APWA 2015 Public Works Project **of the Year Nomination**

Project Category: Environment
Project Division: $25 Million to $75 Million
Project: Airport Water Reclamation Facility, Prescott, Arizona

CITY OF PRESCOTT ARIZONA

WATERWORKS ENGINEERS

PCL FANN
PCL/Fann, a Joint Venture

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1. Background

The City of Prescott has embarked in its largest Capital Improvements Project that consisted of the expansion and upgrades to its Airport Water Reclamation Facility (Airport WRF). The original Airport WRF was constructed in 1965 and designed to treat 0.04 MGD of wastewater. In 1978, the Airport WRF was upgraded with an oxidation ditch to a treatment capacity of 0.75 MGD. The most recent Airport WRF expansion was completed in 1998 with a design capacity of 2.2 MGD. Due to increase in wastewater strength since the most recent upgrade (1998), the effective treatment capacity was limited to 1.2 MGD. Current and anticipated flows have necessitated the plant expansion to handle committed capacities and projected growth in the area.

Using a phasing approach, the Master Plan recommended a total build-out capacity between 9.6 and 15 MGD (dependent on the City's decision of centralized versus decentralized treatment in the future). The treatment capacity recommended for the first phase of the Airport WRF was established at 3.75 MGD.

The City selected the Construction Manager at Risk (CMAR) Delivery Method and selected a team of consultants led by Water Works Engineers, LLC to perform engineering and construction administration services and PCL Construction/Fann Environmental, A Joint Venture as the CMAR. The $42 million dollar project represents an investment of over $1,000 per City resident.

City management was able to foster a unified team of City staff, and engineering and construction professionals that resulted in a successful, quality project, completed on time and below budget.

2. Eligibility: Completion Date

Substantial completion of the liquid stream process, which constituted over 90% of the project, was reached on August 3, 2014. The solids stream processes were substantially complete on November 12, 2014.

3. Selection Criteria

3.1 Construction Management, Techniques, and Project Schedule

The City objective was to implement a project with "the set value approach". The City and engineer evaluated various delivery methods available and selected the CMAR.

3.1.1 Construction Management

The project team took advantage of the CMAR delivery method and implemented various strategies that relied on integrating the design and construction professionals to develop a holistic construction management approach that started during the design phase, and carried through the construction phase and into commissioning.

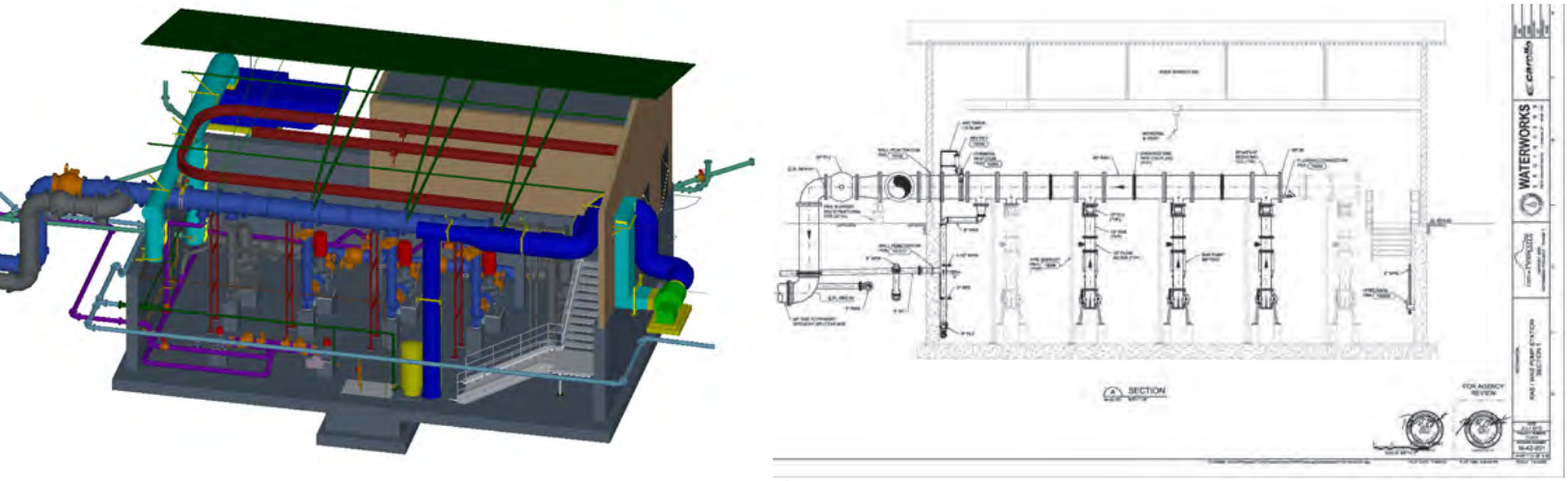
3.1.1.1 Design Phase Techniques

During the design phase, the City, engineer and CMAR developed various initiatives and documents to comply with the funding requirements, review the design features, assist in budget control, schedule control, enhance safety culture, support local businesses, and enhance public involvement.

The design was developed using 3-dimensional (3D) Modeling. The engineer developed 3D models for every process unit and for the overall site. This was adopted as a cutting-edge practice which led to better coordination, integrated cross-checking and comprehensive contract documents. The 3D Models were also used as an invaluable communications tool during workshop and review meetings. The models facilitated a more thorough visualization of the finished product at every stage of the design for all stakeholders with varying levels of technical ability. The 3D models provided a clear understanding of facility geometry, access and clearance issues, and overall system functionality, which helped the CMAR in expediting the quantity takeoff and bidding process as shown in Figure 3-1.

The design review meetings were conducted in a workshop format and addressed discipline coordination, operability, accessibility, future expansions and safety. The City involved engineering, supervisors and operators during the review process which allowed the engineering and construction professionals to better understand Prescott's goals and objectives. This all-inclusive involvement also provided added efficiency during the design development and value engineering process.

Figure 3-1 Side-by-Side Comparison of Improvement Plan and 3D Model for RAS/WAS Pump Station



In parallel, the CMAR prepared a construction management plan (CMP) that included the items shown in the table below. The table also highlights the relevance and importance of each item with regard to project implementation and City goals.

Construction Management Plan (CMP)

Project Elements	Relevance to the Project
Project milestone dates	Allowed the project to identify regulatory milestones, cash flow planning and coordination with the on-going operation
Investigations of subsurface and surface physical conditions	Enabled the project team to minimize change orders due to differing site conditions
Construction phasing and fast-tracking strategies	Allowed the project team to identify the various resources by disciplines, coordinate with plant operation and develop strategies to mitigate the critical path tasks
Subcontractor and supplier selection plan	Allowed the project team and the City to support local contractors, suppliers, and engineering firms, provide competition and develop a best value approach
Permitting strategy	Identified the critical tasks and allowed the engineer and City to proactively manage and meet the critical dates and milestones
Safety training	Enhanced the safety philosophy and committed the project team to a “Safety Conscious” project
Quality control programs	Reinforced the attention to quality and identified the critical workflow and “Hold Points” that will trigger special inspection and additional specialized resources
Commissioning plan/process	Improved the communication and planning with the operation staff and provided for a timely and well planned transition between the old system and new facilities
Cost models and its basis	Allowed the City and engineer to evaluate the cost versus benefit of each project element and make an informed decision when needed to keep the project within budget
Project’s team members’ responsibilities and roles matrix	Allowed for organized and disciplined interaction between the team members
Conflict resolution ladder	Enabled the project team to handle and manage conflicts in a timely and professional manner

The CMP document was also used to comply with the Water Infrastructure Finance Authority of Arizona (WIFA)’s requirements.

3.1.1.2 Budget Control

Budget control was a collaborative task among the team members. Design workshops were conducted biweekly, and input from the CMAR and City staff was solicited to ensure that the project was meeting the City's expectations and preference in a cost effective manner. The CMAR proactively provided cost feedback and information which allowed for a continuous value engineering process. Some noted project features included:

- The site layout was modified from what was recommended in the Master Plan to reduce excavation and retaining walls by taking advantage of the existing site grades. This modification improved construction timing by reducing construction element conflicts. The site layout change also eliminated the need for intermediate pumping facilities.
- The City chose to acquire real property and easements from surrounding property owners to meet noise and odor setback requirements which resulted in net savings since it allowed for less control equipment.
- The major process equipment constituted about 30% of the project budget which led the project team to exert special attention to the selection and bidding of equipment. The project team tracked the selection and budgeting at every phase of the design to maintain competition and ensure the desired equipment was provided.
- The material selection and comparison including piping material, surface paving and soil stabilization was evaluated by the CMAR and engineering team to give the City the most suitable and best value product. This affected major process piping, structural details associated with handrailing and concrete, and surface stabilization.
- The electrical system design and features were continuously evaluated.
    - During the conceptual design phase, the engineering team compared the costs of the service entrance with relation to 480v versus 12.47 kv. Capital costs and recurring utility fees were considered in addition to maintenance and safety constraints.
    - During the detailed design the CMAR obtained pricing for the electrical design at 60% and 90% which led to design modifications. Additional value engineering was conducted with the low bidder electrical contractor. This resulted in a reliable and effective system that met the budget goals.
- Owner-purchased equipment – the team identified the standby generator as an item that should be directly purchased by the City to provide savings. This item was identified since it required minimal coordination during the construction phase and provided $50,000 in savings.
- A management philosophy integrating the design and construction reviews resulted in comprehensive budgetary analyses and reviews that yielded a No Change Order project. The City, engineer and contractor project teams collaborated in a continuous value engineering and constructability process. This enabled the project team to identify the shortcomings and potential pitfalls during the construction phase and devised a project budget that was able to address change in site conditions (such as structural pier depth and varying soil characteristics) without causing cost additions.

3.1.1.3 Schedule Control

The project Notice to Proceed was November 12, 2012. The contract substantial completion date was September 19, 2014 with a final completion date of October 31, 2014. The actual substantial completion date for the liquid stream was August 3, 2014 followed by the solids stream on November 12, 2014. A two-week extension to the project schedule was granted to allow time for completion of City requested added scope and adverse weather days.

The project schedule was developed and maintained using Primavera P6. Monthly updates were submitted by the Construction Manager at Risk. In addition to the project CPM schedule, the CMAR used a short-duration six week look-ahead schedule to coordinate work in the field by subcontractors and its own forces.

During design, the construction sequencing analysis revealed some constraints that were created as a result of the proposed site layout and phasing. This analysis led to the realignment of the chlorine contact tank to allow the contractor to perform work simultaneously at the chlorine contact tank and the surrounding structures.

To keep the project on schedule, the CMAR carefully monitored procurement, critical path tasks, and near-critical path tasks. Five strategies were employed to address any schedule slippage. They were as follows:

- Re-sequencing: Often it is possible to reduce or eliminate the impact of a delay by resequencing the affected task
- Reconsideration of task means and methods to determine if a change in equipment or process will result in a schedule reduction
- Hiring additional workers
- Dedicating additional manpower to the affected task by moving them from another task
- Working additional hours (overtime)

The project schedule was closely monitored by the project team. The CMAR developed a project schedule with feedback from the engineering and management team. The schedule was comprehensive and identified the critical path tasks associated with the design phase, permitting, land acquisition, construction sequencing, and commissioning.

Prior to start-up and commissioning, the engineer, Owner and CMAR worked together to produce a detailed start-up and commissioning plan and schedule. This schedule was incorporated into the overall CPM.

3.1.1.4 Construction Administration

The project team used a shared website hosted by the CMAR to facilitate document transfer and reviews including shop drawings, RFIs, RFCs and other items. This allowed for a consolidated review process that gave the City continuous monitoring of the project progress.

3.2 Safety Performance

The City of Prescott made safety a critical element of the CMAR selection process. In addition, the City used an agreement template that required stringent commitment to safety. The CMAR's institutional safety program provided a perfect match for the City's goals. The adopted safety program reflected the project's strong commitment to provide a safe and healthy work environment. The CMAR developed a Safety Manual that was reviewed with the project team and the plant staff. The program was strictly enforced during the construction phase.

Lost Time Injuries per 1,000 man-hours worked: 0

The Safety Plan included the following:

3.2.1 Policies

The CMAR's Health, Safety and Environmental (HSE) Policy, Safety Philosophy, Environmental Policy, Workplace Violence Policy and Fall Prevention and Protection Policy are the foundation of the site-specific HSE Plan.

3.2.2 Responsibilities

The general superintendent is responsible for implementation of the safety program on the project. However, safety responsibilities are defined for every stakeholder on the project from executive support and project management right down to trade personnel.

3.2.3 Communication

Safety communication started with the employee orientation. The orientation was presented in English and Spanish and addressed general industry standards, project specific hazard control requirements, emergency response plans, incident reporting procedures and owner requirements. Safety was first on the agenda at every coordination meeting. Trades participated in monthly site safety committee meetings. The construction management team conveyed information about near misses, incidents and inspections to the trades in weekly tailgate meetings. Signs were posted and updated as needed that alerted for dangers and on-going activities.

3.2.4 Management Training

Line management was responsible for protecting people and the environment from the potentially adverse effects of construction operations. PCL's supervisory staff had taken the OSHA Outreach Training Program 10 Hour Course and Supervisor Training in Accident Reduction Techniques (START). PCL's Safety and Loss Prevention Business Guide provided the framework for a complete safety program, defining the responsibilities that each employee had for hazard identification, elimination (through process planning and engineering), and control. The Safe Operating Procedures Business Guide provided line managers with proven procedures to control hazardous processes.

3.2.5 Project-Specific Safety Program Overview

The CMAR's ongoing safety program was based on a philosophy of line management taking a proactive approach in identifying and controlling work place hazards. Management was responsible for planning, implementing and monitoring safety conditions through pre-job safety instruction, training and inspection of the work environment. The approach to overall safety included activities in both design and construction phases.

Following are highlights of the project-specific safety program:

- On-site Weekly Meetings
- Pre-Job Safety Instruction
- Safety Analysis
- Project Site Inspections
- Substance Abuse Testing
- Personal Protective Equipment (PPE)
- Emergency Response Plans
- Hazardous Spills
- Subcontractor / Trade Contractor Safety Program
- Corporate Safety Audits

3.3 Community Relations

The City adopted a proactive approach in keeping the City's government and public abreast of the project progress. City management conducted presentations to City Council at every critical milestone. In addition, the City management developed a project webpage hosted by the City website. The webpage provided routine updates and project specific details to encourage public feedback and awareness.

During construction, City Council members visited the site and were guided by the project team who provided explanation and status of the various construction activities.

In April 2014, the Junior Webelos Boy Scouts, from Pack 7006 in Prescott, were guided on a tour of the facility. They were issued safety personal protective equipment and then given a tour of the construction site, where the CMAR staff explained the function of each structure, and construction methods for concrete walls and slabs, and underground pipe installation. They also gave them instruction on crane usage and signaling. Some of the scouts were then given an opportunity to give signals to the Manitowoc 3900 crane to move a dummy load from a pick up point to a designated target. They asked questions about the process, and were most interested in being shown the "smelliest" part of the plant – the project staff was happy to oblige by giving them an up-close look at the headworks.

Junior Webelos Boy Scout Pack 7006

The City also required that the CMAR conduct an open house prior to project bidding to inform the local subcontractors, suppliers and engineering firms about the project requirements and encourage them to participate in the bidding process.

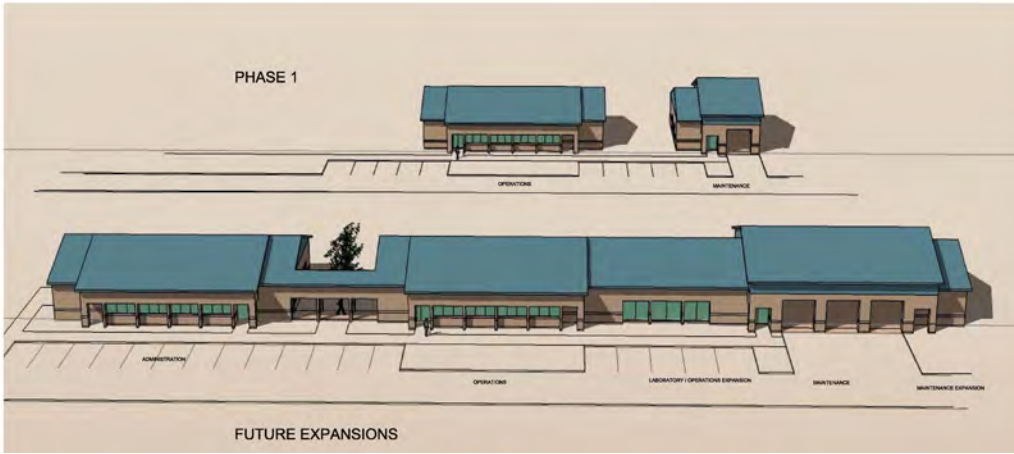
Although the project location was isolated and had minimal impact on the day-to-day activities of the surrounding properties, the City management followed the City procedures to minimize any adverse disruption on the surrounding businesses.

The project location, which is adjacent to the Prescott Airport, required close coordination with the airport operations and FAA permitting. City management fostered collaboration and coordination between the utility and airport departments to mitigate safety and permitting issues. The Airport manager provided feedback during the design phase to ensure that the project complied with the FAA safety and permitting requirements. The Airport Manager also assisted in acquiring the required FAA permits.

City management opted to acquire additional land and easements to create a noise and odor buffer zone. This required numerous meetings and negotiation sessions with the pertinent landowners and their representatives which resulted in a successful and friendly land acquisition that is expected to make the facility a "better neighbor" to the existing and future adjoining land users.

The City has also laid the ground for a future operations and administration facility that will support continuous public outreach and facilitate customer service. The facilities implemented under Phase 1 and future facilities are shown in Figure 3-2 to the right.

Figure 3-2 Operations and Maintenance Facility - Phase 1 and Future Phase



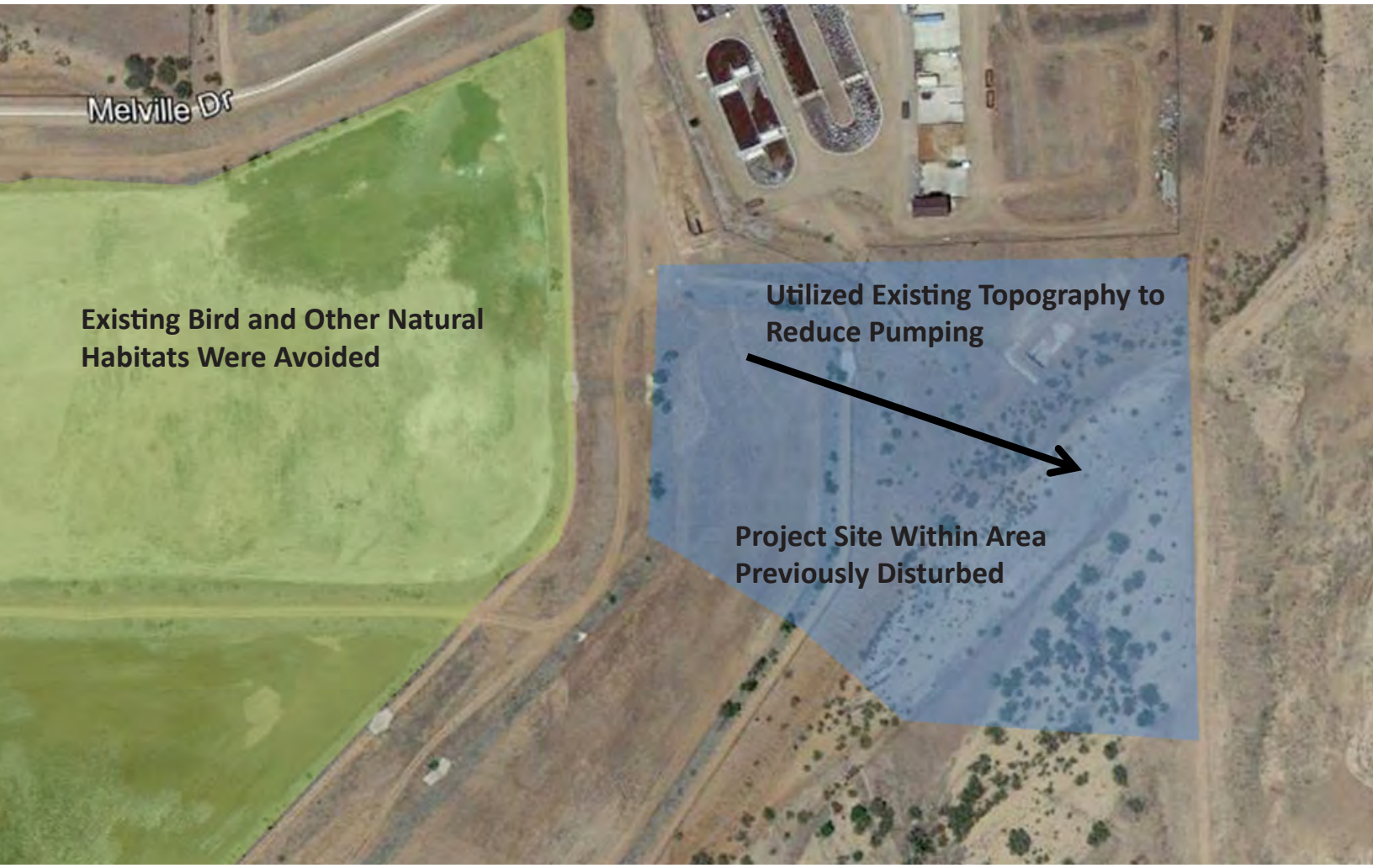
3.4 Environmental Considerations

A water reclamation project is, by nature, a project that shows the City's commitment to environmental stewardship. The City implemented this project to improve the reliability and robustness of its treatment plants and to improve the effluent quality that can be used to reduce reliability on groundwater pumping. This is critical since effluent is a renewable resource that will reduce the use of groundwater.

In addition, the City required that the design features optimize the use of energy. The plant hydraulic profile was set to minimize pumping and where necessary, utilization of high efficiency equipment. The project was setup to allow for future implementation of resource recovery such as use of digester gas. The project also used already disturbed areas or areas planned to be used for effluent recharge to minimize any impact on the native desert. In addition, low profile structures and natural color schemes were designed to minimize visual impact.

The design featured minimal paving to reduce site disturbance, decrease stormwater runoff and minimize the heat island effect.

Preservation of the environment and native species during construction was of the highest priority. Any nests or species that were encountered were carefully relocated out of the construction zone, so as to mitigate the natural habitat as much as possible. In addition, the construction site allowed for safe access to accommodate occasional and avid bird watchers.

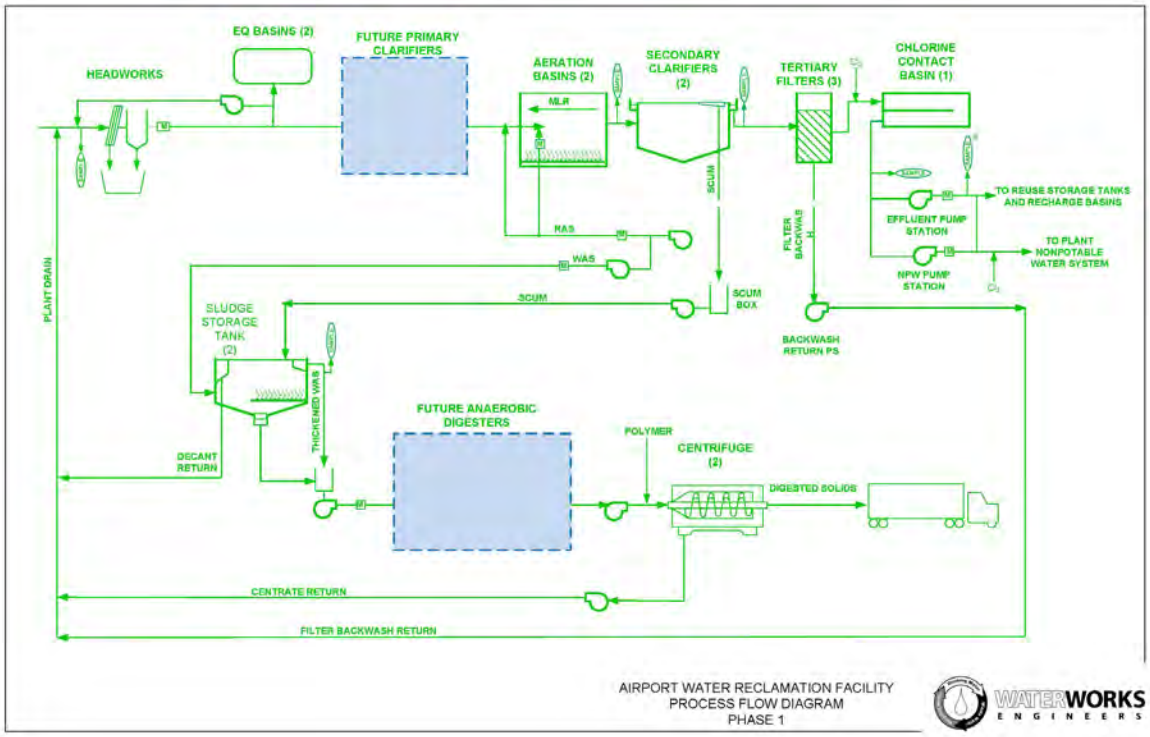


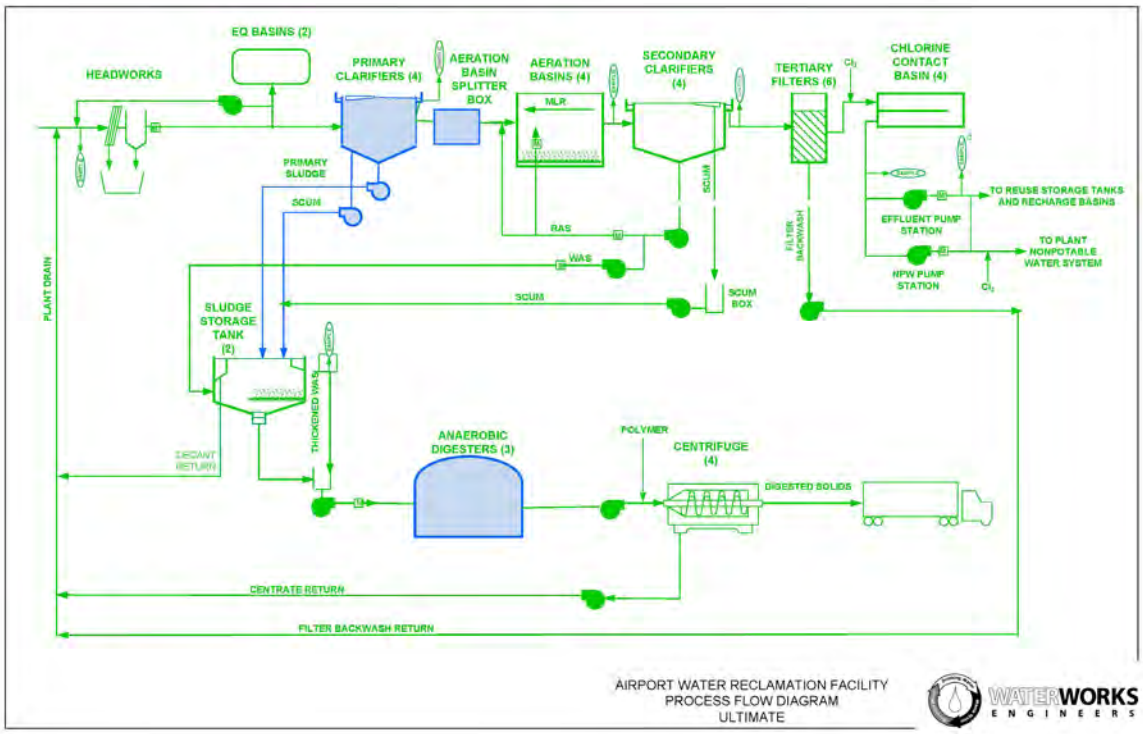
3.5 Unusual Accomplishments

3.5.1 Planning and Design Phase

Future Planning and Plant Expansion - The project planning required that the site be configured to allow phased expansions to serve between 9 and 15 MGD, dependent on the ultimate treatment scenario. The project team devised process trains and structures that can be used to provide the needed expansions without abandoning the implemented facilities. This is depicted in the simplified process schematic shown below. This plan will provide the City with flexibility to adjust the long term plan based on pace and location of growth in a cost effective manner.

Figure 3-3 Simplified Process Schematic for Phase 1 and Future Phase





3.5.2 Using Existing Facilities

The project design incorporated existing structures that were repurposed to be used for other processes at the new facility. Existing Oxidation Ditches were no longer needed and were altered to serve as equalization tanks. This allowed for more optimal sizing of the process units and reduced the size of the standby units. The secondary clarifier was modified to be a sludge holding/thickening tank and the operator building was remodeled for use as the plant laboratory. The savings achieved due to the repurposing of these existing structures were estimated at 10% of the project value.

3.5.3 Structural Design Optimization and Budget Control

The project team evaluated various methods and design features to mitigate flotation of critical structures including the aeration basins and clarifiers. Various options were considered including “pressure relief valves” and thickened slabs. Over 12 valves would have been needed per basin which could potentially result in undetectable leakage. Both options were deemed to be expensive and burdened the project budget.

The project team considered an alternative approach which consisted of a geotechnical/hydrogeotechnical evaluation that included excavating “monitoring holes” and monitoring the water level over a long period of time stretching over multiple seasons. This data was also used to determine that there was no need for dewatering during construction, thus allowing the project team to allocate more funds to benefit process systems.

3.5.4 Construction Phase

The project schedule required that the slabs in the Aeration Basins be poured during January and February of 2013. This period saw 10 days of snowfall, with a 23-day cold streak, including temperatures as low as 7 degrees Fahrenheit. Concrete must be poured when the air temperature is 40 degrees and rising, and the subgrade must be above freezing, or concrete slabs cannot be placed. To minimize the impact to the project schedule, the team implemented two strategies.

The first was to put the work crews on what was called a “flex four” schedule. The weather would dictate which four days of each seven-day week period provided the best weather, and work 10 hours on each of those days. In some cases, three 12-hour days were worked. This allowed the project to shift concrete pours from extremely cold days to days that were somewhat milder.

The second was to use blankets and propane heaters to enclose and warm the subgrade, and to cover and warm the concrete while it was curing.

The implementation of these strategies allowed the work to progress with only two weather days taken during the entire winter of 2013.

Figure 3-4 Cold Weather Causing Adverse Conditions

3.6 Additional Considerations

3.6.1 Electronic As-Builts/BIM Kiosk

During construction, the CMAR used a GPS total station to develop as-builts for all yard piping and electrical ductbanks on the X, Y & Z axis.

Project changes and clarifications were attached to the electronic as-built drawings in real time. The information was uploaded as it was collected into the electronic as-builts document database. Using wireless technology, the CMAR placed all-weather Building Information Modeling (BIM) kiosks in strategic locations on the project site, giving the field personnel, inspection staff, and all stake holders full access to the most current project data via either the Kiosk or an individual's tablet, including the most current shop drawings.

Figure 3-5 BIM Kiosk

3.6.2 Proximity to Prescott's Airport

Since the WRF site is located adjacent to the Airport, special considerations were needed during design and construction. During the design phase, the project had to address bird strike mitigation, temporary and permanent permitting for site structures and construction equipment (i.e. cranes).

The project team reviewed the bird mitigation requirements with input from Airport Operations and identified design features and operational procedures that satisfied these requirements. The design minimized any details that can attract or shelter birds and designed retention basins with "flat" slopes as recommended by the Wildlife Hazard Assessment Report.

The CMAR also acquired needed permits and followed flagging, lighting and signing instructions to address FAA requirements.

3.6.3 Plant Operation During Construction

The City staff was able to maintain a safe work environment while accommodating the site and operational disturbances needed to complete construction. The City staff, CMAR and field engineers coordinated and collaborated on a daily basis to ensure that the plant operation was not undermined and that effluent quality was not impacted by the construction activities.

During the design phase, the project team identified the tie-in points and shutdowns that may be needed. The design engineers, City staff and CMAR construction staff approach was as follows:

- The project team reviewed the design documents to minimize the shutdowns needed and develop a design that will reduce the shutdown duration
- The CMAR developed the project schedule to consolidate shutdowns, when possible, and
- The staff planned their operation to avoid the impacted areas, when feasible.

3.6.4 Startup and Commissioning in Coordination with Plant Operation

The project team had committed to a "zero exceedance" with respect to the existing plant. This was evaluated during the design and construction phases to ensure that all design features, construction sequencing and startup planning would not undermine the operation of the existing plant and impact effluent quality and regulatory compliance. The project team and plant staff were able to switch to the "new plant" without any exceedances. The team was organized and staffed to monitor the performance of both plants and ensure that the plant was continuously in compliance.

3.6.5 ADEQ Aquifer Protection Permit (APP)

The APP was developed and coordinated with ADEQ to address current and future needs. The permit was established to allow for multiple capacities under a single APP, which eliminated the need for multiple modifications as well as associated time and expenses.

Figure 3-6 Operation of Existing Plant While New Plant Was Being Constructed

4. Acknowledgement of Project Team

Project Owner: City of Prescott

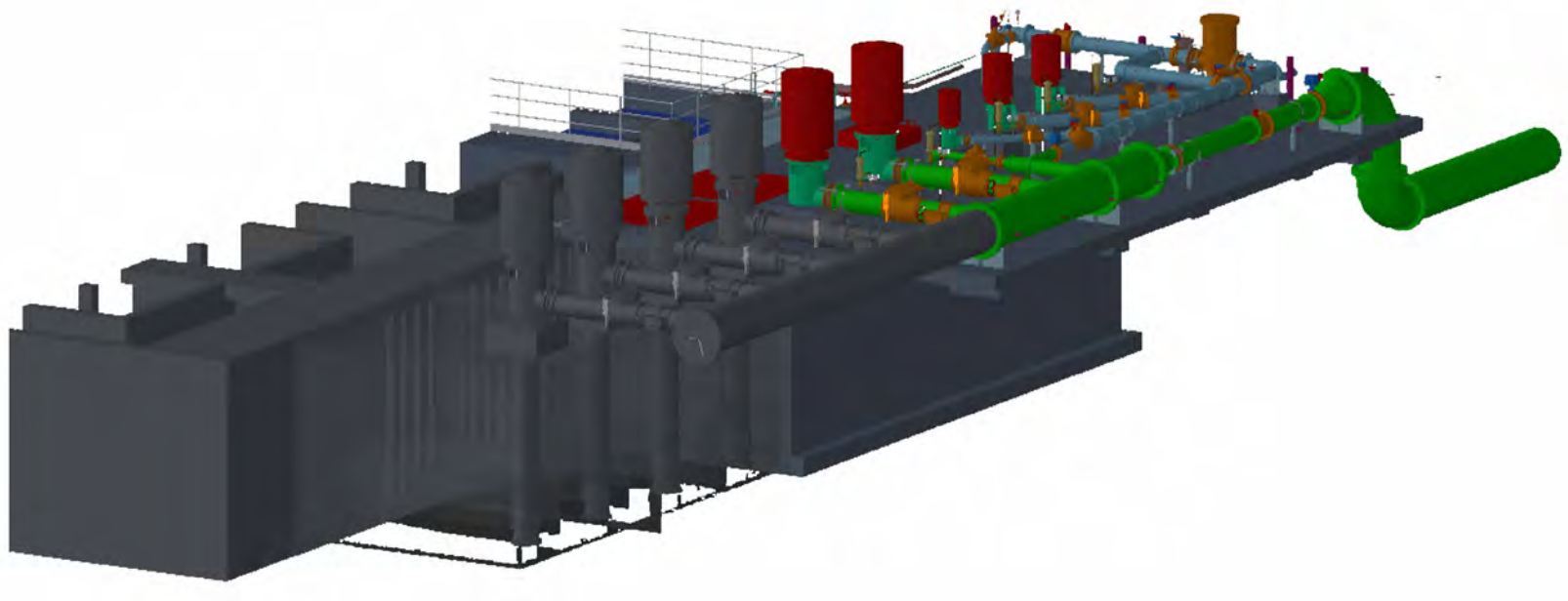
CMAR/General Contractor: Fann Environmental/PCL, A Joint Venture

Designers: Waterworks Engineers, LLC

Major Subconsultants/Subcontractors: Carollo Engineers, Civiltec Engineering, Lyon Engineering, Southwest Ground-water Consultants, Currie & Brown, Fann Contracting, ETC, Ninyo and Moore, Ludvik Electrical, Yavapai Mechanical, Yavapai Block, B's Contracting, Zac Controls, Inc., Carescape Construction,Prescott Fence, Gerdau Rebar, Liapple Masonry, A-O Painting, Cookson, Carpet One, and All West.

Additional photos and 3D models are provided to show project quality and unique siting.

Effluent Pump Station Before



Effluent Pump Station After


AIR
AIR