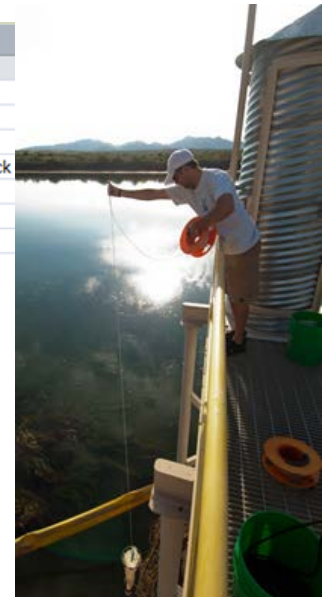# RECLAMATION

Managing Water in the West

Mussel Database Development and Management

Research and Development Office
Science and Technology Program
Final Report ST-A743F-01

tblLocation_def

Field Name	Data Type	
Location_RecID	AutoNumber	This field is an automatically assigned reference number (primary key)
Water_RecID	Number	Number indicating linked Water Body record (foreign key)
Location	Text	Name of the survey/sampling location
LocDescrip	Text	Brief description of the location (e.g. 30m W of ramp, eastern-most dock
Latitude	Text	Latitude in decimal degrees (e.g. 41.7436)
Longitude	Number	Longitude in decimal degrees (e.g. -112.9715)
LocCmmts	Memo	Comments

Lab Sample ID	USBR Area Office	State	Water Body	Sample Location	Sample Date	X Coordinate (Long.)	Y Coordinate (Lat.)
C0333	LBAO	NV	Adam's McGill Rese	Sample 1	5/23/2012		
C0192	KBAO	OR	Agency Lake	Henzel Park Boat Ramp	4/20/2012	10T E: 0654632	N: 4673800
C0759	WYAO	WY	Alcova Reservoir	Alcova Marina	7/11/2012	13T: E 354427	N 4710017
C0760	WYAO	WY	Alcova Reservoir	Inlet	7/10/2012	13T: E 353217	N 4707129
C0761	WYAO	WY	Alcova Reservoir	Oakie Boat Ramp	7/10/2012	13T: E 355553	N 4710637
C0762	WYAO	WY	Alcova Reservoir	Black Beach	6/27/2012	13T: E 359428	N 4710740
C0763	WYAO	WY	Alcova Reservoir	Dam	6/27/2012	13T: E 358666	N 4711937

Mission Statements

The U.S. Department of the Interior protects America's natural resources and heritage, honors our cultures and tribal communities, and supplies the energy to power our future.

The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public.

REPORT DOCUMENTATION PAGE			*Form Approved* *OMB No. 0704-0188*
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13. SUPPLEMENTARY NOTES			
14. ABSTRACT *(Maximum 200 words)* The Reclamation Detection Laboratory for Exotic Species (RDLES) in Denver has analyzed over 15,000 samples representing over 400 water bodies for the presence of dreissenid mussels. At the time of sample collection, numerous environmental parameters were collected with a plankton tow net sample. Each sample, analyzed by numerous methods for the detection of dreissenid mussels, water quality, and zooplankton populations. Additionally, during the ARRA funded portion of the project (2009-2011) each reservoir was sampled for water quality parameters, zooplankton, and phytoplankton. Consequently, there exists a great deal of data on wester water bodies associated with the mussel detection project. Dreissenid mussels are a significant threat to Reclamation facilities and understanding the bio suitability and environmental factors that contribute to population management are critical. Therefore, this relational database project was established to create a georeferenced, relational database that would house all of the data has been collected in association with the mussel detection project.			
15. SUBJECT TERMS Mussel database, zebra, quagga data, Mussel and water quality data, mussel relational database			

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PEER REVIEW DOCUMENTATION

Project and Document Information

Project Name Mussel Database Development and Management   WOID   A743F

Document Mussel Database Development and Management

Document Author(s) Denise M Hosler   Document date Sept 2016

Peer Reviewer: Yale Passamaneck

Review Certification

Peer Reviewer: I have reviewed the assigned items/sections(s) noted for the above document and believe them to be in accordance with the project requirements, standards of the profession, and Reclamation policy.

Reviewer _____ Date reviewed 9/28/2016
   (Signature)

Acknowledgements

Acronyms and Abbreviations

ARRA – American Resource and Recovery Act

DNA - Deoxyribonucleic acid present in the cells of all living organisms

GPS – Global Position System Device

GS – Gene Sequencing

PCR- polymerase chain reaction

RDLES- Reclamation Detection Laboratory for Exotic Species

TDS - total dissolved solids

TOC - total organic carbon

TSC – Technical Services Center

TSS – total suspended solids

QM- quagga mussel

ZM- zebra mussel

XPL – cross polarized light microscopy

Executive Summary

The Reclamation Detection Laboratory Exotic Species (RDLES) at the Technical Services Center (TSC) in Denver has analyzed over 15,000 samples representing over 400 water bodies for the presence of dreissenid mussels. The goal of this project is to create a relational database that will be utilized for dissemination and data analysis purposes. At the time of sample collection, numerous environmental parameters were collected in parallel with a plankton tow net sample. Each sample was analyzed by numerous methods for the detection of dreissenid mussels, water quality, and baseline zooplankton populations. Additionally, during the ARRA funded portion of the project (2009-2011) each reservoir was sampled any analyzed by independent laboratories for water quality parameters, zooplankton, and phytoplankton. Consequently, there is a great deal of data associated with the detection project. Dreissenid mussels are a significant threat to Reclamation facilities and understanding the biosuitability and environmental factors that contribute to population management are critical to future control efforts. Therefore, there is a need to create a database that will house all of the data that has been collected in association with the mussel detection project. Additionally, this database will be utilized for data dissemination and analysis purposes. This will potentially help Reclamation and its stakeholders with management decisions, as well as understanding potential mechanisms for control. The effort for the relational database was started in FY2014 and RDLES staff continued working on it through FY2016. Due to the significant amount and need, it was decided in FY2016 to convert this data project into an open water database starting FY2017.

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Main Report

Introduction

In 2007, adult quagga mussels were discovered in the Colorado River Basin at Lake Mead, the first significant population in a Reclamation reservoir. The two Dreissenid species currently found in the United States have a life cycle that ranges from microscopic larvae to thumbnail size adults, and both have the ability to adapt to extreme environmental conditions. Based upon experience with zebra mussels in the eastern U.S., if mussels are detected early, facility operators may have three to five years to plan, budget, and implement protective measures before the population of mussels are large enough to clog pipes, water intakes, drains, gates and trashracks, and thereby impair generation of hydropower and delivery of water.   Populations in the lower Colorado River Basin have dramatically increased since discovery and are now impacting the hydropower facilities at Hoover, Davis, and Parker Dams. In 2008, larval mussels were found in Pueblo Reservoir, Colorado, and adults were found in San Justo Reservoir in California. Mussels are spread primarily through boating and other human activities that move mussels from an infested water body to an uninfested one. In April 2009, the Research and Development Office requested and received $4.5M of American Recovery and Reinvestment Act (ARRA) Funds to undertake a detection project for Reclamation reservoirs and facilities. The ARRA funding supported sampling and data collection that was performed from 2009 to 2011. Reclamation worked with stakeholders in the western United States, including federal, state, and local agencies to extend sampling and data collection efforts to detect the presence of larval dreissenid mussel larvae in western waters. As the ARRA funding declined, Reclamation Research and Development Office continued to sponsor the mussel detection program for vulnerable Reclamation reservoirs and facilities in the Western U.S. The mussel detection program was designed to assist Reclamation Regional and Area Offices in determining if mussels are currently present in any of their water distribution facilities. The data collected during this effort included georeferenced data at each sample site for mussel presence, water quality data, zooplankton, and GPS data. The resulting data required a massive effort to create a usable database for analysis of biosuitability and environmental factors for future population management.

Mussel Sampling Data Collection

The original 2008 protocol for data collection included substrate samplers and plankton tow net samples to detect veligers (mussel larvae) in water bodies before such a presence becomes a full-scale infestation. Simultaneously, vertical water quality parameters including temperature, dissolved oxygen, pH, conductivity, and depth were collected utilizing a YSI Multiparameter Water Quality Sonde.

Additionally, secchi depths, Global Positioning System Data (GPS), ambient temperature, wind speeds, and weather conditions were recorded. During the 2010 sampling season water samples were sent to a contract laboratory to analyze for Nutrients: soluble orthophosphate, total phosphorus, nitrate+nitrite-N, ammonia-N, total nitrogen; Major ions: calcium, magnesium, sodium, potassium, sulfate, chloride., carbonate, bicarbonate; total dissolved solids (TDS), total suspended solids (TSS), and total organic carbon (TOC). Also during 2010, contract laboratories analyzed water samples for zooplankton and phytoplankton for baseline conditions of the waterbodies being analyzed. It was later decided to utilize the FlowCams in the laboratory to collect zooplankton data for future use.

Once the samples were received at RDLES, they were logged in, assigned and labeled with a unique identifier, and then prepared for microscopic and molecular analysis. This included cross-polarized light microscopy (XPL) to detect the veliger specific birefringence pattern, and polymerase chain reaction (PCR) to determine if either zebra or quagga mussel DNA was present in the sample. During the ARRA program, this was a linear process, and only when a microscopic finding occurred was the sample then analyzed for DNA. It was determined that for early detection, substrate samplers were not the best method, so Reclamation began to rely on plankton tow net sampling as the primary early detection method. Also, it was decided in 2011, that all test methods for mussels should be utilized on any sample that had a microscopic veliger finding at any time previously to improve facility operators' knowledge.
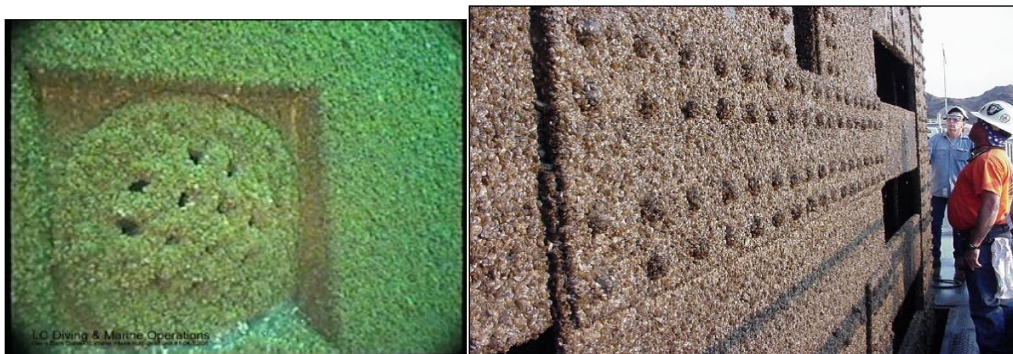

Figure 1: Adult quagga mussel settlement on a water intake (left) and a penstock bulkhead gate (right) Photos by Bureau of Reclamation 2007.

Early Data Tables and Storage

Early data tables were created with multiple spreadsheets (Table 1.) with the concept that these data tables could be imported easily into a single relational database. Some of these tables were purposely set up with redundancy, so that key links and data could be retained when the future relational data base was created. Additionally, data tables could easily be manipulated to fit future need.

Table 1: Mussel Data Tables

Data Spreadsheets or Files	Description
Master Login File	All Samples received in the laboratory and general sample collection
Set up and Take down data	General water appearance and dates of processing
Veliger Enumeration	Microscopic findings and larval counts
PCR Log File	PCR and GS results
SEM files	SEM photos of microscopic findings
FlowCam Data	Photographic record of zooplankton
YSI Data Tables	Water sonde data
ANS Coordinator data	Western State ANS coordinators and state reporting requirements.

Relational Database and Table Design

Originally, Reclamation worked with the Colorado Division of Wildlife on a relational database that would allow the mussel data between Federal and State partners to exchange data (Appendix 1). This was the basis of the current relational database model (Table 2), however, relational data tables require a great deal of planning and are still undergoing modification and conformation.

Table 2: ANS Sample Location Tables

Data Tables	Description
Water Body Master list	Reclamation Water Name Master
Water Body Sample Location	Description of Reclamation Water name
Sample Location GPS Table	GPS Location of the Sample Site
Microscopy Data*	Microscope Data
PCR Data*	PCR and GS Data
SEM Data*	SEM data
Water Chemistry Data	Water Chemistry
YSI Data	Vertical profile data
Phytoplankton Data	Phytoplankton
Zooplankton Data*	Zooplankton

*Separate links to photograph files are to be incorporated with final database

Conformation of Data Tables

With the assistance of the TSC Emergency Management and GIS Group the initial location data tables have been conformed based upon the following:

- Facilities/Owner field values normalized to **Bureau of Reclamation** where appropriate,

- WaterName field values for BOR Reservoirs normalized to match GNIS names as maintained in BORGIS,

- All WaterName field values to upper case,

- Special characters removed from all WaterName field values,

- USBR Facility field values added,

- USBR Connected field normalized to **Yes**, **No**, or **Undetermined.**

Field Name	Data Type	Description
Location_RecID	AutoNumber	This field is an automatically assigned reference number (primary key)
Water_RecID	Number	Number indicating linked Water Body record (foreign key)
Location	Text	Name of the survey/sampling location
LocDescrip	Text	Brief description of the location (e.g. 30m W of ramp, eastern-most dock of marina, 50m N of dam)
Latitude	Text	Latitude in decimal degrees (e.g. 41.7436)
Longitude	Number	Longitude in decimal degrees (e.g. -112.9715)
LocCmmts	Memo	Comments

Figure 2: Current Format for Data Tables

Future Directions

As the work progressed in FY2016, it became apparent from both the conformation effort and the request for the mussel data analysis by outside partners, that the relational data project needed to be expanded into an open access web-based database. The Open Water Data project has some key components that required a revision of this project to complete the proposed goals of this effort. Therefore, the data included in this project will be moved to the Open Water Data effort for completion.

Summary

Over the last decade RDLES has collected data on over 15,000 water samples from waters in the western US. The data for these samples is comprehensive beyond mussel presence and absence, including a georeferenced set of data for all water samples that includes water quality, zooplankton, and chemistry. Current funding from Reclamation Science & Technology Program has helped to develop a schema with the basic location data tables conformed and complete. The work to date has facilitated the development of a relational database structure where of the data collected may reside. In order to facilitate the best use of this data, a proposal to move this data into an open data format has been prepared as next steps to the current project. It is hoped that in addition to making this data available for use, it will also facilitate the ability to utilize the data for analysis of biosuitability and environmental factors for future population management.

Appendix 1: CO ANS Data Schema

ANS SAMPLE LOCATION TABLES

SampleLocation

Column Name	Data Type	Allow Nulls
sampleLocationID	int	☐
waterBodyID	int	☐
locationID	int	☐
name	varchar(256)	☐
description	varchar(1024)	☑
createdby	varchar(50)	☑
createdDate	datetime	☑
modifiedBy	varchar(50)	☑
modifyDate	datetime	☑
active	bit	☐

Location

Column Name	Data Type	Allow Nulls
locationID	int	☐
latitudeDegree	smallint	☑
latitudeMinute	smallint	☑
latitudeSecond	smallint	☑
latitudeDecimalDegree	decimal(10, 6)	☑
latitudeDecimalMinute	decimal(10, 6)	☑
longitudeDegree	smallint	☑
longitudeMinute	smallint	☑
longitudeSecond	smallint	☑
longitudeDecimalDegree	decimal(10, 6)	☑
longitudeDecimalMinute	decimal(10, 6)	☑
utmEast	decimal(11, 2)	☑
utmNorth	decimal(11, 2)	☑
utmZone	smallint	☑
township	char(4)	☑
range	char(5)	☑
section	smallint	☑
quarterSection	varchar(2)	☑
primeMeridian	varchar(50)	☑
elevation	int	☑
createdBy	varchar(50)	☐
createDate	datetime	☐
modifiedBy	varchar(50)	☑
modifyDate	datetime	☑
active	bit	☐

ANSRisk

Column Name	Data Type	Allow Nulls
ansRiskID	int	☐
name	varchar(50)	☐
description	varchar(124)	☑
createdBy	varchar(50)	☐
createDate	datetime	☐
modifiedBy	varchar(50)	☑
modifyDate	datetime	☑
active	bit	☐

WaterBody

Column Name	Data Type	Allow Nulls
name	varchar(50)	☐
description	varchar(1024)	☐
waterBodyTypeID	int	☐
AreaID	int	☐
waterBodyStatusID	int	☑
ansRiskID	int	☑
marinaInfo	varchar(128)	☑
comments	varchar(1024)	☑
boatDockInfo	varchar(128)	☑
ownerID	int	☑
recMgmtID	int	☑
createdBy	varchar(50)	☐
createDate	datetime	☐
modifiedBy	varchar(50)	☑
modifyDate	datetime	☑
active	bit	☑

WaterBodyStatus

Column Name	Data Type	Allow Nulls
waterBodyStatusID	int	☐
code	varchar(50)	☑
description	varchar(124)	☑
createdBy	varchar(50)	☑
createDate	datetime	☑
modifiedBy	varchar(50)	☑
modifyDate	datetime	☑
active	bit	☑

Watershed

Column Name	Data Type	Allow Nulls
watershedID	int	☐
code	varchar(3)	☐
name	varchar(50)	☐
description	varchar(1024)	☑
createdBy	varchar(50)	☐
createDate	datetime	☐
modifiedBy	varchar(50)	☑
modifyDate	datetime	☑
active	bit	☐

Region

Column Name	Data Type	Allow Nulls
dowAreaID	int	☐
dowRegionID	int	☑
name	varchar(50)	☐
description	varchar(1024)	☑
createdBy	varchar(50)	☐
createDate	datetime	☐
modifiedBy	varchar(50)	☑
modifyDate	datetime	☑
active	bit	☐

State

Column Name	Data Type	Allow Nulls
dowRegionID	int	☐
name	varchar(50)	☐
description	varchar(1024)	☑
createdBy	varchar(50)	☐
createDate	datetime	☐
modifiedBy	varchar(50)	☑
modifyDate	datetime	☑
active	bit	☐

WaterBodyType

Column Name	Data Type	Allow Nulls
waterBodyTypeID	int	☐
code	varchar(3)	☐
description	varchar(1024)	☑
createdBy	varchar(50)	☐
createDate	datetime	☐
modifiedBy	varchar(50)	☑
modifyDate	datetime	☑
active	bit	☐

Area Office

Column Name	Data Type	Allow Nulls
waterBodyUseID	int	☐
code	varchar(50)	☐
description	varchar(128)	☑
createdBy	varchar(50)	☐
createDate	datetime	☐
modifiedBy	varchar(50)	☑
modifyDate	datetime	☑
active	bit	☐

Description:

The primary tables in this section are the WaterBody, SampleLocation and Location tables. Every monitored water body in the state is included in the WaterBody table. Each water body has zero to many sample locations associated with it and both water bodies and sample locations have associated point locations. Water Bodies have a WaterBodyType attribute (lake, reservoir, stream, river segment, irrigation canal, etc.) and are associated with both a Watershed and a DOW Area. Each DOW Area is associated with a DOW Region. A water body has a WaterBodyStatus which identifies the water body as containing Aquatic Nusiance species or not and their perceived risk (ANSRisk) of containing the same. Each water body has zero to many WaterBodyUses (fishing, boating, skiing, etc). The WaterBody table also contains information found in the existing plankton tow spreadsheet.

Each sampleLocation contains information about habitat (boat ramp, dock, overhanging vegitation, water vegitation, etc) and Sediment (sand, silt, gravel, concrete, etc).

ANS SAMPLE PERSONNEL TABLES

OrganizationType

Column Name	Data Type	Allow Nulls
organizationTypeID	int	
code	varchar(8)	
description	varchar(1024)	☑
createdBy	varchar(50)	
createDate	datetime	
modifiedBy	varchar(50)	☑
modifyDate	datetime	☑
active	bit	

SamplePermitType

Column Name	Data Type	Allow Nulls
samplePermitTypeID	int	
name	varchar(50)	
description	varchar(1024)	☑
createdBy	varchar(50)	
createDate	datetime	
modifiedBy	varchar(50)	☑
modifyDate	datetime	☑
active	bit	

State

Column Name	Data Type	Allow Nulls
stateID	int	
code	varchar(2)	☑
name	varchar(20)	☑
createdBy	varchar(50)	
createDate	datetime	
modifiedBy	varchar(50)	☑
modifyDate	datetime	☑
active	bit	

Organization

Column Name	Data Type	Allow Nulls
organizationID	int	
organizationTypeID	int	
name	varchar(50)	
description	varchar(1024)	☑
address	varchar(128)	☑
address2	varchar(128)	☑
city	varchar(50)	☑
stateID	int	☑
zipCode	varchar(12)	☑
contactFirstName	varchar(50)	☑
contactLastName	varchar(50)	☑
PhoneNumber	varchar(20)	☑
FaxNumber	varchar(20)	☑
createdBy	varchar(50)	
createDate	datetime	
modifiedBy	varchar(50)	☑
modifyDate	datetime	☑
active	bit	

SamplePermit

Column Name	Data Type	Allow Nulls
samplePermitID	int	
organizationID	int	
samplePermitTypeID	int	
samplePermitStartDate	int	
samplePermitEndDate	int	
createdBy	varchar(50)	
createDate	datetime	
modifiedBy	varchar(50)	☑
modifyDate	datetime	☑
active	bit	

UserRole

Column Name	Data Type	Allow Nulls
userRoleID	int	
name	varchar(50)	
description	varchar(1024)	☑
createdBy	varchar(50)	
createDate	datetime	
modifiedBy	varchar(50)	☑
modifyDate	datetime	☑
active	bigint	

OrganizationSampleLocationXref

Column Name	Data Type	Allow Nulls
organizationID	int	
sampleLocationID	int	
createdBy	varchar(50)	
createDate	datetime	
modifiedBy	varchar(50)	☑
modifyDate	datetime	☑
active	bit	

UserRoleXref

Column Name	Data Type	Allow Nulls
userID	int	☑
userRoleID	int	☑
createdBy	varchar(50)	☑
CreateDate	datetime	☑
ModifiedBy	varchar(50)	☑
ModifyDate	datetime	☑
active	bit	☑

User

Column Name	Data Type	Allow Nulls
userID	int	
userName	varchar(50)	
password	varchar(20)	☑
userFirstName	varchar(50)	
userLastName	varchar(50)	
phoneNumber	varchar(20)	☑
cellPhoneNumber	varchar(20)	☑
emailAddress	varchar(128)	☑
createdBy	varchar(50)	
createDate	datetime	
modifiedBy	varchar(50)	☑
modifyDate	datetime	☑
active	bit	
organizationID	int	☑

SampleLocation

Column Name
sampleLocationID
waterBodyID
locationID
name
description
habitatID
sedimentID
createdBy
createDate
modifiedBy
modifyDate
active

SampleTraining

Column Name	Data Type	Allow Nulls
sampleTrainingID	int	
instructorID	int	
trainingTypeID	int	
trainingDate	int	
createdBy	varchar(50)	
createDate	datetime	
modifiedBy	varchar(50)	☑
modifyDate	datetime	☑
active	bit	
Round Robin	Score	

SamplerSampleTrainingXref

Column Name	Data Type	Allow Nulls
userID	int	
sampleTrainingID	int	
createdBy	varchar(50)	
createDate	datetime	
modifiedBy	varchar(50)	☑
modifyDate	datetime	☑
active	bit	

Certification

Column Name	Data Type	Allow Nulls
Tech	int	
Date	int	☑
Expiration	varchar(50)	
Test	varchar(1024)	☑

SampleTrainingSampleTypeXref

Column Name	Data Type	Allow Nulls
sampleTrainingID	int	
sampleTypeID	int	
createdBy	varchar(50)	
createDate	datetime	
modifiedBy	varchar(50)	☑
modifyDate	datetime	☑
active	bit	

SampleType

Column Name	Data Type	Allow Nulls
sampleTypeID	int	
name	varchar(50)	
description	varchar(1024)	☑
createdBy	varchar(50)	
createDate	datetime	
modifiedBy	varchar(50)	☑
modifyDate	datetime	☑
active	bit	

Sample Personnel Tables

Description:

The primary tables in this section are the Organization and User tables. Organization data includes:

- OrganizationType (Federal Agencies, State Agencies, Testing Labs, Recreational Management Entities, Reservoir Owners, Water Districts, Municipalities, etc)

- SamplePermits: Organizations have been issued zero to many SamplePermits. These permits are of a specific SamplePermitType with start and end dates.

- SampleLocations: Organizations have zero to many SampleLocations that they are authorized to sample.

- Various address and contact information fields.

User Data includes:

- Roles: A user has zero to many roles (sampler, lab tester, application administrator, etc)

- UserName and Password (every user who adds, modifies, or deletes data must log in and pass authentication and authorization)

- SampleTraining: Users who enter sample water and enter sample data must have sampleTraining.

- Samplers: Samplers are Users who:

    o have a username and password

    o are associated with an approved Organization

    o the Organization has a valid current SamplePermit for the type of sample being taken

    o   at one of the Organization's associated SampleLocations

    o and who have training in the SampleType being performed.

ShorelineSurvey

Column Name	Data Type	Allow Null
shorelineSurveyID	int	
waterBodyID	int	
surveyDateTime	datetime	
caseNumber	varchar(50)	☑
surveyorID	int	
visualInspectionResultID	int	
comment	varchar(1024)	☑
createdBy	varchar(50)	
createDate	datetime	
modifiedBy	varchar(50)	☑
modifyDate	datetime	☑

VisualInspectionResult

Column Name	Data Type	Allow Nulls
visualInspectionResultID	int	
code	varchar(50)	
description	varchar(124)	☑
createdBy	varchar(50)	
createdDate	datetime	
modifiedBy	varchar(50)	☑
modifyDate	datetime	☑
active	bit	

archiveType

Column Name	Data Type	Allow Nulls
archiveTypeID	int	
code	varchar(10)	
description	varchar(128)	☑
createdBy	varchar(50)	
createDate	datetime	
modifiedBy	varchar(50)	☑
modifyDate	datetime	☑
active	bit	
Purge	Date	

SampleType

Column Name	Data Type	Allow Nulls
sampleTypeID	int	
name	varchar(50)	
description	varchar(1024)	☑
createdBy	varchar(50)	
createDate	datetime	
modifiedBy	varchar(50)	☑
modifyDate	datetime	☑
active	bit	

SubstrateInspection

Column Name	Data Type	Allow Nulls
substrateInspectionID	int	
substrateID	int	
inspectorID	int	
inspectionDate	datetime	
visualInspectionResultID	int	
comment	varchar(1024)	☑
createdBy	varchar(50)	
createDate	datetime	
modifiedBy	varchar(50)	☑
modifyDate	datetime	☑
active	bit	

SampleContainer

Column Name	Data Type	Allow Nulls
sampleContainerID	int	
ANSID	varchar(50)	
sampleID	int	☑
receivedLabDateTime	datetime	☑
testedDateTime	datetime	☑
veligerCount1	int	☑
sampleCondition	varchar(50)	☑
sampleVolume	decimal(10, 4)	☑
archiveTypeID	int	☑
archiveDateTime	datetime	☑
createdBy	varchar(50)	
createDate	datetime	
modifiedBy	varchar(50)	☑
modifyDate	datetime	☑
active	bit	

Sample

Column Name	Data Type	Allow Nulls
sampleID	int	
sampleLocationID	int	☑
shorelineSurveyID	int	☑
samplerID	int	
sampleTypeID	int	
sampleDateTime	datetime	
physicalDataID	int	☑
comments	varchar(1024)	☑
caseNumber	varchar(50)	
createdBy	varchar(50)	
createDate	datetime	
modifiedBy	varchar(50)	☑
modifyDate	datetime	☑
active	bit	

Substrate

Column Name	Data Type	Allow Nulls
substrateID	int	
sampleLocationID	int	
substrateTypeID	int	
substrateCount	int	☑
deployDate	datetime	☑
deployerID	int	☑
deployDepth	varchar(50)	☑
equipmentID	int	☑
caseNumber	varchar(50)	☑
removalDate	datetime	☑
comment	varchar(1024)	☑
createdBy	varchar(50)	
createDate	datetime	
modifiedBy	varchar(50)	☑
modifyDate	datetime	☑
active	bit	

PhysicalData

Column Name	Data Type	Allow Nulls
physicalDataID	int	
calcium	decimal(10, 6)	☑
alkalinity	decimal(10, 6)	☑
totalHardness	decimal(10, 6)	☑
ph	decimal(10, 6)	☑
dissolvedOxygen	decimal(10, 6)	☑
conductivity	decimal(10, 6)	☑
salinity	decimal(10, 6)	☑
secchiDepth	decimal(10, 6)	☑
chlorophyllA	decimal(10, 6)	☑
totalPhosphorous	decimal(10, 6)	☑
totalNitrogen	decimal(10, 6)	☑
createdBy	varchar(50)	
createDate	datetime	
modifiedBy	varchar(50)	☑
modifyDate	datetime	☑
active	bit	

SubstrateType

Column Name	Data Type	Allow Nulls
substrateTypeID	int	
code	varchar(50)	
description	varchar(128)	☑
createdBy	varchar(50)	
createDate	datetime	
modifiedBy	varchar(50)	☑
modifyDate	datetime	☑
active	bit	

PCR

Column Name	Data Type	Allow Nulls
SampleID		
Result		☑
Date		☑
location		☑

SampleResult

Column Name	Data Type	Allow Nulls
sampleResultID	int	
sampleContainerID	int	
testTypeID	int	
aquaticNuisanceID	int	
testResultID	int	
testerID	int	
comment	varchar(1024)	☑
createdBy	varchar(50)	
createDate	datetime	
modifiedBy	varchar(50)	☑
modifyDate	datetime	☑
active	bit	

AquaticNuisance

Column Name	Data Type	Allow Nulls
aquaticNuisanceID	int	
code	varchar(50)	
description	varchar(128)	☑
phylum	varchar(50)	☑
subPhylum	varchar(50)	☑
class	varchar(50)	☑
[order]	varchar(50)	☑
family	varchar(50)	☑
genus	varchar(50)	☑
species	varchar(50)	☑
createdBy	varchar(50)	
createDate	datetime	
modifiedBy	varchar(50)	☑
modifyDate	datetime	☑
active	bit	

SEM

Column Name	Data Type	Allow Nulls
SampleID		
Result		☑
Date		☑
Photo		☑

TestType

Column Name	Data Type	Allow Nulls
testTypeID	int	
code	varchar(10)	☑
description	varchar(128)	☑
createdBy	varchar(50)	☑
createDate	datetime	☑
modifiedBy	varchar(50)	☑
modifyDate	datetime	☑
active	bit	☑

TestResult

Column Name	Data Type	Allow Nulls
testResultID	int	
code	varchar(10)	☑
description	varchar(128)	☑
createdBy	varchar(50)	☑
createDate	datetime	☑
modifiedBy	varchar(50)	☑
modifyDate	datetime	☑
active	bit	☑

Description:

The main sample tables are Sample, ShorelineSurvey and Substate Inspection. Shoreline survey data is captured in the ShorelineSurvey table. Each shoreline survey is a visual inspection of the shoreline of a water body. Substrate inspection data (Substrate inspected, date inspected, inspector and result) is captured in the SubstrateInspection table.

The Sample table contains information about samples sent away for analysis. It is meant to capture water, plant, and ANS sample information. The Sample table contains who, what, when and where data. Each Sample may contain one or more sample containers (the container sent to the lab(s)). The SampleContainer has a tracking number (ANSID), some tracking information – dates and various testing lab ID numbers and some sample specifics (condition, volume).

The SampleResults table contains the testType s(PCR, etc), the AquaticNusiances being tested for, who tested it, and the TestResults (POS, NEG, UNK, etc) for the submitted SampleContainers.