RECLAMATION RESEARCH
ENVIRONMENTAL MINE WASTE MANAGEMENT DATABASE

Final Report on Minerals Coordinating Committee Project
Environmental Mine Waste Management Database

June 2003

Minnesota
DEPARTMENT OF NATURAL RESOURCES

Minnesota Department of Natural Resources
Division of Lands and Minerals
Reclamation Section
1525 Third Avenue East
Hibbing, MN 55746-1461
(218) 262-7320

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0. EXECUTIVE SUMMARY

In July of 2001 the Minerals Coordinating Committee (MCC) provided funding to initiate the development of an Environmental Mine Waste Management (EMWM) Database for Minnesota Department of Natural Resources Lands and Minerals (MN DNR LAM) research data. The objectives of this two-year project were to provide: 1) a structure that would allow efficient data management of mine waste drainage quality prediction and mitigation research data 2) systematic storage and retrieval of the research data. This project will benefit the State of Minnesota and the mining industry by allowing more efficient data management and report production, improving security of existing and future data, and increasing the value of this data to the MN DNR, the mining industry, and others interested in the environmentally sound management of mine waste.

A developmental method, created by Advanced Strategies Inc. (1998), was used to design the EMWM Database. This method consisted of planning, analysis, design, construction, and implementation phases. The initial year of the project was spent on analysis, design, and finally construction of the database in Microsoft Access. This software is readily available to the MN DNR LAM staff, and does not require extensive hardware or technical support required by other software programs. The second year of the project concentrated on fine-tuning the database structure, and population of the database with drainage quality data from prediction and mitigation experiments. Data were verified prior to import into the database and after the database was populated.

To date, the EMWM Database has been constructed in Microsoft Access and contains drainage quality data, consisting of 47,159 records, for 15 laboratory and field experiments currently in progress. These accomplishments fulfill the requirements of the MCC FY 01-FY03 biennial work plan. Other accomplishments aimed at improving the report generation process for MN DNR LAM and improving the user-friendliness of the EMWM Database include the creation of customized data input forms, report templates of drainage quality data for all 15 experiments, applications to run routine calculations, initial work on the menu-driven interface system, and documentation of the database structure and all forms, tables, and reports.

1. INTRODUCTION

The Minnesota Department of Natural Resources (MN DNR) is responsible for both encouraging mineral resource development and ensuring that this development does not adversely impact other natural resources. Of particular concern are water resources. Mineral resource development generates large quantities of mine wastes including waste rock, tailings and the mine itself. The quality of drainage from these wastes is variable, ranging from environmentally innocuous to highly acidic drainage with elevated concentrations of trace metals. The extent of mitigation required to prevent adverse impacts on water quality is, therefore, dependent on the quality of drainage.

The present approach to mine permitting requires, prior to mineral resource development,

1. prediction of the quantity and quality of drainage from potential mine wastes, and
2. development of mine waste management plans, based on the aforementioned predictions, to prevent adverse impacts on water quality.

With this information, adverse impacts on water quality can be prevented, and the costs of environmentally sound mine waste management can be factored into the economic analysis of mineral resource development.

Minnesota has spent in excess of three million dollars over the past 25 years studying mine waste drainage quality prediction and environmentally sound mine waste management. The MN DNR Division of Lands and Minerals (LAM) has conducted numerous projects. Some of these are funded internally or through various state programs (Minerals Coordinating Committee, Environmental Cooperative Research). Other studies have been conducted in cooperation with the iron mining industry, U.S. and Canadian base metal mining industries, and governmental agencies such as the U.S. Bureau of Mines, U.S. Bureau of Land Management, U.S. Environmental Protection Agency, U.S. Army Corps of Engineers, and the Western Governors' Association (Lapakko et al. 2001).

These extensive laboratory and field studies include research on:

- mine waste characterization and drainage quality prediction methods
- prediction of drainage quality from taconite mine wastes
- prediction of drainage quality from Duluth Complex mine wastes
- prediction of drainage quality from Archean greenstone mine wastes
- prediction of drainage quality from mine waste rock types in the western U.S.
- mitigative potential of subaqueous mine waste disposal
- mitigative potential of mixing alkaline solids with acid-producing mine waste
- mitigative potential of mine waste encapsulation
- mitigative potential of capping waste rock piles
- mitigative potential of sulfate reduction systems

Prediction of mine waste drainage quality may require long term testing, because mine waste drainage can be neutral for several years before becoming acidic. Mitigation studies can also be of extended duration in order to assess the effectiveness of techniques that must prevent, control or treat problematic drainage after mine closure. Consequently, more than 25 years of research by the MN DNR LAM has generated an immense amount of data that have been summarized in reports and technical papers.

For many of the MN DNR LAM research projects, data input, compilation, analysis, and tabular and graphical output represents a substantial time commitment. Those responsible for these tasks are often hired temporarily for a specific project or projects. Therefore, having an efficient and user-friendly data management system is a high priority. Furthermore, voluminous data generated over more than 25 years requires an effective and efficient method for its systematic storage and retrieval.

There are presently several data management systems in use, which are adequate, but they are not highly efficient or user friendly. Furthermore, access to and interpretations of stored data are often limited by lack of standardized and detailed documentation of data structures, as is the case of some of the MN DNR LAM's research. Consequently, it became apparent that a new data management system would greatly improve the capacity to conduct research, as well as communicate and store results.

Due to the availability of sophisticated and user-friendly software, the decision was made to create an environmental mine waste management (EMWM) database for the reclamation section of the MN DNR LAM. A proposal for this purpose was submitted to the Minerals Coordinating Committee (MCC) and funding was granted for a two-year project. This final report presents progress following the second year of funding.

2. OBJECTIVES

The goal of this project is to create an efficient and user-friendly database for data management of the MN DNR LAM environmental mine waste management research data. This database will also serve as a formal, organized repository for the drainage quality prediction and mitigation research data, and allow for more efficient data management and report generation. This project will benefit the State of Minnesota and the mining industry by ensuring secure storage of the data generated over the past 25 years, as well as improves the utility and accessibility of those data.

More specific benefits resulting from the creation of a database for the MN DNR's data include:

-efficient, user-friendly data entry, retrieval, and tabulation, manipulation
-standardization and documentation of data (common units/names, data descriptions)
-improved security, storage, and organization of data

3. METHODS

The EMWM Database, funded by the Minerals Coordinating Committee, was built in Microsoft Access following a system development methodology created by Advanced Strategies, Inc. (1998). This method follows a "common sense" but disciplined approach to system development, with the belief that it should be "user centric". The process was developed incrementally following various phases that include planning, analysis, design, construction, and implementation.

3.1. Planning

The MN DNR LAM Reclamation staff and Information Systems (IS) staff met as a group to plan the EMWM database project. The objectives of the project were discussed and a project plan was developed to identify the activities and resources needed for completion of the project. At this time, roles were assigned (sponsors, project managers), and a work plan was completed to estimate project effort, and duration.

Risk assessment was essential to the EMWM Database project due to the large allocation of time and money. Project managers and sponsors produced a document identifying potential risks to the project, and a list of tentative solutions for managing these risks.

A project definition document was produced for the EMWM Database project. This document provided direction throughout the project by clearly defining the purposes and boundaries of the project. The document focused on obtaining the objectives and requirements of the project, and provided a list of criteria to measure the project's success.

3.2. Analysis

Detailed analysis of the MN DNR LAM's research was necessary in order to design a useful database. Business requirements were analyzed by group meetings, one-on-one discussions, and surveys and items were prioritized according to their level of necessity and desirability. Relevant information was then organized by a technique known as Business Object Modeling via an instrument called an entity relationship diagram (ERD). The diagram included the entities (objects) and their corresponding relationships to one another. Once the business model was completed, it was converted to conceptual and logical models by adding data structure and policy constraints, resulting in a new diagram referred to as the data structure diagram (DSD).

A project manager from the MN DNR LAM attended a four-day training session on Business Object Modeling in St. Paul, MN, and another three-day training session on Technical Database Modeling. This training provided the information necessary to properly model and design the EMWM Database.

Business process modeling, another modeling technique, was used to describe the business processes related to research and the data produced by these processes.

The final step in the analysis phase was to examine the MN DNR LAM's existing data structures. The result of this exercise was to ensure that all of the "business requirements" were accounted for in the model. Also at this time, a search took place both within the agency and outside of the agency to determine whether the project solution already existed. The search determined no previous solution existed, and the decision was made to build the EMWM database from scratch.

3.3. Design

During the design phase, the business requirements were mapped to show the actual architecture of the database tables and relationships on paper. This physical model became the blueprint for construction of the EMWM database.

3.4. Construction

After the physical model was approved, the next step was to actually build the database tables in Microsoft Access. Data verification was performed throughout the construction phase, and upon completion of the construction, a sample set of data was used to test the solution. Modifications were made to the data tables and their relationships as needed.

Referential integrity was applied to the tables to ensure the validity of the data. Customized forms were created for data input as well as a menu system for ease of use.

The database structure was documented using Microsoft Access Documenter. All tables, forms, reports, and modules were manually documented in Microsoft Access.

3.5. Implementation

Data files were examined and prepared prior to import. All files were saved in Microsoft Excel and imported directly into the database tables. Data were then updated manually using the customized input forms.

4. RESULTS

4.1. Planning

<u>Project plan</u>

In August of 2001 the Mineland Reclamation and Information Staff (IS) of the MN DNR LAM met to draft a project plan for the EMWM Database. The project plan was a guide used to ensure that tasks were completed in a timely manner and provided some accountability for these tasks. The basic objectives and scope of the project were determined, and the importance of following a method to meet these objectives was discussed (Appendix 1). A decision was made to follow a method developed by Advanced Strategies, Inc. (1998), which breaks down the development process into incrementally manageable segments (planning, analysis, design, construction, and implementation).

Next the group listed the tasks involved in creating the EMWM Database and inventoried the resources (staffing and hours) needed for such a project (Appendix 1). Some tasks in the original MN MCC work plan were modified according to the needs and resources of the group. A revised work plan was submitted to the MN MCC (Table 1). The final agenda item for the planning session was to set tentative dates (updated throughout the project) and roles for future meetings (Appendix 1, Table 2). Sponsor and project manager roles of the EMWM Database project were also assigned at this time.

Risk assessment

Because a substantial amount of resources were allocated for the project, the risks associated with the project were addressed. A meeting was held with the sponsors and project managers of the EMWM database in mid-August of 2001 to discuss risk management. A list of potential risks was created along with the impact of each risk to the EMWM Database project, the likelihood of each risk occurring, and how to cope with a risk if it materialized (Appendix 2).

Project definition

The next step in the planning process was to conduct a project definition session. This meeting took place in late August of 2001.

The objectives of a project definition are to:

1. define the purposes and boundaries of the project
2. agree to a common understanding of what the project is and is not
3. deliver a document that provides direction and criteria to measure the project's success.

The initial step of the project definition session was to list the wants and needs of the group as they related to the EMWM database. Next, the intentions and expectations of the project were listed. Details of these lists are located in the Project Definition Document (Appendix 3).

The final step of the session documentation was to define the focus statement. An outline was constructed showing the organizational breakdown of reclamation research related data collected within the Division of Lands and Minerals. The group decided that only non-ferrous projects that were currently in progress (some with 14 years of data) and new experiments would be included in the EMWM Database. Data from these projects included, aqueous phase data (drainage quality), solid phase data, and other experimental information from both laboratory and field settings, involving both prediction and mitigation type experiments.

4.2. Analysis

The analysis phase of a project focuses on defining the business requirements/needs (the "what") in greater detail, but does not address the solution to these needs. Detailed analyses of the user's needs and the information to be stored in the database were conducted to ensure the utility of the end product. Therefore, the initial funding year of the EMWM Database was spent primarily on the analysis portion of the project.

Analysis of the EMWM Database was initiated during the project planning and project definition sessions. A preliminary business object model, in the form of an entity relationship diagram (ERD), was created to reflect the real world business of the MN DNR LAM research (Figure 1). Entity relationship diagrams portray the objects (entities) of the "real world", and their relationships to each other. The group determined that the diagram accurately reflected reclamation research needs, and determined the relevant information to the EMWM database as stated by the project the focus. Revisions were made to sections of the ERD during the meeting, while other topics were put on hold for further discussion.

The next step of business object modeling was to complete meta data forms for the ERD. The meta data forms included definitions of data (or data about data) that would be available to anyone accessing the EMWM database. A single form was completed for each entity represented in the ERD, and included a list of all relationships and attributes (name, data type, definitions) associated with that entity (Table 3).

Early in the analysis stage, the group decided to search for a pre-existing database that would fit the needs of the MN DNR LAM. The U.S. Environmental Protection Agency (EPA) developed STORET, a database used by many agencies for data management. While STORET may be used as a standalone database, it also has the ability to download batches of data to an EPA website for accesses to anyone with internet connections. The Minnesota Pollution Control Agency in St. Paul uses STORET and provided a demonstration of the software's capabilities to the MN DNR LAM. After viewing the demonstration, it was determined that STORET would not be a suitable option for the storage of the MN DNR's data. STORET is designed primarily for field activities, whereas much of the MN DNR's research is conducted in a laboratory setting. Also, STORET was not ideal for manual input due to the extensive navigation of windows necessary for data input. Finally, STORET was lacking in mineralogy definitions necessary for the solid phase data collected by the MN DNR LAM. A decision was made to develop a database specifically for the needs of the MN DNR LAM.

Many hours were spent on analyses of the MN DNR LAM's data and numerous iterations of modeling the business needs. Several small and large group discussions and conference calls took place over time to discuss sections of the business object model (Table 4). At each meeting, new and old issues were addressed and the ERD was modified accordingly.

Furthermore, the existing data structures containing the current mine waste characterization research data were examined. Detailed lists including the parameters measured and sample units represented were tabulated. These details provided information to the business requirement section and were also useful when it came time to populate the database. Some preliminary tests of software compatibility were run at this time, and notes were recorded on problems and possible solutions (Appendix 4).

4.3. Design

The design phase converts the business requirements into a blueprint used to construct the database. After extensive analysis and revisions were made to the business object model, it was converted to conceptual and logical models by adding data structure and policies to the ERD (January to February 2002). The DSD, representing the conceptual/logical models, went through many iterations which were based on input from the group discussions (Figure 2). The final conversion from a logical to a physical model took place in February of 2002, and further iteration provided a physical design that was approved for construction.

The decision to build the database in Microsoft Access was made during a March (2002) meeting of the project managers and information systems staff. Access was chosen because it was readily available to MN DNR staff. Other software options, such as Oracle, were discussed and ultimately declined based on the lack of proper hardware or extensive technical support.

4.4. Construction/Data Input

Database construction

Soon after the March meeting, construction of the database began. Over the next few months, tables and their corresponding relationships were built according to the physical model (Figure 3). Project and experimental data tables were created first, then the aqueous-phase related (drainage quality) tables were built. Testing took place throughout the construction process and modifications were made to the tables and their relationships as needed. Time allowed for the construction of solid phase tables, however, difficulties in synchronizing disparate waste characterization data required further examination. Focus returned to the drainage quality data as it accounts for the majority of the LAM research.

Data import

While the data tables were being constructed in Access, existing LAM drainage quality data files were being prepared for import. Data verification was necessary prior to import of these files to ensure that proper data format and parameter units were used. Older experiments took longer to prepare for import. Some experiments contained up to 14 years of data, and had been conducted by different researchers. Additionally, some parameters included lab QA reruns or converted data. LAM drainage quality data files were saved as Excel files and imported into the database tables. Once imported, the data were printed and checked for import errors.

To date, drainage quality data from 15 laboratory experiments and field tests (~48,000 records) have been imported into the EMWM Database. These projects are those presently in progress and all data have been updated through at least March of 2003 (Table 5). Other experimental data have been manually input along with solid-phase data for approximately half of the experiments.

Referential integrity

Referential integrity creates more reliable databases and guarantees the validity of data by using a system of cross-referencing. This system of rules ensures the validity of relationships between records in related tables, and prevents data from being accidentally changed or deleted. Referential integrity was applied to the EMWM Database, and all relationships between tables and other database objects in the EMWM database have been implemented according to the database model (Figure 3).

Documentation

To date, all of the database structure has been completely documented in detail with Microsoft Access Documenter, resulting in five external text files with 2,545 total pages.

Also, 66 macros, 1 module, 22 reports, 65 forms, 75 queries and 50 tables have been documented manually with a description of how they fit into the database application (see Table 6 for glossary of terms). This description is visible in the database window in Microsoft Access (Figure 4).

User-friendliness

Customized data input forms were created for easy input of data. Figure 5 shows the input screen used to enter drainage quality data collected by the LAM personnel (laboratory and field parameters). Figure 6 shows the form used to enter drainage quality results after the sample is analyzed by a contract laboratory. An application was created to place individual sample numbers that were entered into the first form automatically into the second form. This step eliminates the need to re-enter shared data into two different forms.

A menu-driven interface system was created to improve the user-friendliness of the EMWM database. Figure 7 shows the main page organized with buttons pertaining to specific sections of the database such as input forms, report templates and applications that run routine calculations. Clicking on one of these buttons takes the user directly to a specific section of the database, and in so doing eliminates esoteric operator knowledge and improves efficiency. Figure 7 portrays the data input level of the menu system.

Report tabulation/Data manipulation

Report templates of tabulated drainage quality data were created for each of the 15 experiments (Table 7). These templates will automatically update as new drainage quality data are entered into the EMWM Database. This function will ultimately save time during report generation.

Modules and queries were developed for some routine data manipulations and calculations. Fine-tuning of one major routine for data conversion is currently being accomplished. This particular application, which is used for filling in null values, is essential to many of the routine calculations used by MN DNR LAM.

LAM uses SYSTAT software to create graphics for annual reports. It was necessary to purchase an upgrade to this software that contained ODBC drivers. These built-in drivers allow SYTAT to link directly to the EMWM Database.

Non-digital to Digital

LAM often receives results that are not in an electronic format and are therefore difficult to include into annual reports. Optical character recognition software (OmniPage Pro 12 Office) was purchased to allow conversion of non-digital documents to Microsoft Word or other formats (pdf, jpeg). An image is scanned into the computer and with the aid of this software, modification of the image can be made (such as adding report headings). It is important to note that this software does not have the capability to take data from an image and place it directly into database tables. Once an image is saved, it can be accessed or referenced by the EMWM Database. A number of solid-phase analyses results have already been converted into an electronic format for easy inclusion into the MN DNR LAM's annual reports.

4.5. Implementation

Initially, the EMWM Database was only available to the project managers (1 Reclamation staff, 1 IS staff). In 2003, one data entry person was trained to enter data into the drainage quality section of the database. Training of other individuals will occur later in 2003 after fine-tuning of the menu-driven system is completed. An important aspect of fine-tuning the EMWM Database is the application of security measures to prevent unauthorized operators access to critical database functions.

5. SUMMARY

According to the MN MCC work plan, the EMWM Database project has fulfilled the requirements listed for FY 01-03. The EMWM Database has been built in Microsoft Access, and drainage quality data (prediction and mitigation) from the 15 current non-ferrous laboratory and field experiments have been entered.

Additional applications and capabilities were developed to improve the user-friendliness of the EMWM Database and improve efficiency of the report generation process. Navigation within the EMWM Database was made easier by the creation of a layered menu system, and data entry was simplified by the creation of customized data input forms. Applications have been created for some routine calculations used in data analysis, and self-updating report templates were produced to aid in generating report tables. This project has been successful in that it fulfills many of the wants and needs stated in the planning phase of the project. However, there are many improvements and modifications that would further increase the value of the EMWM Database.

While no future funding is available from MCC to work on the EMWM Database, the MN DNR is providing limited funding for personnel to continue improving the database and input new data. Tasks for future work may include:

-streamlining interface to contract lab software for efficient drainage quality data import
-finish developing the remaining calculations and adding them to the menu system
-streamlining interface procedures for graphing with other software such as SYSTAT and Excel
-develop remaining report summary tables and adding them to the menu system
-scanning/converting non-digital results to Word or pdf format, and make accessible to the database
-continue data input/import of new data

A final improvement to the EMWM Database would be the addition of data from the earlier experiments, along with the remaining solid phase data. This would not only provide secure storage and improved organization of this data, but would allow for a broader data set from which to draw upon for future analyses. Ultimately, this would allow the MN DNR LAM Reclamation section to more efficiently correlate drainage quality prediction data with solid phase data for use as a prediction tool in environmentally sound mine waste management.

6. ACKNOWLEDGMENTS

Minnesota Minerals Coordinating Committee provided funding for the EMWM Database project. Participants from the MN DNR Division of Lands and Minerals providing expert advice included: Kim Lapakko, Dave Antonson, Anne Jagunich, Jennifer Engstrom Jon Wagner, John Folman, and Paul Eger. Dale Cartwright, Perry Canton, Larry Swenson, Mike Jordan, and Jill Bornes provided Information System support. Mr. Lapakko, Mr. Antonson, and Mr. Canton also filled the roles of sponsors, and Mr. Cartwright provided project management support as well as construction and documentation of the database structure and applications.

7. REFERENCES

Advanced Strategies, Inc. 1998. Business Data (Object) Modeling: Emphasizing Entity/Relationship Diagramming. Advanced Strategies, Inc., Atlanta Georgia. p. I-5.

Lapakko, K.A., Antonson, D.A., Leopold, E.M., Berndt, M..E. 2001. Mine Waste Characterization and Drainage Mitigation. Research Summary 2001. MN Department of Natural Resources, Division of Lands and Minerals, St. Paul, MN. 58 p.

Table 1. EMWM Database work plan (MCC FY 01-03 Biennial Project work plans)

Project Name: Environmental Mine Waste Management Database				
Proposer: Kim Lapakko			Amount Requested: $46,000/2 yr	
Staff Name	Project Analyst	Anne Jagunich	Dave Antonson	Kim Lapakko
% Time	50	5	5	5

Project Description: During the past 25 years the State of Minnesota has spent in excess of $3 million on research examining the environmentally sound management of mine wastes. Numerous studies have been conducted and reported. Within roughly the last five years, fairly sophisticated database software has been developed and its application has increased. Development of a database and entry of existing data will *allow more efficient data management and report production*, ~~not only~~ secure existing and future data, ~~but also~~ *and* increase their value to the MN DNR, the mining industry, and others interested in the environmentally sound management of mine waste.

Project Benefits: The project will benefit the State of Minnesota and the mining industry by ensuring secure storage of data generated over the past 25 years, as well as the utility and accessibility of those data.

Specific Results and Products: By 30 June 2002, the database will be constructed ~~and data on drainage quality prediction will be entered~~. A status report will be issued at this time. From July 2002 through April 2003, data on *drainage quality prediction and* mitigation *of problematic drainage projects presently in progress* will be entered. A final report describing the contents and application of the database will be issued at the end of the project.

Action Plan Description (Task List)	Beg. Date	End Date
1. Finalize database design for drainage quality prediction data	7/1/01	6/30/02
2. Produce interim report	6/1/02	6/30/02
3. Enter prediction data, conduct verification testing	7/1/02	1/1/03
4. Enter mitigation data, conduct verification testing	1/1/03	6/1/03
5. Produce final report	6/1/03	6/30/03

Project Budget: $46,000	Mineral Diversification Funding	Other Funding
Personnel: $43,000	$43,000	0
Travel		
Supplies		
Equipment		
Other (training): $3,000	$3,000	
Other		
Total: $46,000	$46,000	0

Table 2. Time line of EMWM Database tasks (FY 01- FY 03).

Task	Start date	End date
Planning Meeting	8/8/01	8/8/01
Risk Management Meeting	8/22/01	8/22/01
Project Definition Meeting	8/29/01	8/29/01
Business Data Modeling - ERD	10/3/01	1/9/02
Add cardinality to ERD	11/1/01	11/7/01
Send ERD to St. Paul IS	1/31/02	1/31/02
Revise ERD Documentation	1/21/02	2/11/02
Technical Modeling	7/15/01	7/23/01
Technical Model Review Period	7/23/01	7/31/01
Process Modeling	11/9/01	1/31/02
Existing Database - Identify Files	10/1/01	2/28/02
Physical Data Model	10/1/01	2/28/02
-Existing Database Testing	10/1/01	6/28/02
-Test and analysis Existing Applications	2/19/02	3/19/02
Interface with Systat and MDA database	2/4/02	3/29/02
Convert Object Model to Conceptual Model	1/15/02	1/22/02
Convert Conceptual Model to Physical Model	2/13/02	2/28/02
Choose Software	3/2/02	3/2/02
Make Tables	1/1/02	6/30/02
MCC Interim Report	6/3/02	6/28/02
Testing	6/30/02	6/30/03
Data input and import	8/1/02	3/15/03
Data verification prior to and after import	7/1/02	3/30/03
Data update	12/30/02	6/15/03
Application set-up and testing	1/1/03	6/30/03
MCC Final Report	6/1/03	6/27/03

Table 3. Example of meta data form for the EMWM Database.

Entity Name	Reactor
Entity Type	Supertype
Primary Keys	
Definition	The reaction vessel/container used in an experiment that houses the unleached reactant sample. The experimental materials/methods/design section of a report will describe in more detail the material used in a reactor.

Notes

Attributes

Attribute/Role Name	**Data Type**	**Null**	**Definition**
Reactor Type	Text	No	Is it a cell, column, reactor, tank, bin, wetland
Reactor Tare Weight	Numeric	No	Weight of empty reaction vessel
Reactor Height	Numeric	No	Height dimension of reactor
Reactor Length	Numeric	No	Length dimension of a reactor
Reactor Width	Numeric	No	Width dimension of a reactor
Reactor Diameter	Numeric	No	Diameter of a column type reactor

Relationship

Relationship	**Notes**
Reactor + Reactant consists of Unleached Reactant sample	

Table 4. Time line of EMWM Database meetings.

Date	Meeting/Activity	Location	Participants	Outcome
8/7/2001	Project Planning Meeting	Hinckley	Reclamation IS Staff	work plan
8/22/2001	Risk Assessment Meeting (small group)	Tele-conference	Reclamation IS Staff	identified risks and determined courses of action
8/29/2001	Project Definition Meeting (large group)	FDLC - Cloquet	Reclamation IS Staff	Project Definition Document
9/19/2001	EMWM Project Update (small group)	Tele-conference	Project Managers IS Staff	project update
10/25/2001	ERD update (small group)	Hibbing	Reclamation	revisions to ERD
10/26/2001	ERD update/prep (small group)	Tele-conference	Project Managers IS Staff	revisions to ERD
10/29/2001	EMWM ERD Meeting (large group)	St. Paul	Reclamation IS Staff	revisions to ERD
11/7/01	EMWM ERD Cardinality (small group)	Hibbing	Reclamation IS Staff	ERD with cardinality
11/29/01	EMWM Project Update (small group)	Hibbing	Project Managers IS Staff	project update and revisions to ERD
12/5/01	EMWM Meeting (small group)	Hibbing	Project Managers Reclamation Staff	follow up with SME's and revisions to ERD

Table 4. Time line of EMWM Database meetings (continued).

Date	Meeting/Activity	Location	Participants	Outcome
1/9/02	EMWM Project Update (small group)	Hibbing	Project Managers IS Staff	project update and final revisions to ERD, convert to DSD
2/13/02	EMWM Project Update (small group)	Hibbing	Project Managers IS Staff	revision's to DSD convert to physical model
3/2/02	EMWM Meeting (large group)	St. Paul	Project Managers IS Staff	follow-up with IS Staff decision on software to use
11/14/02	EMWM Project Update (small group)	Hibbing	Project Managers Sponsor	project update, discussion of future work
7/02 – 3/03	One on One Discussions	Hibbing	Project Managers	revisions, decisions, and updates regarding database

Table 5. EMWM Database drainage quality data import status.

Experiment	Imported	Current Week #/Year	Last Update (week #/date)			
			Lab	SO_4	Metals	# Records
WGA Humidity	yes	618 (3/6/03)	618	615	600	5,475
WGA ET	yes	405 (term)	405	405	405	1,929
Particle Size	yes	483 (3/6/03)	480	467	467	7,785
High %S	yes	741 (4/29/03)	741	734	734	13,818
Cominco Tech	yes	54 (3/4/03)	50	32	40	409
Greenstone Lab	yes	162 (3/5/03)	157	154	154	2,826
Greenstone Prediction Field	yes	10/28/02	10/28/02	10/28/02	10/28/02	109
Limestone Add Field	yes	10/28/02	10/28/02	10/28/02	10/28/02	138
Microencapsulation	yes	102 (5/1/03)	102	80	98	1,134
Alternative encapsulation	yes	10/10/02	10/10/02	10/10/02	10/10/02	1,394
Non-ferrous Columns	yes	306 (1/8/03)	306	306	298	1,808
Non-ferrous Field Tanks	yes	290 (4/17/03)	290	290	277	975
Non-ferrous Weekly	yes	664 (3/6/03)	664	660	660	1,973
Alkaline Addition	yes	779 (4/22/03)	779	721	755	7,159
Soudan Columns (10N)	yes	8/97 - 12/12/02	12/12/02	12/12/02	12/12/02	261

Table 6. Glossary of terms.

Term	**Definition**
Form	A database object on which you place controls for entering, displaying, and editing data.
Macro	A series of commands stored as a group, so they can be treated as a single command
Module	A collection of Visual Basic Applications for declarations and procedures that are stored together as a unit
Query	A database object that represents the group of records you want to view. A query is a request for a particular collection of data.

Table 7. EMWM report template of a drainage quality table.

Microsoft Access - [Greenstone Results Proofing Report]

File Edit View Tools Window Help

100% Close

Page 1 of 7.

Table A4. 7. Drainage Quality from 0.05 % sulfide Archean greenstone rock (0.05% sulfur, <0.05% CO_2, cell 2).

Concentrations are in mg/L unless otherwise noted. pH is in standard units. Blank indicates no analysis. * indicates anomalous value.

Week	Volume (mL)	Eh	pH	Alk	Acy	S.C. (µS/cm)	Si	SO_4	Ca	Mg	Na	K	Fe	Al	Mn	Co	Cu	Ni	Zn
0	1319		7.32			37.0	0.60	2.87	0.190	0.060	4.250	4.090	0.010						
1	483		7.60	10.0		42.0	1.59	4.00	0.500	0.200	3.900	6.000	<0.002	0.079	<0.002				
2	486		7.54	7.5		30.0	1.78	3.90	0.400	0.200	2.500	4.400	<0.002	0.054	<0.002				
3	484		7.50	7.5		23.0	1.82	3.40	0.400	0.200	1.900	4.300	<0.002	0.031	<0.002				
4	476		7.44	<5.0		21.0	1.98	2.80	0.400	0.100	1.300	4.300	<0.002	0.047	<0.002				
5			7.63			20.0													
6			7.53	5.0		22.0		2.50	0.400	0.200	0.700	4.200	<0.002	0.043	<0.002				
7			7.23			17.0													
8			7.33	5.0		19.0		2.10	0.400	0.100	0.400	3.900	0.004	0.029	<0.002				
9	487		7.29			18.0													
10	487		7.37	<5.0		15.0		1.70	0.400	0.200	0.200	2.900	0.002	0.029	<0.002				
11	488		7.26			15.0													
12	487		7.29	<5.0		16.0		2.10	0.460	0.220	0.180	2.540	<0.002	0.035	<0.002	<0.002	0.004	<0.002	<0.002
13	484		7.18			15.0													
14	487		7.36	<5.0		13.0		2.31	0.460	0.220	0.120	2.620	<0.002	0.022	<0.002				
15	495		7.06			12.5													
16	495		7.54	5.0		14.0		1.60	0.620	0.290	0.116	1.990	<0.002	0.026	<0.002				
17	496		7.15			12.5													
18	496		7.33	<5.0		12.0		1.50	0.650	0.300	0.096	1.880	<0.002	0.019	<0.002				

Orthophosphate concentrations were less than the detection limit of 0.01 ppm and were eliminated from this table.

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Ready NUM

Figure 1. EMWM Database Business Object Model (ERD)

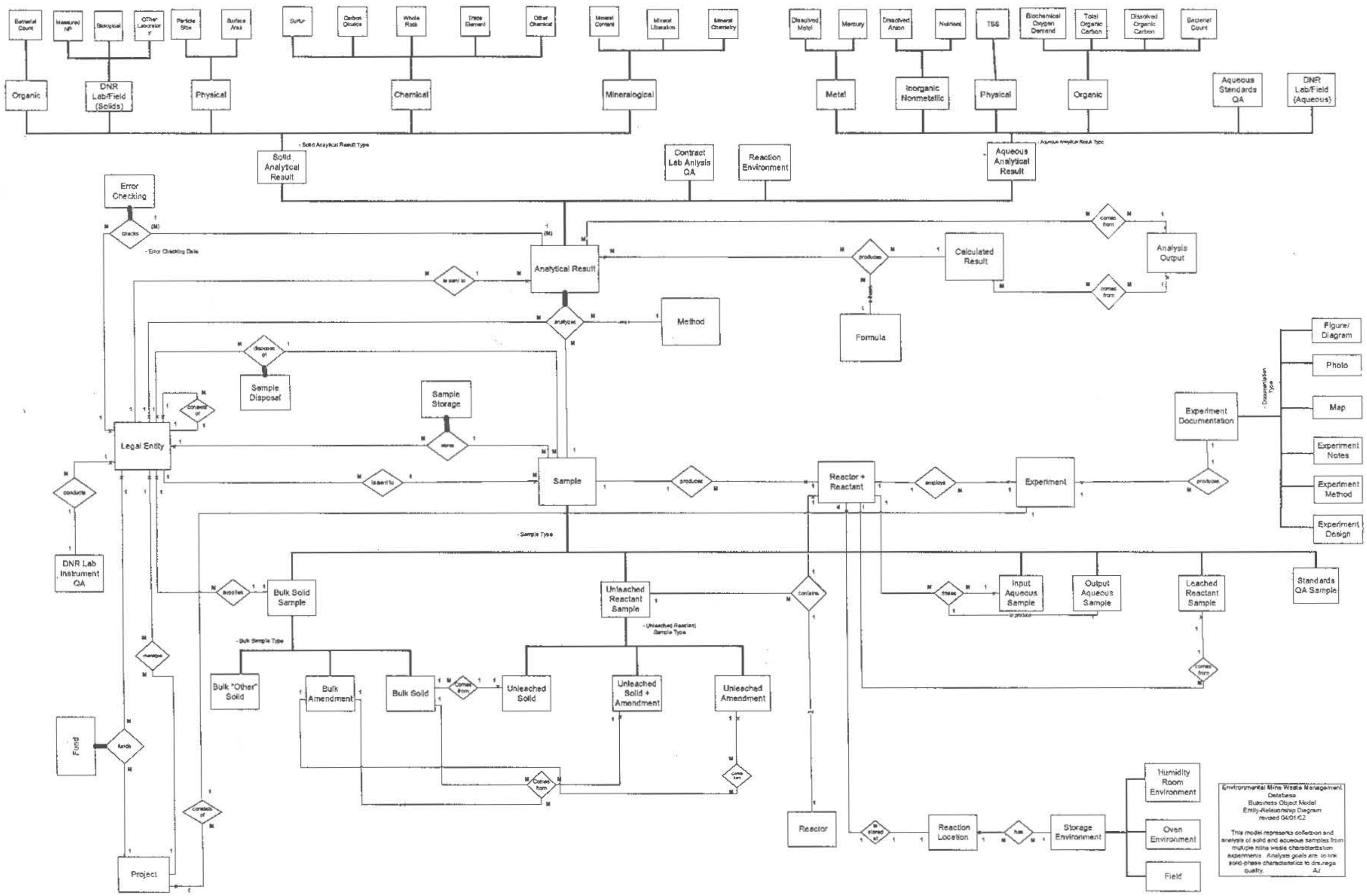


Figure 2. EMWM Database Conceptual/Logical Model (DSD).

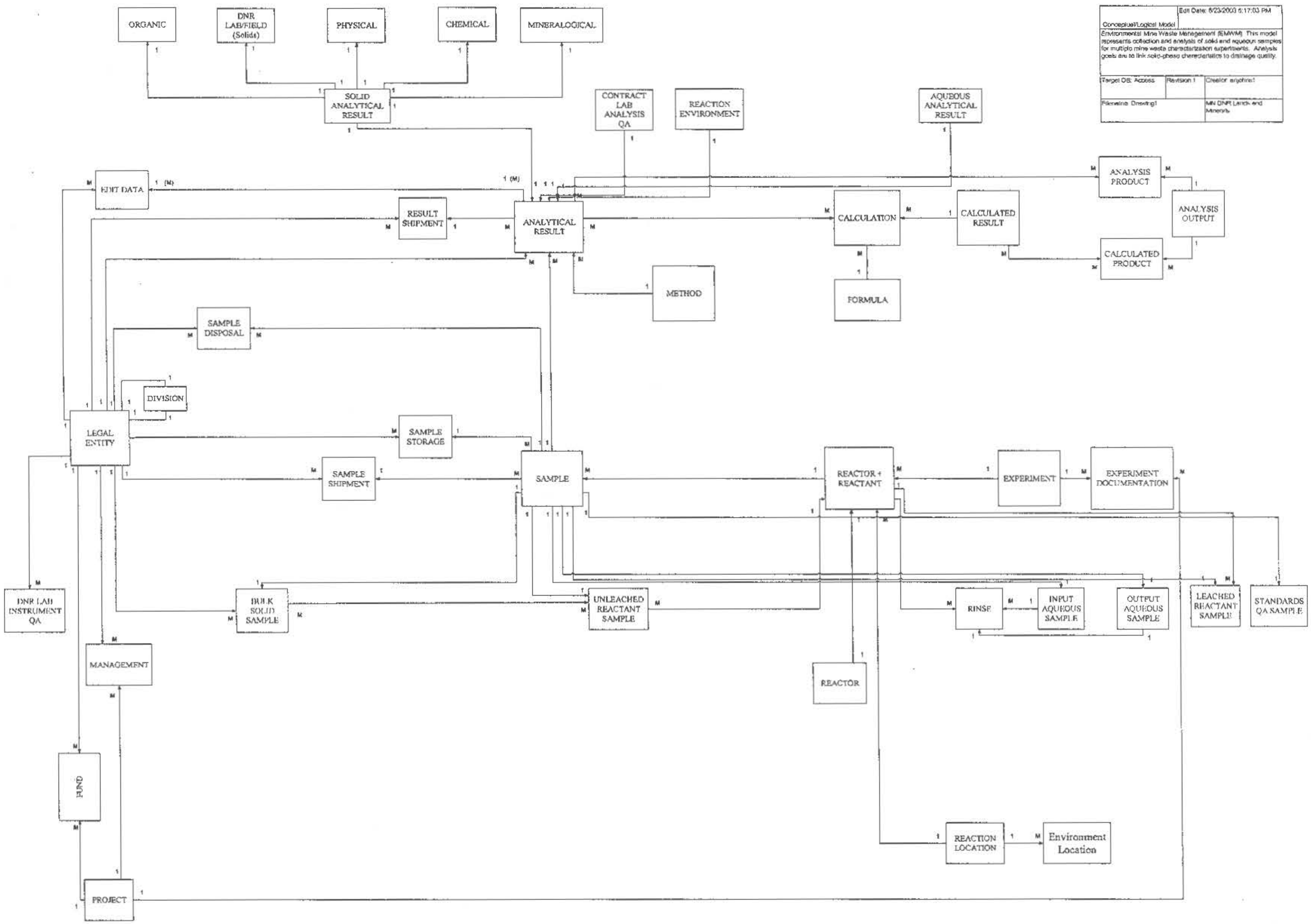


Figure 3. EMWM Database Physical Model showing tables and relationships.

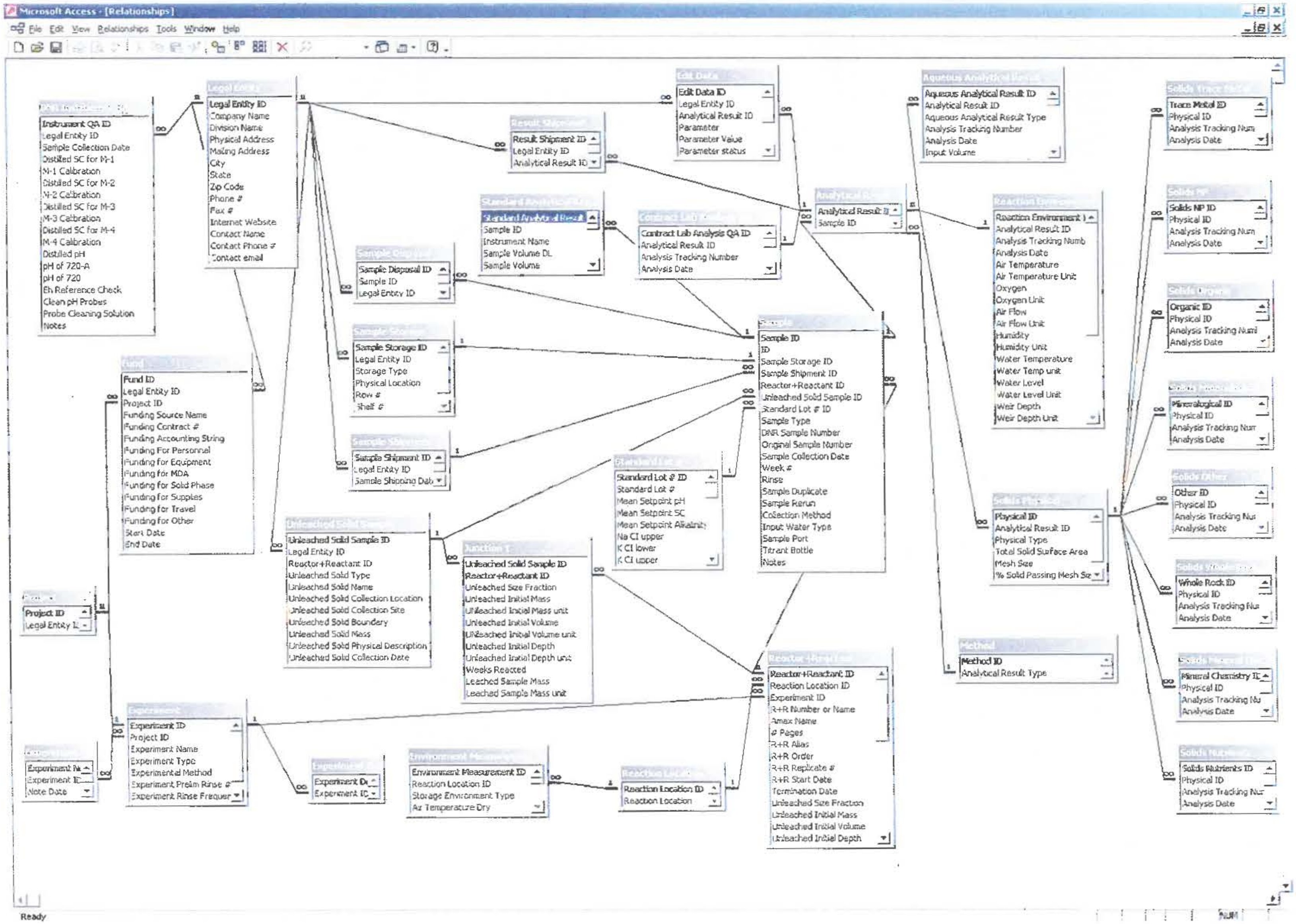
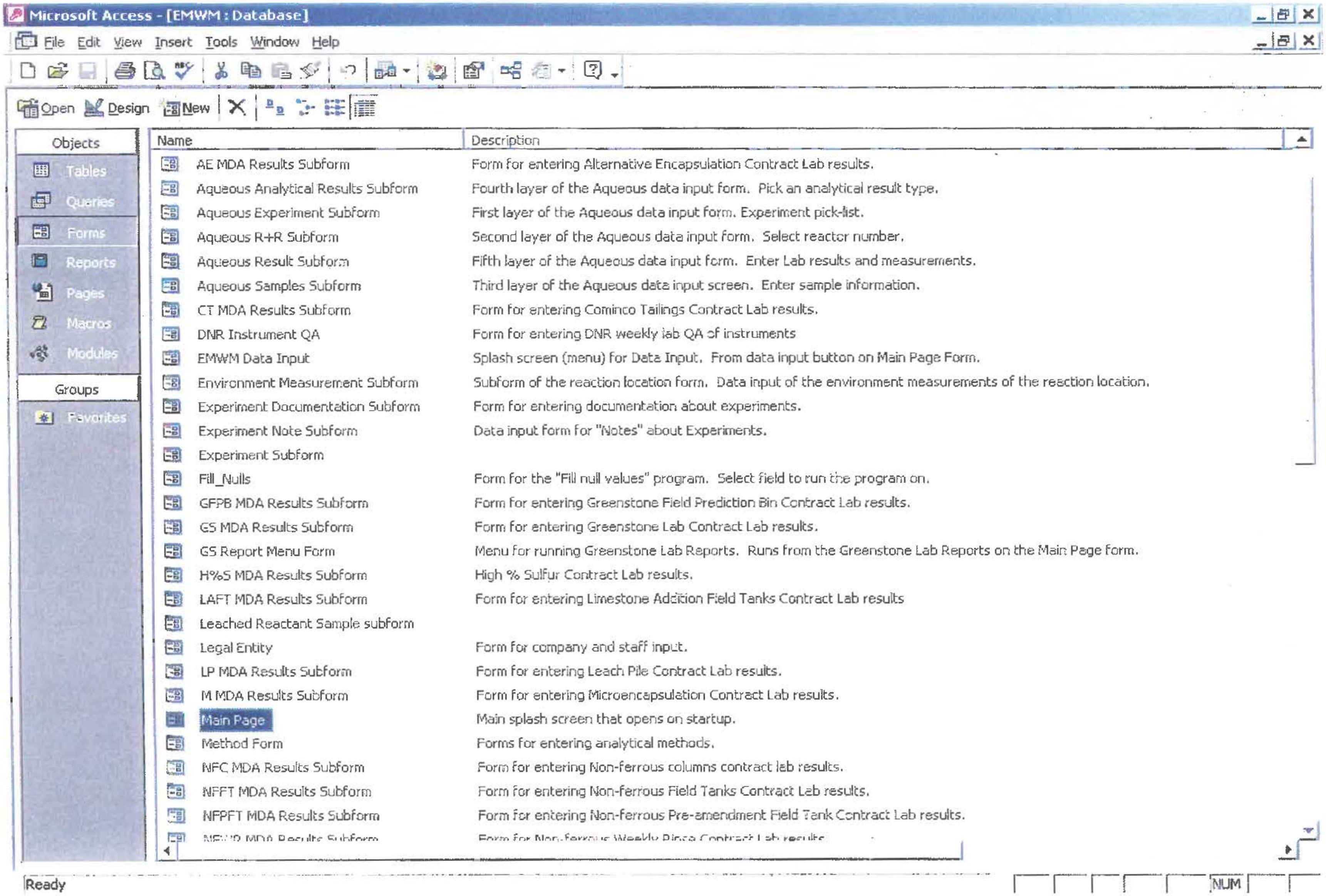


Figure 4. Documentation of forms in the EMWM Database.



Name	Description
AE MDA Results Subform	Form for entering Alternative Encapsulation Contract Lab results.
Aqueous Analytical Results Subform	Fourth layer of the Aqueous data input form. Pick an analytical result type.
Aqueous Experiment Subform	First layer of the Aqueous data input form. Experiment pick-list.
Aqueous R+R Subform	Second layer of the Aqueous data input form. Select reactor number.
Aqueous Result Subform	Fifth layer of the Aqueous data input form. Enter Lab results and measurements.
Aqueous Samples Subform	Third layer of the Aqueous data input screen. Enter sample information.
CT MDA Results Subform	Form for entering Cominco Tailings Contract Lab results.
DNR Instrument QA	Form for entering DNR weekly lab QA of instruments
EMWM Data Input	Splash screen (menu) for Data Input. From data input button on Main Page Form.
Environment Measurement Subform	Subform of the reaction location form. Data input of the environment measurements of the reaction location.
Experiment Documentation Subform	Form for entering documentation about experiments.
Experiment Note Subform	Data input form for "Notes" about Experiments.
Experiment Subform	
Fill_Nulls	Form for the "Fill null values" program. Select field to run the program on.
GFPB MDA Results Subform	Form for entering Greenstone Field Prediction Bin Contract Lab results.
GS MDA Results Subform	Form for entering Greenstone Lab Contract Lab results.
GS Report Menu Form	Menu for running Greenstone Lab Reports. Runs from the Greenstone Lab Reports on the Main Page form.
H%S MDA Results Subform	High % Sulfur Contract Lab results.
LAFT MDA Results Subform	Form for entering Limestone Addition Field Tanks Contract Lab results
Leached Reactant Sample subform	
Legal Entity	Form for company and staff input.
LP MDA Results Subform	Form for entering Leach Pile Contract Lab results.
M MDA Results Subform	Form for entering Microencapsulation Contract Lab results.
Main Page	Main splash screen that opens on startup.
Method Form	Forms for entering analytical methods.
NFC MDA Results Subform	Form for entering Non-ferrous columns contract lab results.
NFFT MDA Results Subform	Form for entering Non-ferrous Field Tanks Contract Lab results.
NFPFT MDA Results Subform	Form for entering Non-ferrous Pre-amendment Field Tank Contract Lab results.

Figure 5. Data input form for drainage quality data.

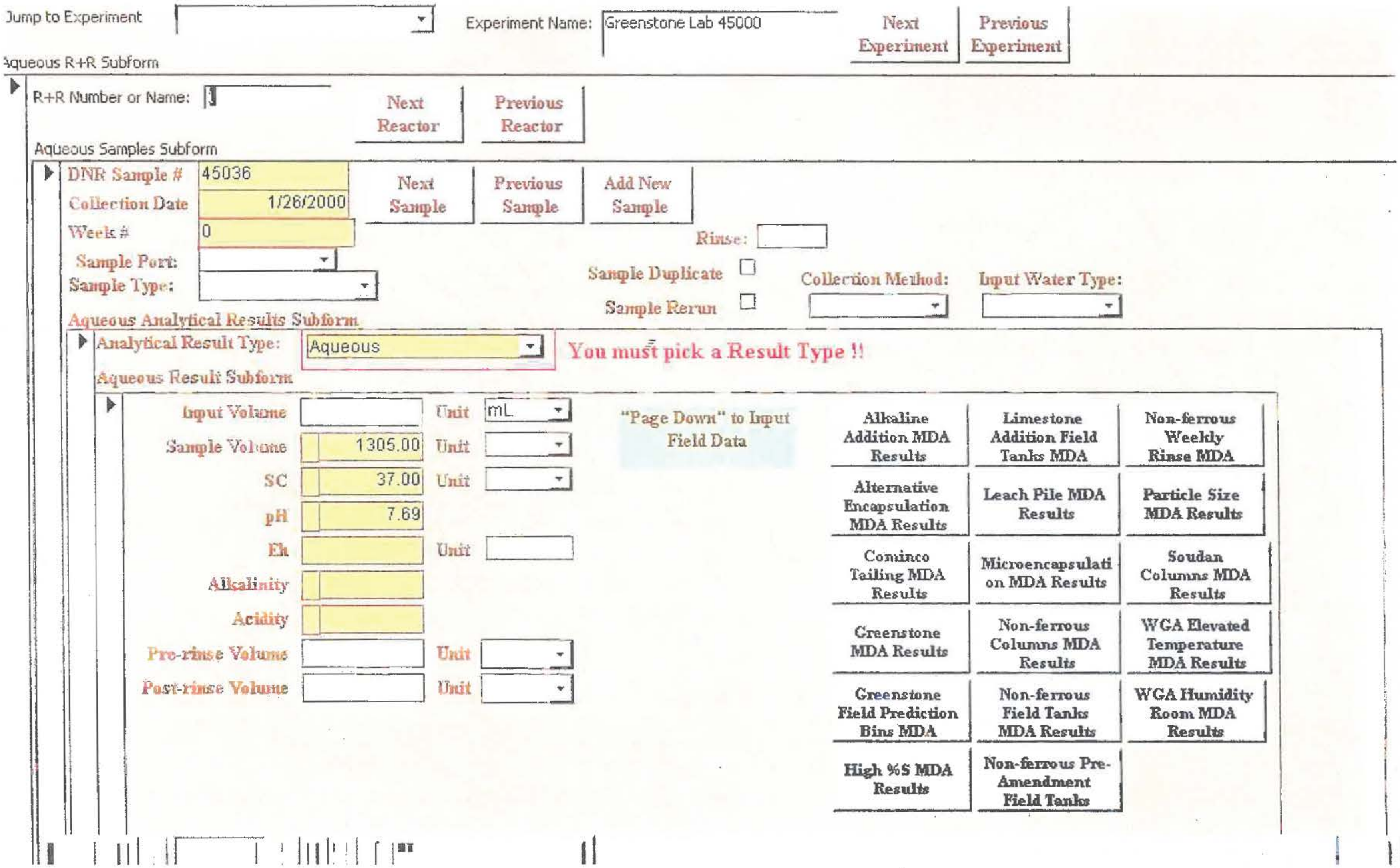
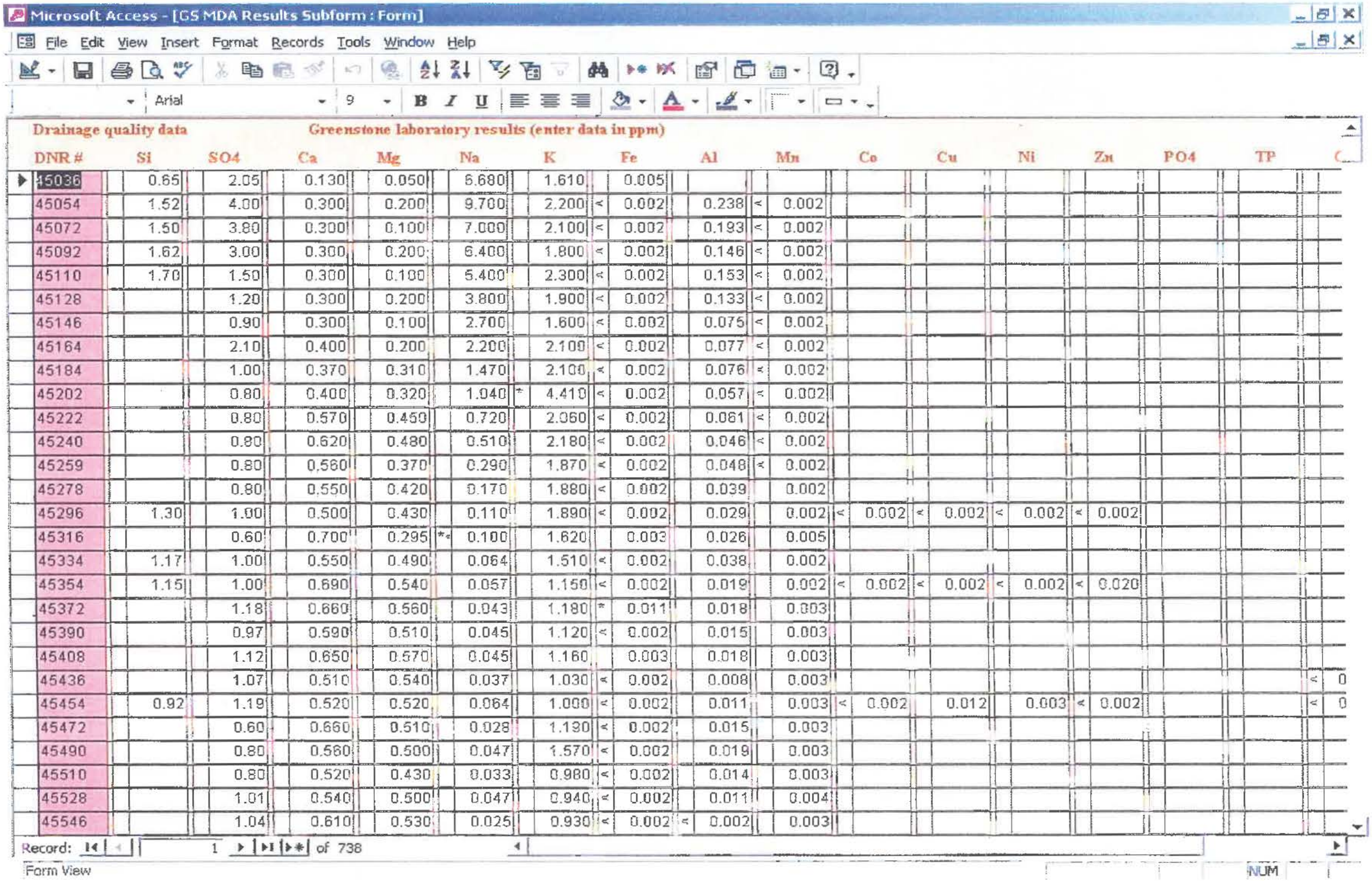


Figure 6. Data input form for drainage quality results from contract laboratories.



Drainage quality data		Greenstone laboratory results (enter data in ppm)														
DNR #	Si	SO4	Ca	Mg	Na	K	Fe	Al	Mn	Co	Cu	Ni	Zn	PO4	TP	(
45036	0.65	2.05	0.130	0.050	6.680	1.610	0.005									
45054	1.52	4.00	0.300	0.200	9.700	2.200	< 0.002	0.238	< 0.002							
45072	1.50	3.80	0.300	0.100	7.000	2.100	< 0.002	0.193	< 0.002							
45092	1.62	3.00	0.300	0.200	6.400	1.800	< 0.002	0.146	< 0.002							
45110	1.70	1.50	0.300	0.100	5.400	2.300	< 0.002	0.153	< 0.002							
45128		1.20	0.300	0.200	3.800	1.900	< 0.002	0.133	< 0.002							
45146		0.90	0.300	0.100	2.700	1.600	< 0.002	0.075	< 0.002							
45164		2.10	0.400	0.200	2.200	2.100	< 0.002	0.077	< 0.002							
45184		1.00	0.370	0.310	1.470	2.100	< 0.002	0.076	< 0.002							
45202		0.80	0.400	0.320	1.040	* 4.410	< 0.002	0.057	< 0.002							
45222		0.80	0.570	0.450	0.720	2.060	< 0.002	0.061	< 0.002							
45240		0.80	0.620	0.480	0.510	2.180	< 0.002	0.046	< 0.002							
45259		0.80	0.560	0.370	0.290	1.870	< 0.002	0.048	< 0.002							
45278		0.80	0.550	0.420	0.170	1.880	< 0.002	0.039	0.002							
45296	1.30	1.00	0.500	0.430	0.110	1.890	< 0.002	0.029	0.002	< 0.002	< 0.002	< 0.002	< 0.002			
45316		0.60	0.700	0.295	*< 0.100	1.620	0.003	0.026	0.005							
45334	1.17	1.00	0.550	0.490	0.064	1.510	< 0.002	0.038	0.002							
45354	1.15	1.00	0.690	0.540	0.057	1.150	< 0.002	0.019	0.002	< 0.002	< 0.002	< 0.002	< 0.020			
45372		1.18	0.660	0.560	0.043	1.180	* 0.011	0.018	0.003							
45390		0.97	0.590	0.510	0.045	1.120	< 0.002	0.015	0.003							
45408		1.12	0.650	0.570	0.045	1.160	0.003	0.018	0.003							
45436		1.07	0.510	0.540	0.037	1.030	< 0.002	0.008	0.003							< 0
45454	0.92	1.19	0.520	0.520	0.064	1.000	< 0.002	0.011	0.003	< 0.002	0.012	0.003	< 0.002			< 0
45472		0.60	0.660	0.510	0.028	1.130	< 0.002	0.015	0.003							
45490		0.80	0.560	0.500	0.047	1.570	< 0.002	0.019	0.003							
45510		0.80	0.520	0.430	0.033	0.980	< 0.002	0.014	0.003							
45528		1.01	0.540	0.500	0.047	0.940	< 0.002	0.011	0.004							
45546		1.04	0.610	0.530	0.025	0.930	< 0.002	< 0.002	0.003							

Figure 7. Main menu for EMWM Database.

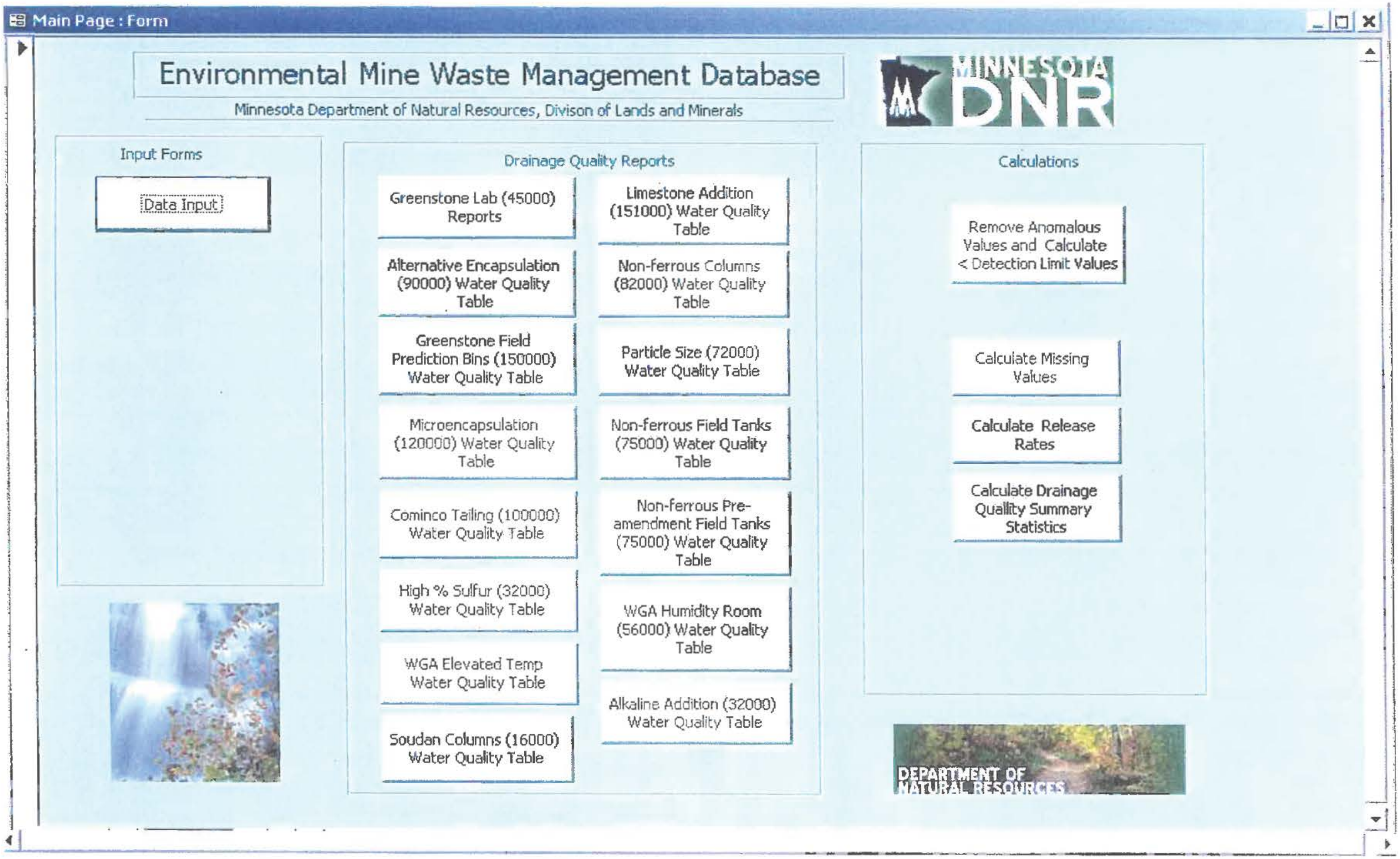
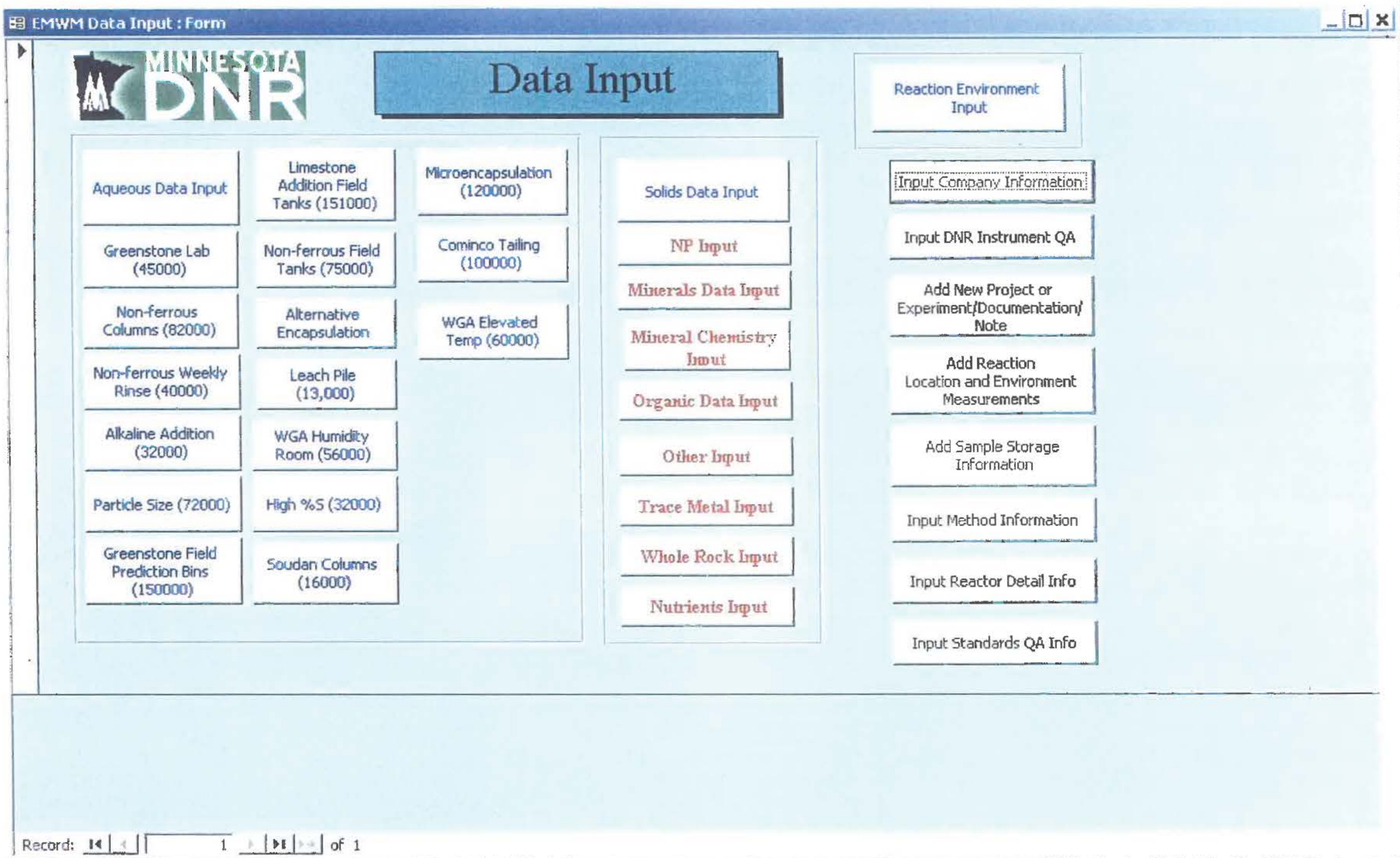


Figure 8. Data input menu for EMWM Database.



APPENDIX 1

EMWM DATABASE
PROJECT PLANNING MEETING AND DOCUMENTATION

Meeting notes: **Environmental Mine Waste Management Database Planning Mtg**

Date:7 August 2001

Attendees:
Mike Jordan, Jill Bornes, Kat Stafford, Larry Swenson, Perry Canton, Dave Antonson, Anne Jagunich, Dale Cartwright, Andrea Johnson

Agenda:

1. Project Plan
    - Tasks
    - Resources Needed
        - Number of staff involved
        - Hours and Time Line
2. Setup Project Definition Session
    - Attendees
    - Preliminary Discussion on Project
3. Project Lead
    - Responsibilities (Plan , Organize, Control, Lead)
    - Reporting Functions (when and to whom)

Project Plan (revised)

Analysis:

Project Definition:
- Pains
- Pleasures
- Stakeholders
- Hopes
- Intentions
- Consequences of Doing nothing
- Values
- Focus Statement
    - Breadth (includes/postpone/excludes, from/until)
    - Scope of Integration
    - Perspective
    - Detail
    - Universality
    - Elevator Intentions

Business Object Model (Business Driven, User Centric)
- Information Needs (Rules, Policies, Processes, Security Needs)

ERD (Entities, Relationships, Attributes)
Flexible
Stable
Navigable
Capable of answering unanticipated questions (Normalized)

Business Process Modeling
DFD (Data Flow Diagram)

Event Modeling

Location Analysis

Risk Assessment

Change Management

Existing Data Structures and Applications
Interface to Systat and Word Processing / Report Generation
What do you want to do with the data?
Are there business processes you want to automate?
Report generator

Design:

Data Base
Conceptual, Logical, Physical (iterative process) (data naming conventions)
Application
Import Screens
Input Screens (views, forms)
Date entry (domains)
Screen mock-ups
Output / Reports (queries, Word merges for reports, etc)
Data Cleansing Routines (validation, adding values)
Analysis Routines (repetitive analysis)
Menus
Documentation Screens (help)
Build in Proofing (produce graph to see anomalies)
Document input rules for data entry (ppm, ppb, <dl, set point blanks)
Construction:
Data Base Selection / Application Tool Selection (needs vs resources)
Code generation
Validation (of code)
Sample data set
Testing of database

Implementation / Rollout:
Installation (Locations, Staff)
Testing
Training
Back-up

Production, Maintenance and Support:
Populate Data Base
Maintenance and compaction

Evaluation / Assessment:
Note: Develop staffing and time frames for the above tasks. Documentation occurs at all phases.

Setup Project Definition Session

<u>To Do List</u>:

1.) Set Date for Project definition meeting (Dale Cartwright)
  Write email to attendees (Dale Cartwright)
  Plan meeting: location, time, date (Mike Jordan, Jill Bornes, Andrea Johnson)
  Prepare project definition forms (Mike Jordan)

2.) Set Date for ERD Validation (Andrea Johnson- following project def mtg & revised ERD)
  Prepare summary of existing ERD (Andrea Johnson, Perry Canton)
  Prepare entity relationship forms (Andrea Johnson, Perry Canton)
  Risk Assessment (Perry Canton)
    Attendees: Mike J., Andrea J., Dale C., Dave A., Kim L.
3.) Write-up new Project Plan (Andrea Johnson, Perry Canton)

4.) Give MCC a copy of Project Definition and revised Work Plan Misc.

<u>Dave</u>: check with Marty to see if we have to treat work plan "as is" (one year for prediction and one year for mitigation), or if we can spend more time on design phase including both prediction and mitigation.

<u>Andrea</u>: work on updating ERD and corresponding entity/attribute lists. Also, review data files for computer version, content, units, negative values, less than detection limits. Document....

Future meeting topics, dates and team members

Meeting Topic	Tentative Date	
Project Definition	end of Aug., early Sept. 2001	
ERD	mid to end Sept. 2001	
Risk Assessment	end of Aug. 2001	
Existing Data Structure & Applications	Oct. to Dec. 2001	
Design	Model	Construction
Database		
Input Screens		
Import Screens		
Output/Reports		
Analysis		

Roles for Project Definition meeting

SME's: Kim Lapakko, Dave Antonson, Anne Jagunich, Jon Wagner, Jennifer Engstrom, Andrea Johnson
Recording Analysts: Perry Canton, Larry Swenson
Facilitators: Mike Jordan, Jill Bornes
Observer: Dale Cartwright
Customers: data output personnel, data input personnel

Project Leads and Roles

Sponsor - Candidates: Kim, Dave, Arlo, Marty, Perry

-someone who has an interest in the project and is willing to go to most of the meetings.
-May end up having a main sponsor and a satellite sponsor
-most likely a manager.
-provides direction
-makes decisions when tradeoffs involved
-controls resources (staff time, etc..)

Project Manager(s) - Dale Cartwright, Andrea Johnson

-make the specific plan
-maintain plan:
  update
  track progress
  make decisions on what happens
-good communication:
  sponsors, team members, clients
-maintain project definition:
  scope and product
  ideas coordinated
-may or may not be responsible for risk management, keep track of risks, make lists/good documentation
-dual role (1 reclamation, 1 IS)
-people report to them about phases of project (diff people may manage tasks)
-person may be a risk if also a developer due to time commitment

Activity/Task Managers

-communicate with people performing tasks and report progress to project manager

Work Roles - to be determined later
Analyst
Developer
Tester
Documenter
SME's (subject matter experts) - Reclamation staff
Coach - informal/advice

Other Discussion topics

- discussed importance of following a method

- discussed setting up a project plan
  allows task to get done in a timely manner
  provides accountability

- agreed that MCC work plan for FY 02 - 03 actually describes two projects:
  1. Formal data repository
  2. Data management tasks

APPENDIX 2

EMWM DATABASE
RISK MANAGEMENT DOCUMENTATION

Environmental Mine Waste Management Database
Risk Management Meeting
August 22, 2001

Attendees: Dale Cartwright, Andrea Johnson, Dave Anstonson, Kim Lapakko, Mike Jordan, Perry Canton

<u>Agenda</u>

1. Risk Management
    1. List each risk
    2. Qualify each risk as to its potential impact and likelihood
    3. Designate a transition indicator for each risk to tell you that the risk is beginning to materialize
    4. Set in advance how you plan to cope with each risk should it begin to materialize
    5. Develop process to discover new risks

2. Risk Containment:
    Discuss nature of the risk, extent of damage, and its likelihood

3. Risk Mitigation:
    Actions you take to reduce the impact of a risk should it materialize

<u>Risk Assessment List</u>

A. 1. <u>Staffing</u> - loss of key staff
2. impact depends on the staff missing, not likely
3.desk empty
4. extend time (revised proposal to MCC), if Dale, replace with someone from St. Paul

B 1. <u>Work priorities change</u>
2. Andrea's schedule no change, this project high on priority for IS staff
3. not meeting deadlines of time line
4. Limit dependencies (inter) work between modules

C . 1. <u>Strike</u>
2. impact dependent on length of time
3. no one working
4. time line pushed back, or cut back on parts of database, focus on design work rather than input forms and views

D. 1. Staff Training
2. should be minimal
3. unfamiliar with database software,
4. set aside time for training

E. 1. Software Change
2. could have large impact
3. loss of software license...
4. keep current on state's decision to change software, have plan for change in

F. 1. Reports or other projects conflicting
2. could have large impact
3. progress slow, not meeting deadlines
4. better time management, delegate responsibilities

G. 1. SME's Availability
2. impact could be large
3. SME's unavailable for meetings, or one-on-one
4. set aside small blocks of time for discussion and testing

H. 1. Change Management
2. could have large impact
3.
4. define what we are building and expectations so no surprises part way through project

I. 1. Excessive Planning
2. could have large impact
3. failing to reach deadlines according to time line
4. good project management to keep on task, prioritize tasks

APPENDIX 3

PROJECT DEFINITION DOCUMENT

Environmental Mine Waste Management Database Project

Project Definition Document

August 2001

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Stakeholders 9

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- Depth 11
- Universality 11
  - Geo-Political 11
  - Factors Driving Project/Change 11
  - Time Frame 11

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Participants List

Environmental Mine Waste Management:

Initials	Name	Project Definition Role	EMWM Database Project Role
DA	Dave Antonson	Expert	Sponsor
AJA	Anne Jagunich	Expert	
AJO	Andrea Johnson	Expert	Project Manager
KL	Kim Lapakko	Expert	Sponsor
JW	Jon Wagner	Expert	

Support Staff

JB	Jill Bornes	Facilitator	
PC	Perry Canton	Recording Analyst	Sponsor
DC	Dale Cartwright	Observer	Project Manager
MJ	Mike Jordan	Facilitator	
LS	Larry Swenson	Recording Analyst	Developer

Additional EMWM Project-Related Staff Not Attending

PE	Paul Eger		Sponsor
JE	Jennifer Engstrom		
JF	John Folman		

Meeting Objectives

Define the purposes and boundaries of the project

Agree to a common understanding and commitment to what the project is and is not

Deliver a document that will provide:
- direction through the project; and,
- criteria to determine whether the project is successful.

Wants and Needs

Wants and needs are things we do not do now, cannot do, cannot do well, or could do better Wants and needs are used to help us determine the specific intentions of the project. This was a structured brainstorm activity later related with intentions and evaluated to determine whether the particular items are in or out of scope for the project.

#	Wants & Needs	Source	Intention #	I/O
1	Report formats - have standard reports/graphs where changes and modifications can be kept to a minimum	JW	14	I
2	Produce reports and quality graphs in 1 step (more easily)	AJA	16	I
3	Easily dump raw data into Systat, Quattro or Excel	DA	15	I
4	Easily access tables or data generated by a certain solid, including any analysis or any tests. Easy searching for solid phase data. (Currently in WP)	AJA	16	I
5	Easy way top get historical data into new database from WordPerfect documents and other formats, including paper to digital and software conversion.	AJA	17	I
6	Get Department of Agriculture data into the database electronically. (The conversion routine is in scope for this project, but the Agriculture data is scope of integration for this project.)	DA	15	O
7	Database to efficiently store, tabulate, calculate, and graph data collected.	KL	1	I
8	Easily tabulate data collected (make tables)	KL	1	I
9	Easily calculate data collected	KL	1,2,13	I
10	Easily make graphs from data collected	KL	1,13,11	I

11	Easily retrieve data on Kim's demand	JW	14	I
12	Standard nomenclature for data files, tables, units (ppm), project names	JW	9	I
13	Way to know if data has been checked for errors by parameter documentation, who did the checking, and when	JW	18	I
14	Documentation of written reports contained in the database	AJA	1	I
15	Database and application must incorporate mitigation and historical data	DA	1	I
16	Calculate missing values (averages).	JW	13,11	I
17	Distinguish between calculated and actual data (i.e., ph data measured vs. calculated) (metadata?)	JW	20	I
18	Convert sample dates to linear time scale	JW	13	I
19	Make date/time conversion standardized	JW	9	I
20	Identify detection units/limits for each parameter	JW	21	I
21	Ability to correct "less than" values to determine numeric values. Also unit conversions (ppb, ppm, mg/l...etc.).	KL	21	I
22	Provide appropriate output for BLM and other contractors	KL	15	I
23	Provide training on use of database application such as importing, queries, reports, exporting, structure...	DA	22	I
24	User-friendly applications for data input and output	AJA	15	I
25	Identify customizable formulas.	JW	23	I
26	Custom views of experiments and projects	AJO	24	I
27	Keep track of physical locations of existing samples	KL	1	I
28	How much of a sample is available? Description of samples. Solid phase only.	JW	1	I
29	Track the chain of custody for Ag samples	AJA	1	I
30	Quality assurance information; e.g., department of Ag.	KL, DA, AJA	1	I
31	Checking data (error checking). Data ranges.	KL	19	I
32	Accommodate re-runs	AJA	25	I
33	(Context) Accommodate both aqueous and solid phase data.[This need is now an assumption of the project - both data types will be accommodated within the scope of this project.]	KL	2	I
34	Accommodate anomalous data	All	19,25	I

35	Track, store, and view photos, maps, memos, figures and other images	AJA	1	I
36	Access and print graphics and/or text from a report or experiment or access and print an entire report or experiment.	AJO	26	I
37	Keep information about related documents (Literature reviews and papyrus references)	KL	1	I
38	Backups and data safety	JW	27	I
39	Security - access to database. Transaction tracking?	AJO	27	I
40	Storing metadata	KL	1	I
41	Be able to accurately describe detail information about parameters (ex. digits/characters)	JW	1,9	I
42	Perfect graphing package	AJO	???	I
43	Place to capture lab notes and time line (status and history tracking)	KL	???	I

Don't Change

These are aspects of the current way of doing EMWM work that we would not want to change.

#	Don't Change	Source
1	Dept of Ag does analyses	AJA
2	Like having individual control of data. Not "too many hands in the pot"	JW
3	Specific people can change/edit/check data, but all can view data	JW
4	Freedom to use software of choice	AJO
5	Competent people doing the work (in a timely manner)	KL

Intentions

Intentions are the purposes or reasons that we are doing a project and the results that are expected from the effort. The intentions answer the question of "what" we want an application to do and why we are making this effort but not how it should be done.

The intentions are not sorted in order of priority or any other sequence. They are derived from the wants and needs identified earlier.

#	Intention
1	Create a formal, organized repository for EMWM information, including: reports; metadata; photos; maps; data; text; sample locations; solid sample quantity, literature reviews; papyrus references...etc.
2-8	*Candidate intentions 2-8 were replaced by intention 13 but may be relevant for the purpose of establishing a more detailed understanding...*
2	*Tabulate all necessary tabulations*
3	*Make concentration vs. time graphs*
4	*Calculate cumulative mass release*
5	*Tabulate cumulative mass release/time (covered in (2) above)*
6	*Graph cumulative mass release/time*
7	*Determine release rates (linear regression and averaging)*
8	*Convert rates of release to mineral dissolution*
9	Standardize nomenclature, including time format
10	Provide improved accurate parameter descriptions
11	Calculate missing values
12	Capture Department of Agriculture data easily
13	Easily calculate tabulate graph and summarize statistics for EMWM data (captures items 2-8 above)
14	Standardize design formats for reports; including graphs, tables, etc...
15	Easily import and export data to other software, including exchanges with BLM and Department of Agriculture
16	Easily search and retrieve data on specific solids and other stuff.
17	Import historical data (convert non-electronic paper formats to digital)
18	Document error checking

19	Check data for errors
20	Distinguish between calculated and actual data (is this metadata?? If so, what kind?))
21	Collect, store and convert detection limits
22	Train people to use the database and application
23	(Provide the ability to) Customize formulas for calculation
24	Provide customized views of data
25	Accommodate, identify, document re-runs & anomalous data. Which (identify & document) value will be used for calculations.
26	Print data, analysis, and graphs for reports and store reports. See #1 for information about items contained in reports.
27	Secure and back up the data
28	Look for and find "perfect" graphic ability
29	Create a place for lab notes and time line

Values

Tradeoffs and judgments that guide or balance project results.

#	Values	Source
rank		
1	Ease of use (intuitive)	all
1	Efficiency (minimum clicks)	AJA, JW
1	Time to completion/Delivery for project (usable)	KL
1	Organization/consistency	AJO
* De facto	Accuracy (has to be accomplished)	KL
	Visual quality of output (consistent)	all

Stakeholders

Anyone who may impact or be impacted by this project.

#	Emphasized	Stakeholder	Source
1	X	Us Us Us (Reclamation staff)	
2		Arlo Knoll	
3		Minerals Coordinating Committee	
4		Lands & Minerals Division	
5		Mining Industry	
6		Bureau of Land Management	
7		Environmental Protection Agency	
8		Contractors	

Focus Statement

The focus statement defines the domain of the enterprise (EMWM) that will be the focus, or main concentration, of the project. In this case it consists of 4 parts: breadth, scope of integration, depth and universality.

Breadth: *clarifies the boundaries of the project.*

(From/Until)

#	Breadth: Our interest extends from...until...
from	Beginning of current, running experiments and new experiments
until	the end of experiments. Never get rid of the data--possibly archive

(Include/ Exclude)

#	Breadth: Includes / Excludes	Inc/Exc
1	Includes aqueous and solids	Incl.
2	Includes predictions and mitigation	Incl.
3	Includes laboratory and field data/experiments (not actually in field)	Incl.
4	Includes data already collected	Incl.
5	Excludes electronic monitoring in real-time	Excl.
6	Excludes taconite research (vegetation, in-pit)	Excl.
7	Excludes collection/inclusion of historical raw data	Excl.
8	Includes citations of publications presenting historical data	Incl.

Scope of Integration: *describes other business elements that this project should be compatible with or coordinated with.*

#	Scope of Integration
1	Historical raw data
2	In-Pit disposal - taconite
3	Vegetation data
4	Prediction data from other sources like U of Utah BLM study
5	MDA data - electronic file for input (transfer). We want a disk.

Depth: *Describes how much detail about EMWM must be explored and documented to be able to create the desired products.*

Full Detail - Detail sufficient to implement and use solutions.

Universality: *describes how generic and/or flexible the solution must be. The more generic or flexible the solution, the more rigorous we need to be in gathering requirements.*

#	Universality: Geo-Political	Source
1	Hibbing	
2	St. Paul	
#	**Factors Driving Project/Change**	**Source**
1	Scientific advances	KL
2	Sources of funding	AJA
3	New/Unforseen/Incompatible experiment	KL/AJO/DC
	Time Frame	
	Stable: 2 years	
	Extensible: 5 years	
	Assertable Life Span: 8 years	

Project Context

Context is information that we have gathered about the project that is important to understand and document but does not fit the formal structure of the project definition. Context may describe project constraints like time and budget, background information, candidate solutions, issues that need to be raised or kept in mind as the project proceeds, or information about business processes or events that need to be investigated and documented through formal procedures in later project phases. The context list should be revisited regularly during the course of the project, and may justifiably serve as a stand-alone document or as an addition to planning and tracking documents.

#	Context
1	Dave A. talked to Marty about changes to original project proposal to MCC. Changes include: • creating only one database instead of two, one for mitigation and one for prediction • task list change to work on database in the first year, then applications in the second • clarify that the goal is to capture current and future data, with the idea that historical information may be added later. Marty said these changes sounded reasonable and that we should write up the proposed changes and submit them to MCC. A modified version of the project definition document may be what is sent to MCC.
2	Keep in mind that the project definition can change down the road. The important thing is to know whether it is a change. (MJ)
3	Jon W. asked whether the project purpose is to develop something that is for use by the division or for use by outside clients. Everyone agreed that the database and applications will be used by the division to help create reports.
4	It is not reasonable to have a standard format for all reports. Written reports need text, graphs and tables. (JW)
5	Department of Agriculture is creating data that needs to go into this project's database.
6	(?) Will probably want to know which data has been checked for errors, which is anomalous by parameter, and who did the checking.
7	Need to come up with what is historical data, what data will go into this [system]. Has not been decided.
8	Keep in mind how much can be accomplished in two years and what the trade offs might be.
9	May want climate data from other sources.
10	Right now people have to manually convert PPM (parts per million) to PPB (parts per billion) from Department of Ag.
11	Because of department conversion to Microsoft Office, should convert current Quattro Pro files to Excel and Word Perfect to Word.
12	Applications should report back what is used to calculate output.

13	One situation to deal with will be conversion/dumping Systat files into a database and getting data from database into Systat.
14	Want to retain values of both original and re-run data.
15	(?) Solid phase descriptors. Relationship between the aqueous and solids used in tests.
16	Want to have photos, maps, memos, figures, drawings, etc. stored in database. Should be retrievable for reports and presentations.
17	Whoever makes corrections to data set has to know status of data set.
18	Only certain people can (and should be able to) enter data.
19	Want to be able to accurately describe what the parameter is. Move into Systat.
20	When referring to calculations or database, we are referring to both aqueous and solid phase.
21	There is uncertainty about which graphing packages are available and how they can be used with the new system/database.
22	Want minimum clicks to move between screens.
23	Scope of integration does not mean developing an interface or connection.
24	This application is not being used for getting money from stakeholders.
25	Use a small data set to verify and test applications

APPENDIX 4

EXISTING DATA STRUCTURES AND SOFTWARE INTERFACE NOTES

Attachment A4.1. MN DNR LAM data file descriptions.

Attachment A4.2. Software interface/data conversion note.

Attachment A4.1. MN DNR LAM data file descriptions for non-ferrous experiments.

Experiment Type: **Prediction**
Scale: **Laboratory**

Project Title: **Dunka Blast Hole /High S**
Experiment Title: High % S
Contact: Jon Wagner
Data file location: P:\recl\RECLAB\his

Data Files:

Aqueous Phase

-All data files are SYSTAT version 6.1?.
-All variables are numeric, 12 characters, 3 decimal places.
-If no values, SYSTAT places a (.) in the cell.
-Alkalinity and acidity have some negative values (-5.000).
-Other negative values are less than the detection limit. (spot check files with Dep of Ag results)

-5 reactors were discontinued on 8/4/97. Reactors 11 and 3 (week 442) and reactors 31, 35 and 37 (week 361).
-6 new reactors were started on 8/12/97 (week 0): reactors 39, 40, 41, 42, 43, 44

HIS01.sys:
DNR sample # 's: 32429 - 32495+
15 reactors: 1, 3, 5, 7, 9, 15, 17, 19, 29, 33, 39, 40, 41, 42, 43
 # rows: 105
variables: REACTOR, SOLIDS, MONTH, DAY, YEAR, WEEK, SC, PH, ALK, ACID, SAMPLE, VOL, SAMP, AL, CA, CO, CU, SMPL, FE, K, MG, SAM, NA, Ni, ZN, SO4, SMPLE, SI

HIS00.sys:
DNR Sample # 's: 32263 - 32428
16 reactors: 1, 3, 5, 7, 9, 15, 17, 19, 29, 33, 39, 40, 41, 42, 43, 44
 # rows: 160
variables: REACTOR, SOLIDS, MONTH, DAY, YEAR, WEEK, SC, PH, ALK,
ACID,
SAMPLE, VOL, SO4, CA, MG, FE, CU, NI, CO, ZN, SAMP, AL, K, NA, N (no values), SI

HIS99.sys:
DNR Sample # 's: 32049 - 32262
16 reactors: 1, 3, 5, 7, 9, 15, 17, 19, 29, 33, 39, 40, 41, 42, 43, 44
 # rows: 310
variables: REACTOR, SOLIDS, MONTH, DAY, YEAR, WEEK, SC, PH, ALK, ACY, SAMPLE, SO4, CA, MG, CU, NI, SAMPL CO, ZN, VOL, SI, AL, FE, K, NA

Attachment A4.1. MN DNR LAM data file descriptions for non-ferrous experiments.

HIS98.sys:

DNR Sample # 's: 31833 - 32046
16 reactors: 1, 3, 5, 7, 9, 15, 17, 19, 29, 33, 39, 40, 41, 42, 43, 44
 # rows: 829
variables: REACTOR, SOLIDS, MONTH, DAY, YEAR, WEEK, SC, PH, ALK, ACY, SAMPLE, SO4, CA, MG, CU, NI, CO, ZN, VOL, X (sample #), FE, AL, SI, SAMPL, K, NA

HIS97.sys:

DNR Sample # 's: 31600 - 31832
21 reactors: 1, 3, 5, 7, 9, 11, 13, 15, 17, 19, 29, 31, 33, 35, 37, 39, 40, 41, 42, 43, 44
 # rows: 808
variables: REACTOR, SOLIDS, MONTH, DAY, YEAR, WEEK, SC, PH, ALK, ACY, SAMPLE, SO4, CA, MG, CU, NI, CO, ZN, SAMPL, K, NA, VOL, FE, AL, SI

HIS96.sys:

DNR Sample # 's: 31382 - 31599
15 reactors: 1, 3, 5, 7, 9, 11, 13, 15, 17, 19, 29, 31, 33, 35, 37
 # rows: 795
variables: REACTOR, SOLIDS, MONTH, DAY, YEAR, WEEK, SC, PH, ALK, ACY, SAMPLE, SO4, CA, MG, CU, NI, CO, ZN, SAMPL, VOL, X, AL, FE, K, NA

HIS95.sys:

DNR Sample # 's: 31109 - 31380
29 reactors: 1 - 19 & 29 - 38
 # rows: 1087
variables: REACTOR, SOLIDS, MONTH, DAY, YEAR, WEEK, SC, PH, ALK, ACY, SAMPLE, SO4, CA, MG, CU, NI, CO, ZN, VOL, X, AL, FE

Other Lab

rh.wb3

file type: Corel Quattro Pro 8
variables: *date (2/14/89 - 3/14/1), Month, Day, Year, temp, humidity
*date was created with @concatenate function, so 2001 is /1 not /01

misc. lab parameters:

receiving flask mass, ____ units
mass of receiving flask plus water, ____units
mass of water, ____ units (derivable attribute)

Attachment A4.1. MN DNR LAM data file descriptions for non-ferrous experiments.

Solid Phase

wholerocktracemetal.wpd

file type: Corel WordPerfect 8

contents: contains 12 tables of whole rock and trace metal data. Values in ( ) in the WordPerfect tables become negative values when copied into Quattro Pro 8.

Whole rock portion (units are %):

%S, reactor, S, S 2- 2, SO42- as S, CO2, Al2O3, CaO, Fe2O3, FeO, K2O, MgO, MnO,Na2O, P2O5, SiO2, TiO2, LOI, LOI2, Total

Trace metal portion (units in ppm):

AG, As, Ba, Bi, Co, Cr, Cs, Cu, Hf, Mo, Ni, Pb, Rb, Sb, Sn, Sr, Ta, V, W, Y, Zn , Zr, Ce, La, Lu, Nd, Tb, Th, U, Yb, Ga, Ge, Nb, In, Pr, Sm, Gd, Dy, Ho, Er, Tm, Tl, Eu

Project Title: **Non-ferrous Weekly**
Experiment Title: nf extended oxidation
Contact: Jennifer Engstrom
Data file location: P:\recl\RECLAB\nfwkly

Aqueous Phase

-All data files are SYSTAT version 6.1?.
-All variables are numeric, 12 characters, 3 decimal places.
-If no values, SYSTAT places a (.) in the cell.
-Alkalinity and acidity have some negative values (-5.000).
-Other negative values are less than the detection limit. (spot check files with Dep of Ag results)
-Reactor 17 (T-9) terminated on 5/25/00 (week 519)

NFWKLY01.sys:

DNR Sample #'s: 40603 -
3 reactors: 3, 11, 19
 # rows:
variables: REACTOR, SOLIDS, MONTH, DAY, YEAR, WEEK, SC, PH, ALK, ACID,
SAMPLE, VOLUME, CA, MG, SO4, AS, NI, PB, ZN

NFWKLY00.sys:

DNR Sample #'s: 40507 - 40602
4 reactors: 3, 11, 17, 19
 # rows: 34
variables: REACTOR, SOLIDS, MONTH, DAY, YEAR, WEEK, SC, PH, ALK, ACY,

Attachment A4.1. MN DNR LAM data file descriptions for non-ferrous experiments.

SAMPLE, VOL, CA, MG, SO4, AS, CU, MO, SAMPL, NI, PB, SB, ZN

NFWKLY99.sys:

DNR Sample # 's: 40516 - 40567
4 reactors: 3, 11, 17, 19
 # rows: 76
variables: REACTOR, SOLIDS, MONTH, DAY, YEAR, WEEK, SC, PH, ALK, ACY, SAMPLE, CA, MG, SO4, VOL, AS, CU, MO, NI, SAMPL, PB, SB, ZN

NFWKLY98.sys:

DNR Sample # 's: 40460 - 40513
4 reactors: 3, 11, 17, 19
 # rows: 208
variables: REACTOR, SOLIDS, MONTH, DAY, YEAR, WEEK, SC, PH, ALK, ACY, SAMPLE, CA, MG, SO4, VOL, CU, NI, CO, ZN

NFWKLY97.sys:

DNR Sample # 's: 40406 - 40459
4 reactors: 3, 11, 17, 19
 # rows: 212
variables: REACTOR, SOLIDS, MONTH, DAY, YEAR, WEEK, SC, PH, ALK, ACY, SAMPLE, CA, MG, SO4, VOL, CU, NI, CO, ZN

NFWKLY96.sys:

DNR Sample # 's: 40352 - 40405
4 reactors: 3, 11, 17, 19
 # rows: 209
variables: REACTOR, SOLIDS, MONTH, DAY, YEAR, WEEK, SC, PH, ALK, ACY, SAMPLE, CA, MG, SO4, VOL, CU, NI, CO, ZN

NFWKLY95.sys:

DNR Sample # 's: 40298 - 40351
4 reactors: 3, 11, 17, 19
 # rows: 212
variables: REACTOR, SOLIDS, MONTH, DAY, YEAR, WEEK, SC, PH, ALK, ACY, SAMPLE, CA, MG, SO4, VOL

NFWKLY94.sys:

DNR Sample # 's: 40240 - 40296
4 reactors: 3, 11, 17, 19
 # rows: 208
variables: REACTOR, SOLIDS, MONTH, DAY, YEAR, WEEK, SC, PH, ALK, ACY, SAMPLE, SO4, CA, MG, VOL, CU, NI, CO, ZN

Attachment A4.1. MN DNR LAM data file descriptions for non-ferrous experiments.

Other Lab

misc. lab parameters:

receiving flask mass, ____ units
mass of receiving flask plus water, ____units
mass of water, ____ units (derivable attribute)

Project Title: **Greenstone Rock**
Experiment Title: Laboratory Dissolution Tests
Contact: Andrea Johnson
Data file location: P:\recl\RECLAB\greenstone\lab

Aqueous Phase

-All data files are SYSTAT version 6.1?.
-All variables are numeric, 12 characters, 3 decimal places.
-If no values, SYSTAT places a (.) in the cell.
-Alkalinity and acidity have some negative values (-5.000).
-Other negative values are less than the detection limit. (spot check files with Dep of Ag results)

GRNLAB01.sys:

DNR Sample # 's: 45408 - 45489
18 reactors: 1 - 18
 # rows: 324
variables: REACTOR, MONTH, DAY, YEAR, WEEK, SC, PH, ALK, ACID, VOL, VOLTUES, VOLWED, SAMP, AL, CA, FE, K, SAMPL, MG, MN, NA, SO4, SI, SAM, OP, NI, ZN, CO, CU

GRNLAB00.sys:

DNR Sample # 's: 45036 - 45407
18 reactors: 1 - 18
 # rows: 882
variables: REACTOR, MONTH, DAY, YEAR, WEEK, SC, PH, ALK, ACID, SAMPLE, VOL, VOLTUE, VOLWED, SO4, SAMPL, SI, AL, CA, FE, K, MG, MN, NA, SAMP, CO, CU, NI, ZN

Other Lab

misc. lab parameters:

receiving flask mass, ____ units
mass of receiving flask + water, ____units
mass of water, ____ units (derivable attribute)

Attachment A4.1. MN DNR LAM data file descriptions for non-ferrous experiments.

Eh, millivolts
reactor tare wt., ___units
reactor + water (dry), ____units
volume Tuesday, ___ units (derivable attribute)
reactor + water (wet), ___ units
volume Wednesday, ___ units (derivable attribute)

Solid Phase

psize.wpd

sample #, %S, %R & %P of each size fraction (+1/4, -1/4+4M, -4+10M, -10+20M, -20+28M, -28M+35M, -35+48M, -48+65M, -65+100M, -100+150M, -150M+200M, 200M

psizewhole.wb3

units in %:SiO2, Al2O3, Fe2O3, MnO, MgO, CaO, Na2O, K2O, TiO2, P2O5, LO1, Total

units in ppm: Ba, Sr, Y, Sc, Zr, Be, V +standards

SCO2psize.wb3

Item #, sample #, S(%).01, CO2 (%).01

Experiment Type: **Prediction**
Scale: **Laboratory**

Project Title: **WGA Humidity** (Western Governors Association)
Experiment Title: Evaluation of kinetic tests
Contact: Jennifer Engstrom
Data file location: P:\recl\RECLAB\WGA

Data Files:

Aqueous Phase

-All data files are SYSTAT version 6.1?.
-All variables are numeric, 12 characters, 3 decimal places.
-If no values, SYSTAT places a (.) in the cell.
-Alkalinity and acidity have some negative values (-5.000).
-Other negative values are less than the detection limit. (spot check files with Dep of Ag results)

WGAHUM01.sys:

DNR Sample # 's: 56365 -
5 reactors: 1, 3, 5, 9, 11
 # rows: 5
variables: REACTOR, SOLIDS (no data), MONTH, DAY, YEAR, WEEK, SC, PH, ALK, ACID, SAMPLE, VOLUME, VOLTUE, more later

Attachment A4.1. MN DNR LAM data file descriptions for non-ferrous experiments.

WGAHUM00.sys:

DNR Sample # 's: 56308 - 56364
8 reactors: 1, 3, 5, 7, 9, 11, 17, 19
 # rows: 55
variables: REACTOR, SOLIDS (no data), MONTH, DAY, YEAR, WEEK, SC, PH, ALK, ACY, SAMPLE, VOLUME, SO4, CA, MG, DECANT

WGAHUM99.sys:

DNR Sample # 's: 56200 - 56307
8 reactors: 1, 3, 5, 7, 9, 11, 17, 19
 # rows: 162
variables: REACTOR, SOLIDS (no data), MONTH, DAY, YEAR, WEEK, SC, PH, ALK, ACY, SAMPLE, SO4, CA, MG, VOL, DECANT (no data)

WGAHUM98.sys:

DNR Sample # 's: 56094 - 56199
8 reactors: 1, 3, 5, 7, 9, 11, 17, 19
 # rows: 408
variables: REACTOR, SOLIDS (no data), MONTH, DAY, YEAR, WEEK, SC, PH, ALK, ACY, SAMPLE, SO4, CA, MG, VOL, DECANT (no data)

WGAHUM97.sys:

DNR Sample # 's: 55955 - 56091
11 reactors: 1, 3, 5, 7, 9, 11, 13, 15, 17, 19, 21
 # rows: 538
variables: REACTOR, SOLIDS (no data), MONTH, DAY, YEAR, WEEK, SC, PH, ALK, ACY, SAMPLE, SO4, CA, MG, VOL, DECANT (no data)

Other Lab

misc. lab parameters:

receiving flask mass, ____ units
mass of receiving flask plus water, ____units
mass of water, ____ units (derivable attribute)

Project Title: **WGA Particle Size**(Western Governors Association)
Experiment Title: WGA Particle size
Contact: Jennifer Engstrom
Data file location: P:\recl\RECLAB\psize
DNR Sample # series: 72000

Attachment A4.1. MN DNR LAM data file descriptions for non-ferrous experiments.

Data Files:

Aqueous Phase

All data files are SYSTAT version 6.1?.
-All variables are numeric*, 12 characters, 3 decimal places.
-If no values, SYSTAT places a (.) in the cell.
-Alkalinity and acidity have some negative values (-5.000).
-Other negative values are less than the detection limit. (spot check files with Dep of Ag results)
*PS94TO98.SYS has one variable with text (SOLID$).

PSIZE01.sys:

DNR Sample #'s: 72120 - 72132
12 reactors: 2, 3, 9, 10, 12, 13, 14, 15, 16, 18, 19, 20
 # rows: 538
variables: REACTOR, SOLIDS (no data), MONTH, DAY, YEAR, WEEK, SC, PH, ALK, ACID, SAMPLE, VOLUME, SO4

PSIZE00.sys:

DNR Sample #'s: 71994 - 72119
14 reactors: 2, 3, 5, 8, 9, 10, 12, 13, 14, 15, 16, 18, 19, 20
 # rows: 122
variables: REACTOR, SOLIDS (no data), MONTH, DAY, YEAR, WEEK, SC, PH, ALK, ACY, SAMPLE, VOLUME, CA, MG, SO4, SAMPL, ZN, CO, NI, CU, AS, CR, SB

PSIZE99.sys:

DNR Sample #'s: 71806 - 71993
15 reactors: 1, 2, 3, 5, 8, 9, 10, 12, 13, 14, 15, 16, 18, 19, 20
 # rows: 255
variables: REACTOR, SOLIDS (no data), MONTH, DAY, YEAR, WEEK, SC, PH, ALK, ACY, CA, MG, NA (no data), K (no data), SAMPLE, VOLONE (no data), VOLTWO (no data), VOLTHREE (no data), SO4, VOLOUT, DECANT (no data), CO, CU, NI, ZN, SAMPL, AS, CR, SB, PB

PS94TO98.sys:

DNR Sample #'s: 70022 - 71805
25 reactors: 1 - 25
 # rows: 5144
variables: REACTOR, SOLIDS$ (text data), MONTH, DAY, YEAR, WEEK, SC, PH, ALK, ACY, CA, MG, NA, K, SAMPLE, VOLONE, VOLTWO, VOLTHREE, SO4, VOLOUT, DECANT, SOLIDS (no data) CU, NI CO, ZN, VOL, X (sample #), AS, CR, PB, SB

Lab Info

Attachment A4.1. MN DNR LAM data file descriptions for non-ferrous experiments.

receiving flask mass, ____ units
mass of receiving flask plus water, ____units
mass of water, ____ units (derivable attribute)

Experiment Type: **Prediction**
Scale: **Field**

Project Title:**Greenstone**
Experiment Title: Dissolution Test
Contact: Andrea J.
Data file location: P:\recl\RECLAB\greenstone\field\

Data Files:

Aqueous Phase

All data files are SYSTAT version 6.1?.
-All variables are numeric, 12 characters, 3 decimal places.
-If no values, SYSTAT places a (.) in the cell.
-Alkalinity and acidity have some negative values (-5.000).
-Other negative values are less than the detection limit. (spot check files with Dep of Ag results)

GRNBIN01.sys:

DNR Sample # 's: 50000 50052 (50015-50020 are alk mix)
4 sites: Bins 1 - 4
 # rows: 41
variables: BIN, MONTH, DAY, YEAR, SAMPLE, VOL, SC, PH, ALK, ACID, SO4, SI, SAMPL, N, NH3_N, NO3_2, TP, Al, CA, CO, CU, FE, K, Mg, MN, NA, NI, ZN, SAM

Experiment Type: **Mitigation**
Mtigation Type: **Treatment**
Scale: **Laboratory**

Project Title: **Alkaline Addition**
Experiment Title:Alk ad
Contact: Jon Wagner
Data file location: P:\recl\RECLAB\alkad\

Data Files:

Aqueous Phase

Attachment A4.1. MN DNR LAM data file descriptions for non-ferrous experiments.

-All data files are SYSTAT version 6.1?.
-All variables are numeric, 12 characters, 3 decimal places.
-If no values, SYSTAT places a (.) in the cell.
-Alkalinity and acidity have some negative values (-5.000).
-Other negative values are less than the detection limit. (spot check files with Dep of Ag results)
-some text columns
-some

ALKAD01.sys:

DNR sample #'s: 36134 -
8 reactors: 6, 7, 8, 9, 10, 11, 13, 14
 # rows:56
variables: REACTOR, MON TH, DAY, YEAR, WEEK, SC, PH, ALK, ACID, VOLUME, SAMPLE, SO4, CA, MG, CO, CU, NI, ZN

ALKAD00.sys:

DNR sample #'s: 36058 - 36133
8 reactors: 6, 7, 8, 9, 10, 11, 13, 14
 # rows:81
variables: REACTOR, MON TH, DAY, YEAR, WEEK, SC, PH, ALK, ACID, VOLUME, SAMPLE, SO4, CA, MG, CO, CU, NI, ZN

ALKAD99.sys:

DNR sample #'s: 35949 - 36057
9 reactors: 3, 6, 7, 8, 9, 10, 11, 13, 14
 # rows:157
variables: REACTOR, MON TH, DAY, YEAR, WEEK, SC, PH, ALK, ACY, SAMPLE, SO4, CA, MG, VOL, SAMPL, CO, CU, NI, ZN

ALKAD98.sys:

DNR sample #'s: 35828 - 35948
9 reactors: 3, 6, 7, 8, 9, 10, 11, 13, 14
 # rows:468
variables: REACTOR, SOLIDS, MON TH, DAY, YEAR, WEEK, SC, PH, ALK, ACY, SAMPLE, SO4, CA, MG, CU, NI, CO, ZN, VOL

ALKAD97.sys:

DNR sample #'s: 35702 - 35827
11 reactors: 3, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14
 # rows:
variables: REACTOR, TYPER$ (10 mesh or RK fines), RATIO, WEEK, MONTH, DAY, YEAR, SAMPLE, SC, PH, ALK, ACY, NETALK, CU, NI, CO, ZN, FE, AL, DUM$, DUMB$, VOLUME, VOLUME2, YEARS, CUGRAF, NIGRAF, COGRAF, ZNGRAF, SO4, LOGSO4, LOGWEEK, CA, CA2, MG, MG2, CATAN, CAMOL,

Attachment A4.1. MN DNR LAM data file descriptions for non-ferrous experiments.

MGMOL, SO4MOL

ALKAD96.sys:

DNR sample # 's: 35564 - 35701
11 reactors: 3, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14
 # rows:589
variables: REACTOR, SOLIDS (no values), MON TH, DAY, YEAR, WEEK, SC, PH, ALK, ACY, SAMPLE, SO4, CA, MG, CU, NI, CO, ZN, VOL, X (= week)

Other Lab

misc. lab parameters:

receiving flask mass, ____ units
mass of receiving flask plus water, ____units
mass of water, _____ units (derivable attribute)

Experiment Type: **Mitigation**
Mtigation Type: **Prevention**

Scale: **Field**

Project Title: **Alternative Encapsulation**
Experiment Title: Alt cap
Contact:
Data file location: P:\recl\RECLAB\ALTCAP

Data Files:

Aqueous Phase

-All data files are SYSTAT version 6.1?.
-12 characters, 3 decimal places.
-If no values, SYSTAT places a (.) in the cell.
-Alkalinity and acidity have some negative values (-5.000).
-Other negative values are less than the detection limit. (spot check files with Dep of Ag results)
-some text fields

WETFINAL.sys:

DNR sample # 's: 90001 - 91006
reactors:
 # rows:1131

Attachment A4.1. MN DNR LAM data file descriptions for non-ferrous experiments.

variables: TANK$, MONTH, DAY, YEAR, SC, PHM, EH, ALK, ACY, SAMPLE, VOLOUT, SO4, CU, NI, CO, SAMPL, ZN, CA, MG, NA, K, AL, MN, FE, TP, NO3_2, TF$, TEMP, DOSAT, SAM, DO, TKN, NH3_N, SAT, Z

Experiment Type: **Mititgation**
Mtigation Type: **Control**
Scale: **Field**

Project Title: **Archean Geenstone**
Experiment: Limestone Addition(mixing)
Contact: Andrea Johnson
Data file location: P:\recl\RECLAB\greenstone\field\alkmix

Aqueous Phase

-All data files are SYSTAT version 6.1?.
-12 characters, 3 decimal places.
-If no values, SYSTAT places a (.) in the cell.
-Alkalinity and acidity have some negative values (-5.000).
-Other negative values are less than the detection limit. (spot check files with Dep of Ag results)

-some text fields

gralk01.sys (6 tanks:1, 2, 3, 4, 5, 6)
TANK$, TANK, MONTH, DAY, YEAR, SAMPLE, VOL, SC, PH, ALK, ACID, N, NH3_2, NO3_2, TP, SO4, CA, MG, SAMP, MN, SI, NA, NI, ZN, AL, CO, CU, FE, K, DATE

Solid Phase

tracemetal.wb3

sco2.wb3
Item #, sample No., S(%).01, SO4(%).01, CO2(%).01

Experiment Type: **Mitigation**
Mtigation Type: **Prevention /Control**
Scale: **Laboratory**

Project Title: **Subaqueous Disposal**
Experiment Title: Subaqueous columns with barriers
Contact:
Data file location: P:\recl\RECLAB\NFINPIT\COL\
Data Files:

Attachment A4.1. MN DNR LAM data file descriptions for non-ferrous experiments.

Aqueous Phase

-All data files are SYSTAT version 6.1?.
-If no values, SYSTAT places a (.) in the cell.
-Alkalinity and acidity have some negative values (-5.000).
-Other negative values are less than the detection limit. (spot check files with Dep of Ag results)
-some text fields

NFCOL978.sys:

DNR sample # 's: 81000 - 81689
reactors: 1-19
 # rows:978
variables: COLUMN$, COLUMN,, MON TH, DAY, YEAR, WEEK, EVAP2, EH, SC, ALK, ACY, SAMPLE, CA, CO, CU, K, MG, NA, NI, SO4, VOLADD, VOLOUT, EVAP, RINSEVOL, ZN, IOC, SI, SO4MASS, CUMSO4, DUMMY$

NFCOL99sys:

DNR sample # 's: 81692- 82110
reactors:1-19
 # rows:383
variables: COLUMN$, COLUMN, MON TH, DAY, YEAR, WEEK, PH, EH, SC, ALK, ACY, SAMPLE, CA, CAREDO, CO, CU, NI, K, MG, NA, SAMP, SO4, SO4REDO, VOLADD, VOLOUT, EVAP, RINSEVOL, ZN, IOC, SI, SO4MASS, CUMSO4, DUMMY$

NFCOL00.sys:

DNR sample # 's: 82111 - 82287
reactors: 1-19
 # rows:171
variables: COLUMN$, COLUMN, MON TH, DAY, YEAR, WEEK, PH, EH, SC, ALK, ACY, SAMPLE, VOLOUT, SO4, CA, MG, CU, NI

NFCOL01.sys:

DNR sample # 's: 82288 - 82403
reactors: 1-19
 # rows:114
variables:COLUMN$, COLUMN, MON TH, DAY, YEAR, WEEK, PH, EH, SC,

ALK, ACID, SAMPLE, VOLOUT, SO4, CA, MG, CU, NI

Solid Phase

Attachment A4.1. MN DNR LAM data file descriptions for non-ferrous experiments.

COLTABS.wpd: includes the following tables

- -Table A1.1 Whole rock analysis
- -Table A1.2 Trace elements
- -Table A1.3 Mineral content
- -Table A.4 P-size
- -Table A1.5 Analysis of yard waste compost

Attachment A4.2. Software interface/data conversion notes.

Saving Systat files to import or copy into Access

Save Sytat as a text file
-Fixed width (if choose deliminated it thinks the whole table is one field)
-eliminated field breaks between column title and data
-save in new table or existing table
-data with decimal places need to change data type from long interger to single
-edit field names & data types
-choose primary key

Save text files
-if directly from Sytát it is fixed width
-options in Quattro - tab deliminated
- comma deliminated

Saved Systat as txt file.
-imported,
-asked if Del (tab or comma) or fixed width
-adjusted/deleted lines
-import (new or existing table)

error creating file, primary key cannot contain null value, Access puts 0 but no field names

HIS99.sys saved as ASCII txt in Systat (no blank lines)
-ge external import
-Wizard says fixed width (fields aligned in col. w spaces)
-next, must physically adjust columns (wants to make each field and values separate columns)
Good reason to merge files!
-store data in New Table
-Field options (name type (no numbers)indexing)
-pH called (double)
-choose own primary key

fix size, name fields and type, delete top row, go to design view & make sure everything okay
not getting decimal places when adjust

Graphing - need Microsoft graph 97

created by:
-add new chart to a form or report
-link existing chart to specific record
-add existing chart to form or report

APPENDIX 5

EMWM DATABASE
PROCESS MODELS

Figure A5.1. Aqueous phase process model (drainage quality).

Figure A5.2. Solid phase process model (waste rock characterization).

Figure A5.3. Error checking process model.

Figure A5.4. Data conversion/calculation process model.

Figure A5.1. Aqueous phase process model (drainage quality).

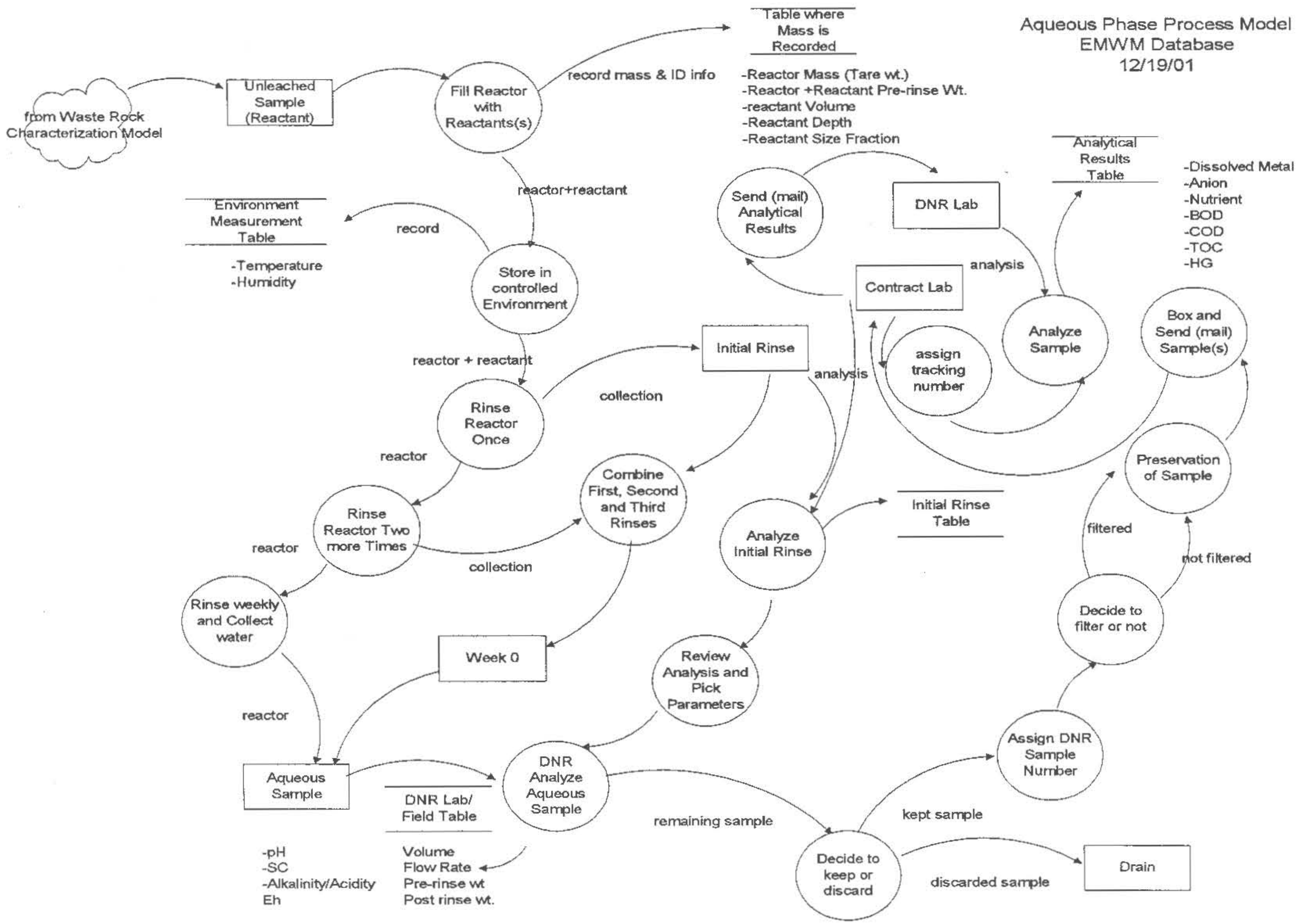

Figure A5.2. Solid phase process model (waste rock characterization).

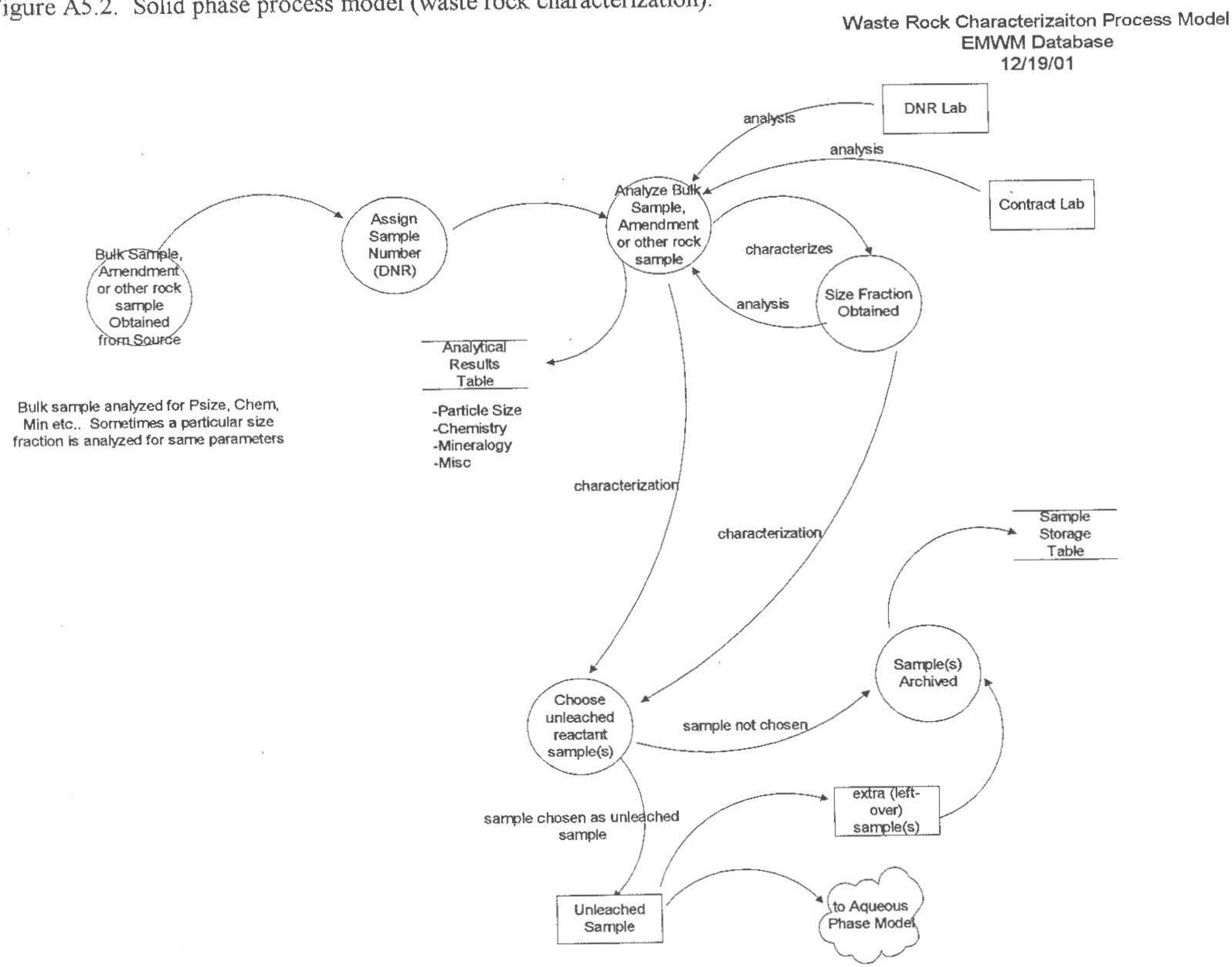

Figure A5.3. Error checking process model.

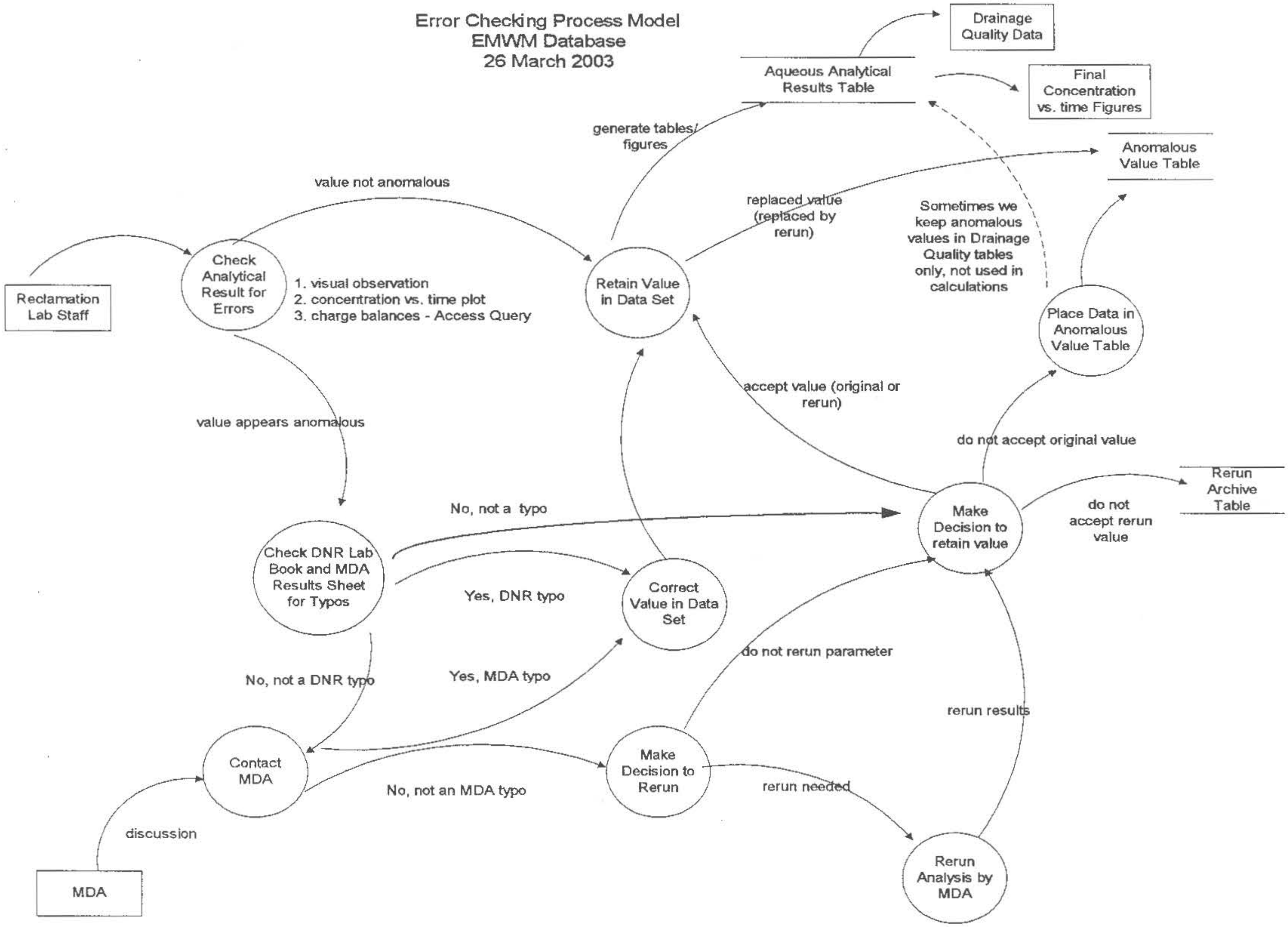

Figure A5.4. Data conversion/calculation process model.