coal mine permit boundaries. GeoMine indicates how impacts from mining in one State (hydrologic, slope stability, blasting, subsidence, etc.) may extend into an adjacent State.

"An active underground coal mine operation was penetrated without warning by natural gas developers permitted in an adjoining state. Drillers, mine operators, and regulators all lacked the ability to share and review mining data across state lines. The surface mine operating across state lines could have potential hydrologic or slope stability issues originating from one state and impacting the adjoining state's land. A comprehensive, standardized and accessible GIS would have enabled regulators to identify the potential impacts and then work with operators to modify permits or inspection protocol."

- West Virginia Department of Environmental Protection Program Manager

Use Case C: Digital maps provide enhanced visibility of critical relationships and patterns on the landscape.

GeoMine map showing spatial relationships between surface coal mining operations (orange polygons and red point) and downstream aquatic species critical habitats (magenta line). Watershed boundaries (thin red line) and stream courses with flow direction arrows (blue lines with triangles) supplement the map to aid in delineation of potential impact areas.

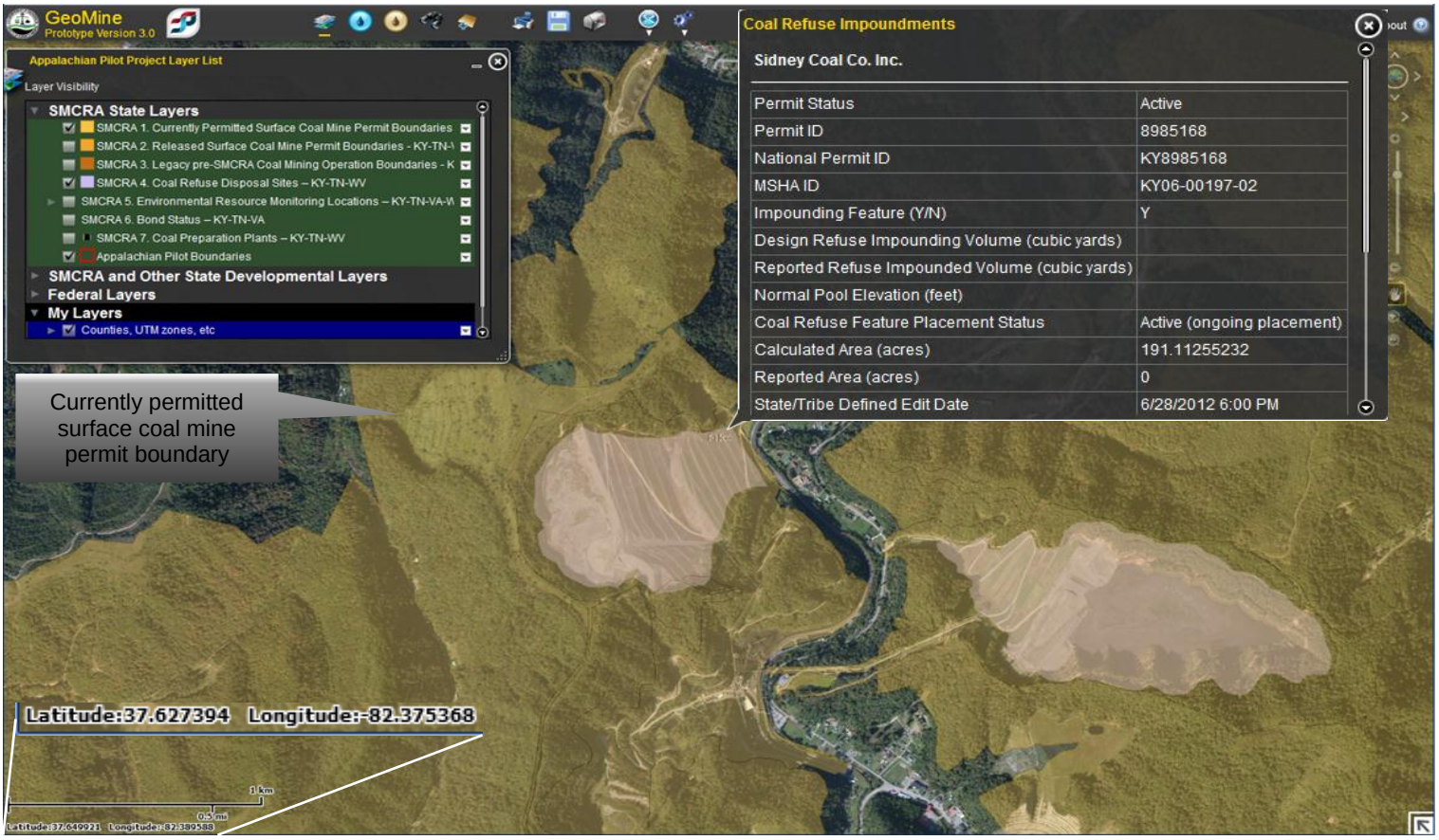
"GeoMine will provide the U.S. Fish and Wildlife Service with information our field staff had limited or no access to previously. This is critical in determining the potential for adverse impacts to terrestrial and aquatic habitats and species due to surface coal mining activities. GeoMine will also improve coordination among agencies, reducing redundant processes."
-U.S. Fish and Wildlife Service Energy Coordinator

Use Case D: The ability to download data by watersheds links surface coal mining data with hydrologic areas of concern.

Using the data extraction tool in GeoMine allows users to download all geospatial features within a watershed boundary (HUC 8 or 12). In this screen, the user has selected for extraction all active surface coal mine permit boundaries, fills, and coal mine refuse disposal sites within the Spruce Fork HUC 12 watershed. Results are sent to the users' computer where they can be downloaded into other software application for detailed analysis and reporting.

"The Corps of Engineers has used GeoMine to access geospatial data to assist in the final decision–making process for 404 individual permits reviewed under Clean Water Act provisions. GeoMine is used to visualize coal mine boundaries, fills and coal refuse impoundment locations in relation to Hydrologic Unit Code 12 (HUC12) watershed boundaries. The HUC12 boundary is then used as a geospatial selection tool through the GeoMine Viewer Data Extraction function. The resulting mining-related features are then downloaded into GIS software for analysis on a HUC12 watershed basis." **– Army Corps of Engineers Project Manager**

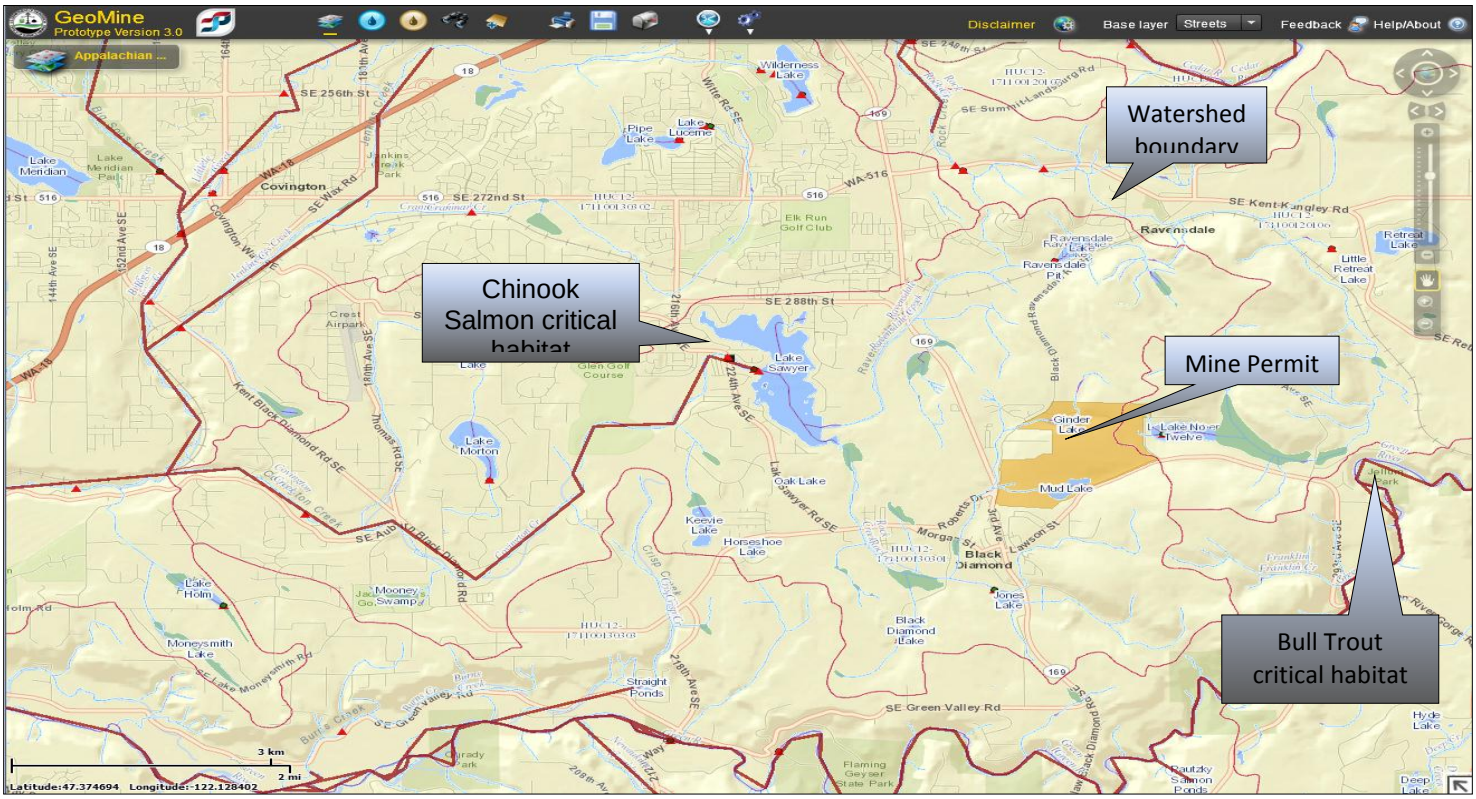
Use Case E: Supporting Special Studies of Mining and Reclamation



GeoMine was used to efficiently identify active slurry impoundments by permit number for a special study (the two lighter colored polygons in this image with transparency turned up). OSMRE was also able to discern which impoundments appeared to have most recently pumped coal slurry and identify the larger impoundments for a given county (note that a County boundaries layer can be added using the 'add data from web' tool). GeoMine also enabled OSMRE Lexington to determine the precise grid coordinates of each impoundment using the coordinate readout in the lower left corner. Realized time savings for this activity – approximately 52 hours.

"Without the use of GeoMine the task of condensing the list of permits would have taken a significant amount of time. First the locations would have been obtained from the SMIS database and plotted using Google Earth. Next the aerial would have been examined for an impounding feature. If there was an impoundment adjacent to the permit location one could assume that the impoundment was the one that belonged to the permit number. However, this would have to be verified. Verification would be completed by downloading all the MRP maps from an FTP site and verify the locations. Downloading these maps takes roughly one hour per map. Without GeoMine this process would have taken more than 60 hours, instead of the 8 hours using GeoMine. Therefore, the time savings realized from using GeoMine for this business activity totaled about 52 hours" ***– OSMRE Surface Mining Reclamation Specialist***

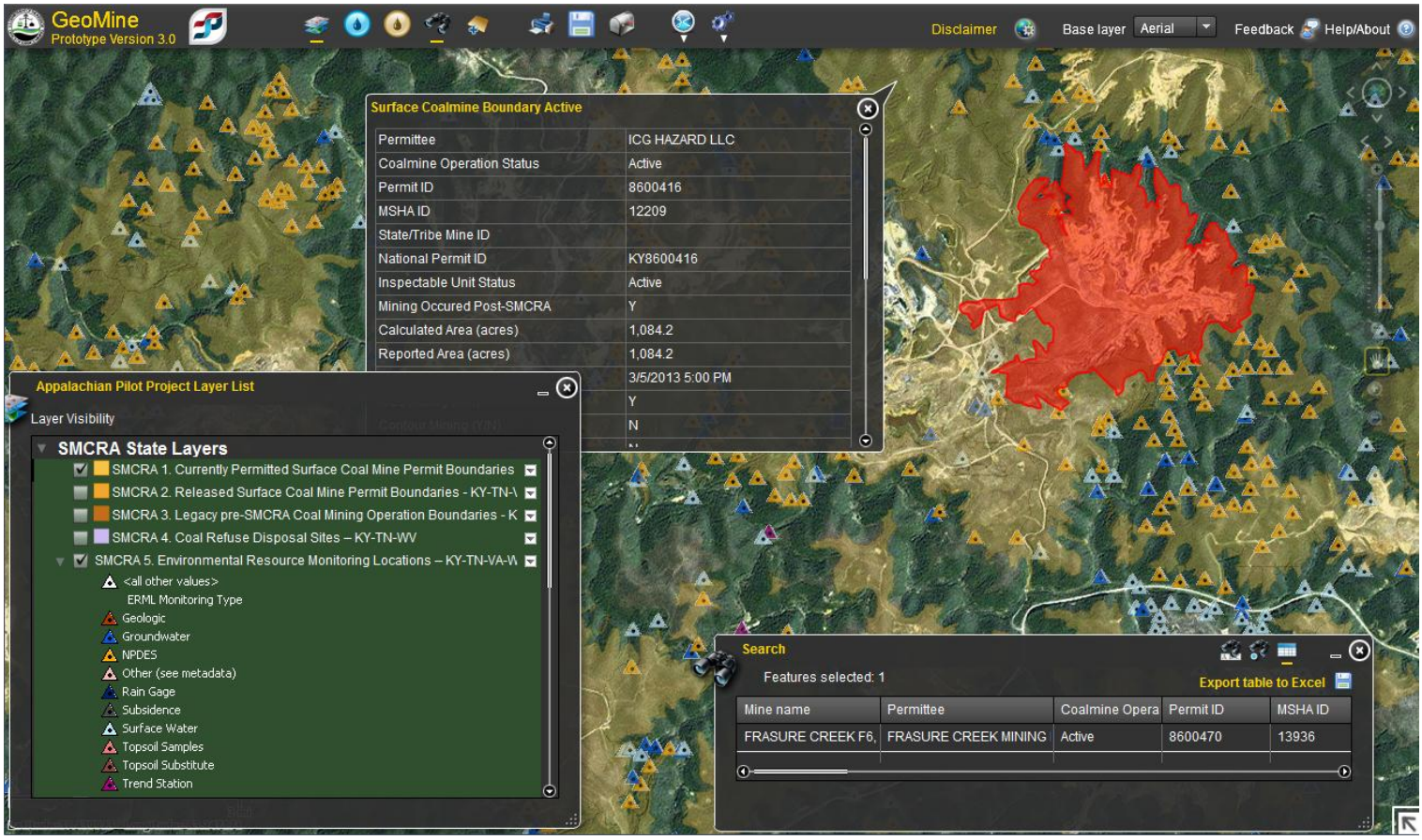
Use Case F: Improving the Data Discovery Process for Section 7 Threatened and Endangered Species Consultation



GeoMine was used to conduct data discovery project scoping for a Section 7 threatened and endangered species consultation. The standard approach to request an official T&E species list for a mine area has users access the Fish and Wildlife Service IPAC website. There, one can launch a query to create a list of T&E species for a drawn search area or within a county. Often this results in a simplified habitat map covering multiple states that does not specify the detailed locations where T&E species may be impacted relative to a mine. GeoMine is a powerful visual tool to identify quickly where impacts could exist, such as specific streams where aquatic T&E species reside. See Appendix P for a discussion of cost savings realized by use of GeoMine for Section 7 consultation.

"In a matter of a few minutes we determined which species could potentially be impacted by mining, and spatially where the critical habitats are relative to the mine. This saves valuable time in the process of data discovery, improves understanding of critical spatial relationships, and enhances awareness of features or situations that may not have been previously considered. The last time this Section 7 discovery process was conducted, it required about 19 hours of work to gather the necessary information and create reports for a mine site. Using GeoMine, the same process took about half the time. I really like GeoMine's printing and emailing capabilities, which provide a simple and quick means to create maps and share them with other agencies like FWS. I currently process 10 of these per year. Cumulative time savings realized over a year is estimated at 95 hours." ***– OSMRE Natural Resource Specialist***

Case G: OSMRE Lexington Field Office Mine Reclamation Plan Review



GeoMine has been used in Kentucky to streamline the process of preparing for mine inspections instead of standard Mine Reclamation Plan review procedures. Mine inspectors found significant time savings in 1) locating mine permits (search tool and result highlighted in red on the map) and determining access/meeting points to meet State RA, 2) analyzing aerial imagery in permit area for inspection planning and situational awareness, 3) finding adjacent permit numbers (ID window on map) and boundaries, and 4) identifying water monitoring stations (multi-colored triangle symbols).

Each of the 6 OSMRE Lexington inspectors conducts 52 random oversight inspections per year, for a total of 312 inspections per year. Each inspector conducts a file review of each one of their permits. Based on a savings of 4.2 hours per inspection, the time savings adds up to 216.7 hours per year per inspector, or 1300 hours for the Lexington office.

"Finding adjacent permit numbers and boundaries with GeoMine only take 5 minutes. Currently OSMRE inspectors have no easy way to be able to conduct this type of review. A conservative estimate of 3 hours was assigned which would encompass making a few phone calls to the RA and having to download multiple maps. If the permit in question was in the middle of a large mining complex figuring out where the boundaries lined up and downloading all the maps could take days. GeoMine provides this information in a very fast and usable format." ***– OSMRE Surface Mining Reclamation Specialist***

6: What were the Pilot Project objectives and what are the resulting findings?

The following discussion outlines the Pilot Project's five major objectives along with summary findings by the Interagency Team. As the findings demonstrate, the objectives of the Pilot Project were fully met in each case.

Objective 1:
Create a Pilot Project collaborative model for discovering, collecting, harmonizing, managing, and serving coal mining map layers pertinent to SMCRA and Clean Water Act (CWA) for coal mining and reclamation activities located in the States of Virginia, West Virginia, Kentucky, and Tennessee.

Findings:
- SMCRA states now share over 128,000 mapped sites in seven key map layers for coal mining and reclamation activities with four layers under development.
- Federal agencies now contribute over 415,000 mapped sites.
- The source of SMCRA surface coal mining permit data is the states' database entries for these sites.
- The GeoMine model merges data from multiple sources into seamless map layers extending across the Pilot Project extent.

Objective 2:
Recognize the agencies as Authoritative Data Sources (ADS) for data under their control and establish data stewards for the map layers.

Findings:
- Each of the state and Federal agencies has designated data stewards as the point of contact for GeoMine.
- Each agency has remained engaged in maintaining, updating and enhancing their contributed map services and data.

Objective 3:
Developing a shared, Cloud-based GIS platform for Appalachian coal mining map layers available to the SMCRA state and Federal users

Findings:
- The Cloud-based approach affords a neutral ground for storage and integration of GIS data from all member sources.
- The development of databases and web-based GIS tools was greatly enhanced by the ability to quickly try new configurations without the need to change physical computer systems.
- The Cloud has high capacity networks that make accessing web-based applications and data very easy from any Internet connected location.

Objective 4:

Provide resources through OSMRE-sponsored Federal Cooperative Agreement grants for SMCRA RAs to convert data to digital GIS map layers and create services sharable through the GeoMine platform.

Findings:

OSMRE provided funding for cooperative agreement grants to the SMCRA-state partners:

- $714,260 to fund work in 2011.
- $407,000 to fund work in 2012, 2013 and 2014.
- AmeriCorps and state interns contributed to 10,500 currently permitted coalmines and over 21,500 AML features added to SMCRA state GIS for GeoMine sharing (as of 5/8/13 continuing through 9/15/14).

Objective 5:

Deploy GeoMine Viewer with simple geospatial data layers pertinent to SMCRA, CWA and ESA regulatory programs.

Findings:

- GeoMine decreases the complexities of using shared data by enabling discovery and use through a single Internet-accessible Viewer.
- The GeoMine Viewer provides discovery and access to map data, including the ability to download hydrologic data in user-friendly formats [by design the GeoMine Viewer does not incorporate analytic or modeling tools.]
- Deploying an additional Federal-data-only Viewer (Federal Viewer Prototype) allows discovery of nationwide Federal agency geospatial data to allow search and download capabilities for Federal, state and tribal permit reviewers, inspectors and management.

7: What are the results of the OSMRE supplemental grants awarded to the GeoMine SMCRA states?

The OSMRE grants assisted the states in further developing their GIS processes and populating their databases. The grants allowed them to scan, store, and georeference hard-copy maps into digital formats resulting in the following additional digital data (as of 1/23/2014):

KFO

- 288 digital currently permitted surface coal mining boundaries created;
- 280 released surface coal mining boundaries created;
- 2,732 total surface coal mining boundaries have been verified for TN;
- 2,128 digital AML features (point, lines, polygons) created; and
- 98 AML planning units and 311 AML problem areas digitized.

KY

- 51,643 digitized surface coal mining boundaries and related features;
- 27,151 environmental resource monitoring locations; and
- 9,727 AML Problem Areas/Planning Units and problems.

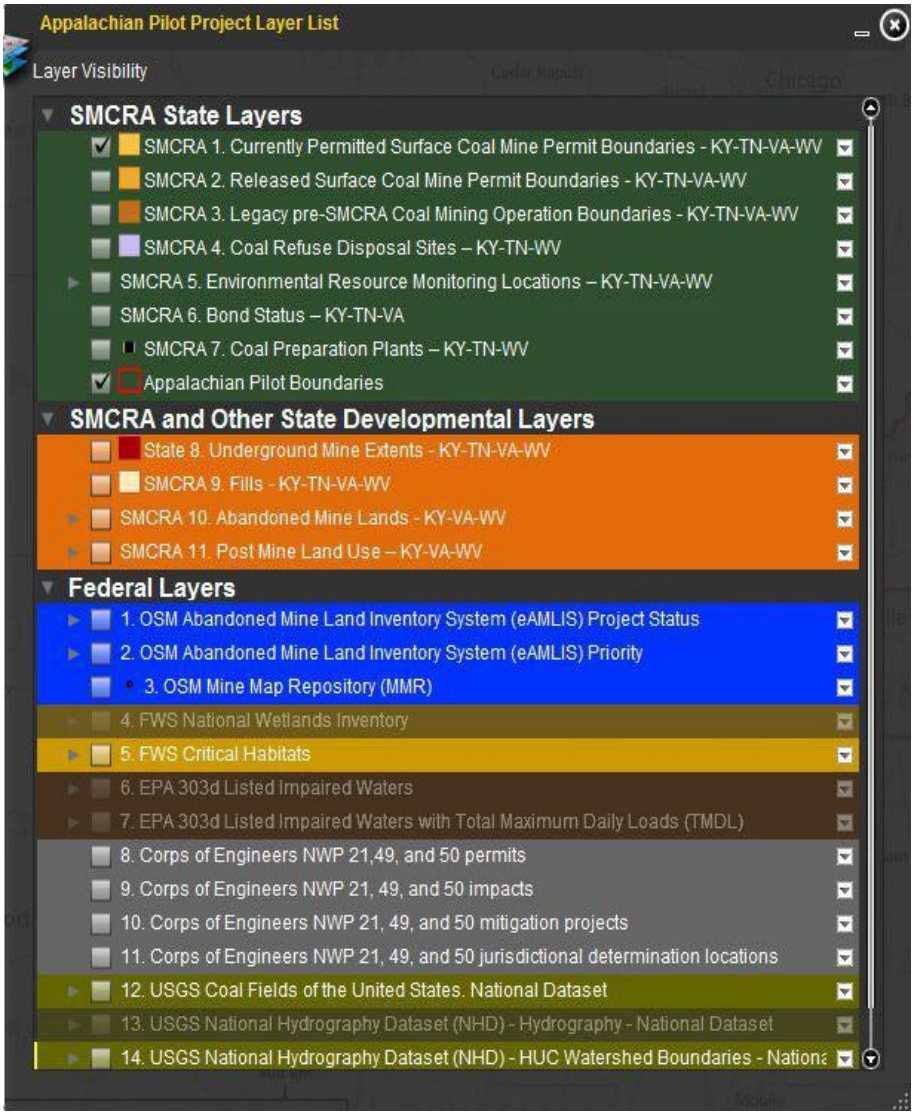
VA

- 3,447 released surface coal mining boundaries;
- 365 active permits;
- 10,612 environmental resource monitoring locations; and
- 6,763 AML Problem Areas/Planning Units and problems.

WV

- 3,517 currently permitted surface coal mining boundaries, including those from 571 annual progress maps dating back to 2005;
- 46,334 environmental resource monitoring locations;
- 2,939 post mining land-use; and
- Scanned 3,400 of 4,000 AML Problem Areas to be georeferenced and digitized.

8: What map layers are available to be shared in the GeoMine Viewer?



SMCRA Map Layers

- Data meet ASTM D7780-12 Standards for Coal Mine Operations.
- Layers are still being populated with completion expected by the end of 2013.
- Over 29,000 surface coal mining permit boundaries are mapped.
- 3.5 million acres of permit boundaries are located.
- 89,479 environmental resource monitoring locations are mapped.
- Active permits completion is anticipated by the end of 2013.

Federal Map Layers

- The Federal Map Layers listed on the left are currently available for the entire country, except for the Corps of Engineers layers which are only available for KY, TN, VA, and WV.
- 415,784 coal-mining related sites.

9: Interagency Team Alternatives Considered

The Interagency Appalachian GeoMine Pilot Project Team considered the following three alternatives:

Alternative 1: Deploy the Federal Viewer Prototype for all Nationally-Available Federal Data Layers[1]; Discontinue the GeoMine Viewer. Allow all contracts, grants, and support services and data sharing for the GeoMine Viewer to expire at the end of FY13. This includes discontinuing the GeoMine Viewer cloud web application. Upon acceptance of the GeoMine Pilot Project Report by agency executives, the Federal Viewer Prototype will be released to the public. Implications of this course of action, both positive and negative, are as follows:

PROS	CONS
• Limited resources needed to deploy Federal Viewer Prototype. • State GIS data created through the Pilot Project will be usable by the State Regulatory Authorities in their own programs. • Over 63% of the currently permitted inspectable mine site boundaries in the U.S. already have been rendered digitally by the Pilot Project. • Lessons learned will be transferred via the Pilot Project report. • Access to Federal Viewer Prototype data by agencies, academics and the public will be available.	• No single-source access to SMCRA coal mining map data. • Ability to upload to or download from GeoMine Viewer eliminated. • Continued risk of data gaps in coal mining-related mapping data. Lack of ready access to coal permit and geospatial data. • States may abandon voluntary compliance with geospatial data standards for their own proprietary formats. • Due to costs and technical issues, states may decide not to share their data with other states or Federal regulatory authorities.

Alternative 2: (Recommended by Interagency Team) Deploy the Federal Viewer Prototype prototype for all Nationally-Available Federal Data Layers[2] as Soon as Possible; GeoMine Viewer Deployed Nationwide with Public Access at Version 4.0 in early 2014. The Federal Viewer would be deployed as a prototype until the GeoMine Viewer 4.0 is operational. Nationwide deployment of the GeoMine Viewer to the remaining SMCRA State, Federal and Indian Programs would be staged over a five-year period. As data is incorporated into GeoMine it would be made available to the agencies and the public. Implications of this course of action, both positive and negative, are as follows:

PROS	CONS
• Voluntary participation by all SMCRA states in GeoMine will result in a "One-Stop-Shop" for national coal mining data. • Access and use of GeoMine for analysis by agencies, academics and the public immediately available. • GIS data created through the Pilot Project will be usable by all agencies. • Over 63% of the currently permitted inspectable mine site boundaries in the U.S. already have been rendered digitally by the Pilot Project. • Pilot Project states support GeoMine implementation for this alternative. • Public availability of data may reduce FOIA requests for these data.	• Deployment nationwide will require new Federal funding and assistance to SMCRA states.

[1,2] The USACE will share data when it is made publically available through its ORM2 public interface.

Alternative 3: Deploy the Federal Viewer Prototype for all Nationally-Available Federal Data Layers[3]; GeoMine Viewer Deployed Nation-wide with Immediate State/Federal/Tribal Access; Public Access Delayed. The Federal Viewer would be deployed as a prototype until the GeoMine Viewer 4.0 is operational. Nationwide deployment to remaining SMCRA State, Federal and Indian Programs would be staged over a five-year period. As data is incorporated into GeoMine, it would be made immediately available to State, Federal and Tribal agencies only. Access to the public would be delayed until state and federal programs are more comfortable with public access.	
PROS	CONS
• Voluntary participation by all SMCRA states in GeoMine will result in a "One-Stop-Shop" for the unique collection of national coal mining data provided by partnering agencies. • Access and use of GeoMine for analysis made available immediately to only the agencies. • GIS data created through the Pilot Project will be usable by all agencies. • Over 63% of the currently permitted inspectable mine site boundaries in the U.S. already have been rendered digitally by the Pilot Project.	• Deployment nationwide will require new Federal funding and assistance to SMCRA states and tribes. • Public access to the GeoMine Viewer would be delayed. • Public and academic access to the data for study and public engagement not available in the near term. • While the GeoMine Viewer is not publically available there may be an increase in FOIA requests for these data.

[3] The USACE will share data when it is made publically available through its ORM2 public interface.

10: Interagency Team Recommendations

The Interagency Appalachian GeoMine Pilot Project Team makes the following recommendations as a result of the Pilot Project findings:

1. To implement Alternative 2 as a continuing program administered by OSMRE. After thoughtful discussion and deliberation by the Interagency Team, Alternative 2 was selected as superior and is recommended in the draft report. Alternative 1, terminating the GeoMine Pilot Project services and not extending GeoMine nationally, was considered to have little merit as the Interagency Team realized the following benefits of extending GeoMine to additional partners nationally:
    - **The two-year project demonstrated the feasibility and value of sharing mapping data** among the eight partners, thus reducing duplication of effort and improving efficiencies;
    - **It can add value by improving regional-level decision-making**--critical coal mining-related data extending beyond individual state boundaries, including hydrologic and geologic data, will be more accessible to technical staff in multiple agencies, resulting in more-informed technical reports (use cases illustrate that GeoMine is already starting to help);
    - **The GeoMine Viewer is practical**--it has easy to use tools that allow data search and download capabilities for permit reviewers, inspectors, scientists/engineers and program managers/executives;
    - **The Federal Viewer Prototype has utility for SMCRA, CWA and ESA tasks**—the Federal data search and download capabilities has value for permit reviewers, inspectors, scientists/engineers and program managers/executives;
    - **The project was technically successful**: coal mining map layers and data are being shared routinely among all the partners and the innovative Amazon-Esri Cloud solution worked; and
    - **Greater transparency** of data shared between Federal, State and Tribal agencies will result in more responsible stewardship, improved customer service, increased productivity, and greater efficiency as it relates to the public interests.

Alternative 2 was preferred over Alternative 3 to maximize availability of data to SMCRA state and Federal agencies, as well as the public. This alternative also demonstrates governmental transparency and will likely reduce the number of FOIA requests.

2. To continue, and where possible expand, the geospatial data sharing and collaboration among state and Federal agencies involved in SMCRA, CWA, and ESA issues.

11: Deployment Plan and Operational Costs for Alternative 2 Implementation

The OSMRE and SMCRA states in the Pilot Project developed a deployment plan that was reviewed by the Interagency Team (Chapter XV of the Report), with cost estimates to extend the GeoMine effort to the other SMCRA State, Federal and Indian Programs. The cost estimates in the table below are based on costs for the Pilot Project, including the OSMRE grant funds utilized by the Pilot Project states to create surface coal mining boundaries and associated data in FY11 through FY13. The Interagency Team has provided the estimates to agency executives for their review. Please note that the costs were developed for the seven key SMCRA map layers approved as foundational by the Interagency Team. AML costs are not calculated, as theses layers are considered developmental. In the future, AML layers may be included in GeoMine, with costs expected to be minimal as many AML programs have established GIS for their AML projects.

GeoMine System Projected Total Costs FY14-18						
Category	FY14 Funds	FY15 Funds	FY16 Funds	FY17 Funds	FY18 Funds	FY19 O&M Funds
1. Awarding OSMRE Federal cooperative agreements for purposes of SMCRA RA data acquisition and transfer to GeoMine	$497,595	$507,547	$517,698	$528,052	$538,613	
2. GeoMine OSMRE operation and maintenance costs	$510,960	$521,179	$531,603	$542,234	$553,079	$564,140
3. SMCRA state operation and maintenance costs for GIS data	$80,943	$106,320	$132,205	$158,608	$185,538	$189,249
4. GeoMine National Coal Geographic Information System development costs	$214,200	$218,484	$222,854	$227,311	$231,856	$225,452
Total OSMRE Costs	$1,303,698	$1,353,530	$1,404,360	$1,456,205	$1,509,086	$978,841

APPENDIX R. Interagency Appalachian GeoMine Pilot Project Fact Sheet

1/23/2014

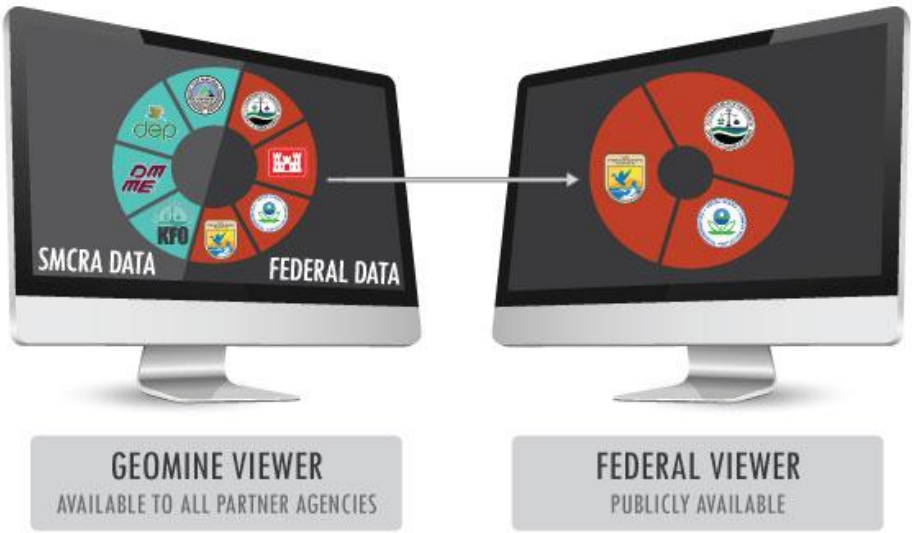
The GeoMine Appalachian Pilot Project is an interagency collaboration that began in August 2009 with the goal to develop and deploy a prototype interactive Internet-based mapping application (GeoMine Viewer), to display and share available State and Federal geo-data among eight partner agencies and eventually, as appropriate, the public. Participants include OSMRE, FWS, USACE, EPA, KY, VA, WV, the TN federal program, and the Interstate Mining Compact Commission.

The GeoMine Viewer is an easy-to-use cloud-hosted web application that allows Federal and state staff and managers to view and share geospatial data in various desktop and mobile computing mapping applications including ESRI software (ArcGIS, ArcGIS Server), Google Earth, iPhone/iPAD apps, etc. Pilot Project geospatial layers were designed using approved American Society for Testing and Material Coal Mining and Reclamation Data Standards.

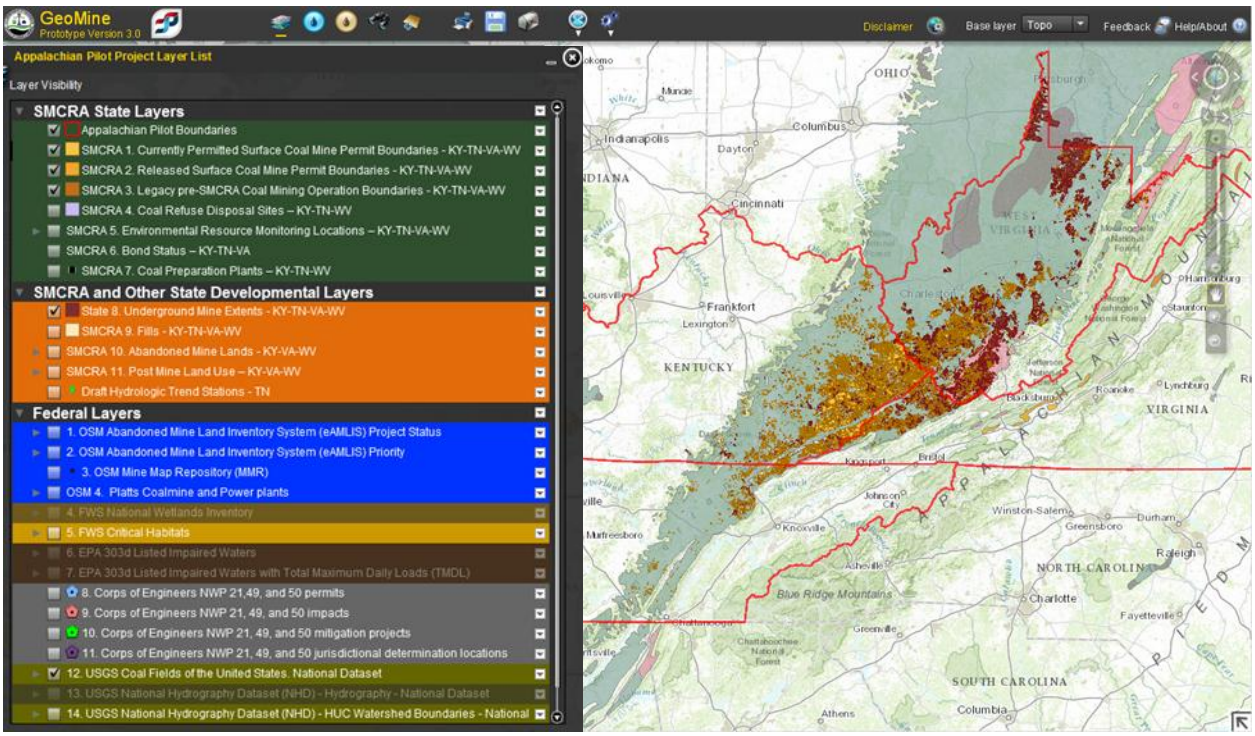
In 2012, OSMRE seized an opportunity to create a Federal-data-only viewer (Federal Viewer Prototype), to accommodate current nationwide data needs within other coal mining States. We are currently in the testing phase of this national Federal data viewer, which will be released to the public upon executive approval. This will serve as a precursor to the eventual implementation of the national GeoMine Viewer that would incorporate both SMCRA state and Federal coal mining geospatial data.

Pilot Project Next Steps

- Launch Federal Viewer Prototype for public access upon executive approval. Distribute final draft report for Interagency executive approval (December, 2013)
- Publish final report and recommendations (December, 2013)



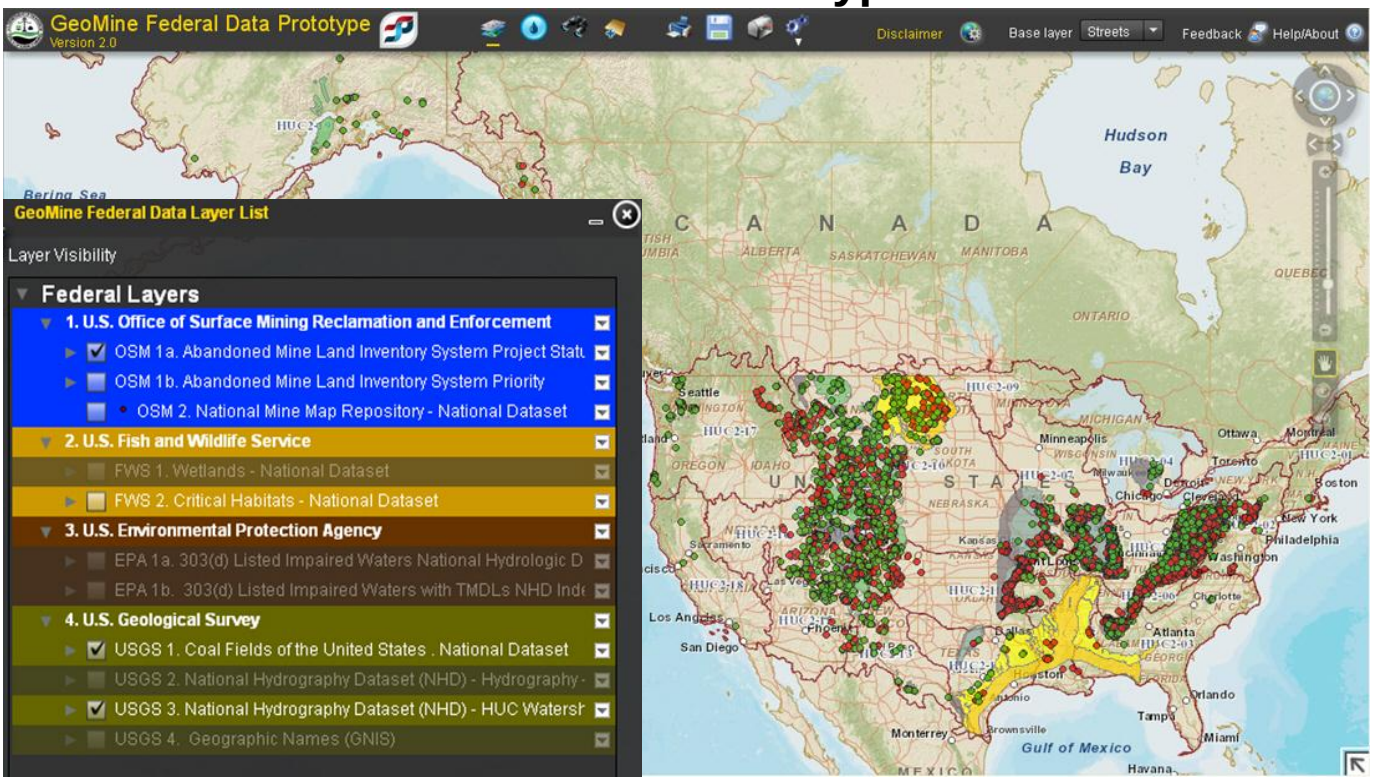
GeoMine Viewer



GeoMine Viewer Features:

- The Pilot Project Viewer 3.0 prototype has 25 geospatial layers and 2 hydrologic tools contributed by State and Federal partners:
  - **SMCRA agencies** – 11 SMCRA permit-related layers covering KY, TN, VA, and WV, including: Coal Mine Permit Boundaries, Coal Refuse Disposal sites, Environmental Resource Monitoring Locations, and Hydrologic Trend Station data for WV.
  - **OSMRE** – point locations for the Abandoned Mine Land Information System (eAMLIS) inventory and project sites, and Mine Map Repository underground coal mining map collection.
  - **FWS** – 2 layers: National Wetlands Inventory and critical habitat for threatened and endangered species.
  - **USACE** – 4 layers associated with Nationwide permits.
  - **EPA** – 303d and Storage and Retrieval (STORET)/National Water Information System (NWIS) hydrologic data.
- Federal Cooperative Agreement grants totaling $1.1 million were awarded in 2011 and 2012 to KY, VA, and WV, which have already facilitated the creation of over 10,500 new digital SMCRA coal mining boundaries.
- Over 128,000 SMCRA coal mining activity sites have been added to the Viewer, including over 3.5 million acres of surface coal mine operation boundaries.
- Over 415,000 Federal agency sites, including hydrologic sampling stations with analytical data.
- 'Add Data from Web' tool allows upload of external map service layers for overlay and map-making in GeoMine
- Print, Save, and Email tools allow users to share maps created in the viewer

Federal Viewer Prototype



Federal Viewer Prototype Features:

- The Federal Viewer Prototype 2.0 has 7 national geospatial data layers and 1 hydrologic widget from OSMRE, FWS, and EPA, as well as other tools and USGS base layers present in the GeoMine Viewer.

  OSMRE – point locations for the Abandoned Mine Land Information System (eAMLIS) inventory and project sites, and Mine Map Repository underground coal mining map collection.

  FWS – 2 layers: National Wetlands Inventory and critical habitat for threatened and endangered species.

  EPA – 303d and STORET/NWIS hydrologic data.
- Phase I and II product testing by GeoMine interagency team, SMCRA GeoCommittee, nationwide SMCRA data stewards, TIPS Steering Committee, and TIPS team is now complete. Over 60 reviews and comments were taken, and appropriate changes and upgrades are now being incorporated into the viewer.

Primary Pilot Project Team Members: ***OSMRE*** - Bill Clark, *OSMRE Sponsor*, Robert Welsh, *Project Manager,* Greg Morlock, *System Administrator,* Chris Benson, *Data Analyst,* ***IMCC*** - Greg Conrad, ***Kentucky*** - Daryl Hines, ***Virginia*** - Daniel Kestner, ***West Virginia*** – Mike Shank, ***FWS*** - Christy Johnson-Hughes, ***EPA*** - Brian Topping, ***ACE*** - Desiree Morningstar