
Bureau of Reclamation Report to Congress

Tularosa Basin National Desalination Research Facility Study



This report was prepared for the U. S. Bureau of Reclamation by:

**Sandia National Laboratories
Albuquerque, New Mexico**

September 2002

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Report to Congress**

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FOREWORD

In the U.S. Senate Report 107-39 (accompanying S.1171 ENERGY AND WATER DEVELOPMENT APPROPRIATION BILL), the *Science and Technology, Desalination Research and Development Program* section provided \$1,000,000 to the Bureau of Reclamation “to complete a study to determine the most effective and efficient manner of, and to develop a technology progress plan to be used in, the development of a desalination research and development facility in the Tularosa Basin in New Mexico”. In this Senate report, the Bureau of Reclamation was instructed to consult with Sandia National Laboratories in the development of the technology and implementation plan and submit a report by the end of fiscal year 2002 to the Senate Committee on Appropriations outlining the development of desalination technology for the basin.

Based on this direction, the Bureau of Reclamation and Sandia National Laboratories coordinated the development of a Desalination Technology Research Plan, or roadmap identifying future research needed to reduce costs and accelerate the use of desalination technologies to improve the quality of life and availability of fresh water in water-scarce regions. In developing the Desalination Technology Research Plan, potential roles for a Tularosa Basin desalination research facility were considered that would enable the facility to effectively and efficiently support future desalination technology research and development. A study was undertaken to identify potential research opportunities, appropriate site locations, and the necessary site plans and research facilities needed to fully utilize the extensive and unique brackish water and renewable energy resources of the Tularosa Basin for future desalination research and development.

This document summarizes the basic elements of the Desalination Technology Research Plan being developed and how a Tularosa Basin desalination research facility could best support that plan. This report comprises the Tularosa Basin National Desalination Research Facility Study and includes the Tularosa Research Facility Executive Committee’s recommendations and alternatives analysis for the facility mission, location, conceptual design, site layout, anticipated costs and an organizational structure for management and operation. Additionally, ideas are provided to accelerate the design, construction, and initial operational capability of the facility.

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1. EXECUTIVE SUMMARY

In 2001, the Congress of the United States directed the Bureau of Reclamation, in cooperation with Sandia National Laboratories, to evaluate the potential for developing a desalination research facility in the Tularosa Basin of New Mexico. The role of the facility would be to help address the major technical, environmental, and economic desalination issues that prevent wider use of this technology to supplement increasingly limited sustainable fresh water supplies. To support of this legislation, the Bureau of Reclamation's Science and Technology Program worked with its Water Treatment Engineering and Research Group and Sandia to study establishing a desalination research facility in the Tularosa Basin to assess the cost and performance of innovative desalination technologies. Funding for the study was received in December 2001 and the study started in January 2002.

Study Background and Approach

An Executive Committee was formed to support the project and insure stakeholder involvement. Members of the Committee included experts in water resources, desalination, saline concentrate engineering, and renewable energy. Specifically, the Committee was comprised of representatives from the Bureau of Reclamation, Sandia National Laboratories, the U.S. Geological Survey, the Office of the New Mexico State Engineer, the New Mexico Water Resources Research Institute, and several southwestern municipal water utilities (El Paso, Phoenix, and Tucson). The Executive Committee provided insight into facility mission and research focus, site evaluations and recommendations, facility design to meet the identified mission, and operational and management structures needed to insure quality desalination research with national and international impact.

The Bureau of Reclamation and Sandia selected Livingston Associates of Alamogordo, to assist the Executive Committee in evaluating the basin's hydrology, conduct site planning and engineering, support facility layout and design, and conduct facility cost estimating. The company has experience in conducting desalination studies in the Tularosa Basin and has worked closely with local communities in the basin. To insure widespread availability of information on the feasibility study progress, Sandia coordinated with the New Mexico Water Resources Research Institute (WRRI) at New Mexico State University in Las Cruces to host the Executive Committee meetings and to post the information developed during the study on their web site. The WRRI provided a well-known, neutral, and easily accessible venue for the Executive Committee meetings and enabled easy public access to the meetings and the study information. The technical information posted included background information on the study goals and objectives, information on identified roles and missions of a Tularosa Basin facility, presentations of the facility given to various groups and organizations, and Executive Committee meeting minutes and study reports.

The Executive Committee met monthly from January 2002 through August 2002. Activities included tours of the Tularosa Basin to see potential site locations and a tour of pilot desalination plant operation in the Tularosa Basin. The tours provided the Executive Committee with an understanding of the topography and geology of the basin, available resources, and possible facility locations. The Executive Committee meetings identified potential roles and missions of a Tularosa Basin desalination research center, established recommended research directions relative to other national research centers, identified optimum facility site locations, and developed a recommended facility design to optimize use of the facility for its identified desalination research and development role.

Identified Facility Mission and Role

An associated technology roadmapping activity initiated by the Bureau of Reclamation and Sandia in January 2002 identified several future desalination research and development needs that must be addressed to help accelerate the application of desalination technologies. A broad spectrum of desalination and water resource researchers and water managers participated in this technology roadmapping activity. The forum identified inland desalination, areas not near a coastal zone, as one of the major desalination issues that must be addressed to enhance the overall utilization of desalination technologies. Though inland brackish waters often have significantly lower salinity levels than sea water, brackish water chemistries are highly variable and often contain high concentrations of silicates and sulfates that often are problematic for traditional desalination technologies. Other inland problems

include disposal of the desalination concentrate or salt, which is often environmentally difficult and can be very costly, and the problem that most inland applications are smaller in size and can not take advantage of economies of scale as can large desalination plants near major metropolitan areas.

The United States does not currently have a desalination research center focused on desalination of brackish ground water, nor do we have a research facility to support renewable energy applications or concentrate management research for inland applications. Congress identified the Tularosa Basin of New Mexico, which has extensive brackish ground water resources that have been extensively studied, as a potential location to conduct desalination research on brackish ground water and concentrate management. In the basin the brackish ground water is in a relatively shallow, permeable aquifer. Within a 5-mile radius, ground water with salinity from 2,000 parts per million (ppm) total dissolved solids (TDS) to over 10,000 ppm TDS is available. Additionally, a wide range of water chemistries including sodium-chloride, carbonate, and sulfate based brackish waters are available. This provides a unique opportunity to evaluate new desalination technologies over a wide range of natural water qualities at one location. Additionally, the basin has a wide range of renewable energy resources, especially solar, and areas to evaluate a wide range of concentrate management and disposal concepts. After reviewing the available information, the Executive Committee agreed that the Tularosa Basin is an excellent location for brackish ground water desalination research and development and identified this as a major role for the facility.

Facility Location and Design

Based on the identified role of the Tularosa Basin facility, the Executive Committee developed a site layout and design to effectively conduct the activities required to support inland brackish ground water desalination and concentrate minimization research and renewable energy desalination evaluation. A site of about 20 acres was identified as needed to provide the necessary areas for desalination, concentrate management and reuse, and renewable energy research. To allow for future expansion, several sites of 20 to 30 acres were identified and evaluated. Site location evaluation criteria included proximity to water resources of varying quality and chemistry, availability of water rights, high visibility and ease of access, land costs, environmental and cultural considerations, proximity to existing utilities, and other factors affecting overall costs. Based on these criteria, a city-owned site in the southwest part of Alamogordo located near the intersection of US Highway 70 to White Sands and Las Cruces and US Highway 54 to El Paso, was identified as the preferred location for the research facility. A state-owned site two miles west of the city-owned site and a private site a mile west of the city-owned site, both on US Highway 70, were identified as potential alternative locations for the research facility. These sites have good access and visibility from major highways, room for expansion, minimal environmental issues, potential availability of a wide range of water qualities, and each site can be obtained at minimal or no cost. The city-owned site is expected to provide the lowest overall facility construction and operational costs, though final site selection should be based on final environmental, cultural, and hydrologic investigations.

The research facility design developed by the Executive Committee includes an approximately 13,000 square foot passive-solar building for desalination research. The facility design includes six research bays for desalination technology pilot testing, a water analysis laboratory, control room, office space for permanent staff and visiting researchers, a conference room, shop and storage areas, and a resource area and learning center for visitors. The desalination research areas will enable research on up to five 30-gallon per minute desalination technologies at a time and maintain one fully operational desalination system for facility water. This configuration will enable treatment of approximately 100,000 gallons of brackish water per day. Areas were also provided for testing of bench-scale desalination systems and outdoor research areas for larger-scale desalination technology demonstrations. The site layout also provides 4-5 acres for evaluation of renewable energy desalination applications, and 10 acres for desalination concentrate research including concentrate minimization, beneficial reuse, and reduction in environmental and ecological impacts. The facility layout was developed to enable self-guided visitor tours of the different research areas as well as enable researchers from around the world to use the facility. Public outreach and education on desalination and resource conservation were primary concerns of the final design and site layout. An artist's rendering of the developed research facility is shown in Figure 1.

Projected Facility Costs and Operational Schedule

Preliminary engineering cost estimates suggest that the design and construction of the research building, well field, exterior testing and concentrate research areas, and furnishing of the facility will cost approximately \$4.5-5 million for the preferred city-owned site. Environmental compliance, well drilling, and cultural resource permitting, as well as design-build proposal package development activities have been initiated to help accelerate final site selection and facility design and construction. Once Congress authorizes and appropriates funds for the facility, it is anticipated that the construction phase could be initiated within three to six months, with initial facility startup within fifteen to eighteen months of start of construction as part of a design-build package. The facility could be expected to be at full operational capability within a year of facility start up.

The Executive Committee suggested that the facility be federally owned by either the Department of Energy or Department of Interior and that fiscal oversight and management be provided by an Executive Board composed of representatives from federal agencies and laboratories, such as the Bureau of Reclamation, Sandia, and others. This structure will help insure that the research priorities and projects conducted at this facility support the national desalination technology research plan and are closely coordinated with other federal desalination research facilities, activities, and projects. It was recommended that the daily operations of the facility be conducted and coordinated by either a local technical services contractor or a university affiliated research group. The Committee also recommended that oversight of the research, demonstrations, evaluations, and operations be provided by a review board of desalination research agencies and technology users to insure that all activities support the emerging and future needs of both the public and water resource managers.

The mission and vision identified by the Executive Committee for the Tularosa Basin National Desalination Research Facility is as a national leader in addressing brackish inland ground water desalination issues. The resources and capabilities needed to effectively and efficiently conduct research to accelerate the application of technologies for these applications do not currently exist at one research facility in the United States. The site location, site layout, and facility design details identified by the Executive Committee would enable a Tularosa Basin desalination research facility to address all the major research issues associated with inland brackish ground water desalination including concentrate minimization and beneficial reuse, renewable energy applications, and the flexibility to conduct bench, pilot, and even demonstration-scale desalination technology evaluations. These capabilities will support and assist U.S. industries in developing and accelerating the use of innovative and cost effective desalination technologies for inland applications. By including research and office space for visiting researchers, the facility has an opportunity to play a major national and international role brackish in ground water desalination research. The design concepts included in the facility will also enhance the ability of visitors to view and tour the desalination and concentrate minimization technology areas, improving the public's awareness of resource conservation and instructing future generations in the concepts and benefits of sustainable resource management. The developed Tularosa Basin desalination research facility design will help accelerate the development and application of desalination technologies and help reduce the growing shortages of fresh water in environmentally and ecologically sound ways.



LIVINGSTON ASSOCIATES, P.C.

NCA
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 ARCHITECTS ■ PLANNERS ■ AIA

TULAROSA BASIN
 NATIONAL DESALINATION
 RESEARCH FACILITY STUDY
 RENDERING FIGURE 1

2. DESALINATION ISSUES AND NEEDS

Access to fresh water is an increasingly critical national and international issue. Demand for fresh water in many regions of the world has already outstripped supply. Severe water-related stress due to pollution, inadequate supply, and lack of coordinated management is a complicating factor in many regions of the world, including the United States. In order to maintain economic development, improve standards of living and health, and minimize future regional and international conflicts, we will need to develop sustainable supplies of high-quality water for drinking and other uses. Meeting these challenges will require a systematic approach to balancing water supplies with demand. This will require the development of innovative and cost-effective methods to improve water management, use, and reuse as well as developing revolutionary techniques and methods that can increase water supplies or “create” fresh water from nontraditional sources.

One area that can no longer be overlooked is the development of the “next-generation” of desalination technologies. Saline and brackish waters constitute over 97% of the water in the world. Supplementing fresh water supplies through cost-effective “revolutionary” brackish and saline water desalination technologies could provide significant relief to the limited fresh water resources in many parts of the world.

Technical Issues and Concerns

Today there are over 12,000 desalination plants in operation in the world, generating over 5 billion gallons per day (BGD) of fresh water. This accounts for 1% of the world’s drinking water supplies. The costs of saline and brackish water desalination now range from \$1.50-\$2.00 per 1000 gallons for a plant capacity of about 3-5 million gallons per day (MGD) depending on salinity and disposal options¹. These costs vary depending on plant size, water collection system, water quality, salt or brine disposal costs, and energy costs. Desalination costs of small inland systems are often two or more times higher than these averages.

Significant effort has been devoted to desalination technology research, development, and implementation over the past 50 years. Those efforts have led to significant improvements in the reduction in cost and the improved performance of desalination technologies. Unfortunately, there are still only two major desalination processes in common application today, thermal distillation and membrane separation. Though there are several major commercially available technologies in these categories, reverse osmosis and multistage flash distillation continue to be the most prominent, accounting for 90% of the number of plants and 80% of the capacity in the world. The desalination industry estimates that in the next 20 years over \$70B will be invested world-wide in designing and building new desalination plants and facilities. This will add an additional 10 BGD in fresh water capacity, doubling the amount of fresh water generated by desalination to about 2% of the world’s daily use in 2020. Even at these unprecedented levels of sustained investment, it is clear that the projected desalination system expansion will have minimal impact on significantly increasing the availability of fresh water in the next 20 years.

Though industry has made significant improvements over the past 50 years in desalination technology cost and performance, these projections above indicate that new revolutionary approaches or “next generation” concepts for desalination technology must be developed to significantly improve the use of available saline and brackish waters. Since this type of innovative technology research and development is not commonly conducted by industry, federally supported research is needed to make the significant strides needed in desalination technology development. This is especially true for smaller inland applications where economies of scale and concentrate disposal issues have received less attention from technology researchers and developers. Federally supported efforts are needed to make the cost of water from desalination competitive with other water supply options, providing communities with a broader array of options to meet their growing water needs in a manner that conserves this most precious natural resource and is sustainable over the long-term.

National Desalination Technology Research Plan

The FY2002 Committee on Appropriations, in U.S. Senate Report 107-39 as part of the Energy and Water Development Appropriation Bill, 2002, directed the Bureau of Reclamation in consultation with Sandia to develop a desalination technology research plan during FY2002.² The plan was to identify the major desalination research needs and priorities for the nation for the next 20 years. The Bureau of Reclamation's partnership with Sandia leverages the strengths of both agencies - Reclamation's leadership role in desalination research and development, and its experience in desalination facility, design, construction, and operations; and Sandia's expertise in basic science, renewable energy, and salt and brine engineering. The combined technical capabilities of these two organizations provide valuable expertise in developing a long-term desalination research plan. Furthermore, the practical knowledge and experience of the Bureau of Reclamation in water resources management will ensure the relevancy of the research to stakeholder needs and enhance the transfer of new technologies to water providers and users.

The purpose of the desalination technology research plan was to identify and rank research, development, and demonstration activities required to make the significant technical improvements needed to accelerate the application and implementation of desalination technologies and improve the availability of water from non-traditional water resources. With an overall desalination technology plan in place, funding could be focused or directed to the highest ranked areas needed to realistically and cost-effectively impact future fresh water supplies.

To help develop this Desalination Technology Research Plan, the Bureau of Reclamation and Sandia conducted a series of collaborative workshops with diverse groups of researchers, technology providers, technology users, water resource interest groups, and water associations to identify and rank future desalination research goals and objectives.³ Several major programmatic research areas were identified and ranked by the participants. They identified several new technology and process improvements needed to effectively address the growing number of water quantity and water quality issues and to help improve the beneficial use of nontraditional water resources. The major desalination research and development areas identified in the workshops included:

- Coastal desalination. Many coastal cities and areas could employ desalination technologies, but environmental issues of concentrate disposal and cogeneration to reduce energy costs need to be addressed.
- Inland urban and rural domestic needs. Many small, inland, municipal water districts around the world have limited fresh water reserves but they often have large saline or brackish water resources. Significant costs stand in the way of full use of these extensive brackish water resources and brine disposal is a large ecological and environmental issue for these inland cities.
- Industrial and domestic water pretreatment and reuse. As water conservation and reuse become increasingly more important, more robust and cost-effective industrial water and wastewater treatment technologies will be required to remove a growing number of contaminants to increasingly lower levels. Also security issues of water supplies may require increasingly more sophisticated water treatment technology implementation to remove chemical or biological agents.
- Fossil energy production. Saline and brackish waters are commonly co-produced in oil and gas production. These brackish waters can pose significant disposal costs and environmental concerns for fresh water aquifers in oil and gas production areas due to leakage and common production and disposal practices. For the US, produced water from fossil energy production is expected to increase significantly over the next several decades; desalination technologies offer a means to minimize any impacts of produced water by creating cost-effective methods for treatment and beneficial reuse of this water.
- Irrigated agriculture. Irrigated agriculture accounts for up to 80% of the total water use in most developing countries and 30-70% of water use in developed countries. Changes in some irrigation practices to reduce water use may exacerbate salt build up and soil degradation. Methods are needed to remove high levels of salt from rivers and irrigation return flows. Compounding this problem will be efforts to reduce agricultural runoff contaminant levels for compounds such as nitrates, phosphates, pesticides, and herbicides. Based on typical crop yields and crop values, very inexpensive methods will be needed to treat impacted irrigation waters.

Many of the identified needs and applications of improved desalination technologies are to address inland brackish ground water and surface water issues. Inland desalination applications have several major issues. Though the salinity of most inland brackish waters are significantly lower than sea water, the water chemistry's of these inland brackish waters are highly variable and often contain high concentrations of silicates and sulfates that are problematic for many existing desalination technologies. Many of the proposed inland applications are small in scale and cannot take advantage of the economies-of-scale like large coastal plants serving high population areas. Additionally, disposal of the desalination concentrate from inland plants or facilities can be costly and environmentally difficult.

The United States does not presently have a desalination research center focused on brackish ground water desalination issues. We also do not have a research facility directly designed to support evaluation of renewable energy technologies for a broad range of desalination and concentrate disposal applications. A research facility with these capabilities would complement existing desalination and water quality and reuse research centers and enhance the development and testing of water treatment technologies that address a much broader range of applications and capabilities.

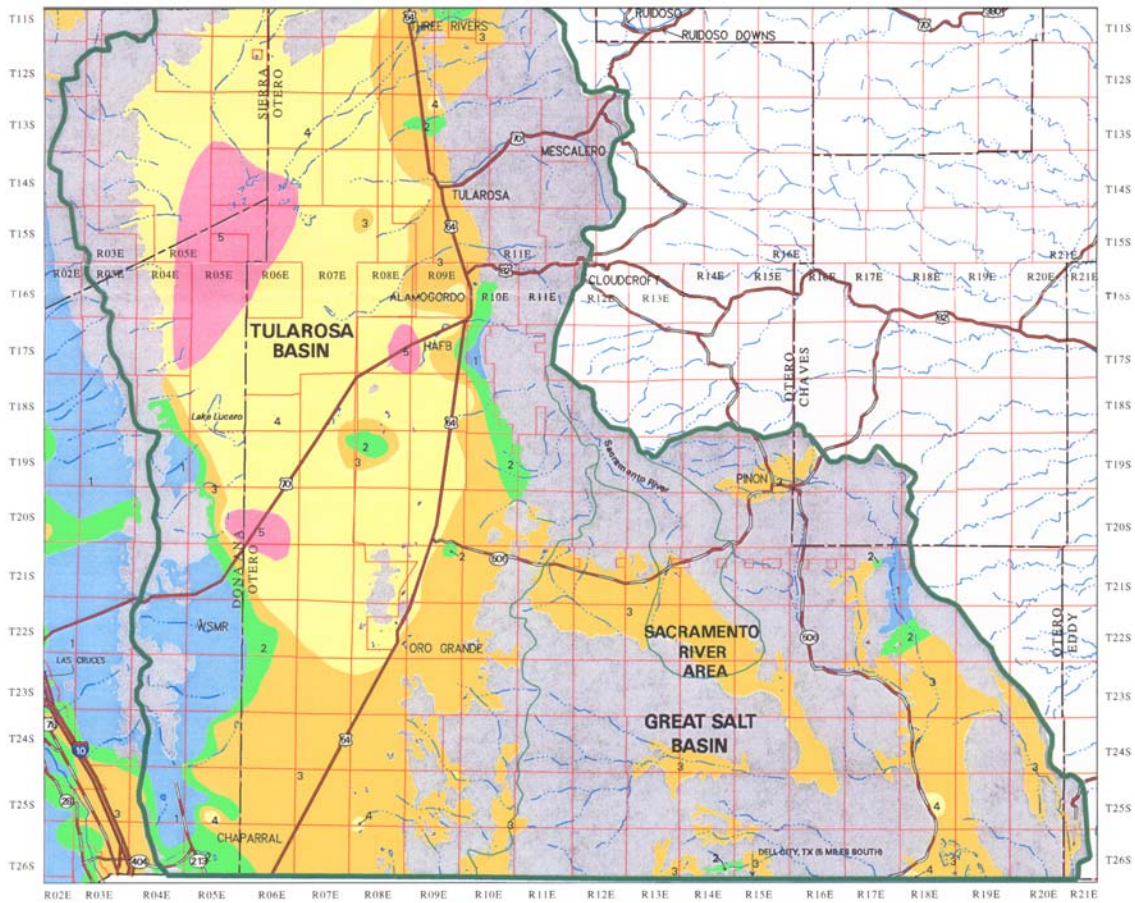
Brackish Ground Water Desalination Research and the Tularosa Basin

The Tularosa Basin of New Mexico has been often suggested as an ideal location to conduct research and development on brackish ground water desalination. This basin has been extensively studied and has extensive brackish and saline water resources.^{4,5,6} These resources are mostly shallow and lie in a permeable aquifer. Within a 5-mile radius, water with salinity from 2,000 ppm total dissolved solids (TDS) to over 10,000 ppm TDS is available. As an example, Figure 2 shows the location and relative water quality of ground water in the southeastern quadrant of the Tularosa Basin. Additionally, a wide range of brackish water chemistries including carbonate and sulfate waters is available in the Tularosa Basin. The basin therefore provides the unique opportunity to evaluate new desalination technologies over a wide range of natural water qualities at a single location. Additionally, the Tularosa Basin provides opportunities to make use of wind, solar, and geothermal renewable energy resources.

Based on the preliminary results of the National Desalination Technology Research Plan, the development of a desalination research and development facility in the Tularosa Basin to address brackish ground water desalination issues appears to have several technical and programmatic benefits for the nation. Based on the identified research needs, a facility to conduct "next generation" desalination research for brackish ground water applications should include the ability to conduct pilot-scale testing to evaluate the cost and performance of innovative concepts and technologies that will:

- Improve applications of renewable energy to reduce desalination energy costs,
- Support development of cost-effective systems for smaller-scale applications,
- Improve pretreatment and treatment technologies for the beneficial use of produced water, and
- Improve the beneficial use of concentrate, reduce the environmental impacts of concentrate disposal, or eliminate or minimize concentrate generation.

To support the research and development efforts needed to create "next generation" desalination technologies, Congress directed the Bureau of Reclamation, working with Sandia, to evaluate the feasibility of establishing a desalination research and development facility in the Tularosa Basin of New Mexico.² Based on the preliminary results of the Desalination Technology Research Plan, inland brackish ground water desalination and associated concentrate management pose major technical concerns, significant opportunities, and are compatible with the resources in the Tularosa Basin. Therefore, the study focus of a Tularosa Basin desalination research facility became brackish ground water, complementing other desalination and water quality research centers and helping to support the US in expanding the use of brackish ground water supplies by inland communities in an environmentally and ecologically appropriate manner to supplement their often limited fresh water resources.



Produced by New Mexico Water Resources Research Institute, June 2002
 Base map prepared by the U.S. Geography Survey

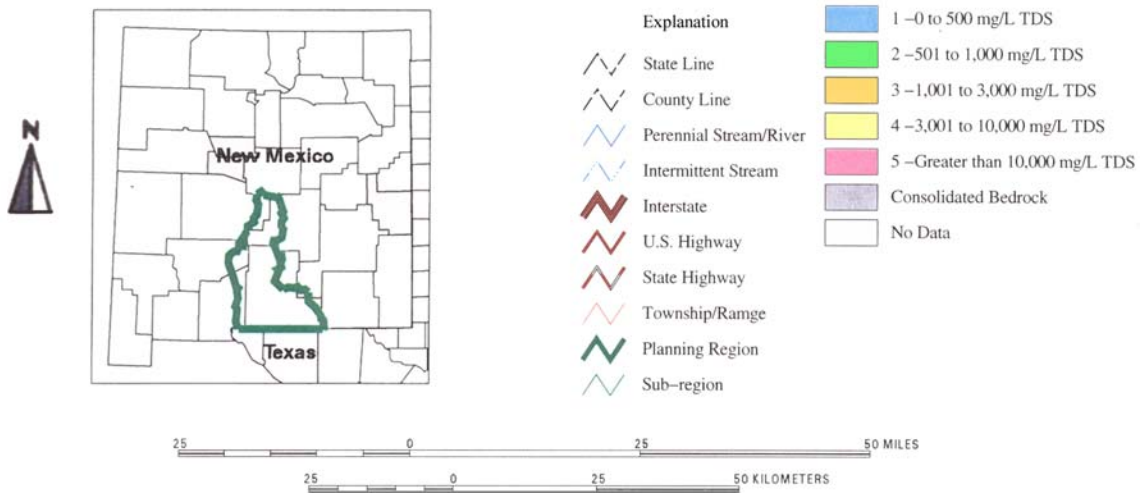


Figure 2. Tularosa Basin Location in South Central New Mexico and Brackish Water Quality

3. RESEARCH FACILITY STUDY APPROACH

As discussed in Section 2, the Desalination Technology Research Plan being developed by the Bureau of Reclamation and Sandia has identified several desalination concerns that need to be addressed to help accelerate the implementation of desalination technologies. These issues and concerns were considered in developing the overall Tularosa Basin desalination research facility study approach and direction.

Goals and Objectives

Based on the directions provided by Senate Report 107-39, the Bureau of Reclamation and Sandia developed the following goals and objectives for the research facility study:

- Identify unique desalination research and development directions for a Tularosa Basin facility,
- Formulate how the facility would complement other desalination centers,
- Identify a regional, national, and international role for the facility,
- Develop technically and economically sound facility design and operation and management structures,
- Complete a draft of the study by June 2002 and complete the study by September 2002 to meet the required delivery of the facility study, and
- Develop a suggested path forward to accelerate the construction and operational capability of the facility following authorization and appropriation; including design/build concepts, permitting needs, and other associated activities.

Roles and Responsibilities

Three major elements were used to ensure a technically sound evaluation. These included:

- An Executive Committee of desalination and water resource experts and municipal water utilities to provide input and oversight on the feasibility study,
- A consulting engineer with an understanding of the hydrology of the Tularosa Basin and of desalination technology applications to provide technical support for the review of potential sites, water rights availability, and to prepare conceptual design drawings, and
- A regional water group to host the research facility study meetings and provide public access to the study efforts and results.

The Executive Committee was organized in January 2002. Representatives were identified and selected from state and federal water agencies and groups and included the USGS, the Bureau of Reclamation, Sandia, the New Mexico State Engineers Office, the New Mexico Water Resources Research Institute, and several southwestern water utilities. Executive Committee members are listed in Table 1.

The Executive Committee met monthly from January through August 2002 to ensure appropriate progress of the study. The roles of the Executive Committee included:

- Provide input on the vision, mission, and utility of a desalination research facility in the Tularosa Basin,
- Provide input on the technical issues associated with facility research needs; facility design, operation, and management; visiting researcher access; public access; and education,
- Participate in periodic (30%, 60%, and 90%) design reviews of potential facility locations, site layouts, and facility designs, and
- Provide input on options to accelerate facility construction and initial operational capability such as design/build options, accelerated requests for quotes, and parallel environmental and cultural resource evaluation activities.

TABLE 1. Executive Committee Members

NAME	AFFILIATION	TECHNICAL EXPERTISE
Mike Hightower	Sandia National Laboratories Albuquerque, NM 87185	Water Resources Desalination Research
Eddie Livingston	Livingston Associates Alamogordo, NM 88310	Water Resources Desalination Plant Design
Michael Norris	USBR- Water Quality Improvement Center Yuma, AZ 85364	Desalination Research
Lorenzo Arriaga	USBR El Paso, TX 79901	Water Resources
Bobby Creel	Assoc. Director, WRRRI Las Cruces, NM 88003	Water Resources Research
Andrea Mendoza	Office of State Engineer Las Cruces, NM 88004	Water Resources and Water Rights
Karl Wood	Director, WRRRI Las Cruces, NM 88003	Water Resources Research
Tom Jennings	USBR, Denver Federal Center Denver, CO 80225-0007	Desalination Research Management
Calvin Chavez	Office of State Engineer Las Cruces, NM 88004	Water Resources and Water Rights
Jim Sizemore	Office of State Engineer Albuquerque, NM 87102	Water Resources and Water Rights
Ed Fierro	City of El Paso El Paso, TX 79925	Water Utilities
Mike Landis	USBR El Paso, TX 79901	Water Resources
Rick Huff	USGS Las Cruces, NM 88003	Water Resources
Jim Pacheco	Sandia National Laboratories Albuquerque, NM 87185	Renewable Energy
Ian Watson	RosTek Assoc. Tampa, FL 33647	Desalination Plant Design
Paul Kinshella	City of Phoenix , Water Services Phoenix, AZ 85003	Water Utilities
Del Holz	USBR, Denver Federal Center Denver, CO 80225-0007	Environmental Compliance
Bruce Johnson	City of Tucson, Tucson Water Tucson, AZ 85748	Water Utilities
Signa Larralde	USBR Albuquerque, NM 87102	Cultural Resources
Tom Hinkebein	Sandia National Laboratories Albuquerque, NM 87185	Brine Disposal

The Bureau of Reclamation and Sandia selected Livingston Associates of Alamogordo as the consulting engineer for the research facility study. Livingston Associates has conducted desalination pilot studies in the Tularosa Basin for the City of Alamogordo for the past several years. They have studied the hydrology of the basin and have conducted several pilot desalination tests with their own pilot desalination system at wells in many areas of the basin. Livingston Associates also contracted with RosTek, a well-known desalination engineering and design company, to assist in them in the site and water chemistry evaluations and plant conceptual designs.

After assessing several options for hosting the Executive Committee meetings and providing public access to information on the progress of the research facility study, the New Mexico Water Resources Research Institute (WRRRI) at New Mexico State University was selected to host the Executive Committee meetings and distribute and disseminate information on the facility study. The WRRRI provided a well-known, neutral, and easily accessible venue for the Executive Committee as well as the public to observe discussions and reviews. The WRRRI also had a well-established and maintained web site for posting information on the status and progress of the study.

The Executive Committee chose to have all the technical information and presentations developed during the facility study placed on the WRRRI web site. This included background information on the goals and objectives of the study, information on the roles and mission of a Tularosa Basin facility, presentations given to various groups on the progress of the facility study, Executive Committee meeting minutes, and associated evaluations and reports.

Location, Siting, and Environmental Considerations

As previously discussed, Congress directed the Bureau of Reclamation in cooperation with Sandia to investigate the role of a potential desalination research facility in the Tularosa Basin of New Mexico. The preliminary results of the Desalination Technology Research Plan indicated that desalination of brackish ground water is a major emerging need. Since the U.S. does not have facilities solely dedicated to research in this area, and the fact that the Tularosa Basin appears to be an ideal area for brackish ground water desalination and concentrate reuse and minimization research, the Executive Committee chose to focus the study on developing a facility in the Tularosa Basin to address brackish ground water desalination needs. Several initial criteria were developed by the Executive Committee to enable the research facility to become the focal point for research on “next generation” brackish ground water desalination and concentrate management. These criteria became the guidelines for siting of the facility and included:

- Locations with easy access to brackish waters of approximately 2,000, 7,000, and 15,000 ppm TDS and variable water chemistry, including sulfate-based waters,
- Locations where water rights can be obtained or leased and with expansion ability,
- Facility orientation and design to enable use of renewable (including solar) energy,
- Locations with easy access to major highways for high visibility and easy access, and
- Locations without major environmental compliance or cultural concerns.

Design Considerations

The Executive Committee identified several concepts to provide the flexibility needed to conduct a variety of research. These features also provided for public education on desalination technology capabilities and developments. The primary facility design guidelines included:

- Sufficient office space for a facility manager, engineers and technicians, secretarial and administrative staff, visiting research offices, a resource room, and conference room for technical meetings, tours, and presentations,
- Experimental space to include a high bay area for multiple research projects, including operation of a desalination system to provide site process water, a control room, and water laboratory, as well as space for larger-scale demonstrations and renewable energy applications,
- Design layout such that future expansion would be possible and tours can be easily conducted,
- Storage space to include pre- and post-treatment water storage, below grade piping. Piping to each bay is to be designed for up to 30 gpm pilot system design,
- Room for equipment maintenance, pilot system repair and refurbishment, chemical storage, etc.,
- Pipelines and pumps from multiple wells to the facility to handle nominally 100 gpm flows and up to 150 gpm, providing a range of water qualities,
- Areas for evaluation of concentrate reuse for agricultural products, wetlands, etc., and
- Concentrate management research capabilities including evaporation pond(s), solar ponds, and a possible concentrate disposal well.

■ **Management and Operations Considerations**

The Executive Committee identified the following main considerations in developing appropriate operational and management functions for the Tularosa Basin desalination research facility. These elements will insure that the appropriate research activities are conducted at the facility in accord with both inland ground water desalination needs and the overall Desalination Technology Research Plan. These included:

- Development of the roles and responsibilities of an Executive Board to oversee facility fiscal and fiduciary management and evaluate research priorities and progress from a national perspective,
- Development of a facility operational plan identifying daily operational roles and responsibilities, and technical support requirements. Technical support would include technology testing, water analysis, tour scheduling, facility upkeep and maintenance, administrative functions, development of testing and evaluation schedules, cost/performance evaluation reports, progress reporting, etc.,
- Development of roles and the makeup of a Program Review Board to help provide technical direction on research activities and directions,
- Development of a community outreach, public education, and public awareness program for K-14 to help generate public support and interest in the facility's research and development activities and their importance to the community and the nation, and
- Development of an operational and management structure that encourages visiting and international researchers to conduct research activities and tour the facility.

4. FACILITY DESIGN EVALUATIONS

The following section summarizes the results of the study of the development of a Tularosa Basin desalination research and development facility to address brackish ground water desalination and concentrate minimization and reuse. The Executive Committee met from January 2002 through August 2002 to develop a site, facility layout, and design for this facility. The criteria identified in Section 3 were used to assess and rank options and alternatives. The developed facility location, site plan, design, and expected costs are presented in this section.

Facility Location

Seven sites were identified by the consulting engineer for evaluation by the Executive Committee with available land of 20-30 acres in areas of the basin with a wide range of brackish ground waters. The sites are shown in Figure 3. Most are near the city of Alamogordo in the southeast part of the Tularosa Basin. Site 1 was the farthest north site and is about 15 miles north of Alamogordo and near the proposed Alamogordo desalination facility. All of the other sites (Sites 2-7) have predominately calcium sulfate water, which is the major inland desalination concern, and are near areas of higher variability brackish water. For this facility, water quality of from 2,000 –15, 000 ppm TDS, with an ability to access water of up to 50,000 ppm TDS, was desired.

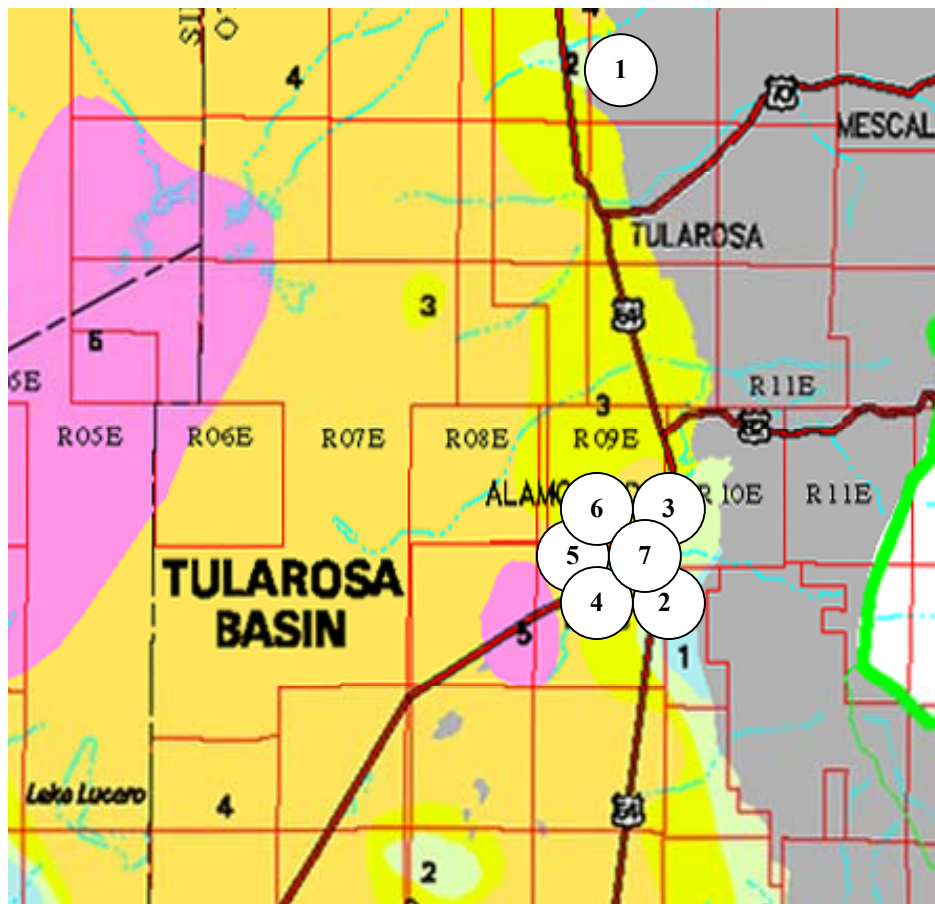
Ten evaluation criteria were used for the site evaluations including; proximity to water of varying quality and chemistry, water rights, land costs, proximity to existing utilities, availability of land for expansion, evaluation of environmental and cultural issues, adjoining property concerns, visibility, ease of access, and proximity to active airport runways because of potential migratory bird use of possible concentrate evaporation ponds. Based on the above criteria and following discussions of the various issues for each site, the Executive Committee toured and ranked the sites as shown in Table 2.

Table 2. Potential Site Rankings

SITE	COMMENTS	RANK
Site 7 – Southwest side of Alamogordo	In city limits, water rights available, city water reclaim line, high traffic flow, utilities on site, pipeline easements available.	Preferred
Site 4- State land south of Alamogordo on White Sands highway	High water variability, low state lease costs, high traffic flow, no utilities, need to obtain water rights.	2A Alternate
Site 6 – Private land south of Alamogordo on White Sands highway	High traffic flow, land offered free by owner, limited utilities, adjoining property zoning issues, need to obtain water rights, will need pipeline right-of-way.	2B Alternate
Site 2- Private land south of Alamogordo on White Sands highway	High traffic flow, land offered free by owner, close to airport and city sewage treatment plant are problems, expansion concerns, need water rights and pipeline easements.	4
Site 5- Land further southwest and closer to Holloman AFB	Similar to Site 4 but closer to HAFB, which may have landing issues if waterfowl take up residence in evaporation ponds.	5
Site 3 – Southwest side of Alamogordo	In city limits, water rights available, water reclaim line, high traffic flow, utilities on site, near old landfill so environmental concerns.	6
Site 1- Location about 15 miles north of Alamogordo	Adjacent to proposed city desalination facility, utilities available, water quality probably too good, out of the way for tourists.	7

Based on the criteria, four sites were identified for closer investigation. These were: Site 3 and Site 7, city-owned sites in the southwest part of Alamogordo located near the intersection of US Highway 70 to White Sands and Las Cruces and US Highway 54 to El Paso; Site 4, state land a few miles further west of Site 7 on Highway US 70, and Site 6, private land between Site 4 and Site 7 and also on Highway US 70. Preliminary environmental and cultural resource evaluations and a tour of each of the sites were conducted and of the top four sites, environmental issues were revealed only at Site 3. There are indications that Site 3 is part of a former landfill and for this reason was removed from further consideration. Site 7 has good access and visibility from two major highways, room for easy expansion, utilities, and the City of Alamogordo is willing to make the land available and transfer water rights for the research facility. The City of Alamogordo has easements to the property for a water pipeline to bring in lower quality brackish water as needed.⁷ The state-land, Site 4, can be easily leased at minimal cost from the state, has room for significant expansion, and a broader range of water quality on-site. Site 6 also could be obtained at minimal cost and has flexibility for expansion. Both Sites 4 and 6 are in the county and do not have easy access to city utilities, fire protection, etc. All utilities will have to be brought to these two sites, this could cost up to \$ 1 million, and water rights would have to be obtained.

For these reasons, Site 7 is the preferred location for the facility. The Executive Committee is proceeding with more detailed brackish water availability evaluations, utility cost evaluations, water rights investigations, and environmental and cultural evaluations at the top three ranked sites, Sites 7, 4, and 6, which should be completed by the end of 2002. Views of the top preferred and alternated facility locations are shown in Figure 4. Figure 5 shows the location of the preferred Site 7 in Alamogordo.



**Figure 3. Facility Site Locations Investigated
(Numbers Denote Site Designations)**



Site 7 – Alamogordo-owned site



Site 4- State-owned Site



Site 6 – Private-owned Site

Figure 4. Highest Ranked Facility Locations

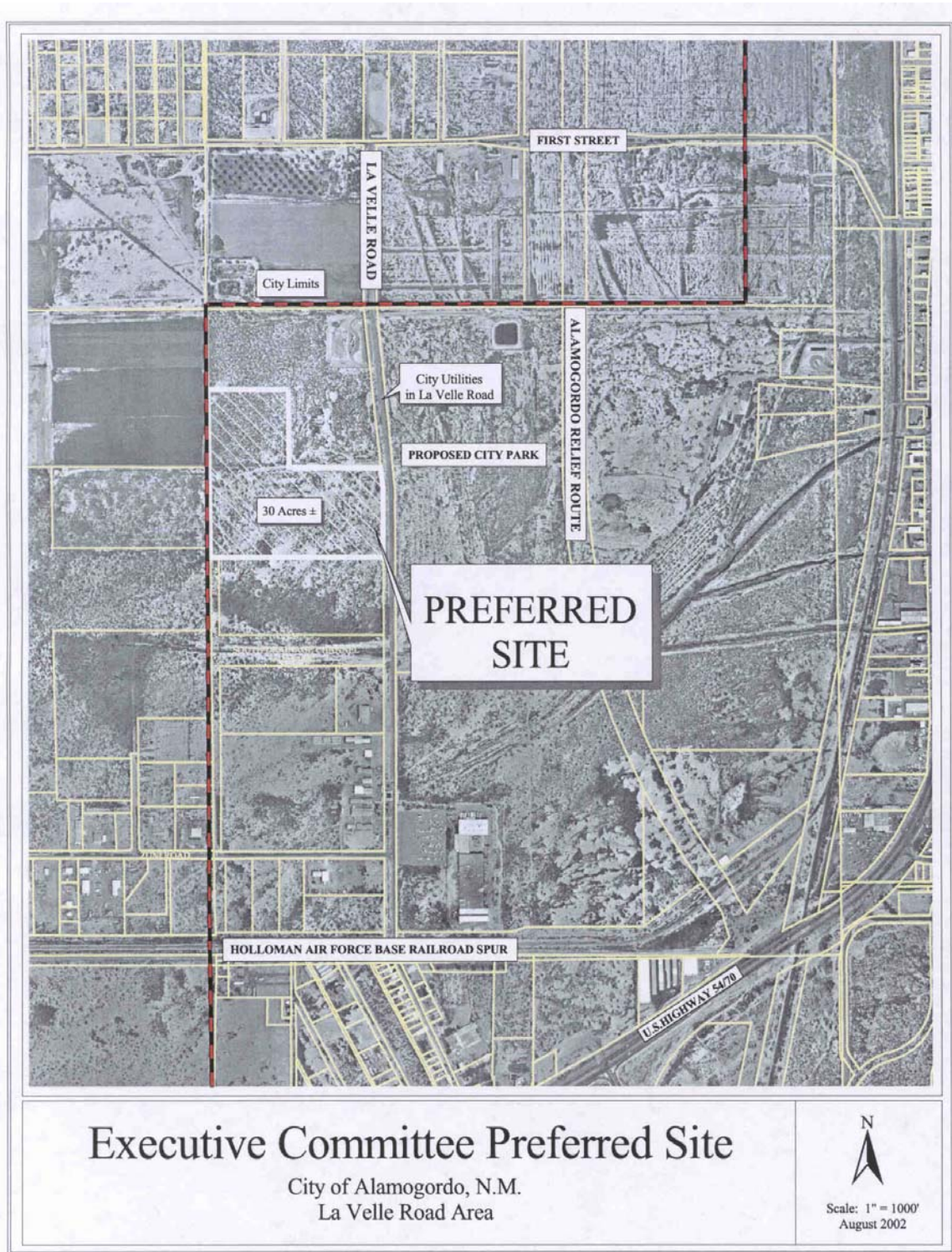


Figure 5. Preferred Facility Location

Facility Site Plan

The site plan for the research facility included the following considerations:

- Layout to enable solar energy utilization for outside desalination research and to enhance facility heating, cooling, and lighting,
- Include provisions and flexibility for concentrate treatment and reuse evaluation and testing since many inland cities are very concerned with this aspect of desalination research,
- Include provisions for agricultural and wetland areas for beneficial use research, and
- Provide room for future facility, renewable energy, and concentrate research area expansion.

These considerations were expected to require about 20 acres. This included: five acres for the desalination research facility building, parking, and service roads, larger scale testing areas, and landscaping; five acres for evaporation and solar ponds including several different sizes for concentrate treatment and utilization evaluations; three acres for renewable energy research applications and testing, and three acres for agricultural evaluations. About four acres were left for future expansion and larger scale system testing.

The overall layout including the production water wells and the facility site layout developed by the Executive Committee are shown in Figures 6 and 7. The suggested site plan is oriented to enable a generally south facing front exposure. The concentrate testing and solar pond area was located on the north side of the site so the prevailing wind from the southwest would blow any water from the concentrate research area away from the facility and other research areas. The solar desalination research area is furthest away from the disposal research area. These expected types of research needs at the facility suggested that a buffer zone for potential brine spray and for possible expansion of about 10 acres be included in the site selection, increasing the expected site requirements to about 30 acres.

Facility Design

Based on the identified facility capabilities, an overall building size of about 13,000 square feet was finally developed by the Executive Committee. The proposed facility floor plan and section and elevation views are shown in Figures 7 and 8 respectively. The recommended research center design is for a passive-solar building housing a high bay research area, water laboratory, control room, office space for permanent staff and visiting researchers and a resource area and learning center for visitors.

The design uses a split-level concept with a one-story office suite in front of the high bay test area. This allows clerestory windows in the high bay to enable direct day lighting in the high bay research area and reduce energy costs. The one story office area allows the use of passive-solar heating and lighting. The split-level design allows for insulation of parts of the building and provides a natural elevated viewing area to look out over the interior test bays. The floor plan was also developed to facilitate routing of self-guided tours of the facility while protecting tour participants and keeping them from coming into direct contact with the research projects and equipment. The building design includes a heat pump cooling and heating system, taking advantage of the desalination process water to help reduce energy costs. Specific facility elements are discussed in more detail below.

Desalination Research Bays

The desalination research areas would be provided for up to five 30-gpm pilot desalination technologies at a time and one fully operational desalination system for tours and facility water. Areas would also be provided for bench-scale research systems and outdoor pads available for larger-scale demonstrations. The research areas include in-floor piping for safety of pilot operation. Each bay will include multiple water quality ports to facilitate easy access to different water qualities. Each bay will also include power and communication connections to allow easy hookup and process monitoring. The communication connections will be routed to the control room where each process can be monitored as well as to the visiting researcher area so that process changes can be easily adapted.

Water Analysis Laboratory

The water analysis laboratory would be a state-of-the-art lab housing the primary water quality testing and water chemistry evaluations needed for routine and some specialized testing. The water laboratory would contain common laboratory equipment including a fume hood, wet benches, emergency shower and eye wash, deionized water system, refrigerator and ovens. Water analysis capabilities for the lab would include an atomic adsorption spectrometer for cation speciation and analysis, an ion chromatograph with auto sampler for anion speciation, a CO2 analyzer, a spectrophotometer, an optical microscope, pH meters, turbidity meters, a gas chromatograph, and a scale and balance and balance table. The water laboratory also is adjacent to the chemical storage for chemical storage and will provide an area for technician office areas.

Office Areas

The office areas are clustered together to provide a team based environment. As part of the office space, sufficient areas are provided for visiting researchers. The office areas also include a conference room for meetings and technology reviews as well as a lounge for the employees. The office space includes room for the director, facility manager, budget and contracting comptroller, and engineers.

Control Room

The control room is in the office area and overlooks the desalination research bays. The control room provides a central area to monitor the operation of each of the tests being conducted and collect data on the performance of the ongoing research. The control room is located near the entrance and resource areas to enable easy access for facility tours.

Resource Area

The resource area has been designed as an open area for displays, posters, and a viewing area of the research bays. This is an area designed to facilitate education on desalination issues and resource conservation. All tours and educational opportunities are expected to originate from this area.

Chemical/Water Storage

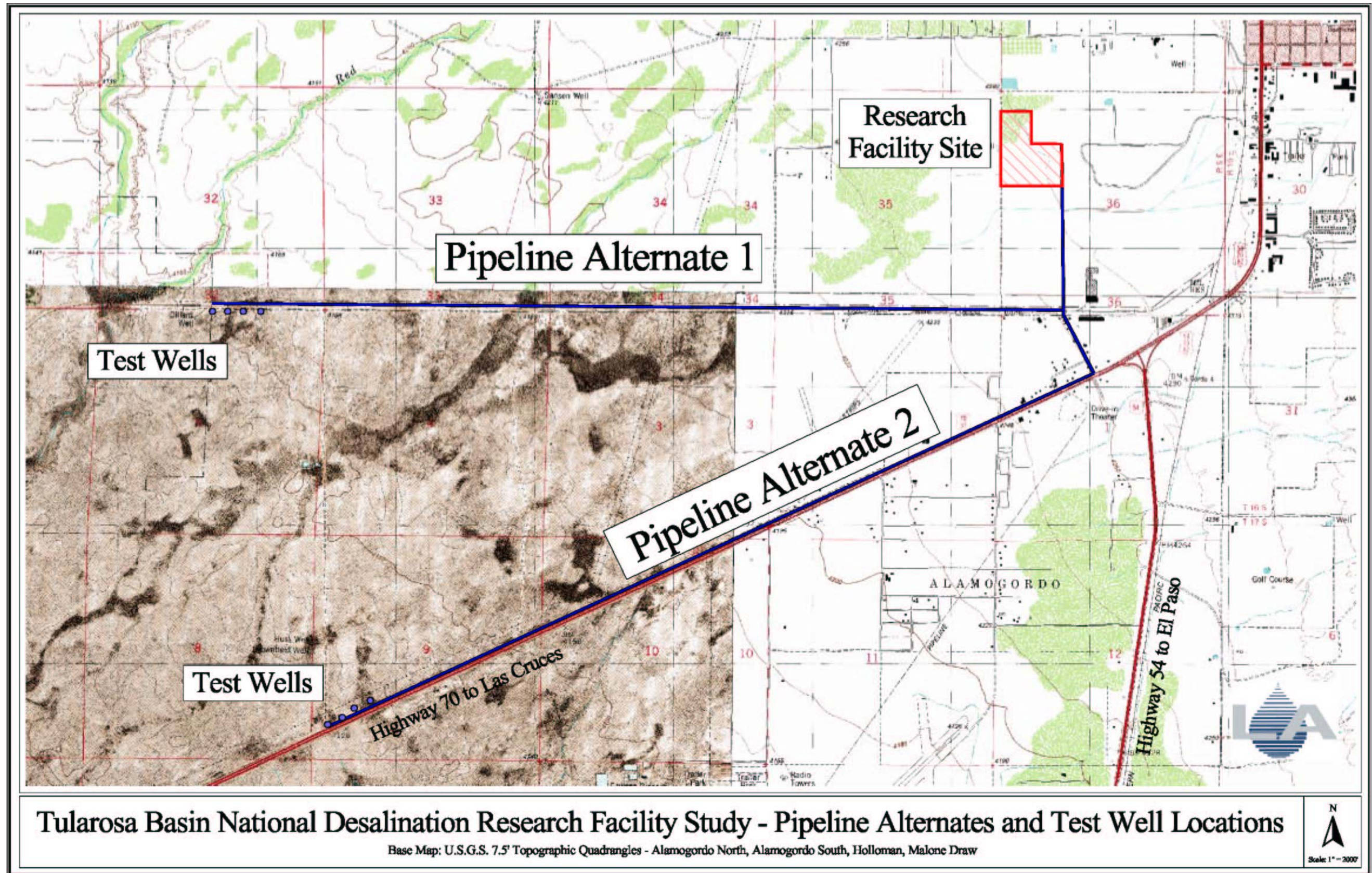
The facility includes areas to store and hold the different quality water from the different wells that will be used. The area will also be used to store treatment concentrate and residuals prior to further treatment or disposal. The chemical storage area also keeps potential hazardous chemicals away from the research areas.

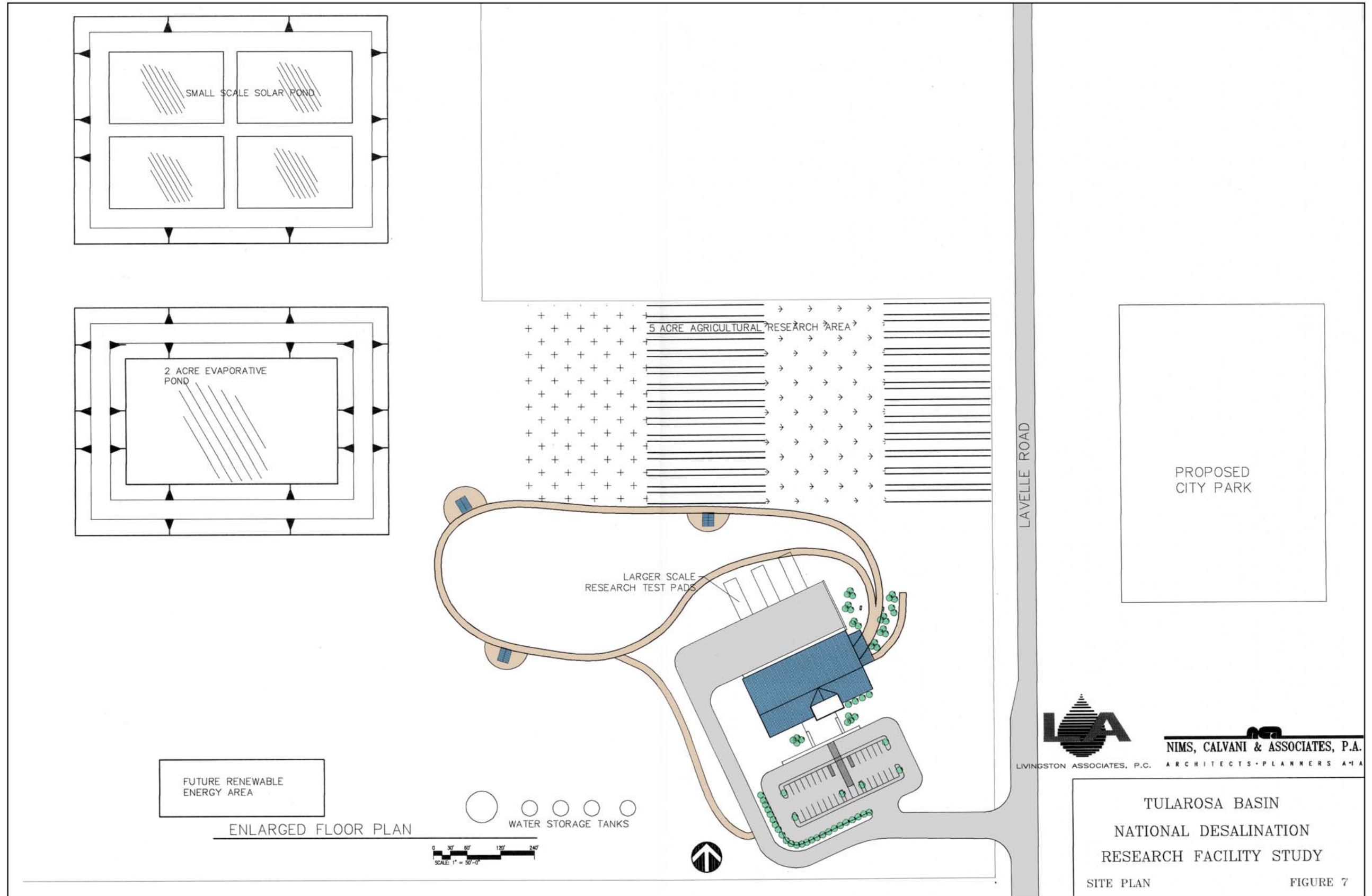
Shop Area

The shop area allows the facility to be able to modify research skids and broken equipment in a more controlled and safer area than trying to make modifications to equipment in the research areas. The shop area is designed to be handle most routine test fixture modifications or repairs that would be needed. The shop area also includes provisions for an overhead crane for heavy lifting and loading and unloading of oversize test fixtures.

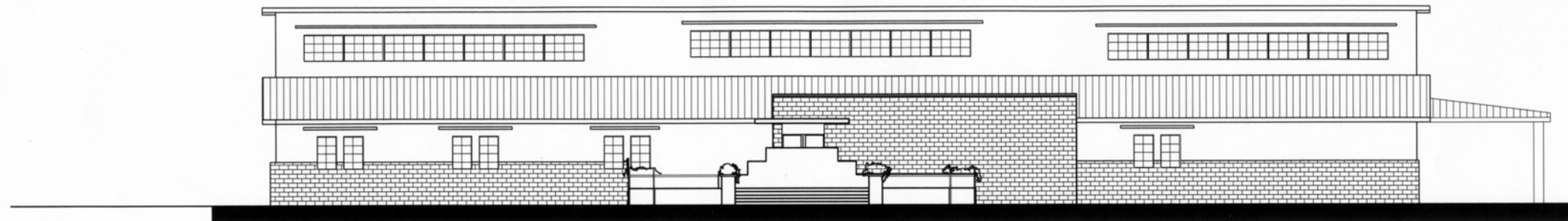
Exterior Large Scale Test Areas

It is expected that some larger-scale research will need to be conducted at the facility that will not easily fit into the research test bays being provided. Additionally, some desalination research systems may be better suited for outdoor applications, whether those may be for safety, noise, or renewable energy availability reasons. Therefore, the facility was designed to include outdoor pads for desalination technology testing. The pads will also contain the water, power, and communications capabilities provided at the research bays within the facility. The testing pad designs were based on similar applications used for remote renewable energy technology evaluation at Sandia.

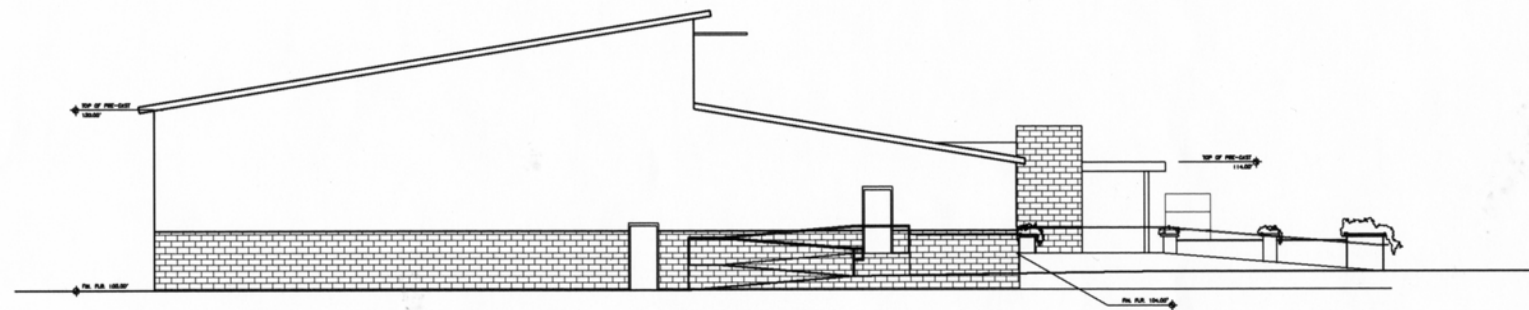




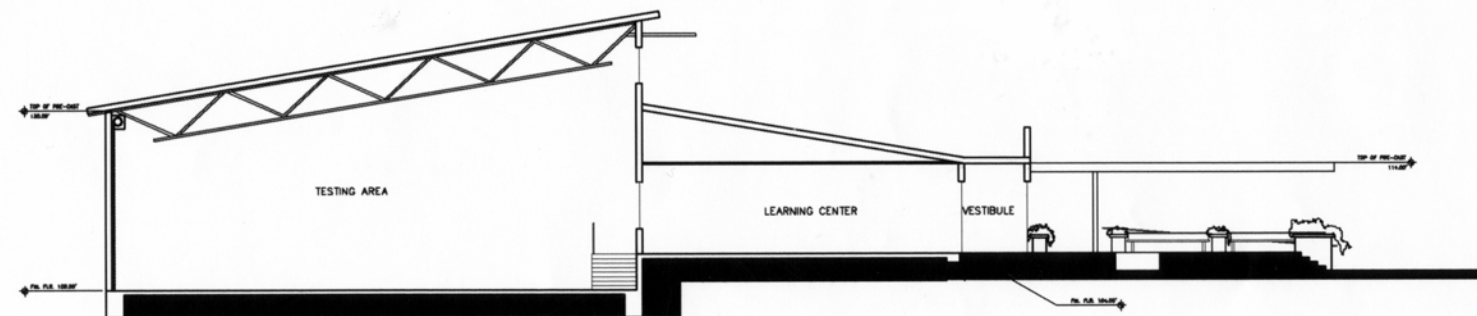




BUILDING FRONT ELEVATION

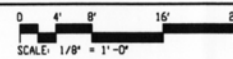


BUILDING ELEVATION



BUILDING SECTION

BUILDING SECTIONS AND ELEVATION



LIVINGSTON ASSOCIATES, P.C.



NIMS, CALVANI & ASSOCIATES, P.A.
ARCHITECTS · PLANNERS AIA

TULAROSA BASIN
NATIONAL DESALINATION
RESEARCH FACILITY STUDY
ELEVATIONS AND SECTION FIGURE 9

Projected Facility Construction Costs

Table 3 summarizes a preliminary estimate of site grading, facility construction, and equipment and furnishings for the developed Tularosa Basin desalination research facility layout and design. These costs are based on construction of the research facility at the highest ranked site previously discussed using local construction and engineering costs for federal buildings. The research facility costs for each of the other top ranked sites is expected to be somewhat higher than the costs shown in Table 3 because of the need for more extensive utility upgrades, and should be considered as a final site is selected.

Both contractors and subcontractors in the Alamogordo area have extensive experience with federal construction activities because of the proximity to several federal installations including Holloman AFB, White Sands Missile Range, Fort Bliss, and NASA's facility in Las Cruces. The costs have been broken into several subcategories to provide information on the expected cost elements for each phase of the design, site work, construction, and furnishing and initial startup of the research facility.

Table 3. Estimated Research Facility Costs

Cost Element	Description	Costs	Subtotals
Site preparatory work	Engineering	\$ 100,000	\$ 650,000
	Utilities upgrades and pump test	\$ 150,000	
	Excavation, grading, site work	\$ 400,000	
	Land costs	\$ 0	
Facility construction	Engineering	\$ 600,000	\$ 3,800,000
	Building Construction	\$ 1,300,000	
	Water Supply System – wells, pipelines, concentrate disposal, agricultural areas	\$ 1,900,000	
Equipment and Furnishings	Office Furnishings	\$ 150,000	\$ 550,000
	Water Laboratory	\$ 250,000	
	Equipment and materials	\$ 100,000	
	Water storage equipment	\$ 50,000	
TOTAL:			\$5,000,000

Additional costs associated with the management and oversight of the research facility design and construction, which could be provided by either, Sandia, DOE, or the Bureau of Reclamation, depending on the final federal agency owner, will need to be included in the overall costs. These costs are estimated at an additional 10% of the final construction costs over the expected two-year effort for construction and initial facility startup.

5. MANAGEMENT AND OPERATION CONCEPTS

The following sections identify the proposed management and operations structure for the Tularosa Basin desalination research and development facility. Also included are the expected initial operational costs and a suggested schedule of possible facility operational capability based on possible congressional funding authorization and appropriations for the research facility.

Facility Management Structure

The Executive Committee proposed that the Tularosa Basin desalination research facility be constructed and operated as a federally owned facility. This matches the general structure of other national desalination research facilities in the United States and insures a national and international focus of the research being conducted. It also ensures that all researchers to have a fair and equal opportunity to use this facility. As a national desalination research center, the Tularosa Basin desalination research facility should be funded through Congressional appropriations and direction as an element of the national desalination research program.

The Executive Committee developed a management and organizational structure for the facility as shown in Figure 9. This structure is similar to other national water research centers, including the Bureau of Reclamation's Water Quality Improvement Center in Yuma. The main management elements include: an executive board representing federal entities to oversee management of the facility and ensure that it maintains a research scope compatible with the national desalination research program directed by the Bureau of Reclamation and complements research at other national water centers; a director to serve as the Chief Executive Officer of the facility and who is directly responsible to the Executive Board for overall facility management; a program review board consisting of industry, utility, and other researchers and stakeholders to help in establishing facility research priorities and reviewing progress; and a facility operations team to manage and conduct day-to-day operations of the facility and technology research, testing, and evaluation.

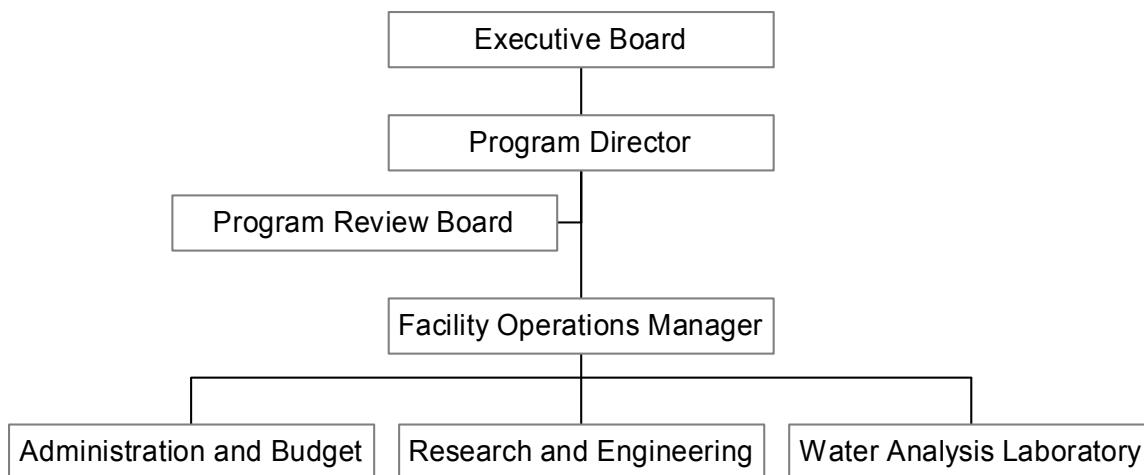


Figure 10. Suggested Management Structure

Executive Board

The Executive Board could consist of senior executives of appropriate federal agencies, for example the Department of Energy and Sandia or other national labs, the Department of the Interior and the Bureau of Reclamation, and other agencies such as the Department of Defense, Department of Agriculture, or the Environmental Protection Agency. The executive board would provide federal oversight and guidance to the facility director on overall facility direction and operations to ensure that activities complement efforts at other water research facilities and support the overall national desalination program plan goals and objectives. The Executive Board should include a Chairman with the responsibility and authority to oversee and coordinate facility activities with the Program Director.

Program Director

The Program Director is expected to be an employee of a federal or state agency or prime contractor such as the Department of Energy, Bureau of Reclamation, the State of New Mexico and their university system, a national laboratory such as Sandia, or the major collateral duty of an existing federal employee.

The director would be responsible for overseeing all research and testing conducted at the facility, ensure that research is in accordance with the national desalination program goals, coordinate community, regional, and international outreach for the facility, develop and coordinate research with other national water research activities; and oversee the fiscal and operational management of the facility in accordance with federal and state guidelines. If appropriate, an associate program director could be identified to support the director in coordinating local activities and outreach in the community.

Program Review Board

The program review board could consist of representatives from regional and national water resource and desalination agencies and groups, industry, municipal and other users, national laboratories, other research institutions, and academia. The review board would be an extension of the existing Executive Committee for this facility study and would meet on an approximately quarterly basis to provide technical guidance and oversight to the facility director and operations staff on research directions, progress, and future needs. The board would help rank research needs, evaluate research portfolios, and review annual progress and technical reports to ensure the quality, effectiveness, and value of the research being performed.

Facility Operations - Manager and Staff

Day-to-day operations and management of the research facility could be overseen by a technical services and management organization. This includes either a university-lead organization or a private technical services organization. There are several university affiliated technical service groups in the region, some providing natural resource technical services, others providing a wide-range of technical services to support defense industry projects throughout the Tularosa Basin, such as White Sands Missile Range and Fort Bliss. There are also many private regional technical service groups supporting these defense projects in the Tularosa Basin. Each of these groups has a good knowledge of the region's technical staff resources and capabilities, local salary and benefit structures, and local visibility. This structure for day-to-day management and operation would help accelerate facility startup and streamline operations, and avoid bureaucratic indecisions on selecting and hiring operations personnel.

Daily operations of the research facility would be coordinated by the facility operations manager. The manager would be the lead technical services person on site and coordinate the daily administration, budgeting, engineering and testing, and maintenance of the facility test areas and water supply and production wells and pipelines. This person would be a senior engineer, such as a civil, chemical, or mechanical, with a background in engineering, cost accounting and budgeting, testing and evaluation, plant operations, and water monitoring. Their role would be to coordinate the activities of the operations staff to meet the goals and objectives identified by the executive board, director, and program review board.

Facility Operational Structure

Figure 10 identifies the Executive Committee’s recommended operational structure for the research facility. As previously discussed, it is recommended that the positions identified be staffed through a local or regional technical services contractor. The three main operational elements should include administration and budgeting, research operations and engineering, and water testing and analysis, coordinated under the facility operations manager.

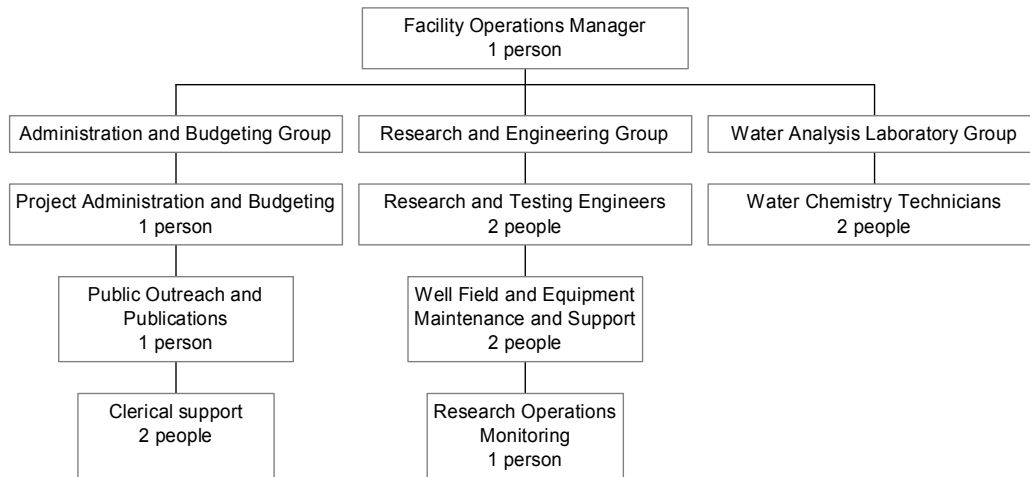


Figure 11. Suggested Facility Operations Structure of Contract Staff

Administration and Budgeting

Administration and budgeting should include approximately four people and include clerical support for the staff, budgeting and contracting support, and public outreach and research report publication support.

The public outreach position is suggested as an important role to insure both adequate informational material and public awareness of the facility function as well as quality cost and performance reports on the technologies and processes evaluated. The position would also include coordinating education, tours, and public outreach on the role and activities of the facility in particular but also water and energy resource conservation and sustainable development.

Research Operations and Engineering

This group would include up to two test engineers, in addition to the operations manager, to help researchers design and coordinate pilot system testing in the facility. They would also review and oversee all safety and hazardous material management evaluations, test planning and operations, and verification water monitoring. They would prepare the cost and performance testing and evaluation reports based on the test data collected. To provide maintenance on the equipment, pumps, test fixtures, and process water pipelines, the group should have a maintenance support staff of up to two people. Additionally, any time a test is in progress a control room operator is collecting processing data and is available to conduct emergency shut down procedures if conditions in a pilot test become unsafe.

Water Analysis

This group should include approximately two technicians to analyze water treatment performance results from each pilot system operating. These technicians could provide other facility roles, such as operations monitoring, engineering, or maintenance support depending on the number of research projects underway at any given time.

Facility Funding and Research Operations

As stated previously, the facility would be operated as part of the United States' water research centers supporting the Desalination Technology Research Plan being developed. This Research Plan includes a wide range of research and development activities including basic research, bench-scale and pilot testing, and large demonstrations. As part of this plan, Congress is expected to provide increased funding to expand desalination activities. As this funding and research activities expand, it is expected that industry and other water sectors will expand activities in these areas, providing additional funding for research and development through cooperative agreements and other mechanisms.

As part of the national desalination effort, the Tularosa Basin desalination research facility could obtain basic operational funding as part of the expanded national desalination technology program. As such, pilot testing at the Tularosa Basin facility will need to be closely coordinated with the research activities at other facilities. Through the Program Review Board, the Tularosa Basin facility would identify major inland and brackish ground water desalination and concentrate management issues and needs. These would be provided to the Bureau of Reclamation as part of their annual desalination technology research and development solicitation. Technologies from industry, academia, or national organizations identified through that evaluation process applicable to inland brackish ground water needs could be funded through the Bureau of Reclamation, or other groups, to use the Tularosa Basin research facility to conduct the selected research. In this way, the research and testing and evaluation activities would be closely aligned with the national desalination program coordinated by the Bureau of Reclamation.

As a national water research center, the Tularosa Basin National Desalination Research Facility should be available for use by other government or water agencies, utilities, private industry, academia, or other groups for research and development activities and projects appropriate for the facility. Research or testing activities that address the inland and brackish ground water needs identified by the facility's Program Review Board or national needs, should be encouraged and cost sharing or fee-based use agreements should be used to help fund the facility's activities and operations to enable widespread use.

Projected Facility Operational Costs

Based on the suggested operational structure, the Executive Committee estimates that about nine employees would be needed as the facility begins initial startup, and would expand to about twelve people as the facility moves into full operations. Based on these estimates, an initial annual operating budget was developed for nine personnel including a director, two research engineers, two administrative staff, two maintenance technicians, an operations technician and a water analysis technician. The estimated costs based on local wage rates are presented in Table 4. Out-year operating costs would increase by approximately 25-30% as additional personnel are added to support the expected growth of the research efforts and activities. These costs are expected to be recovered through a combination of state and federal appropriations, directed research grants, and research and user fees.

Table 4. Estimated Initial Annual Operating Costs

Cost Element	Description	Costs	Totals
Annual Operating Costs	Labor and other direct costs	\$ 650,000	
	Overhead/indirect costs	\$ 200,000	
	Treatment technology integration into facility	\$ 100,000	
	Equipment, materials, and other direct costs	\$ 150,000	
	Utilities	\$ 50,000	
TOTAL:			\$1,150,000

■ **Construction and Operational Schedule**

The following activities and general time frames are suggested by the Executive Committee for development of the Tularosa Basin desalination research facility. Activities would be conducted with oversight from a construction review committee consisting of members of the Executive Committee and construction management groups. The general schedule of the proposed activities include:

Facility Design/Build (Years 1 and 2)

- Complete facility conceptual design and site plan, including additional environmental compliance and permitting, and develop facility design/build RFP by January 2003.
- Twelve months to fifteen months facility design/build activity including permitting, construction, and water resource investigations
- Facility construction.

Facility Initial Operational Capability (Years 2 and 3)

- Facility initial startup and shakedown.
- Initial operational capability including operation of reverse osmosis pilot system and evaluation of two pilot systems for four months each.

Facility Full Operational Capability (Years 3 and 4)

- Full operational capability
- Operation of RO pilot system and evaluation of five to six pilot systems for four months each for each year of operation.

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Appendix A-1

U.S. Senate Report 107-39, accompanying S.1171 - *ENERGY AND WATER DEVELOPMENT APPROPRIATION BILL, 2002, Science and Technology, Desalination Research and Development Program, pg 90*

107th Congress, 1st Session

ENERGY AND WATER DEVELOPMENT APPROPRIATION
BILL, 2002

Senate Report 107-39, to accompany S1171

Excerpt from Page 90,

Science and Technology, Desalination Research and Development Program.—Within the funds provided \$500,000 is for research of brine disposal alternatives in “land locked” areas such as Phoenix, Arizona, and Las Vegas, Nevada, and \$1,000,000 to the Bureau of Reclamation to complete a study to determine the most effective and efficient manner of, and to develop a technology progress plan, to be used in, the development of a desalination research and development facility in the Tularosa Basin in New Mexico. The Committee recognizes that effective desalination cost reduction is the key to wider use of desalination for improving the quality of life in water-scarce regions. The Secretary of the Interior shall consult with the Secretary of Energy and the Director of the Sandia National Laboratories in the development of the technology and implementation plan and will submit a report by the end of fiscal year 2002 to the Senate Committee on Appropriations outlining the development of desalination technology for the basin. Within available funds, the Committee directs the Bureau to work with other Federal and State agencies, including the National Academy of Sciences, universities, and non-government entities to act as a national clearinghouse for desalination technologies. The Bureau shall establish a peer review process to validate the efficacy of the multitude of desalination techniques available.

Appendix A-2

Initial NEPA Review Summary



IN REPLY REFER TO:

D-8580

United States Department of the Interior

BUREAU OF RECLAMATION
Commissioner's Office
PO Box 25007
Denver Federal Center
Denver, Colorado 80225-0007

OCT 01 2002

Mike Hightower
Sandia National Laboratories
P.O. Box 5800, MS 0755
Albuquerque, NM 87185

Dear Mike:

An environmental assessment (EA) is under preparation by the Bureau of Reclamation in conjunction with the Tularosa Basin National Desalination Research Facility Study as part of the required compliance with the National Environmental Policy Act (NEPA). The Bureau of Reclamation has conducted visits of the three alternative sites identified by the study's Executive Committee. It does not appear that there will be any significant environmental issues involved with the construction and operation of the research facility at these sites.

Environmental concerns that are being evaluated in the EA include, but are not limited to, the potential impact of the research facility and operations on groundwater, threatened and endangered species, cultural, and archaeological resources. Preliminary NEPA evaluations conducted by the Bureau of Reclamation have not identified any potential concerns or issues that would cause any NEPA related delays in the construction or operation of the research facility.

Sincerely,

Del Holz, Manager
Resource Management and Planning Group
Bureau of Reclamation
Technical Service Center
Denver, CO 80225