AWP Case Study

New Municipal RO Water Treatment Plant

Client Overview

Client Name: **Detention Facility in West Texas**
Industry: **Drinking water treatment system**
Location: **Sierra Blanca, Texas, U.S.A**
Client Type: **Detention center – Potable Water supply for WTDF Population and Staff**

PROJECT SUMMARY:

The primary challenge was to reduce total dissolved solids levels from **2,000 mg/L to 500 mg/L**, in compliance with **TCEQ's maximum contaminant level (MCL)** for municipal drinking water. Total dissolved solids is considered one of TCEQ's secondary health-based contaminants, and addressing it was a critical need for the client.

The facility's primary water source was the City's water supply, which had no backup system in place. The City, in turn, received its water from another smaller water district. The District's and the City's water infrastructure is over 60 years old and has suffered from decades of underinvestment, with no upgrades or routine maintenance due to a lack of funding. The detention center was originally established in Sierra Blanca, Texas, as part of an effort to generate revenue for the City. With future expansion plans underway and a growing prison population and staff, the facility was in urgent need of a supplemental water source that could also function as a reliable backup to the City's aging and vulnerable supply system.

ALPHA'S STRATEGY:

To address the facility's need for a supplemental and reliable water source, Alpha developed a phased approach focused on reducing dependency on the aging City water infrastructure. The strategy involved identifying and implementing an alternative water supply source to serve as both a primary and backup system.

PROPOSED SOLUTION: ALTERNATIVE WATER SUPPLY DEVELOPMENT

Phase 1:

- Design and installation of a **100,000-gallon bolted steel storage tank**
- Installation of a **distribution booster pump system** to integrate with the facility's existing infrastructure

Phase 2:

- Drilling and development of a new groundwater well
- Design and installation of:
    - Three (3) 20,000-gallon storage tanks
    - Feed pumps and a media filtration system
    - A containerized reverse osmosis (RO) plant for TDS and contaminant removal
- Installation of reject water holding tanks, with plans for off-site hauling and disposal of RO reject water

This phased solution ensures long-term water supply reliability, improved water quality, and compliance with TCEQ standards, while supporting the detention center's future expansion needs.

PROPOSED SOLUTION: REVERSE OSMOSIS SYSTEM

Alpha proposed the installation of a new RO system due to key advantages of RO technology to include:

- **Lower Chemical Usage:**
  RO systems require minimal, non-hazardous chemical use. All treatment chemicals are NSF-approved, ensuring safety and regulatory compliance.
- **Higher Efficiency and Lower OPEX:**
  RO systems offer high recovery rates, generating less waste and lowering disposal costs. They also have lower maintenance needs, minimal downtime, and reduced chemical dependency.
- **Cost-Effective and Scalable:**
  RO systems are supported by a competitive vendor landscape, offering easy access to components such as membranes, high-pressure pumps, and pressure vessels—leading to lower lifecycle costs.
- **Proven Technology:**
  RO is widely accepted and approved by TCEQ for treating water with high TDS and removing a broad range of contaminants, including:
    - Total Dissolved Solids

ALPHA WATER SCOPE OF SERVICES

- **Project Delivery:**
  Alpha Water provided full Engineering, Procurement, and Construction (EPC) services for a new groundwater well and a containerized Reverse Osmosis (RO) water treatment plant, designed to produce 100 gallons per minute (GPM) of feed water and 70 GPM of permeate water, operating at a 70% recovery rate.

- **Turnkey Scope of Work**

  Alpha's comprehensive turnkey services included:

  - Well development, drilling, and completion in compliance with TCEQ drinking water standards
  - Complete consulting, design, and engineering services
  - TCEQ permitting support and coordination
  - Furnishing and installation of the containerized water treatment system
  - Integration of automation and control systems
  - Site supervision, final commissioning, and operator training
  - All installation work performed by Alpha's licensed General Contractor
  - Implementation of an annual maintenance service program

SYSTEM INSTALLATION OVERVIEW

Phase 1:

- Installation of a **100,000-gallon bolted steel storage tank**
- Installation of a **distribution pump skid** to supply treated water to the facility

Phase 2:
Installation of a **containerized 100,000 GPD RO system**, including:

- **(1) 20,000-gallon raw water storage tank (fiberglass)**
  – Stores well water prior to treatment
- **Feed booster pump system**
  – Transfers raw water to the RO system
- **Media filtration pretreatment system** including:
- **Turbidex filters** – to remove silt, sediment, and turbidity

- **Filox filters** – to remove iron from the feed water
- **Clean-in-Place (CIP) skid** – for routine RO membrane cleaning
- **(3) 20,000-gallon finished water storage tanks (fiberglass)**
- **(2) 20,000-gallon reject water storage tanks (fiberglass)** – for brine handling and off-site disposal
- All associated equipment, piping, electrical, and control systems

ANNUAL MAINTENANCE PROGRAM:

The proposed water treatment system was supported by a comprehensive **routine maintenance service program**. This program includes:

- Furnishing of filters and chemicals
- Scheduled quarterly inspections and routine maintenance services
- 24/7 remote troubleshooting
- On-call labor support for any issues related to the water treatment system

The overall goal of this maintenance program is to assist plant operators in **optimizing system performance** by:

- Fine-tuning antiscalant dosing
- Reducing cleaning frequency
- Increasing recovery rates
- Enabling early detection of operational issues

By implementing appropriate and timely service, the program helped achieve lower operational and maintenance costs and ensure the system's long-term reliability and efficiency.

RO SYSTEM DESIGN CRITERIA:

In accordance with TCEQ Title 30 TAC §290.45(b)(1), public water system was designed to have one well with a production capacity of at least 150 gallons per minute (GPM).

To meet and exceed this requirement, the reverse osmosis (RO) treatment plant was designed and sized to produce 100,000 gallons per day (GPD) of final finished water, aligning with both regulatory mandates and the Prison's operational needs.

Primary Treatment Objective

The core objective of the project was to reduce contaminant levels in the ground water well raw water—specifically:

- Total Dissolved Solids (TDS)

This was done to bring water quality within the limits set forth under TCEQ Title 30 TAC §290.105(b), which defines secondary drinking water standards for aesthetic contaminants.

DESIGN FLOW RATES:

Description	**Design Conditions**
Feed water flow rate to RO	100 GPM
Permeate water flowrate	70 GPM
Blend flow rate	10 GPM
Total Blended finished water flow rate	80 GPM
Reject water flowrate	30 GPM
Overall recovery rate	70%
Feed water TDS (mg/L or PPM)	2,000 mg/L

FINISHED WATER QUALITY TARGET GOALS :

Description	**Finished Water Quality** **(Select Primary and Secondary drinking water standards per 30 TAC (290.105) (b))**
Arsenic, mg/l	<0.01 mg/l (or 10 ppb)
Total Dissolved Solids, PPM	< 1000 PPM
Sulfates, mg/l	Not to exceed 300 mg/l
Chlorides, mg/l	Not to exceed 300 mg/l
Fluorides, mg/l	Not to exceed 2.0 mg/l
pH	> 7.0

SCOPE OF WORK

Phase	Description
Needs Assessment	Describe site survey, client collaboration, data analysis
Design & Engineering	Describe membrane selection, P&ID, CAD models, automation systems
Manufacturing	Skid fabrication, custom controls, factory testing
Installation	On-site installation timeline and coordination
Commissioning	Startup, performance verification, troubleshooting
Training & Handover	Hands-on operator training, O&M manuals, ongoing support

Key Technologies

Water Treatment Process: (Reverse-osmosis membrane filtration)

Primary goal was to reduce total dissolved solids concentration in raw water to levels below the TCEQ's secondary drinking water standards in Title 30 TAC §290.105 (b) using reverse osmosis membrane filtration techniques.

PRETREATMENT PROCESS DESCRIPTION:

- Constituents of concern in feed water to the RO unit are total dissolved solids (TDS) to meet TCEQ's primary and secondary drinking water standards set forth in Title 30 TAC §290.105 (b).
- Antiscalant chemical blend will be added to prevent any fouling and scaling caused due to presence of carbonate, silicate & sulfate hardness in water. This will also help to increase life of the membranes.
- A 1-micron or 5-micron cartridge prefiltration is provided before the membranes on RO skid as pre-treatment for removal of sand, silt and any particulate matter that may be present in water.
  Due to low levels of other constituents such as iron, manganese & other particulate matter, any additional pre-treatments are not proposed for this system at this time.

RO TREATMENT PROCESS DESCRIPTION:

The operation of the Reverse Osmosis (RO) system is initiated based on the water level in the finished water storage tanks. When the water level falls below a predetermined setpoint, the RO system automatically starts to produce treated water.

The permeate (treated water) is directed to the onsite finished water storage tanks, from where it is distributed to the facility's water system.

The concentrated reject (brine) stream is collected in a dedicated onsite reject water

storage tank. This reject water is then hauled off-site for proper disposal in accordance with regulatory requirements.

POST TREATMENT PROCESS DESCRIPTION:
Prior to distribution, the finished water undergoes a post-treatment process to ensure compliance with drinking water standards and to protect distribution infrastructure.

- Disinfection:
  A gas chlorine disinfection system is used to maintain a free chlorine residual of not less than 0.2 mg/L and not more than 4.0 mg/L throughout the distribution system, as required by TCEQ.

- pH Adjustment:
  The pH of the finished water is adjusted to maintain a level greater than 8.0 using a calcite filter system, which helps in stabilizing the water chemistry.

- Corrosion Control:
  A corrosion inhibitor injection system was installed to dose an NSF-approved chemical to help prevent corrosion of piping and infrastructure within the distribution system.

All chemicals used in the antiscalant feed system and corrosion control process are NSF-certified for use in drinking water applications, ensuring regulatory compliance and safe water quality for end users.

AUTOMATION & CONTROLS: SCADA / HMI INTEGRATION:

With the advanced automation package, the system is capable of operating in a fully automated mode. This included operation of Well to feed the Break Tank based on tank water level, pre & post treatments, RO unit & distributions pumps to the Customer's finished Water Tank. Automation package was capable of monitoring and recording operational data such as pressures, flows, tank levels, conductivity, TDS, pH, and temperature on a daily basis. The operator have capability to remotely access and view all operating data as well as start/stop of well based on raw water tank level; start/stop of Ro unit based on Customer's finished water tank level, receive & acknowlege alarms.

Under Alpha's maintenance program and with Customer's permission, Alpha has capability to remotely access and view all operating data, tank levels, alarms etc. Operator labor required is very minimal for routine visual inspections to check for any leaks, broken plumbing or parts, any electrical issues. Automation package included (1) PLC cabinet with control Panel, fuses, terminal blocks, HMI, enclosure; (1) master controller with (2) Google tablets, tabletop HMI, cell modem/antenna; (4) IP cameras, (1) NVR recorder.

INSTRUMENTATION

Instrument	Manufacturer/Type	Locations	Display
Conductivity/ Temperature	GF Signet	Feed, Product, Reject conductivities	Transmitter
		Feed, Product Water temperatures	
Pressure Transmitters	IFM, or Equal	Pre-filter inlet, pre-filter outlet, Pump Discharge, membrane feed, interstage, reject, combined permeate @ common header	HMI
Flow Meters	Signet/Paddlewheel	Reject, Product	HMI
PH monitor	Signet	product	Transmitter

REMOTE MONITORING PACKAGE:

A remote monitoring package was provided to allow the user to remotely monitor the system operation and receive alarm alerts. The remote monitoring was available via a cellular modem and used from any smart device or PC. The remote monitoring package allowed the user to view real time operating parameters and make some minor adjustments to the system. The package would also allow for remote trouble shooting of the system.

- **CONTAINERIZED WATER TREATMENT SYSTEM**

  Fully skid-mounted prepiped and prewired Containerized Reverse-Osmosis System factory tested prior to shipment. The skid mounted system included prefilter cartridge housing, fiberglass pressure vessels, spiral-wound thin-film composite LG membranes, high pressure membrane feed pump, a PLC and instrumentation and controls. Target overall recovery rate for the system is 80%.

  An on-board blend feature to be provided to allow for blending of raw water into the permeate water.

- **CLEAN-IN-PLACE SKID**

  A pre-piped clean in place system with a CIP pump and CIP tank was provided for cleaning of membranes to optimize their performance, extend their useful life, and to prevent and control bacterial proliferation in the proposed system.

  This system will be consist of a recirculation pump, pressure gauge, flow sensor, a polyethylene cleaning solution tank, and all the necessary instrumentation and controls to complete the cleaning operation. The flush system will also be utilized

for a clean in place system should the membranes become fouled. Hard Piping in the field will be done for connections of CIP skid to the RO system.

A permeate flush will be incorporated into the system. This will allow the system to flush with fresh permeate water upon every normal shut down. This will help to inhibit the growth of organic materials in the membranes.

- **ANTISCALANT CHEMICAL FEED SYSTEM AND CORROSION INHIBITOR CHEMICAL FEED SYSTEM:**

  A chemical feed system with a dual chemical pump configuration capable of injecting antiscalant at desired dosing rate will be provided. The second pump will be a stand-by unit. The chemical feed pump will be controlled by the main control panel located on RO skid; the pump is turned on every time when RO unit starts up. An injector quill will be provided for feed line. System will consist of chemical feed pump and a 30 gallons capacity day tank. A level switch to trigger alarm on low level will be included for monitoring the level of chemical in the tote.

Project Results

Metric	Before AWP	After AWP
Water Recovery Rate		70%
Regulatory Compliance 1.%Salt rejection rate	2,000 mg/L	350-500 mg/L (97.2%)

FINISHED WATER QUALITY SUMMARY BASED ON LABORATORY ANALYSIS:

CONSTITUENTS	FEED WATER	RO PERMEATE	FINAL FINISHED BLENDED WATER
Calcium, mg/l	75.7	0.23	8.66
Sodium, mg/l	574	17.1	80.2
Chlorides, mg/l	650	20	97
Fluoride, mg/l	6.47	<0.2	0.83
Aluminum, mg/l	<0.01	<0.01	<0.01
Sulfates, mg/l	448	2	55
Arsenic, mg/l	0.0056	<0.0005	<0.0005

Nitrate-N, mg/l	<0.5	<0.1	<0.5
Nitrite-N, mg/l	<0.5	<0.1	<0.5
Copper, mg/l	0.006	<0.005	<0.005
Lead, mg/l	0.0032	0.0013	<0.0005
Total iron, mg/l	0.056	<0.01	<0.01
Manganese, mg/l	0.027	<0.01	<0.01
Total Dissolved Solids, mg/l	1940	56	264
Conductivity, us/cm	3620	117	543
Total Alkalinity, mg/L	314	10	46
Silica, mg/l	41.6	1.09	6.36
Zinc, mg/l	0.011	0.011	0.012
pH, standard units	7.6	6.0	7.1

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