Well Sampling for Aquifer Biota

Monitoring Plan

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1.0 INTRODUCTION

The Edwards Aquifer Authority (the Authority) is a political subdivision of the State of Texas and was created by the Texas Legislature to replace the Edwards Underground Water District. Governed by a board of directors, elected by popular vote, the Authority is empowered to manage, conserve, preserve, and protect the San Antonio portion of the Balcones Fault Zone Edwards Aquifer.

The Authority has undertaken a comprehensive program for the study and management of the aquifer. This program, known as the Edwards Aquifer Optimization Program (EAOP), consists of a series of interrelated, mission-directed hydrogeologic and biological research studies designed to evaluate potential technical options for increasing the amount of water stored in the aquifer and identify various methods for optimizing the amount of water available for withdrawal. Data and information obtained from these studies will provide aquifer managers with the tools necessary to make scientifically-sound decisions to benefit aquifer users and preserve the environment supported by the aquifer, including the Comal and San Marcos Springs and downstream aquatic habitats. An EAOP Technical Advisory Group (TAG) has been assembled to provide necessary input for studying these issues. TAG consists of subgroups, including a Biological Assessment subgroup, consisting of representatives from the South Central Texas Water Advisory Committee, federal, state, regional, and local entities.

The Authority is also formulating a regional Habitat Conservation Plan (HCP). Data collected from components of the EAOP will be incorporated into the HCP. The HCP will be submitted to the United States Fish and Wildlife Service (FWS) for approval and subsequent granting of a Section 10A permit.

The Well Sampling of Aquifer Biota Study (the Study) is one of 17 studies identified in the EAOP. It was formulated to address the need for more expanded and updated information regarding subterranean aquifer-dwelling organisms. Thirty-seven species of these organisms have been collected from the portion of the aquifer regulated by the Authority. Thirty-three species are invertebrates, such as amphipods, snails, and flatworms. The amphipods and snails are the most diverse groups of all species collected to date. The invertebrates are widely distributed throughout the aquifer. Four species of subterranean vertebrates have been collected. They include two fish species and two salamander species. They exhibit a much more limited distribution than do the invertebrates. Subsequently, both fish species, the widemouth blindcat (*Satan eurystomus*) and the toothless blindcat (*Trogloglanis pattersoni*) are listed as threatened by the Texas Parks and Wildlife Department. The United States Fish and Wildlife Service lists one salamander species, the Texas blind salamander (*Eurycea rathbuni*), as endangered. No subterranean invertebrate species are listed.

The subterranean aquifer-dwelling organisms have generated substantial interest in the scientific community because of their unique biology, distribution patterns, phylogenetic relationships, and evolutionary history. Limited information about their abundance, distribution, population trends, and other life history information has been developed.

Dr. Glenn Longley, his research associates, and graduate students performed the last comprehensive survey of these organisms in 1979. New information about these organisms will support better-informed decisions regarding aquifer management.

In November 2000, the Authority entered into a contract with Southwest Texas State University (SWTSU) through its Edwards Aquifer Research and Data Center (EARDC). The contract stipulates that EARDC shall develop a comprehensive Monitoring Plan (the Plan) for sampling locations across the aquifer so as to meet the specific objectives and desires of the Authority, its EAOP, and the HCP. The purpose of this document is to function as the Plan for the Study as funded by the Authority. The Plan provides a simple, concise document that outlines procedures and protocols that will allow researchers to fully implement the Study upon the Authority's review and approval of the Plan. It is understood that, depending upon results and future developments, through time the Plan may be further modified, with approval of the Authority. Modifications may be required to facilitate implementation and completion of the Study and will be documented in required quarterly progress reports and the final report.

2.0 PLAN OBJECTIVES

Develop a comprehensive Monitoring Plan for addressing the need for new, expanded data and information regarding the subterranean aquifer-dwelling organisms of the San Antonio portion of the Balcones Fault Zone Edwards Aquifer. In preparation for developing the Plan, the Contractor (EARDC) shall determine points (wells, springs, and caves) previously sampled, determine current owner/operators of these points, and contact them to assess their willingness to allow sampling of these points during the duration of the Study. EARDC shall also determine the approximate number and location of points not previously sampled that may be included in the Study. Contact will be made with these owner/operators to assess their willingness to participate in the Study. Using this preliminary information, EARDC shall develop the Plan and submit it for review and approval by the Authority prior to implementation of the Study.

The Plan as stipulated by Contract shall, at a minimum:

describe methods used to determine points sampled for aquifer-dwelling biota in 1979, and provide the number of such points tentatively available for re-sampling as part of the Study;

describe methods proposed to compare the newly-collected species population data to the previously-collected data;

describe the area proposed for sampling of points not previously sampled, to the extent possible throughout the entire aerial extent of the Edwards Aquifer, and provide the number of such points tentatively available for sampling as part of the Study;

describe mechanisms for establishing and maintaining working agreements with private well owner/operators for notification of sampling opportunities, such as during crop irrigation, and describe mechanisms by which EARDC shall be prepared to respond quickly to such situations;

describe mechanisms for establishing and maintaining working agreements with regional water purveyors for notification of sampling opportunities, such as when a pump is removed for maintenance from a flowing production well, or prior to installation of pumping equipment, and describe mechanisms by which the EARDC will be prepared to respond in a timely manner to such situations;

describe mechanisms by which monitoring wells constructed by San Antonio Water System for its Freshwater/Saline Water Interface Study may be sampled following completion of construction;

indicate a general schedule for sampling, indicating prioritization of certain types of wells at certain time periods (such as agricultural wells scheduled for sampling of

biota during the irrigation seasons and production wells scheduled for sampling of biota at other times);

describe net specifications and sampling methodology including: elimination of surface organisms from spring samples; placement and securement of nets on discharge pipes; length of sample times, etc.;

describe methodology for recording data and labeling specimens in accordance with applicable permits;

describe methodology for managing specimens, including transport, preservation, storage, curation, and deposition of specimens collected in appropriate museums in accordance with applicable permits, and including maintenance of live specimens, if any, in appropriate facilities, in accordance with applicable permits;

describe methodology to identify specimens collected and evaluate population and distribution data for *Satan eurystomus*, *Trogloglanis pattersoni*, *Eurycea rathbuni*, *Eurycea robusta* and any invertebrate species collected, comparing to previously-collected data; and

describe a tentative work plan and schedule to accomplish all tasks identified in the Contract to complete the Study.

3.0 WORK PLAN/TASKS SCHEDULE

Pending review and approval of the Plan, by the Authority, the Study will be implemented and is tentatively set to follow the schedule outlined below. EARDC anticipates the field portion of the Study will be completed in approximately 28 months. This will allow four to five months for completion of identification and enumeration of all organisms collected to date and associated analyses for inclusion into the final report. Generation and review, with comments, of the final report will occur during this period.

Initially, the first two months of the Study will entail ordering and gathering of equipment and supplies, manufacture of collection nets, and the continuation of seeking points for sampling. The search will be a continuous process throughout the length of the study. EARDC anticipates the initiation of sampling to commence at the end of the second month, if not sooner.

Sampling will be an ongoing process throughout the duration of the study. As described below (Section 5.0), sampling will rotate from area to area, approximately, on a weekly basis. Priority sampling will occur in the Bexar, Medina, and Uvalde counties during the pre-irrigation and irrigation seasons. Sampling emphasis will be placed on non-agricultural wells in the remaining areas of the aquifer at other times. At the end of one or two sampling periods (~ one – two weeks), all collected organisms will be transported to EARDC facilities for sorting, initial identification, and shipment to collaborators for further identification, if required, and analyses. Transportation of collected organisms to EARDC facilities will be dependent on the location of the area where sampling is occurring. Live organisms collected will be immediately transported to EARDC facilities. Supply replenishment, equipment maintenance, and administrative duties will be performed at regular intervals. EARDC anticipates that a minimum of three weeks of every quarter will be spent in non-field activities. Flexibility, for sampling on short notice or for sampling "one-time only" wells, will be maintained at all times.

Quarterly progress reports, special reports, a final report, and other items will be prepared as dictated by terms of the contract.

4.0 SAMPLING POINTS

The sampling program will be as comprehensive as possible for the entire extent of the aquifer. EARDC will attempt to sample as many points as possible during the length of this study. The intent of the Study is to collect organisms from all possible points. This will allow researchers to develop the quantitative data that is necessary to fulfill the objectives of the Study. Numbers of points will not be a quantitative component of the Study. Points will include wells, springs, and caves. All points must be physically accessible, produce appropriate volumes of water, and possess plumbing discharge designs conducive to sampling. Owner/operator permission must be received prior to sampling. A majority of points will be irrigation wells located in the counties of Bexar, Medina, and Uvalde. Previous studies found that these wells were the most feasible for collecting aquifer-dwelling organisms, due to their ability to produce large volumes of water. Numbers of points will most likely be in a state of flux during the Study. Owner/operators may decide to drop out of the Study, while others may decide to participate. Some points sampled in previous studies did not produce subterranean aquifer-dwelling organisms and it is anticipated that this will again hold true. EARDC plans to continually add points for sampling.

4.1 PREVIOUSLY SAMPLED POINTS

EARDC has determined previously sampled points, current owner/operatorship, and willingness of these owner/operators to participate in the Study. EARDC has utilized historic records of previous cooperators, to facilitate the search for points to sample for the Study. The owner/operators noted in these records are being contacted by telephone and asked for their consent to allow researchers access for sampling. The Authority has provided a script (Telephone Talking Points, Appendix A) to use during these conversations. Contact is also being attempted by mail or facsimile, as required. Appointments for site visits are being set with cooperating owner/operators, to determine if sampling is possible, by inspecting the system as a whole and specifically, the discharge plumbing design. Information regarding participants in the Study is recorded on Consent Form and Record sheets (Appendix B) and kept in a binder. If the owner/operatorship has changed, efforts are being made to determine current contacts to obtain permission for sampling access. A fact sheet (Appendix C) and accompanying map, generated by the Authority, is available for interested owner/operators. This sheet describes the aquifer, its associated fauna, and the Study. The previous sampling areas where some of the more important organisms were collected are identified.

Gaining access to sampling points for the Study is contingent upon fostering cooperative relationships with owner/operators.

4.2 NEW SAMPLING POINTS

While gaining access to the maximum number of previously sampled points, the search for new points will remain a high priority during the length of the Study. A list of initially permitted wells has been obtained from the Authority, containing contact

information for over 1,000 wells, including irrigation, industrial, municipal, and domestic or other exempt wells. EARDC has been seeking permission from these contacts, by telephone, to sample for the Study. Primary contact is by telephone. The Authority has provided a script (Telephone Talking Points) to use during these conversations. Contact has also been attempted by mail or facsimile, as required. Appointments for site visits are being set with cooperating owner/operators, to determine if sampling will be possible. Information regarding participants in the Study will be recorded on Consent Form sheets and kept in a binder.

EARDC is in contact with the Authority for updates to the list and suggested new points that might be included in the Study. Contact with well owner/operators through referrals from the Texas Agriculture Extension Agency, the Texas State Health Department, the Texas Natural Resource Conservation Commission, the United States Natural Resource Conservation Service, the United States Geologic Survey, river authorities, groundwater conservation districts, and other entities are an ongoing process throughout the length of the Study.

A fact sheet and accompanying map, generated by the Authority, is made available to interested owner/operators. This describes the aquifer and it's associated fauna. Brief mention is made regarding the sampling area and some of the more important organisms previously collected.

Gaining access to sampling points for this study is contingent upon fostering cooperative relationships with owner/operators.

4.3 ACCESS TO SAMPLING POINTS BY COOPERATION WITH SPECIFIC OWNER/OPERATORS

EARDC is familiar with the various agencies currently doing well studies and will coordinate sampling activities with their work. For example, the San Antonio Water System (SAWS) is currently drilling or reworking a network of 52 monitoring wells, transecting the freshwater/saline water interface zone in geologically important portions of the aquifer. The Authority has an Interlocal Cooperation Contract (ICC) with SAWS. The ICC (Appendix D) provides joint funding, by the Authority and SAWS for this network of monitoring wells. The ICC entitles Authority staff and contractors to sample these wells following completion of construction. Continued sampling of these wells, with the cooperation of SAWS, is anticipated. EARDC will establish a working agreement with SAWS to reach this goal.

EARDC has strong working relationships with many of the regional industrial and municipal water users, including water purveyors such as the Bexer Metropolitan Water District (BexarMet). A number of the wells owned and/or operated by these entities are artesian or flowing wells. Sampling could be done on many of these wells during maintenance events or on newly completed wells while they are being tested. EARDC will coordinate sampling activities with these entities.

EARDC will work quickly, in the initial stages of gaining access to points for sampling, to establish working agreements with owner/operators of these types of wells. EARDC will employ a full-time Research Associate (RA) for sampling away from the San Marcos area. The RA will maintain regular contact, using telephone, e-mail, conventional correspondence, facsimile, and site visits, with owner/operators. This will facilitate sampling of the wells in the SAWS network, the important agricultural wells operated during the irrigation season in the western counties of Uvalde, Medina, and Bexar, or the industrial and municipal (water purveyors) wells during periods of well testing or pump servicing.

The RA will work primarily out of the San Antonio metropolitan area. As this is a centralized location to the region, RA will be able to respond, on short notice, to opportunities for sampling.

One goal of the Study, is to sample all participating wells on a regular basis, while being flexible for sampling "one-time only" wells. Great effort will be made to avoid missing sampling opportunities.

4.4 PROSPECTIVE SAMPLING POINTS

Currently, EARDC has been granted access to 49 sampling points (See sampling point locator map, Fig. 1):

eight in Hays County;

three in Comal County;

one in Guadalupe County;

two in Atascosa County;

fifteen in Bexar County;

nine in Medina County;

ten in Uvalde County; and

one in Kinney County.

These points include industrial, municipal, and irrigation wells, as well as springs and caves. These numbers will continue to be tentative until completion of the study. The map will be updated as access to sampling points is granted.

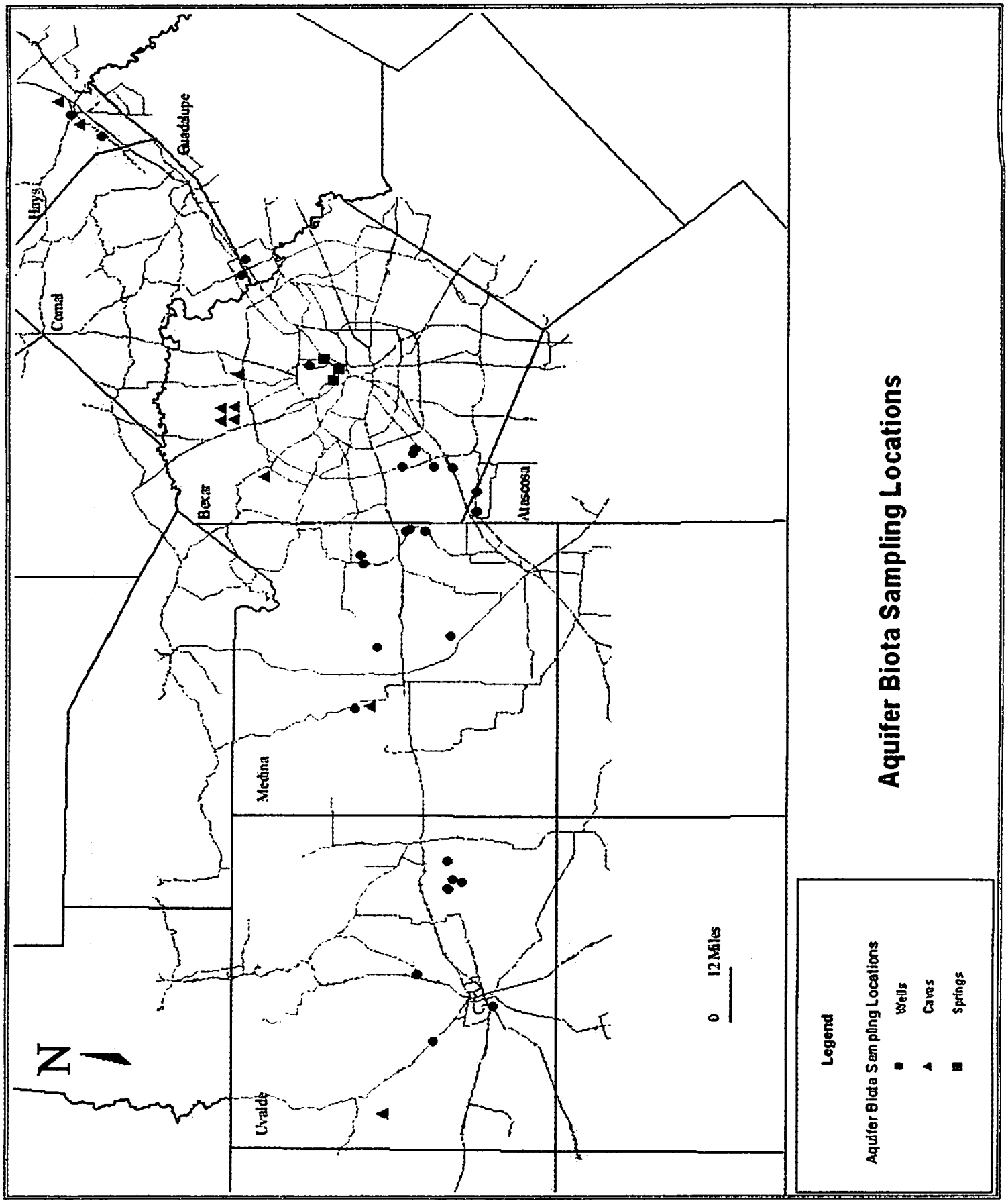

Fig. 1. Sampling Point Locater Map. (Adapted from the Authority)

5.0 SAMPLING

The aquifer will be divided into four sampling areas. The areas are set up to facilitate sampling. The areas roughly coincide with the five main counties of the aquifer region. These counties are Uvalde, Medina, Bexar, Comal, and Hays. Sampling locations in Hays and Comal counties will be grouped together. These two counties have historically had few sampling locations. EARDC plans to sample in each of the areas a minimum of eight weeks per year. A rotating schedule will be used, whereby EARDC will switch areas every week. Sampling in the western counties, Uvalde, Medina, and Bexar, will be a priority during the irrigation season. In Hays County, sampling will be nearly continuous at SWTSU artesian well and at the "Diversion Spring" at San Marcos Springs. Each point, mainly wells, in a specific area will be sampled continuously for four to five days. At the end of this period, sampling efforts will be transferred to a new area. Each well being sampled will be visited daily during the sampling period. Multiple visits to various wells will occur on a rotating basis, depending on time and distance concerns. This will facilitate checking nets as frequently as possible to assure organisms are removed and preserved shortly after collection occurs. This will insure collection of fresh or even live organisms and will serve to avoid damage and degradation from exposure to prolonged flow or other organisms. Springs will be sampled, if possible, by placing PVC pipe of various lengths and diameters into the spring orifice. Collection nets will be attached in a similar fashion to those on well discharges. Great effort will be made to eliminate surface organisms from collections. Divers will sample to the extent possible in caves, and water storage tanks in cooperation with tank inspection teams. BexarMet has indicated this as a possibility.

5.1 SAMPLING DEVICES

EARDC has experienced numerous sampling situations and has designed sampling schemes for each as they presented themselves. The key to such sampling is flexibility and adapting appropriate techniques to the situation. EARDC will be responsive to various situations that may present themselves by having a variety of nets of different shapes and lengths. This will allow field workers to adapt to various sampling situations. The differing shapes and lengths of nets are required to aid in dispersing various volumes of flow.

In general the following characteristics will apply to the nets (Fig. 2). Nets will be constructed of 500μ mesh nylon material. This mesh size was used in previous studies. They will have a diameter between six and thirty inches. They will be tapered or conical, with a length of between six and twelve feet long. Some nets will be constricted for some portion of their lengths. A removable sampling cup constructed from threaded PVC fittings will be at the end of all nets. Nets will be attached to the discharge plumbing of a well. Secure attachment will be obtained by using stainless steel hose clamps or nylon cable ties. This will facilitate collection of organisms without removing the nets from the discharge. The sample cup will have a cutout covered with the netting material to allow for flow through the cup. Placement of the nets during collection is an important

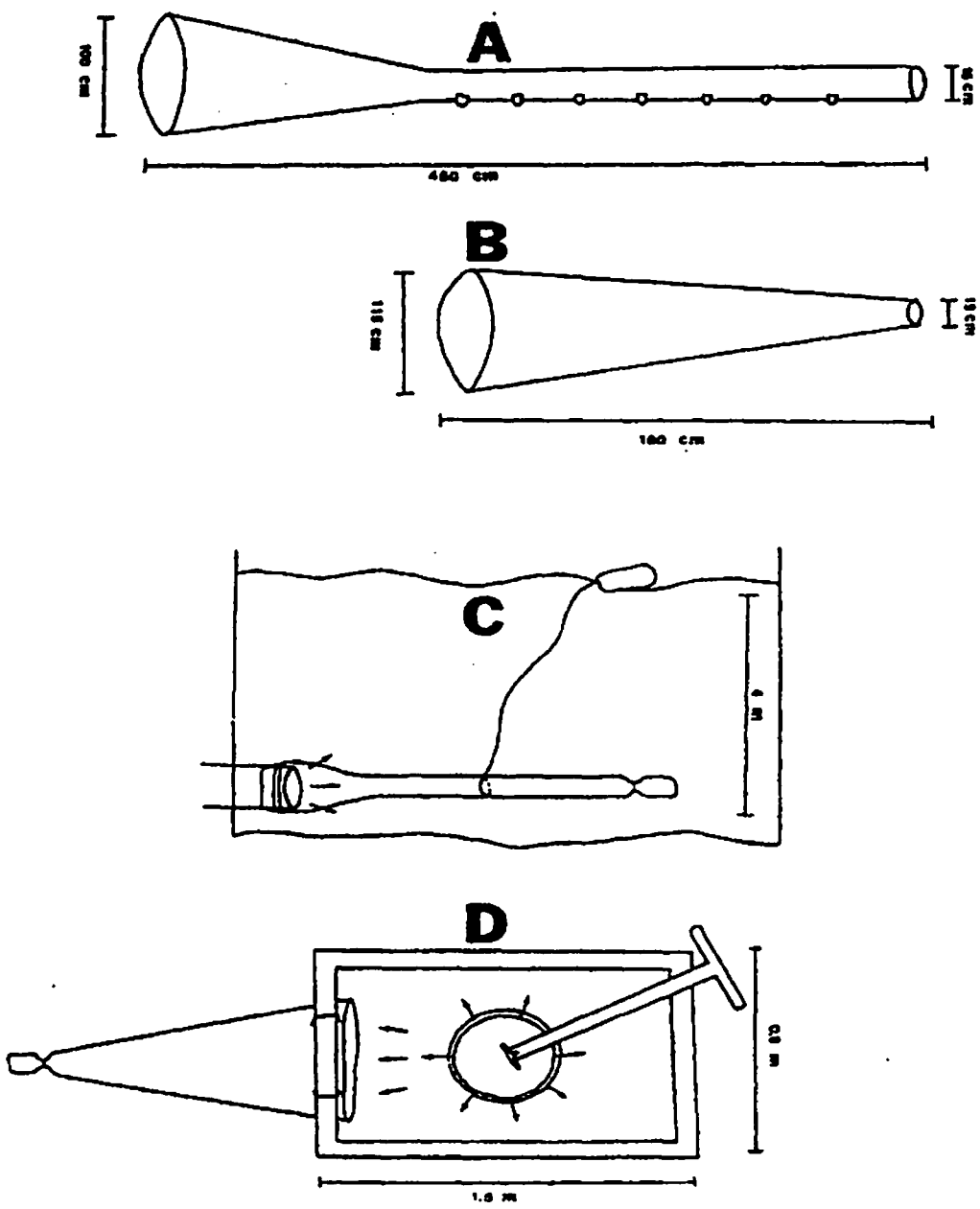

Fig. 2. General Schematic of Collection Nets and Attachment. (Adapted from Karnei.)

consideration. Efforts to totally immerse the nets in the well discharge are required to prevent collected organisms from being damaged or desiccated.

5.2 SAMPLE PRESERVATION

Approximately 90% of vertebrate organisms collected, if not alive, will have their livers removed and frozen for genetic analyses. The remainder of the organism will be preserved in 10% formalin. The remaining 10% of organisms collected will be preserved for stable isotope assays, as appropriate.

At least 70% of invertebrate specimens collected will be placed in 95% ethanol. Thirty percent (up to 40 individuals) of the collected organisms will be frozen for genetic analyses.

Live vertebrate organisms will be transported, held, and treated in accordance with the requirements of all state and federal collecting permits. These organisms will be held at EARDC facilities, collaborators' facilities, or facilities stipulated by terms in collecting permits. These locations may include the San Marcos National Fish Hatchery and Technology Center, the Dallas Aquarium, the Cincinnati Zoo, or the Texas Memorial Museum at the University of Texas in Austin.

5.3 SAMPLE LABELING, HANDLING, AND CURATION

Labels and data recording will be in accordance with the requirements of all state and federal collecting permits. All collected materials will be transported to EARDC facilities for analyses

Labels will be placed with all collected organisms denoting:

Collector;

Date and time collected;

Collection point; and

Preservative.

The collected organisms will be stored at Southwest Texas State University after sorting unless they are in a group that will be sent to a specific collaborator for further study and identification. Reference and type organisms will be placed in various museums. These will include the Texas Memorial Museum at the University of Texas, the National Museum of Natural History in Washington D.C., and other associated museums and collections as appropriate for the particular taxonomic group. Records of specimen location and museum identification number will be carefully maintained. A database and accession system conducive to the classical and genetic identification of organisms, data analysis, and report generation will be established.

5.4 OTHER COLLECTED DATA

Detailed field notes, chronicling the sampling event will be maintained. Information will include:

Owner/operator contact information;

Directions to sampling points;

Global Positioning System Coordinates;

Well characteristics, if available, such as depth, flow, drilling logs, etc.;

Date and time of sampling and duration; and

Flow rate, if available;

Physicochemical parameters will be measured and recorded, if possible, including:

Temperature;

Dissolved oxygen;

Specific conductivity; and

pH

6.0 ANALYSES AND INTERPRETATION

Primary analyses will be identification and numeration of all organisms collected. Since many of the aquifer organisms collected during this study have already been described, EARDC staff will easily identify most forms found in the samples. Organism identification will follow classic protocols. Morphological characteristics will be the primary sources for identification. Identification will occur at EARDC facilities or facilities used by collaborators. Organisms will be identified to the lowest possible taxonomic level.

Identification of collected organisms will be facilitated by the use of cooperative collaborators. EARDC has reached agreement with several collaborators who are recognized experts on identification of organisms expected to be collected from the aquifer. They include:

Dr. Robert Hershler (Department of Invertebrate Zoology, National Museum of Natural History, Smithsonian Institution);

Dr. John Holsinger (Professor of Biological Sciences and Eminent Scholar, Old Dominion University);

Dr. Dean Hendrickson (Professor, Section of Integrative Biology, University of Texas, Curator of Ichthyology, Texas Memorial Museum);

Dr. Tom Iliffe (Professor of Marine Biology, Texas A&M University-Galveston);

Mr. James Reddell (Curator of Non-Arthropod Invertebrates, Texas Memorial Museum);

and their staffs.

Other collaborators will be used as required.

Total numbers of each collected taxon will be determined and used, when possible, with volume of water sampled to estimate population characteristics. These estimates will be compared to estimates generated by previous studies. Comparisons will be limited due to lack of complete data sets from previous studies. Population estimates generated from genetic analyses are expected to supplement these comparisons.

In addition to classic morphological identification, DNA sequencing techniques will be employed to provide genetic identification. These techniques will supplement the traditional morphological identification process and allow researchers to determine unique species "fingerprints". Methods used can be found in *Molecular Systematics* (1996), edited by Dr. David Hillis (Professor, Section of Integrative Biology, Director of School of Biological Sciences, University of Texas). Sequencing will involve large (16S) or small (12S) rRNA genes as well as mitochondrial cytochrome b. Once a technique has

been developed to characterize that species, it becomes a relatively simple task to identify many samples. The time required for identification using genetic techniques is minimal compared to the effort it takes to examine morphological characteristics. Another advantage to using these techniques is that organisms at early life stages or those destroyed by pumps or pressure changes can be identified.

These genetic studies will also be used to test hypotheses of specific genetic communication between various well, spring, and cave locations in the Aquifer. When this genetic communication is interpreted in a hydrogeologic framework, hypotheses concerning population characteristics may be made. Analyses will assess genetic diversity, distribution, and hydrogeology to possibly determine linkages within the aquifer. For example, a hypothetical species taken from two widely separated wells, displaying high levels of genetic similarity between the collected organisms might support a hypothesis of hydrologic communication between the two sites and be indicative of continuous habitat for the species. In another example, a large amount of specific genetic variation at only a single sampling site may indicate the presence of a large population.

Overlaying species locality information onto subterranean flowpaths and basins will allow for hypotheses about the entire ranges of species, although there may be only a small number of organisms collected or they may have only been collected at only a few sites. By interpreting species distribution data in a hydrological framework, a more accurate, interdisciplinary picture of ranges of the aquifer organisms and insights into their habitats and factors controlling their distributions might be obtained.

7.0 QUALITY ASSURANCE/QUALITY CONTROL

For all sampling, data collection, analyses, interpretation, and reporting, a quality assurance/quality control (QA/QC) program to insure reliability is employed, as delineated throughout the Plan. EARDC will coordinate the overall QA/QC for the Study.

8.0 REPORTING

Quarterly progress reports will be submitted to the Authority outlining Study activities for the previous time period.

An annual summary report will be submitted to the Authority highlighting activities for the previous year. Sufficient tables, graphs, and exhibits will be provided in the document to clearly indicate data collected and its analyses, along with appropriate interpretation.

Upon evaluation of each annual report, the Plan and the Study, may be modified as needed. Modifications will have to be submitted to the Authority for review and approval, prior to implementation. Sampling and data collection will proceed with no interruption.

The final report will describe in detail the Study data, analyses, and interpretation in total.

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APPENDICES

APPENDIX A – TELEPHONE TALKING TIPS

APPENDIX B – CONSENT FORM AND RECORD

APPENDIX C – FACT SHEET

APPENDIX D – INTERLOCAL COOPERATION CONTRACT

APPENDIX A – TELEPHONE TALKING TIPS

TELEPHONE TALKING POINTS

EDWARDS AQUIFER WELL BIOTA STUDY

Good Morning/Evening, Mr. Mrs. _____. My name is John Burch. I'm a research biologist at Southwest Texas State University (SWT). SWT has been contracted by the Edwards Aquifer Authority (the Authority) to conduct a three-year study to collect, identify, and count organisms found in the Edwards Aquifer.

The Edwards Aquifer is known to have 37 different species of organisms living within it. The U.S. Fish & Wildlife Service (USFWS) lists the Texas blind salamander, found only in Hays County. as "endangered," and the Texas Parks & Wildlife Department lists the widemouth blindcat and the toothless blindcat catfishes, found only in Bexar County. as "threatened." The Authority's purpose for this study is to expand the current knowledge of the Edwards Aquifer and its organisms using new, biological technologies.

New biological techniques, such as genetic testing, will be utilized to estimate the relative size, structure and distribution of organism populations within the aquifer. The data will be used to help determine possible inter-connections within the aquifer and the functions of the subterranean ecosystem. The study is designed to collect organisms from the Edwards Aquifer through caves, springs and during the normal operation of wells.

Right now I am making initial contacts with well owner/operators, to see if they will allow SWT to sample their wells during the next three years. Some of the people I am contacting have previously allowed their wells to be sampled. If you have an irrigation well, we would like to sample the well while it is being pumped during the irrigation season. If you have a municipal or industrial well, we would like to sample it during normal operations. If the well is a flowing artesian well, we would like to sample it during the service period.

Participation in this study is strictly voluntary.

I can answer any questions that you might have on the biology or the study. However, if you have any questions on aquifer management or policy, I will need to refer you to the Authority.

Questions?

APPENDIX B – CONSENT FORM AND RECORD

Consent Form

Owner Name: _____ Contact Name: _____

EAA Docket # (Ac-Ft): _____ Contact Phone #: _____

Contact Address: _____

City: _____

Well ID #: _____ Zip Code: _____

Other Phone: _____

Date Consent Obtained: _____

Location/Directions/Comments: _____

APPENDIX C – FACT SHEET

EDWARDS AQUIFER AUTHORITY

EDWARDS AQUIFER WELL BIOTA STUDY

The Edwards Aquifer Authority has engaged a team of researchers, headed by Southwest Texas State University (through its Edwards Aquifer Research and Data Center), to identify and locate potential caves, springs and wells to sample for subterranean Edwards Aquifer organisms. The purpose of the research is to expand the current database using new biological technologies to gain more insight into the Edwards Aquifer ecosystem. This study will collect different subterranean aquatic species and estimate the relative size, structure and distribution of their populations within the aquifer.

The Edwards Aquifer is one of the most permeable and productive aquifers in the United States. The Balcones Fault Zone portion of the aquifer in the San Antonio region extends from the groundwater divide near Brackettville in Kinney County (west of San Antonio and Bexar County) northeast to the groundwater divide near Kyle (Hays County), a distance of about 180 miles. The aquifer is the water source for approximately 1.7 million people in the region and is also a major resource for agricultural and industrial interests. In addition, aquifer discharges from Comal Springs and San Marcos Springs provide surface water for downstream interests and aquatic habitat for a number of terrestrial and aquatic species in the Guadalupe River basin.

During previous studies, the Edwards Aquifer was found to support an extensive array of subterranean aquatic organisms (Fig. 1, on back). Various caves, springs and wells have been sampled throughout the Edwards Aquifer Authority's jurisdictional area. Currently, there are 37 species known to live within this portion of the Edwards Aquifer. Of these 37 subterranean species, only four are vertebrates (animals with a backbone): the widemouth blindcat, the toothless blindcat (southern Bexar Co.), the Texas blind salamander and the Blanco blind salmander (San Marcos area, Hays Co.). The U.S. Fish and Wildlife Service lists the Texas blind salamander as "endangered". The State of Texas lists the widemouth blindcat and the toothless blindcat as "threatened". However, other than a 1979 study conducted by Southwest Texas State University and some localized follow-up work, very little research has been done on the Edwards Aquifer ecosystem.

Participation by public entities, as well as private landowners, in this aquifer biota study is voluntary, encouraged and essential for success. If you have any further questions, please contact:

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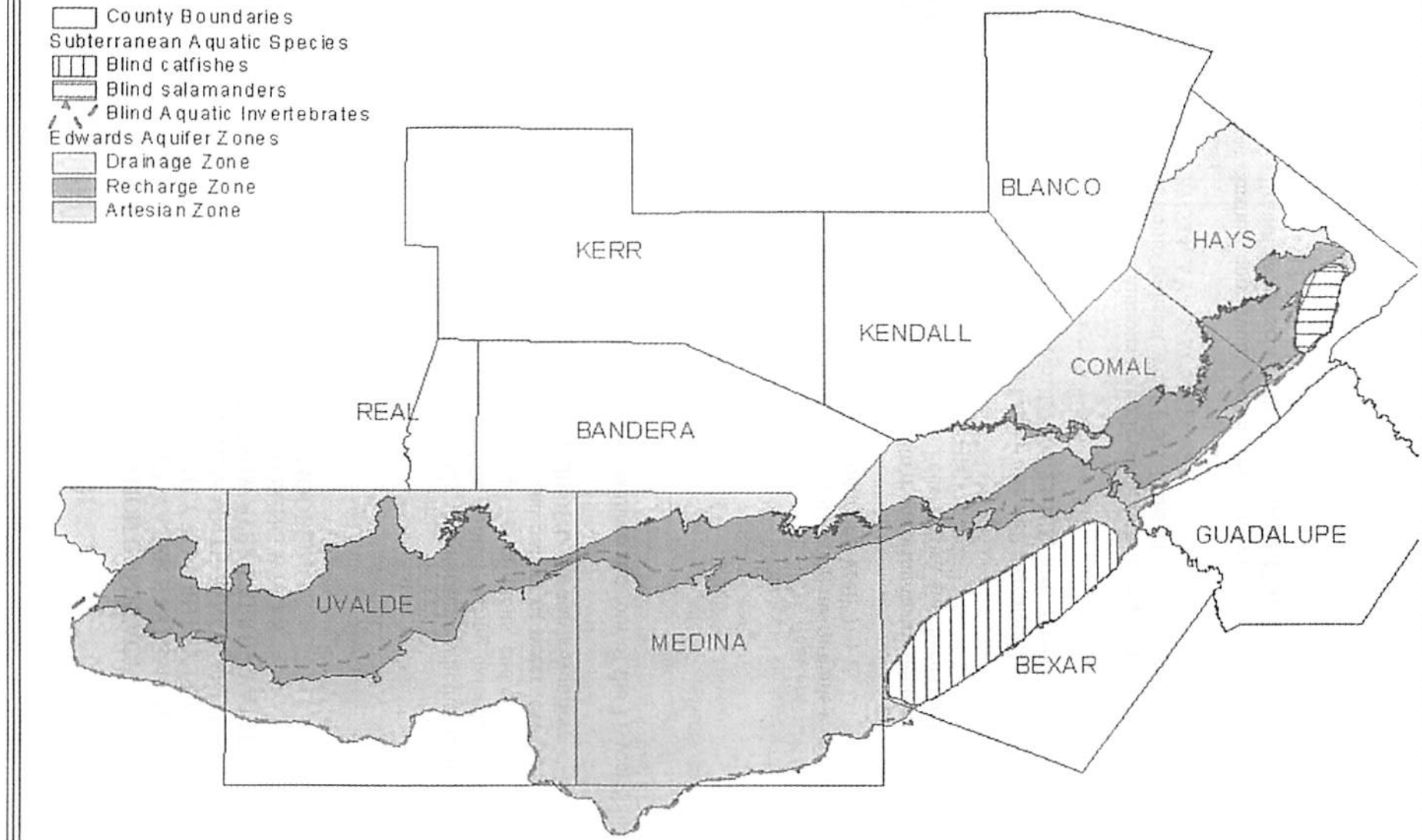

EXHIBIT A
TO
INTERLOCAL COOPERATION CONTRACT
BETWEEN THE SAN ANTONIO WATER SYSTEM AND
THE EDWARDS AQUIFER AUTHORITY TO JOINTLY FUND THE
CONSTRUCTION, OPERATION, MAINTENANCE AND USE
OF EDWARDS AQUIFER FRESHWATER/SALINE WATER
INTERFACE MONITORING WELLS
AND AQUIFER MODELING

Scope of Work
March 10, 2000

SAWS is conducting an 11-year Saline Water Study to determine whether saline water could encroach into the freshwater portion of the Edwards Aquifer during extended drought periods. This will be accomplished by obtaining dynamic, static, continuous, and/or real time hydrologic information necessary to understand the flow paths and impact of water level reductions in the saline zone, on the major springs, and municipal wells of the Edwards Aquifer.

The work described below will be performed in years three and four of the 11-year Saline Water Study, based upon SAWS' fiscal years.

SAWS shall be responsible for the following tasks:

Task Name	Task Description
Tri-County #5:	Drill, test, log and equip with monitoring instruments a data gathering well in Comal County (the "Tri-County #5 Well")
Fish Hatchery #1 and #2:	Drill, test, log and equip with monitoring instruments two data gathering wells near the San Marcos Federal Fish Hatchery (the "Fish Hatchery #1" and "Fish Hatchery #2" Wells)
Fish Hatchery #105:	Rework, test, log, and equip one well near the San Marco Federal Fish Hatchery (Well No. DX-68-23-105, also referred to as "Fish Hatchery #105")
SA Transect WO:	Install continuous water level monitoring equipment on three San Antonio transect wells ("SA Transect" Well Nos. AY-68-37-521, AY-68-37-524, AY-68-37-526)
NB Transect WO:	Install continuous water level monitoring equipment on three New Braunfels transect wells ("NB Transect" Well Nos. DX-69-23-616A, DX-68-23-618, DX-68-23-619)