North Harris County Regional Water Authority
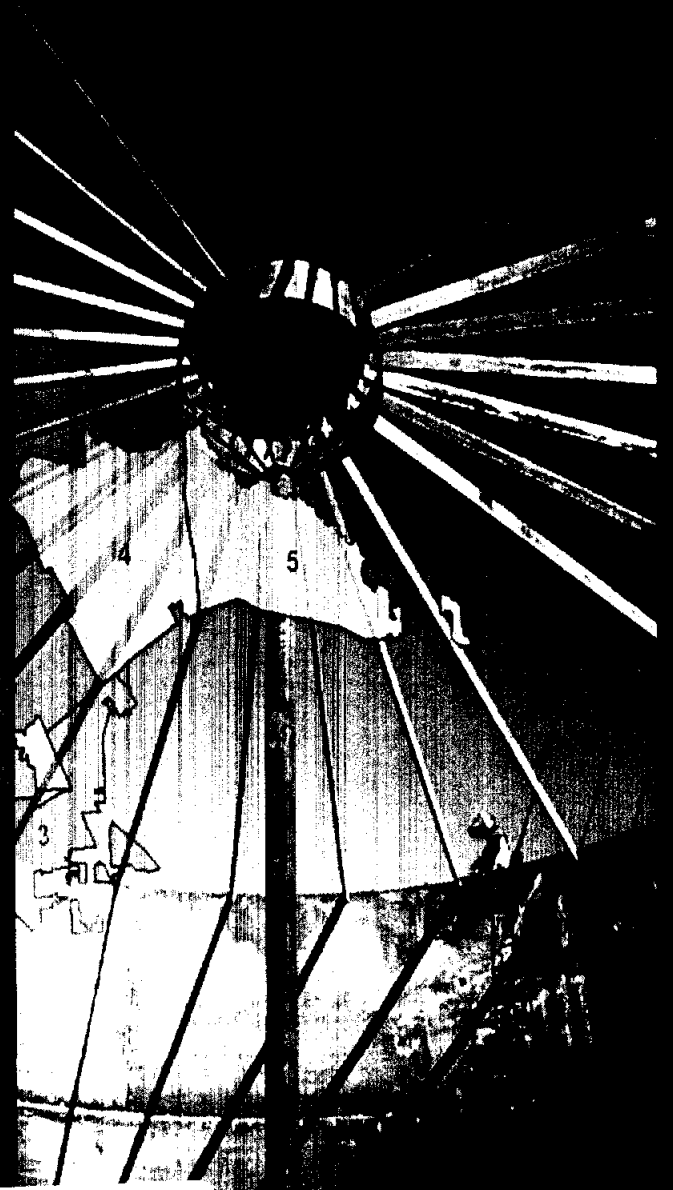# Geographic Information System
Project Manual

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North Harris County Regional Water Authority
Geographic Information System

Project Manual

Prepared By:

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**North Harris County Regional Water Authority
Geographic Information System**

EXECUTIVE SUMMARY

This project manual documents the Geographic Information System (GIS) prepared for the North Harris County Regional Water Authority (NHCRWA). The NHCRWA encompasses approximately 200 water supply systems. Three quarters of those systems are publicly owned by cities or water districts. The remaining quarter consists of privately owned systems, typically water supply corporations or individual non-residential private groundwater wells.

The purpose of the GIS is to furnish the Authority with the information needed to plan the effective and efficient conversion to surface water within the time constraints mandated by the Harris Galveston Coastal Subsidence District (HGCSD).

The Geographic Information System's development can be described in three major parts – data collection, database design, and applications. Data collection primarily included sending questionnaires to the owners of each of the water supply systems within the Authority's jurisdiction. Four-fifths of all questionnaires were completed and returned by water system owners. The collection effort included data such as contact information, groundwater well characteristics, storage tanks, system interconnects, water use, and wastewater effluent flows. The result is a GIS that exceeds the information available in previous databases for this region.

Database design incorporated the collected information into two software programs – Environment Systems Research Institute (ESRI) ArcInfo version 8.0 and Microsoft Access 2000. ESRI employs one of the most common program for the handling of spatial data, or data that can be located as a position on a map. Access is the most common program for non-spatial data, or data that is normally text or numerals shown in a table format. The benefits of using these programs are the same as for other programs that lead the industry in use – more program features, greater chance to import and export data in accepted formats, relatively more program users, and less chance of program obsolescence. The GIS has also been designed as a relational database, which provides the greatest flexibility in making queries to the data.

In addition, the use of the two leading programs allows greater flexibility in updating the database. Computer users familiar with only one program can add data without being limited by the other program. For example, a Microsoft Access user may enter new non-spatial data without knowledge of ArcInfo.

Applications were programmed to ease the use of the GIS. Written applications assist the user in data entry, printing and updating the link between ArcView and Access. In addition, a selection of complex queries was programmed to speed the

analysis of the data. The results from these automated queries can be analyzed further by continuing with manual queries.

The resulting GIS can assist the NHCRWA in analyzing the overall needs of their constituents, plan the conversion to surface water, and communicate that plan to the public. Later, as new facilities are planned and added, the GIS can be used to provide a continually updated system. By updating the database to reflect new water production and distribution facilities, the GIS can continue as a primary analytical tool.

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North Harris County Regional Water Authority
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I.   SCOPE OF WORK

Introduction

In August 2000, the North Harris County Regional Water Authority ("NHCRWA") contracted with Cobourn, Linseisen & Ratcliff, Inc., ("CLR") to collect data and create a GIS database to support the future analysis needs of the NHCRWA. The scope of this project included preparing a data collection questionnaire, collecting data using the questionnaire, developing a database to hold both spatial and non-spatial data, creating applications for data entry and queries, and documenting the database and applications. This scope was later expanded to include additional subtasks as outlined below.

Scope

- Project Management and Coordination
    - Monthly Progress Reports
    - Project Review Meeting
    - Kickoff Meeting

- Prepare Data Collection Instruments
    - Review Schemas
    - Prepare Data Element List
    - Prepare Data Collection Instruments
        - Data Collection Plan
        - Questionnaire Map Plots
        - Data Questionnaire
    - Deliver Final Data Element List
    - Deliver Final Data Collection Plan
    - Deliver Final Data Collection Questionnaire

- Design Database and Define Requirements
    - Prepare Draft GIS Database Design
    - Identify Revisions and Additions to Required Data
    - Participate in Meetings for Data and Database Design Review
    - Finalize GIS Database Design
    - Define GIS Data Consolidation and Document Technical Procedures
    - Deliver Recommended Additions/Revisions to Required Data
    - Deliver Final Database

- Data Collection
    - Confirm Billing Information
    - Develop Questionnaire Mailing List
    - Create mail out packages
        - Print NHCRWA letters
        - Print mailing labels
        - Print maps
        - Print Questionnaires

- - Print Questionnaire Instructions
  - - Mail out Questionnaires
  - o Perform follow-up based on Data Collection Plan

- Develop Entry Forms and Applications
  - o Develop Automated Data Entry Forms and Data Manipulation Applications

- Develop NHCRWA GIS Database
  - o Georeference All Data Sources
  - o Digitize New GIS Map Features
  - o Perform Data Entry Training
  - o Enter Attribute Data Collected
  - o Convert Database from Temporary to Final Database Design
  - o QA/QC Data
  - o Incremental Data Delivery to NHCRWA

- Prepare GIS Database and Application Documentation
  - o Prepare Data Dictionary
  - o Document Data Collection Methods
  - o Prepare User Documentation of GIS Applications
  - o Prepare Project Documentation
  - o Deliver Data, Applications and Project Documentation

Contributors

The study was contracted and managed by the NHCRWA's program manager, TC&B Inc. and Arcadis/WSBC, Inc. The CLR Team consisted of the following members (with roles indicated):

CLR, Inc.	Provided overall project management and coordination, preparation/collection of the data collection instruments, gathered/reviewed the existing data sources and overall Geographic Information System. Produced the technical documentation and provided technical assistance to the NHCRWA and program management team during the implementation of the GIS.
IT Nexus, Inc.	Assisted CLR in project management, development of the GIS database design, application design/development and support with the data collection questionnaire development and technical documentation.
Brown & Gay, Inc.	Assisted CLR in the entry of the tabular data, provided map mark-up application and built the graphical features into the GIS.

II. DATA COLLECTION

Introduction

This section provides an overview of the data sources gathered to develop the GIS. A brief summary is given to describe the development of the questionnaire, data collection and data tracking procedures

Summary of Data Sources

The approach used by CLR, Inc., to develop the NHCRWA's GIS database involved collecting information about the needs of the users who would be performing the analysis on the data, and the maps and data currently available for this analysis. In order to gather this information, The CLR team drew from a variety of sources for the existing maps and data, and conducted interviews with potential users of the data. For additional information about the data sources gathered by CLR; see Appendix A.

Existing Data Sources

TNRCC - Texas Natural Resource Conservation Commission provided the following files to CLR:
MUDs – Water systems owned by a political subdivision such as a City, public or water authority
CCNs – Privately owned public water subdivision such as water supply corporation, or water supply company

The MUD and CCN files were provided to CLR in the shapefile format and assisted in the development of the NHCRWA's District and Service area coverages.

Projection of the MUD and CCN source files:

Map Projection Name:	Lambert Conformal Conic
Standard Parallel # 1:	34d 55m 00s
Standard Parallel # 2:	27d 25m 00s
Longitude of Central Meridian:	100d 00m 00s
Latitude of Projection Origin:	31d 10m 00s
False Easting:	1,000,000 meters
False Northing:	1,000,000 meters

Geodetic Model:
Horizontal Datum Name: North American Datum 1983
Ellipsoid Name: Geodetic Reference System 80

PLEASE NOTE:
For more information about the datasets provided by TNRCC please contact:
CCN's – Suzanne Jaster at (512) 239-6950.
MUD's - Robin Adorno (512) 239-3139
Technical information – (512) 239-1887

TXDOT - Texas Department of Transportation provided the following files to CLR:
Roads in Harris County
Street Names in Harris County

The Road and Street Name files were provided to CLR in ESRI export format (.e00).

Projection of the Road and Street Name source files:

Map Projection Name:	Lambert Conformal Conic
Ellipsoid:	Clarke 1866
Datum:	North American 1927
Longitude of Origin:	100 degrees west (-100)
Latitude of Origin:	31 degrees 10 minutes north
Standard Parallel # 1:	27 degrees 25 minutes north latitude.
Standard Parallel # 2:	34 degrees 55 minutes north latitude.
False Easting:	3,000,000 feet
False Northing:	3,000,000 feet
Unit of Measure:	feet (international)

PLEASE NOTE:
For more information about the datasets provided by TXDOT visit their website:
www.dot.state.tx.us

TC&B and Arcadis/WSBC - Provided the following files to CLR:

The following files were sent in CAD format:
Cad Roads
Cad Street Names

The following files were sent in shapefile format:
Harris County and Adjacent County Boundaries
House Districts in Harris County
Major Roads
MUDs by Voting District
NHCRWA's Boundary
NHCRWA's Voting Districts
Precinct Boundaries
Wells in Harris and Galveston County
Wells within the NHCRWA
Zip Codes in Harris County

Map Projection of Source files:

Projection:	Stateplane
Datum:	North American 1983
Zone:	5401
Units:	Feet
Spheroid	GRS 1980

HGCSD - Houston Galveston Coastal Subsidence District provided the following file to CLR:

Hwells.dbf

PLEASE NOTE:
For more information about the data provided by HGCSD please contact:
Tom Michaels at (281) 486-1105

Existing ArcInfo Coverages

Note: All metadata (data about data) for the graphic data (Arc/Info Coverages) can be found in ArcCatalogs metadata tab. The following outline briefly describes how the coverages were created.

Region Coverages:
District – MUD
The primary data source was provided by TNRCC, a supplementary dataset was given to CLR by Arcadis/WSBC. These two files were cross-referenced and merged to create the district coverage. Additional revisions were obtained form the map mark-ups and district boundary maps returned to CLR.

Servarea – CCN
The primary data source was provided by TNRCC. CLR made revisions based on the mylar map provided by TNRCC and map markups received by the questionnaire. The sewer CCNs were removed from the original TNRCC shapefile, this study was only concerned with the water CCNs.

NHCRWAbnd – Boundary
The primary data source was provided by Arcadis/WSBC, created from USGS quad maps to develop a CAD drawing. The file was originally in Stateplane NAD 27, then projected to Stateplane NAD 83. The update for the NHCRWA boundary was received form Arcadis/WSBC on March 16, 2001. This file follows the 1990 Harris County precincts' outer boundaries provided by Paul Bettencourt the Harris County Tax Assessor-Collector. The precinct boundaries will change periodically.

Votebnd – Vote
The primary data source was provided by Arcadis/WSBC, created from hardcopy maps, provided to Arcadis/WSBC by Paul Bettencourt the Harris County Tax Assessor-Collector. The file was originally in Stateplane NAD 27, then projected to Stateplane NAD 83.

Point Coverages:
Futwell
This coverage represents the future groundwater wells within the NHCRWA. The graphics were obtained from the questionnaire and map mark-ups returned to CLR.

Sysint

This coverage represents those points where districts or service areas provide water to adjacent water districts. The graphics were obtained from the questionnaire and map mark-ups returned to CLR.

Tanks

This coverage represents the elevated and ground storage tanks within the NHCRWA. The graphics were obtained from the questionnaire and map mark-ups returned to CLR.

Well

The primary data source was provided by Harris Galveston Costal Subsidence District. The Arcadis/WSBC team created a point coverage for this file using the latitude and longitude fields. The file was clipped to extract those well within the NHCRWA. Arcadis/WSBC added the following fields: VD_No, Class District_no, and Pws_id and Pumpage items for the 2000-quarter. The CLR team then queried those wells pumping greater or equal to 5 million gallons in 1999 to make a shapefile. Additional changes were made to the graphic as questionnaire and map mark-ups were received.

Wwtp

This coverage represents the wastewater treatment plants within the NHCRWA. The graphics were obtained from the questionnaire and map mark-ups returned to CLR.

Methodology

Interview Participants

The following were the participants involved in the meetings conducted by The CLR Team:

Questionnaires
  Arcadis/WSBC
- Jack Sakolosky, P.E.
- Joe Wozny, P.E.
- Dennis Seeman, P.E.

  TC&B
- Michael Baugher, P.E.
- Bruce Davidson
- Mark Lowry, P.E.
- David Dow, P.E.

  Dannenbaum
- Wayne Ahrens, P.E.

Database Requirements
  Arcadis/WSBC
- Paul Kipp
- Juling Bao
- Nathon Billiot

  TC&B
- Bruce Davidson

Application Requirements (Simple Queries)
  Arcadis/WSBC
- Jack Sakolosky, P.E.
- Paul Kipp
- Juling Bao
- Nathon Billiot

Questionnaire

To obtain the data required for the NHCRWA's GIS, a questionnaire was designed that would not only supply the needed raw data, but provide a structured way to organize the data in a uniform and consistent format. The CLR Team formulated an extensive questionnaire to collect the appropriate data that would provide the essential elements to assist the NHCRWA in the GRP and to facilitate any future analysis. Before the questionnaire was distributed, the HGCSD provided The CLR Team with the names of the permittees, or well owners, of all wells in the Harris/Galveston Counties. Through this information, the selection of wells pumping greater than 5 million gallons in 1999 was extracted. The permittees in this selection were used as the initial recipients of the questionnaire.

A corresponding color map was attached to the questionnaire to provide the permittees with a general location of their entity, as well as provide the current location of their existing well(s). The permittees were asked to confirm the location of their well or wells and to modify the wells and district/service area boundaries where necessary. The permittees also were asked to add the following to the attached map: the ground storage tank, elevated storage tank, system interconnects, and the wastewater treatment plant. The purpose of this map was to provide CLR with the district/service area's existing feature locations. This allowed us to not only check the accuracy of existing facilities, but to correctly locate any projected facilities. The Questionnaires were mailed to the permittees on November 20, 2000. An example of the questionnaire is provided in Appendix B.

Below is a brief description of each section of the questionnaire.

Section 1 – Contact Information
This section enables the NHCRWA along with its legal counsel, financial advisors and engineering consultants to communicate directly with the appropriate representatives for the operator, engineer, attorney, board president, district office, and current owner of each individual well, district or service area. This data will provide the NHCRWA with the appropriate information to follow-up with any individual or entity for additional data.

Section 2 – Water Connections Associated with Existing and New Development
The NHCRWA must provide sufficient alternative water supplies to serve not only today's needs, but also to size water transmission mains and other water supply facilities to meet future water demands for the next 30 to 50 years. The information in this section gives us an idea of the district's or service area's planned future growth and also provides the peak hourly/peak daily water demands based on current usage. This information is needed to appropriately size the NHCRWA's future water transmission and distribution mains, which will be needed to deliver adequate water supply during peak conditions.

Section 3 – Elevated Storage Tank Data Sheet
The data from this section provides information about the existing volume and quality of the elevated storage tank(s) within the NHCRWA. The data on elevated storage tank(s) combined with the other data collected will enable the NHCRWA to evaluate required supply pressures for alternative transmission system concepts.

Section 4 – Existing System Interconnects

The data requested on system interconnects provides the NHCRWA with the location, size and type of system interconnect(s) between Districts. This will allow for the determination of whether a District or Service area might be more economically served with alternative water supplies passing through an interconnect, as opposed to building additional water transmission lines.

Section 5 – Wastewater Treatment Plant Information

The NHCRWA is investigating alternatives for reclaiming and reusing wastewater effluent for such purposes as irrigation and industrial use (i.e., cooling). For every gallon of wastewater that is reused, one less gallon of groundwater is pumped from this region's wells. The data in this section provides existing and future information about the volume and quality of wastewater effluent.

Section 6 – Non-Potable Users

This data helps the NHCRWA identify additional potential applications for reclaimed water reuse. Other water-scarce areas have successfully used reclaimed wastewater effluent for irrigation, for industrial (i.e., cooling) use, for separate "gray water" systems in residential areas for watering lawns, toilet flushing, car washing, amenity ponds, etc.

Section 7A & 7B–Existing Water Well Data Sheet & Ground Storage Tank Data Sheet

The data requested in Section 7 will provide the NHCRWA with necessary information about the well(s) and ground storage tank(s). The HGCSD 1999 Regulatory Plan requires well permittees within the NHCRWA to reduce their groundwater pumpage to more than 20% of their total water demand within the next 30 years. This means the region will need to significantly reduce groundwater pumpage from wells within the NHCRWA. Nonetheless, many of these may warrant being placed on standby for reactivation as needed to supplement the alternate water supply system during peak usage periods and droughts. The information from this section will enable the NHCRWA to determine which wells are already experiencing water quality or quantity problems, which wells might be of inadequate depth due to declining water table levels and are therefore near the end of their useful life, and which wells might offer high quality water and sufficient depth below the current water table to offer many more years of service. These sections also provide information about the existing volume and quality of the ground storage tank(s) within the NHCRWA.

Data Collection Tracking

A tracking document was created to track the status of questionnaires to the permittee through the follow-up by CLR. This document indicated the owner, phone number, date questionnaire was mailed, and date the questionnaire returned to CLR. Additional columns were maintained for supplementary contact names and to record any comments made by the respondent. This provided CLR with necessary documentation to track the contacts responses and prompted follow-up phone calls to the permittees who had not returned their questionnaire.

As the questionnaires were returned, each received a stamp declaring it was the "ORIGINAL IF RED", and the review process began. The first step in the review process was to check for any blanks or inconsistencies. Subsequently, the questionnaires were sent to the supervisor for a final review before data entry. If blanks or inconsistencies were present, the respondent was contacted to correct the issue. If several issues were present, secondary measures were taken, which are outlined in the Data Collection Plan provided in Appendix 'C'.

After the supervisor checked the questionnaire, it received an additional stamp declaring it was the "Working Copy". Supplementary information and corrections were made to the Working Copy. This Working Copy was forwarded to the data entry technicians to populate the database.

The following provides statistics on the questionnaires mailed out and returned.
CLR mailed out 186 questionnaires to the well permittees within the NHCRWA. Of those 186 questionnaires 139 were returned to CLR. The following list will show the entities that have not returned their questionnaire to CLR by the end of April 2001.

ADAMS RANCHES, INC., BUD
AQUASOURCE UTILITY INC.
BAMMEL OAKS 2
BAMMEL U.D.
BERRY HILL
C & P UTILITIES, INC.
CASTLE COUNTRY HOMES, INC.
CHAMPION WINDOW, INC.
CHASEWOOD LAND VENTURE
COMPAQ COMPUTER CORP.
CONSUMERS WATER CORPORATION
CYPRESS FOREST P.U.D.
FOUNTAINHEAD M.U.D.
HARRIS CO. F.W.S.D. 52
HARRIS CO. M.U.D. 109
HARRIS CO. M.U.D. 132
HARRIS CO. M.U.D. 151
HARRIS CO. M.U.D. 44
HARRIS CO. W.C.I.D. 109
HARRIS CO. W.C.I.D. 116
HARRIS CO. W.C.I.D. 119
HARRIS CO. W.C.I.D. 92

HOMETOWN UTILITIES LP
HUNTERS GLEN M.U.D.
INLINE DEVELOPMENT CORP.
JAEGER, KENNETH V.
LAKES OF CYPRESS HILL HOMEOWNERS
MICHAEL G. ROBOSON
MILLS ROAD M.U.D.
NW HARRIS CO. M.U.D. 10
NW HARRIS CO. M.U.D. 24
OAKWOOD VILLAGE
R CREEK LP
RAVENEAUX COUNTRY CLUB
SAM HOUSTON RACE PARK
SMITH, B.G.
SOUTHWEST UTILITIES, INC.
SUBURBAN UTILITY COMPANY
TATTOR ROAD M.U.D.
TXI OPERATIONS, L.P.
WINDY HILL UTILITIES, INC.
ZAZ INC.

III.   ARCINFO/ACCESS DATABASE DESIGN

Introduction

As part of the data collection project, The CLR Team designed and implemented a GIS/RDBMS database to store the information collected during the project. The NHCRWA is using ESRI's ArcInfo v8.0 and ArcView v3.2 software as its spatial data management platform and Microsoft's ACCESS 2000 (ACCESS) software as its relational database management system (RDBMS).

Purpose and Content of this Report

This report presents the GIS/RDBMS database design for the NHCRWA's GIS. The design defines the following characteristics of the data components of the NHCRWA's GIS database:
- ArcInfo map feature content, structure and format

- ACCESS attribute data content, structure, format and constraints

- Relationships between map features and attribute data

- Relationships between attribute data tables

- Data dictionary definitions of map feature and attribute data

This GIS database design document is organized into the following outline:
- Introduction which provides an overview of the project and a description of this document's contents.

- Methodology which defines the terms used throughout the document, describes the modeling techniques used during the design, and provides a basic introduction to how both ArcInfo and ACCESS store data. Also this section is divided into two subsections that document the design for the GIS and the design for the RDBMS. The following information is presented:

  - An **Entity Relationship Diagram** (ERD) that illustrates the RDBMS entities (tables) and the data relationships that have been defined between the entities, see Appendix D.

  - The **Feature Definition** for the map features associated with the project,

  - The **INFO table(s)** design for storing the spatial data associated with each feature,

  - The **ACCESS tables** that will store the attribute data linked to the map features

Security and User Set-up

This document does not address certain security and user setup. This will be the responsibility of the NHCRWA or its Program Manager.

Maintaining the Database Design/Data Dictionary

This document presents a well-documented data dictionary along with the metadata stored in the NHCRWA's GIS coverages. It is the NHCRWA's primary documentation of its GIS database and is an essential document for the routine administration and maintenance of the database as well as the design and programming of GIS applications.

During database development and on-going database administration it is likely that small changes and future updates to the database design will need to be implemented. It is common practice to implement incremental modifications to the original database design to:

- accommodate new information that is learned during routine data maintenance,

- allow the addition of new data categories to the data model,

- increase data retrieval speeds as experience with high access patterns become apparent,

- support evolving application and system integration requirements.

The CLR team recommends that the NHCRWA update this document to reflect each and every change that is made to the data model. **It is very important that changes made to the database design be reflected in this documentation.**

Methodology

How to Read an Entity-Relationship Diagram

An ***entity-relationship diagram*** (ERD) is used in RDBMS design to model the database's table, attribute and relationship structure. Tables in the RDBMS are represented by an ***entity***. The follow table describes how to read and interpret an ERD.

Symbol	Description	Notation	Enforcement/Notes
A single record of A is related to only one record in B; and a single record of B is related to only one record in A.		1:1	A one-to-one relationship usually (but not always) involves a subset table. Established using a primary key and foreign key.
	A single record of A is related to one or many records in B; and a single record of B is related to only one record in A.	1:M	Existence of a primary key and an associated foreign key.
	A single record of A is related to one or many records in B; and a single record of B is related to one or many records in A.	M:N	Established using a cross-reference table. (See detail below.)
			Resolution of a M:N relationship
	Type of Participation A record in A can exist regardless of the existence of B (Optional), A record in B can only exist if a related record exists in A (Mandatory).		
	Degree of Participation A record in A can be related to 2-10 records in B, A record in B can be related to 1-many records in A.		

A is a super-entity. B and C are sub-entities of A. B and C have distinguishing characteristics that require they be represent as their own entities.

How ArcInfo and ACCESS Store Data

ESRI's ArcInfo stores both map features and attribute data in a variety of spatial data formats. The most common format is called a **coverage**. A coverage is a single, seamless map database that can contain one or more type of map features. Of the basic types of features ArcInfo allows, the following were used in this design: points and areas (**regions**). Map features in ArcInfo are stored in tables managed by the INFO software component of ArcInfo.

The link between the GIS attribute data and the map features can be managed by the INFO software of ArcInfo. But more often, GIS attribute data is managed by an external RDBMS to take advantage of the ability of RDBMS software to efficiently organize and store data, and its strong transaction management, integrity control and security enforcement features.

Microsoft ACCESS is the RDBMS selected by the NHCRWA and is one of the RDBMS products commonly used in companion with ArcInfo. ACCESS stores data in one or more tables that are in turn composed of **columns** (also referred to as **fields**, **attributes**, or **items**) and **rows** (also referred to as **records**). A typical RDBMS database consists of many tables with associations between tables managed through relationships in the RDBMS data model that are defined by the database designer.

An ACCESS table is related to another ACCESS table or an ArcInfo table by using a common data element that must be found in both the tables. For example, a well table (**WELL**) that uniquely identifies each record by the attribute *WELL_ID* (**primary key**) can be related to the water system (**WATSYS**) table, which has its own unique identifier *WATSYS_ID*. In constructing this relationship the *WATSYS_ID* of the water system containing the well is populated into the well table as a **foreign key**, thus establishing the link between the two tables. Temporary joins between tables can also be established based on these relationships using commands in the GIS or in the RDBMS.

Certain tables in the ACCESS database are set up as **look-up tables**, which contain a list of valid values for a field in another table. For example, in the **CONTACT** table there is a field *CONTACT_TYPE* which can be assigned one of six possible values. A table was added to the database (**CONTACT_TYPE**) to hold these "allowed" values and is related to the CONTACT table by the *CONTACT*_TYPE field which serves as a foreign key in the **CONTACT** table. The use of look-up tables eliminates the need for a user to type-in data and, instead, provides a list of allowed values from which the user can select, thus creating an easy to use database and eliminating some of the error that often accompanies the manual data entry of values.

Data Dictionary

ArcInfo Data Structures

When a map feature is set up in ArcInfo, ArcInfo automatically generates and maintains one or more tables to manage the data. The primary table of interest is called the *feature attribute table* (FAT). The FAT can also store user-defined attribute data that may be more appropriately stored in ArcInfo as opposed to the RDBMS.

The name assigned by ArcInfo to the FAT varies depending on the type of map feature being stored (e.g., PAT for polygons, AAT for arcs, NAT for nodes, etc.). In addition, different fields are required by ArcInfo in the FAT based on the type of feature being used to represent the graphic entity. The following tables describe the required data fields for each of ArcInfo's feature types, the: Polygon Attribute Table, Arc Attribute Table, Point Attribute Table, Node Attribute Table, Region Sub-class Attribute Table, Route Attribute Table and the Section Attribute Table.

Polygon Attribute Table (PAT)

ITEM	DESCRIPTION	FORMAT
AREA	Units in square coverage units, double precision	8,12,F,3
PERIMETER	Units in coverage units, double precision	8,12,F,3
<Cover>#	Polygon internal number, assigned and maintained by ArcInfo	4,5,B
<Cover>-ID	User-ID, if not assigned by user, will default to <Cover>#	4,5,B

Arc Attribute Table (AAT)

ITEM	DESCRIPTION	FORMAT
FNODE#	from node internal number; beginning point of arc	4,5,B
TNODE#	to node internal number; ending point of arc	4,5,B
LPOLY#	left polygon internal number, set to zero if only a line coverage	4,5,B
RPOLY#	right polygon internal number, set to zero if only a line coverage	4,5,B
LENGTH	units in coverage units, double precision	8,12,F,3
<Cover>#	arc internal number, assigned and maintained by ArcInfo	4,5,B
<Cover>-ID	User-ID, if not assigned by user, will default to <Cover>#	4,5,B

Point Attribute Table (PAT)

ITEM	DESCRIPTION	FORMAT
AREA	inapplicable for point, set to zero	8,12,F,3
PERIMETER	inapplicable for point, set to zero	8,12,F,3
<Cover>#	polygon (point) internal number, assigned and maintained by ArcInfo	4,5,B
<Cover>-ID	User-ID, if not assigned by user, will default to <Cover>#	4,5,B

Node Attribute Table (NAT)

ITEM	DESCRIPTION	FORMAT
ARC#	arc internal number, assigned and maintained by ArcInfo	4,5,B
<Cover>#	node internal number, assigned and maintained by ArcInfo	4,5,B
<Cover>-ID	User-ID, if not assigned by user, will default to <Cover>#	4,5,B

Region Subclass Attribute Table (PAT<subclass>)

ITEM	DESCRIPTION	FORMAT
AREA	Units in square coverage units, double precision	8,12,F,3
PERIMETER	Units in coverage units, double precision	8,12,F,3
<subclass>#	Region internal number, assigned and maintained by ArcInfo	4,5,B
<subclass>-ID	User-ID, if not assigned by user, will default to <subclass>#	4,5,B

Route Attribute Table (RAT)

ITEM	DESCRIPTION	FORMAT
<subclass>#	Route internal number, assigned and maintained by ArcInfo	4,5,B
<subclass>-ID	User-ID, if not assigned by user, will default to <subclass>#	4,5,B

Section Table (SEC)

ITEM	DESCRIPTION	FORMAT
ROUTELINK#	Internal sequence number of the route to which the section belongs (RAT internal number)	4,5,B
ARCLINK#	Internal sequence number of the arc to which the section references (arc internal number from the ARC and AAT files)	4,5,B
F-MEAS	Start measure of the section	4,12,F,3
T-MEAS	End measure of the section	4,12,F,3
F-POS	Start position of the section, defined as the percentage along the arc from the from-node	4,12,F,3
T-POS	End position of the section, defined as the percentage along the arc from the from-node	4,12,F,3
<subclass>#	Section internal number, assigned and maintained by ArcInfo	4,5,B
<subclass>-ID	User-ID, if not assigned by user, will default to <subclass>#	4,5,B

When designing the FAT, the format of each field must be considered and specified in the GIS design: the item width or storage size of the data field, the output width or storage size of the display, the item or data type, and if appropriate the number of units reserved to the right of the decimal (only specified for certain data types). For example, the format for the AREA field in a FAT is 8,12,F,3, where: 8 defines the storage size of the data field, 12 defines the storage size for displaying the value, F defines the data type (in this case "Floating Point" to allow a decimal number), 3 defines the number of units reserved to the right of the decimal.

Item width and output width may differ. If no output width is specified, ArcInfo will assign the item width as the value for this required item. Table 2 defines the most common elements of the FORMAT definition that must be used when designing ArcInfo data elements.

Table 2
ArcInfo Item Types

ITEM TYPE	ALLOWED WIDTH	DESCRIPTION
B	2 or 4	Binary integer. No decimal points allowed.
C	320 (ARC imposed)	Fixed-length character string. Although 4096 is the maximum allowed width, ARC can only support a maximum width of 320.
D	8	Date. Output width of 10 produces the display: mm/dd/yyyy
F	4 or 8 specify decimal number	Floating point number. Decimal point counts in the output width.
I	1 to 16	Decimal number. No decimal points allowed.
N	1 to 16	Decimal floating point number. Decimal point counts in the input and output widths.

Municipal Utility Districts

The Municipal Utility Districts coverage represents areas where a well owner has agreed to provide water service to that given area.

COVERAGE NAME:	DISTRICT
FEATURE CLASS:	Area
COVERAGE TYPE:	Region
SUBCLASSES:	*MUD* – Groups the polygons by owner.
UPDATE FREQUENCY:	Moderate
ALIASES:	None
DATA SOURCES:	TNRCC MUD Coverage
ANNOTATION:	None
LABELS:	MUD_NAME, MUD_NO
SYMBOLOGY:	No standard specified

INFO Tables

DISTRICT.PAT

ITEM	FORMAT	NULL	ITEM DEFINITION
AREA	8,12,F,3	N/A	Area in square coverage units, generated by ArcInfo.
PERIMETER	8,12,F,3	N/A	Perimeter in coverage units, generated by ArcInfo.
DISTRICT#	4,5,B	N/A	Internal sequence number, generated by ArcInfo.
DISTRICT-ID	4,5,B	N/A	Internal polygon ID – do not use as primary key for ACCESS data tables.

DISTRICT.PATMUD

ITEM	FORMAT	NULL	ITEM DEFINITION
AREA	8,12,F,3	N/A	Area in square coverage units, generated by ArcInfo.
PERIMETER	8,12,F,3	N/A	Perimeter in coverage units, generated by ArcInfo.
MUD#	4,5,B	N/A	Internal sequence number, generated by ArcInfo.
MUD-ID	4,5,B	N/A	Internal polygon ID – do not use as primary key for ACCESS data tables.
WATSYS_UID	5,5,I	No	User-defined, unique identifier for each boundary.
MUD_NAME	40,40,C	No	**Unique identifier for each municipal utility district. Serves as a link to ACCESS data tables.**
MUD_NO	7,7,C	No	**Unique identifier for each municipal utility district. Serves as a link to ACCESS data tables.**
CREATOR	5,5,C	No	Initials or acronym of user/entity that created the graphic.
CREATE_DATE	8,10,D	No	Date the graphic was added to the coverage.
MODIFIER	5,5,C	No	Initials or acronym of last user/entity to update graphic.
MOD_DATE	8,10,D	No	Date of last update to graphic.

INFO DATABASE TABLES

CCN Boundaries

The Certificate of Convenience and Necessity (CCN) coverage represents those areas that a well owner provides water services to individuals living on his/her property but has not established the board representation of a Municipal Utility District. This coverage has a CCN number that distinguishes the polygons between wastewater and water CCNs. Only the water boundaries have been provided for this study.

COVERAGE NAME:	SERVAREA
FEATURE CLASS:	Area
COVERAGE TYPE:	Region
SUBCLASSES:	*CCN* – groups polygons by CCN owner
UPDATE FREQUENCY:	Moderate
ALIASES:	None
DATA SOURCES:	Digital and hard copy maps from TNRCC.
ANNOTATION:	None
LABELS:	CCN_NAME, CCN_NO
SYMBOLOGY:	No standard specified

INFO Tables

SERVAREA.PAT

ITEM	FORMAT	NULL	ITEM DEFINITION
AREA	8,12,F,3	N/A	Area in square coverage units, generated by ArcInfo.
PERIMETER	8,12,F,3	N/A	Perimeter in coverage units, generated by ArcInfo.
SERVAREA#	4,5,B	N/A	Internal sequence number, generated by ArcInfo.
SERVAREA-ID	4,5,B	N/A	Internal polygon ID – do not use as primary key for ACCESS data tables.

SERVAREA.PATCCN

ITEM	FORMAT	NULL	ITEM DEFINITION
AREA	8,12,F,3	N/A	Area in square coverage units, generated by ArcInfo.
PERIMETER	8,12,F,3	N/A	Perimeter in coverage units, generated by ArcInfo.
CCN#	4,5,B	N/A	Internal sequence number, generated by ArcInfo.
CCN-ID	4,5,B	N/A	Internal polygon ID – do not use as primary key for ACCESS data tables.
WATSYS_UID	7,7,C	No	User-defined, unique identifier for each boundary.
CCN_NAME	40,40,C	No	Unique identifier for each area with a Certificate of Convenience and Necessity. Serves as a link to ACCESS data tables.
CCN_NO	5,5,C	No	Unique Identifier for each area with a Certificate of Convenience and Necessity. Serves as a link to ACCESS data tables.
CREATOR	5,5,C	No	Initials or acronym of user/entity that created the graphic.
CREATE_DATE	8,10,D	No	Date the graphic was added to the coverage.
MODIFIER	5,5,C	No	Initials or acronym of last user/entity to update graphic.
MOD_DATE	8,10,D	No	Date of last update to graphic.

INFO DATABASE TABLES

Storage Tanks

The Storage Tanks coverage is made up of points that represent the elevated and ground water storage tanks associated with a MUD or CCN.

COVERAGE NAME:	TANK
FEATURE CLASS:	Point
COVERAGE TYPE:	Point
UPDATE FREQUENCY:	Low
ALIASES:	None
DATA SOURCES:	This data will be acquired through the questionnaire data and the map mark-ups received from each well operator.
ANNOTATION:	None
LABELS:	TANK_NAME
SYMBOLOGY:	TANK_TYPE (symbols not yet determined)

INFO Tables

TANK.PAT

ITEM	FORMAT	NULL	ITEM DEFINITION
AREA	8,12,F,3	N/A	Inapplicable for point, set to zero
PERIMETER	8,12,F,3	N/A	Inapplicable for point, set to zero
TANK#	4,5,B	N/A	Internal sequence number, generated by ArcInfo.
TANK-ID	4,5,B	N/A	Internal polygon ID – do not use as primary key in SQL Server data tables.
TANK_UID	6,6,C	No	Unique Identifier for each tank. Serves as a link to ACCESS data tables.
TANK_TYPE	3,3,C	No	Indicates if the tank is an elevated (ELV) or a ground (GRD) storage facility.
WATSYS_NAME	40,40,C	No	Name of the water system with which the tank is associated.
TANK_NAME	40,40,C	No	Name of the tank.
CREATOR	5,5,C	No	Initials or acronym of user/entity that created the graphic.
CREATE_DATE	8,10,D	No	Date the graphic was added to the coverage.
MODIFIER	5,5,C	No	Initials or acronym of last user/entity to update graphic.
MOD_DATE	8,10,D	No	Date of last update to graphic.
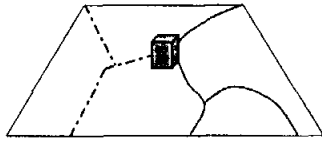
INFO DATABASE TABLES

This point coverage represents the wastewater treatment plants in the study areas.

Wastewater Treatment Plants

COVERAGE NAME:	WWTP
FEATURE CLASS:	Point
COVERAGE TYPE:	Point
UPDATE FREQUENCY:	Low
ALIASES:	None
DATA SOURCES:	Data collected from NHCRWA questionnaires and map mark-ups.
ANNOTATION:	None
LABELS:	PLANT_NAME
SYMBOLOGY:	No standard specified

INFO Tables

WWTP.PAT

ITEM	FORMAT	NULL	ITEM DEFINITION
AREA	8,12,F,3	N/A	Inapplicable for point, set to zero
PERIMETER	8,12,F,3	N/A	Inapplicable for point, set to zero
WWTP#	4,5,B	N/A	Internal sequence number, generated by ArcInfo.
WWTP-ID	4,5,B	N/A	Internal polygon ID – do not use as primary key in SQL Server data tables.
WWTP_UID	3,3,C	No	**Unique identifier for each wastewater treatment plant. Serves as a link to ACCESS data tables.**
WATSYS_NAME	40,40,C	No	Name of the water system with which the wastewater treatment plant is associated.
PLANT_NAME	30,30,C	No	The name of the wastewater treatment plant.
CREATOR	5,5,C	No	Initials or acronym of user/entity that created the graphic.
CREATE_DATE	8,10,D	No	Date the graphic was added to the coverage.
MODIFIER	5,5,C	No	Initials or acronym of last user/entity to update graphic.
MOD_DATE	8,10,D	No	Date of last update to graphic.

INFᴜ DATABASE TABLES
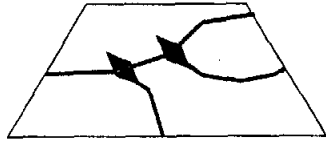
System Interconnects

This coverage represents those points where districts or service areas connect to an adjacent water system other than the NHCRWA supply lines.

COVERAGE NAME:	SYSINT
FEATURE CLASS:	Point
COVERAGE TYPE:	Point
UPDATE FREQUENCY:	Moderate
ALIASES:	None
DATA SOURCES:	This data will be acquired through the questionnaire data and the map mark-ups received from each well operator.
ANNOTATION:	None
LABELS:	None
SYMBOLOGY:	INT_TYPE (symbols not yet specified)

INFO Tables

SYSINT.PAT

| ITEM	FORMAT	NULL	ITEM DEFINITION
AREA	8,12,F,3	N/A	Inapplicable for point, set to zero
PERIMETER	8,12,F,3	N/A	Inapplicable for point, set to zero
SYSINT#	4,5,B	N/A	Internal sequence number, generated by ArcInfo.
SYSINT-ID	4,5,B	N/A	Internal polygon ID, generated by A/I
SYSINT_UID	10,10,C	No	Unique Identifier for each system Interconnects. Serves as a link to ACCESS data tables.
WATSYS_NAME	40,40,C	No	Name of the water system with which the system interconnect is associated.
INT_TYPE	2,2,C	No	Indicates if the interconnect is an emergency (EM) or a normally open (NO) connection.
CREATOR	5,5,C	No	Initials or acronym of user/entity that created the graphic.
CREATE_DATE	8,10,D	No	Date the graphic was added to the coverage.
MODIFIER	5,5,C	No	Initials or acronym of last user/entity to update graphic.
MOD_DATE	8,10,D	No	Date of last update to graphic.

INFO DATABASE TABLES
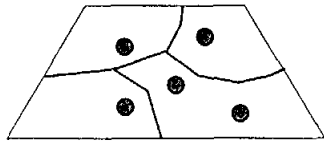
Existing Wells

The Existing Wells coverage depicts those groundwater wells with pumpage rates greater than or equal to 5 million gallons per year, chosen by the NCHRWA for the current study.

COVERAGE NAME:	WELL
FEATURE CLASS:	Point
COVERAGE TYPE:	Point
UPDATE FREQUENCY:	Low
ALIASES:	None
DATA SOURCES:	Original Microsoft Excel file from Harris Galveston Costal Subsidence District was imported into a shapefile using the latitude/longitude found in the file. The file was clipped for those groundwater wells that fall in the NHCRWA boundary and pump 5 million gallons and greater of water per year (1999). Data gathered from NHCRWA questionnaires and map mark-ups.
ANNOTATION:	None
LABELS:	WELL_NO
SYMBOLOGY:	No standard specified

INFO Tables

WELL.PAT

| ITEM	FORMAT	NULL	ITEM DEFINITION
AREA	8,12,F,3	N/A	Inapplicable for point, set to zero
PERIMETER	8,12,F,3	N/A	Inapplicable for point, set to zero
WELLS#	4,5,B	N/A	Internal sequence number, generated by ArcInfo.
WELLS-ID	4,5,B	N/A	Internal polygon ID – do not use as primary key in SQL Server data tables.
WELL_UID	4,4,C	No	**Unique identifier for each existing well. Serves as a link to ACCESS data tables.**
WELL_NUMBER	4,4,C	No	Number of well as assigned by TNRCC.
CREATOR	5,5,C	No	Initials or acronym of user/entity that created the graphic.
CREATE_DATE	8,10,D	No	Date the graphic was added to the coverage.
MODIFIER	5,5,C	No	Initials or acronym of last user/entity to update graphic.
MOD_DATE	8,10,D	No	Date of last update to graphic.

INFO DATABASE TABLES
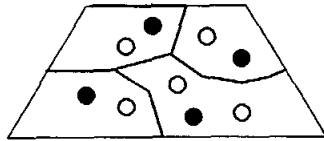
Future Wells

This coverage depicts locations that owners of the MUDs, CCNs, or private owners have designated as potential groundwater well sites in the future.

COVERAGE NAME:	FUTWELL
FEATURE CLASS:	Point
COVERAGE TYPE:	Point
UPDATE FREQUENCY:	High
ALIASES:	None
DATA SOURCES:	Data collected from NHCRWA questionnaires and map mark-ups
ANNOTATION:	None
LABELS:	None
SYMBOLOGY:	No standard specified

INFO Tables

FUTWELL.PAT

ITEM	FORMAT	NULL	ITEM DEFINITION
AREA	8,12,F,3	N/A	Inapplicable for point, set to zero
PERIMETER	8,12,F,3	N/A	Inapplicable for point, set to zero
FUTWELL#	4,5,B	N/A	Internal sequence number, generated by ArcInfo.
FUTWELL-ID	4,5,B	N/A	Internal polygon ID – do not use as primary key in SQL Server data tables.
FUTWELL_UID	7,7,C	No	**Unique identifier for each existing well. Serves as a link to ACCESS data tables.**
WATSYS_NAME	40,40,C	No	Name of the water system with which the future well will be associated.
CREATOR	5,5,C	No	Initials or acronym of user/entity that created the graphic.
CREATE_DATE	8,10,D	No	Date the graphic was added to the coverage.
MODIFIER	5,5,C	No	Initials or acronym of last user/entity to update graphic.
MOD_DATE	8,10,D	No	Date of last update to graphic.

INFO DATABASE TABLES
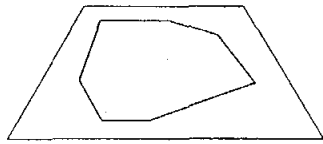
NHCRWA
Boundary

The NHCRWA Boundary contains the limit outlines of the North Harris County Regional Water Authority's area of study. This area is where the NHCRWA will study the impacts of groundwater usage and future plans.

COVERAGE NAME:	NHCRWABND
FEATURE CLASS:	Area
COVERAGE TYPE:	Region
SUBCLASS:	*BOUNDARY*
UPDATE FREQUENCY:	Low
ALIASES:	None
DATA SOURCES:	CAD drawings downloaded from TxDOT (Nov. 2000), matched to georeferenced quad maps. Hardcopy maps from Harris County Tax Assessor-Collector's Office (1990).
ANNOTATION:	None
LABELS:	BND_NAME
SYMBOLOGY:	No standard specified

INFO Tables

NHCRWABND.PATBOUNDARY

ITEM	FORMAT	NULL	ITEM DEFINITION
AREA	8,12,F,3	N/A	Area in square coverage units, generated by ArcInfo.
PERIMETER	8,12,F,3	NA	Perimeter in coverage units, generated by ArcInfo.
BOUNDARY#	4,5,B	N/A	Internal sequence number, generated by ArcInfo.
BOUNDARY-ID	4,5,B	N/A	Internal polygon ID, generated by ArcInfo.
BND_NAME	40,40,C	No	Name of boundary.
CREATOR	5,5,C	No	Initials or acronym of user/entity that created the graphic.
CREATE_DATE	8,10,D	No	Date the graphic was added to the coverage.
MODIFIER	5,5,C	No	Initials or acronym of last user/entity to update graphic.
MOD_DATE	8,10,D	No	Date of last update to graphic.

The Voting Districts coverage contains the depiction of the voting districts within the NHCRWA boundary.

Voter District Boundaries

COVERAGE NAME:	VOTEBND
FEATURE CLASS:	Area
COVERAGE TYPE:	Region
UPDATE FREQUENCY:	Low
SUBCLASS:	*VOTE*
ALIASES:	None
DATA SOURCES:	CAD drawings downloaded from TxDOT (Nov. 2000), matched to georeferenced quad maps. Hardcopy maps from Harris County Tax Assessor-Collector's Office (1990).
ANNOTATION:	None
LABELS:	VOTE_DIST_NO
SYMBOLOGY:	No standard specified

INFO Tables

VOTEBNDPATVOTE

ITEM	FORMAT	NULL	ITEM DEFINITION
AREA	8,12,F,3	N/A	Area in square coverage units, generated by ArcInfo.
PERIMETER	8,12,F,3	N/A	Perimeter in coverage units, generated by ArcInfo.
VOTE#	4,5,B	N/A	Internal sequence number, generated by ArcInfo.
VOTE-ID	4,5,B	N/A	Internal polygon ID, generated by ArcInfo.
VOTE_DIST_NO	1,1,C	No	Unique identifier for each voting district.
CREATOR	5,5,C	No	Initials or acronym of user/entity that created the graphic.
CREATE_DATE	8,10,D	No	Date the graphic was added to the coverage.
MODIFIER	5,5,C	No	Initials or acronym of last user/entity to update graphic.
MOD_DATE	8,10,D	No	Date of last update to graphic.

ACCESS Data Structure

The majority of the NHCRWA's GIS attribute data is stored in the ACCESS tables. The types of tables prepared for the GIS design include:

Primary Data Table — an RDBMS table that stores the primary non-graphic attribute data associated with the map feature or other primary attribute data associated with the map feature.

Superentity Table — RDBMS table that represents the parent table of a superentity/subentity relationship. A superentity table is a table that holds general information about a feature type that can be furthered subdivided into more specific categories. In this database, **TANK** is a superentity table, it is a general table for storage tanks that stores attributes that can be used to describe all specialized tanks. The primary key of the superentity is propagated as the primary key of the subentity table.

Subentity Table — RDBMS table that represents the child table of a superentity/subentity relationship. A subentity table holds information that is related to a specific category of a superentity. In this database, **ELEVTANK** and **GRNDTANK** are both subentities to the **TANK** superentity. These subentities are specialization tables for elevated storage tanks and ground storage tanks (both are types of storage tanks) that store attributes that only describe each particular subentity. This table receives its primary key from the superentity table.

Association Table — RDBMS table used to resolve a many-to-many relationship in the physical database.

Look-up Table — RDBMS table that enforces data integrity by defining the valid values allowed in a field of a related table.

ACCESS Item Definitions

The ACCESS database tables presented in the design define the following parameters for each field in the table:

Name — short name (column heading) used for storage and access of the records. Typically, an item name should be clear and well defined, not obscure or cryptic.

Key — identifies columns that serves as a primary or foreign key. Primary keys are used as unique identifiers for a feature. A primary key must be unique, cannot be empty, and should be dataless (i.e., independent of the information the key is representing). A table with multiple fields serving as a primary key is said to have a compound primary key. Foreign keys are used to relate two tables. A primary key in one table serves as a foreign key in the related table.

Unique — identifies whether the data in columns must be unique.

Req'd — identifies if a field must have a value ("Y") or can remain empty or *null* ("N"). An empty or null value cannot be represented by a zero or blank (one or more spaces in the case of textual data.) An empty or null value is when nothing is entered into the column.

Type — identifies the data type of the column. When a table is created and a column is defined, each column must have a data type specified. Data type indicates the nature of the data that is stored in the field and thus defines the storage format of the item. Common ACCESS data types are defined in Table 3.

Table 3
Common ACCESS Data Types

Data Type	Usage	Size
Text (*n*)	Alphanumeric data	Up to 255 characters
Number	Numeric data	1,2,4 or 8 bytes
Date/Time	Dates and times	8 bytes
AutoNumber	Unique value generated by ACCESS for each new record.	4 bytes
Yes/No	Boolean (true/false) data	1 bit

Size — identifies the size of the field if the field is text or numeric. Numbers shown in parentheses indicate the number of decimal places.

Constraints — identifies columns have certain validation rules, such as check constraints or range constraints. *Check constraints* enforce data integrity by limiting the values that are accepted by a column. *Range constraints* enforce data integrity by limiting the value entered into the column to fall within a specified range.

Definition — provides a definition of the column.

ACCESS Database Tables

BOOSTER_PUMP
Booster pump information.

Column Name	Key	Unique	Reg'd	Type	Size	Constraints	Description/Notes
HYDROTANK_UID	PK FK	Yes	Yes	Number	Long Integer		Foreign key to HYDRO_TANK table. Identifies the hydropneumatic tank the booster pump is or will be associated with.
BP_FUTURE		No	No	Text	1	Validation Rule: In ("Y","N")	Flags if booster pump is a planned pump not yet in existence: Y for future, N for existing.
BP_CAPACITY		No	No	Number	Long Integer		Pump capacity (or expected pump capacity for future pumps) in gallons per minute (gpm).
BP_CL_ELEV		No	No	Number	Long Integer		Elevation of centerline of booster pump in feet.
BP_CURVE_FILED		No	No	Text	1	Validation Rule: In ("Y","N")	Flags if booster pump curve (flow rate vs. elevation graph) is on file at NHCRWA.
BP_TESTED		No	No	Text	1	Validation Rule: In ("Y","N")	Flags if booster pump capacity has been tested since original installation.
BP_TEST_DATE		No	No	Date/Time		Format: Short Date	Date booster pump was last tested for its pumping capacity.
BP_CURVE_MOD		No	No	Text	1	Validation Rule: In ("Y","N")	Flags if booster pump curve has been modified.
BP_MOD_CURVE_ FILED		No	No	Text	1	Validation Rule: In ("Y","N")	Flags if modified booster pump curve is on file at NHCRWA.
BP_CAPACITY_ INCREASE		No	No	Text	1	Validation Rule: In ("Y","N")	Flags if current booster pump capacity will increase with time.
MODIFIER		No	Yes	Text	3		Initials of last person to modify record.
DATE_LAST_MOD		No	Yes	Date/Time		Format: Short Date	Date of last modification to record.

Relationships

BOOSTER_PUMP
| 🔑 HYDROTANK_UID (FK) |

HYDRO_TANK
| 🔑 HYDROTANK_UID |
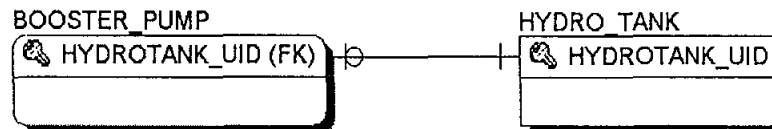
HYDRO_TANKBOOSTER_PUMP   A BOOSTER_PUMP can serve one and only one HYDRO_TANK.
A HYDRO_TANK is served by one or no BOOSTER_PUMP.

Attributes: Enforced
Relationship Type: One-To-Optional One

ACⱢESS Database Tables

CCN

CCN (Certificates of Convenience and Necessity) information. Also referred to as service areas.

Column Name	Key	Unique	Reg'd	Type	Size	Constraints	Description/Notes
WATSYS_UID	PK FK	Yes	Yes	Number	Long Integer		System-generated unique identifier for CCN. (sequential number)
CCN_NO		Yes	No	Text	5		CCN number that uniquely identifies a CCN. Generated by TNRCC.
CCN_NAME_ TNRCC		No	No	Text	50		Name of water system as show in TNRCC_MUD database.
MODIFIER		No	Yes	Text	3		Initials of last person to modify record.
DATE_LAST_MOD		No	Yes	Date/Time		Format: Short Date	Date of last modification to record.
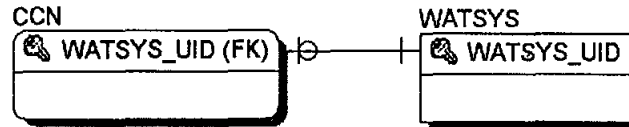
Relationships

WATSYSCCN	A CCN is a WATSYS. A WATSYS can be a CCN or not (MUD, private service).	
	Attributes: Relationship Type:	Enforced One-To-Optional One

ACCESS Database Tables

CONTACT
Contact information for district, service area or private individual.

Column Name	Key	Unique	Req'd	Type	Size	Constraints	Description/Notes
CONTACT_UID	PK	Yes	Yes	AutoNumber	Long Integer		System-generated unique identifier for district/service area contact. (sequential number)
CONTACT_TYPE	FK	No	Yes	Text	2		Foreign key to CONTACT_TYPE table. Type of contact for district/service area: OP, EN, AT, BD (for district only), DO (for district only), CO (for service area only).
WATSYS_UID	FK	No	Yes	Number	Long Integer		Foreign key to WATSYS table. District/service area with which the contact is associated.
CONTACT_NAME		No	Yes	Text	30		Name of district/service area contact.
CONTACT_ATTN		No	No	Text	30		Attention name of district/service area contact.
CONTACT_ADDR		No	Yes	Text	60		Street address of district/service area contact.
CONTACT_CITY		No	Yes	Text	20		City of district/service area contact.
CONTACT_ST		No	Yes	Text	2		State of district/service area contact.
CONTACT_ZIP		No	Yes	Text	50		Five-digit zip code of district/service area contact.
CONTACT_PH		No	Yes	Text	16		Phone number of district/service area contact.
CONTACT_FAX		No	No	Text	16		Fax number of district/service area contact.
CONTACT_EMAIL		No	No	Text	50		Email address of district/service area contact.
MODIFIER		No	Yes	Text	3		Initials of last person to modify record.
DATE_LAST_MOD		No	Yes	Date/Time		Format: Short Date	Date of last modification to record.

Relationships

CONTACT_TYPE

CONTACT_TYPE

CONTACT

CONTACT_UID

CONTACT_TYPE (FK)

WATSYS_UID (FK)

WATSYS

WATSYS_UID
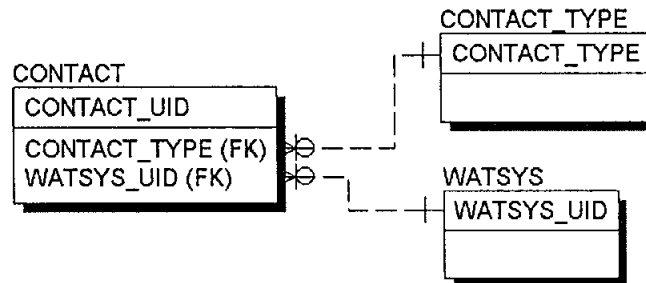
CONTACT_TYPECONTACT   A CONTACT_TYPE can be related to zero, one, or many CONTACTs.
                           A CONTACT can only be one CONTACT_TYPE.

                           Attributes: Enforced
                           Relationship Type: One-To-Optional Many

WATSYSCONTACT   A CONTACT is designated for a WATSYS.
                          A WATSYS can have zero, one, or many CONTACTs.

                           Attributes: Enforced
                           Relationship Type: One-To-Optional Many

ACCESS Database Tables

CONTACT_TYPE
Type of contact.

Column Name	Key	Unique	Req'd	Type	Size	Constraints	Description/Notes
CONTACT_TYPE	PK	Yes	Yes	Text	2		Code for type for district/service area contact.
CONTACT_DESC		Yes	Yes	Text	18		Description of district/service area contact type.
MODIFIER		No	Yes	Text	3		Initials of last person to modify record.
DATE_LAST_MOD		No	Yes	Date/Time		Format: Short Date	Date of last modification to record.

CONTACT TYPE	CONTACT DESC
OP	perator
EN	ngineer
AT	ttorney
DO	istrict Office
BP	oard President
CO	urrent Owner

Relationships
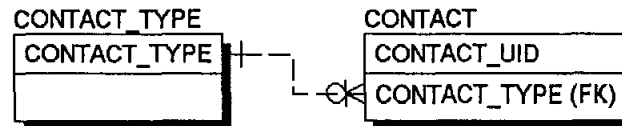
CONTACT_TYPE

CONTACT_TYPE

CONTACT

CONTACT_UID
CONTACT_TYPE (FK)

CONTACT_TYPECONTACT   A CONTACT_TYPE can be related to zero, one, or many CONTACTs.
A CONTACT can only be one CONTACT_TYPE.

Attributes: Enforced
Relationship Type: One-To-Optional Many

ACCESS Database Tables

ELEVTANK
Elevated storage tank information.

Column Name	Key	Unique	Req'd	Type	Size	Constraints	Description/Notes
TANK_UID	FK	Yes	Yes	Number	Long Integer		Foreign key to TANK table. Unique identifier of elevated storage tank. (Generated by dataentry application during creation of tank in TANK table)
EST_BOT_BOWL_ELEV		No	No	Number	Decimal (2)	Validation Rule: >-1	Elevation of the tank to the bottom of the bowl in feet relative to surface elevation (assumed to be 0 feet).
EST_TANK_MFG		No	No	Text	18		Manufacturer of tank.
EST_BOWL_CONFIG		No	No	Text	18		Configuration of the tank bowl.
MODIFIER		No	Yes	Text	3		Initials of last person to modify record.
DATE_LAST_MOD		No	Yes	Date/Time		Format: Short Date	Date of last modification to record.

Relationships

ELEVTANK   TANK

🔑 TANK_UID (FK)   🔑 TANK_UID
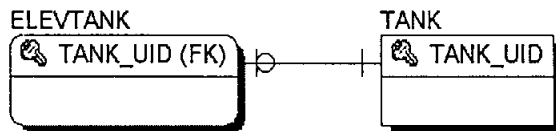
ELEVTANKTANK   An ELEVTANK is a TANK.
                      A TANK can be an ELEVTANK or not (GRNDTANK).

                      Attributes: Enforced
                      Relationship Type: One-To-Optional One

FUTWELL
Future well information.

Column Name	Key	Unique	Req'd	Type	Size	Constraints	Description/Notes
FUTWELL_UID	PK	Yes	Yes	AutoNumber	Long Integer		System-generated unique identifier for future well. (sequential number)
WATSYS_UID	FK	No	Yes	Number	Long Integer		Foreign key to WATSYS table. Identifies the water system with which the future well is associated.
FW_CAPACITY		No	No	Number	Long Integer		Planned capacity of future well in gallons per minute (gpm).
FW_INSTALL_DATE		No	No	Date/Time		Format: Short Date	Planned install date of future well in MM/DD/YYYY format.
MODIFIER		No	Yes	Text	3		Initials of last person to modify record.
DATE_LAST_MOD		No	Yes	Date/Time		Format: Short Date	Date of last modification to record.

Relationships

FUTWELL

FUTWELL_UID
WATSYS_UID (FK)

WATSYS

WATSYS_UID

WATSYSFUTWELL   A WATSYS can have zero, one, or many FUTWELLs.
A FUTWELL is owned by one and only one WATSYS.

Attributes: Enforced
Relationship Type: One-To-Many

ACCESS Database Tables

GRNDTANK
Ground storage tank information.

Column Name	Key	Unique	Req'd	Type	Size	Constraints	Description/Notes
TANK_UID	FK	Yes	Yes	Number	Long Integer		Foreign key to TANK table. Unique Identifier of ground storage tank.
GST_BOT_TANK_ ELEV		No	No	Number	Decimal (1)	Validation Rule: >-1	Elevation to the bottom of the tank (bottom of water storage level) in feet relative to surface elevation (assumed to be 0)
GST_TANK_ DIAMETER		No	No	Number	Single (3)		Diameter of the tank in decimal feet.
MODIFIER		No	Yes	Text	3		Initials of last person to modify record.
DATE_LAST_MOD		No	Yes	Date/Time		Format: Short Date	Date of last modification to record.

Relationships

GRNDTANK   TANK

🔑 TANK_UID (FK)   🔑 TANK_UID

GRNDTANKTANK   An GRNDTANK is a TANK.
A TANK can be an GRNDTANK or not (ELEVTANK).

Attributes: Enforced
Relationship Type: One-To-One

ACCESₛ Database Tables

HIST_WELL_CAP
Historical well capacity information.

Column Name	Key	Unique	Req'd	Type	Size	Constraints	Description/Notes
HISTWELLCAP_UID	PK	Yes	Yes	AutoNumber	Long Integer		System-generated unique identifier for historical water well capacity recording. (sequential number)
WELL_UID	FK	No	Yes	Number	Long Integer		Foreign key to WELL table. Identifies the water well with which the historical capacity recording is associated.
HWC_CAPACITY		No	Yes	Number	Long Integer		Historical capacity of well from testing for the date given in gallons per minute (gpm).
HWC_DATE_TEST		No	Yes	Date/Time			Date of historical well capacity test.
MODIFIER		No	Yes	Text	3		Initials of last person to modify record.
DATE_LAST_MOD		No	Yes	Date/Time		Format: Short Date	Date of last modification to record.

Relationships

HIST_WELL_CAP   WELL

HISTWELLCAP_UID   WELL_UID

WELL_UID (FK)
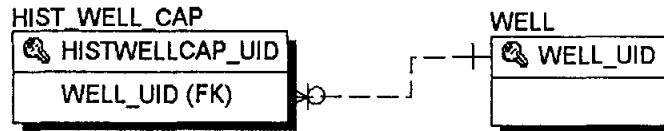
WELLHIST_WELL_CAP   A WELL can have zero, one, or many HIST_WELL_CAP records.
An HIST_WELL_CAP can be recorded for one and only one well.

Attributes: Enforced
RelationshipType: One-To-Optional Many

ACCESS Database Tables

HYDRO_TANK
Hydropneumatic tank information.

Column Name	Key	Unique	Req'd	Type	Size	Constraints	Description/Notes
HYDROTANK_UID	PK	Yes	Yes	AutoNumber	Long Integer		System-generated unique identifier for hydropneumatic tanks. (sequential number)
WATERTP_UID	FK	No	Yes	Number	Long Integer		Foreign key to WATERTP table. Identifies the water treatment plant with which the booster pump is or will be associated.
HT_CAPACITY		No	Yes	Number	Long Integer		Capacity of hydropneumatic tank in gallons (gal).
MODIFIER		No	Yes	Text	3		Initials of last person to modify record.
DATE_LAST_MOD		No	Yes	Date/Time		Format: Short Date	Date of last modification to record.
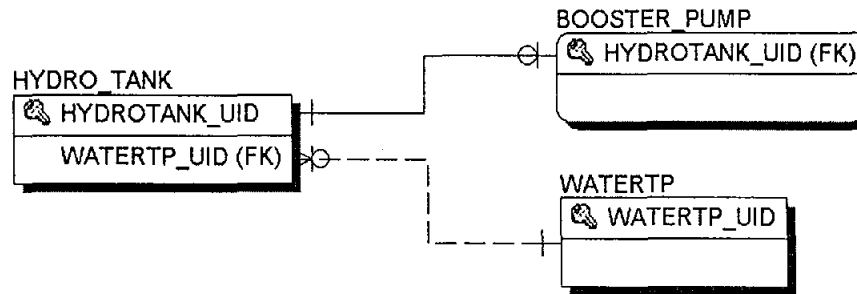
Relationships

HYDRO_TANKBOOSTER_PUMP

A BOOSTER_PUMP can serve one and only one HYDRO_TANK.
A HYDRO_TANK is served by one or no BOOSTER_PUMP.

Attributes: Enforced
Relationship Type: One-To-Optional One

WATERTPHYDRO_TANK

A HYDRO_TANK can serve one and only one WATERTP.
A WATERTP is served by zero, one or many HYDRO_TANKs.

Attributes: Enforced
Relationship Type: One-To-Optional Many

ACCESS Database Tables

LUT_MONTH
Months of the year.

Column Name	Key	Unique	Req'd	Type	Size	Constraints	Description/Notes
MONTH_NO	PK	Yes	Yes	Number	Long Integer		
MONTH		Yes	No	Text	9		

MONTH_NO	MONTH
1	JANUARY
2	FEBRUARY
3	MARCH
4	APRIL
5	MAY
6	JUNE
7	JULY
8	AUGUST
9	SEPTEMBER
10	OCTOBER
11	NOVEMBER
12	DECEMBER

Relationships
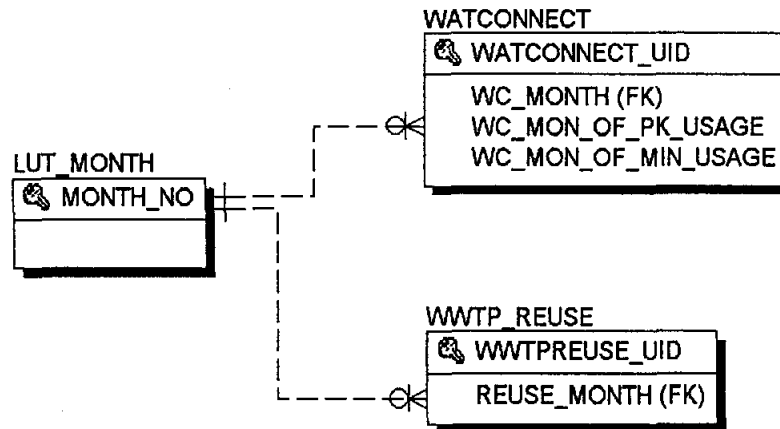
WATCONNECT
- WATCONNECT_UID
- WC_MONTH (FK)
- WC_MON_OF_PK_USAGE
- WC_MON_OF_MIN_USAGE

LUT_MONTH
- MONTH_NO

WWTP_REUSE
- WWTPREUSE_UID
- REUSE_MONTH (FK)

LUT_MONTHWATCONNECT   An LUT_MONTH can be related to zero, one or many WATCONNECT records.
A WATCONNECT record can have one and only one LUT_MONTH in which the data was compiled.

Attributes: Enforced
RelationshipType: One-To-Optional Many

LUT_MONTH (CONTINUED)

LUT_MONTHWWTP_REUSE   An LUT_MONTH can be related to zero, one or many WWTP_REUSE records.
A WWTP_REUSE record can have one and only one LUT_MONTH for which the data was collected.

Attributes: Enforced
RelationshipType: One-To-Optional Many

ACCESS Database Tables

LUT_PERIOD
Periods for water connection projections.

Column Name	Key	Unique	Req'd	Type	Size	Constraints	Description/Notes
PERIOD	PK	Yes	Yes	Text	20		Periods for water connection projections.
MODIFIER		No	Yes	Text	3		Initials of last person to modify record.
DATE_LAST_MOD		No	Yes	Date/Time		Format: Short Date	Date of last modification to record.

PERIOD
2000-2010
2010-2020
2020-2030
2030-2040
2040-2050
Ultimate Development

Relationships

LUT_PERIODWATPROJ   An LUT_PERIOD can be related to zero, one or many WATPROJ records.
A WATPROJ record can have one and only one LUT_PERIOD for which the data was collected.

Attributes: Enforced
RelationshipType: One-To-Optional Many

ACCESS Database Tables

LUT_WPMETHOD
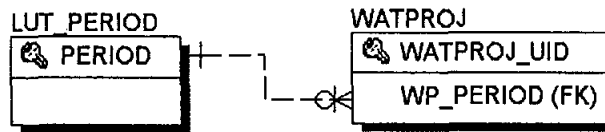Method of water connection projection.

Column Name	Key	Unique	Req'd	Type	Size	Constraints	Description/Notes
METHOD	PK	Yes	Yes	Text	5		Code for methodology used to collect/calculate water connection projections.
METHOD_DESCR		No	Yes	Text	100		Description of methodology used to collect/calculate water connection projections.
MODIFIER		No	Yes	Text	3		Initials of last person to modify record.
DATE_LAST_MOD		No	Yes	Date/Time		Format: Short Date	Date of last modification to record.

METHOD	METHOD_DESCR
5MIL	Study data collection for groundwater wells with pumpage greater than 5 mgy

Relationships

LUT_WPMETHOD

🗝 METHOD

WATPROJ

🗝 WATPROJ_UID

WP_METHOD (FK)

LUT_WPMETHODWATPROJ   An LUT_WPMETHOD can be related to zero, one or many WATPROJ records.
A WATPROJ record can have one and only one LUT_WPMETHOD for how the data was determined.

Attributes: Enforced
RelationshipType: One-To-Optional Many

ACCESS Database Tables

LUT_YEAR
List of valid years.

Column Name	Key	Unique	Req'd	Type	Size	Constraints	Description/Notes
YEAR	PK	Yes	Yes	Number	Integer		List of valid years.
MODIFIER		No	Yes	Text	3		Initials of last person to modify record.
DATE_LAST_MOD		No	Yes	Date/Time		Format: Short Date	Date of last modification to record.

YEAR
1996
1997
1998
.
.
.
2029
2030

Relationships

LUT_YEARWATCONNECT

An LUT_YEAR can be related to zero, one or many WATCONNECT records.
A WATCONNECT record can have one and only one LUT_YEAR for which the data was collected.

Attributes: Enforced
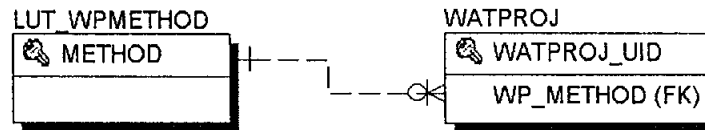RelationshipType: One-To-Optional Many

ACCESS Database Tables

LUT_YEAR (CONTINUED)

LUT_YEARQUARTER_WELL_PUMPAGE   An LUT_YEAR can be related to zero, one or many QUARTER_WELL_PUMPAGE records.
A QUARTER_WELL_PUMPAGE record can have one and only one LUT_YEAR for which the data was collected.

Attributes: Enforced
RelationshipType: One-To-Optional Many

LUT_YEARWWTP_REUSE   An LUT_YEAR can be related to zero, one or many WWTP_REUSE records.
A WWTP_REUSE record can have one and only one LUT_YEAR for which the data was collected.

Attributes: Enforced
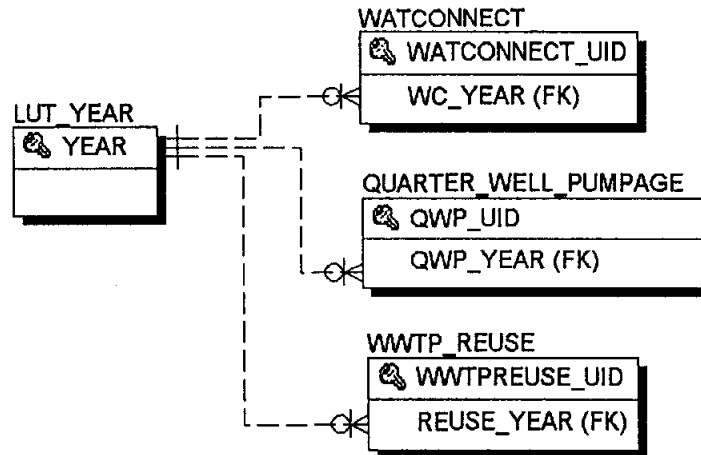RelationshipType: One-To-Optional Many

ACCESS Database Tables

MODTYPE

Type of groundwater well modification

Column Name	Key	Unique	Req'd	Type	Size	Constraints	Description/Notes
MOD_TYPE	PK	Yes	Yes	Text	9		Code for the type of well modification (See list below).
MOD_DESC		Yes	Yes	Text	50		Description of well modification type (See list below).
MODIFIER		No	Yes	Text	3		Initials of last person to modify record.
DATE_LAST_MOD		No	Yes	Date/Time		Format: Short Date	Date of last modification to record.

MOD_TYPE	MOD_DESC
ADDPUMP	Add a pump
CLEAN	Cleaning of screens
ELIMINATE	Elimination of any production zone
INSTALL	Installation
LINER	Liner
LOWER	Lowering of pump
NEW	New well
RAISE	Raise well head
REDUCE	Reduce
REPLACE	Replacement of pump production string
SET	Set pump
OTHER	Other

Relationships

MODTYPE

🔑 MOD_TYPE

WELLMOD

🔑 WELLMOD_UID

MOD_TYPE (FK)

MODTYPEWELLMOD   A MODTYPE can be related to zero, one, or many WELLMODs.
A WELLMOD can only be one MODTYPE.

Attributes: Enforced
RelationshipType: One-To-Optional Many

ACCESS Database Tables

MUD

Municipal Utility District information. Also referred to as district.

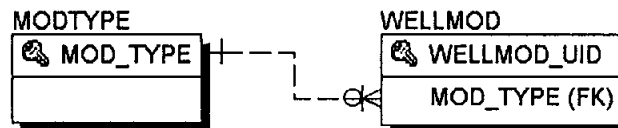| Column Name	Key	Unique	Req'd	Type	Size	Constraints	Description/Notes
WATSYS_UID	PK FK	Yes	Yes	Number	Long Integer		Foreign key to WATSYS table. Unique identifer of the MUD. (Generated by application during creation of water system in WATSYS table)
MUD_NO		Yes	No	Number	Double		MUD number (district number) assigned by TNRCC. A MUD is a publicly-owned water service system. (aka: District, Municipal Utility District. Also represents ID, UD, SUD, etc).
MUD_NAME_TNRCC		No	No	Text	60		Name of water system as shown in ORIG_TNRCC_MUD database.
MUD_NAME_WSBC		No	No	Text	50		Name of water system as shown in ORIG_WSBC_MUD database.
PWS_ID		No	No	Number	Long Integer		TNRCC identifier for owner of MUD. Used to link to other data.
STATUS		No	No	Text	1		Status of district from TNRCC original data.
MODIFIER		No	Yes	Text	3		Initials of last person to modify record.
DATE_LAST_MOD		No	Yes	Date/Time		Format: Short Date	Date of last modification to record.

Relationships

MUD

🔑 WATSYS_UID (FK)

WATSYS

🔑 WATSYS_UID

WATSYSMUD   A MUD is a WATSYS.
A WATSYS can be a MUD or not (CCN, private service).

Attributes: Enforced
Relationship Type: One-To-Optional One

ACCESS Database Tables

NON_POTABLE_USER
Non-potable water (reclaimed wastewater) user information.

Column Name	Key	Unique	Req'd	Type	Size	Constraints	Description/Notes
NONPOT_UID	PK	Yes	Yes	Number	Long Integer		System-generated unique identifier of a non-potable user. (sequential number)
WATSYS_UID	FK	Yes	Yes	Number	Long Integer		Foreign key to the water system associated with the non-potable user.
NPU_NAME		No	Yes	Text	35		Name of the non-potable user.
NPU_ADDRESS		No	No	Text	35		Street address of the non-potable user.
NPU_CITY		No	No	Text	18		City of the non-potable user.
NPU_ZIP		No	No	Text	50		Zip code of the non-potable user.
NPU_PHONE		No	No	Text	16		Phone number of the non-potable user.
NPU_FAX		No	No	Text	16		Fax number of the non-potable user.
NPU_EMAIL		No	No	Text	35		Email address of the non-potable user.
NPU_USER_TYPE		No	Yes	Text	3	Validation Rule: In ('COM','IRR','IND','INS')	Type of non-potable user: COM=commercial, IRR=irrigation, IND=industrial, INS=institutional.
NPU_USE		No	Yes	Text	1	Validation Rule: In ('Y','N','U')	Flags if user currently uses non-potable water: Y=Yes, N=No, U=Unknown.
NPU_AMOUNT		No	No	Number	Decimal (2)		Amount of non-potable water used in millions of gallons per day (Mgal/day), if the user currently uses non-potable water.
NPU_USE_MORE		No	Yes	Text	1	Validation Rule: In ('Y','N','U')	Flags if the non-potable user would be willing to use more non-potable water: Y=Yes, N=No, U=Unknown.
NPU_USE_MORE_AMT		No	No	Number	Decimal (2)		Amount of non-potable water the user would be willing to use in addition to what is being used in millions of gallons per day (Mgal/day).
NPU_TNRCC_210		No	Yes	Text	1	Validation Rule: In ('Y','N','U')	Flags if non-potable user is authorized by TNRCC 210: Y=Yes, N=No, U=Unknown.
NPU_CONVERT_USE		No	Yes	Text	1	Validation Rule: In ('Y','N','U')	Flags is user would be willing to convert to non-potable water: Y=Yes, N=No, U=Unknown.
NPU_CONVERT_AMOUNT		No	No	Number	Decimal (2)		Amount of water the user is willing to convert to non-potable in millions of gallons per day (Mgal/day), if the user is willing to convert.
NPU_WELL_USE		No	Yes	Text	1	Validation Rule: In ('Y','N','U')	Flags if non-potable user currently uses well water: Y=Yes, N=No, U=Unknown.
NPU_WELL_AMOUNT		No	No	Number	Decimal (2)		Amount of well water used in millions of gallons per day (Mgal/day), if the non-potable user uses well water.
NPU_REUSE_INTEREST		No	Yes	Text	1	Validation Rule: In ('Y','N','U')	Flags if the non-potable user is interested in participating in a reuse program: Y=Yes, N=No, U=Unknown.
MODIFIER		No	Yes	Text	3		Initials of last person to modify record.
DATE_LAST_MOD		No	Yes	Date/Time	8	Format: Short Date	Date of last modification to record.

NON_POTABLE_USER (CONTINUED)

Relationships

NON_POTABLE_USER

🔑 NONPOT_UID
WATSYS_UID (FK)

WATSYS

🔑 WATSYS_UID

WATSYSNON_POTABLE_USER   A WATSYS can have zero, one, or many NON_POTABLE_USERs.
A NON_POTABLE_USER is located within one and only one WATSYS.

Attributes: Enforced
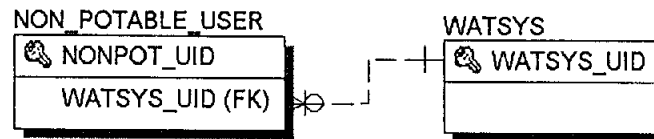Relationship Type: One-To-Optional Many

ACCESS Database Tables

ORIG_CCN_WATER

TNRCC CCN database filtered for water CCNs only.

See TNRCC data dictionary in Appendix A.

<u>**Relationships**</u>

```
ORIGINAL_CCN_WATER                    CCN
┌──────────────────────┐             ┌──────────────────────┐
│                      │             │ 🗝 WATSYS_UID        │
├──────────────────────┤             ├──────────────────────┤
│      UTILITY         │─────────────│  CCN_NAME_TNRCC      │
└──────────────────────┘             └──────────────────────┘
```

Attributes: Not Enforced
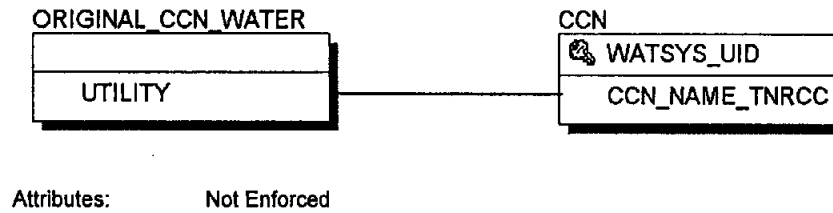
ACCESS Database Tables

ORIG_TNRCC_MUD
TNRCC MUD database.

See TNRCC data dictionary in Appendix A.

<u>Relationships</u>

```
ORIGINAL_TNRCC_MUD              MUD
┌──────────────────────┐        ┌──────────────────────────┐
│                      │        │ 🔑 WATSYS_UID            │
├──────────────────────┤        ├──────────────────────────┤
│     DISTRICT         │────────│   MUD_NAME_TNRCC         │
└──────────────────────┘        └──────────────────────────┘
```

Attributes: Not Enforced

ACCESS Database Tables

ORIG_WELL
ARCADIS/WSBC-modified HGCSD well database.

See HGCSD data dictionary in Appendix A. (ARCADIS/WSBC added the VD_NO_, CLASS, PWS_ID and DISTRICT_N fields)

Relationships

ORIGINAL_WELL

ID
PWS_ID
DISTRICT_N

MUD

WATSYS_UID
MUD_NO
PWS_ID
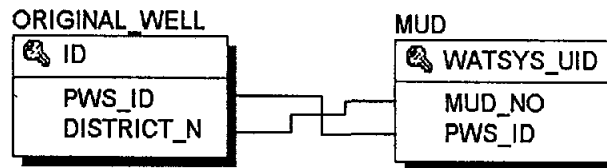
Attributes: Not Enforced

ACCESS Database Tables

ORIG_WSBC_MUD
ARCADIS/WSBC MUD database.

ORIGINAL_WSBC_MUD

🔑 ID
LIST_OF_MU

MUD

🔑 WATSYS_UID
MUD_NAME_WSBC
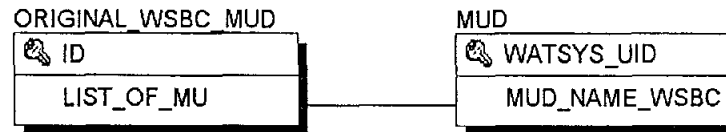
Attributes: Not Enforced

ACCESS Database Tables

QUARTER_WELL_PUMPAGE
Quarterly well pumpage information and history.

| Column Name	Key	Unique	Req'd	Type	Size	Constraints	Description/Notes
QWP_UID	PK	Yes	Yes	AutoNumber	Long Integer		System-generated unique identifier for quarterly well pumpage data record. (sequential number)
WELL_UID	FK	No	Yes	Number	Long Integer		Foreign key to WELL table. Identifies the well with which the pumpage record is associated.
QWP_QUARTER		No	Yes	Text	1	Validation Rule: In ("1","2","3","4")	Quarter for which well pumpage data was obtained: 1 for 1st (Jan-Mar), 2 for 2nd (Apr-Jun), 3 for 3rd (Jul-Sep), 4 for 4th (Oct-Dec).
QWP_YEAR	FK	No	Yes	Number	Integer		Foreign key to LUT_YEAR. Year for which data is compiled.
QWP_AMOUNT		No	No	Number	Long Integer		Amount of well pumpage for the quarter in millions of gallons (Mgal).
MODIFIER		No	Yes	Text	3		Initials of last person to modify record.
DATE_LAST_MOD		No	Yes	Date/Time		Format: Short Date	Date of last modification to record.
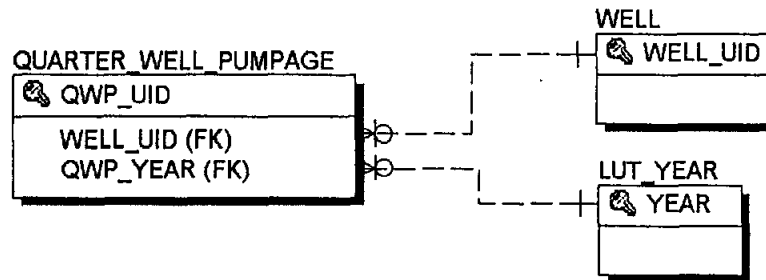
Relationships

WELLQUARTER_WELL_PUMPAGE   A WELL can have zero, one, or many QUARTER_WELL_PUMPAGE reports.
A QUARTER_WELL_PUMPAGE is produced for one and only one WELL.

Attributes: Enforced
Relationship Type: One-To-Optional Many

LUT_YEARQUARTER_WELL_PUMPAGE   An LUT_YEAR can be related to zero, one or many QUARTER_WELL_PUMPAGE records.
A QUARTER_WELL_PUMPAGE record can have one and only one LUT_YEAR for which the data was collected.

Attributes: Enforced
RelationshipType: One-To-Optional Many
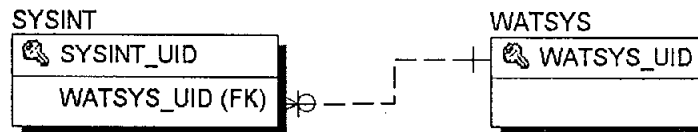
ACCESS Database Tables

SYSINT
System interconnect information.

Column Name	Key	Unique	Req'd	Type	Size	Constraints	Description/Notes
SYSINT_UID	PK	Yes	Yes	AutoNumber	Long Integer		System-generated unique identifier of a system interconnect. (sequential number)
WATSYS_UID	FK	Yes	Yes	Number	Long Integer		Foreign key to WATSYS table. District or service area that uses a system interconnect to connect with an external
SI_FUTURE		No	Yes	Yes/No			Flags whether system interconnect is a planned interconnect (to be implemented in the future).
SI_LATITUDE		No	No	Number	Single (4)		Latitude of system interconnect in decimal degrees.
SI_LONGITUDE		No	No	Number	Single (4)	Validation Rule: <0	Longitude of system interconnects in decimal degrees.
SI_TYPE		No	Yes	Text	2	Validation Rule: In ('EM','NO','UN')	Type of system interconnect: EM=emergency, NO=normally open, UN=unknown.
SI_SIZE		No	No	Number	Integer		Size of interconnect (e.g. valve, meter, fitting) in inches.
SI_CON_ENTITY		No	Yes	Text	40		Name of the entity connected to the district/service area through the system interconnect.
SI_CON_SIZE		No	No	Number	Integer	Validation Rule: >0	Size of the connected entities pipe in inches.
MODIFIER		No	Yes	Text	3		Initials of last person to modify record.
DATE_LAST_MOD		No	Yes	Date/Time		Format: Short Date	Date of last modification to record.

Relationships

SYSINT   WATSYS

| ⚷ SYSINT_UID | | ⚷ WATSYS_UID |
|---| |---|
| WATSYS_UID (FK) | | |

WATSYSSYSINT

A WATSYS can have zero, one, or many SYSINTs.
A SYSINT is associated with one and only one WATSYS.

Attributes: Enforced
Relationship Type: One-To-Optional Many

ACCESS Database Tables

TANK
General tank information (covers both elevated and ground storage tanks).

Column Name	Key	Unique	Req'd	Type	Size	Constraints	Description/Notes
TANK_UID	PK	Yes	Yes	Number	Long Integer		System-generated unique identifier for ground and elevated storage tanks. (sequential number)
TANK_NAME_ID		No	Yes	Text	35		Name or ID of tank. (If none given, name them EST 1, EST 2, etc. or GST 1, GST 2, etc.)
TANK_TYPE		No	Yes	Text	3	Validation Rule: In ('ELV','GRD')	Type of tank: ELV=elevated, GRD=ground.
TANK_CAPACITY		No	No	Number	Long Integer	Validation Rule: >-1	Capacity of tank in gallons.
TANK_OVERFLOW_ELEV		No	No	Number	Integer	Validation Rule: >-1	Longitude of system interconnects in decimal degrees.
MODIFIER		No	Yes	Text	3		Initials of last person to modify record.
DATE_LAST_MOD		No	Yes	Date/Time		Format: Short Date	Date of last modification to record.
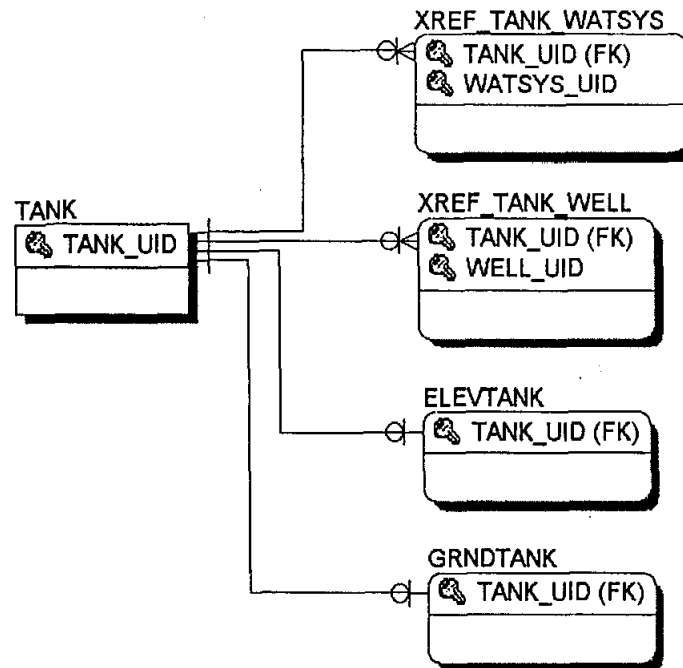
Relationships

ACCESS Database Tables

TANK (CONTINUED)

TANKXREF_TANK_WATSYS   A TANK can be associated with zero, one or many WATSYSs as shown in XREF_TANK_WATSYS.
A record in XREF_TANK_WATSYS can be associated one and only one TANK.

Attributes: Enforced
RelationshipType: One-To-Many

TANKXREF_TANK_WELL   A TANK can be associated with zero, one or many WELLs as shown in XREF_TANK_WELL.
A record in XREF_TANK_WATSYS can be associated one and only one TANK.

Attributes: Enforced
RelationshipType: One-To-Many

ACCESS Database Tables

WATCONNECT
Past and current water connection information.

Column Name	Key	Unique	Req'd	Type	Size	Constraints	Description/Notes
WATCONNECT_UID	PK	Yes	Yes	AutoNumber	Long Integer		System-generated unique identifier of a water connection record. (sequential number)
WATSYS_UID	FK	No	Yes	Number	Long Integer		Foreign key to the WATSYS table. District/service area to which the existing water connection information is related.
WC_YEAR	FK	No	Yes	Number	Integer		Foreign key to LUT_YEAR table. Year for which data is compiled.
WC_MONTH	FK	No	Yes	Text	9		Foreign key to LUT_MONTH table. Month of the year through which the annual accumulation data is valid.
WC_ANN_USAGE		No	Yes	Number	Single (3)	Validation Rule: Between 0 and 1200	Annual water usage in millions of gallons per year (Mgal/yr). Estimated valid range: 0-1200 Mgal/yr.
WC_PK_MO_USAGE		No	No	Number	Single (3)	Validation Rule: Between 0 and 100	Amount of water usage in the peak usage month in millions of gallons per month (Mgal/mo).
WC_MO_OF_PK_ USAGE	FK	No	No	Text	9		Foreign key to LUT_MONTH table. Month of peak water usage.
WC_MIN_MO_USAGE		No	No	Number	Single (3)	Validation Rule: Between 0 and 100	Amount of water usage in the minimum usage month in millions of gallons per month (Mgal/mo).
WC_MO_OF_MIN_ USAGE	FK	No	No	Text	9		Foreign key to LUT_MONTH table. Month of minimum water usage.
WC_PK_DAILY_ USAGE		No	No	Number	Single (3)	Validation Rule: Between 0 and 10	Amount of water usage for the peak usage day in millions of gallons per day (Mgal/day).
WC_ACT_RES_NO		No	No	Number	Integer		Number of active residential connections.
WC_ACT_COM_NO		No	No	Number	Integer		Number of active commercial connections.
WC_ACT_IRR_NO		No	No	Number	Integer		Number of active irrigationl connections.
WC_ACT_IND_NO		No	No	Number	Integer		Number of active industrial connections. .
WC_ACT_RES_ USAGE		No	No	Number	Single (3)	Validation Rule: Between 0 and 1200	Amount of water usage by active residential connections in millions of gallons per year (Mgal/yr).
WC_ACT_COM_ USAGE		No	No	Number	Single (3)	Validation Rule: Between 0 and 1200	Amount of water usage by active commercial connections in millions of gallons per year (Mgal/yr).
WC_ACT_IRR_ USAGE		No	No	Number	Single (3)	Validation Rule: Between 0 and 1200	Amount of water usage by active irrigation connections in millions of gallons per year (Mgal/yr).
WC_ACT_IND_ USAGE		No	No	Number	Single (3)	Validation Rule: Between 0 and 1200	Amount of water usage by active industrial connections in millions of gallons per year (Mgal/yr).
WC_EXT_RES_NO		No	No	Number	Integer		Number of external residential connections.
WC_EXT_COM_NO		No	No	Number	Integer		Number of external commercial connections.
WC_EXT_IRR_NO		No	No	Number	Integer		Number of external irrigation connections.
WC_EXT_IND_NO		No	No	Number	Integer		Number of external industrial connections.
WC_EXT_RES_ USAGE		No	No	Number	Single (3)	Validation Rule: Between 0 and 1200	Amount of water usage by external residential connections in millions of gallons per year (Mgal/yr).
WC_EXT_COM_ USAGE		No	No	Number	Single (3)	Validation Rule: Between 0 and 1200	Amount of water usage by external commercial connections in millions of gallons per year (Mgal/yr).
WC_EXT_IRR_ USAGE		No	No	Number	Single (3)	Validation Rule: Between 0 and 1200	Amount of water usage by external irrigation connections in millions of gallons per year (Mgal/yr).
WC_EXT_IND_ USAGE		No	No	Number	Single (3)	Validation Rule: Between 0 and 1200	Amount of water usage by external industrial connections in millions of gallons per year (Mgal/yr).
MODIFIER		No	Yes	Text	3		Initials of last person to modify record.
DATE_LAST_MOD		No	Yes	Date/Time		Format: Short Date	Date of last modification to record.

WATCONNECT (CONTINUED)

Relationships
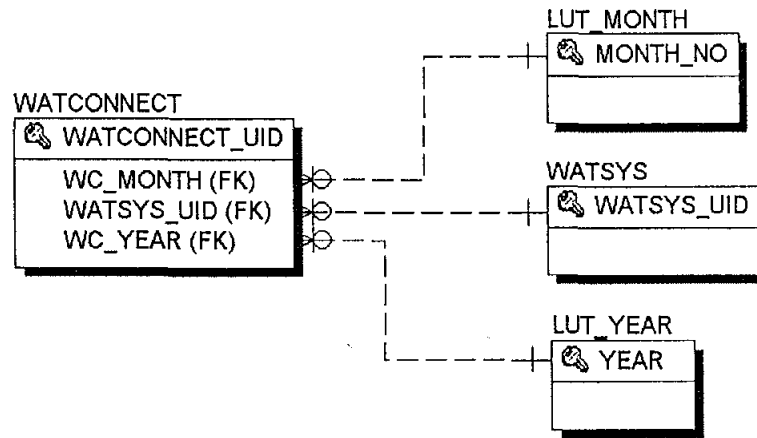
WATSYSWATCONNECT

A WATSYS can have zero, one, or many WATCONNECTs.
A WATCONNECT is recorded for one and only one WATSYS.

Attributes: Enforced
RelationshipType: One-To-Optional Many

LUT_MONTHWATCONNECT

An LUT_MONTH can be related to zero, one or many WATCONNECT records.
A WATCONNECT record can have one and only one LUT_MONTH in which the data was compiled.

Attributes: Enforced
RelationshipType: One-To-Optional Many

LUT_YEARWATCONNECT

An LUT_YEAR can be related to zero, one or many WATCONNECT records.
A WATCONNECT record can have one and only one LUT_YEAR for which the data was collected.

Attributes: Enforced
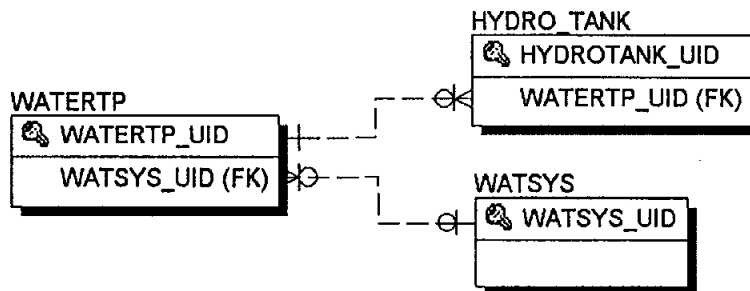RelationshipType: One-To-Optional Many

ACCESS Database Tables

WATERTP
Water treatment plant information.

Column Name	Key	Unique	Req'd	Type	Size	Constraints	Description/Notes
WATERTP_UID	PK	Yes	Yes	AutoNumber	Long Integer		System-generated unique identifier for water treatment plants. (sequential number)
WATSYS_UID	FK	No	Yes	Number	Long Integer		Foreign key to WATSYS table. Water system with which the water treatment plant is associated.
WATERTP_NAME		No	Yes	Text	50		Name of the water treatment plant.
WATERTP_ADDR		No	Yes	Text	50		Street address of the water treatment plant.
MODIFIER		No	Yes	Text	3		Initials of last person to modify record.
DATE_LAST_MOD		No	Yes	Date/Time		Format: Short Date	Date of last modification to record.

Relationships

WATSYSWATERTP

A WATSYS can have zero, one, or many WATERTPs.
A WATERTP serves one and only one WATSYS.

Attributes: Enforced
RelationshipType: One-To-Optional Many

WATERTPHYDRO_TANK

A HYDRO_TANK can serve one and only one WATERTP.
A WATERTP is served by zero, one or many HYDRO_TANKs.

Attributes: Enforced
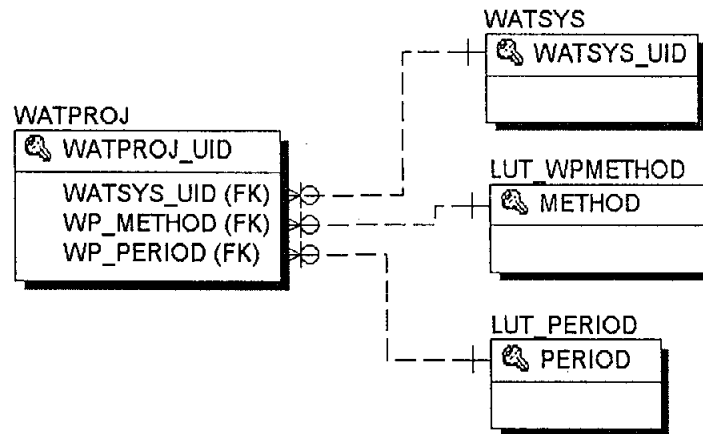Relationship Type: One-To-Optional Many

ACCESS Database Tables

WATPROJ

Project water connection information (potential new connections).

Column Name	Key	Unique	Req'd	Type	Size	Constraints	Description/Notes
WATPROJ_UID	PK	Yes	Yes	AutoNumber	Long Integer		System-generated unique identifier for water projection information. (sequential number)
WATSYS_UID	FK	No	Yes	Number	Long Integer		Foreign key to the WATSYS table. District/service area the water projection (potential for new development) information is for.
WP_METHOD	FK	No	Yes	Text	5		Foreign key to LUT_WPMETHOD table. Methodology used to collect data.
WP_PERIOD	FK	No	Yes	Text	20		Foreign key to LUT_PERIOD table. Period for which projection information is estimated.
WP_RES_CONNECTS		No	No	Number	Integer		Number of potential new residential water connections for period.
WP_COM_CONNECTS		No	No	Number	Integer		Number of potential new commercial water connections for period.
WP_IRR_CONNECTS		No	No	Number	Integer		Number of potential new irrigation water connections for period.
WP_IND_CONNECTS		No	No	Number	Integer		Number of potential new industrial water connections for period.
MODIFIER		No	Yes	Text	3		Initials of last person to modify record.
DATE_LAST_MOD		No	Yes	Date/Time	8	Format: Short Date	Date of last modification to record.

Relationships

WATSYS
WATSYS_UID

WATPROJ
WATPROJ_UID
WATSYS_UID (FK)
WP_METHOD (FK)
WP_PERIOD (FK)

LUT_WPMETHOD
METHOD

LUT_PERIOD
PERIOD

WATSYSWATPROJ   A WATSYS can have zero, one, or many WATPROJ records.
A WATPROJ is recorded for one and only one WATSYS.

Attributes: Enforced
RelationshipType: One-To-Optional Many

ACCESS Database Tables

WATPROJ (CONTINUED)

LUT_WPMETHODWATPROJ

An LUT_WPMETHOD can be related to zero, one or many WATPROJ records.
A WATPROJ record can have one and only one LUT_WPMETHOD for how the data was determined.

Attributes: Enforced
RelationshipType: One-To-Optional Many

LUT_PERIODWATPROJ

An LUT_PERIOD can be related to zero, one or many WATPROJ records.
A WATPROJ record can have one and only one LUT_PERIOD for which the data was collected.

Attributes: Enforced
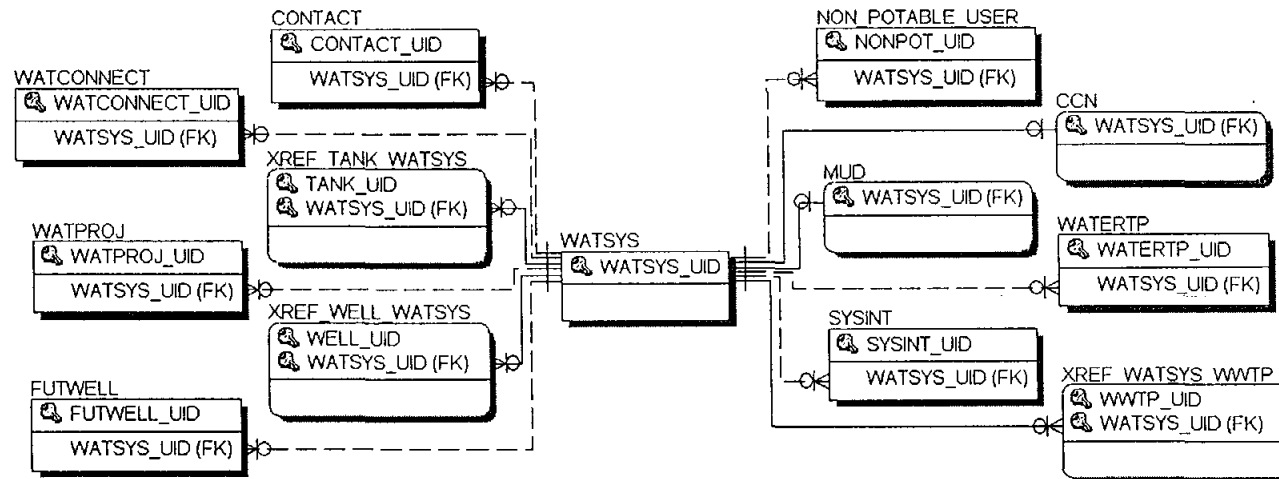RelationshipType: One-To-Optional Many

ACCESS Database Tables

WATSYS

Water system information. Water systems include MUDs, CCNs, and private individuals.

Column Name	Key	Unique	Req'd	Type	Size	Constraints	Description/Notes
WATSYS_UID	PK	Yes	Yes	AutoNumber	Long Integer		System-generated unique identifier for water service system or individual. (sequential number)
WATSYS_NAME		Yes	Yes	Text	40		Name of water system.
WATSYS_TYPE		No	Yes	Text	4	Validation Rule: In ('D','SA','I','D/SA')	Identifies the type of water service system: D=district (MUD), SA=service area (CCN), I=private individual, D/SA=district with a CCN.
WS_DATE_COLLECT		No	Yes	Date/Time		Format: Short Date	Date questionnaire data was recorded.
WS_PERSON_ COLLECT		No	Yes	Text	35		Name of person who recorded the questionnaire data.
WS_PHONE_ COLLECT		No	Yes	Text	16		Phone number of person who recorded the questionnaire data.
MODIFIER		No	Yes	Text	3		Initials of last person to modify record.
DATE_LAST_MOD		No	Yes	Date/Time		Format: Short Date	Date of last modification to record.

Relationships

WATSYSCCN

A CCN is a WATSYS.
A WATSYS can be a CCN or not (MUD, private service).

Attributes: Enforced
Relationship Type: One-To-Optional One

ACCESS Database Tables

WATSYS (CONTINUED)

WATSYSCONTACT

A CONTACT is designated for a WATSYS.
A WATSYS can have zero, one, or many CONTACTs.

Attributes: Enforced
Relationship Type: One-To-Optional Many

WATSYSFUTWELL

A WATSYS can have zero, one, or many FUTWELLs.
A FUTWELL is owned by one and only one WATSYS.

Attributes: Enforced
RelationshipType: One-To-Many

WATSYSMUD

A MUD is a WATSYS.
A WATSYS can be a MUD or not (CCN, private service).

Attributes: Enforced
Relationship Type: One-To-Optional One

WATSYSNON_POTABLE_USER

A WATSYS can have zero, one, or many NON_POTABLE_USERs.
A NON_POTABLE_USER is located within one and only one WATSYS.

Attributes: Enforced
Relationship Type: One-To-Optional Many

WATSYSSYSINT

A WATSYS can have zero, one, or many SYSINTs.
A SYSINT is associated with one and only one WATSYS.

Attributes: Enforced
Relationship Type: One-To-Optional Many

WATSYSWATCONNECT

A WATSYS can have zero, one, or many WATCONNECTs.
A WATCONNECT is recorded for one and only one WATSYS.

Attributes: Enforced
RelationshipType: One-To-Optional Many

WATSYSWATERTP

A WATSYS can have zero, one, or many WATERTPs.
A WATERTP serves one and only one WATSYS.

Attributes: Enforced
RelationshipType: One-To-Optional Many

WATSYSWATPROJ

A WATSYS can have zero, one, or many WATPROJ records.
A WATPROJ is recorded for one and only one WATSYS.

Attributes: Enforced
RelationshipType: One-To-Optional Many

ACCESS Database Tables

WATSYS (CONTINUED)

WATSYSXREF_TANK_WATSYS   A WATSYS can be associated with zero, one or many TANKs as shown in XREF_TANK_WATSYS.
A record in XREF_TANK_WATSYS can be associated one and only one WATSYS.

                          Attributes: Enforced
                          RelationshipType: One-To-Many

WATSYSXREF_WELL_WATSYS   A WATSYS can be associated with zero, one or many WELLs as shown in XREF_WELL_WATSYS.
A record in XREF_WELL_WATSYS can be associated one and only one WATSYS.

                          Attributes: Enforced
                          RelationshipType: One-To-Many

WATSYSXREF_WWTP_WATSYS   A WATSYS can be associated with zero, one or many WWTPs as shown in XREF_WWTP_WATSYS.
A record in XREF_WWTP_WATSYS can be associated one and only one WATSYS.

                          Attributes: Enforced
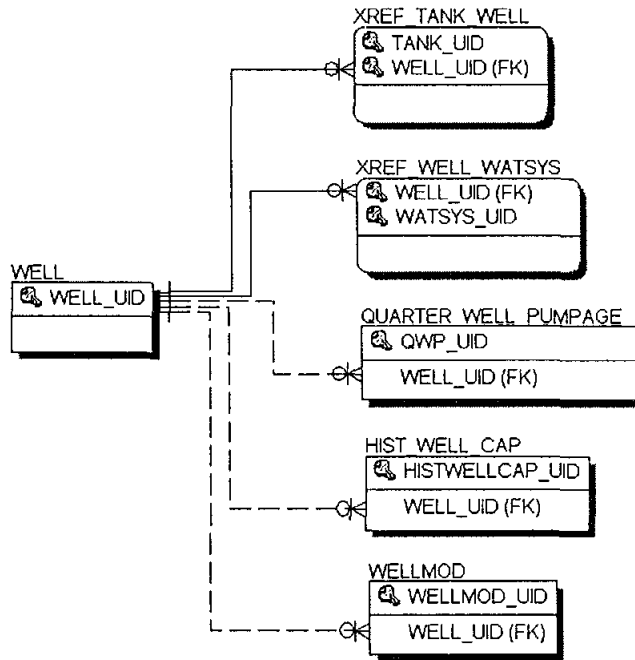   RelationshipType: One-To-Many

ACCESS Database Tables

WELL
Groundwater well information.

Column Name	Key	Unique	Req'd	Type	Size	Constraints	Description/Notes
WELL_UID	PK	Yes	Yes	Number	Long Integer		System-generated unique identifier of a water well. (sequential number)
WELL_NO		Yes	Yes	Number	Integer		Number associated with water well as established by HGCSD (permit number). Same number that is in Harris County-Galveston Coastal Subsidence District.
WELL_ADDRESS		No	No	Text	70		Street address of water well.
WELL_DIAMETER		No	No	Number	Integer		Diameter of water well in inches.
WELL_CAPACITY		No	No	Number	Long Integer		Current capacity of water well in gallons per minute (gpm).
WELL_ANN_PUMP_RATE		No	No	Number	Decimal (2)		Annual pumpage rate of water well in millions of gallons per year (Mgal/yr or Mgy).
WELL_DATE_CONSTRUCTED		No	No	Number	Integer		Year the well was constructed in format YYYY.
WELL_DEPTH		No	No	Number	Integer	Validation Rule: <0	Total water well depth in feet relative to the ground surface (ground surface assumed to be 0). Well depth will be a negative number.
WELL_EST_REPLACEMENT		No	No	Text	8	Validation Rule: In ('2-5 YRS','5-10 YRS','10+ YRS')	Estimated water well replacement time frame (i.e. when well might need to be replaced): 2-5 YRS, 5-10 YRS, 10+ YRS.
WELL_SUBMERGENCE		No	No	Number	Integer	Validation Rule: <0	Current amount of submergence of the water well pump in feet.
WELL_PROD_SAND		No	Yes	Text	1	Validation Rule: In ('Y','N','U')	Flags if the water well produces sand: Y=Yes, N=No, U=Unknown.
WELL_PROD_GAS		No	Yes	Text	1	Validation Rule: In ('Y','N','U')	Flags if the water well produces gas: Y=Yes, N=No, U=Unknown.
WELL_RADON_RADIUM_PROBLEM		No	Yes	Text	1	Validation Rule: In ('Y','N','U')	Flags if there is any known radon or radium problem with the water well: Y=Yes, N=No, U=Unknown.
WELL_OTHER_PROBLEM		No	No	Text	255		Description of any other known problem with the water well.
WELL_DISCHARGE		No	Yes	Text	3	Validation Rule: In ('GST','EST','WDS','OTH')	Feature or system that the water well discharges into: GST=ground storage tank, EST=elevated storage tank, WDS=water distribution system, OTH=other.
MODIFIER		No	Yes	Text	3		Initials of last person to modify record.
DATE_LAST_MOD		No	Yes	Date/Time		Format: Short Date	Date of last modification to record.

ACCESS Database Tables

WELL (CONTINUED)

Relationships

WELLHIST_WELL_CAP

A WELL can have zero, one, or many HIST_WELL_CAP records.
An HIST_WELL_CAP can be recorded for one and only one well.

Attributes: Enforced
RelationshipType: One-To-Optional Many

WELLWELLMOD A WELL

can have zero, one, or many WELLMODs.
A WELLMOD can only be associated with one WELL.

Attributes: Enforced
RelationshipType: One-To-Optional Many

WELLQUARTER_WELL_PUMPAGE   A WELL can have zero, one, or many QUARTER_WELL_PUMPAGE reports.
A QUARTER_WELL_PUMPAGE is produced for one and only one WELL.

Attributes: Enforced
Relationship Type: One-To-Optional Many

WELL (CONTINUED)

WELLXREF_TANK_WELL	A WELL can be associated with zero, one or many TANKs as shown in XREF_TANK_WELL. A record in XREF_TANK_WELL can be associated one and only one WELL.

Attributes: Enforced
RelationshipType: One-To-Many

WELLXREF_WELL_WATSYS	A WELL can be associated with zero, one or many WATSYSs as shown in XREF_WELL_WATSYS. A record in XREF_WELL_WATSYS can be associated one and only one WELL.

Attributes: Enforced
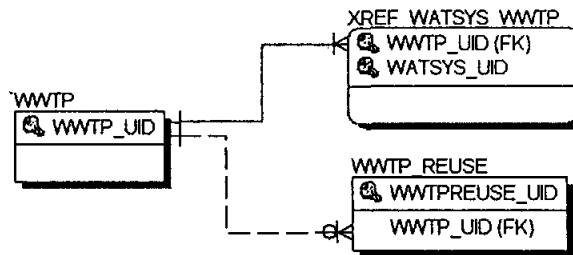RelationshipType: One-To-Many

ACCESS Database Tables

WWTP

Wastewater treatment plant information.

Column Name	Key	Unique	Req'd	Type	Size	Constraints	Description/Notes
WWTP_UID	PK	Yes	Yes	Number	Long Integer		Application-generated unique identifier of a wastewater treatment plant. (sequential number)
WWTP_NAME		No	Yes	Text	40		Name of wastewater treatment plant.
WWTP_PERMIT_NO		No	Yes	Text	18		Texas/TPDES permit number of wastewater treatment plant.
WWTP_LATITUDE		No	No	Number	Single (4)		Latitude of wastewater treatment plant in decimal degrees.
WWTP_LONGITUDE		No	No	Number	Single (4)	Validation Rule: <0	Longitude of wastewater treatment plant in decimal degrees.
WWTP_YR_AVG_ DAILY_FLOW		No	No	Number	Decimal (3)		Annual average daily flow in millions of gallons per year (Mgal/yr).
WWTP_MINMO_ AVG_DAILY_FLOW		No	No	Number	Decimal (3)		Average daily flow for minimum flow month in millions of gallons per year (Mgal/yr).
WWTP_REUSE		No	Yes	Yes/No		Format: Yes/No	Flags if the wastewater treatment plant produces treated water for reuse.
WWTP_REUSE_ TREATMENT_TYPE		No	Yes	Text	2	Validation Rule: In ('I','II')	Type of wastewater treatment: I, II - if applicable.
MODIFIER		No	Yes	Text	3		Initials of last person to modify record.
DATE_LAST_MOD		No	Yes	Date/Time		Format: Short Date	Date of last modification to record.

Relationships

XREF_WATSYS_WWTP
- WWTP_UID (FK)
- WATSYS_UID

WWTP
- WWTP_UID

WWTP_REUSE
- WWTPREUSE_UID
- WWTP_UID (FK)

WWTP_REUSE

A WWTP can have zero, one, or many WWTP_REUSE records.
A WWTP_REUSE is recorded for one and only one WWTP.

Attributes: Enforced
RelationshipType: One-To-Optional Many

WWTPXREF_WWTP_WATSYS

A WWTP can be associated with zero, one or many WATSYSs as shown in XREF_WWTP_WATSYS.
A record in XREF_WWTP_WATSYS can be associated one and only one WWTP.

Attributes: Enforced
RelationshipType: One-To-Many

ACCESS Database Tables

WWTP_REUSE (CONTINUED)

LUT_YEARWWTP_REUSE An LUT_YEAR can be related to zero, one or many WWTP_REUSE records.
A WWTP_REUSE record can have one and only one LUT_YEAR for which the data was collected.

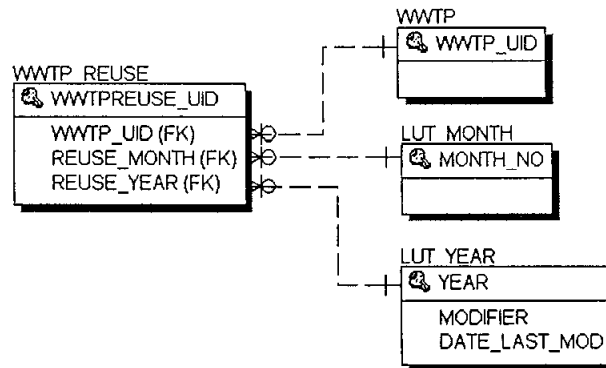Attributes: Enforced
RelationshipType: One-To-Optional Many

ACCESS Database Tables

WWTP_REUSE
Wastewater treatment plant reuse information and history.

Column Name	Key	Unique	Req'd	Type	Size	Constraints	Description/Notes
WWTPREUSE_UID	PK	Yes	Yes	AutoNumber	Long Integer		System-generated unique identifier for wastewater treatment plant reuse history. (sequential number)
WWTP_UID		No	Yes	Number	Long Integer		Foreign key to WWTP table. Identifier wastewater treatment plant for which this information is associated.
REUSE_MONTH	FK	No	Yes	Text	9	Default Value: 'DECEMBER'	Foreign key to LUT_MONTH table. Month of the year through which the amount of reuse is valid.
REUSE_YEAR	FK	No	Yes	Number	Long Integer		Foreign key to LUT_YEAR. Year for which data (amount of reuse) is compiled.
REUSE_AMT		No	Yes	Number	Single (3)		Amount of reuse in millions of gallons per day (Mgal/day).
MODIFIER		No	Yes	Text	3		Initials of last person to modify record.
DATE_LAST_MOD		No	Yes	Date/Time	8	Format: Short Date	Date of last modification to record.

Relationships

WWTPWWTP_REUSE

    A WWTP can have zero, one, or many WWTP_REUSE records.
    A WWTP_REUSE is recorded for one and only one WWTP.

    Attributes: Enforced
    RelationshipType: One-To-Optional Many

LUT_MONTHWWTP_REUSE

    An LUT_MONTH can be related to zero, one or many WWTP_REUSE records.
    A WWTP_REUSE record can have one and only one LUT_MONTH for which the data was collected.

    Attributes: Enforced
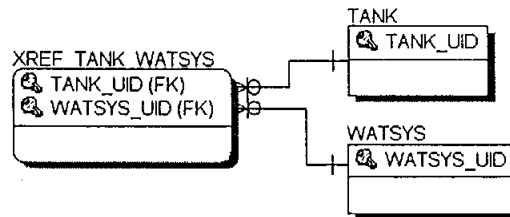   RelationshipType: One-To-Optional Many

ACCESS Database Tables

XREF_TANK_WATSYS
Cross-reference table between TANK and WATSYS. Identifies which tanks are associated with which water systems.

Column Name	Key	Unique	Req'd	Type	Size	Constraints	Description/Notes
TANK_UID	PK FK	No	Yes	Number	Long Integer		Foreign key to TANK table. Tank with which the water system is associated.
WATSYS_UID	PK FK	No	Yes	Number	Long Integer		Foreign key to WATSYS table. Water system with which the tank is associated.
OWNER		No	Yes	Yes/No		Format: Yes/No	Flags if the given water system is the owner of the tank (or is the water system with which the tank is associated).
MODIFIER		No	Yes	Text	3		Initials of last person to modify record.
DATE_LAST_MOD		No	Yes	Date/Time		Format: Short Date	Date of last modification to record.

Relationships

TANKXREF_TANK_WATSYS

A TANK can be associated with zero, one or many WATSYSs as shown in XREF_TANK_WATSYS.
A record in XREF_TANK_WATSYS can be associated one and only one TANK.

Attributes: Enforced
RelationshipType: One-To-Many

WATSYSXREF_TANK_WATSYS

A WATSYS can be associated with zero, one or many TANKs as shown in XREF_TANK_WATSYS.
A record in XREF_TANK_WATSYS can be associated one and only one WATSYS.

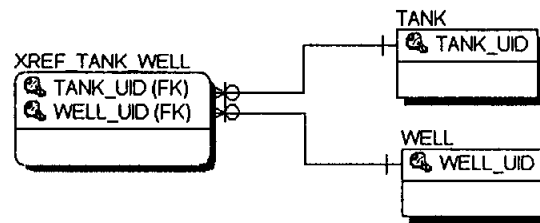Attributes: Enforced
RelationshipType: One-To-Many

XREF_TANK_WELL
Cross-reference table between TANK and WELL. Identifies which tanks are associated with which wells.

Column Name	Key	Unique	Req'd	Type	Size	Constraints	Description/Notes
TANK_UID	PK FK	No	Yes	Number	Long Integer	.	Foreign key to TANK table. Tank with which the water well is associated.
WELL_UID	PK FK	No	Yes	Number	Long Integer		Foreign key to WELL table. Well with which the tank is associated.
MODIFIER		No	Yes	Text	3		Initials of last person to modify record.
DATE_LAST_MOD		No	Yes	Date/Time		Format: Short Date	Date of last modification to record.

Relationships

TANKXREF_TANK_WELL

A TANK can be associated with zero, one or many WELLs as shown in XREF_TANK_WELL.
A record in XREF_TANK_WATSYS can be associated one and only one TANK.

Attributes: Enforced
RelationshipType: One-To-Many

WELLXREF_TANK_WELL

A WELL can be associated with zero, one or many TANKs as shown in XREF_TANK_WELL.
A record in XREF_TANK_WELL can be associated one and only one WELL.

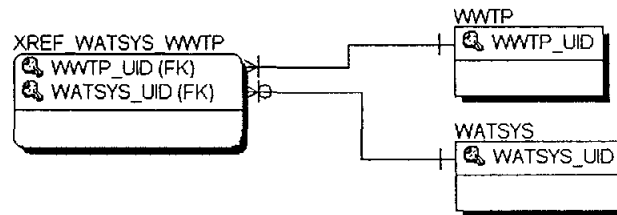Attributes: Enforced
RelationshipType: One-To-Many

ACCESS Database Tables

XREF_WATSYS_WWTP

Cross-reference table between WATSYS and WWTP. Identifies which water systems are associated with which wastewater treatment plants.

Column Name	Key	Unique	Req'd	Type	Size	Constraints	Description/Notes
WWTP_UID	PK FK	No	Yes	Number	Long Integer		Foreign key to WWTP table. Wastewater treatment plant with which the water system is associated.
WATSYS_UID	PK FK	No	Yes	Number	Long Integer		Foreign key to WATSYS table. Water system with which the wastewater treatment plant is associated.
OWNER		No	Yes	Yes/No		Format: Yes/No	Flags if the given water system is the owner of the wastewater treatment plant (or is the water system with which the wastewater treatment plant is associated).
REUSE_INTEREST		No	Yes	Text	1	Validation Rule: In ('Y','N','U')	Flags if district/service area is interested in participating in a wastewater treatment and reuse program for this wastewater treatment plant: Y=Yes, N=No, U=Unknown.
MODIFIER		No	Yes	Text	3		Initials of last person to modify record.
DATE_LAST_MOD		No	Yes	Date/Time		Format: Short Date	Date of last modification to record.

Relationships

WATSYSXREF_WWTP_WATSYS   A WATSYS can be associated with zero, one or many WWTPs as shown in XREF_WWTP_WATSYS. A record in XREF_WWTP_WATSYS can be associated one and only one WATSYS.

Attributes: Enforced
RelationshipType: One-To-Many

WWTPXREF_WWTP_WATSYS   A WWTP can be associated with zero, one or many WATSYSs as shown in XREF_WWTP_WATSYS. A record in XREF_WWTP_WATSYS can be associated one and only one WWTP.

Attributes: Enforced
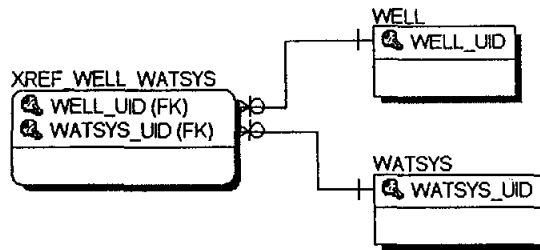RelationshipType: One-To-Many

ACCESS Database Tables

XREF_WELL_WATSYS
Cross-reference table between WELL and WATSYS. Identifies which wells are associated with which water systems.

Column Name	Key	Unique	Req'd	Type	Size	Constraints	Description/Notes
WELL_UID	PK FK	No	Yes	Number	Long Integer		Foreign key to WELL table. Water well with which the water system is associated.
WATSYS_UID	PK FK	No	Yes	Number	Long Integer		Foreign key to WATSYS table. Water system with which the water well is associated.
MODIFIER		No	Yes	Text	3		Initials of last person to modify record.
DATE_LAST_MOD		No	Yes	Date/Time		Format: Short Date	Date of last modification to record.

Relationships

WATSYSXREF_WELL_WATSYS   A WATSYS can be associated with zero, one or many WELLs as shown in XREF_WELL_WATSYS. A record in XREF_WELL_WATSYS can be associated one and only one WATSYS.

Attributes: Enforced
RelationshipType: One-To-Many

WELLXREF_WELL_WATSYS   A WELL can be associated with zero, one or many WATSYSs as shown in XREF_WELL_WATSYS. A record in XREF_WELL_WATSYS can be associated one and only one WELL.

Attributes: Enforced
RelationshipType: One-To-Many