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Environmental Database For Water-Quality Data For the Penobscot River, Maine: Design Documentation and User Guide

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By Sarah E. Giffen

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ABSTRACT

An environmental database was developed to store water-quality data collected during the 1999 U.S. Geological Survey investigation of the occurrence and distribution of dioxins, furans, and PCBs in the riverbed sediment and fish tissue in the Penobscot River in Maine. The database can be used to store a wide range of detailed information and to perform complex queries on the data it contains. The database also could be used to store data from other historical and any future environmental studies conducted on the Penobscot River and surrounding regions.

INTRODUCTION

In 1999, the U.S. Geological Survey (USGS), in cooperation with the Bureau of Indian Affairs (BIA), the Penobscot Indian Nation's Department of Natural Resources (PINDNR), and the U.S. Environmental Protection Agency (USEPA) conducted a study to examine the occurrence and distribution of dioxins, furans, and polychlorinated biphenyls (PCBs) in fish tissues and sediments along a 50-mile stretch of the Penobscot River between Old Town and Grindstone, Maine. As part of this project, the USGS developed a database that is capable of storing the data from this study, as well as environmental data from other (past and future) studies conducted on the Penobscot River.

The database, known as the Penobscot Indian Nation, Department of Natural Resources, Environmental (PINE) Database, is a Microsoft Access database created using the database modeling program ERwin^{TM} version 3.5.2 (Platinum Technologies). The database is capable of storing various types of environ

mental data and provides an efficient way to conduct queries on the data that reside in the database. This report describes the development of the PINE Database and serves as its user manual. The user guide section of this report aids the user in populating the database but does not describe the processes of conducting queries or generating reports. To use the database, users should have a properly installed version of Access 2000, or future versions of Access that are backward compatible, on their computer.

DESIGN DOCUMENTATION

The PINE Database is intended as a storage and retrieval device for water-quality data, including the description of places and organizations involved in environmental monitoring activities, details regarding the procedures used to collect samples, and sample results. The database is designed to store a variety of data in one structure, allowing the user to explore and synthesize environmental data efficiently while

ensuring the integrity of the data. The PINE Database may serve as a common location for environmental data on the Penobscot River, creating the potential to combine data and allow greater insight into water-quality issues.

Although significant analytical capabilities are inherent in its design, the PINE Database is not an analytical tool. Users of the PINE Database may extract data in whatever combinations and formats are needed. Extracted data sets can subsequently be analyzed with statistical or modeling applications.

Database Model Principles

The PINE Database is an Access database that was generated from a database model. The PINE Database model was designed with the modeling tool ERwin^{TM} version 3.5.2 (Platinum Technologies). Database modeling tools facilitate the rapid design and modification of a database, handling many of the important details that could affect the quality of the data structures.

Designing a database model is a precursor to any correctly structured database. Database modeling is the process of analyzing and reducing a set of data to its separate components and establishing the nature and direction of relations between those components. This structure enforces a system of data integrity and provides easy access to all the information stored in the database. A good data model also recognizes change as a partner in data management and allows corrections and extensions to be made to the database without affecting the purity of data already residing in the database. In addition, a database model is used to create and maintain a data dictionary. The data dictionary is an index that catalogues all of the elements in the database, and thus provides a common language and reference for all users of the database. Database users should be able to examine the completed data model and its data dictionary and confirm that it contains all specific, categorical, and classificatory parameters needed to store, describe, validate, list, summarize, and aggregate environmental information (Tessler, in press).

Database Model Design Conventions

Several design conventions were adopted for use in the PINE Database model. These conventions provide standard rules for creating and assembling the various elements, and facilitate communication on how the different elements of the database function together. The following sections outline the basic design conventions used by the PINE database model.

Database Model Structure

The model consists of tables, each of which has one or more keys. Relationships join the tables by way of the keys. Tables, keys, and relationships are defined and discussed in more detail in the following sections.

Tables

Tables are the basic element of the database. The model contains many different tables, each of which is designed to hold a specific, defined, and delimited set of data. Data are compartmentalized into different tables to prevent redundancy and enable queries to be conducted on multiple aspects of the data. For example, one table may contain information on all the agencies involved in data collection; another table may contain information on the field methods used in data collection; and so on. Each table contains fields that hold a specific piece of information. For example, the agency table may have fields for the name of the agency, the contact person at that agency, or the address for the headquarters of that agency.

The model contains several different types of tables. The type of table used depends on its function in the database. The different types of tables will be discussed later in the Naming Conventions section of this report.

Keys

Each record in a table (row) is identified by a unique number, which is referred to as the primary key. The unique primary key in one table can be used in another table as a surrogate for all the information it represents in the first table. In this relationship, the primary key from the first (source) table is called a foreign key in the second (receiving) table. The shared primary key/foreign key fields provide a path to relate data in various tables to one another. It is in this way that the relational model provides a way to extract data from two or more tables in any desired combination (Tessler, in press).

Most of the data tables in the PINE Database have a single field (column) that serves as the primary key. The key itself is simply an incremental integer that

represents each row of data in the table. Exceptions are the association tables described below, where a single key field is not practical or desirable.

In some tables, a complex key consisting of two or more fields together serves as the primary key. For example, the Detection Limit table uses four fields together to serve as the primary key: the Sample Type_ID, the Laboratory_ID, the Constituent_ID, and the Effective Date. A unique combination of these four fields makes a primary key that identifies a unique detection limit.

Relationships

Relationships between tables using keys (primary keys and foreign keys) are modeled and built into the database. Relationships define how the data in the various tables are connected to one another. The concept of relationships can be illustrated using grammatical terms. Tables in a data model can be thought of as nouns. The relationships between tables can be thought of as verb phrases, which clearly and concisely define the nature and restrictions of the associations between nouns. For example, one could say that, "A site can have one or more samples." In this sentence, the nouns identify two tables (Site and Sample), and the verb phrase (can have one or more) describes a "one-to-many" relationship between them. In other words, each Site has associated data for one or more Samples (Tessler, in press).

Naming Standards in the Model

Naming standards are an important tool that conveys information about an item's identity or contents. In the PINE Database, naming standards apply to both tables and fields.

Name Construction

The three name construction standards are:

1. Names are generally constructed using whole words in order to provide as much intuitive meaning as possible. There are a few exceptions to this rule, including for example, "Det" which is sometimes used in place of "Detection" to help limit the size of the item.

2. When names are composed of word phrases, the first letter of each word in the phrase is capitalized in order to assist in reading the name. Examples include AgencySampleNumber, and ToxicEquivalentFactor.

3. Names are constructed of only alphabetic characters, with no numerals, punctuation, or other special characters (such as spaces or dashes). Primary keys, which consist of the table name and an _ID suffix, are the only exception. The _ID suffix provides visual distinction between key and non-key (data) fields.

Table Functional Prefixes

In the PINE Database, the naming standards for tables are a modification and extension of those in common use by Access developers and MS Visual Basic programmers. Five functionally distinct types of tables are defined by a distinct three-letter prefix applied to the table name. The five table name prefixes used in the PINE Database and their definitions are given below (Tessler, in press).

tbl – simple data table, for example tblSite. Tables with the tbl prefix hold primary data entered in the database. They have a single primary key field. This primary key is an integer automatically incremented for each new record. Consequently, each row of data in the table is identified by a unique integer. These tables typically contain one or more fields that are foreign keys from other tables. Thus, the tbl tables acquire data elements from other tables as their own extended attributes.

tds – domain table, static, for example tdsHUC. Tables with the tds prefix are called domain tables because they provide specific information describing a particular subject domain. These tables typically hold a list of classification/descriptive items that are used by other tables. The table is described as static because it should be complete, although it may need to be extended in the future. For example the tdsHUC table is fully populated with records describing all the hydrologic unit codes in Maine from the 8- to 14-digit level, but other elements may need to be added to this table in the future. Tds tables have a primary key field that is a unique integer and exists in other tables as a foreign key. Tds tables can be easily extended without affecting the rest of the database design.

tdx – domain table, user-extendable, for example tdxSpecies. Tables with the tdx prefix are domain tables that provide a list that the user will add to as needed. Unlike the tds tables, the tdx tables are not considered complete and will most likely need to be added to while using the database. For example, the tdxSpecies table will have entries added to it whenever new plant or animal species are added to the database.

The tdx tables have a primary key field that is identified by a unique integer. Tdx tables provide an extendable domain list for characterizing records in data tables.

tad – association table, for example tadSedimentSize. Tables with the tad prefix are used to resolve many-to-many relations between two other tables. They contain the key fields from other tables and store data that describe some property unique to the association between these tables. For example, tadSedimentSize combines a Sample_ID with a particular Sieve_ID to form its primary key and stores data for a non-key field, SedimentPct. Hence, the table defines the percent of sediment captured at the specified sieve size for the specified sample. TadSedimentSize is related to the other tables (tblSediment and tdxSieve) in a many-to-many relation. This allows individual samples to be associated with more than one sieve and each sieve to be associated with more than one sample.

tas – association table, for example tasConstituentClassification. Tables with the tas prefix are used to resolve many-to-many relations between two other tables. They contain the key fields from the other tables and therefore the associations between these tables. Unlike the tad tables, they do not store any data other than the association between the key fields. For example, tasConstituentClassification associates a Constituent_ID with a ConstituentClass_ID. Hence, the table defines the relationship between a constituent and a constituent class. Also note that one constituent can be associated with more than one constituent class.

The naming conventions described above are a useful feature in understanding the PINE Database. As the database evolves, new fields or tables should use these naming convention standards to ensure consistent communication about the functional properties of the new items.

Diagramming the Model

Diagrams are used to view the model and visualize database designs. These diagrams are referred to as E/R (Entity/Relationship) diagrams because they illustrate both the entities (tables) and relationships between these tables in the database model. The diagrams in this document use the "IDEF1X" (Integration DEFinition for Information Modeling) standard as defined in National Institute of Standards and Technology (1993) and implemented in the ERwin modeling software. The entire E/R diagram for the PINE Database model is shown in plate 1 (back of this report). Standards relevant to understanding the diagram are described below.

Tables

Boxes in the diagram are used to denote a table in the database, and different colors are used to identify the types of tables. The name of the table appears above the box in the diagram, and the fields in the table appear within the box.

Keys

In the diagram, the primary key for each table is listed at the top of the box and is separated from the other fields by a horizontal line. The primary key has a 'PK' designation in the diagrams. When a primary key from one table (the source table) is passed or migrated to another table (the receiving table) through a relation, the key is called a "foreign key" in the receiving table and has a 'FK' designation in the diagrams (Tessler, in press).

Relationships

Lines connecting tables in the diagram are used to represent the relation between those tables in the database. Each relation line has a direction and cardinality. The origin of the line is at the primary key field in the source table and is recognized by a single perpendicular on the relation line. The terminus of the line is at the acquired foreign key field in the receiving table and is recognized by a more complex cardinality symbol (usually a branch). The cardinality symbol defines the exact nature of the relationship between the tables. The most common relation in the PINE Database model is a "one-to-none-or-many." This means that each source table can have none, or one or more receiving tables, and each receiving table must have a source table. The relationship is symbolized by an empty circle with three-branches (a crows' foot) at the terminus of the relation line. If the foreign key is part of the primary key in the receiving table, the relation is said to be strong and the relation line is solid in the diagram (this will always be true for association tables). If the foreign key is a non-key (descriptive) attribute of the receiving table, the relation is weak and the line is dashed (Tessler, in press).

Examination of the PINE Database Model

The detailed structure of the PINE Database model is shown in plate 1. The core of the PINE Database model consists of three basic elements or subject areas: site, sample, and result. These elements and their relationship to one another are examined in the following sections. More detailed table and field definitions are contained in the Data Dictionary in the appendix.

Site Subject Area of the Model

A site is defined as any source or place where an environmental sample is collected. A site can be a discrete point (a spot defined by a specific latitude and longitude) or a reach (a stretch of river defined by an upstream latitude/longitude and a length). Figure 1 shows the location of site information in the PINE Database model for comparison to the detailed diagram in plate 1.

The site subject area is centered on the table tblSite but also includes the tables tdsSiteType, tdsHUC, and tdsAgency. Refer to plate 1 for details of the site subject area of the model.

TblSite

TblSite stores information on the locations where samples are collected. The table has a primary key, Site_ID, which is a unique number automatically assigned to each site entry in the database and can therefore be used to identify a site. It is used to represent all information associated with that particular Site_ID and is referenced in other tables in the database. TblSite also contains the foreign keys Agency_ID, SiteType_ID, and HUC_ID that are acquired from the tdsAgency, tdsSiteType, and tdsHUC tables, respectively. TblSite also contains the fields ParentSiteID, SiteName, SiteCode, Latitude, Longitude, SiteLength, SiteContact, and SiteComment to further describe a site.
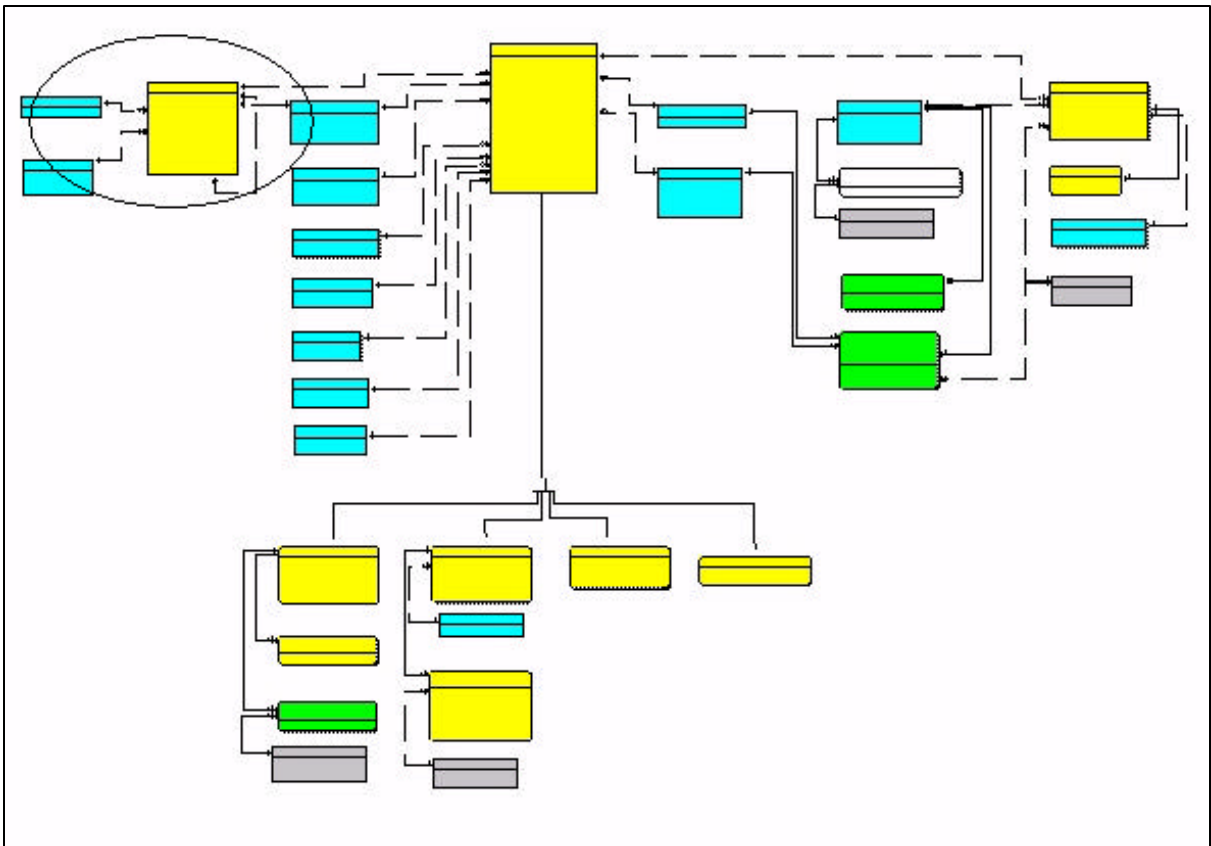

Figure 1. General view of the site subject area of the model. (See plate 1 for details.)

TdsSiteType

TdsSiteType stores a list of types of sites where samples are collected. The SiteType for a sediment sample is a point, whereas the SiteType for a tissue sample may be a reach. SiteType_ID is the primary key in this table and is a unique integer that is assigned to each SiteType entry in the database. It can therefore be used to identify a type of site.

TdsHUC

TdsHUC stores a list of hydrologic unit codes (surface-water drainage basins). HUC_ID is the primary key in this table and is a unique integer that is assigned to each HUC entry in the database. TdsHUC contains the fields HUC08, HUC11, HUC14, HUCName, and HUC14SQMI.

TdsAgency

TdsAgency stores a list of agencies or parties that own or maintain sites or collect samples. Agency_ID is the primary key in this table and is a unique integer that is assigned to each agency entry in the database. It can therefore be used to identify an agency or party that owns or maintains sites or collects samples. TdsAgency contains the fields AgencyAbbrev, Agency, AgencyContact, and AgencyComment to further describe an agency.

Sample Subject Area of the Model

Any medium collected at a site is called a sample. A site is related to a sample in a one-to-many relationship, that is, many samples can be collected at a single site. Sample information includes the date and time that the sample was collected, the field method that was used to collect the sample, and the type of sample that was collected. Figure 2 shows the location of sample information in the model.

Refer to plate 1 for a detailed diagram of the sample subject area of the model. The database is configured to store information on four different types of samples: sediment samples, tissue samples, semi-permeable membrane device (SPMD) samples, and water samples. General information that pertains to all four types of samples is stored in the main sample table, tblSample. Further information specific to each of the four types of samples is stored in their respective tables, tblSediment, tblTissue, tblSPMD, and tblWater. These tables appear under the main sample table,

tblSample, in the model and are related to tblSample in a one-to-one-or-none relationship. Descriptions of the main sample area, the sediment sample area, the tissue sample area, the SPMD sample area, and the water sample area follow.

Main Sample Area of the Model

The general sample information for all samples (sediment samples, tissue samples, SPMD samples, and water samples) is stored in the main sample area of the model. The main sample area of the model includes the following tables: tblSample and the domain tables, tdsAgency, tdsFieldMethod, tdsWeatherConditions, tdsRiverConditions, tdsWaterLevel, tdsFoamRanking, tdsFoamSource, tdsSampleType, and tdsLab, which are described below.

TblSample

TblSample stores information on samples of field data or collected material at a particular site. Sample_ID is the primary key in this table. The key is a unique integer that is assigned to each sample entry in the database and can therefore be used to identify a sample. Site_ID is a foreign key in this table and is acquired from the table tblSite. Consequently, Site_ID is the field that relates a sample to a site. This is a one-to-many relationship, meaning that one site can have many samples, so multiple Sample_IDs may be related to the same Site_ID. TblSample also contains the foreign keys SampleType_ID, Agency_ID, FieldMethod_ID, Lab_ID that are acquired from the tdsSampleType, tdsAgency, tdsFieldMethod, and tdsLab tables respectively. TblSample also contains the fields SampleDate, SampleTime, AgencySampleNumber, QualityControlSample, LabSampleNumber, ExtractionDate, AnalysisDate, and SampleComment to further describe the sample.

TdsAgency

TdsAgency stores a list of agencies or parties that own or maintain sites or collect samples. Agency_ID is the primary key in this table and is a unique integer that is assigned to each agency entry in the database. It can therefore be used to identify an agency or party that owns or maintains sites or collects samples. TdsAgency also contains the fields AgencyAbbrev, Agency, AgencyContact, and AgencyComment to further describe an agency.
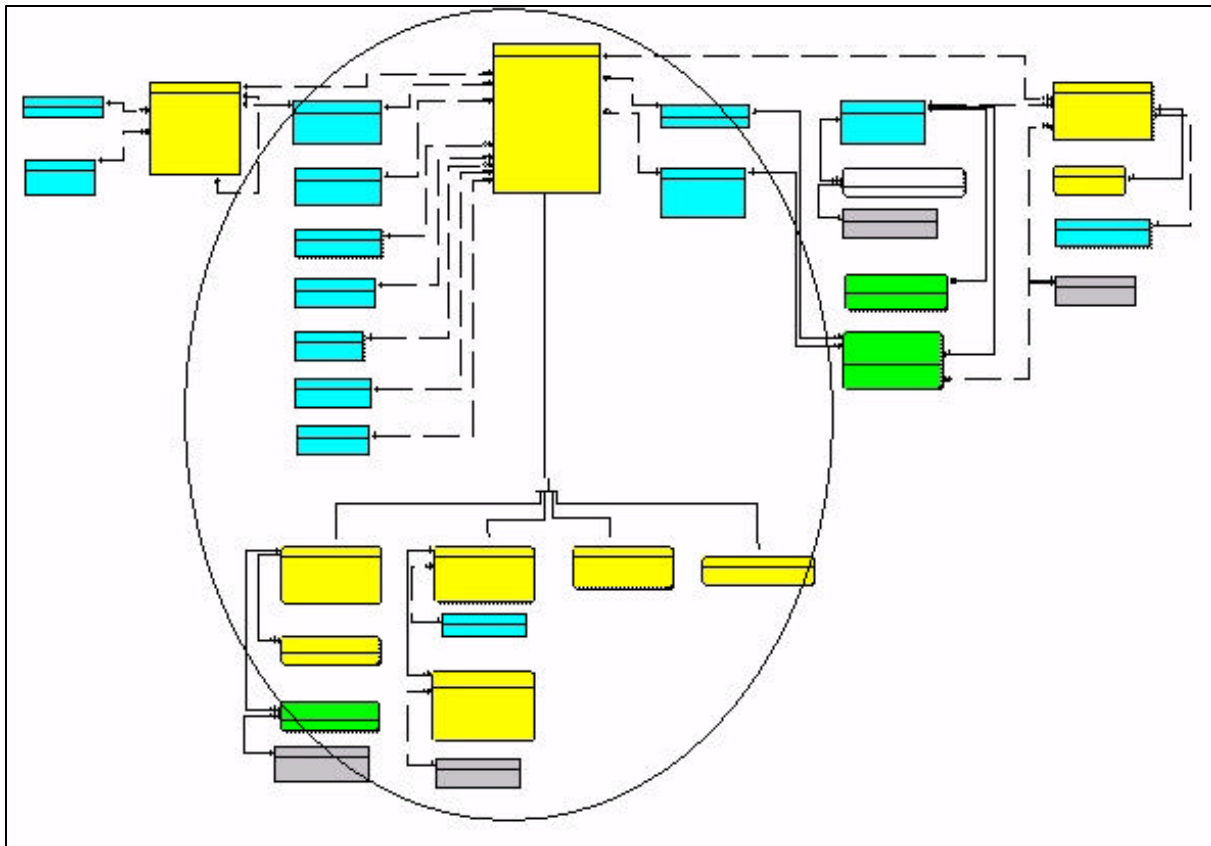
Figure 2. General view of the sample subject area of the model. (See plate 1 for details.)

TdsFieldMethod

TdsFieldMethod stores a list of methods and equipment used to collect field samples. FieldMethod_ID is the primary key in this table. The key is a unique integer that is assigned to each field method entry in the database and can therefore be used to identify a field method. TdsFieldMethod also contains the fields FieldMethod, Equipment, and FieldMethodComment to further describe a field method.

TdsWeatherConditions

TdsWeatherConditions stores information on the weather conditions at the time a sample is collected. WeatherConditions_ID is the primary key in this table and is a unique integer that is assigned to each weather condition entry in the database. It can therefore be used to identify a weather condition. TdsWeatherConditions

also contains the fields WeatherConditions and WeatherConditionsComment.

TdsRiverConditions

TdsRiverConditions stores information on the river conditions at the time a sample is collected in the field. RiverConditions_ID is the primary key in this table and is a unique integer that is assigned to each river condition entry in the database. It can therefore be used to identify a river condition. TdsRiverConditions also contains the fields RiverConditions and RiverConditionsComment.

TdsWaterLevel

TdsWaterLevel stores information on the water level in a stream or river during the collection of a sample. WaterLevel_ID is the primary key in this table

and is a unique integer that is assigned to each water level entry in the database. It can therefore be used to identify a water level. TdsWaterLevel also contains the fields WaterLevel and WaterLevelComment.

TdsFoamRanking

TdsFoamRanking stores information on the foam ranking, based on the amount of foam in a river, stream, or lake, during the collection of a sample. FoamRanking_ID is the primary key in this table and is a unique integer that is assigned to each foam ranking entry in the database. It can therefore be used to identify a foam ranking. TdsFoamRanking also contains the fields FoamRanking and FoamRankingComment.

TdsFoamSource

TdsFoamSource stores information on the foam source during the collection of a sample. FoamSource_ID is the primary key in this table and is a unique integer that is assigned to each foam source entry in the database. It can therefore be used to identify a foam source. TdsFoamSource also contains the fields FoamSource and FoamSourceComment.

TdsSampleType

TdsSampleType stores a list of types of samples collected. SampleType_ID is the primary key in this table and is a unique integer that is assigned to each sample type entry in the database. It can therefore be used to identify a type of sample.

TdsLab

TdsLab stores a list of laboratories responsible for analyzing samples and reporting results. Lab_ID is the primary key in this table and is a unique integer that is assigned to each laboratory entry in the database. It can therefore be used to identify a laboratory. TdsLab also contains the fields LabAbbrev, Lab, LabContact, EPACertified, and LabComment to further describe a laboratory.

Sediment Sample Area of the Model

Four tables hold information specific to a sediment sample: tblSediment, tblGrab, tadSedimentSize, and tdxSieve. Refer to plate 1 for a detailed diagram of the sediment sample area of the model.

TblSediment

TblSediment stores information on the details of a sediment sample. Sample_ID is used as a foreign key in this table to represent all information associated with that particular Sample_ID. The Sample_ID is acquired from the table tblSample. TblSediment also contains the fields SedimentComposite, WetWeight, DryWeight, MoisturePct, OrganicContentPct, and SedimentComment to further describe a sediment sample.

TblGrab

TblGrab is a table that stores information pertaining to the individual grabs in a sediment sample. One sediment sample may be composed of many grabs. Sample_ID is a foreign key in table tblGrab that is acquired from the table tblSediment. Consequently, Sample_ID is the field that links tblGrab to the main sediment table tblSediment. It links these two tables in a one-to-many relationship, meaning that one sediment sample can be composed of many grabs. TblGrab also contains the fields GrabNumber and GrabDepthof-Water.

TadSedimentSize

TadSedimentSize stores information about the particle-size distribution of a sediment sample. It holds information on the percentage of the sediment sample captured in various sieves. Sample_ID is a foreign key in this table that is acquired from table tblSediment. Sieve_ID also is a foreign key in this table that is acquired from the table tdxSieve and is used to uniquely identify a specific sieve used for grain-size analysis. TadSedimentSize also contains the field SedimentPercent.

TdxSieve

TdxSieve holds information on the various sieves used to determine the sediment-size distribution of a sediment sample. Sieve_ID is the primary key in this table. The key is a unique integer that is assigned to each sieve entry in the database and can therefore be used to identify a sieve. TdxSieve also contains the fields SieveSize, SieveCode, and SedimentFraction.

Tissue Sample Area of the Model

Four tables hold information specific to a tissue sample: tblTissue, tdsTissueType, tblSpecimen, and tdxSpecies. Refer to plate 1 for a detailed diagram of the tissue sample area of the model.

TblTissue

TblTissue stores information on a tissue sample. Sample_ID is a foreign key in this table and is acquired from the table tblSample. This key uniquely identifies a sample. TblTissue also contains the fields Tissue-Composite, TissueType_ID, TissueWeight, LipidPct, NumSpecimens, and TissueComment to further describe a tissue sample.

TdsTissueType

TdsTissueType stores a list of tissue types used for analysis. TissueType_ID is the primary key in this table. The key is a unique integer that is assigned to each tissue type entry in the database and can therefore be used to identify a tissue type. TdsTissueType also contains the field TissueType.

TblSpecimen

TblSpecimen stores information about the individual specimens that make up a tissue sample. Sample_ID is a foreign key in this table that is acquired from the table tblTissue. The Sample_ID links tblTissue to tblSpecimen in a one-to-many relationship. Therefore, a tissue sample can be composed of many specimens. TblSpecimen also contains the fields SpecimenNumber, Species_ID, SpecimenWeight, SpecimenLength, SpecimenWidth, Gender, SpecimenAge, and SpecimenComment to further describe a specimen.

TdxSpecies

TdxSpecies stores a list of biotic species used for tissue sampling. Species_ID is the primary key in this table and is a unique integer that is assigned to each species entry in the database. It can therefore be used to identify a species. TdxSpecies also contains the fields SpeciesCode and Species.

SPMD Sample Area of the Model

The SPMD area of the model consists of the table tblSPMD (plate 1). This table stores all information pertaining specifically to an SPMD sample. The fields in this table are described below.

TblSPMD

TblSPMD stores details for an SPMD sample. Sample_ID is a foreign key in this table that is acquired from the table tblSample. TblSample also contains the fields SolventUsed, SolventVolume, SPMDDepthOf-Water, and SPMDComment.

Water Sample Area of the Model

The water sample area of the model consists of the table tblWater (plate 1). This table stores all information pertaining specifically to a water sample. The fields in this table are described below.

TblWater

TblWater stores details pertaining to a water sample. Sample_ID is a foreign key in this table that is acquired from the table tblSample. TblWater also contains the fields WaterSampleVolume and WaterComment.

Result Subject Area of the Model

Results are the data associated with the analysis of a sample and commonly are the values reported by the analyzing laboratory. The location of the result information in the model is shown in figure 3. The result information can be broken down into three subject areas: the main result area, the detection limit area, and the toxic equivalent factor area. These three areas of the model will be discussed in more detail in the following sections.

Main Result Area of the Model

The main result area stores information reported by a laboratory on the analysis of a sample. The main result area consists of tblResult and related domain tables: tdsConstituent, tdsResultFlag, tasConstituentClassification, tdxConstituentClass, and tdxUnit (plate1). Descriptions of these tables follow.

TblResult

TblResult stores information on results for a specific constituent in a sample. Result_ID is the primary key in this table. The key is a unique integer that is assigned to each result entry in the database and can therefore be used to identify a result. TblResult also contains the foreign key Sample_ID, which is acquired from the table tblSample. Sample_ID links tblSample to tblResult in a one-to-many relationship. This means that one sample can have many results associated with it. TblResult also contains the foreign keys Constituent_ID, ResultFlag_ID, and Unit_ID that are acquired from the tdsConstituent, tdsResultFlag, and tdxUnit tables respectively. TblResult also contains the fields Result and ResultComment to further describe the result.
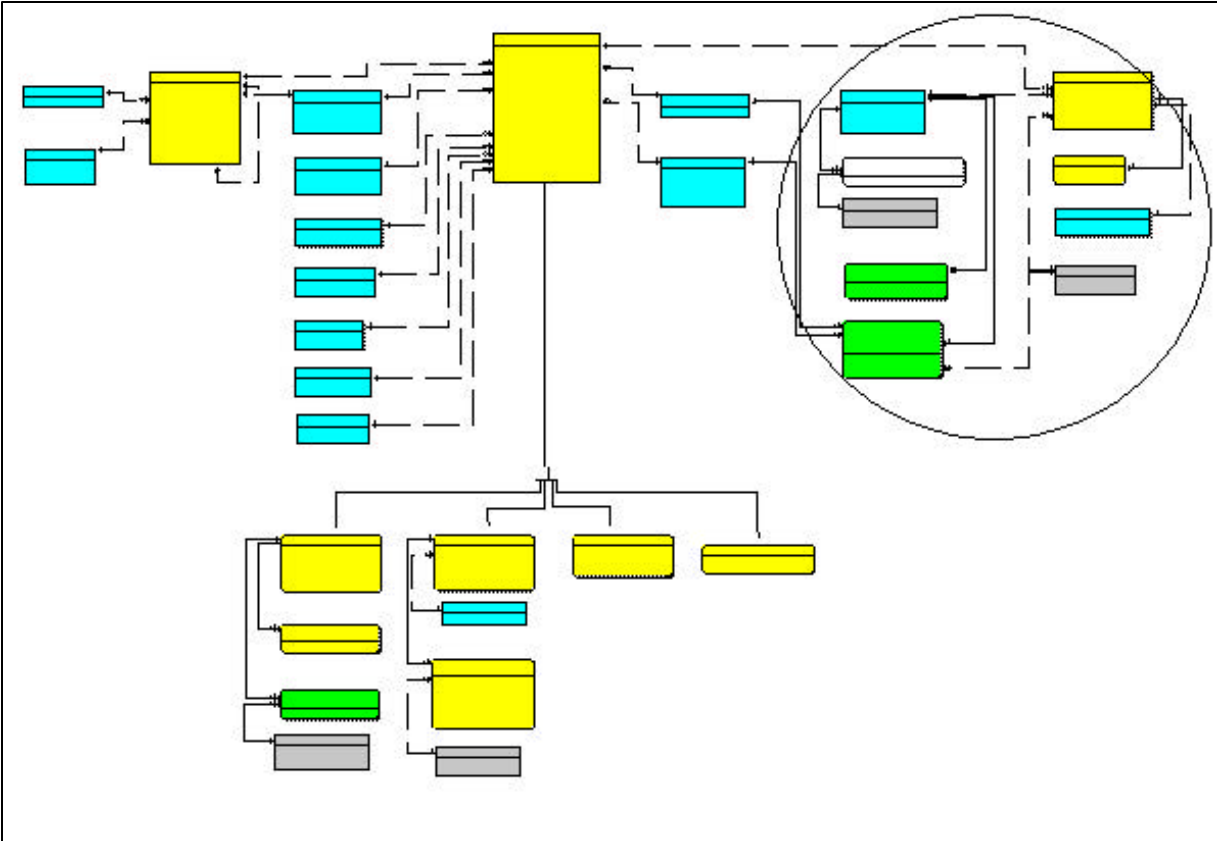
Figure 3. General view of the result subject area of the model. (See plate 1 for details.)

TdsConstituent

TdsConstituent stores a list of constituents for which measurement or analytical results are reported. Constituent_ID is the primary key in this table. The key is a unique integer that is assigned to each constituent entry in the database and can therefore be used to identify a constituent. TdsConstituent also contains the fields ConstituentCode, ConstituentAbbrev, and Constituent.

TdsResultFlag

TdsResultFlag stores a list of flags used to qualify individual results (<, >, non-detect, etc.). It should be noted that the use of the word "average" in the database refers specifically to the arithmetic mean. ResultFlag_ID is the primary key in this table. The key is a unique integer that is assigned to each result flag entry in the database and can therefore be used to iden-

tify a result flag. TdsResultFlag also contains the fields ResultFlag and ResultFlagDescr.

TasConstituentClassification

TasConstituentClassification stores information on the association of a constituent with a classification group. TasConstituentClassification contains the foreign keys Constituent_ID and ConstituentClass_ID that are acquired from the tdsConstituent and tdxConstituentClass tables respectively.

TdxConstituentClass

TdxConstituentClass stores a list of groups used to classify constituents (such as nutrients, PCBs, or dioxin). ConstituentClass_ID is the primary key in this table. The key uniquely identifies a classification group for individual constituents. TdxConstituentClass also contains the field ConstituentClass.

TdxUnit

TdxUnit stores a list of measurement or reporting units for constituent results. Unit_ID is the primary key in this table. The key uniquely identifies a measurement or reporting unit for a result. TdxUnit also contains the fields Unit and UnitAbbrev.

Detection Limit Area of the Model

The detection limit subject area describes the table tadDetectionLimit (plate 1). Data on detection limits helps to qualify the value of results that are obtained.

Each detection limit is identified by a unique combination of a sample type, a specific laboratory, a specific constituent, and a date. These are the four elements that determine the value of the detection limit. Therefore, they are the four fields that compose the primary key value of the table tadDetectionLimit. If any one of these elements changes, the detection limit may change as well. The only table that will be described in detail here is the table tadDetectionLimit. The other tables related to tadDetectionLimit have already been described in previous sections of this document.

TadDetectionLimit

TadDetectionLimit stores information on the associations of a sample type, laboratory, and constituent to record the detection limit in effect during a certain period of time. TadDetectionLimit contains the foreign keys SampleType_ID, Lab_ID, Constituent_ID, and Unit_ID that are acquired from the tdsSampleType, tdsLab, tdsConstituent, and tdxUnit tables respectively. TadDetectionLimit also contains the fields DetEffectiveDate, DetectionLimit, and DetectionLimitComment.

Toxic Equivalent Factor Area of the Model

The toxic equivalent factor area describes the table tadToxicEquivalentFactor (plate 1). Each toxic equivalent factor is identified by a unique combination of a constituent and a date. Therefore, they are the two fields that compose the primary key value of the table tadToxicEquivalentFactor. If either of these elements changes, the toxic equivalent factor may change as well.

TadToxicEquivalentFactor

TadToxicEquivalentFactor stores information on the associations of a constituent with a toxic equivalency factor weighting in effect over a period of time. The table tadToxicEquivalentFactor contains the foreign key Constituent_ID that is acquired from the table tdsConstituent. The table tadToxicEquivalentFactor also contains the fields TEFEffectiveDate, ToxicEquivalentFactor, and TEFComment.

Customizing / Extending the Database Model

The PINE database was designed to be fully extendable and customizable for changing needs. The two basic ways to extend the database to hold new data are to add fields and add tables. In either case, any extensions to or customizations of the data model should respect the existing design conventions. The data model also can be customized by reducing the number of fields and tables. That decision should be based on the value of the data to be stored, not on the difficulty of obtaining or entering it (Tessler, in press).

A field can be added to any table; however, fields should not be added indiscriminately to a working copy of the database to solve short-term needs, such as to translate outside data into the PINE Database format, or to accommodate an unusual data inquiry. In those cases, additional accessory tables can be created to temporarily hold data in a one-to-one relationship with the parent table. The full power of PINE Database can then be applied to the added data without changing the basic model structure. Accessory tables allow new data to be entered for those records in the parent table that need them without altering existing structures. Adding tables to the structure is the easiest way to extend the data model. Adding tables provides a means to experiment with new data elements without affecting the data already residing in the database. Relating new tables to existing tables in a one-to-none-or-one relationship is the equivalent of adding fields to an existing table (Tessler, in press).

USER GUIDE

The Access Database and User Interface

The PINE Microsoft Access database was gener-ated from the database model, discussed in the previous sections, using the ERwin^{TM} version 3.5.2 (Platinum Technologies) software. A user interface was then added to the database. The interface consists of a set of forms that simplify the process of adding data to and editing data in the database. The following sections describe the basic structure of the database and the process of adding and editing data. They guide the user in populating the database but do not describe the processes of creating queries or reports. An Access user manual may be consulted for more information on how to conduct queries and generate reports.

Structure of the Database

The PINE database consists of two files: Penobscot_Data.mdb (which is the back-end of the database) and Penobscot_Forms.mdb (which is the front-end of the database). The back-end of the data-base stores the tables and the data that resides in those tables. The front-end of the database is linked to the back-end of the database. The front-end of the database does not contain actual tables; it contains only copies of the tables, and therefore does not hold any of the data that resides in the database. The front-end of the data-base acts as a user interface to the back-end of the data-base. This front-end, back-end design enables multiple users to interact with a single back-end via multiple front-end files on different computers. The following sections will examine the back-end and front-end of the database in more detail.

The back-end of the database (Penobscot_Data.mdb) consists of the tables that were generated from the database model and any data that was entered into those tables. The relationships between these tables, which were defined during the development of the database model, function behind the scenes in the database. All the tables that reside in the back-end of the database under the Tables tab are shown in figure 4.
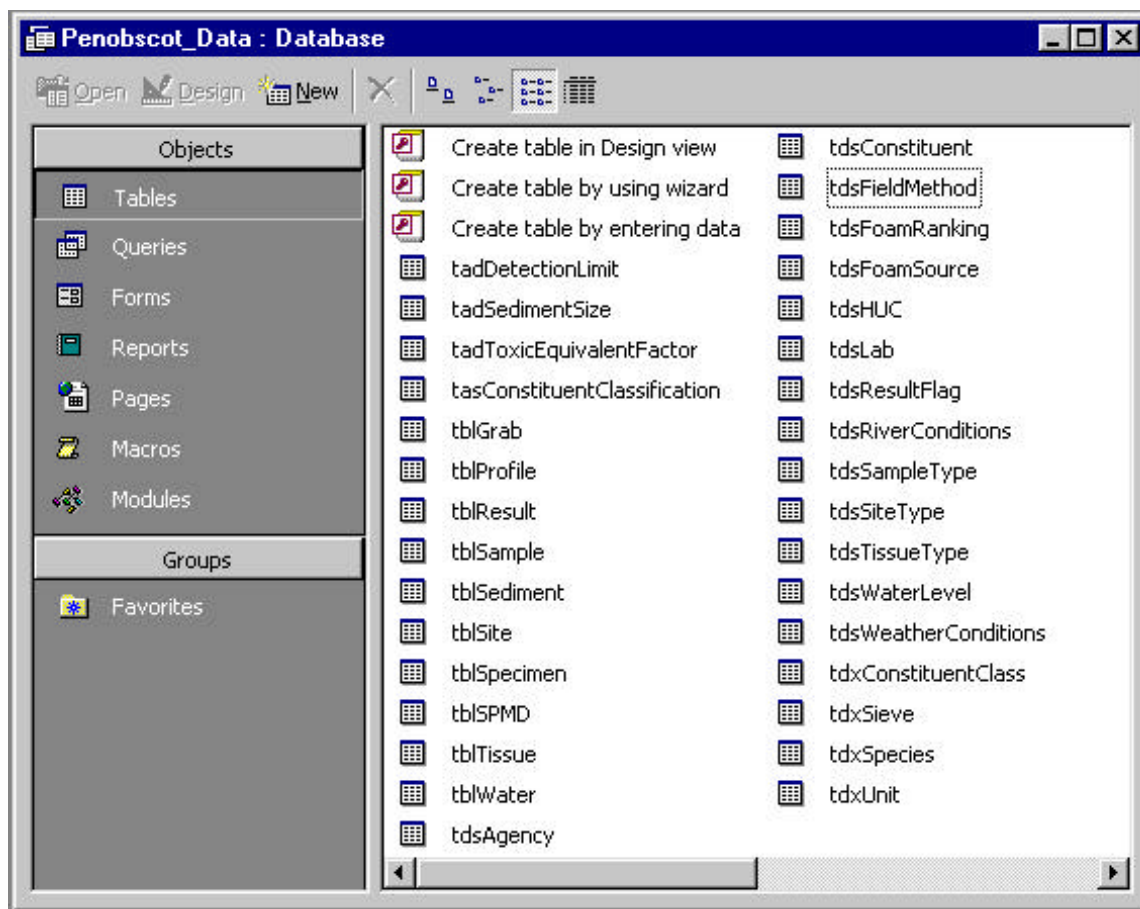
Figure 4. View of the tables in the back-end of the PINE database (Penobscot_Data.mdb).

There are two ways to view the tables in the back-end of the database: form view and design view. Form view is the default view and allows the database user to see the data that has been entered into the table. The table tdsFieldMethod in form view is shown in figure 5.

Tables in the back-end of the database also can be viewed in design view by highlighting the table and then clicking on 'Design' instead of 'Open'. Design view allows the user to see the field properties in the table as they were defined during the development of the database model. The table tdsFieldMethod in design view is shown in figure 6. When the row containing the primary key for the table is selected, a key icon appears in the left-most column.

The back-end of the database is composed solely of tables and the data they hold. There are no elements under the Forms, Report, and Queries tabs. Forms, reports, and queries are all part of the front-end of the database.

The front-end of the database serves as the database user interface. The tables in the front-end of the database are linked to their corresponding tables in the back-end of the database. Consequently, data entered into the tables in the front-end of the database are stored in the tables in the back-end of the database. Figure 7 shows the tables under the Tables tab in the front-end of the database. The linkage between the front-end of the database and the back-end of the database is represented by the arrows next to the tables in the front-end of the database.

tdsFieldMethod : Table

FieldMethod_ID	FieldMethod	Equipment	FieldMethodComment
0	Unknown	Unknown	Unknown Field Method and Equipment
1	Dredge	Ekman	
2	Dredge	Ponar	
3	Dredge	Shipek	
4	Dredge	Van Veen	
5	Dredge	Smith-McIntyre	
6	Dredge	Petersen	
7	Core	Krajak-Brinkhurst	
8	Core	Phleger	
9	Core	Box	
10	Core	Piston	
11	Fishing	Gill Net	
12	Fishing	Tackle	
13	Fishing	Electrofishing	

Figure 5. Form view of the table tdsFieldMethod in the back-end of the database.

tdsFieldMethod : Table

Field Name	Data Type	Description
FieldMethod	Text	Field Method used in collecting a Sample
Equipment	Text	Equipment used in collecting a Sample using a particular Field Method
FieldMethodComment	Memo	Comment about a Field Method and Equipment used in collecting a Sample

Figure 6. Design view of the table tdsFieldMethod in the back-end of the database.
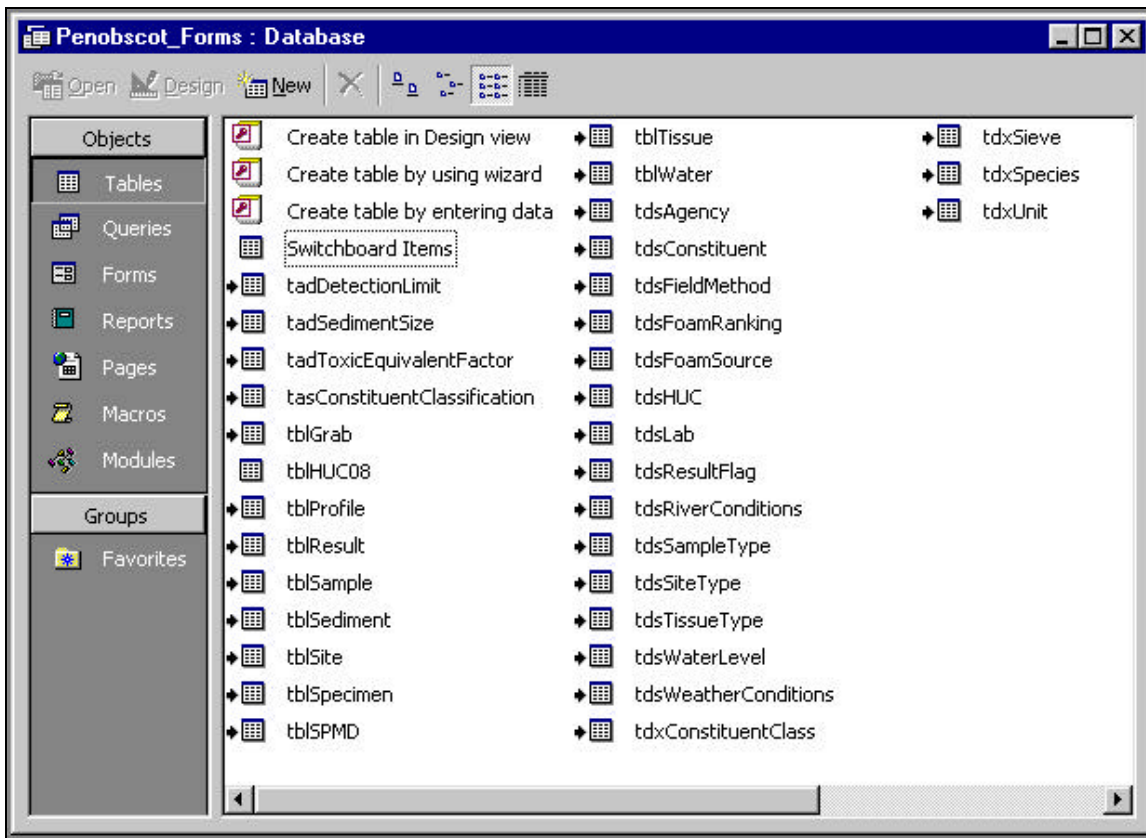
Figure 7. View of linked tables in the front-end of the database.

The front-end of the database also contains data-entry forms under the Forms tab. These forms are used for entering data into the database. Due to the complexity of the database structure, entering data directly into the tables would be confusing and prone to error. The forms simplify the process of both entering and editing data. The forms under the Forms tab in the front-end of the database are shown in figure 8.

Because of the large number of forms, a master form, known as the switchboard, was created. All data-entry forms (such as those shown in figure 8 and identified by the frm prefix) are accessed through the switchboard. The switchboard automates the process of opening and closing the forms necessary to perform various tasks. The switchboard is itself a form and exists under the Forms tab in the front-end of the database. Unlike the other forms, however, the switchboard has been programmed to open automatically when the user opens the front-end of the database. Figure 9 shows the switchboard as it appears when the front-end of the database is opened.

The switchboard consists of various options and menus that the user can navigate through to perform different tasks and will automatically open when the front-end of the database, Penobscot_Forms.mdb, is opened. The switchboard opens the forms displayed in figure 8 to perform these tasks. To decrease the likelihood of error and ensure the integrity of the data in the database, the user should add or edit data in the database via the switchboard. The forms also contain an exit button that will return the user to the appropriate form or switchboard. It must be noted, however, that in some cases the exit button on the forms may be inaccessible. For example, the fields and buttons, including the exit button, on the form to edit a site will be inaccessible if there are no site entries in the database. In this case, the user can manually close the form by clicking on the X in the upper right-hand corner of the form. It must also be noted that the switchboard does not contain a function to exit the database itself. To exit the database, go to 'file' in the upper left-hand corner of the Access window and select 'exit' or click on the X in the upper right-hand corner of the Access window. A diagram of the various menus and options in the switchboard is shown in figure 10.

Figure 8. View of forms in the front-end of the database.

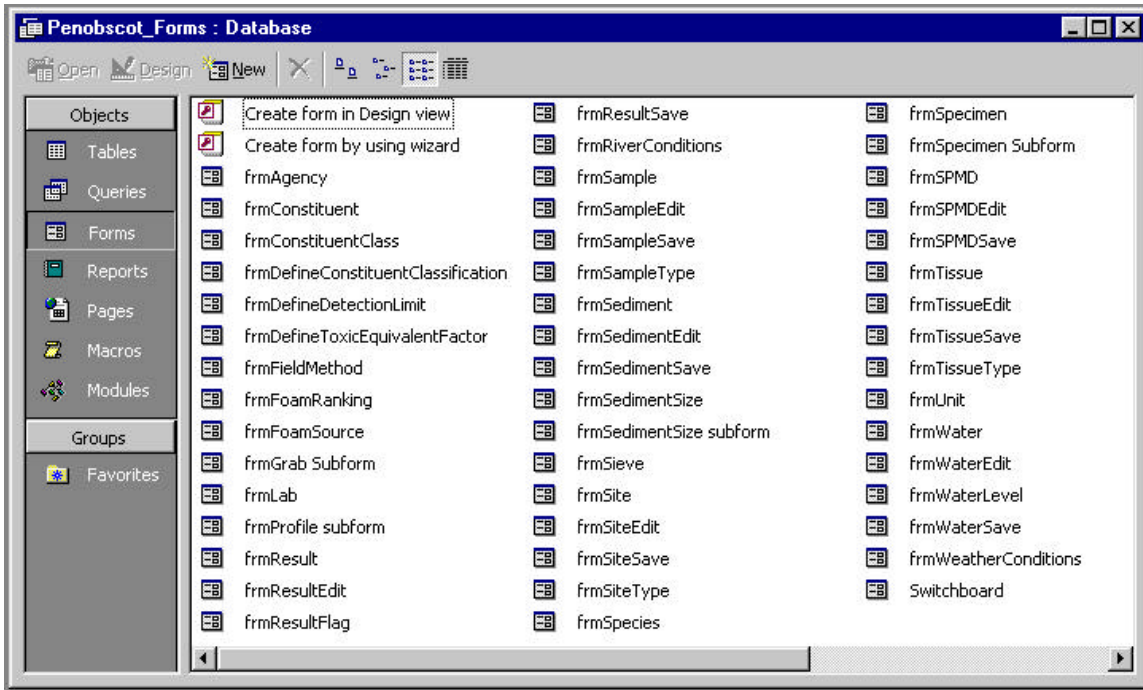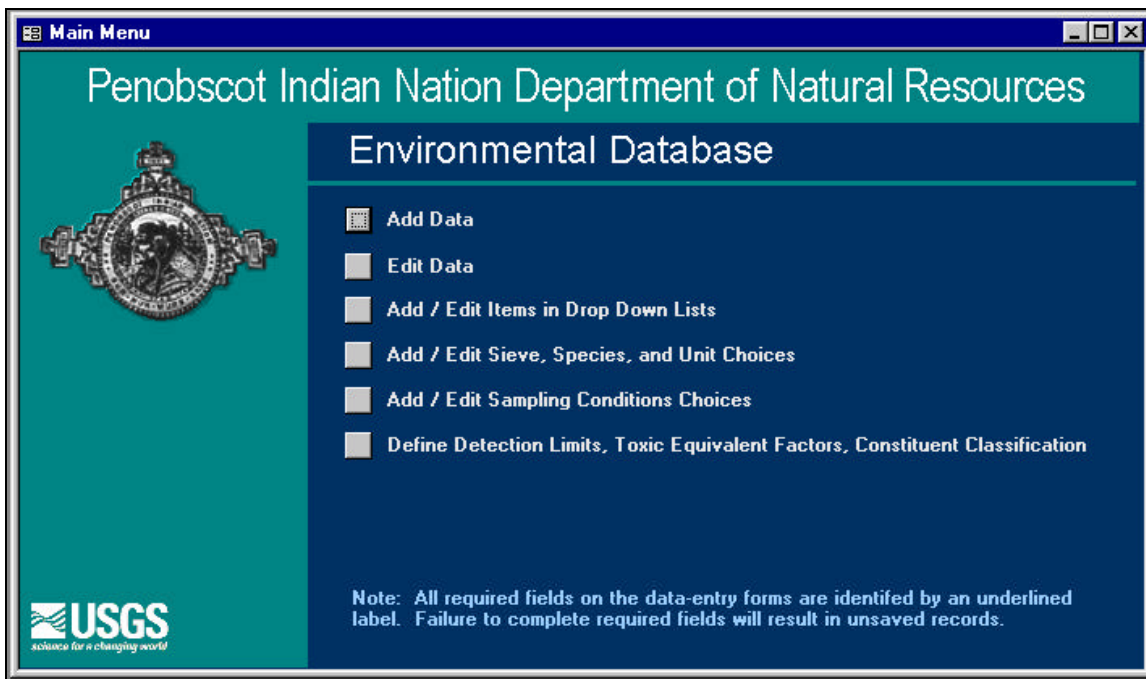**Figure 9.** View of the switchboard in the front-end of the PINE database.

Figure 10. Diagram of the database switchboard.

Setting up the Database

To use the database, users should have a comparable, properly installed version of Access on their computer. When the Access Database is placed in a new location, the front-end of the database will not be linked to the back-end of the database. The user must manually link these two files by following the steps listed below. This linking process must be performed on every front-end file installed on each computer. One back-end file will exist on a single computer network, and all front-end files will be linked to this back-end file.

1. Put the Penobscot_Data.mdb file and the Penobscot_Forms.mdb file on your computer or network. The Penobscot_Data.mdb and Penobscot_Forms.mdb files do not have to reside on the same computer to be linked, if they are being used on a connected system network.

2. Open the Penobscot_Forms.mdb (front-end) file.

3. Go to tools, database utilities, linked table manager.

4. Click on 'Select all'.

5. Check the 'always prompt for new location' button in the bottom left corner and click ok.

6. Navigate to the Penobscot_Data.mdb (back-end) file and click ok.

7. The notice 'all selected linked tables were successfully refreshed' will be displayed.

8. Close the linked table manager.

Adding Data to the Database

Data in the database are added and edited through the switchboard in the Penobscot_Forms.mdb (front-end) file. Although the switchboard narrates the process of data entry, some basic principles must be understood to use the switchboard successfully. Three levels of information are held in the database: site information, sample information, and result information. The order of data entry is very important. Site information must be entered into the database before all other information. Once a site has been entered into the database, then a sample corresponding to that site can be entered. Finally, when a sample has been entered into the database, a result can be entered for that sample.

When entering data via the switchboard into the data-entry forms, it is important to fill out all required fields. These fields are underlined on the forms. Failure to complete required fields will result in unsaved records.

Add a New Site

To enter information for a new site:

1. Click on 'Add Data' in the main menu of the switchboard.

2. Click on 'Add Site'. This opens the form frmSite-Save.

3. Enter the information for the new site in the appropriate fields.

4. Click 'Save Record' to save the new site in the database and return to the switchboard or Click 'Cancel' to abort. If you cancel, none of the data will be entered into the database and you will be returned to the switchboard.

Add a New Sample

To enter information for a new sample:

1. Click on 'Add Data' in the main menu of the switchboard.

2. Click on 'Add New Sample'. This opens the form frmSite and allows the user to see all sites that have been entered into the database.

3. Use the record navigation bar at the bottom of the form to scroll to the appropriate site in the database.

4. Click on 'Add Samples' to add a sample for the site you have selected (this opens the form frmSampleSave) or click 'Cancel' to abort. If you cancel, none of the sample information will be entered into the database and you will be returned to the form frmSite where you will click 'Exit Site' to exit the application and return to the switchboard.

5. In the form frmSampleSave, enter general sample information in the appropriate fields.

6. Click on 'AddSedimentInfo', 'AddTissueInfo', 'AddSPMDInfo', or 'AddWaterInfo' (depending on what type of sample you are entering) to add more detailed information about the sample.

7. Enter the information in the appropriate fields.

8. Click 'Save Sample' to save the information in the database or click 'Cancel' to abort. You will be

returned to the form frmSite. Click on 'exit Site' to exit the application. The 'Cancel' button cancels only the additions/changes that have been made in the main form if no data have been entered into the subforms. If the subform has been accessed, hitting the 'Cancel' button will close the main form but will not actually cancel any changes or additions that have been made.

Add a New Result for a Sediment Sample

To enter information for a new sediment sample result:

1. Click 'Add Data' in the main menu of the switchboard.

2. Click 'Add Results for Sediment Sample'. This opens the form frmSediment and allows the user to see all sediment samples that have been entered into the database.

3. Use the record navigation bar at the bottom of the form to scroll to the sediment sample for which you want to add a result.

4. Click on 'Add Results'. This opens the form frmResult.

5. Enter the result information in the appropriate fields. If the results pertain to a profile, leave the 'Result' field itself blank and complete the subform, frmProfile subform, at the bottom of the Result form.

6. Click on 'Save Results' to save the result information in the database and return to the form frmSediment or click 'Cancel' to abort. If you cancel, you will be returned to the form frmSediment. The 'Cancel' button cancels only the additions/changes that have been made in the main form, if no data have been entered into the subform. If the subform has been accessed, then hitting the 'Cancel' button will close the main form but will not actually cancel any changes or additions that have been made.

7. Click on 'Add Results' to add another result for this sediment sample or click 'Exit Sample' to exit the form frmSediment and return to the switchboard.

Add a New Result for a Tissue Sample

To enter information for a new tissue sample result:

1. Click 'Add Data' in the main menu of the switchboard.

2. Click 'Add Results for Tissue Sample'. This opens the form frmTissue.

3. Use the record navigation bar at the bottom of the form to scroll to the tissue sample for which you want to add a result.

4. Click on 'Add Results'. This opens the form frmResult.

5. Enter the result information in the appropriate fields. If the results pertain to a profile, leave the 'Result' field itself blank and complete the subform, frmProfile subform, at the bottom of the Result form.

6. Click on 'Save Results' to save the result information in the database and return to the form frmTissue or click 'Cancel' to abort. If you cancel, you will be returned to the form frmTissue. The 'Cancel' button cancels only the additions/changes that have been made in the main form if no data have been entered into the subform. If the subform has been accessed, then hitting the 'Cancel' button will close the main form but will not actually cancel any changes or additions that have been made.

7. Click on 'Add Results' to add another result for this tissue sample or click 'Exit Sample' to exit the form frmTissue and return to the switchboard.

Add a New Result for an SPMD Sample

To enter information for a new SPMD sample result:

1. Click 'Add Data' in the main menu of the switchboard.

2. Click 'Add Results for SPMD Sample'. This opens the form frmSPMD.

3. Use the record navigation bar at the bottom of the form to scroll to the SPMD sample for which you want to add a result.

4. Click on 'Add Results'. This opens the form frmResult.

5. Enter the result information in the appropriate fields. If the results pertain to a profile, leave the 'Result' field itself blank and complete the subform, frmProfile subform, at the bottom of the Result form.

6. Click on 'Save Results' to save the result information in the database and return to the form frmSPMD or click 'Cancel' to abort. If you cancel, you will be returned to the form frmSPMD. The 'Cancel' button cancels only the additions/ changes that have been made in the main form, if no data have been entered into the subform. If the subform has been accessed, then hitting the 'Cancel' button will close the main from but will not actually cancel and changes or addition that have been made.

7. Click on 'Add Results' to add another result for this SPMD sample or click 'Exit Sample' to exit the form frmSPMD and return to the switchboard.

Add a New Result for a Water Sample

To enter information for a new water sample result:

1. Click 'Add Data' in the main menu of the switchboard.

2. Click 'Add Results for Water Sample'. This opens the form frmWater.

3. Use the record navigation bar at the bottom of the form to scroll to the water sample for which you want to add a result.

4. Click on 'Add Results'. This opens the form frmResult.

5. Enter the result information in the appropriate fields. If the results pertain to a profile, leave the 'Result' field itself blank and complete the subform, frmProfile subform, at the bottom of the Result form.

6. Click on 'Save Results' to save the result information in the database and return to the form frmWater or click 'Cancel' to abort. If you cancel, you will be returned to the form frmWater. The 'Cancel' button cancels only the additions/changes that have been made in the main form, if no data have been entered into the subform. If the subform has been accessed, then hitting the 'Cancel' button will close the main form but will not actu-

ally cancel any changes or additions that have been made.

7. Click on 'Add Results' to add another result for this water sample or click 'Exit Sample' to exit the form frmWater and return to the switchboard.

Editing Data in the Access Database

Editing existing data in the access database is the second option in the main menu of the switchboard. The process of editing site, sample, and result information is explained below.

Edit an Existing Site

To edit information for an existing site:

1. Click 'Edit Data' in the main menu of the switchboard.

2. Click 'Edit Existing Site'. This opens the form frmSiteEdit.

3. Use the record navigation bar at the bottom of this form to scroll to the appropriate site.

4. Make any necessary changes to the site information.

5. Click 'Save Changes' to save the changes you have made and return to the switchboard or click 'Cancel' to abort. If you cancel, none of the changes you made to the site will be saved in the database and you will be returned to the switchboard.

Edit General Sample Information

To edit information for an existing sample:

1. Click 'Edit Data' in the main menu of the switchboard.

2. Click 'Edit General Sample Information'. This opens the form frmSampleEdit.

3. Use the record navigation bar at the bottom of this form to scroll to the appropriate sample.

4. Make any necessary changes to the general sample information.

5. Click 'Save Changes' to save the changes you have made and return to the switchboard or click 'Cancel' to abort. If you cancel, none of the changes you made to the sample will be saved in the database and you will be returned to the switchboard.

Edit Specific Sediment Sample Information

To edit information for an existing sediment sample:

1. Click on 'Edit Data' in the main menu of the switchboard.

2. Click 'Edit Sediment Sample Information'. This opens the form frmSedimentEdit.

3. Use the record navigation bar at the bottom of this form to scroll to the appropriate sediment sample.

4. Make any necessary changes to the sediment sample information.

5. Click 'Save Changes' to save the changes you have made and return to the switchboard or click 'Cancel' to abort. If you cancel, you will be returned to the switchboard. The 'Cancel' button cancels only the changes that have been made in the main form, if no data have been changed in the subforms, frmGrab subform and frmSedimentSize subform. If the subforms have been accessed, then hitting the 'Cancel' button will close the main form but will not actually cancel any changes that have been made.

Edit Specific Tissue Sample Information

To edit information for an existing tissue sample:

1. Click 'Edit Data' in the main menu of the switchboard.

2. Click 'Edit Tissue Sample Information'. This opens the form frmTissueEdit.

3. Use the record navigation bar at the bottom of this form to scroll to the appropriate tissue sample.

4. Make any necessary changes to the tissue sample information.

5. Click 'Save Changes' to save the changes you have made and return to the switchboard or click 'Cancel' to abort. If you cancel, you will be returned to the switchboard. The 'Cancel' button cancels only the changes that have been made in the main form, if no data have been entered into the subform, frmSpecimen subform. If the subform has been accessed, then hitting the 'Cancel' button will close the main form but will not actually cancel any changes that have been made.

Edit Specific SPMD Sample Information

To edit information for an existing SPMD sample:

1. Click on 'Edit Data' in the main menu of the switchboard.

2. Click 'Edit SPMD Sample Information'. This opens the form frmSPMDEdit.

3. Use the record navigation bar at the bottom of this form to scroll to the appropriate SPMD sample.

4. Make any necessary changes to the SPMD sample information.

5. Click 'Save Changes' to save the changes you have made and return to the switchboard or click 'Cancel' to abort. If you cancel, none of the changes you made to the sample will be saved in the database and you will be returned to the switchboard.

Edit Specific Water Sample Information

To edit information for an existing water sample:

1. Click 'Edit Data' in the main menu of the switchboard.

2. Click 'Edit Water Sample Information'. This opens the form frmWaterEdit.

3. Use the record navigation bar at the bottom of this form to scroll to the appropriate water sample.

4. Make any necessary changes to the water sample information.

5. Click 'Save Changes' to save the changes you have made and return to the switchboard or click 'Cancel' to abort. If you cancel, none of the changes you made to the sample will be saved in the database and you will be returned to the switchboard.

Edit a Result

To edit information for an existing result:

1. Click 'Edit Data' in the main menu of the switchboard.

2. Click 'Edit Existing Results'. This opens the form frmResultEdit.

3. Use the record navigation bar at the bottom of this form to scroll to the appropriate result.

4. Make any necessary changes to the result information.

5. Click 'Save Changes' to save the changes you have made and return to the switchboard or click 'Can-

cel' to abort. If you cancel, you will be returned to the switchboard. The 'Cancel' button cancels only the changes that have been made in the main form, if no data have been added/changed in the subform frmProfile. If the subform has been accessed, then hitting the 'Cancel' button will close the main form but will not actually cancel any changes or additions that have been made.

Adding / Editing Items in the Drop Down Lists

Adding or editing items to a drop down list or domain table is done through the switchboard. This includes adding or editing agencies, field methods, weather conditions, river conditions, water levels, foam rankings, foam sources, laboratories, tissue types, and constituents in the database.

Add / Edit Agency in Drop Down List

To enter or edit information for a new or existing agency:

1. Click 'Add / Edit Items in Drop Down List' in the main menu of the switchboard.

2. Click 'Add / Edit Agency in Drop Down List'. This opens the form frmAgency.

3. Use the record navigation bar to scroll to the Agency you want to edit or advance to a blank copy of the form to add a new agency.

4. Make any necessary changes or additions. (Note: If you are adding a new agency, you have to assign an Agency_ID. Make sure the number you assign is not already in use.)

5. Click 'Save' to save the changes or additions you have made or click 'Cancel' to cancel any changes or additions you have made.

Add / Edit Field Method in Drop Down List

To enter or edit information for a new or existing field method:

1. Click 'Add / Edit Items in Drop Down List' in the main menu of the switchboard.

2. Click 'Add / Edit Field Method in Drop Down List'. This opens the form frmFieldMethod.

3. Use the record navigation bar to scroll to the field method you want to edit or advance to a blank copy of the form to add a new field method.

4. Make any necessary changes or additions. (Note: If you are adding a new field method, you have to assign a FieldMethod_ID to uniquely identify that field method. Make sure the number you assign is not already in use.)

5. Click 'Save' to save the changes or additions you have made or click 'Cancel' to cancel any changes or additions you have made.

Add / Edit Weather Condition in Drop Down List

To enter or edit information for a new or existing weather condition:

1. Click 'Add / Edit Items in Drop Down List' in the main menu of the switchboard.

2. Click 'Add / Edit Weather Condition in Drop Down List'. This opens the form frmWeatherCondition.

3. Use the record navigation bar to scroll to the weather condition you want to edit or advance to a blank copy of the form to add a new weather condition.

4. Make any necessary changes or additions. (Note: If you are adding a new weather condition, you have to assign a WeatherConditions_ID. Make sure the number you assign is not already in use.)

5. Click 'Save' to save the changes or additions you have made or click 'Cancel' to cancel any changes or additions you have made.

Add / Edit River Condition in Drop Down List

To enter or edit information for a new or existing river condition:

1. Click 'Add / Edit Items in Drop Down List' in the main menu of the switchboard.

2. Click 'Add / Edit River Condition in Drop Down List'. This opens the form frmRiverCondition.

3. Use the record navigation bar to scroll to the river condition you want to edit or advance to a blank copy of the form to add a new river condition.

4. Make any necessary changes or additions. (Note: If you are adding a new river condition, you have to assign a RiverConditions_ID. Make sure the number you assign is not already in use.)

5. Click 'Save' to save the changes or additions you have made or click 'Cancel' to cancel any changes or additions you have made.

Add / Edit Water Level in Drop Down List

To enter or edit information for a new or existing water level:

1. Click 'Add / Edit Items in Drop Down List' in the main menu of the switchboard.

2. Click 'Add / Edit Water Level in Drop Down List'. This opens the form frmWaterLevel.

3. Use the record navigation bar to scroll to the water level you want to edit or advance to a blank copy of the form to add a new water level.

4. Make any necessary changes or additions. (Note: If you are adding a new water level, you have to assign a WaterLevel_ID. Make sure the number you assign is not already in use.)

5. Click 'Save' to save the changes or additions you have made or click 'Cancel' to cancel any changes or additions you have made.

Add / Edit Foam Ranking in Drop Down List

To enter or edit information for a new or existing foam ranking:

1. Click 'Add / Edit Items in Drop Down List' in the main menu of the switchboard.

2. Click 'Add / Edit Foam Ranking in Drop Down List'. This opens the form frmFoamRanking.

3. Use the record navigation bar to scroll to the foam ranking you want to edit or advance to a blank copy of the form to add a new foam ranking.

4. Make any necessary changes or additions. (Note: If you are adding a new foam ranking, you have to assign a FoamRanking_ID. Make sure the number you assign is not already in use.)

5. Click 'Save' to save the changes or additions you have made or click 'Cancel' to cancel any changes or additions you have made.

Add / Edit Foam Source in Drop Down List

To enter or edit information for a new or existing foam source:

1. Click 'Add / Edit Items in Drop Down List' in the main menu of the switchboard.

2. Click 'Add / Edit Foam Source in Drop Down List'. This opens the form frmFoamSource.

3. Use the record navigation bar to scroll to the foam source you want to edit or advance to a blank copy of the form to add a new foam source.

4. Make any necessary changes or additions. (Note: If you are adding a new foam source, you have to assign a FoamSource_ID. Make sure the number you assign is not already in use.)

5. Click 'Save' to save the changes or additions you have made or click 'Cancel' to cancel any changes or additions you have made.

Add / Edit Lab in Drop Down List

To enter or edit information for a new or existing laboratory:

1. Click 'Add / Edit Items in Drop Down List' in the main menu of the switchboard.

2. Click 'Add / Edit Lab in Drop Down List'. This opens the form frmLab.

3. Use the record navigation bar to scroll to the laboratory you want to edit or advance to a blank copy of the form to add a new lab.

4. Make any necessary changes or additions. (Note: If you are adding a new laboratory, you have to assign a Lab_ID. Make sure the number you assign is not already in use.)

5. Click 'Save' to save the changes or additions you have made or click 'Cancel' to cancel any changes or additions you have made.

Add / Edit Tissue Type in Drop Down List

To enter or edit information for a new or existing tissue type:

1. Click 'Add / Edit Items in Drop Down List' in the main menu of the switchboard.

2. Click 'Add / Edit Tissue Type in Drop Down List'. This opens the form frmTissueType.

3. Use the record navigation bar to scroll to the tissue type you want to edit or advance to a blank copy of the form to add a new tissue type.

4. Make any necessary changes or additions. (Note: If you are adding a new tissue type, you have to assign a TissueType_ID. Make sure the number you assign is not already in use.)

5. Click 'Save' to save the changes or additions you have made or click 'Cancel' to cancel any changes or additions you have made.

Add / Edit Constituent in Drop Down List

To enter or edit information for a new or existing constituent:

1. Click 'Add / Edit Items in Drop Down List' in the main menu of the switchboard.

2. Click 'Add / Edit Constituent in Drop Down List'. This opens the form frmConstituent.

3. Use the record navigation bar to scroll to the constituent you want to edit or advance to a blank copy of the form to add a new constituent.

4. Make any necessary changes or additions. (Note: If you are adding a new constituent, you have to assign a Constituent_ID. Make sure the number you assign is not already in use.)

5. Click 'Save' to save the changes or additions you have made or click 'Cancel' to cancel any changes or additions you have made.

Add / Edit Constituent Class in Drop Down List

To enter or edit information for a new or existing constituent class:

1. Click 'Add / Edit Items in Drop Down List' in the main menu of the switchboard.

2. Click 'Add / Edit Constituent Class in Drop Down List'. This opens the form frmConstituentClass.

3. Use the record navigation bar to scroll to the constituent class you want to edit or advance to a blank copy of the form to add a new constituent class.

4. Make any necessary changes or additions.

5. Click 'Save' to save the changes or additions you have made or click 'Cancel' to cancel any changes or additions you have made.

Add / Edit Result Flag in Drop Down List

To enter or edit information for a new or existing result flag:

1. Click 'Add / Edit Items in Drop Down List' in the main menu of the switchboard.

2. Click 'Add / Edit Result Flag in Drop Down List'. This opens the form frmResultFlag.

3. Use the record navigation bar to scroll to the result flag you want to edit or advance to a blank copy of the form to add a new result flag.

4. Make any necessary changes or additions. (Note: If you are adding a new result flag, you have to assign a ResultFlag_ID. Make sure the number you assign is not already in use.

5. Click 'Save' to save the changes or additions you have made or click 'Cancel' to cancel any changes or additions you have made.

Adding /Editing Sieve, Species, and Unit Choices

Adding or editing choices to the tdx tables also is done through the switchboard. To add or edit sieve, species, or units in the database:

1. Click 'Add / Edit Sieve, Species, and Unit Choices' in the main menu of the switchboard.

2. Click 'Add / Edit Sieve, Species, or Unit in Drop Down List'. This opens the form frmSieve, frmSpecies, or frmUnit.

3. Use the record navigation bar to scroll to the record you want to edit or advance to a blank copy of the form to add a new record.

4. Make any necessary changes or additions. (Note: If you are adding a new record, you have to assign a Sieve_ID, Species_ID, or Unit_ID. Make sure the number you assign is not already in use.)

5. Click 'Save' to save the changes or additions you have made or click 'Cancel' to cancel any changes or additions you have made.

Defining Detection Limits/ Toxic Equivalent Factors/ Constituent Classification

Adding or editing choices to the tad and tas tables also is done through the switchboard. To add or edit Detection Limits, Toxic Equivalent Factors, or Constituent Classifications:

1. Click 'Define Detection Limits/ Toxic Equivalent Factors/ Constituent Classification' in the main menu of the switchboard.

2. Click 'Define Detection Limits, Toxic Equivalent Factors, or Constituent Classification in Drop Down List'. This opens the form frmDefineDetectionLimits, frmDefineToxicEquivalentFactors, or frmDefineConstituentClassification.

3. Use the record navigation bar to scroll to the record you want to edit or advance to a blank copy of the form to add a new record.

4. Make any necessary changes or additions.

5. Click 'Save' to save the changes or additions you have made or click 'Cancel' to cancel any changes or additions you have made.

Deleting Data from the Access Database

Deleting data from the database can compromise the integrity of the database if it is not done properly and should be done only by a database administrator. Once data have been deleted from the database, it cannot be recovered.

Data are not deleted through the switchboard. To delete a record, you have to manually delete all information pertaining to that record in all tables. Deletions are made only from the tas, tbl, and tad tables because these are the only tables that store primary data about a record. The other tables (tds and tdx) are domain tables that provide a list of choices but do not actually store any of the primary data for the record.

Due to the system of primary and foreign keys, and the various dependencies of the data on one another, a specific order must be followed to delete records from the database. You cannot delete data from one table if those data are referenced in another table. For example, you cannot delete a site if a number of samples refer to it. If data are not deleted from the tables in the correct order, fatal errors can occur and the database can be rendered completely unusable.

Follow these steps to delete record(s) from the database. If the record being deleted does not have data in one of the tables listed, skip that table and go on to the next one that contains data for that record. If you get a message that tells you that the entry that you are trying to delete is referenced in another table, DO NOT PROCEED. Find the table(s) that the entry is referenced in and delete the entry from those tables first.

1. Open the back-end of the database, by selecting the Penobscot_Data.mdb file, and click on the Tables tab.

2. TblProfile: Open the table tblProfile. Choose the row(s) that contains the Result_ID you want to remove from the database and hit the delete key on your keyboard.

3. TblResult: Open the table tblResult. Choose the row that contains the Result_ID you want to remove from the database and hit the delete key on your keyboard.

4. TadDetectionLimit: Open the table tadDetectionLimit. Choose the row(s) that contain the DetectionLimit(s) you want to remove from the database and hit the delete key on your keyboard.

5. TadToxicEquivalentFactor: Open the table tadToxicEquivalentFactor. Choose the ToxicEquivalentFactor(s) you want to remove from the database and hit the delete key on your keyboard.

6. TasConstituentClassification: Open the table tasConstituentClassification. Choose the ConstituentClassification(s) you want to remove from the database and hit the delete key on your keyboard.

7. TadSedimentSize: Open the table tadSedimentSize. Choose the SedimentPct(s) you want to remove from the database and hit the delete key on your keyboard.

8. TblGrab: Open tblGrab. Select the row that contains the Sample_ID you want to remove from the database and hit the delete key on your keyboard.

9. TblSpecimen: Open tblSpecimen. Select the row that contains the Sample_ID you want to remove from the database and hit the delete key on your keyboard.

10. TblSediment: Open tblSediment. Select the row that contains the Sample_ID you want to remove from the database and hit the delete key on your keyboard.

11. TblTissue: Open tblTissue. Select the row that contains the Sample_ID you want to remove from the database and hit the delete key on your keyboard.

12. TblSPMD: Open tblSPMD. Select the row that contains the Sample_ID you want to remove from the database and hit the delete key on your keyboard.

13. TblWater: Open tblWater. Select the row that contains the Sample_ID that you wish to remove from the database and hit delete.

14. TblSample. Open tblSample. Select the row that contains the Sample_ID you want to remove from the database and hit the delete key on your keyboard.

15. TblSite. Open tblSite. Because this table is referenced to itself (Site_ID is referenced to ParentSiteID), the deletion process is more complicated. First, delete all ParentSiteID values that match the Site_ID value you want to delete. For example, if you want to delete Site_ID number one, you must first delete the number one everywhere in the ParentSiteID column. Second, select the row that contains the Sample_ID you want to remove from the database and hit delete.

If you want to delete a record that has data in all of these tables, you will have to go through the 15 steps in the deletion process. You also can delete parts of a record, as long as you follow the order outlined above. For example, if you want to delete the results that have been entered for a sample but not the sample itself, follow steps 1 to 3. If you want to delete all samples collected at a given site, follow steps 1 through 14 for all of the samples that were collected at that site. Do not delete data from one table that are referenced in another table.

REFERENCES CITED

National Institute of Standards and Technology, 1993, Standard for integration definition for information modeling (IDEF1X): Federal Information Processing Standards Publication 184, 155 p.

Tessler, Steven, in press, Data model and relational design for the New England water-use data system: U.S. Geological Survey Open-File Report 01-359.

APPENDIX 1- Data Dictionary

Data Dictionary Table of Contents

DATA DICTIONARY

The data dictionary contains detailed information on the tables in the PINE database. It describes the tables and provides information on the fields in those tables. In the following sections, PK denotes primary key and FK denotes foreign key. The tables are organized in alphabetical order.

Table and Field Listings

TadDetectionLimit

[TadDetectionLimit stores information on the associations of a sample type, lab, and constituent to record the detection limit in effect during a certain period of time]

Field Name	PK	FK	Required	Type	Default	Description
SampleType_ID	X	X	X	Number		Key that uniquely identifies a type of sample (sediment, tissue, SPMD, water)
Lab_ID	X	X	X	Number		Key that uniquely identifies a lab that processes samples and reports results
Constituent_ID	X	X	X	Number		Key that uniquely identifies a specific constituent
DetLimitEffectiveDate	X		X	Date/Time		Date from which a specific detection limit takes effect (is adopted); the limit remains in effect until another date and associated limit are defined
DetectionLimit			X	Number		Numerical value of a detection limit defined by a combination of a specific sample type, analyzing lab, constituent, and effective date
Unit_ID		X	X	Number		Key that uniquely identifies a measurement or reporting unit for a result
DetectionLimitComment				Memo		Comment about a detection limit (e.g., reason for a new value or a change from a previous value)

TadSedimentSize

[TadSedimentSize stores information about the grain-size distribution of a sediment sample. It contains information on the percentage of the sediment sample captured in various sieves]

Field Name	PK	FK	Required	Type	Default	Description
Sample_ID	X	X	X	Number		Key that uniquely identifies a sample
Sieve_ID	X	X	X	Number		Key that uniquely identifies a specific sieve used for sediment grain-size analysis
SedimentPct			X	Number		Percent of sediment sample captured at a specific sieve size

TadToxicEquivalentFactor

[TadToxicEquivalentFactor stores information on the associations of a constituent with a toxic equivalent factor weighting in effect over a period of time]

Field Name	PK	FK	Required	Type	Default	Description
Constituent_ID	X	X	X	Number		Key that uniquely identifies a specific constituent
TEFEffectiveDate	X		X	Date/Time		Date from which a specific toxic equivalent factor takes effect (is adopted)
ToxicEquivalentFactor			X	Number		Numerical value of a toxic equivalent factor pertaining to a specific constituent and effective date
TEFComment				Memo		Comment associated with a toxic equivalent factor

TasConstituentClassification

[TasConstituentClassification stores a list of groups used to classify constituents into groups (dioxins, furans, nutrients, etc.)]

Field Name	PK	FK	Required	Type	Default	Description
Constituent_ID	X	X	X	Number		Key that uniquely identifies a specific constituent
ConstituentClass_ID	X	X	X	Number		Key that uniquely identifies a classification group (dioxins, furans, etc.) for individual constituents

TblGrab

[TblGrab stores information pertaining to the individual grabs in a sediment sample. One sediment sample may be composed of one grab or of many grabs]

Field Name	PK	FK	Required	Type	Default	Description
Sample_ID	X	X	X	Number		Key that uniquely identifies a sample
GrabNumber	X		X	Text		Number assigned by the collecting agency or organization to an individual grab in a sediment composite
GrabDepthOfWater			X	Number		Depth of water (in feet) at the point where an individual sediment sample grab is collected

TblProfile

[TblProfile stores the result values for water samples collected at the various depths belonging to a profile]

Field Name	PK	FK	Required	Type	Default	Description
Result_ID	X	X	X	Number		Key that uniquely identifies a result from a sample
ProfileDepth	X		X	Number		Depth of water where a sample was collected in a profile
ProfileValue				Number		Result value at a given depth of water in the profile

TblResult

[TblResult stores information on results for a specific constituent in a sample]

Field Name	PK	FK	Required	Type	Default	Description
Result_ID	X		X	Number		Key that uniquely identifies a result from a sample
Sample_ID		X	X	Number		Key that uniquely identifies a sample
Constituent_ID		X	X	Number		Key that uniquely identifies a specific constituent
ResultFlag_ID		X	X	Number	0	Key that uniquely identifies a result flag used to qualify a result value; the default of 0 indicates no result flag (values accepted as reported)
Result				Number		Result reported for a constituent from an analysis of a sample (the field may be left as null if it is a 'non-detect')
Unit_ID		X	X	Number		Key that uniquely identifies a measurement or reporting unit for a result
ResultComment				Memo		Comment about a result

TblSample

[TblSample stores information on samples of field data or collected material at a particular site]

Field Name	PK	FK	Required	Type	Default	Description
Sample_ID	X		X	Number		Key that uniquely identifies a sample
Site_ID		X	X	Number		Key that uniquely identifies a site or place where samples are taken or collected
SampleDate			X	Date/Time		Date when a sample was collected in the field
SampleTime				Date/Time		Time when a sample was collected in the field
SampleType_ID		X	X	Number		Key that uniquely identifies a type of sample (e.g., sediment, tissue, SPMD, water)
Agency_ID		X	X	Number		Key that uniquely identifies an agency or organization that has primary responsibility for a given site, or collects samples
Collector				Text		Initials or name(s) of person(s) collecting a sample
AgencySampleNumber			X	Text		Number or code assigned to a sample in the field by the collecting agency (WDSS008 for Weldon Dam Sediment Sample #8)
FieldMethod_ID		X	X	Number	0	Key that uniquely identifies a field method and equipment used in collecting a sample; the default of 0 indicates field method is unknown
QualityControlSample			X	Yes/No		Key that identifies whether or not a sample is a quality-control sample
SampleDepthOfWater				Number		Depth of water where a sample is collected
Lab_ID		X	X	Number	0	Key that uniquely identifies a lab that processes samples and reports results; the default of 0 indicates a field measurement
LabSampleNumber				Text		Number assigned to a sample by the analyzing lab
ExtractionDate				Date/Time		Date that an extraction is performed on a sample
AnalysisDate				Date/Time		Date that an analysis is performed on a sample
WeatherConditions_ID		X		Number		Key that uniquely identifies a weather condition
SamplingAirTemp				Number		Air temperature (in degrees Celsius) when a sample is collected in the field
RiverConditions_ID		X		Number		Key that uniquely identifies a river condition

TblSample—Continued

[TblSample stores information on samples of field data or collected material at a particular site]

Field Name	PK	FK	Required	Type	Default	Description
WaterLevel_ID		X		Number		Key that uniquely identifies a water level
FoamRanking_ID		X		Number		Key that uniquely identifies a foam ranking
FoamSource_ID		X		Number		Key that uniquely identifies a foam source
SampleComment				Memo		Comment about a sample; can include field collection and lab handling notes

TblSediment

[TblSediment stores information on the details of a sediment sample]

Field Name	PK	FK	Required	Type	Default	Description
Sample_ID	X	X	X	Number		Key that uniquely identifies a sample
SedimentComposite				Text		Composite number assigned to a sediment sample in the field (code for composite sample)
WetWeight				Number		Weight of sediment sample (in grams) before drying
DryWeight				Number		Weight of sediment sample (in grams) after drying
MoisturePct				Number		Percent moisture content of a sediment sample
OrganicContentPct				Number		Percent organic content of a sediment sample
SedimentComment				Memo		Comment about a sediment sample

TblSite

[TblSite stores detailed information on the site or place where samples are collected]

Field Name	PK	FK	Required	Type	Default	Description
Site_ID	X		X	Number		Key that uniquely identifies a site or place where samples are taken
ParentSiteID				Number		ParentSiteID is used to group sites together spatially; the ParentSiteID of a reach is the same as the Site_ID for that reach; the ParentSite of a point is the Site_ID of the reach that the point falls within
Agency_ID		X	X	Number		Key that uniquely identifies an agency or party that owns or maintains sites, or collects samples
SiteType_ID		X	X	Number		Key that uniquely identifies a type of site
SiteName			X	Text		Common name of a site (Weldon Dam Impoundment)
SiteCode			X	Text		Code or abbreviation for the name of a site
HUC_ID		X		Number		Key that uniquely identifies a hydrologic unit
Latitude				Number		Latitude of a site in decimal degrees; for a reach this pertains to the upstream end of that reach
Longitude				Number		Longitude of a site in decimal degrees; for a reach, this pertains to the upstream end of that reach
SiteLength			X	Number	-1	Length of a reach; the length is the distance (in feet) from the location defined by the latitude and longitude of the upstream end of the reach to the downstream end of the reach; if the site is a point, the site length for this mandatory entry is 0; the default of –1 indicates that the length is not determined
SiteContact				Memo		Name of the organization to contact for information about the site
SiteComment				Memo		Comment about a site

TblSpecimen

[TblSpecimen stores details about individual specimens of a tissue sample]

Field Name	PK	FK	Required	Type	Default	Description
Sample_ID	X	X	X	Number		Key that uniquely identifies a sample
SpecimenNumber	X		X	Text		Identification number assigned to a specimen when it is collected in the field
Species_ID		X	X	Number		Key that uniquely identifies a species name
SpecimenWeight				Number		Weight (in grams) of a specimen; the weight for a turtle specimen is a rough estimate
SpecimenLength				Number		Length (in millimeters) of a specimen; the length of a turtle specimen is defined as the upper carapace length; the length of a muskrat specimen is defines as the length from the nose to the base of the tail
SpecimenWidth				Number		Width (in millimeters) of a specimen; the width of a turtle is defined as the width of the upper carapace
Gender				Text		Gender of a specimen (male, female, juvenile, unknown)
SpecimenAge				Text		Age of a specimen (adult, immature)
SpecimenComment				Memo		Comment about a specimen, including parasites, injuries, or deformities

TblSPMD

[TblSPMD stores details pertaining to an SPMD (semi-permeable membrane device) sample]

Field Name	PK	FK	Required	Type	Default	Description
Sample_ID	X	X	X	Number		Key that uniquely identifies a sample
SolventUsed				Text		Name of the solvent used in an SPMD sample
SolventVolume				Number		Volume of the solvent (in milliliters) used inside the SPMD to collect the sample
SPMDDepthOf Water				Number		Depth of the water (in feet) over an SPMD sampling point
SPMDComment				Memo		Comment about an SPMD sample

TblTissue

[TblTissue stores details pertaining to a tissue sample]

Field Name	PK	FK	Required	Type	Default	Description
Sample_ID	X	X	X	Number		Key that uniquely identifies a sample
TissueComposite				Text		Composite number/code assigned to a tissue sample in the field (WDSMB01 for Weldon Dam Smallmouth Bass #01)
TissueType_ID		X	X	Number		Key that uniquely identifies a type of tissue
TissueWeight				Number		Weight (in grams) of a tissue sample used for analysis
LipidPct				Number		Percent lipid composition of a tissue sample used for analysis
NumSpecimens			X	Number	0	Total number of specimens used in a tissue sample; a number greater than 1 identifies composite samples (see specimen data); default of 0 indicates 'not reported'
TissueComment				Memo		Comment about a tissue sample

TblWater

[TblWater stores detailed information for a water sample]

Field Name	PK	FK	Required	Type	Default	Description
Sample_ID	X	X	X	Number		Key that uniquely identifies a sample
WaterSampleVolume				Number	0	Volume of water sample in milliliters; default of 0 indicates 'not reported'
WaterComment				Memo		Comment about a water sample

TdsAgency

[TdsAgency stores a list of agencies or organizations that have primary responsibility for sites, or collect samples]

Field Name	PK	FK	Required	Type	Default	Description
Agency_ID	X		X	Number		Key that uniquely identifies an agency or organization that maintains sites, or collects samples
AgencyAbbrev			X	Text		Abbreviation (USGS) for an agency or organization that has primary responsibility for a given site, or collects samples
Agency			X	Text		Full name (U.S. Geological Survey) of an agency or organization that has primary responsibility for a given site, or collects samples
AgencyContact				Memo		Contact information for an agency or organization (name of person to contact at the given agency or organization, phone number, address)
AgencyComment				Memo		Comment about an agency

TdsConstituent

[TdsConstituent stores a list of constituents for which measurement or analytical results are reported]

Field Name	PK	FK	Required	Type	Default	Description
Constituent_ID	X		X	Number		Key that uniquely identifies a specific constituent
CASNumber				Text		CAS (Chemical Abstract Service) registry number corresponding to the given substance name in the Chemical Substance Index
ConstituentAbbrev			X	Text		Abbreviation for a constituent (2,3,7,8-TCDD)
Constituent			X	Text		Full name of a constituent (2,3,7,8, tetrachlordibenzo-p-dioxin)
IUPACNumber				Text		IUPAC (International Union of Pure and Applied Chemistry) Code Number

TdsFieldMethod

[TdsFieldMethod stores a list of methods and equipment used to collect field samples]

Field Name	PK	FK	Required	Type	Default	Description
FieldMethod_ID	X		X	Number		Key that uniquely identifies a field method and equipment used in collecting a sample
FieldMethod			X	Text		Description of the field method used in collecting a sample
Equipment				Text		Description of the equipment used in collecting a sample using a particular field method
FieldMethodComment				Memo		Comment about a field method and equipment used in collecting a sample

TdsFoamRanking

[TdsFoamRanking stores a list of foam ranking classifications used to describe the presence and amount of foam at a site

Field Name	PK	FK	Required	Type	Default	Description
FoamRanking_ID	X		X	Number		Key that uniquely identifies a foam ranking
FoamRanking			X	Text		Description of a foam ranking in a lake, river, or stream during the collection of a sample
FoamRankingComment				Memo		Comment on a foam ranking

TdsFoamSource

[TdsFoamSource stores a list of possible sources of foam at a site]

Field Name	PK	FK	Required	Type	Default	Description
FoamSource_ID	X		X	Number		Key that uniquely identifies a foam source
FoamSource			X	Text		Description of the source of foam on a lake, river, or stream
FoamSourceComment				Memo		Comment on the source of foam

TdsHUC

[TdsHUC stores a list of Hydrologic Unit Codes (basins)]

Field Name	PK	FK	Required	Type	Default	Description
HUC_ID	X		X	Number		Key that uniquely identifies a Hydrologic Unit Code (basin)
HUC08				Text		Hydrologic Unit Code (basin) at the 08-digit level
HUC11				Text		Hydrologic Unit Code (basin) at the 11-digit level
HUC14				Text		Hydrologic Unit Code (basin) at the 14-digit level
HUC14Name				Text		Name of the Hydrologic Unit Code (basin) at the 14-digit level
HUC14SQMI				Text		Area in square miles of the Hydrologic Unit Code (basin) at the 14-digit level

TdsLab

[TdsLab stores a list of labs responsible for analyzing samples and reporting results]

Field Name	PK	FK	Required	Type	Default	Description
Lab_ID	X		X	Number		Key that uniquely identifies a lab that processes samples and report results
Lab			X	Text		Name of lab analyzing samples and reporting results
LabAbbrev			X	Text		Abbreviation used to refer to a lab
LabContact			X	Text		Contact information for a lab
EPACertified			X	Yes/No		Identifies whether or not a lab is USEPA-certified for the types of analyses required by the samples
LabComment				Memo		Comment about a lab

TdsResultFlag

[TdsResultFlag stores a list of flags used to qualify individual Results (<, estimated, non-detect, etc.)]

Field Name	PK	FK	Required	Type	Default	Description
ResultFlag_ID	X		X	Number		Key that uniquely identifies a result flag used to qualify a result value
ResultFlag			X	Text		Flag that qualifies a result value (<, est, avg, ND); 'null' applied as a flag indicates that a value is acceptable as reported; 'average' is defined as the 'mean'
ResultFlagDescr			X	Text		Description of a result flag

TdsRiverConditions

[TdsRiverConditions stores a list of river conditions that may exist during the collection of samples]

Field Name	PK	FK	Required	Type	Default	Description
RiverConditions_ID	X		X	Number		Key that uniquely identifies a river condition
RiverConditions			X	Text		Description of a river condition that exists when a sample is collected in the field
RiverConditionsComment				Memo		Comment on a river condition

TdsSampleType

[TdsSampleType stores a list of types of samples]

Field Name	PK	FK	Required	Type	Default	Description
SampleType_ID	X		X	Number		Key that uniquely identifies a type of sample (sediment, tissue, SPMD, or water)
SampleType			X	Text		Type of sample collected (sediment, tissue, SPMD, or water)

TdsSiteType

[TdsSiteType stores a list of types of sites where samples are taken or collected]

Field Name	PK	FK	Required	Type	Default	Description
SiteType_ID	X		X	Number		Key that uniquely identifies a type of site
SiteType			X	Text		Type of site (point or reach) where a sample is collected; the SiteType for a sediment sample is a point, whereas the SiteType for a tissue sample may be a reach

TdsTissueType

[TdsTissueType stores a list of tissue types which are analyzed for various constituents]

Field Name	PK	FK	Required	Type	Default	Description
TissueType_ID	X		X	Number		Key that uniquely identifies a type of tissue
TissueType			X	Text		Type of tissue (fish liver, whole fish, fish fillet) used to analyze a sample for various constituents

TdsWaterLevel

[TdsWaterLevel stores a list of descriptions of water levels in a lake, river or stream]

Field Name	PK	FK	Required	Type	Default	Description
WaterLevel_ID	X		X	Number		Key that uniquely identifies the water level in a lake, river, or stream during the collection of a sample
WaterLevel			X	Text		Description of the water level in a lake, river, or stream during the collection of a sample
WaterLevelComment				Memo		Comment associated with the water level in a lake, river, or stream

TdsWeatherConditions

[TdsWeatherConditions stores a list of weather conditions that may exist during the collection of a sample in the field]

Field Name	PK	FK	Required	Type	Default	Description
WeatherConditions_ID	X		X	Number		Key that uniquely identifies a weather condition
WeatherConditions			X	Text		Description of a weather condition that may exist in the field during the collection of a sample
WeatherConditionsComment				Memo		Comment about a weather condition

TdxConstituentClass

[TdxConstituentClass stores a list of groups used to classify constituents]

Field Name	PK	FK	Required	Type	Default	Description
ConstituentClass_ID	X		X	Number		Key that uniquely identifies a constituent class
ConstituentClass			X	Text		Constituent class or classification (e.g. dioxin, furan, PCB) used to group constituents
ConstituentClassComment				Memo		Comment about a constituent class

TdxSieve

[TdxSieve stores a list of sieves used to characterize the grain-size distribution of sediment samples]

Field Name	PK	FK	Required	Type	Default	Description
Sieve_ID	X		X	Number		Key that uniquely identifies a specific sieve used for sediment grain-size analysis
SieveSize			X	Number		Numerical value (in millimeters) describing the mesh size of a sieve (0.425)
SieveCode				Text		Code used to refer to a specific sieve
SedimentFraction			X	Text		Category of sediment that is captured in the specified sieve size (fine sand, coarse sand, cobble)

TdxSpecies

[TdxSpecies stores a list of biotic species]

Field Name	PK	FK	Required	Type	Default	Description
Species_ID	X		X	Number		Key that uniquely identifies a species name
SpeciesCode			X	Text		Code used to refer to a species name ('smb' for Smallmouth Bass)
Species			X	Text		Common name of a species (Smallmouth Bass)

TdxUnit

[TdxUnit stores a list of measurement or reporting units]

Field Name	PK	FK	Required	Type	Default	Description
Unit_ID	X		X	Number		Key that uniquely identifies a measurement or reporting unit
UnitAbbrev			X	Text		Abbreviation for a measurement or reporting unit ('pg/g' for picogram per gram)
Unit			X	Text		Measurement or reporting unit (picogram per gram)

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