GIS-Based Sediment Quality Database for the St. Louis River Area of Concern (AOC)

Help Section for Database Users

Prepared – *September 2003* – by:

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List of Acronyms

AOC	Area of Concern
ARDC	Arrowhead Regional Development Commission
AVS	Acid Volatile Sulfide
CAS	Chemical Abstracts Service
CD	Compact Disk
CPRD	Coastal Protection and Restoration Division
DBF	Database File
DDT	Dichloro-diphenyl-trichloroethane
ESRI	Environmental Systems Research Institute
GIS	Geographic Information System
GLNPO	Great Lakes National Program Office
IDL	Instrument Detection Limit
IJC	International Joint Commission
MARPLOT	Mapping Application for Response, Planning and Local Operational Tasks
MDL	Method Detection Limit
MESL	MacDonald Environmental Sciences Ltd.
MN	Minnesota
MPCA	Minnesota Pollution Control Agency
MS	Microsoft
N	Nitrogen
NAD	North American Datum
NH_3-N	Ammonia Nitrogen
NOAA	National Oceanic and Atmospheric Administration
PAH	Polycyclic Aromatic Hydrocarbons
PCB	Polychlorinated Biphenyls
PEC	Probable Effect Concentration
PEC-Q	Probable Effect Concentration-Quotient
ppm	parts per million
PQL	Practical Quantitation Limit
QA/QC	Quality Assurance/Quality Control
RAP	Remedial Action Plan
SEM	Simultaneously Extracted Metals
SQL	Structured Query Language
SQT	Sediment Quality Target
USEPA	United States Environmental Protection Agency
UTM	Universal Transverse Mercator
WDNR	Wisconsin Department of Natural Resources
WI	Wisconsin

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Chapter 1. Introduction

The St. Louis River constitutes the second largest tributary to Lake Superior. The headwaters begin in northeastern Minnesota (MN), and the lower estuary, which covers an area of approximately 12,000 acres, bisects the border between Duluth, MN and Superior, WI (MPCA and WDNR 1992). The lower estuary culminates in the Duluth-Superior Harbor, which is one of the largest inland seaports in the world and the most heavily used port in the Great Lakes basin.

The middle and lower portions of the estuary support a variety of industrial, commercial, residential, and recreational activities. In addition, these areas provide essential habitats for aquatic organisms (e.g., walleye) and aquatic-dependent wildlife species (e.g., bald eagle). However, aquatic habitats in some of these areas have been adversely affected by economic development of the St. Louis River over the past 130 years.

In 1987, concerns over environmental quality conditions prompted the International Joint Commission (IJC) to designate 43 Areas of Concern (AOCs) in the Laurentian Great Lakes region between the United States and Canada (IJC 1989). The lower 72 nautical kilometers of the St. Louis River from Cloquet, MN to the Duluth, MN and Superior, WI entries to Lake Superior were designated as one of these AOCs. Contaminated sediments contribute to several use impairments in the St. Louis River AOC, including the issuance of fish advisories, restrictions on dredging, and habitat impairments to bottom-feeding organisms. A number of ecosystem health indicators have been selected to support the assessment of sediment quality conditions within the St. Louis River AOC, including sediment chemistry, sediment toxicity, benthic macroinvertebrate community structure, tissue chemistry, the physical characteristics of sediments, and biomarkers in fish (Crane *et al.* 2000). Investigations conducted using data on multiple indicators provide a weight-of-evidence approach for assessing the effects of contaminated sediments on the beneficial uses of this aquatic ecosystem.

As part of the Remedial Action Plan (RAP) process for the St. Louis River AOC, stakeholders identified a need to compile the sediment quality data collected from the St. Louis River in a database format. As a first step, the Arrowhead Regional Development

Commission (ARDC) developed a sediment quality database in 1990 that included all available sediment quality data (31 studies) from the early 1970s to 1990 (MPCA and WDNR 1995). The sources of these studies included the United States Army Corps of Engineers, United States Environmental Protection Agency (USEPA), Minnesota and Wisconsin (WI) state agencies, contractors, and university researchers. However, no attempt was made to evaluate quality assurance/quality control (QA/QC) procedures in these studies due to a lack of resources. In addition, accurate locational information was not available for most of these sampling stations so the data could not be plotted on maps based on geographic information system (GIS) software.

In October 2000, the Minnesota Pollution Control Agency (MPCA) obtained a grant from the United States EPA's Great Lakes National Program Office (GLNPO) to develop a GIS-based sediment quality database for the St. Louis River AOC. MacDonald Environmental Sciences Ltd. (MESL) was retained in April 2001 to assist the MPCA with this effort. A Quality Assurance Project Plan was completed and approved by GLNPO in July 2001 (Crane 2001) so that work could commence on the project. In October 2001, MESL and MPCA staff met with over 60 stakeholders in Duluth and St. Paul to obtain input on the development of this GIS-based database. Stakeholders were asked to identify priority sediment quality indicators, sources of candidate data sets, and key types of GIS data for the St. Louis River watershed (MacDonald *et al.* 2001). Their input was very useful in producing what should be considered as Phase I of the GIS-based sediment quality database. Additional funding is in the process of being secured to further expand the Microsoft™ (MS) Access 2000 database and ArcView 3.2 projects with additional sediment quality and GIS watershed data. This database, and associated GIS-mapping component, will support the assessment, preservation, and restoration of the lower St. Louis River AOC and adjoining Lake Superior ecosystems.

The purpose of this Help Section for Database Users is to provide an overview of the MS Access 2000 sediment quality database, as well as general instructions for retrieving data from this database. The Help Section is organized into seven chapters and is indexed in such a way as to provide a quick reference guide for users. For more detailed information regarding the content and organization of the GIS-based sediment quality database, users should refer to the accompanying Technical Documentation (Smorong *et al.* 2003a). The

Technical Documentation is available upon request by contacting Judy Crane (MPCA) at 651-297-4068 (voice), 651-297-7709 (fax), or judy.crane@pca.state.mn.us (email).

The sediment quality database was developed in MS Access 2000 format, which is the database format that is available on the project compact disk (CD). The data compiled in the MS Access 2000 database can also be accessed in the National Oceanic and Atmospheric Administrations (NOAA's) St. Louis River Watershed database, which can be viewed using NOAA's free Query Manager software. Query Manager provides a menu of flexible, built-in database queries, and seamless linking to two different mapping applications (ArcView 3.2 and MARPLOT). The advantage that Query Manager offers is the easy-to-use user interface, which is suitable for users with little or no experience using database software. Although there is some loss of flexibility if complex data analyses are necessary, Query Manager offers a wide range of data queries and provides an excellent way for most users to view and query the data. Although the focus of this Help Section for Database Users is designed to help users with the MS Access 2000 version of the database, Chapter 6 provides an overview of the Query Manager software, as well as guidance for accessing and installing the following products available from NOAA's Office of Restoration and Response: Query Manager software, MARPLOT software, the St. Louis River Watershed database, and tools to link Query Manager and ArcView 3.2 (Coastal Protection and Restoration Division; CPRD tools).

Users should note that this Help Section is not meant to replace formal training in the use of MS Access 2000 software. Microsoft™ provides formal training sessions, a detailed built-in Help section, as well as on-line technical support for MS Access 2000 users. Users should refer to these information sources for detailed guidance on the use of MS Access 2000 software.

Chapter 2. Database Design

This chapter is intended to provide database users with a description of the design of the GIS-based sediment quality database in MS Access 2000 format. As such, the design of the database is described in terms of the rationale for the organization of database components, a database description (outlines the content and function of each database component), and the database relationships (outlines the connections between database components).

2.1 Organization of Database Components

The GIS-based sediment quality database was designed primarily as a data storage system for sediment quality data collected from the St. Louis River AOC. In designing the database structure, the existing sediment quality data were examined to facilitate the identification of data types, key variables, and required database fields. Some of the factors that were considered during the design of the database included:

- The need to retrieve data by chemical class [e.g., metals, polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), organochlorine pesticides, etc.];
- The need for assuring compatibility with GIS [e.g., Environmental Systems Research Institute's (ESRI's) ArcView 3.2 software] to facilitate geographic interpretation of the underlying data;
- The requirement for incorporating ancillary information related to the data (e.g., laboratory qualifier codes, sample dates, sediment descriptions, bibliographic references); and,
- The need for subsequently expanding the database to include other data types (e.g., benthic invertebrate community data, etc.).

The design of the GIS-based sediment quality database was patterned after NOAA's Watershed databases, in which sediment chemistry, sediment toxicity, and tissue chemistry data have been compiled, and which can be viewed using NOAA's Query Manager software. A key component of this design is that each sample is georeferenced to facilitate spatial analyses of the underlying data and presentation of the information on appropriate base maps (i.e., in ArcView 3.2 projects). In order to design a system that most directly met the needs of stakeholders, two meetings were held in October 2001 to garner stakeholder input on a number of data management issues. Stakeholders were asked to describe how they foresee using the database (i.e., the likely ways that they would extract and use the data contained in the database), to identify and prioritize sediment quality indicators, and to identify and prioritize GIS data sets of interest. A comprehensive account of the stakeholder meetings has been compiled in a summary report which is available on the MPCA's Contaminated Sediments Web page at http://www.pca.state.mn.us/water/sediments/stlouis-stakeholdermtg (MacDonald *et al.* 2001). Subsequently, the draft database design was reviewed and approved by the MPCA grant and project manager (i.e., Judy Crane).

2.2.1 Description of Database Structure

A detailed description of the database components is provided in Table 1. This table includes a description of the structure and content of each database table, and a description of the information contained in each of the fields (columns) that comprise the tables. To view table descriptions in the database, select the Details icon in the Database window (far right icon in the Database window header), and the table description will be displayed in the Description column. To view field descriptions in the database, see the upper portion of the table in the Design view, or click on a cell in the field of interest and the field description will display in the Status Bar at the bottom of the screen.

2.2.2 Description of Database Relationships

The GIS-based sediment quality database is a relational database. This means that the database consists of several tables that can be linked together (i.e., relationships have been defined) to facilitate retrieval of the data in a wide variety of ways. The purpose of defining relationships is to coordinate the retrieval of information in the different tables. The main advantage of a relational database is that queries, forms, and reports can be created to display information from several tables at once. A relationship works by matching data in key fields (usually a field with the same name in both tables), and these matching fields provide a unique identifier for each data record. Figure 1 shows the database relationships for the database. The key fields that are used to match the data in different tables, and thus provide a unique identifier, are the ***SITEID, STUDYID***, ***STATIONID***, ***SAMPLEID, FIELDREP, LABREP***, and ***CHEMCODE*** fields. These fields were designed to be consistent with fields used in Query Manager.

Chapter 3. Retrieving Data from the GIS-Based Sediment Quality Database

3.1 Introduction

This chapter is intended to provide database users with instructions to support the retrieval of information from the GIS-based sediment quality database . To fulfill this objective, this chapter includes instructions for designing custom queries in MS Access 2000, along with a description of the different data treatment options that should be considered when designing queries.

3.2 Instructions for Designing Custom Queries

Queries are used to view, change, and analyze data in different ways. The power of queries lies in being able to bring together or perform an action on data from more than one table in the database. For example, it may be desirable to view the concentrations of mercury for each sediment sample along with the location of each sample. To see this information, data needs to be extracted from two tables (i.e., **ptbl - CHEM** and **ptbl - SAMPLE**). The most common type of query is a *select query*. A *select query* retrieves data from one or more tables by using specified criteria and then displays it in the desired order (e.g., ascending order based on data value). For more information on queries refer to Appendix 1, which presents instructions for creating *select* queries. In addition, refer to the following topics in MS Access 2000 Help (search for "query" in the Answer Wizard or Index):

- Queries: What they are and how they work;
- Design a query;
- Ways to customize a query;
- Types of queries; and,
- Open or run a query.

Chapter 4. Options for Data Treatment

There are characteristics of sediment quality data (e.g., detection limits for chemical parameters) that require database users to make decisions regarding how to handle the information for the purposes of data analyses. It is essential that these decisions are understood and that the implications of these decisions are considered in the design of database queries (e.g., by including criteria to eliminate certain results and/or samples). This section reviews the alternatives that are available for treating undetected data, QA/QC samples, acid volatile sulfide (AVS) and simultaneously extracted metal (SEM) results, and non-numerical or zero results. In addition, there is a summary of the database development decisions that were made regarding how samples were categorized as surficial or sub-surface, how totals were calculated, and how chemical names were standardized.

4.1 Treatment of Undetected Data

Detection limits are estimates of concentrations at which one can be fairly certain that the compound is present. Concentrations below this limit may not be detected. Concentrations above this limit are almost certainly detected in the analysis. Analytical laboratories use several different kinds of detection limits. An instrument detection limit (IDL) is the lowest limit that the instrument can detect. It is determined on samples which have not gone through any sample preparation steps. A method detection limit (MDL) is similar to an IDL, but it is based on samples which have gone through the entire sample preparation scheme prior to analysis. A practical quantitation limit (PQL) is normally 3 to 10 times the MDL and is considered the lowest concentration that can be accurately measured, as opposed to just detected. Detection limits are actually determined by the analysis of low-level samples or blanks. This information gives the variation in instrument response at levels near the detection limit, from which 99% confidence limits are calculated from the standard deviation. The type of detection limit information included in the MS Access 2000 database varied depending on how the detection limits were reported in each study.

A number of investigators have evaluated the implications of applying various procedures for estimating the concentrations of contaminants from undetected data (Gaskin *et al.* 1990; Porter and Ward 1991; El-Shaawari and Esterby 1992; Clarke and Brandon 1994; Clarke 1998). While there is no consensus on which data censoring method should be used in various applications, the simplest methods tend to be used most frequently, including deletion of undetected values or substitution of a constant, such as zero, the detection limit, or one-half the detection limit for the undetected values (USACE 1995).

To address the need for guidance on statistical treatment of undetected data, the United States Army Corps of Engineers (USACE 1995) conducted a simulation study to assess the performance of 10 methods for censoring data. The results of that investigation indicated that no single data censoring method works best in all situations. Accordingly, the USACE recommended a variety of methods depending on the proportion of the data that requires censoring, the distribution and variance of the data, and the type of data transformation to be applied. For data sets for which a low to moderate proportion of the data require censoring, substitution of the detection limit is generally the preferred method [i.e., to optimize statistical power and control Type I error (an error in a statistical test which occurs when a true hypothesis is rejected; a false negative in terms of the null hypothesis)]. However, as the proportion of the data that requires censoring and the coefficient of variation of the data increase, statistical power is better maintained by substituting of one-half the detection limit for the undetected data, particularly for lognormally distributed and transformed data. Substitution of zero or other constants was also recommended in several circumstances. Overall, it was concluded that simple substitution methods work best to maintain power and control error rates in statistical comparisons of chemical concentration data (USACE 1995; Clarke 1998).

The GIS-based sediment quality database was designed so that there are four data treatment options available to the database user for censoring undetected data:

1. Substituting undetected values with one-half the detection limit.
   If this is the desired data treatment option, the data user must consider the ***MESL_C_CALC*** results field in the **ptbl - CHEM** table.

2. Deleting undetected values.

If this is the desired data treatment option, the data user must consider the ***CONC*** results field in the **ptbl - CHEM** table. In addition, the criteria **Like "NUM"** must be entered in the query design grid for the ***MESL_QUAL_CALC*** field (i.e., only detected results are included in the query results).

3. Substituting undetected values with the detection limit.

   If this is the desired data treatment option, the data user must consider the ***CONC*** results field in the **ptbl - CHEM** table.

4. Excluding undetected values with high detection limits.

   This data treatment option can be used in conjunction with the first and third data treatment options described above. The undetected values with high detection limits [i.e., detection limits greater than the Level II sediment quality targets (SQTs) recommended for use in Minnesota (Crane *et al.* 2000, 2002)] have been identified in the ***MESL_EXCLUDE HIGH ND*** field. As such, the criteria **Not Like "X"** must be entered in the query design grid for this field to exclude these results.

4.2 Treatment of Data for Quality Assurance/Quality Control Samples

In a number of studies, additional samples were collected and/or analyzed as part of the quality assurance program (i.e., field replicates, analytical laboratory duplicates). The reasons QA/QC samples are analyzed along with environmental samples is to provide information on the accuracy and precision of the analytical results. Data for field replicate and analytical laboratory duplicate samples were included in the database, although other types of QA/QC samples were not included (e.g., method blanks, matrix blanks, trip blanks, etc.). Field replicate samples (i.e., two or more individual samples collected in close proximity to assess the degree of spatial variability in field samples) are identified in the ***FIELDREP*** field in the **ptbl - SAMPLE** and **ptbl - CHEM** tables. Analytical laboratory duplicates (i.e., one sample that has been split into two sub-samples and analyzed by the laboratory to assess method precision) are identified in the ***MESL_LABDUP_AVG*** field in the **ptbl - CHEM** table. It should be noted that laboratory split samples are NOT entered as unique samples, rather, the results from the two sub-samples have been averaged to support subsequent data analysis.

4.3 Treatment of AVS and SEM Results

AVS is produced by bacterial breakdown of organic material in sediments, and it is represented as the sum of iron sulfide, manganese sulfide, and metal sulfides. AVS varies with temperature and depth (i.e., lowest in early spring, highest in summer, and increases with depth). SEM includes cadmium, copper, lead, nickel, silver, and zinc that are extracted during the AVS procedure. Assuming that AVS binds a molar equivalent of SEM metal (Di Toro *et al.* 1990), the fraction of SEM metals in excess of AVS concentrations may be available for uptake by benthic biota. Most benthic organisms, including those used in toxicity tests, survive in sediments that have a thin oxidized surface layer and then an anoxic layer. The anoxic layer can have higher AVS concentrations that would reduce the metal activity to which these organisms are exposed (Di Toro *et al.* 1992). When SEM exceeds AVS by a factor of 5 (on a molar basis), a higher incidence of toxicity (80% to 90%) has been observed in freshwater and saltwater amphipod tests (USEPA 1997). Thus, [SEM] - [AVS] $ 5 is a better predictor of sediment toxicity to amphipods.

In the MS Access 2000 database, the results for SEM have been reported in multiple units to support subsequent data analysis. Results for SEM in the **ptbl - CHEM** table are reported in units of parts per million (ppm). This facilitates including both SEM and total metals in data analysis (e.g., making comparisons to Level I and Level II SQTs). The ***MESL_SEMQUAL*** field is populated with “B” to indicate SEM results for samples that also have results for total metals. The purpose of this field is to exclude SEM results for samples that also have results for total metals (i.e., enter the criteria Not Like “B” to only include total metal results for samples that have results for total metals and SEM).

In addition, the SEM results have been included in the **ptbl - AVS and SEM** table in units of :mol/g. This table also includes AVS results reported in units of :mol/g (note that AVS is **NOT** included in the **ptbl - CHEM** table in units of ppm, as these data are not interpreted on this basis).

4.4 Non-Numerical and Zero Results

There are numerous sediment chemistry results in the database for which either non-numerical (e.g., not reported, missing, not quantified, etc.) or zero results were reported in the original data files. The data treatment decision for zero results was to assume these were undetected results (i.e., "ND" was substituted). The data treatment decision for non-numerical results was to include this information in the database, along with the capacity to exclude these results for the purpose of data analyses. The ***MESL_QUAL_CALC*** field in the **ptbl - CHEM** table allows the user to select criteria to ensure that only numerical results are considered. This field has been populated with "NUM" (detected), "U" (undetected), "UX" (undetected and detection limit not indicated), and "X" (no result). Therefore, when designing queries, enter NOT LIKE "*X*" criteria in the ***MESL_QUAL_CALC*** field to consider only numerical results [note the use of the asterisk (*) as it is a wild card]. However, when counting the sample number with undetected results, the criteria should be such that the "UX" results are included (i.e., NOT LIKE "X", therefore not using the asterisk wild card).

4.5 Categorizing Samples as Surficial or Sub-surface

The **ptbl - SAMPLE** table includes the ***MESL_SURF_SUB*** field, which designates each sample as either a surficial or sub-surface sample. The criteria that have been used to categorize samples on this basis are consistent with the criteria used by NOAA for the St. Louis River Watershed database. Samples considered to be surficial have an upper sampling depth of zero and a lower sampling depth of less than or equal to 30 cm (i.e., 0 to #30 cm).

Samples considered to be sub-surface have an upper sampling depth either greater than zero or a lower sampling depth of greater than 30 cm (i.e., >0 cm or $30 cm). For example, a sample collected at 0-10 cm is categorized as a surficial sample, whereas samples collected at 0-40 cm or 5-10 cm are categorized as sub-surface samples.

4.6 Methods for Calculating Total Chemical Concentrations and Mean PEC-Qs

The **ptbl - CHEM** table includes calculated totals for PAHs, PCBs, and pesticides (i.e., chlordane and DDTs). In addition, mean probable effect concentration quotients (PEC-Qs) have been calculated and included in the **ptbl - CHEM** table, which allows for these results to be queried along with other chemistry results. In addition, the mean PEC-Qs are incorporated in the **ptbl - Mean PEC-Q** table, which includes more information about the PEC-Qs contributing to the mean. Mean PEC-Qs were calculated to provide an overall measure of chemical contamination and to support an evaluation of the combined effects of multiple contaminants in sediments. The mean PEC-Qs have been shown to provide a reliable basis for classifying sediments as toxic or not toxic in the St. Louis River AOC, in the larger geographic areas of the Great Lakes, and elsewhere in North America (Ingersoll *et al.* 2001; Crane *et al.* 2002)

Mean PEC-Qs were calculated using the methods that were recommended by Ingersoll *et al.* (2001) and outlined in Crane *et al.* (2000). Generally, a PEC-Q was first determined for each metal for which a reliable PEC was available (i.e., arsenic, cadmium, chromium, copper, lead, nickel, and zinc). Then, an average PEC-Q for metals was calculated by summing the PEC-Qs of each metal and dividing by the number of metals that were included in the calculation. PEC-Qs were also calculated for total PAHs (based on a subset of 13 low molecular weight and high molecular weight PAHs) and total PCBs. Finally, the mean of the average PEC-Q for metals, the PEC-Q for total PAHs, and the PEC-Q for total PCBs was determined for each sediment sample (termed the mean PEC-Q).

The CHEMCODEs that delineate calculated totals can be identified by referring to the records in the **lkp - CHEMDICT** table that have "TOTAL" entered in the ***CHEMCLASS*** field. More details regarding the methods for calculating totals and mean PEC-Qs are included in the **ptbl - STUDYNOT** table.

4.7 Standardization of Chemical Names

One of the main challenges associated with compiling several data sets into a database so the data are comparable and can be combined for the purpose of data analyses is standardizing the chemical names used in the individual data sources. Many chemicals typically have several synonyms (e.g., "ammonia" is commonly referred to as ammonia-N, ammonia, ammonia-total, ammonia as N, NH_3-N, etc.). A problem arises because data from each study were generated at different analytical laboratories, each potentially using their own list of chemical names to report the results. There are a variety of systems that provide unique identifiers for chemical substances to provide an unambiguous way to identify a chemical substance when there are many possible systematic, generic, proprietary, or trivial names [e.g., Chemical Abstracts Service (CAS)].

In order to handle the issue of standardizing chemical names in the database, a standard chemical code (i.e., the ***CHEMCODE*** field) was assigned for each chemical name. Assigning a short code to represent long chemical names also reduces the chance of error in entering long chemical names that must be exact to ensure that related data tables are correctly connected. The **lkp - CHEMDICT** table lists each of the unique chemical codes (i.e., *CHEMCODE*) and provides the full chemical name and other associated information that is helpful in the evaluation of the data (e.g., chemical classification, standard units of measure, etc.). It is especially important to refer to the ***CHEMNAME*** field in the **lkp - CHEMDICT** table when interpreting particle size data, as the micron size applicable to that CHEMCODE is specified in this field.

Chapter 5. Linking the GIS-Based Sediment Quality Database with Accompanying ArcView 3.2 Projects

The watershed GIS data that were compiled in the accompanying ArcView 3.2 projects provide a basis for users to spatially view and interpret the data incorporated in the sediment quality database (see the Help Section for ArcView 3.x Users for further information; Smorong *et al.* 2003b). The ArcView 3.2 projects contain three basemap options in which to overlay the locations of sediment sample locations contained in the database: digital orthographic aerial photographs, digital orthographic topographic maps, and basic line and polygon theme data. There are ten ArcView 3.2 projects, each containing GIS watershed data categorized by major theme (e.g., contaminated areas, ecological areas, hydrology, land use, etc.), as well as the three basemap options.

In order to plot the data in ArcView 3.x, the data must have associated geographical coordinates. The sediment quality database stores the UTM Zone 15 NAD 83 coordinates in the **ptbl - STATION** table. As such, the user must combine the data of interest (e.g., mercury concentrations, toxic/not toxic designations for 10-day *Hyalella azteca* survival toxicity tests) with these geographical coordinates. To accomplish this task, a query must be designed and saved (see Appendix 1 for instructions for designing custom queries in MS Access 2000).

Data can be imported into any of the ArcView 3.2 projects using ArcView's Structured Query Language (SQL) connection feature. This feature allows users to query a database using SQL and to store the returned records in an ArcView table. Section 4.2 of the Help Section for ArcView 3.x Users provides instructions for linking the ArcView 3.2 projects with the MS Access 2000 version of the GIS-based sediment quality database (Smorong *et al.* 2003b). Query results obtained from NOAA's Query Manager software can also be seamlessly linked to the ArcView 3.2 projects. Users should refer to Chapter 6 for additional information regarding the accessability, installation, and set-up of the Query Manager software, as well as information on how to link the Query Manager and ArcView applications.

Chapter 6. Applications Available from NOAA

6.1 Introduction

Protecting and restoring coastal watersheds involves understanding an array of complex environmental issues and synthesizing various kinds of information. The challenge of evaluating multiple environmental issues is made easier by combining scientific data and watershed characteristics into a GIS. NOAA's CPRD has developed numerous Watershed Database and Mapping Projects that combine a standard database structure (Query Manager) with a database-mapping application (MARPLOT) and GIS tools. Sediment chemistry concentrations, sediment toxicity and tissue data, natural resources, and potential habitat restoration projects can be overlaid on a watershed's features and land uses, and displayed on maps at flexible spatial scales.

The data compiled in the MS Access 2000 database have been converted and included in NOAA's St. Louis River Watershed database, which can be viewed using NOAA's Query Manager software. Query Manager provides a menu of flexible, built-in database queries, and provides seamless linking to two different mapping applications (ArcView 3.x and MARPLOT). The advantage that Query Manager offers is the easy-to-use user interface, which is suitable for users with little or no experience using database software. Although there is some loss of flexibility if complex data analyses are necessary, Query Manager offers a wide range of data queries and provides an excellent way for most users to view and query the data.

6.2 Accessing NOAA's Applications

The following products are available for free from NOAA's Office of Restoration and Response Web page:
(http://response.restoration.noaa.gov/cpr/watershed/watershedtools.html):

- Query Manager 2.5 software (data delivery application that offers a menu of flexible, built-in database queries);
- MARPLOT 3.3 software (a mapping application that can be seamlessly linked to display query results from Query Manager software; this software is best used by people lacking ArcView 3.x);
- NOAA's CPRD Tools (a collection of GIS tools created for ArcView 3.x to assist with the development and analysis of spatial data); and,
- The St. Louis River Watershed database.

Each of these applications is accompanied by detailed instructions for installation and use. Users should note the following details regarding NOAA's St. Louis River Watershed database:

- The Watershed database will be updated in October-November 2003 to incorporate all of the data included in the MS Access 2000 sediment quality database for the St. Louis River AOC, as well as some additional data sets for the Interlake/Duluth Tar Superfund site;
- The data sets that are unique to the NOAA St. Louis River Watershed database (i.e., not included in the MS Access 2000 database) have not undergone the same data evaluation procedures as the data sets incorporated in the MS Access 2000 database;
- Users should be aware that there are other minor differences between the NOAA Watershed database and the MS Access 2000 sediment quality database (e.g., any field prefixed by "MESL_" in the MS Access 2000 database is not included in NOAA's database, mean PEC-Qs are calculated using different methods, etc.); and,
- Under the "Data and Maps" section of NOAA's Web page, the date of the most recent database update is provided (users should check this web page periodically for future updates).

6.3 Converting the MS Access 2000 Database to Query Manager Format

Some users may wish to use the Query Manager software with the version of the data compiled in the MS Access 2000 database, particularly because the mean PEC-Qs (as described in Section 4.6) are included in the **ptbl - CHEM** table. If so, contact Judy Crane (MPCA) at 651-297-4068 (voice), 651-297-7709 (fax), or judy.crane@pca.state.mn.us (email) for a copy of the Query Manager database prepared by MESL staff from the MS Access 2000 database. As a short-hand descriptor, this database will be referred to as the "MESL Query Manager" database to avoid confusion with NOAA's Watershed database for the St. Louis River.

Users can also make this conversion themselves by following the step by step instructions given below for converting the MS Access 2000 database from the project CD to a format compatible with Query Manager version 2.5:

1. Split the **ptbl - SAMPLE** table into two tables, one named "SAMPLE" which contains the surficial samples, and one named "SMPSEDSB" which contains the sub-surface samples (identified in the ***MESL_SURF_SUB*** field).
2. Split the **ptbl - CHEM** table into two tables, one named "CHEM" which contains the results for surficial samples, and one named "CHEMSB" which contains the results for sub-surface samples. This step will require the user to build a make-table query:
   - Add the **ptbl - CHEM** table and the **ptbl - SAMPLE** tables;
   - Change the Query Type to "Make-table" and enter the Table Name as CHEM;
   - Include all fields from the **ptbl - CHEM** table and the ***MESL_SURF_SUB*** field from the **ptbl - SAMPLE** table;
   - Click the check mark in the ***MESL_SURF_SUB*** field to uncheck it;
   - Enter "Surficial" as criteria in the ***MESL_SURF_SUB*** field;
   - Run the query (click the button with the exclamation mark);

- Change the criteria in the ***MESL_SURF_SUB*** field to "subsurface";
- Click on the Query Type button and change the Table Name to CHEMSB; and
- Run the query (click the button with the exclamation mark).

3. In the CHEM and CHEMSB tables, update the ***MISSINGVAL*** field to "-1" where there is an "X" in the ***MESL_EXCLUDE HIGH ND*** field. This will exclude the undetected results with detection limits greater than the Level II SQT when running queries in Query Manager.

4. Export the following tables as database file (DBF) files to the C:\qm25win\stlouis\sl_data folder. Note that the table names must not include the "ptbl" prefix. Note that the following tables will be replaced if the St. Louis River Watershed database has previously been downloaded from NOAA's web site.
   - BIOSUMM
   - CHEM
   - CHEMSB (this is a table that has just been created)
   - CHEMTISS
   - SAMPLE
   - SITE
   - SMPSEDSB (this is a table that has just been created)
   - SMPTISS
   - STATION
   - STUDY
   - STUDYNOT
   - STUDYREF

4. Export the following tables as DBF files to the C:\qm25win folder. Note that the table names must not include the "lkp" prefix. The following tables will be replaced in this step.
   - CHEMDICT

- QUALIFY
- SPECIES
- SQC
- SQCDICT
- SQCPAIRS
- TESTDICT
- TISSQUAL
- TISSTYPE

5. Proceed with using the “MESL Query Manager” database.

Chapter 7. Project Contact

For further information about the MS Access 2000 or "MESL Query Manager" sediment quality databases for the St. Louis River AOC, contact Judy Crane at:

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MPCA
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Funds are currently being sought by the MPCA to expand the GIS-based sediment quality database, including expanding the geographic coverage of sediment quality data sets and adding benthic community data to the database. Users will be notified when additional phases of this project have been completed.

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Table 1. Detailed Description of Database Components.

TABLE NAME / Field Name	Data Type	Field Size	TABLE DESCRIPTION / Field Description
lkp - CHEMDICT	**NA**	**NA**	**Chemical dictionary (only included chemicals represented in the ptbl - CHEM table).**
CHEMCODE	Text	10	Chemical code (defined in lkp - chemdict).
CHEMNAME	Text	45	Chemical name.
CHEMCLASS	Text	8	Class of chemical.
CATEGORY	Text	8	Query Manager field (not populated).
SUBCATGY	Text	10	Query Manager field (not populated).
CHEMTOTAL	Text	10	Query Manager field (not populated).
MOLWT	Number	8	Molecular weight of chemical.
CASNUM	Text	24	Chemical abstract services number.
UNITS	Text	6	Units of chemical concentration.
WA_UNITS	Text	6	Query Manager field (not populated).
EDITDATE2	Text	8	Query Manager field (not populated).
EDITBY	Text	15	Query Manager field (not populated).
EDITDATE	Date/Time	8	Query Manager field (not populated).
MESL_synonym	Text	150	Synonym for chemical name.
MESL_syn2	Text	150	Synonym for chemical name.
MESL_syn3	Text	150	Synonym for chemical name.
MESL_casno	Text	50	Chemical abstract services number (MESL version).
MESL_update	Text	50	Indicates if the record has been updated from the original NOAA Query Manager CHEMDICT file.
lkp - QUALIFY	**NA**	**NA**	**Lookup table for sediment chemistry qualifiers (QUALCODE).**
SITEID	Text	4	Site ID code (from Query Manager).
STUDYID	Text	2	Study ID code.
QUALCODE	Text	5	Qualifier code for concentration value, modified to be compatible with Query Manager (all ND data has a "U" in this field).
QUALIFIERS	Text	30	Qualifier code for concentration value, as designated in report.
DESCRIPT	Text	80	Description of the meaning of the qualifier, as indicated in the original report or data file.
MESL_LIBNO	Text	50	MESL - library number.

Table 1. Detailed Description of Database Components.

TABLE NAME / Field Name	Data Type	Field Size	TABLE DESCRIPTION / Field Description
lkp - SPECIES	**NA**	**NA**	**Lookup table for tissue samples species type (SPP).**
SPP	Text	5	Species code.
COMMONNAME	Text	25	Common name.
SCIENTIFIC	Text	40	Scientific name.
GROUP	Text	25	Query Manager field (not populated).
EDITDATE2	Text	8	Query Manager field (not populated).
EDITBY	Text	15	Query Manager field (not populated).
EDITDATE	Date/Time	8	Query Manager field (not populated).
MESL_COMMENT	Text	50	MESL - comments.
lkp - SQC	**NA**	**NA**	**Sediment Quality Criteria: Level I and Level II SQTs (Crane *et al.* 2000).**
SQCCODE	Text	10	Code for Sediment Quality Criteria (see lkp - Sqcdict for a description of the codes).
CHEMCODE	Text	10	Chemical code (defined in lkp - chemdict).
CONC	Number	8	Chemical concentration.
UNITS	Text	6	Units of SQC is reported in.
NORM	Text	2	Indicates measurement basis SQC are reported in.
MESL_chemical name	Text	50	MESL - chemical name.
MESL_units	Text	50	MESL - units.
MESL_comment	Text	100	MESL - comments.
lkp - Sqcdict	**NA**	**NA**	**Lookup table for Sediment Quality Criteria references (SQCCODE).**
SQCCODE	Text	10	Code for Sediment Quality Criteria.
SQCDESCR	Text	90	Description of the SQCCODE.
YEAR	Text	4	Year of publishing for study reporting the sediment quality criteria.
AUTHORS	Text	160	Authors for study reporting the sediment quality criteria.
TITLE	Text	160	Title of the study reporting the sediment quality criteria.
SOURCE	Text	160	Source (location) for study reporting the sediment quality criteria.
COMMENT	Text	160	Comments.

Table 1. Detailed Description of Database Components.

TABLE NAME / Field Name	Data Type	Field Size	TABLE DESCRIPTION / Field Description
lkp - SQCPAIRS	**NA**	**NA**	**Lookup table for identifying Sediment Quality Criteria pairs.**
PAIRNAME	Text	50	High and low Sediment Quality Criteria (how Query Manager will reference the pair).
SQCLOW	Text	10	SQCCODE of low Sediment Quality Criteria.
SQCHIGH	Text	10	SQCCODE of high Sediment Quality Criteria.
LOW_NAME	Text	8	Low Sediment Quality Criteria (how Query Manager will reference the SQC).
HIGH_NAME	Text	8	High Sediment Quality Criteria (how Query Manager will reference the SQC).
SORT_ORDER	Number	2	Query Manager field (did not populate).
lkp - TESTDICT	**NA**	**NA**	**Lookup table for toxicity test dictionary (TESTID).**
TESTID	Text	12	Code describing the bioassay.
MEDIUM	Text	15	Medium used in toxicity test (e.g., bulk sediment or pore water).
MEDCODE	Text	2	Code used to indicate medium used in toxicity test.
GROUP	Text	20	Group of organism used in toxicity test (e.g., bacteria or amphipod).
ALTGROUP	Text	20	Group of organism used in toxicity test - alternate.
SPECIES	Text	40	Species used in toxicity test.
SPPCODE	Text	3	Code used to indicate species used in toxicity test.
LHS	Text	10	Life stage of organism used in toxicity test.
LHSCODE	Text	1	Code used to indicate life stage of organism used in toxicity test.
ENDPOINT	Text	30	Endpoint of toxicity test (e.g., growth or survival).
ENDCODE	Text	2	Code used to indicate endpoint of toxicity test.
DURATION	Text	10	Duration of toxicity test.
DURCODE	Text	4	Code used to indicate duration of toxicity test.
HABITAT	Text	2	Query Manager field (not populated).
EDITDATE	Date/Time	8	Query Manager field (not populated).
EDITDATE2	Text	8	Query Manager field (not populated).
EDITBY	Text	15	Query Manager field (not populated).
lkp - TISSQUAL	**NA**	**NA**	**Lookup table for tissue chemistry qualifiers (QUALCODE).**
SITEID	Text	4	Site ID code (from Query Manager).
STUDYID	Text	2	Study ID code.

Table 1. Detailed Description of Database Components.

TABLE NAME / Field Name	Data Type	Field Size	TABLE DESCRIPTION / Field Description
lkp - TISSQUAL (cont.)			
QUALCODE	Text	5	Qualifier code for concentration value, modified to be compatible with Query Manager (all ND data has a "U" in this field).
QUALIFIERS	Text	30	Qualifier code for concentration value, as designated in report.
DESCRIPT	Text	80	Description of the meaning of the qualifier, as indicated in the original report or data file.
MESL_LIBNO	Text	50	MESL - library number.
lkp - TISSTYPE	**NA**	**NA**	**Lookup table for tissue sample tissue types (TISSCODE).**
TISSCODE	Text	6	Tissue type code.
DESCRIPT	Text	50	Description of tissue type.
EDITDATE	Date/Time	8	Query Manager field (not populated).
EDITDATE2	Text	8	Query Manager field (not populated).
EDITBY	Text	15	Query Manager field (not populated).
ptbl - AVS_SEM	**NA**	**NA**	**Sediment chemistry results for Acid Volatile Sulfides and Simultaneously Extracted Metals (units of µmol/g).**
SITEID	Text	4	Site ID code (from Query Manager).
STUDYID	Text	2	Study ID code.
STATIONID	Text	6	Station ID code (this is the MESL_STATIONID, unless it exceeded 6 characters, then the QM_STATIONID was substituted).
SAMPLEID	Text	2	Sample ID code.
FIELDREP	Text	2	Identifies field replicate samples (samples collected in close proximity).
LABREP	Text	2	This field will not be populated (lab dups will be averaged and the MESL_LABREP_AVG field identifies these averaged results).
CHEMCODE	Text	10	Chemical code (defined in lkp - CHEMDICT).
QUALCODE	Text	5	Qualifier code for concentration value, modified to be compatible with Query Manager (all ND data has a "U" in this field).
CONC	Number	8	Chemical concentration (dry weight basis).
UNITS	Text	6	Units of chemical concentration.

Table 1. Detailed Description of Database Components.

TABLE NAME / Field Name	Data Type	Field Size	TABLE DESCRIPTION / Field Description
ptbl - AVS_SEM (cont.)			
MEASBASIS	Text	2	Measurement basis - dry weight (DW).
MISSINGVAL	Yes/No	1	'Yes' indicates a missing value (i.e., not reported, not sampled, lost, etc; -9 entered in CONC field).
MESL_LIBNO	Text	20	MESL - library number.
MESL_STATIONID	Text	50	MESL - station ID (retains the Station ID code as it appears in the original datafiles and/or reports).
MESL_UNITS	Text	7	MESL - units of concentration value.
MESL_QUAL_CALC	Text	10	MESL - qualifier code for concentration value - used for calculation purposes (NUM - value, U - less than detect value; X - do not include in calculations).
MESL_semqual	Text	50	MESL - qualifier code to indicate whether to use SEM metal conc. or total metal conc. (B entered in this field indicates that both are measured, therefore do not use the SEM result).
MESL_C_TXT	Text	50	MESL - concentration value represented in a text field (nondetected results include a "<").
MESL_LABDUP_AVG	Yes/No	1	MESL - indicates if Lab Reps were averaged.
MESL_C_CALC	Number	8	MESL - concentration value represented in a number field (nondetected results included as 1/2 the detection limit).
MESL_EXCLUDE HIGH ND	Text	50	MESL - X entered in this field indicates a nondetected result with a detection limit greater than the Level II SQT.
MESL_comment	Text	250	MESL - comments.
ptbl - BIOSUMM	**NA**	**NA**	**Sediment toxicity test and bioaccumulation test results.**
SITEID	Text	4	Site ID code (from Query Manager).
STUDYID	Text	2	Study ID code.
STATIONID	Text	6	Station ID code (this is the MESL_STATIONID, unless it exceeded 6 characters, then the QM_STATIONID was substituted).
SAMPLEID	Text	2	Sample ID code.
FIELDREP	Text	2	Identifies field replicate samples (samples collected in close proximity).
TESTID	Text	12	Code describing the bioassay (see lkp - TESTDICT table for a description of the codes).
GROUP	Text	2	Query Manager field (did not populate).
SERIES	Text	2	Associates control sample results with test results.
EFFECTVAL	Number	8	Toxicity test result (e.g., percent survival).

Table 1. Detailed Description of Database Components.

TABLE NAME / Field Name	Data Type	Field Size	TABLE DESCRIPTION / Field Description
ptbl - BIOSUMM (cont.)			
SIGEFFECT	Yes/No	1	Toxic (-1) or Not toxic (0).
NEG	Yes/No	1	Negative control sample? Yes (-1) or No (0).
REF	Yes/No	1	Reference sample? Yes (-1) or No (0).
STAT	Yes/No	1	Identifies sample used to determine significance (T/NT) - ND results (i.e., growth endpoint not measured because of low survival) from SQT database added as NOT TOXIC.
SIG_ORIGIN	Text	50	Original significance designations - from QM database.
CTRLADJ	Number	8	Control adjusted result (test result/control result*100).
TOXCODE	Text	1	Query Manager field (did not populate).
MESL_LIBNO	Text	50	MESL - library number.
MESL_STATIONID	Text	50	MESL - Station ID (retains the Station ID code as it appears in the original datafiles and/or reports).
MESL_TOXIC	Text	2	Toxic (T), Not toxic (NT), or ND (growth endpoint not measured because of low survival).
MESL_comment	Text	250	MESL - comments.
ptbl - CHEM	**NA**	**NA**	**Sediment chemistry results for surficial sediment samples (upper depth 0 cm and lower depth </= 30 cm).**
SITEID	Text	4	Site ID code (from Query Manager).
STUDYID	Text	2	Study ID code.
STATIONID	Text	6	Station ID code (this is the MESL_STATIONID, unless it exceeded 6 characters, then the QM_STATIONID was substituted).
SAMPLEID	Text	2	Sample ID code.
FIELDREP	Text	2	Identifies field replicate samples (samples collected in close proximity).
LABREP	Text	2	This field will not be populated (lab dups will be averaged and the MESL_LABREP_AVG field identifies these averaged results).
CHEMCODE	Text	10	Chemical code (defined in lkp - CHEMDICT).
QUALCODE	Text	5	Qualifier code for concentration value, modified to be compatible with Query Manager (all ND data has a "U" in this field).
CONC	Number	8	Chemical concentration (dry weight basis)
UNITS	Text	6	Units of chemical concentration.

Table 1. Detailed Description of Database Components.

TABLE NAME / Field Name	Data Type	Field Size	TABLE DESCRIPTION / Field Description
ptbl - CHEM (cont.)			
MEASBASIS	Text	2	Measurement basis - dry weight (DW).
MISSINGVAL	Yes/No	1	'Yes' indicates a missing value (i.e., not reported, not sampled, lost, etc; -9 entered in CONC field).
MESL_LIBNO	Text	20	MESL - library number.
MESL_STATIONID	Text	50	MESL - station ID (retains the Station ID code as it appears in the original datafiles and/or reports).
MESL_UNITS	Text	7	MESL - units of concentration value.
MESL_QUAL_CALC	Text	10	MESL - qualifier code for concentration value - used for calculation purposes (NUM - value, U - less than detect value; X - do not include in calculations).
MESL_semqual	Text	50	MESL - qualifier code to indicate whether to use SEM metal conc. or total metal conc. (B entered in this field indicates that both are measured, therefore do not use the SEM result).
MESL_C_TXT	Text	50	MESL - concentration value represented in a text field (nondetected results include a "<").
MESL_LABDUP_AVG	Yes/No	1	MESL - indicates if Lab Reps were averaged.
MESL_C_CALC	Number	8	MESL - concentration value represented in a number field (nondetected results included as 1/2 the detection limit).
MESL_EXCLUDE HIGH ND	Text	50	MESL - X entered in this field indicates a nondetected result with a detection limit greater than the Level II SQT.
MESL_comment	Text	250	MESL - comments.
ptbl - CHEMTISS	**NA**	**NA**	**Tissue chemistry results.**
SITEID	Text	4	Site ID code (from Query Manager).
STUDYID	Text	2	Study ID code.
STATIONID	Text	10	Station ID code (this is the MESL_STATIONID, unless it exceeded 6 characters, then the QM_STATIONID was substituted).
SAMPLEID	Text	2	Sample ID code.
FIELDREP	Text	2	Identifies field replicate samples (samples collected in close proximity).
LABREP	Text	2	Not populated (lab dups will be averaged and the MESL_LABREP_AVG field identifies these averaged results).
CHEMCODE	Text	10	Chemical code (defined in lkp - chemdict)

Table 1. Detailed Description of Database Components.

TABLE NAME / Field Name	Data Type	Field Size	TABLE DESCRIPTION / Field Description
ptbl - CHEMTISS (cont.)			
CONC	Number	8	Chemical concentration (wet weight basis).
QUALCODE	Text	5	Qualifier code for concentration value, as designated in report (see lkp_TISSQUAL table for a description of the codes).
UNITS	Text	6	Units of chemical concentration.
MEASBASIS	Text	2	Measurement basis - wet weight (WW).
MISSINGVAL	Yes/No	1	'Yes' indicates a missing value (i.e., not reported, not sampled, lost, etc; -9 entered in CONC field).
MESL_LIBNO	Text	20	MESL - library number.
MESL_STATIONID	Text	50	MESL - Station ID (retains the Station ID code as it appears in the original datafiles and/or reports).
MESL_UNITS	Text	7	MESL - units of concentration value.
MESL_QUAL_CALC	Text	10	MESL - qualifier code for concentration value - used for calculation purposes (NUM - value, U - less than detect value; X - do not include in calculations; UX - less than MDL, detection limit not known).
MESL_comment	Text	250	MESL - comments.
MESL_CONC_TXT	Text	50	MESL - concentration field that retains significant figures reported in datafile/study, as well and "<" symbols (for printing).
MESL_LABREP_AVG	Yes/No	1	MESL - "Yes" indicates an averaged result for laboratory duplicates (QA/QC split samples which were both analyzed by the lab).
ptbl - Mean PEC-Q	**NA**	**NA**	**Mean Probable Effect Concentration-Quotients (Mean PEC-Q). NOT A QUERY MANAGER TABLE.**
SITEID	Text	4	Site ID code (from Query Manager).
STUDYID	Text	2	Study ID code.
STATIONID	Text	6	Station ID code (this is the MESL_STATIONID, unless it exceeded 6 characters, then the QM_STATIONID was substituted).
SAMPLEID	Text	2	Sample ID code.
FIELDREP	Text	2	Identifies field replicate samples (samples collected in close proximity).
LABREP	Text	2	This field will not be populated (lab dups will be averaged and the MESL_LABREP_AVG field identifies these averaged results).

Table 1. Detailed Description of Database Components.

TABLE NAME / Field Name	Data Type	Field Size	TABLE DESCRIPTION / Field Description
ptbl - Mean PEC-Q (cont.)			
PECQ met	Number	8	PEC quotient for metals.
PECQ pah	Number	8	PEC quotient for PAHs.
PECQ pcb	Number	8	PEC quotient for PCBs.
MeanPECQ	Number	8	Mean PEC quotient (as calculated).
MeanPECQ (3 sf)	Number	8	Mean PEC quotient (3 significant figures).
ptbl - SAMPLE	**NA**	**NA**	**Surficial sediment sample information (upper depth 0 cm and lower depth </= 30 cm).**
SITEID	Text	4	Site ID code (from Query Manager).
STUDYID	Text	2	Study ID code.
STATIONID	Text	6	Station ID code (this is the MESL_STATIONID, unless it exceeded 6 characters, then the QM_STATIONID was substituted).
SAMPLEID	Text	2	Sample ID code.
FIELDREP	Text	2	Identifies field replicate samples (samples collected in close proximity).
LABREP	Text	2	This field will not be populated (lab dups will be averaged and the MESL_LABREP_AVG field identifies these averaged results).
UDEPTH	Number	8	Upper sampling depth (cm).
LDEPTH	Double	8	Lower sampling depth (cm).
SAMPDATE	Text	8	Sample date (YYYYMMDD).
SAMPTIME	Text	5	Sample time.
TOC	Number	8	Total organic carbon (%).
PCTFINES	Number	8	Percent fines (sand + clay).
UAN_PW	Number	8	Unionized ammonia in pore water.
H2S_PW	Number	8	Hydrogen sulfide in pore water.
EXSAMPID	Text	15	Original station ID reported in study or data file.
MESL_LIBNO	Text	50	MESL - library number.
MESL_STATIONID	Text	50	MESL - station ID (retains the Station ID code as it appears in the original datafiles and/or reports).
MESL_Mean PEC-Q	Number	8	MESL - Mean PEC-Q (3 significant figures).
MESL_MATCH	Text	50	MESL - indicates if the sample has matching sediment chemistry and toxicity data.

Table 1. Detailed Description of Database Components.

TABLE NAME / Field Name	Data Type	Field Size	TABLE DESCRIPTION / Field Description
ptbl - SAMPLE (cont.)			
MESL_WATERDEPTH	Text	50	MESL - water depth at the point of sediment sampling (m).
MESL_SOFTDEPTH	Text	50	MESL - soft sediment depth (m).
MESL_SEDDESC	Text	255	MESL - sediment description (have included the sediment description if this data was available electronically).
MESL_SURF_SUB	Text	50	MESL - indicates if the sample is designated as surficial or sub-surface, according to NOAA's Query Manager rules.
MESL_comments	Text	255	MESL - comments.
ptbl - SITE	**NA**	**NA**	**QM table.**
SITEID	Text	4	Site ID code (from Query Manager).
SITENAME	Text	40	
EPAREGION	Number	2	
COUNTY	Text	25	
STATE	Text	2	
CERCLIS	Text	12	
REACH	Text	8	
REACHSEG	Text	11	
LATITUDE	Number	8	
LONGITUDE	Number	8	
WATERSHED	Text	20	
ptbl - SMPTISS	**NA**	**NA**	**Tissue sample information.**
SITEID	Text	4	Site ID code (from Query Manager).
STUDYID	Text	2	Study ID code.
STATIONID	Text	10	Station ID code (this is the MESL_STATIONID, unless it exceeded 6 characters, then the QM_STATIONID was substituted).
SAMPLEID	Text	2	Sample ID code.
FIELDREP	Text	2	Identifies field replicate samples (samples collected in close proximity).

Table 1. Detailed Description of Database Components.

TABLE NAME / Field Name	Data Type	Field Size	TABLE DESCRIPTION / Field Description
ptbl - SMPTISS (cont.)			
LABREP	Text	2	Not populated (lab dups will be averaged and the MESL_LABREP_AVG field identifies these averaged results).
SAMPDATE	Text	8	Date sample collected (YYYYMMDD).
SAMPTIME	Text	5	Time sample collected.
SPECIES	Text	5	Species from which the tissue sample was collected (see the lkp_SPECIES table for a description of the codes).
SPP	Text	5	Species code (see the lkp_SPECIES table for a description of the codes).
TISSUE	Text	30	Tissue type analyzed (see the lkp_TISSTYPE table for a description of the codes).
TISSCODE	Text	6	Tissue type code (see the lkp_TISSTYPE table for a description of the codes).
LIFESTAGE	Text	1	Lifestage of the organism at the time of sampling (not populated).
NOINCOMP	Number	2	Number of individuals in a composite sample.
LENGTH	Number	8	Length (cm) of individual organisms collected for tissue analysis.
WEIGHT	Number	8	Weight of individual organisms collected for tissue analysis (not populated).
SEX	Text	1	Sex of individual organisms collected for tissue analysis (not populated).
AGE	Number	2	Age of individual organisms collected for tissue analysis (not populated).
PCTLIPID	Number	8	Percent lipids (%).
EXSAMPID	Text	15	Query Manager field (not populated).
MESL_LIBNO	Text	50	MESL - library number.
MESL_STATIONID	Text	50	MESL - Station ID (retains the Station ID code as it appears in the original datafiles and/or reports).
MESL_COMMENT	Text	255	MESL - comments.
ptbl - STATION	**NA**	**NA**	**Station information (sediment and tissue samples).**
SITEID	Text	4	Site ID code (from Query Manager).
STUDYID	Text	2	Study ID code.
STATIONID	Text	6	Station ID code (this is the MESL_STATIONID, unless it exceeded 6 characters, then the QM_STATIONID was substituted).
AREA	Text	50	Waterbody (corresponds with 'DB_AREA' theme in GIS projects).
LOCDESC	Text	50	Reach (corresponds with 'Location Description' theme in GIS projects).

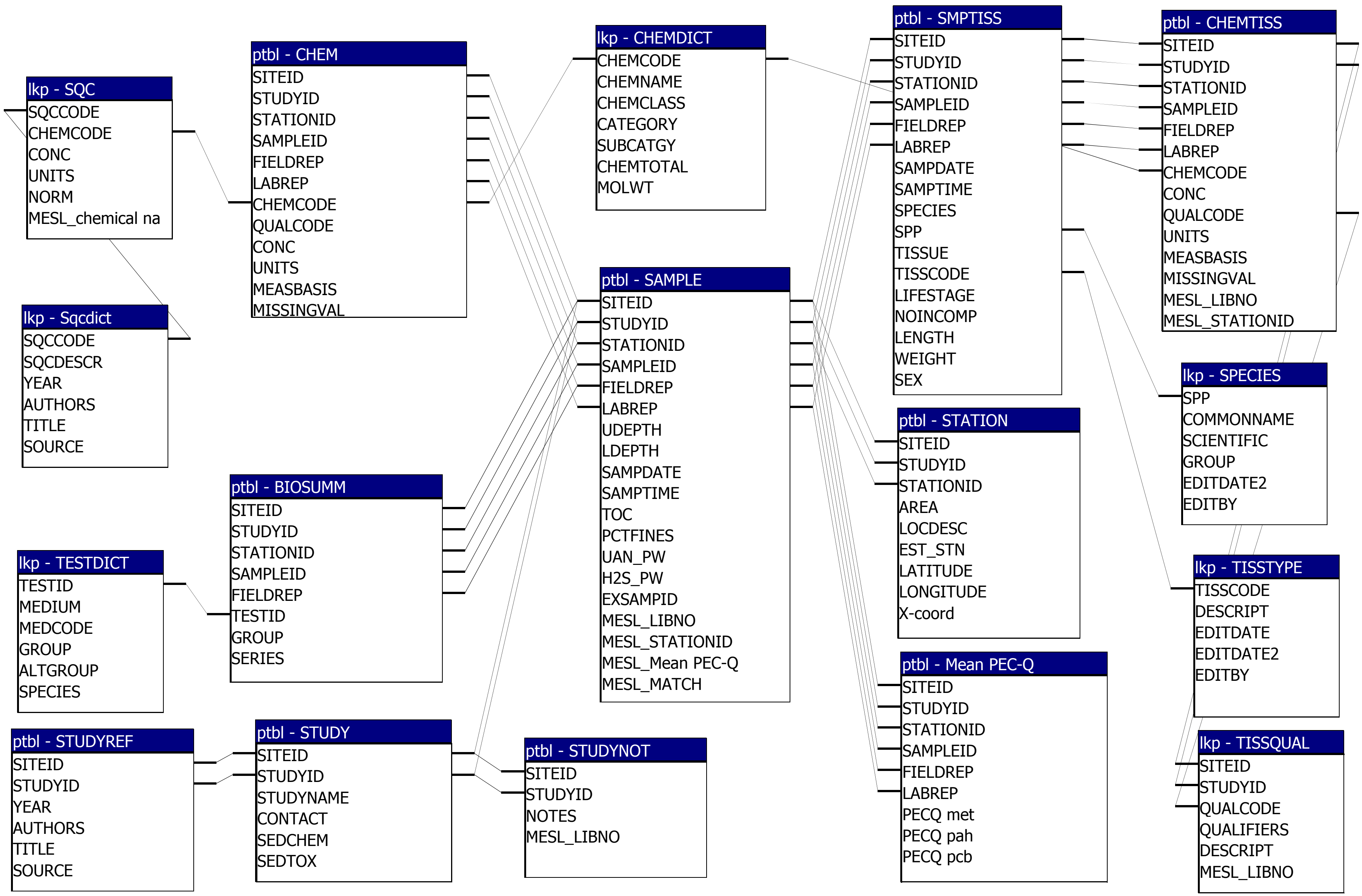
Table 1. Detailed Description of Database Components.

TABLE NAME / Field Name	Data Type	Field Size	TABLE DESCRIPTION / Field Description
ptbl - STATION (cont.)			
EST_STN	Text	50	Code indicating how the geographic coordinates were obtained (R = reported; P = plotted in GIS based on a map from the report; E = estimated using site descriptions from report; U = unknown).
LATITUDE	Number	8	Geographical coordinates (decimal degrees).
LONGITUDE	Number	8	Geographical coordinates (decimal degrees).
X-coord	Text	50	Geographical coordinates (UTM Zone 15 NAD83 datum).
Y-coord	Text	50	Geographical coordinates (UTM Zone 15 NAD83 datum).
MESL_LIBNO	Text	50	MESL - library number.
MESL_EST_STN	Text	50	Description of how the geographic coordinates were obtained.
MESL_CORELENGTH	Text	50	MESL - core length (units are in meters). Note that this field has only been populated when the information has been readily available (electronic format).
MESL_Habitat class	Text	50	MESL - relevant to REMAP studies only (STUDYID 04 & 06). Codes: 1 = Shallow area; 2 = Channel; 3 = Reservoir.
MESL_LOCDESC2	Text	50	MESL - additional station location descriptions.
MESL_COMMENTS	Text	150	MESL - comments.
ptbl - STUDY	**NA**	**NA**	**Studynames and the types of data associated with each study.**
SITEID	Text	4	Site ID code (from Query Manager).
STUDYID	Text	2	Study ID code.
STUDYNAME	Text	40	Study name.
CONTACT	Text	40	Contact person/agency.
SEDCHEM	Yes/No	1	Indicates if the study has surficial sediment chemistry data incorporated in the database.
SEDTOX	Yes/No	1	Indicates if the study has sediment toxicity data incorporated in the database.
SUBSURF	Yes/No	1	Indicates if the study has sub-surface sediment chemistry data incorporated in the database.
LABACCUM	Yes/No	1	Indicates if the study has bioaccumulation test data incorporated in the database.
TISSCHEM	Yes/No	1	Indicates if the study has tissue chemistry data incorporated in the database.
Location/Sampling Year	Text	40	Location and sampling year.
MESL_LIBNO	Text	50	MESL library number.

Table 1. Detailed Description of Database Components.

TABLE NAME / Field Name	Data Type	Field Size	TABLE DESCRIPTION / Field Description
ptbl - STUDYNOT	**NA**	**NA**	**Study notes.**
SITEID	Text	4	Site ID code (from Query Manager).
STUDYID	Text	2	Study ID code.
NOTES	Memo	-	Notes.
MESL_LIBNO	Text	50	MESL - library number.
ptbl - STUDYREF	**NA**	**NA**	**Bibliographic references for each study.**
SITEID	Text	4	Site ID code (from Query Manager).
STUDYID	Text	2	Study ID code.
YEAR	Text	4	Publish year for report.
AUTHORS	Text	160	Authors of the report.
TITLE	Text	160	Title of the report.
SOURCE	Text	160	Source (locations).
STUDYCOMM	Text	160	Comments.
MESL_LIBNO	Text	50	MESL - library number.

Figure 1. Diagram showing the relationships between database components.

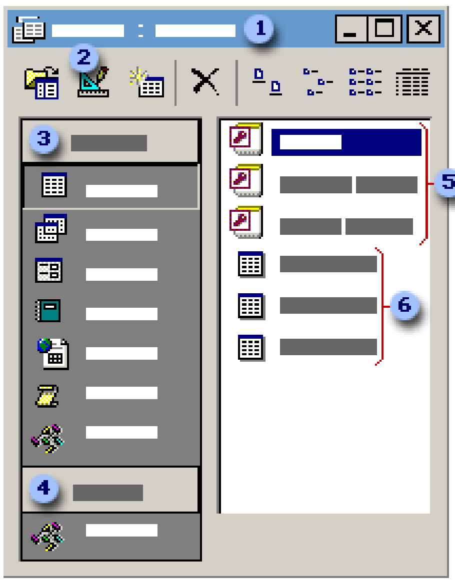


Appendix 1. Instructions for Creating Select Queries in Microsoft Access

A select query retrieves data from one or more tables by using specified criteria and then displays it in the desired order (e.g., ascending order). The following instructions outline the basic steps required to create a select query in query Design View.

Step 1. Under **Objects** (on the left-hand side of the DATABASE window), click **Queries**.

The database window looks like this:



The Database window is the command center of your Access file. From here, you can create and use any object in your Access database or Access project.

1. The title bar of the Database window shows the name and file format of the database.
2. On the Database window toolbar, use the Open button to work with existing objects, use the Design button to modify existing objects, or use the New button to create new objects.
3. Under Objects, click one of the object types, such as Tables or Forms, to show the list of objects of that type.
4. A list of groups of database objects appears under Groups. You can add objects of different types to a group, which consists of shortcuts to the database objects that belong to it.
5. You can use the new object shortcuts at the top of the object list to create new database objects.
6. The list of database objects changes according to which object type you have clicked under Objects.

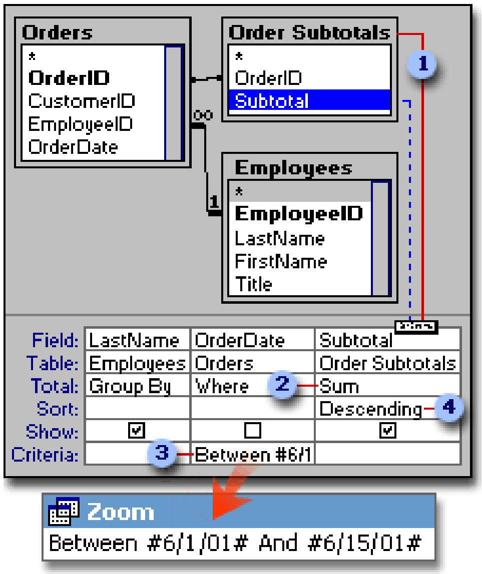
Step 2. Click **New** (top of the DATABASE window).

Step 3. In the NEW QUERY window select **Design View**, then **OK**.

Step 4. Select the data you want to work with by adding the tables or queries that contain the data of interest.

Step 5. The query is completed by filling in the design grid:

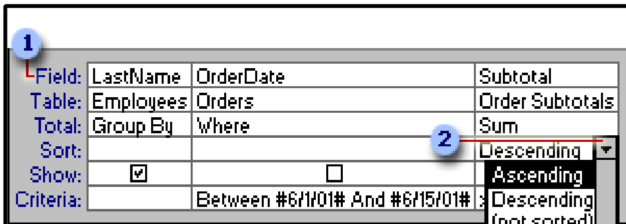
The design grid looks like this:



1. Add or remove tables, queries, and fields
2. Calculate amounts
3. Limit results using criteria
4. Sort records

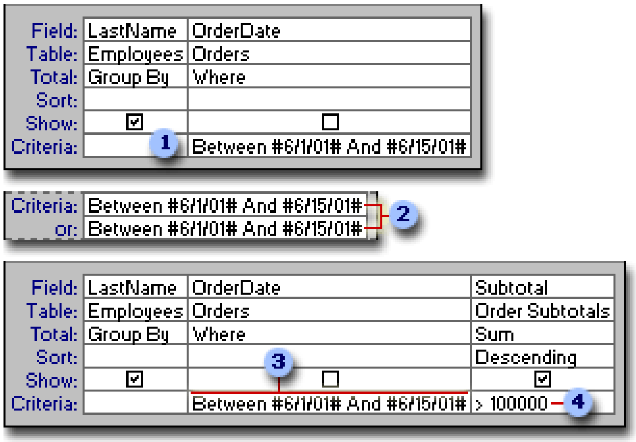
Step 5a. To add a field to the design grid, drag the field from the field list to a column in the design grid (1.), or double-click the field name in the field list (to remove a field from the design grid, click the column selector to highlight the column, and then press the **DELETE** key);

Step 5b. To sort records in the query results, click in the **Sort** cell (4.) for the field you want to sort, click the arrow, and then select a sort order (e.g., sort Chemical name in ascending order);



1. If you specify a sort order for more than one field, Microsoft Access sorts the leftmost field first, so you should arrange the fields you want to sort from left to right in the design grid.
2. Sort by ascending or descending order, or remove a sort.

Step 5c. To limit the records that you see in the query's results, specify criteria in the **Criteria** row (3.) for one or more fields (e.g., to include only samples collected in Lac de Gras enter "*Lac de Gras*"); and,



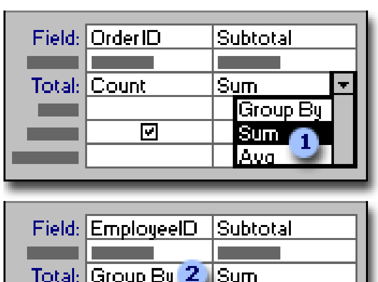
1. To limit the records in the query's results, enter criteria in one or more fields.

2. Use the Or row for alternative criteria in the same field.

3. Enter criteria for different fields. For example, for orders between 6/1/01 and 6/15/01 ...

4. ... calculate total order amounts, but display only those that are more than $100,000.

Step 5d. To perform calculations on the values in a field, click **Totals** on the tool bar (Sum icon; or select **Totals** from the **View** menu) to display the **Total** row in the design grid, then select a function by using the drop-down list [e.g., sum, average, etc.(2.)].



1. Use an aggregate function, such as Sum or Avg, to calculate one amount for all the records in each field in the design grid.

2. Use Group By to calculate separate amounts for groups of records in a field.

Step 6. Run the query by clicking the **Run** button (exclamation point icon) on the toolbar.