# WRAP Integrated Geospatial Information Management Strategy (WIGIMS)
## *Needs Assessment Report*

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**Submitted to:**


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## Table of Contents


1.0 INTRODUCTION 2

2.0 EXECUTIVE SUMMARY 3

3.0 NEEDS ASSESSMENT SUMMARY 4

OVERVIEW 4
SURVEY RESPONDENT CHARACTERISTICS 4
STATEMENT OF NEED TO INTEGRATE AIR QUALITY AND CONTEXTUAL LAYER INFORMATION 4
AIR QUALITY INFORMATION NEEDS AND THEMATIC SPECIFICATION 5
CONTEXTUAL LAYER NEEDS AND THEMATIC SPECIFICATION 5
DESCRIPTION OF INTEGRATED PRODUCTS: UNIQUENESS AND VALUE 6
LEVEL OF DATA AGGREGATION 6
MONTHLY USER MAGNITUDE, USER DESCRIPTION, AND IMPORTANCE LEVEL OF INTEGRATION 7
ANTICIPATED TOOL/APPLICATION DEVELOPMENT BASED ON CAPACITY FOR INTEGRATED ACCESS 8
COMPONENTS AND/OR REQUIREMENTS FOR APPLICATION/TOOL DEVELOPMENT 8

APPENDIX A – INTRODUCTION TO WEB-BASED WIGIMS NEEDS ASSESSMENT SURVEY FORM 9

APPENDIX B – WEB-BASED WIGIMS NEEDS ASSESSMENT SURVEY FORM 11

APPENDIX C – FULL-TEXT RESPONSES TO WIGIMS NEEDS ASSESSMENT SURVEY QUESTIONS 14

APPENDIX D – GLOSSARY 17

APPENDIX B – LIST OF ACRONYMS 20

## 1.0 Introduction

The WRAP Integrated Geospatial Information Management Strategy (WIGIMS) project is designed to analyze WRAP's geospatial information and related decision support needs, and then plan for the development of WRAP's capability to fulfill its mission by fully leveraging existing and emerging geospatial information, standards, technologies, and applications in an efficient and integrated manner. The project will result in a strategy for developing a spatial data infrastructure (SDI) that meets the needs of WRAP and its user community. This infrastructure will provide the means to discover, evaluate, and/or access the emissions, monitoring, and modeling data related to air quality and visibility for the WRAP user region, and facilitate integration of these data for use in custom tools or applications. In doing so, WRAP's ability to provide the data and technical and policy tools to its clientele - state and tribal members, federal land managers, committees, forums, and all other interested parties - as well as to its own staff, will be improved both in the short- and long-term.

The Needs Assessment phase of the WIGIMS project represents a critical step towards developing an infrastructure that will meet the present and future functional requirements of WRAP staff and its clientele. In conducting the Needs Assessment phase of the WIGIMS project, Pangaea Information Technologies, Ltd., and WRAP staff developed a series of questions directed to its known and potential future data consumers and application users. Requests for participation in this survey were issued via email and on the WRAP website. Solicited participants were given three weeks to complete a questionnaire that was accessible over the Internet in a web-based format. This document is intended to communicate the results of the WIGIMS Needs Assessment process.

It is important to note that this project is designed to produce strategy options for development of an *infrastructure* that provides access to integrated datasets and/or facilitates the integration of those datasets. It does *not* attempt to design or recommend *specific tools or applications* that support the particular needs of WRAP users, but rather to generate and evaluate options that, when implemented, would provide a robust platform upon which those tools and applications could be built.

## 2.0 Executive Summary

The Needs Assessment phase of the WIGIMS project represents a critical step towards developing a spatial data infrastructure (SDI) that will meet the present and future functional requirements of WRAP staff and its clientele. This infrastructure will provide the means to discover, evaluate, and/or access the emissions, monitoring, modeling, and contextual data for the WRAP user region, and facilitate integration of these data for use in custom tools or applications. In order to conduct this phase of the WIGIMS project, Pangaea Information Technologies, Ltd. (www.pangaeatech.com) and WRAP staff developed a series of questions directed to its known and potential future data consumers and application users.

In addition to posting an announcement of and link to the survey on the WRAP homepage, responses were solicited from the Committee, Forum, and Work Group membership via two email requests to each group's Co-Chairs. A summary of 15 responses, with representation from 1 tribe and 8 different WRAP member states, allows a synthesis of similarities, trends, and patterns in terms of geospatial information integration needs of the survey participants themselves and the users that they support. Included within this pool of respondents were staff from the three primary WRAP "data nodes", the Emissions Data Management System (EDMS), the Visibility Information Exchange Web System (VIEWS), and the Regional Monitoring Center (RMC), as well as staff of the Causes of Haze Assessment Project (CoHA), which could be considered a fourth data node due to its significant geodata holdings for the WRAP region.

The survey results can be distilled down into 4 primary points:

1) The responses to several questions provided concrete support to the *a priori* assumption that a large number of WRAP-supported users need access to integrated geospatial emissions, monitoring, and modeling information.
2) Access to integrated ancillary (i.e., contextual) geospatial information is also required to improve understanding of the 3 primary data types.
3) Users require a diverse set of spatial and temporal aggregation levels; flexibility should be maintained by providing for user-defined levels of data aggregation.
4) A geospatial data infrastructure is needed and should support non-proprietary application and tool development including web-based graphical interfaces that allow user-defined selection and download of feature sets, and the capability to integrate user-owned data with the datasets described within this survey.

This report is the first in the series of three WIGIMS publications, which include a *Resource Inventory Report,* and a *Geospatial Information Management Strategy and Implementation Recommendations Report*. Preliminary results of the WIGIMS project were presented at the Technical Oversight Committee meeting on 13 May 2004.

## 3.0 Needs Assessment Summary

### Overview

In addition to posting the survey on the WRAP homepage, we solicited responses from all Committee, Forum, and Work Group membership via two email requests to the Co-Chairs of each group. We received 16 responses, one of which was deemed to be incomplete and unusable and will not be included in this summary. For the purposes of this assessment, it will be assumed that the remaining 15 responses were provided without error and can be considered to be representative of the entire WRAP user community. Although many respondents provided highly detailed comments illuminating a diverse set of their needs and those of the users that they support, a number of similarities, trends, and patterns in terms of geospatial information integration needs can be discerned.

### Survey Respondent Characteristics

Of the numerous tribes and 14 states currently participating to varying degrees in the WRAP activities, 1 tribe and 8 states participated in the survey: the Confederated Salish & Kootenai Tribes, AZ (3 respondents), CA (4 respondents), CO, MT, NM, NV, UT, and WY (2 respondents).

Of these 15 responses, 10 were members of a WRAP Committee, Forum, and/or Work Group, and 7 identified themselves as an Air Quality Manager, Policy-Maker, or Analyst. The 3 respondents that identified themselves as an "Interested Party" were also associated with a WRAP Committee, Forum, and/or Work Group.

Of the three primary WRAP "data nodes", all participated in the survey: the Emissions Data Management System (EDMS, E. H. Pechan), the Visibility Information Exchange Web System (VIEWS, Colorado State University [CIRA] staff), and the Regional Monitoring Center (RMC, ENVIRON staff). Desert Research Institute (DRI) staff representing the Causes of Haze Assessment Project (CoHA), which could be considered a fourth data node given its voluminous data warehouse, also participated in the survey.

### Statement of Need to Integrate Air Quality and Contextual Layer Information

All respondents (15/15) indicated the need for a capacity to integrate emissions, monitoring, modeling, and ancillary geodata. This was one of only two unanimous responses in the survey. This finding represents an affirmation of our *a priori* expectation that WRAP users need to integrate different types of air quality information.

In retrospect, it may have been beneficial to exclude "ancillary" geodata from this question, as this would have eliminated the possibility that respondents were referring to the integration of ancillary geodata with a single air quality layer (emissions, monitoring, or modeling geodata), and not two air quality layers. Fortunately, this possibility was eliminated by specified layer requirement responses, as discussed below.

## Air Quality Information Needs and Thematic Specification

Almost all respondents (12/15) specified their need, or that of the users that they support, to integrate all three air quality data layers (emissions, monitoring, or modeling geodata). Moreover, all respondents (15/15) specified a need to integrate at least two of the three air quality themes. Selected requirements for the individual layers were as follows[1]:

| Response (x/15) | Data/Layer Type | Description | Examples |
|---|---|---|---|
| 14 | Emissions | Pollutant sources | Point Sources (e.g., stacks) |
| | | | Mobile Sources (e.g., semi-tractors) |
| | | | Area Sources (e.g., agricultural land, prescribed burns) |
| 13 | Monitoring and Data Analysis | Pollution-level measurements and analyzed data | Stations with depositional fluxes |
| | | | Networks with pollutant concentrations in ambient air |
| | | | Interpolated pollutant concentration surfaces |
| | | | Time series of visual impairment |
| | | | Pie charts of pollutant species |
| 15 | Modeling output | Pollution estimation for areas (usually gridded / raster). | Source apportionment |
| | | | Dispersion from source(s) |
| | | | Control strategy scenario analysis |

## Contextual Layer Needs and Thematic Specification

All respondents (15/15) indicated their need to integrate contextual geospatial information, presumably to support interpretation of the air quality geodata. As evident in the response counts, the majority of respondents indicated that several of the layers would be desirable. Specified requirements regarding the individual layers were as follows:

| Response (x/15) | Data/Layer Type | Description | Examples |
|---|---|---|---|
| 12 | Administrative boundaries | Linear features enclosing legally-defined areas | Political – State of Nevada |
| | | | Regulatory – Class I Areas |
| | | | Reservations |
| | | | Public lands |
| 13 | Atmospheric &/or surface conditions | Meteorological measurements or climatological settings (specific to a point or area for a time or period) | 30-year normals, 10-year means |
| | | | Palmer Drought Severity Index |
| | | | Relative humidity |
| 13 | Transportation networks | Linear features used for travel | Road network |
| | | | Railroad network |
| | | | Shipping lanes |
| 13 | Census data | Areas with linked population and demographic info | Population density by County |
| | | | Mean # autos per household, by Tract |
| | | | Type of heating, by Block-group |
| 13 | Elevation | Measurements above mean sea level | Shaded topographic relief |
| | | | Hypsography – "topo lines" |
| | | | Digital Elevation Models (DEM) |

[1] All of the information in the two above summary tables, excepting the "Response" counts, was visible with "scroll-over / mouse-over" functionality when the cursor was moved over "Data/Layer Type" titles.

| | | | |
|---|---|---|---|
| 13 | Land use / cover type | Area features with the same land use or land cover. | Urban or built-up |
| | | | Row crops |
| | | | Pasture / feedlot |
| | | | Tree species composition |
| 3 | Hydrography | Linear or polygonal water features | Oceans |
| | | | Lakes |
| | | | Rivers |
| 10 | Imagery | Remotely-sensed information from aerial or satellite platform | Landsat-TM |
| | | | IKONOS |
| | | | Orthoimagery |

For the "Other" ancillary data category, 5 respondents defined other ancillary data themes that would be useful to them or the users they support: soils data (2 respondents), geology, other demographic and economic data themes/feature sets, Digital Raster Graphics (DRG), Geographic Names Integration System (GNIS), e.g., toponomy, physiographic and climatic regions, "quad grids", and aerial photographs.

## Description of Integrated Products: Uniqueness and Value

The respondents were asked to describe "the unique information provided by integrating two or more of the primary datasets (emissions, monitoring, and or modeling)" by writing in a text box (see Appendix 2). All but one participant (14/15) responded to the question. The answers were varied, but could be roughly grouped into the 4 following categories:

- Integration (of the primary datasets) would enable user-defined analyses, allowing the formulation and answers to new, unique questions from each user.
- Integration would allow cross-checking of datasets and model results.
- Integration would facilitate impact analyses to be conducted.
- Integration would facilitate interpretation of datasets and/or model results, or would lead to improved understanding.

Of these categories, the "cross-checking" process was mentioned most often (7/14 responses), although each of the other responses were stated in 4/14 or 5/14 cases. For full answers of this and other text box answers, see Appendix 3.

## Level of Data Aggregation

The respondents were asked to answer the question, "What level of data aggregation is or will be necessary for integration that is meaningful to the end user?" by writing in a text box. Twelve survey participants (12/15) provided responses that ranged fully across both the spatial and temporal spectrums. Specification of spatial aggregation ranged from point, grid cell (4 $km^2$), SMSA, county, state, tribal boundary, to regions, and from hourly to yearly (including seasonally) for temporal aggregation. Five respondents explicitly stated that the flexibility for user-defined spatial and temporal aggregation was necessary. The range of temporal and spatial aggregation that the respondents specified supports the need for options and/or user-defined levels of aggregation.

## Monthly User Magnitude, User Description, and Importance Level of Integration

Respondents were asked to (1) select a category that specified the anticipated number of users that would be served by access to the integrated primary geospatial datasets, (2) describe the users, and (3) select a category that described the importance of this type of integration. Because it is useful to consider these responses in unison, these survey response components are presented together in the following table:

| # Monthly Users | Description of Users | Importance Level of Integration |
|---|---|---|
| Under 5 | | Low |
| Under 5 | | Moderate |
| Under 5 | | Moderate |
| Under 5 | Academic researchers on fugitive dust. | Moderate |
| Under 5 | | High |
| 5-10 | WRAP Forum Participants, FLMs, EPA and State personnel, other RPOs | Moderate |
| 5-10 | Engineers, SIP Planners, Modelers, Monitoring Staff | High |
| 11-50 | | Moderate |
| 11-50 | Given EAF stuff works, and it serves its intended purposes, then would see a number of states and tribes, in addition to some other stakeholders, plus most members of EAF itself. | Moderate |
| 11-50 | Tribes that are involved with emissions inventories | High |
| Over 50 | WRAP Oversight Committee Members; WRAP State, Local and Tribal Agencies; Enviros; Media; Other RPOs, EPA | Low |
| Over 50 | Public, State Agencies, Federal Agencies, Industry Stakeholders | High |
| Over 50 | Forecasters, burners, public through our Prescribed Fire Incident Reporting System (PFIRS) and our Air Quality and Meteorological Information System (AQMIS) web sites. | High |
| Over 50 | The [integrated] products are designed to be of primary interest to WRAP and CENRAP states, local agencies, tribal governments as well as federal agencies (Forest Service, BLM, NPS) but will be useful to the other state governments, students and teachers in educational institutions in the US and worldwide | Critical |
| Over 50 | Air quality analysts, planners, permit engineers, compliance engineers, monitoring staff, ADEQ management. | Critical |

The anticipated number of monthly users cited by the 15 respondents can be divided into thirds: 5 for “Under 5”, 5 for “Over 50”, and 5 for the “5-10” and “11-50” categories combined. Respondents were given the opportunity to rank the importance of this type of integration, using rankings of “Low”, “Moderate”, “High”, and “Critical”. Of all 15 respondents, the majority chose either “Moderate” (6 respondents) or “High” (5 respondents), with only 2 choosing “Low”, and the remainder (2 respondents) choosing “Critical”. Not surprisingly, the importance level closely tracks the user magnitude, with the exception of the associated “Low” and “Over 50” response.

In parallel with the diversity of responses evident in the response to the "Level of Data Aggregation" question, the User Descriptions are collectively very broad. Even within a single response record (row in above table), the number of different types of users served is remarkable. Also noteworthy is the reference to "state" or "tribal" users within 7 of the 10 statements by the participants who elected to respond to this question. Of course this is not surprising given the solicited set of participants, but it does give some assurance that the targeted community was reached.

## Anticipated Tool/Application Development Based on Capacity for Integrated Access

When asked if plans existed to develop tools or applications that would require access to a geospatial infrastructure that included the integrated datasets, only one respondent declined to answer. Of the remaining 14, almost all respondents (13) answered "Yes". This response provides further support of our *a priori* assumption that WRAP users need to integrate different types of air quality information, and goes beyond that by affirming the need for an integrated geospatial information management strategy (and implemented infrastructure).

## Components and/or Requirements for Application/Tool Development

The final survey question – "What are or will be the system components and requirements that will facilitate development of applications/tools that meet your user needs?" – like the others with text box response formats, was intended to facilitate open-ended responses and provide the respondent the opportunity to express their needs in an unconstrained manner. Given that this particular question was possibly the least-well defined among those presented, the respondents statements were difficult to summarize or categorize. With that said, a synthetic response comprised of those requirements stated by more than one respondent might be: "a web-based graphical interface that allows user-defined selection and download of feature sets, and the capability to integrate my own data with the datasets described within this survey". Again, full answers are presented in Appendix 3.

## Appendix A – Introduction to Web-based WIGIMS Needs Assessment Survey Form


WRAP Integrated Geospatial Information Management Strategy (WIGIMS) Project
User / Developer Needs Assessment Questionnaire
23 February 2004

Problem Statement: WRAP has identified four primary types of geospatial information that may need to be integrated to support ongoing and future activities of its user community: emissions, monitoring, modeling, and ancillary geodata. Currently, these sets of information are distributed at a respective WRAP "data center" or "data node" as follows:

Emissions Data Management System (EDMS), http://www.pechan.com/edms/

Visibility Information Exchange Web System (VIEWS), http://vista.cira.colostate.edu/views/

Regional Modeling Center (RMC), http://pah.cert.ucr.edu/aqm/308/

Causes of Haze Assessment (CoHA) project, http://coha.dri.edu/index.html

Near Emissions project, http://wrapair.org/forums/class1/near/htmlfiles/main.html

While other geodata would need to be accessed and integrated (e.g., that available through the Institute for Tribal Environmental Professionals (ITEP), USGS's National Map, the OMB's Geospatial One-Stop (GOS) initiative, etc.), the above four WRAP data nodes represent the majority of information anticipated to be needed by the WRAP user community.

*Currently, there is no systematic way to discover, evaluate, and/or access the emissions, monitoring, and modeling data for the WRAP user region, and no over-arching plan to facilitate integration of these data for use in custom tools or applications.*

Purpose of Project: The purpose of this work is to analyze WRAP's geospatial information and related decision support needs, and then plan for the development of WRAP's capability to fulfill its mission by fully leveraging existing and emerging geospatial information, standards, technologies, and applications in an efficient and integrated manner. In doing so, WRAP's ability to provide the data and technical and policy tools to its clientele - state and tribal members, committees, forums, and all other interested parties - as well as to its own staff, will be improved both in the short- and long-term.

Project Description: WRAP has hired Pangaea Information Technologies, Ltd. ( www.pangaeatech.com) to develop an integrated geospatial information management strategy and implementation recommendations for the Western Regional Air Partnership. The Contractor will propose a system design, focused on geospatial data and tools, that provides integrated discovery, access, review, and analysis functionality that best addresses WRAP needs given available resources. System properties to be addressed will be flexibility, extensibility, sustainability, compatibility/interoperability, complexity, robustness, security, as well as cost.

Organizational needs will be evaluated in the context of existing or emerging resources, with gaps identified.

Project Components: The WIGIMS project is comprised of six distinct tasks: interview WRAP staff and that of its primary data centers, assess user (and developer) needs, document resources, evaluate and prioritize user needs, develop geospatial information management strategy options respecting user needs and available resources, and prepare strategy and implementation recommendations.

Project Milestones: Final versions of the following reports should be available by dates indicated:

| | |
|---|---|
| *User Needs Report* | 26 March |
| *Resource Inventory Report* | 9 April |
| *Geospatial IM Strategy and Implementation Recommendations Report* | 14 May |

We have prepared a questionnaire for a Needs Assessment Survey, which will address three primary questions:

1. Within the WRAP User Community, is there and/or will there be a need to integrate any of the following types of geospatial information: emissions, monitoring, modeling, and ancillary geodata?
2. What are the data requirements that would meet that need?
3. What tools will be developed that require this integration, and what are the specific data and system requirements for those applications?

Your participation in this survey, either directly or by facilitating response by your respective committee, forum, or working group, will be invaluable in ensuring all existing and future needs are included in this assessment.

## Appendix B – Web-based WIGIMS Needs Assessment Survey Form


WRAP Integrated Geospatial Information Management Strategy (WIGIMS) Project
User / Developer Needs Assessment Questionnaire
23 February 2004

This short survey is designed to aid in defining and planning for a spatial data infrastructure that will facilitate information integration and future application development, with an emphasis on decision support tools that utilize information from one or more of the "data nodes" listed on the preceding page. In this context, "integration" refers to the vertical and/or horizontal alignment of geospatial information that allows spatial relationships to be discerned.

Your help is greatly appreciated.

**Responder Profile:**
Please fill in the following contact information:

| | |
|---|---|
| Organization: | |
| Name: | |
| Job Title: | |
| Address 1: | |
| Address 2: | |
| City, State Zip Code: | |
| Phone: | |
| Fax: | |
| Email: | |

User Groups Identification: (choose all that apply)

- ☐ WRAP Committee, Forum, and Work Group Members
- ☐ Federal, Regional, State, Tribal, and Local air quality managers, policy-makers, or analysts
- ☐ Staff at a primary WRAP data nodes or resource center
- ☐ All other interested parties (e.g., Public Interest Groups, Regulated Community)

**Questions:**

1. Do you and/or does your organization have or will have a need to integrate any of the following types of geospatial information: emissions, monitoring, modeling, and ancillary geodata?

   ☐ Yes
   ☐ No

2. If "Yes", please indicate, from the following two lists, what geodata would be required.

   *Place mouse cursor over text to view a description and examples of each data.*

   Air Pollution Data

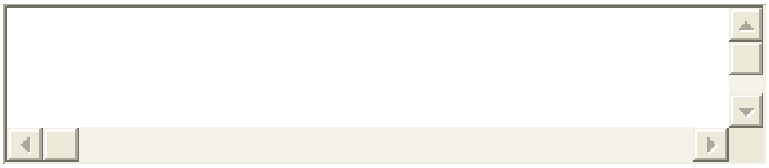
   ☐ Emissions
   ☐ Monitoring and Data Analysis
   ☐ Modeling Output

   Ancillary Data

   ☐ Administrative Boundaries
   ☐ Atmospheric and/or Surface Conditions
   ☐ Transportation Networks
   ☐ Census Data
   ☐ Elevation
   ☐ Land Use / Cover Type
   ☐ Hydrography
   ☐ Imagery
   ☐ Other:

3. Describe (in as much detail as necessary) the unique information provided by integrating two or more of the primary datasets (emissions, monitoring, and or modeling).

4. What level of data aggregation is or will be necessary for integration that is meaningful to the end user?



5. By integrating these primary datasets, how many users would be served in a month?

Number of Users: Under 5

Describe Users:

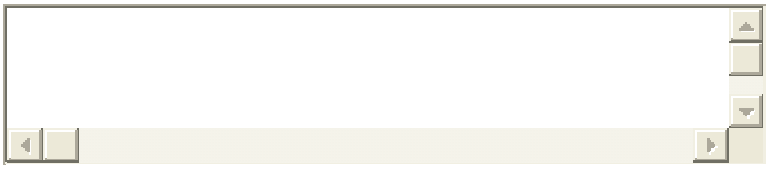
6. What is the importance level of this type of integration?

Low

7. Are you or is your organization planning to develop tools or applications that would require access to a geospatial data infrastructure that is comprised of the set of information listed above?

- Yes
- No

8. What are or will be the system components and requirements that will facilitate development of applications/tools that meet your user needs?



Submit Reset

## Appendix C – Full-text Responses to WIGIMS Needs Assessment Survey Questions

3. Describe (in as much detail as necessary) the unique information provided by integrating two or more of the primary datasets (emissions, monitoring, and or modeling).

| |
|---|
| Integrating land / use & soil type with monitoring and modeling data to improve source apportionment of fugitive dust. |
| Emissions & Monitoring provide a cross-check on the accuracy of the data (ie/ high emissions reported, but low monitoring values indicates some sort of problem). Monitoring is the primary calibration check for any Modeling effort. Emission calculations need Census Data to compute values and apportion the results. |
| Our primary goal with integrating these different datasets is to revisit any assumptions in data analysis based upon any observed disparities and/or similarities between the datasets. |
| Not sure yet. Will wish to highlight changes to demographic and economic baseline data from differing policy option runs -- plus, the change in emissions and impact categories (visibility, health, ...) from modeling (air quality, economic framework, ...). It would be ideal to have some control over the display and management of display -- If ArcGIS is still the platform, I have access to such. |
| Use of GIS spatial data to show modeled concentrations in relation to Class I areas, populated areas, emission sources/emission density. These data would also be useful in conjunction with monitor locations for model evaluation studies. |
| Easier to interpret modeling results. Corroborative analysis of model control strategy results. |
| A unique output from the Causes of Haze project is the trajectory products that integrate model output, emissions as well as monitoring data. By showing all of these layers at once, it gives a better picture of describing regional haze problem areas and helps interpret monitoring data. We're also producing maps of each site that describe admin boundaries, transportation networks, elevation, land use, hydrography as well as imagery. For example, combining terrain, emissions inventory data, and population density shows an experienced meteorologist the potential pathways of urban pollutants that can impact wilderness areas without a monitoring site. |
| We would like to compare modeled concentrations to measured concentrations or compare emissions in an area to measured ambient concentrations. |
| Integrating the data will enable Tribes to include this information into emissions reports and also enable Tribes to see impacts to Reservation Airsheds from outside of Boundaries. |
| Looking at emissions near a monitor, especially one that exhibits unique characteristics. Integrating emissions data with landuse/census/etc. information. Displaying model results and monitor locations. Comparing spatial/seasonal patterns of model and monitored output. |
| Integrating emissions, monitoring, and modeling will provide valuable insight into the environmental effects of prescribed burning and how these activities affect visibility within an air basin. In addition, integrating these data could aid forecasters making burn decisions and thereby mitigating visibility transport issues. |
| Comparison of emissions temporally and spatially, especially useful for creating projection emissions based on modeling scenario criteria (using greater control, imposing process limits, etc...)and contrasting to actual or baseline emission estimates to analyze emission reduction techniques. |

| |
|---|
| Integrating emissions and monitoring data in a spatial context would provide insights into the relation of emission density, location of emission sources and location of monitors with the predicted ambient pollutant concentrations from modeling. This would be a quality check for modeling, and would show if monitor locations are at a location to adequately monitor pollutant levels. In addition, adding different data layers such as census data and transportation networks to emissions data and modeling results would provide very useful spatial relationships between these different data types and a better understanding of the complex relationships between emissions and air quality. |
| Emissions+Modelling leads to ability to predict pollutant transport and sensitivity of final pollutants (after chemical reaction) to emissions. |

4. What level of data aggregation is or will be necessary for integration that is meaningful to the end user?

| |
|---|
| Complete |
| Our needs will primarily be for daily, weekly, monthly, and seasonal aggregations. |
| Not clear yet -- will probably be sticking to the geopolitical boundaries such as SMSAs, Counties, States, tribal and reservation areas. |
| Ability to project all spatial data into a common GIS framework, and to create maps and other graphical displays that are accessible to all of the states, tribes, and RPO's. This framework should be user friendly for end users with little to no GIS background. |
| Depends on end user. We already integrate emissions, monitoring and modeling resutls as part of the WRAP RMC. |
| At DRI we have all of the items in the "Ancillary Data" check list. As far as items in the "Air Pollution Data" list, it would be useful to have access to all of the data sets available from the other WRAP data nodes in a format that I can use with my software. Most of our data is in a common GIS format that can be useful to the end user. Right now our GIS data sits on an internal server not accessible to the outside. All of the project deliverables such as descriptions and maps are outside of the firewall and will be available on the website http://coha.dri.edu. |
| As far as Tribes are concerned the level of detail does not have to be to a minimus level but should truly reflect conditions. |
| Not sure what you're asking. Daily info is less important than monthly, seasonal, and annual. Would like results by pollutant, not just total visibility extinction. |
| Aggregating emissions and monitoring data in near real-time hourly resolved increments would be required for these data to be of use in forecasting and burn decision-making. During significant ambient air quality events and smoke episodes, modeling data that are near real-time and provide predictive results would be beneficial. |
| So that data can be compared one to one for individual sources as well as summary information comparisons. |
| At the least, the data should be at a county level. Ideally, the data should be able to be gridded to cells as small as 4 kilometers on a side to allow emissions, atmospheric conditions, topography, and ancillary data such as population to be input to dispersion models or for additional processing in emissions models. |
| This depends on the purpose of the simulation and is very hard to predict beforehand. But, as a first cut, most intermediate chemical species can be disposed of. Most meteorlogical variables also. |

8. What are or will be the system components and requirements that will facilitate development of applications/tools that meet your user needs?

| |
|---|
| Wyoming is developing a WISE-View Emission Inventory system that will require updated GIS based databases for future Inventory compilation. |
| Network, Site, and region selection by map (rather than picking sites from a list, for example). Some way of displaying results on a map, such as visibility rating per region for a given day/date range. A way of visually identifying "hot" spots for pollutant concentrations. |
| Not clear at this time -- but probably hot links and drop down menus within ArcGIS for access to results from EAF product sets. |
| Storage Area Network (SAN) with 4 terra bytes of data storage, Gigabit switches, MS SQL server, MS Access, and Fortran programming languages. Windows and Linux OS environments. |
| Easy ftp access to high resolution databases. Linux and Windows (e.g., xls) friendly files. |
| First we'll need access to other's data and metadata through some channel like an ftp or web site. As far as our data, I can reserve space to provide data to our users using both ftp and the web outside our firewall. It would be nice to have a central place linked from the WRAP web site that directs people to the individual data providers. One of the problems I see is the many data formats that people are using. To narrow down the number of formats, time and money are needed to do that. For example, it would be useful to combine the modeling center's data with our descriptive mapping but it's in a different data format. |
| I will have to wait and access the requirements of a system when the geospatial integration is complete. |
| Data that are available in standard formats (for example comma delimited text files) that can be accessed via the World Wide Web (again for example via an ftp site) would be useful. Modeling data should be provided using programs that are selected by consensus of the group and provide significant flexibility to the end users. |
| Include geospatial and temporal data elements so that data can be mapped from selected time periods. We will be attempting to take advantage of Oracle Spatial functionality/capabilities for mapping and analysis of the information on a spatial basis. |
| Computer hardware and software for storing and processing spatially referenced emissions, topography, land use, census, jurisdiction boundaries, atmospheric conditions, roads, and prescribed / wildfire locations and emissions in a geodatabase that will use a GIS type interface for selecting areas of interest and for portraying results on maps and images, and sending output to data files. |
| To give you an idea of this I will tell you what we are considering currently: Mostly dealing with CMAQ output, there is a need for post-processing tools and graphical presentation tools. In the first category we at LBL are considering Root (from CERN, Geneva) and MatLab. These are useful for detailed digging at the data. For better graphics capability, but less ability to manipulate data we are considering Tecplot and AVS. We already use PAVE and find it useful, but it does not meet many of our needs. |

## Appendix D – Glossary

**aggregation**: Combining data to a lower-level of spatial and/or temporal specificity; the grouping together of a selected set of like entities to form a single entity. For example, grouping sets of adjacent areal units to form larger units.

**ancillary data**: Geodata that provides context to aid in the interpretation and provide meaning to other geodata or geospatial information.

**aspatial**: A term that is used to describe non-spatial data that is usually referenced to spatial data, for example, attributes.

**attribute**: A characteristic of a geographic feature described by numbers, characters, images and CAD drawings, typically stored in tabular format and linked to the feature by a user-assigned identifier (e.g., the attributes of a well might include depth and gallons per minute); a column in a database table.

**auxillary**: See ancillary (above).

**browser**: Web browser such as Netscape Navigator or MS-Explorer.

**cache**: A repository, usually temporary.

**catalog**: Listing of data resources and/or collection of metadata files.

**chaining**: An operation that binds a sequence of services where, for each adjacent pair of services, occurrence of the first action is necessary for the occurrence of the second action.

**Class I Area**: Areas of special national or regional natural, scenic, recreational, or historic value for which the Prevention of Significant Deterioration (PSD) regulations provide special protection. Under the Clean Air Act (CAA), three kinds of Class I areas either have been, or may be, designated. These are “Mandatory Federal Class I areas”, “Federal Class I areas”, or “Non-Federal Class I areas.”

**Clearinghouse**: A decentralized system of web servers, sponsored by the FGDC, that supports a detailed metadata catalog service with support for links to spatial data and browse graphics through the individual metadata files.

**controlled vocabulary**: A prescribed set of consistently used and carefully defined terms.

**cross-walk**: A table that maps the relationships and equivalencies between two or more metadata formats. Crosswalks or metadata mapping support the ability of search engines to search effectively across heterogeneous databases, i.e. crosswalks help promote interoperability.

**data dictionary**: A catalog of all data held in a database, or a list of items giving data names and structures. Also referred to as DD/D for data dictionary/directory. Commercial RDBMSs have online data dictionaries stored in special tables called system tables.

**data mediation**: A service that bridges that gap between the data provider and the data consumer; can include format standardization and possibly integration.

**data node**: An organizational component that produces and/or maintains a significant amount of geodata. For WRAP, this would include EDMS, VIEWS, RMC, and CoHA (DRI).

**data steward**: The party responsible for the maintenance of a database or data set.

**database schema**: A collection of items that model part or all of a real world object.

**datum**: A set of parameters and control points used to accurately define the three-dimensional shape of the Earth (e.g., as a spheroid). The datum is the basis for a planar coordinate system. For example, the North American Datum for 1983 (NAD83) is the datum for map projections and coordinates within the United States and throughout North America.

**Dublin Core**: A standard set of 15 metadata elements for cross-domain information resource description; intended to facilitate discovery of electronic resources.

**entity**: In cartography, a real world object that cannot be further subdivided into similar objects, for example a road, or a building. In relational databases, an entity is an object and its associated attributes.

**entity relationship model**: A logical way of describing entities and their relationships within relational databases. An entity-relationship model is often used in the conceptual design phase of creating a relational database and is usually expressed as a diagram showing the entities and the linkages that exist between them.

**feature**: Abstraction of a real-world phenomena, normally associated with a location relative to the Earth.

**gateway**: An annotated directory of web resources; any mechanism for providing access to another system.

**geodata**: A geospatial database or data set.

**geographic information system**: A system of capturing, storing, checking, integrating, analyzing and displaying data about the earth that is spatially referenced. Normally includes hardware, software, data, and humans.

**geospatial**: A property denoting a locational reference the Earth's surface.

**hydrography**: The description and study of bodies of water or their representations on a map.

**integration**: The vertical, horizontal, and temporal alignment of geospatial information that allows spatial and temporal relationships among 2 or more databases to be discerned. Integration can take place at two levels: visual and computational.

**interoperability**: The capability to communicate, execute programs, or transfer spatial data among various functional units in a manner that requires the user to have little or no knowledge of the unique characteristics of those units.

**lattice**: A surface representation that uses a rectangular array of mesh points spaced at a constant sampling interval in the x and y directions relative to a common origin.

**metadata**: In general, "data about data;" functionally, "structured data about data." Information about an information resource.

**orthoimagery**: A modified version of a perspective photograph of the earth's surface with distortions due to tilt and relief removed.

**plot**: A map containing both geospatial data and cartographic elements.

**portal**: Typically a "Portal site" has a catalog of web sites, a search engine, or both. A Portal site may also offer other services to entice people to use that site as their main "point of entry" (hence "portal") to a particular information community.

**projection**: The representation on a plane surface of any part of the surface of the earth.

**raster**: A regular division of space, i.e., a grid of cells covering an area.

**registry**: A system to provide management of metadata elements, data elements, or web services. Metadata registries are formal systems that provide authoritative information about the semantics and structure of data elements. Each element will include the definition of the element, the qualifiers associated with it, mappings to multilingual versions and elements in other schema.

**resolution**: The smallest spacing between two display elements; the smallest size of feature that can be mapped or sampled.

**scale**: The relation between the size of an object on a map and its size in the real world.

**spatial data infrastructure (SDI)**: An integrated, on-line network that delivers geospatial data, services and information for applications, better business and policy decision-making, and value-added commercial activities.

**spheroid**: Part of the mathematical model that describes the shape of the earth.

**toponomy**: A dataset which includes the names of geographic features, normally used for cartographic (map) product.

**vector**: Refers to potentially irregular divisions of space, based upon points; points can form lines, and lines can form polygons.

**web mapping**: A type of web service that provides static or interactive maps over the Internet.

**web service**: A network-based, distributed, modular component that performs specific tasks, and conforms to a specific set of technical specifications that make it interoperable with compatible components.

Glossary Acknowledgements:

The *GIS Dictionary*, by the Association for Geographic Information, http://www.agi.org.uk/resources/index.htm, accessed 25 May 2004.

The *Dublin Core Metadata Glossary*, by the Dublin Core User Guide Committee http://dublincore.org/documents/2001/04/12/usageguide/glossary.shtml, accessed 25 May 2004.

The ESRI *Glossary of GIS Terms*, http://www.esri.com/library/glossary/glossary.html, accessed 25 May 2004.

## Appendix B – List of Acronyms

**AoH** - Attribution of Haze [Project]

**ASCII** - American Standard Code for Information Interchange

**CAPITA** - Center for Air Pollution Impact & Trend Analysis

**CDX** - Central Data Exchange

**CENRAP** - Central Regional Air Planning Association

**CGDI** - Canadian Geospatial Data Infrastructure

**CIRA** - Cooperative Institute for Research in the Atmosphere

**CoHA** - Causes of Haze Assessment [Project]

**CSDGM** - Content Standard for Digital Geospatial Metadata

**DIF** - Directory Interchange Format

**DRI** - Desert Research Institute

**EDMS** - Emissions Data Management System

**ESRI** - Environmental Systems Research Institute

**FAQ** - Frequently Asked Questions

**FGDC** - Federal Geospatial Data Committee

**GCMD** - Global Change Master Directory

**GIS** - geographic information system

**GML** - Geographic Markup Language

**GOS** - Geospatial One-Stop

**GSDI** - Global Spatial Data Infrastructure

**GSM** - General Service Model

**HTML** - hyper-text markup language

**IMPROVE** - Interagency Monitoring of Protected Visual Environments

**INEGI** - Instituto Nacional de Estadistica, Geografia e Informatica

**ITEP** - Institute for Tribal Environmental Professionals

**ISO** - International Organization of Standards

**NEI** - National Emissions Inventory

**NIF** - NEI Information (file) Format

**NSDI** - National Spatial Data Infrastructure

**OGC** - OpenGIS Consortium

**RMC** - Regional Monitoring Center

**RPO** - Regional Planning Organization

**SDI** - spatial data infrastructure

**SIP** - State Implementation Plan

**SLD** - Style Layer Descriptor

**TIP** - Tribal Implementation Plan

**TRI** - Toxic Release Inventory

**UML** - unified modeling language

**URL** - Universal Resource Locator

**USGS** - United States Geological Survey

**VIEWS** - Visibility Information Exchange Web System

**WIGIMS** - WRAP Intgerated Geospatial Information Management Strategy

**WCS** - Web Coverage Service

**WFS** - Web Feature Service

**WMS** - Web Mapping Service

**WRAP** - Western Regional Air Partnership

**XML** - Extensible Markup Language