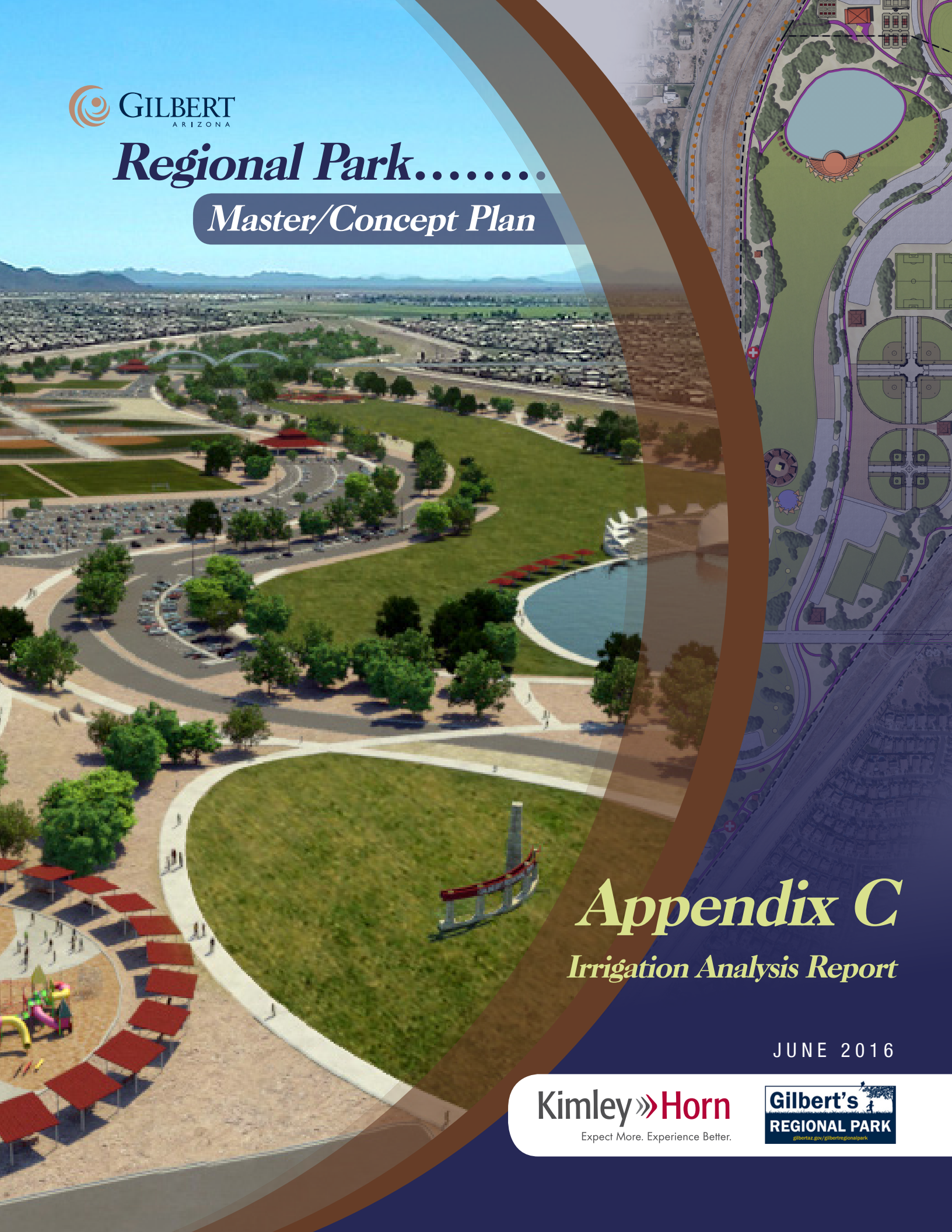
GILBERT
ARIZONA

Regional Park.....

Master/Concept Plan



Appendix C

Irrigation Analysis Report

JUNE 2016

Kimley»Horn
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TOWN OF GILBERT NEW REGIONAL PARK

IRRIGATION MASTER PLAN REPORT

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June 2, 2016

TO: Sean Wozny, P.E. LEED-AP BD+C
Kimley-Horn & Associates

FROM: Douglas G. Macdonald, FASIC LEED-AP BD+C
Cullen Kinoshita, CLIA

Project Background

The Town of Gilbert (TOG) intends to develop a new Regional park within a Non-exclusive Recreational Use Easement from Flood Control District of Maricopa County (FCDMC). The site consists of approximately 225 acres of designated property within Chandler Heights Basin. The 225 acre site is contiguous with 47 acres of TOG owned property and is located between Higley Road and East Maricopa Floodway and south of Queen Creek Road. This total 272 acre area within the basin is being considered for recreational enhancements and when developed would be the largest park in Gilbert. Kimley-Horn & Associates (Kimley-Horn) was selected as the Prime Consultant to provide a comprehensive Master/Concept Plan for the project. The goal of the TOG Park Master/Concept Plan is to develop a conceptual site plan with a preliminary estimate of probable implementation costs for identified improvements.

Aqua Engineering was included on the Kimley-Horn consulting team to provide master planning services related to the irrigation system for the park site. Aqua Engineering's scope of work for this Master Plan/Concept effort is focused on the following specific task items related to the landscape irrigation system and lake amenity design for the park:

1. Irrigation Water Resource Opportunities
   - Research and coordination with appropriate water agencies and water purveyors to understand the potential available water resources and their associated supply parameters or constraints for this project.
2. Irrigation Supply and Demand Modeling
   - Based on potential site programming elements, calculate anticipated irrigation water supply and demand requirements using several master plan scenarios developed by Kimley Horn team
3. Irrigation Water Supply, On-site Storage Facility, and Irrigation System Concept Development and Preliminary Cost Development
   - Based on anticipated irrigation water supply and demand calculations for the scenarios listed above, provide concept and preliminary cost development for on-site water resource delivery infrastructure , irrigation pumping system and distribution system elements, and on-site water storage facility. It is proposed that the on-site water storage facility will include provisions for a Community Fishing Program amenity to meet the recommendations of the Arizona Game & Fish Department (AZGFD).

Irrigation Water Resource Opportunities

Potable Water - Town of Gilbert actively discourages the use of potable water for irrigation purposes if alternative water sources are available. Due to the anticipated volume of water required to service the irrigation system at this site, and the availability of alternative water source infrastructure in close proximity to the site; the use of potable water has been deemed inappropriate as the primary water source for irrigation use at this project.

It is possible that potable water may be a desirable back-up water source for the lake and irrigation system, to be used only if the selected alternative water source(s) or conveyance infrastructure requires shut-down or repair. A line item is included in the Opinion of Probable Cost for a 2-inch potable back-up source, which is not sized to meet the anticipated peak season demand for irrigation and evaporative loss from the lake surface, but will provide a means of providing a volume of water to enable short-term management of the lake level and irrigation for the higher priority sportsturf areas shown on the overall site Master Plan. The feasibility and value of this back-up source will need to be determined by TOG representatives and the selected consulting team during the project design stage.

Salt River Project (SRP) Water – According to Town of Gilbert Water Resources Staff, SRP water infrastructure for direct irrigation use is not available at or near this project site. The process and timeframe involved in procuring a raw water source agreement with SRP, and the design and construction of the required off-site infrastructure to deliver water to this site are extremely cost-prohibitive. Therefore, the use of SRP water for irrigation use at this project has been deemed unfeasible.

Roosevelt Water Conservation District (RWCD) Water – RWCD owns and operates a surface water canal conveyance that runs along the entire western reach of the park site, on the west side of the East Maricopa Floodway (EMF). RWCD currently supplies water to Town of Gilbert for potable use at specific sites that are within the RWCD district boundaries, as referenced in the Town of Gilbert General Plan, Chapter 7:

> *Gilbert's lands located within RWCD's service area are also entitled to an allocation of surface and ground water. Gilbert only utilizes the surface water component of RWCD water, which during a normal water year varies from 0.2 to 0.6 acre-feet of water per acre of land. This water, as well as the surface water received from SRP, is treated to drinking water standards at the North Water Treatment Plant and delivered to our customers.*

Aqua Engineering, Kimley-Horn and TOG representatives met with RWCD representatives on February 16, 2016 and March 18, 2016 to discuss the potential for using RWCD water or conveyance infrastructure to service the irrigation systems at the park. Summary notes from each of those meetings are included as Appendix A and Appendix B respectively at the end of this memorandum.

At each meeting RWCD representatives expressed a strong interest in supplying water to the site, however it was determined that the site is outside of the RWCD statutory boundary of service, and that expansion of that boundary is not feasible. Other means of providing water via the RWCD infrastructure were also explored in the intial meeting including:

- Conveying water through the RWCD canal from other suppliers to a location near the site via a "Wheeling Agreement"

- Developing a “Long Term Storage Credit Exchange Agreement” to use surface water within the RWCD canal

Each of these options would require construction of a turnout structure and piped conveyance infrastructure from the RWCD canal across the EMF and into the site.

In addition, RWCD representatives indicated that there is a possibility for developing an exchange agreement between RWCD, Town of Queen Creek and Town of Gilbert to use Queen Creek treated effluent water to supplement Town of Gilbert treated effluent water that is already available for use at this site.

After further research, RWCD representatives determined that neither a “Wheeling Agreement” nor a “Long Term Storage Credit Exchange Agreement “ for water within the canal is feasible due to legal and jurisdictional issues related to “Waters of the United States”, and that an exchange agreement for treated effluent water is not an acceptable option for the Town of Queen Creek. Therefore, each of these water resource options were deemed unfeasible.

An additional option was presented by RWCD representatives at the 3/18/16 meeting involving the relocation of an existing RWCD groundwater well near the Appleby Road alignment and providing a piped conveyance from the new well location, north along the RWCD Canal to Queen Creek Road, east across the EMF to a discharge point at the park site. RWCD representatives indicated that the capacity of the existing well is approximately 2,500,000 GPD and therefore capable of accommodating the anticipated peak season irrigation demands for the site. This option would also require the establishment of a “Long Term Storage Credit” agreement between RWCD and TOG to use the groundwater.

In addition, TOG would be responsible for capping the existing well, drilling the new well, installing the new well pump and controls, and installing the new conveyance infrastructure. RWCD representatives indicated “order-of-magnitude” costs for drilling the well of $500,000, and approximately $200,000 for the new well pump and control instrumentation. The conveyance infrastructure is anticipated to require installation of approximately 4,800 LF of 8-inch PVC buried transmission pipe, and 500 LF of 8-inch Steel pipe attached to the Queen Creek Road bridge over the EMF. Aqua Engineering estimates the construction cost for this conveyance piping to be approximately $150,000. Therefore, the total cost for construction of this potential water source is approximately $850,000.

Town of Gilbert Reclaimed Water

Town of Gilbert strongly encourages the use of Reclaimed Water for irrigation and for activities that do not require water that is treated to drinking water standards. In fact, based on the current Town of Gilbert “Reclaimed Water Users Manual”;

> *Gilbert has taken a pro-active approach to the wise use of its water resources. This includes the goal of 100% reuse of its reclaimed water. This will be accomplished by either direct use for irrigation, industry and lakes maintenance or indirect use by recharging the water and storing it underground.*
>
> *In accordance with this goal, Gilbert’s Neely Wastewater Reclamation Plant and the Mesa/Gilbert/Queen Creek- shared Greenfield Wastewater Reclamation Plant produce class A+ effluent, satisfactory for open access landscape irrigation and groundwater recharge. Gilbert has obtained Reuse and Aquifer Protection Permits from the Arizona Department of Environmental Quality (ADEQ) and*

Storage and Recovery Permits from the Arizona Department of Water Resources (ADWR). Gilbert currently recharges (stores underground) all reclaimed water that cannot be used directly and recovers (pumps back) a portion of the recharged water for reuse.

Further evidence of the Town's commitment to provide Reclaimed Water as an alternative to potable water is conveyed in the following policy statement contained within the manual:

Reclaimed Water Policy
Gilbert recognizes reclaimed water as a dependable supply source that will enable Gilbert to conserve potable water supplies. It is the policy of Gilbert to, whenever possible, incorporate the use of reclaimed water. Gilbert will work actively to provide service to users that can be practically and economically served by the reclaimed water system. Gilbert's reclaimed water distribution system is continuously pressurized. System pressure is typically between 30 and 60 psi which may require the end user to install a reservoir and booster pump system if higher pressures are needed.

The latest edition of "Town of Gilbert General Plan, Chapter 7 - Environmental Planning" describes some of the infrastructure and accounting policies pertinent to Reclaimed Water treatment and distribution within TOG jurisdiction that are already in place:

Water Reclamation Facilities (WRF)
Gilbert currently operates two water reclamation facilities (WRF) that treat sewage and produce A+ quality reclaimed water, with a loss of approximately 8 to 10% of the influent total to sludge (solids) treatment. The Greenfield WRF is a joint facility operated in partnership with the City of Mesa and the Town of Queen Creek. The plant capacity is currently 16 MGD, with 8 MGD of capacity available to Gilbert, and is planned to be expanded to treat up to 42 MGD, with Gilbert's share of the capacity at 16 MGD.

Reclaimed Water
For 2009, Gilbert produced 11.32 MGD of reclaimed water, which equates to 12,683 acre-feet at the WRF's. Gilbert reuses a portion of this water through direct delivery to customers such as HOA's, schools, parks, churches, golf courses and Town park facilities. Recharge of reclaimed water is also an important component for Gilbert's water portfolio. Reclaimed water recharge credits are accumulated and are used to offset groundwater pumping in a recharge/recovery scenario, as well as for the development of Long Term Storage Credits. Gilbert recharged 8,553 acre-feet of reclaimed water in 2009 within its service area.

Recharge Facilities
In the early 1980's, Gilbert committed to reusing 100% of the reclaimed water produced through direct reuse and recharge. Reclaimed water is wastewater that has been treated at the WRF to a standard acceptable for recharge and reuse. Gilbert recharges water for the purpose of accumulating Long Term Storage Credits, which are utilized to offset current and future groundwater pumping, as well as to firm up the Assured Water Supply (see section on ADWR). Gilbert recharges unused surface water from Salt River Project and CAP, as well as unused reclaimed water that is not directly delivered to a

> *reclaimed water customer. Recharge facilities consisting of percolation basins and injection wells deliver reclaimed water to the aquifer (natural underground water storage) through infiltration.*
> *Current recharge facilities and permitted recharge amounts include:*
> - *The Neely Recharge Facility at 2.9 MGD (though it is currently limited to 800,000 GPD until the TCE contamination at a former industrial site nearby has been mitigated*
> - *The Riparian Preserve Recharge Facility at 8 MGD*
> - *The South Recharge Site at 9 MGD (upon completion of construction of basins and addition of five (5) vadose zone injection wells)*
> - *Two (2) vadose zone injection wells located at the municipal center are permitted to inject up to 1 MGD of reclaimed water directly into the ground. Three more injection wells will be constructed in the future at sites yet to be determined.*

On January 20, 2016 representatives from the Kimley-Horn consulting team and Town of Gilbert conducted a meeting to discuss potential irrigation water resource options for the park. During this meeting it was confirmed that there are several existing Reclaimed Water distribution pipelines running adjacent to, and through, the project site. These are summarized as follows:

- There is a 42-inch Reclaimed Water main installed under Queen Creek Road and Higley Road – This is a "low-head" (low pressure) line that is intended for secondary delivery of Reclaimed Water to the South Recharge Site on the east side of Higley Road north of Ocotillo, and it is currently not operational.
- There is an 18-inch pressurized Reclaimed Water main installed under Higley Road
- There is an 18-inch pressurized Reclaimed Water main installed through the center of the project site along the Ocotillo Road alignment. This line is serviced from the Greenfield WRF and it is constantly pressurized between 50-55 PSI. This line is the preferred option for supplying Reclaimed Water to the site if that alternative water source is selected as the primary source of water for irrigation purposes.

During the 1/20/16 meeting, TOG representatives indicated that in 2015

> *Reclaimed Water demands on their highest day in July used all but 300,000 gallons of the reclaimed water available from the Greenfield WRF, therefore, 300,000 GPD is the reclaimed water volume that is potentially currently available for Town of Gilbert use at this site. Queen Creek is currently not utilizing any of its 1,000,000 GPD allotment of reclaimed water from the Greenfield plant; Mesa and Gilbert have been splitting this available 1,000,000 GPD. At the point in time when Queen Creek has infrastructure in place to utilize its 1,000,000 GPD allotment, which is anticipated to be the near future, Gilbert's available allotment from Greenfield will be reduced by 500,000 GPD.*

This 500,000 GPD reduction in available Reclaimed Water represents a potential 200,000 GPD peak season deficit in the current available supply from the Greenfield plant. According to TOG representatives, the supply volume from Greenfield will likely increase as the area develops, but currently is not sufficient by itself to supply the anticipated peak season build-out demand for the Final Master Plan Concept, and a supplementary water source will be required (refer to Irrigation Supply and Demand Modeling section of this memorandum for additional information).

During this meeting, TOG representatives indicated a desire to research the possibility of developing an on-site Aquifer Storage Recovery (ASR) well to service a portion of the irrigation demands for the site. This type of well may provide the required daily demand to the lake storage facility from a groundwater source similar to the RWCD well (using Town of Gilbert storage credits) during peak season months when the reclaimed water system is not capable of providing the anticipated build-out demand, and partially or fully offset the volume water from the aquifer during peak season months by injecting reclaimed water into the aquifer during off-peak months when the irrigation demand is significantly lower.

In response to this request, representatives from Aqua Engineering, Kimley-Horn, and TOG participated in a tour on April 5, 2016 of two ASR well sites operated by the City of Chandler associated with their Airport WRF. Summary notes from that meeting are included as Appendix C at the end of this memorandum.

The purpose of this meeting was to gain a greater understanding of the operation and maintenance requirements, order-of-magnitude construction costs, site footprint, and the value that this type of facility brings to City of Chandler in order to determine if an ASR well site is a viable option to explore for the Gilbert New Regional Park site.

The basic functions of an ASR well are to provide a means of providing water into an underground aquifer for storage purposes when suitable water is available from surface sources (recharge function) and a means of drawing water from the aquifer when it is needed for beneficial use such as for irrigation (recovery function). City of Chandler operates several active ASR wells, two of which were observed during this meeting; one well is developed below grade in a vault enclosure and one well is developed on-grade within a fenced enclosure.

According to City of Chandler representatives, the order of magnitude cost range for each of the well and pumping systems is approximately $1.0M to $1.5M, and the cost range for the below grade vault installation is estimated to be approximately $500,000 more than the above-ground well and pumping system. Annual maintenance costs for either solution are approximately $20,000 (not including labor).

Following the meeting, TOG representatives indicated that the development of an on-site ASR well site that would be owned, operated and maintained by the TOG is the preferred option over the TOG's development of an off-site well and conveyance system that would be owned, operated and maintained by the RWCD.

The Gilbert New Regional Park site represents a significantly large site area, therefore either the on-grade or below grade alternative would be feasible from a space planning standpoint, with the final selection likely being based on project budgetary constraints. The below grade solution will require supplementary permitting due to the confined space requirements. For the purposes of this Master Planning effort, Aqua Engineering is showing an ASR well site on the Town of Gilbert "high and dry" property, with the vault or equipment constructed adjacent to the irrigation pumping system within a secured maintenance yard. The Irrigation Master Plan Opinion of Probable Cost indicates a budgetary number for this item with the assumption that an on-grade facility is preferred.

Irrigation Supply and Demand Modeling

Aqua Engineering assisted the consulting team with modeling of potential irrigation water supply and demand scenarios throughout the course of the Master Planning process. Numerous iterations of supply and demand modeling were required as the site Master Plan programming elements were developed.

The initial iteration provided estimated peak season flow demand as well as peak season daily and annual water demands based on 25 % increments of the site planted with turfgass and evaporative loss from a 5-acre lake. This model was used by the consulting team as an early "order of magnitude" estimate (prior to the development of site programming) for discussion purposes during the initial meetings with TOG and RWCD representatives, and this iteration is presented as Figure 1 below:

FIGURE 1: PEAK SEASON DESIGN AND ANNUAL WATER REQUIREMENTS - PRELIMINARY

Aqua Engineering, Inc.
11022 South 51st Street, Suite 104
Phoenix, AZ 85044

February 15, 2016
Project Name: Gilbert New Regional Park
Location: Gilbert, AZ
Prepared By: CBK/DGM

		Percentage of Irrigated Turfgrass at Site				
		100%	75%	50%	25%	Lake
AREA , acres		272.00	204.00	136.00	68.00	5.00
PEAK SEASON DESIGN						
PLANT WATER REQUIREMENT, inches/day		0.26 [3]	0.26 [4]	0.26 [5]	0.26 [6]	
OPERATING LOSS, inches	[1]	0.09	0.09	0.09	0.09	
TOTAL DAILY APPLICATION REQUIREMENT, inches		0.34	0.34	0.34	0.34	0.42
TOTAL DAILY APPLICATION REQUIREMENT, acre*ft		7.74	5.80	3.87	1.93	0.18
TOTAL DAILY APPLICATION REQUIREMENT, gallons		2,521,086	1,890,815	1,260,543	630,272	57,374
SEASONAL PLANT WATER REQUIREMENTS, inches		57.4	57.4	57.4	57.4	
SEASONAL EFFECTIVE PRECIPITATION, inches	[7]	0.0	0.0	0.0	0.0	
TOTAL SEASONAL IRRIGATION APPLICATION, inches	[1]	57.4	57.4	57.4	57.4	0.0
TOTAL SEASONAL IRRIGATION APPLICATION, acre*ft		1300.7	975.5	650.4	325.2	39.3
TOTAL SEASONAL IRRIGATION APPLICATION, gallons		423,837,910	317,879,000	211,918,000	105,961,000	12,813,973
IRRIGATION FLOW REQUIREMENT WITH AN IRRIGATION WINDOW OF 6 HOURS, 6 DAYS A WEEK (gpm)	[2]	10213	7660	5106	2553	
IRRIGATION FLOW REQUIREMENT WITH AN IRRIGATION WINDOW OF 8 HOURS, 6 DAYS A WEEK (gpm)	[2]	7660	5745	3830	1915	
IRRIGATION FLOW REQUIREMENT WITH AN IRRIGATION WINDOW OF 10 HOURS, 6 DAYS A WEEK (gpm)	[2]	6128	4596	3064	1532	

NOTES:

1 IRRIGATION SYSTEM APPLICATION EFFICIENCY IS ASSUMED TO BE 75%.
2 IRRIGATION SYSTEM TAP UTILIZATION EFFICIENCY IS ASSUMED TO BE 80%.
TAP UTILIZATION EFFICIENCY IS DEFINED AS THE AVERAGE DESIGN FLOW/AVERAGE AVAILABLE FLOW.
3 PEAK SEASON PLANT WATER REQUIREMENT OF 0.26 IN/DAY IS ASSUMED FOR 1
AND IS BASED ON Enter literature source here DATA AND A CROP COEFFICIENT OF 80%.
4 PEAK SEASON IRRIGATION REQUIREMENT OF 0.26 IN/DAY IS ASSUMED FOR 0.75
AND IS BASED ON Enter literature source here DATA AND A CROP COEFFICIENT OF 80%.
5 PEAK SEASON IRRIGATION REQUIREMENT OF 0.26 IN/DAY IS ASSUMED FOR 0.5
AND IS BASED ON Enter literature source here DATA AND A CROP COEFFICIENT OF 80%.
6 PEAK SEASON IRRIGATION REQUIREMENT OF 0.26 IN/DAY IS ASSUMED FOR 0.25
AND IS BASED ON Enter literature source here DATA AND A CROP COEFFICIENT OF 80%.
7 A SEASONAL PRECIPITATION OF 6.4-INCHES IS USED AND IS BASED ON Enter literature source here DATA
PRECIPITATION IS ASSUMED TO BE 0% EFFECTIVE.

As the programming elements were developed and refined based on public meetings and consensus, the supply and demand model was updated. Figure 2 below shows a calculation on a per acre basis for active use turfgrass, passive use turfgrass and desert plant canopy area. This model assisted with the iterative process by enabling the assignment of water demands for a variety of Master Plan Concepts:

F I G U R E 2 : PEAK SEASON DESIGN AND ANNUAL WATER REQUIREMENTS PER ACRE - PRELIMINARY

Aqua Engineering, Inc.
11022 South 51st Street, Sute 104
Phoenix, AZ 85044

February 9, 2016
Project Name: Gilbert New Regional Park
Location: Gilbert, AZ
Prepared By: CBK

		Ballfields	Turf	Plantings	0
AREA , acres		1.00	1.00	1.00	0.00
PEAK SEASON DESIGN					
PLANT WATER REQUIREMENT, inches/day		0.32 (3)	0.26 (4)	0.16 (5)	0.00 (6)
OPERATING LOSS, inches	(1)	0.11	0.09	0.05	0.00
TOTAL DAILY APPLICATION REQUIREMENT, inches		0.43	0.34	0.21	0.00
TOTAL DAILY APPLICATION REQUIREMENT, acre*ft		0.04	0.03	0.02	0.00
TOTAL DAILY APPLICATION REQUIREMENT, gallons		11,586	9,269	5,793	0
SEASONAL PLANT WATER REQUIREMENTS, inches		71.7	57.4	35.9	0.0
SEASONAL EFFECTIVE PRECIPITATION, inches	(7)	0.0	0.0	0.0	0.0
TOTAL SEASONAL IRRIGATION APPLICATION, inches	(1)	71.7	57.4	35.9	0.0
TOTAL SEASONAL IRRIGATION APPLICATION, acre*ft		6.0	4.8	3.0	0.0
TOTAL SEASONAL IRRIGATION APPLICATION, gallons		1,947,785	1,558,000	974,000	0
IRRIGATION FLOW REQUIREMENT WITH AN IRRIGATION WINDOW OF 6 HOURS, 6 DAYS A WEEK (gpm)	(2)	47	38	23	0
IRRIGATION FLOW REQUIREMENT WITH AN IRRIGATION WINDOW OF 8 HOURS, 6 DAYS A WEEK (gpm)	(2)	35	28	18	0
IRRIGATION FLOW REQUIREMENT WITH AN IRRIGATION WINDOW OF 10 HOURS, 6 DAYS A WEEK (gpm)	(2)	28	23	14	0

NOTES:

1 IRRIGATION SYSTEM APPLICATION EFFICIENCY IS ASSUMED TO BE 75%.
2 IRRIGATION SYSTEM TAP UTILIZATION EFFICIENCY IS ASSUMED TO BE 80%.
TAP UTILIZATION EFFICIENCY IS DEFINED AS THE AVERAGE DESIGN FLOW/AVERAGE AVAILABLE FLOW.
3 PEAK SEASON PLANT WATER REQUIREMENT OF 0.32 IN/DAY IS ASSUMED FOR Ballfields
AND IS BASED ON Enter literature source here DATA AND A CROP COEFFICIENT OF 100%.
4 PEAK SEASON IRRIGATION REQUIREMENT OF 0.26 IN/DAY IS ASSUMED FOR Turf
AND IS BASED ON Enter literature source here DATA AND A CROP COEFFICIENT OF 80%.
5 PEAK SEASON IRRIGATION REQUIREMENT OF 0.16 IN/DAY IS ASSUMED FOR Plantings
AND IS BASED ON Enter literature source here DATA AND A CROP COEFFICIENT OF 50%.
6 PLANT TYPE NOT DEFINED
--
7 A SEASONAL PRECIPITATION OF 6.4-INCHES IS USED AND IS BASED ON Enter literature source here DATA
PRECIPITATION IS ASSUMED TO BE 0% EFFECTIVE.

In accordance with the project scope of work, Kimley Horn used the information gathered from numerous public meetings to develop three distinct Master Plan Concepts for review by TOG representatives and other stakeholders (please reference these concepts in the overall Master Plan Concept report by Kimley-Horn). Figure 3 below shows the anticipated irrigation water use and lake evaporative losses based on each of those three initial concepts (also provided in larger format as Appendix D):

FIGURE 3 - PRELIMINARY IRRIGATION WATER USE SUMMARY

BY: JHK/EGK
DATE: 3-14-2016
= Input Required

INPUT:

Note: Below tabular information is in the Water Use per Acre spreadsheet

Landscape Type	Peak Demand per Acre (GPM/Acre)	Peak Daily Requirement per Acre (Gallons/Day per Acre)	Seasonal Irrigation Requirement per Acre (Acre-Feet per Acre)
Ballfields	35	11,586	6.0
Turf Areas	28	9,269	4.8
Plantings	18	5,793	3.0

8 = Assumed usable average lake depth, ft
6.3 = Estimated annual lake evaporation, ft

OUTPUT:

Landscape Concept	Irrigated Areas (acres)** Ballfields	Turf Areas	Plantings	Peak Demand (GPM)	Peak Daily Requirement* (Gallons/Day)	Seasonal Requirement* (Acre-Feet per Year)	Lake Area (Acres)	Usable Pond Storage** (Acre-Ft)	Days of Storage for Current Lake Concept*
1	24.8	45.2	36.9	2,794	1,085,404	571.7	15.46	107.4	32
2	40.3	13.7	41.6	2,535	967,107	508.4	12.4	85.0	29
3	18.0	39.5	32.8	2,323	993,446	528.8	21.34	155.2	51

*Including evaporation from lake
**Calculated using CAD tools (Areas.dwg)

Pond Storage Requirement for the Followings Days of Storage (Acre-Ft):					
2	3	5	7	10	14
6.7	10.0	16.7	23.3	33.3	46.6
5.9	8.9	14.8	20.8	29.7	41.6
6.1	9.1	15.2	21.3	30.5	42.7

Ultimately a single Master Plan Concept was developed by Kimley Horn based on TOG and stakeholder comments, and this concept was used to develop updated Peak Season Irrigation Water Use and Flow Demand Calculations per acre (see Figure 4).

FIGURE 4 : PEAK SEASON DESIGN AND ANNUAL WATER REQUIREMENTS PER ACRE

Aqua Engineering, Inc.
11022 South 51st Street, Suite 104
Phoenix, AZ 85044

May 5, 2016
Project Name: GILBERT-CHBP
Location: Gilbert, Arizona
Prepared By: CBK

		Sport Turf	Turf	Plantings
AREA , acres		1.00	1.00	1.00
PEAK SEASON DESIGN				
PLANT WATER REQUIREMENT, inches/day		0.32 (3)	0.26 (4)	0.16 (5)
OPERATING LOSS, inches	(1)	0.08	0.06	0.04
TOTAL DAILY APPLICATION REQUIREMENT, inches		0.41	0.32	0.20
TOTAL DAILY APPLICATION REQUIREMENT, acre*ft		0.03	0.03	0.02
TOTAL DAILY APPLICATION REQUIREMENT, gallons		11,003	8,802	5,501
SEASONAL PLANT WATER REQUIREMENTS, inches		69.8	55.9	34.9
SEASONAL EFFECTIVE PRECIPITATION, inches	(7)	3.8	3.8	3.8
TOTAL SEASONAL IRRIGATION APPLICATION, inches	(1)	82.6	65.1	39.0
TOTAL SEASONAL IRRIGATION APPLICATION, acre*ft		6.9	5.4	3.3
TOTAL SEASONAL IRRIGATION APPLICATION, gallons		2,243,044	1,769,000	1,059,000
IRRIGATION FLOW REQUIREMENT WITH AN IRRIGATION WINDOW OF 6 HOURS, 6 DAYS A WEEK (gpm)	(2)	48	38	24
IRRIGATION FLOW REQUIREMENT WITH AN IRRIGATION WINDOW OF 8 HOURS, 6 DAYS A WEEK (gpm)	(2)	36	29	18
IRRIGATION FLOW REQUIREMENT WITH AN IRRIGATION WINDOW OF 10 HOURS, 6 DAYS A WEEK (gpm)	(2)	29	23	14

NOTES:

1 IRRIGATION SYSTEM APPLICATION EFFICIENCY IS ASSUMED TO BE 80%.
2 IRRIGATION SYSTEM TAP UTILIZATION EFFICIENCY IS ASSUMED TO BE 75%.
TAP UTILIZATION EFFICIENCY IS DEFINED AS THE AVERAGE DESIGN FLOW/AVERAGE AVAILABLE FLOW.
3 PEAK SEASON PLANT WATER REQUIREMENT OF 0.32 IN/DAY IS ASSUMED FOR Sport Turf
AND IS BASED ON World Water for Agriculture DATA AND A CROP COEFFICIENT OF 100%.
4 PEAK SEASON IRRIGATION REQUIREMENT OF 0.26 IN/DAY IS ASSUMED FOR Turf
AND IS BASED ON World Water for Agriculture DATA AND A CROP COEFFICIENT OF 80%.
5 PEAK SEASON IRRIGATION REQUIREMENT OF 0.16 IN/DAY IS ASSUMED FOR Plantings
AND IS BASED ON World Water for Agriculture DATA AND A CROP COEFFICIENT OF 50%.
6 PEAK SEASON IRRIGATION REQUIREMENT OF 0.00 IN/DAY IS ASSUMED FOR Plant Material D
AND IS BASED ON World Water for Agriculture DATA AND A CROP COEFFICIENT OF 0%.
7 A SEASONAL PRECIPITATION OF 7.5-INCHES IS USED AND IS BASED ON World Water for Agriculture DATA
PRECIPITATION IS ASSUMED TO BE 50% EFFECTIVE.

This calculation was used in conjunction with historical monthly evapotranspiration (ET) and open water surface evaporation data for the region to determine the irrigation demand and lake evaporative loss on a monthly and daily basis throughout the year, as well as the annual water supply requirements for the site at build-out.

Aqua Engineering also requested historic data regarding average daily available reclaimed water supply for each month of the year from TOG representatives to determine if the available water supply from the reclaimed source is greater than 300,000 GPD in off-peak season demand months. TOG representatives indicated that, based on data from the past two years, the off-peak season months of January through March and September through December the reclaimed source can provide between 1.3 million gallons per day (MGD) and 1.6 MGD. The peak season months of April through August should still use a supply volume of 300,000 GPD for the project.

Based on the reclaimed water supply data provided by TOG representatives, Aqua Engineering made the assumption for this Master Planning effort that January and December would provide approximately 1.6 MGD, February and November would provide approximately 1.5 MGD, October would provide approximately 1.4 MGD, and March and September would provide approximately 1.3 MGD. Using these figures, Aqua Engineering developed an Irrigation Water Supply & Demand Balance Study for project build-out demands to determine anticipated seasonal and annual surplus and deficit parameters (see Figure 5, also provided as Appendix E).

FIGURE 5 - Irrigation Reclaimed Water Supply & Demand Balance Study - DRAFT (Revised 5/18/16)

5/18/2016

Daily Supply and Demand

	J	F	M	A	M	J	J	A	S	O	N	D	TOTAL
Reclaimed Supply (1000 gal)	1600	1500	1300	300	300	300	300	300	1300	1400	1500	1600	11,700
Irrigation Demand (1000 gal)	172	258	362	530	675	780	758	681	561	374	225	160	5,537
Lake Evaporative Loss (1000 gal)	21	31	43	63	79	92	92	83	70	48	30	21	673
Irrigation and Evaporation Demand (1000 gal)	193	289	405	592	755	872	850	765	632	422	255	180	6,210
Surplus or Deficit (1000 gal)	1,407	1,211	895	-292	-455	-572	-550	-465	668	978	1,245	1,420	5,490

Surplus or Deficit Graph

Monthly Supply and Demand

	J	F	M	A	M	J	J	A	S	O	N	D	TOTAL
Reclaimed Supply (1000 gal)	49,600	42,000	40,300	9,000	9,300	9,000	9,300	9,300	39,000	43,400	45,000	49,600	354,800
Irrigation Demand (1000 gal)	5,328	7,231	11,227	15,889	20,931	23,405	23,500	21,122	16,840	11,607	6,755	4,947	168,783
Lake Evaporative Loss (1000 gal)	658	873	1,327	1,877	2,461	2,752	2,846	2,579	2,105	1,479	902	643	20,503
Irrigation and Evaporation Demand (1000 gal)	5,986	8,104	12,554	17,766	23,393	26,157	26,346	23,700	18,945	13,087	7,657	5,590	189,286
Surplus or Deficit (1000 gal)	43,614	33,896	27,746	-8,766	-14,093	-17,157	-17,046	-14,400	20,055	30,313	37,343	44,010	165,514

Surplus or Deficit Graph

Based on this supply and demand study, it is estimated that the off-peak months of January through March and September through December will provide a reclaimed water supply surplus of approximately 237 million gallons. The remaining months of the year all show a supply deficit totaling approximately 71.5 million gallons, resulting in a net annual supply surplus of approximately 165.5 million gallons from the available reclaimed water source.

If the Town of Gilbert decides to pursue their preference for developing an on-site ASR Well, then the surplus months can be used to recharge the entire volume of groundwater that will need to be withdrawn using their available Long Term Storage Credits during the deficit months. Alternatively, the reclaimed water could be augmented with groundwater from the off-site RWCD well and conveyance as described previously in this memorandum.

Irrigation Water Supply, On-site Storage Facility, and Irrigation System Concept

Reclaimed Water Supply Flow Volume Parameters

In order to develop an Opinion of Probable Cost for the Reclaimed Water service line from the Ocotillo supply main, the 1.6 MGD parameter provided by TOG representatives was used, and it is assumed that the Reclaimed Water supply would flow on a 24/7 basis during peak season. That equates to a flow volume of approximately 1,100 GPM which, based on AWWA C701 parameters for continuous duty turbine meters, will require a 6” water meter. Further, assuming 4,750 linear feet of Class 200 PVC from the point of connection at the Ocotillo Reclaimed Water supply main to the anticipated location of the ASR Well site at a maximum velocity of 5 feet per second, it is estimated that the on-site Reclaimed Water conveyance pipe will be 10” in nominal diameter for the entire length of the pipe run.

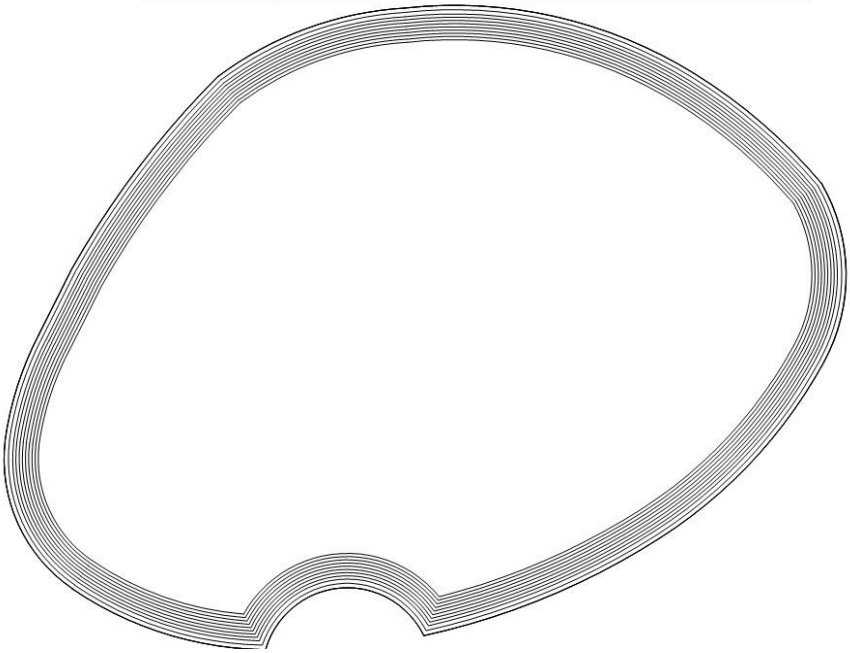
Lake Storage Volume Calculations

As previously noted, the available water supplied by the Reclaimed Water source is insufficient by itself to service the build-out demands of the Gilbert New Regional Park. During the peak season month of June it is estimated that the daily deficit from the Reclaimed Water source is approximately 572,000 gallons. The effect of this deficit may be partially offset by the on-site lake that has been included in the Master Plan Concept for use as an irrigation water storage facility as well as a Community Fishing Amenity.

Using the Final Master Plan Concept for an 8-acre lake surface as provided by Kimley Horn, Aqua Engineering completed order-of-magnitude lake grading and storage volume modeling to determine storage volume in the lake for irrigation use (see Figure 6 on the next page, also provided as Appendix F).

Figure 6 Lake Grading & Volume Calculations

Depth	Average Slope X-1	Cubic Feet	Acre Feet	Cubic Yards	Gallons	Liner Area	Surface Area	Perimeter	% of Total Volume
12	0	348696.19	8.00	12914.67	2608428.68	2229.04	348867.09	2218.31	9.13
11	0	348474.43	8.00	12906.46	2606769.77	2228.36	348585.30	2217.64	9.12
10	4.00	343956.56	7.90	12739.13	2572973.73	9085.28	346363.57	2216.96	9.00
9	4.00	335196.19	7.70	12414.67	2507441.63	8974.68	339549.55	2190.07	8.77
8	3.00	327612.88	7.52	12133.81	2450714.52	6809.34	330842.83	2163.31	8.58
7	3.00	321182.92	7.37	11895.66	2402615.11	6746.19	324382.92	2143.31	8.41
6	3.00	314812.80	7.23	11659.73	2354963.25	6683.21	317982.92	2123.37	8.24
5	3.00	308502.34	7.08	11426.01	2307757.79	6620.39	311642.67	2103.48	8.07
4	3.00	302251.43	6.94	11194.50	2260997.69	6557.70	305362.02	2083.63	7.91
3	3.00	296059.92	6.80	10965.18	2214682.01	6495.14	299140.84	2063.83	7.75
2	3.00	289927.71	6.66	10738.06	2168809.89	6432.70	292979.01	2044.07	7.59
1	3.00	283854.69	6.52	10513.14	2123380.53	287203.32	286876.42	2024.34	7.43
Totals	32.20	3820528.06	87.71	141501.04	28579534.59	356065.36	3854515.13	25592.32	100.00



This calculation assumes a two-foot vertical wall around the entire lake perimeter in order to reduce the visual effect of lake draw-down from irrigation water use and lake evaporative loss during peak season conditions. The lake grading study incorporates an initial recovery shelf at a 4:1 slope for public safety; this shelf provides a shallow water zone around the perimeter of the lake that enables a person to climb out of the lake in the event that they accidentally fall into the water. Beyond that recovery shelf, the lake slope increases to a 3:1 slope until it reaches the maximum depth of 12-feet.

It is anticipated that the available water storage for irrigation use will exclude the bottom 3-feet of the lake, due to the fact that the intake screen and intake piping from the lake to the irrigation pump station wet well will be set above the bottom of the lake. Therefore, the maximum useable water storage volume for the lake is approximately 24.3 million gallons. Applying that maximum storage volume to the calculated peak season daily irrigation demand and lake evaporative loss of approximately 872,000 gallons per day indicates that the on-site lake will provide approximately 28 days of water storage during peak season.

However, it is generally assumed that the daily lake draw-down will not exceed 6-inches of vertical loss for aesthetic and functional reasons, particularly because the lake is intended to be used as a Community Fishing amenity. Since the top 12-inches of the lake has a storage capacity of approximately 2.6 million gallons in this model, a 6-inch draw-down equates to a loss

of 1.3 million gallons and the 872,000 daily loss would need to be replenished every 1.5 days during peak season.

Lake Liner Considerations

In order to mitigate loss of water through seepage into the ground, and to comply with the regulations of the FCDMC regarding the Waters of the United States, the lake will require a lining system. There are numerous alternatives for effective lake lining systems including synthetic liner material (PVC, RPP, RPE and HDPE), expansive soil liner (bentonite clay) and soil sealant techniques (ESS-13). A critical step in determining the most appropriate liner system is to understand the existing soil conditions at the site. It will be necessary for the design team to engage the services of a geotechnical engineering firm during the Construction Document development process to conduct a study and present the results in a report that can be used to identify possible lining solutions.

Based on FCDMC regulations, Aqua Engineering believes that a synthetic liner is the most likely solution for this project. Of the typical synthetic liner alternatives, HDPE is likely the least desirable for this project due to its tendency to expand and contract with temperature variations. RPP and RPE may be reasonable solutions, they tend to be slightly more expensive for the liner material than the PVC liner solution but they do not degrade from direct UV exposure in sunlight, which is a characteristic of PVC liner material. However, because this facility is intended to be a Community Fishing amenity, it is anticipated that the bottom of the lake will require a compacted soil cover to facility an effective fish habitat, so exposure of the PVC liner to sunlight will not be an issue. Therefore, for cost purposes this Master Plan assumes the use of a PVC liner, installed over a clean, compacted soil base, and below a protective layer of geo textile and a 12-inch layer of compacted soil cover. The following photos are examples of successful PVC liner installations in Community Fishing lakes around the region:

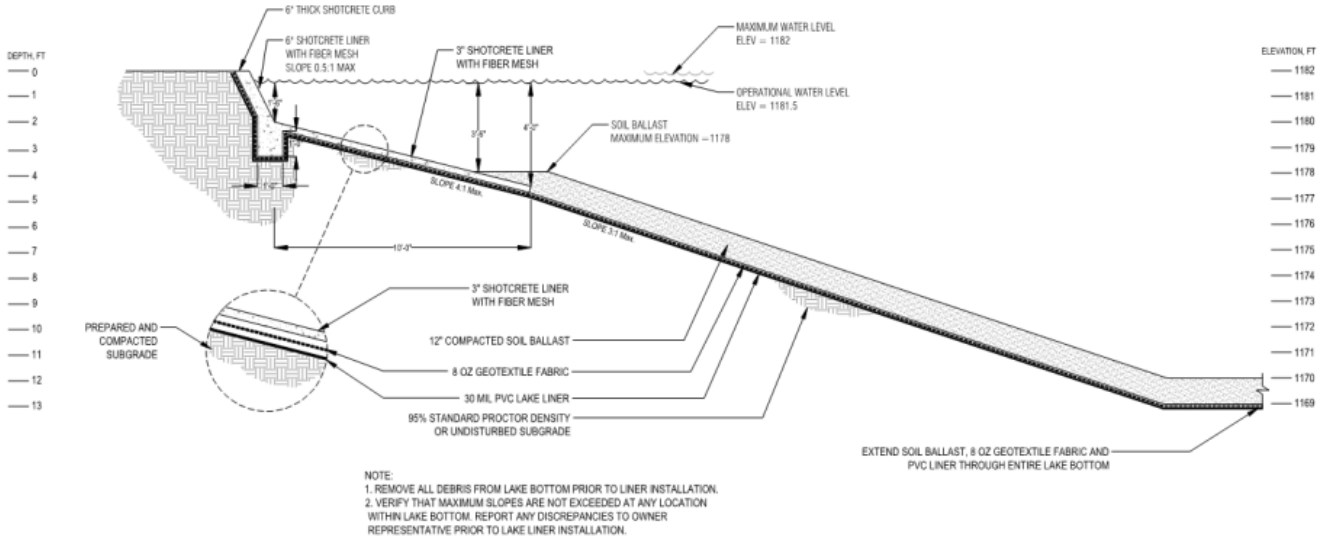
PVC Liner Installation at Pioneer Park in Peoria, Arizona

PVC Liner Installation In-progress at Copper Sky Park in Maricopa, Arizona

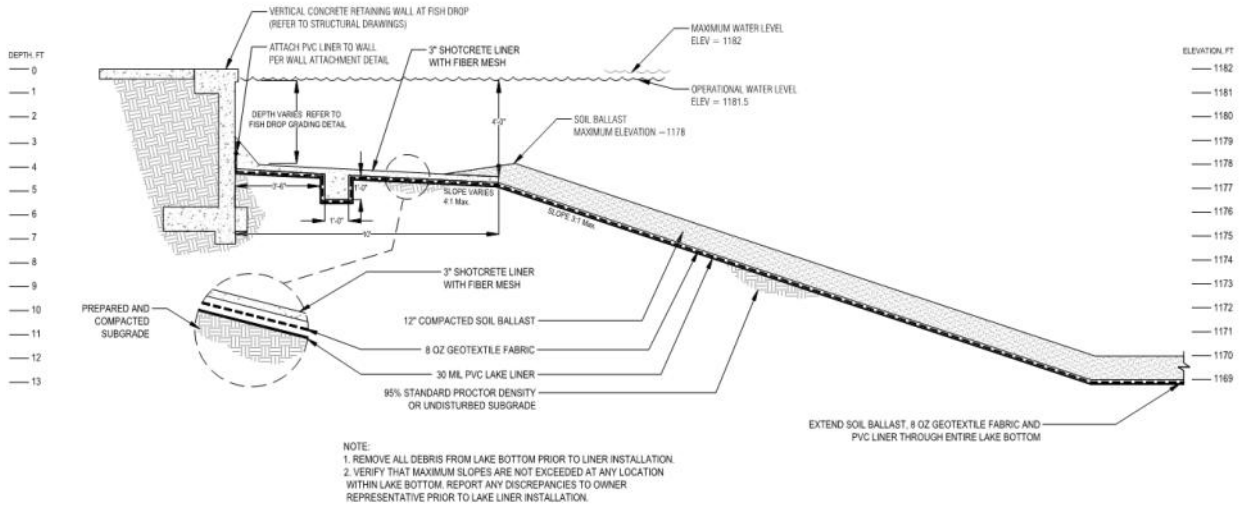
Lake Edge Treatment Considerations

Similar to lake lining solutions, there are numerous possible approaches to providing an effective edge treatment around the perimeter of the lake. Because the lake is intended to be a Community Fishing amenity, the most likely and cost effective solution will be a combination of a near vertical shotcrete edge, and a vertical reinforced concrete structural edge. The shotcrete edge enables the installation of the liner to wrap up behind the hard surface to effectively contain water within the lake while providing a durable consistent edge that enables anglers to fish along the edge of the lake. The vertical reinforced concrete edge enables viewing and fishing platforms along the lake edge and also facilitates vehicular access to the edge of the lake for fish stocking purposes by the AZGFD. For this type of edge treatment, Aqua Engineering has had success retaining the liner below water level on the vertical concrete face using a batten strip sealant contained by stainless-steel hardware.

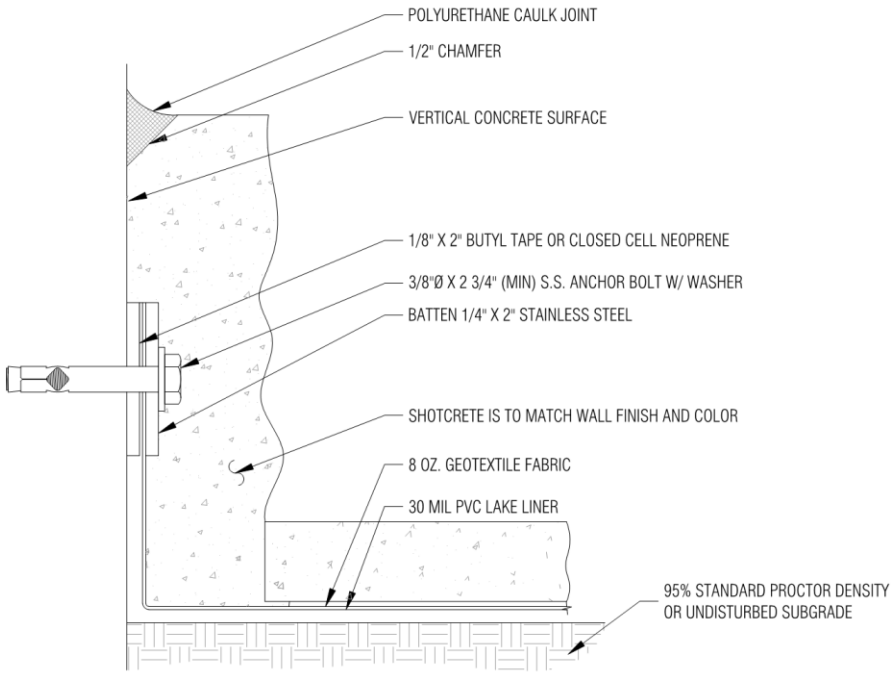
The lake design consultant will need to coordinate closely with TOG representatives during the Construction Document process to determine which lake edge treatment solutions are appropriate for specific site conditions. The following examples of possible edge treatment details are provided for each of these conditions:



Example of Shotcrete Edge & PVC Liner Treatment



Example of Vertical Concrete Structural Edge Treatment



Example of Batten Strip Liner Attachment Technique for Vertical Concrete Edge

Lake Perimeter Recirculation System

In order to maintain a high level of water quality and to mitigate “dead spots” in the lake that tend to collect surface debris and promote algae blooms, a recirculation piping system is anticipated around the lake perimeter. This system typically uses a high volume, low head fixed speed recirculation pump that is included as part of the irrigation pumping system skid package. Based on the size of the lake and an estimated quantity of recirculation discharge points around the lake, Aqua Engineering is estimating the following equipment for the purpose of developing an Opinion of Probable Cost:

- Recirculation Pumping System: Constant speed 30 HP vertical turbine recirculation pump (1,100 GPM, 30 PSI)
- Recirculation piping:
  - 12” – 460’
  - 8” – 560’
  - 6” – 1,000’
  - 4” – 450’
  - 2” - 550’
- Recirculation System Balance Valves at Lake Edge
  - 2-inch gate valves: 22

Lake Bottom Aeration System

A pond aeration system is recommended to maintain suitable water quality in the irrigation storage and Community Fishing lake. Typically, lake bed aeration systems use aeration diffuser module that bubble air through the water. This method is efficient and is not noticeable unless the water surface is totally calm. In addition, this type of aeration system removes the possibility of accidental spray leaving the lake perimeter boundary. Aqua Engineering typically sizes lake bed aeration systems, particularly those that use Reclaimed Water as a source, such that the water moves from the lake bed to the surface (also termed “lake turnover rate”) at least four times per day, within a 12-hour operational timeframe.

An air compressor system is specified to generate the volume of air that is pumped to each diffuser module within the lake. Air distribution tubing conveys the compressed air to the lake bottom diffuser modules; it is estimated that a lake of the size indicated on the Master Plan Concept will require between 25 to 30 diffuser modules. Flow meters and balance valves are typically specified on the discharge of the compressor for each aeration module to regulate and balance the air flow rate.

The lake bed aeration compressors and controls are typically located in the same enclosure as the irrigation pumping system, and it is important to maintain an ambient temperature not to exceed 105-degrees Fahrenheit within the enclosure, so shade or a means of controlling temperature is recommended. The following photo is an example of a lake bed aeration mechanical system installation in Henderson, Nevada:

Example of Lake Aeration Mechanical System Installation

Fish Habitat Considerations

As previously noted, the lake for this project is anticipated to provide a Community Fishing amenity that meets the recommendations of the Arizona Game and Fish Department. Those recommendations include the development of habitat that will promote a healthy fish population within the lake. It is recommended that the design team coordinate with the Community Fishing Program Specialist prior to commencing with the lake design to identify potential strategies for fish habitat development within the lake.

Generally, AZGFD recommends several different rock reef habitats that will enable the development of fish population growth and regeneration. These include a spawning reefs (2-inch minus gravel) in the shallow perimeter of the lake, mid-size reefs (4-12 inch rock) in the middle depth portion of the lake, and large material reefs (12-inch plus rock and material) on the lake bottom. The following photos show examples of fish habitat installations in Community Fishing lakes around the region:

Example of Varied Fish Habitat Treatments in Pioneer Park Lake Peoria, Arizona

Example of Lake Edge, Spawning Reef, & Lake Bottom Fish Habitat in Copper Sky Lake Maricopa, AZ

Irrigation Pump Station

Water will be delivered from the irrigation lake to the irrigation pump station via an intake structure, intake pipe, and precast concrete wet well. The following is anticipated for this project based on the Final Master Plan Concept:

- One 48-inch square intake screen.
- 36-inch HDPE DR32.5 PE4710 Resin intake pipe from intake screen to the wet well.
- 8-foot diameter circular concrete wet well with an approximate depth of 30-feet.

The irrigation pump station is anticipated to be an engineered, prefabricated, multiple pump, vertical turbine pump station that includes the following:

- Three 75 HP vertical turbine main pumps and a 7.5 HP submersible pressure maintenance pump (2,500 GPM, 100 PSI)
- Constant speed 30 HP vertical turbine recirculation pump as previously noted
- Variable Frequency Drive
- Water level sensors and controls
- Electromagnetic flow sensor
- Wet well hatch
- Dog leg discharge pipe
- Two automatic flushing, suction scanner, filtration systems with 200 micron stainless steel screens. Filters plumbed in parallel.

It is anticipated that the irrigation pumping system, lake bed aeration mechanical system, and ASR Well site will be contained within a secure and shaded area adjacent to the on-site maintenance facility.

Irrigation System Equipment

A preliminary irrigation system Master Plan Concept Diagram was developed to assist with the build-out Opinion of Probable Cost (refer to Appendix G). Mainline pipe sizes have been estimated based on the anticipated mainline routing using a hydraulic modeling software program (refer to Appendix H).

During the research stage of this Master Planning effort, Aqua Engineering contacted TOG parks maintenance staff about their current irrigation equipment standards, and it is noted that TOG is currently in the process of updating their standards for irrigation equipment. The town historically has used the Motorola Irrinet/Scorpio central control system, but they are beginning a pilot program with four different manufacturers to determine whether they will continue to use the next generation of Motorola central controls (currently the Motorola ACE system) or change to a different manufacturer's system.

For the purpose of providing a build-out Opinion of Probable Cost for this Master Plan Concept, Aqua Engineering has assumed the following equipment standards:

- Motorola ACE satellite controllers with conventional low-voltage wiring and radio communications interface to the TOG existing central control system
- PVC mainline piping
    - 12" and larger using C900 PVC with deep bell ductile-iron gasketed fittings
    - 4" and 10" using Class 200 PVC with deep bell ductile-iron gasketed fittings
    - 3" and smaller using Sch 40 PVC with Sch 80 solvent-weld fittings
- Isolation gate valves at appropriate locations along mainline routing to isolate segments of the system
- Air/Vacuum Relief Valves at appropriate locations along mainline routing to enable draining and recharging the system during repairs
- Quick Coupling Valves at an approximate interval of 200' along mainline routing to enable hose connections for incidental watering and hardscape washdown
- Solenoid actuated Sprinkler and Drip Remote Control Valves
- Pop-up rotary sprinklers to irrigate turfgrass with horizontal dimensions greater than 30-feet across
- Pop-up spray sprinklers to irrigate turfgrass with horizontal dimension less than 30-feet across
- Single outlet and multiple outlet emitters to irrigate trees, shrubs and groundcover planting

An effort has been made to quantify this equipment at the Master Plan Concept level, and it is presented in the following Opinion of Probable Cost documentation.

Preliminary Irrigation and On-site Storage Facilities Opinion of Probable Cost

Gilbert New Regional Park
Irrigation Master Plan Opinion of Probable Construction Cost
Town of Gilbert, Arizona

REV1 DRAFT for client review and comment

May 18, 2016

No.	Description	Units	Number	Unit Cost	Total Cost
Irrigation Water Supply					
1	Reclaimed Water Meter w/ CMU Enclosure (6" Turbine Meter) NIC plant investment fees	LS	1	$18,000.00	$18,000.00
2	Reclaimed Water Supply Line to Lake (10" Class 200 PVC)	LF	4,750	$30.00	$142,500.00
3	Reclaimed Air Gap Wet Well Assembly at Lake	LS	1	$12,000.00	$12,000.00
4	ASR Well Equipment & Controls (assumes above grade installation in maintenance yard similar to Chandler ASR)	LS	1	$1,300,000.00	$1,300,000.00
5	Potable water back-up supply (for short-term emergency only, 2" Meter & supply line, Air Gap Assembly) NIC plant investment fees	LS	1	$7,500.00	$7,500.00
	Subtotal Irrigation Water Supply Construction Costs			**Subtotal**	**$1,480,000.00**
Lake					
1	Excavation of Lake (assumes 24" vertical wall, 4:1 recovery shelf, 3:1 slope to 12' depth at bottom)	CY	141,501	$5.00	$707,505.00
2	Stock Pile Excavated Soil On Site	per 10 CY truckload	14,150	$18.00	$254,701.80
3	Lake Edge Treatment (assumes combination shotcrete edge and structural edge)	LF	2,400	$75.00	$180,000.00
4	Lake Liner (Inludes fine grading, 30 mil PVC Liner, 8 oz geotextile, 12" soil cover and compaction)	SF	352,000	$1.75	$616,000.00
5	Soils & Liner Testing	LS	1	$7,500.00	$7,500.00
6	Pond Aeration System with Diffusers	LS	1	$45,000.00	$45,000.00
7	Overflow Pipe to Sewer (18" PVC)	LF	400	$45.00	$18,000.00
8	Recirculation Piping (avg 6" PVC)	LF	3,100	$18.00	$55,800.00
9	Recirculation Balance Valves (2" gate valve)	EA	22	$400.00	$8,800.00
10	Lake Level Controls	LS	1	$10,000.00	$10,000.00
11	Fish Habitat Allowance	LS	1	$50,000.00	$50,000.00
	Subtotal Lake Construction Costs			**Subtotal**	**$1,953,306.80**
Irrigation Pump System & Enclosure					
1	4" CL200 PVC Filter Backwash Pipe to Lake	LF	450	$12.00	$5,400.00
2	36" HDPE Pump System Intake Pipe (incl intake screen)	LF	600	$200.00	$120,000.00
3	96" diam x 30' deep Wet Well	EA	1	$40,000.00	$40,000.00
4	Pre-fabricated Irrigation Pump System Skid with Automatic Filtration	EA	1	$285,000.00	$285,000.00
5	Pump Station Electrical	LS	1	$65,000.00	$65,000.00
6	Pump Station CMU Enclosure with Shade Structure	LS	1	$75,000.00	$75,000.00
	Subtotal Pump & Enclosure Construction Costs			**Subtotal**	**$590,400.00**
Irrigation System					
1	14" C900 PVC w DI Fittings	LF	360	$42.00	$15,120.00
2	12" C900 PVC w DI Fittings	LF	2,600	$36.00	$93,600.00
3	10" CL200 PVC w DI Fittings	LF	2,400	$30.00	$72,000.00
4	8" CL200 PVC w DI Fittings	LF	3,100	$24.00	$74,400.00
5	6" CL200 PVC w DI Fittings	LF	6,200	$18.00	$111,600.00
6	4" CL200 PVC w DI Fittings	LF	6,200	$12.00	$74,400.00
7	3" SCH40 PVC w PVC Fittings	LF	1,600	$9.00	$14,400.00
8	2" SCH40 PVC w PVC Fittings	LF	8,000	$6.00	$48,000.00
9	12" Gate Valve	EA	2	$3,000.00	$6,000.00
10	10" Gate Valve	EA	4	$2,400.00	$9,600.00
11	8" Gate Valve	EA	6	$1,800.00	$10,800.00
12	6" Gate Valve	EA	8	$1,500.00	$12,000.00
13	4" Gate Valve	EA	8	$1,000.00	$8,000.00
14	3" Gate Valve	EA	4	$800.00	$3,200.00
15	2" Gate Valve	EA	12	$400.00	$4,800.00
16	2" Air/Vac Relief Valve	EA	6	$800.00	$4,800.00
17	1" Quick Coupling Valve	EA	155	$350.00	$54,250.00
18	Irrigation Satellite Controllers w Central Communication	EA	10	$8,500.00	$85,000.00
19	Sprinkler Irrigation in Sportsturf Areas (inc RCV, wire, lateral, sprinkers)	SF	1,151,703	$0.65	$748,606.95
20	Sprinkler Irrigation in Passive Turf Areas (inc RCV, wire, lateral, sprinkers)	SF	2,109,764	$0.55	$1,160,370.20
21	Drip Irrigation in DG Areas (30% canopy cover, inc RCV, wire, lateral, emitters)	SF	522,720	$0.35	$182,952.00
22	Contigency for Rock Trenching & Bedding	LS	1	$50,000.00	$50,000.00
	Subtotal Irrigation Construction Costs			**Subtotal**	**$2,843,899.15**
Miscellaneous					
1	Allowance for Incidentals	LS	1	$100,000.00	$100,000.00
2	Mobilization & General Conditions (7.5%)	LS	1		$522,570.45
3	Contingency (10%)	LS	1		$749,017.64
	Subtotal Miscellaneous				**$1,371,588.09**
	Total Construction Costs				**$8,239,194.04**

NOTES:
1. This Opinion of Probable Construction Cost is not intended for use in bidding or ordering of equipment. Aqua Engineering will not be responsible for differences between this information and actual project equipment quantities or construction costs.
2. This Opinion of Probable Construction Cost does not include design and consulting fees or other soft cost items.

Appendix and Supplementary Documentation

APPENDIX A – RWCD Investigative Meeting #1_2016-02-16

APPENDIX B – RWCD Investigative Meeting #2_2016-03-16

APPENDIX C – Chandler ASR Well Site Meeting_2016-04-05

APPENDIX D – Prelim Water Use for Three Concepts_2016-03-14

APPENDIX E – Water Supply & Demand Balance Study-REV1_2016-05-18

APPENDIX F – Preliminary Lake Grading & Volume Study_2016-05-09

APPENDIX G – Irrigation Master Plan Concept Diagram_2016-05-06

APPENDIX H – Preliminary Irrigation Mainline Hydraulic Model_2016-05-05

APPENDIX I – Draft Irrigation & Lake Opinion of Probable Cost-REV1_2016-05-18

APPENDIX A

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MEMORANDUM

February 17, 2016

TO: Sean Wozny
Kimley Horn

FROM: Douglas G. Macdonald

RE: **Gilbert CHBP Master Plan**
Roosevelt Water Conservation District Investigative Meeting on Feb 16, 2016

The following represents a summary of my notes from the meeting at Town of Gilbert Civic Center regarding potential for using water supplied from existing RWCD infrastructure to service a portion of the irrigation demand at the referenced project:

- RWCD representatives in attendance expressed a strong interest in providing water for irrigation purposes at this site.
- It was noted by RWCD representatives that the project site is outside of their district boundary, and they have no precedence for providing water to a site outside of their boundary
    - The opportunity to use their available water supply will require further investigation to confirm the legal ramifications for supplying that water to the project.
    - If the legal ramifications can be resolved, they will also need to determine a rate structure for supplying that water, since no precedence exists
- RWCD outside counsel present at the meeting indicated that the East Maricopa Floodway (EMF) is considered “Waters of the United States”, and RWCD is not permitted to discharge water from their system into “Waters of the US”
    - Town of Gilbert, Kimley Horn and Aqua Engineering representatives indicated that it is likely that water supplied to the site for irrigation purposes will be delivered and stored either on the Town of Gilbert “High and Dry” parcel, or the Maricopa County Flood Control District “Upper Basin” parcel as identified in the Site Tour Book which was distributed to meeting attendees by Kimley Horn during this meeting
    - This may have ramifications in the RWCD delivery of water to the site, how the water is used by Town of Gilbert on-site for irrigation if there is potential that the water may find its way into the EMF under certain conditions, and where the dividing line between RWCD water delivery and Town of Gilbert use of the water is drawn.
    - Further investigation by both parties will be required as it relates to this item.

- Town of Gilbert representatives inquired about the potential and effort involved in adjusting RWCD district boundaries to include the project site
    - RWCD representatives responded that the district boundaries are statutory and regulated by ADWR and other state agencies, so adjusting the boundaries are likely to be difficult, costly and time consuming.
    - Further investigation by RWCD will be required as it relates to this item.
- RWCD representatives indicated that there may be several options available for delivery of water through their infrastructure to the project site including:
    - Using the RWCD canal infrastructure to carry water that is purchased or leased from other water suppliers to a turnout structure near the site – this is termed a "wheeling agreement". This would require Town of Gilbert to obtain the water on their own, the RWCD channel is only used for conveyance under this option.
    - Develop an agreement with RWCD for "long-term storage credit" exchange to use water that is in the RWCD channel for on-site purposes based on credits previously established by Town of Gilbert
    - Develop an exchange agreement between Town of Gilbert, Town of Queen Creek and RWCD for use of Queen Creek treated effluent water to supplement the Gilbert treated effluent for use at this site
    - Further investigation by both parties will be required as it relates to each of these items.
- RWCD representatives inquired about the potential volume of water required for irrigation at the project site
    - Aqua Engineering provided a PRELIMINARY worksheet that describes potential irrigation demand based on 100%, 75%, 50% and 25% of the site being developed as irrigated turfgrass, and for anticipated evaporative losses from a 5-acre open water storage facility (lake). A copy of that worksheet in pdf format is provided with these notes.
- It was determined that RWCD representatives will provide further investigation into the costs and feasibility of pursuing the following:
    - Potential water exchange agreements as described in this memo
    - Potential for "wheeling water" to the site through their infrastructure
    - Potential for expanding their district boundary to include all, or a portion of, the project site
- A follow-up meeting will be scheduled by Town of Gilbert representatives for mid-March to discuss the findings of RWCD for these items.

The foregoing is our understanding of the issues discussed during this meeting. Please contact Doug Macdonald (970.372.6123) immediately should you have any revisions or clarifications.

T A B L E 1: PEAK SEASON DESIGN AND ANNUAL WATER REQUIREMENTS - PRELIMINARY

Aqua Engineering, Inc.
375 E. Horsetooth Rd, Bldg 2-202
Fort Collins, CO 80525-3196

February 15, 2016
Project Name: Gilbert New Regional Park
Location: Gilbert, AZ
Prepared By: CBK/DGM

		Percentage of Irrigated Turfgrass at Site				
		100%	75%	50%	25%	Lake
AREA , acres		272.00	204.00	136.00	68.00	5.00
PEAK SEASON DESIGN						
PLANT WATER REQUIREMENT, inches/day		0.26 (3)	0.26 (4)	0.26 (5)	0.26 (6)	
OPERATING LOSS, inches	(1)	0.09	0.09	0.09	0.09	
TOTAL DAILY APPLICATION REQUIREMENT, inches		0.34	0.34	0.34	0.34	0.42
TOTAL DAILY APPLICATION REQUIREMENT, acre*ft		7.74	5.80	3.87	1.93	0.18
TOTAL DAILY APPLICATION REQUIREMENT, gallons		2,521,086	1,890,815	1,260,543	630,272	57,374
SEASONAL PLANT WATER REQUIREMENTS, inches		57.4	57.4	57.4	57.4	
SEASONAL EFFECTIVE PRECIPITATION, inches	(7)	0.0	0.0	0.0	0.0	
TOTAL SEASONAL IRRIGATION APPLICATION, inches	(1)	57.4	57.4	57.4	57.4	0.0
TOTAL SEASONAL IRRIGATION APPLICATION, acre*ft		1300.7	975.5	650.4	325.2	39.3
TOTAL SEASONAL IRRIGATION APPLICATION, gallons		423,837,910	317,879,000	211,918,000	105,961,000	12,813,973
IRRIGATION FLOW REQUIREMENT WITH AN IRRIGATION WINDOW OF 6 HOURS, 6 DAYS A WEEK (gpm)	(2)	10213	7660	5106	2553	
IRRIGATION FLOW REQUIREMENT WITH AN IRRIGATION WINDOW OF 8 HOURS, 6 DAYS A WEEK (gpm)	(2)	7660	5745	3830	1915	
IRRIGATION FLOW REQUIREMENT WITH AN IRRIGATION WINDOW OF 10 HOURS, 6 DAYS A WEEK (gpm)	(2)	6128	4596	3064	1532	

NOTES:

1 IRRIGATION SYSTEM APPLICATION EFFICIENCY IS ASSUMED TO BE 75%.
2 IRRIGATION SYSTEM TAP UTILIZATION EFFICIENCY IS ASSUMED TO BE 80%.
TAP UTILIZATION EFFICIENCY IS DEFINED AS THE AVERAGE DESIGN FLOW/AVERAGE AVAILABLE FLOW.
3 PEAK SEASON PLANT WATER REQUIREMENT OF 0.26 IN/DAY IS ASSUMED FOR 1
AND IS BASED ON Enter literature source here DATA AND A CROP COEFFICIENT OF 80%.
4 PEAK SEASON IRRIGATION REQUIREMENT OF 0.26 IN/DAY IS ASSUMED FOR 0.75
AND IS BASED ON Enter literature source here DATA AND A CROP COEFFICIENT OF 80%.
5 PEAK SEASON IRRIGATION REQUIREMENT OF 0.26 IN/DAY IS ASSUMED FOR 0.5
AND IS BASED ON Enter literature source here DATA AND A CROP COEFFICIENT OF 80%.
6 PEAK SEASON IRRIGATION REQUIREMENT OF 0.26 IN/DAY IS ASSUMED FOR 0.25
AND IS BASED ON Enter literature source here DATA AND A CROP COEFFICIENT OF 80%.
7 A SEASONAL PRECIPITATION OF 6.4-INCHES IS USED AND IS BASED ON Enter literature source here DATA
PRECIPITATION IS ASSUMED TO BE 0% EFFECTIVE.

APPENDIX B

Aqua Engineering Inc.
Innovative Water Solutions

11022 South 51st Street, Suite 104
Phoenix, AZ 85044-1789
480.222.0360 office
970.226.3855 fax
www.aquaengineering.com

MEMORANDUM

March 18, 2016

TO: Sean Wozny
Kimley-Horn

FROM: Douglas G. Macdonald

RE: **Gilbert CHBP Master Plan**
Roosevelt Water Conservation District Investigative Meeting on March 16, 2016

The following represents a summary of my notes from the follow-up meeting at Town of Gilbert Civic Center regarding potential for using water supplied from existing RWCD infrastructure to service a portion of the irrigation demand at the referenced project:

- This is a follow-up meeting to the previous meeting that was conducted on 2/16/16; further investigation of the water delivery issues identified in that meeting was conducted and the findings were presented during this meeting.
- RWCD representatives indicated that a “wheeling agreement”, i.e. using the RWCD canal infrastructure to carry water that is purchased or leased from other water suppliers to a turnout structure near the site would create legal and jurisdictional issues related to “Waters of the United States” which RWCD is not in a position to allow, and therefore is not a viable option.
- RWCD representatives also confirmed that their district boundaries are statutory and regulated by ADWR and other state agencies, so adjusting their boundaries to include this site is not a viable option.
- It has also been determined that exchange agreement between Town of Gilbert, Town of Queen Creek and RWCD for use of Queen Creek treated effluent water to supplement the Gilbert treated effluent for use at this site is not an acceptable option for the Town of Queen Creek, so that option has also been eliminated from consideration.
- RWCD representatives indicated that there may be an opportunity to provide ground water to the site from one of the two existing wells they own and operate near the site. In order for this to be a viable option, the following would need to occur:
    - Develop an agreement between RWCD and Town of Gilbert for “long-term storage credit” exchange to use groundwater based on credits previously established by Town of Gilbert. Permitting for recovery purposes of the groundwater will be required by Town of Gilbert for this option.
    - Relocate one of the wells, most likely the well near the Appleby Road alignment, from the west side of their canal to the east side and provide piped conveyance infrastructure from the new well location to a discharge point on the project site.

        - This will require capping the existing well, drilling a new well, installing a new well pump and controls as well as the piped conveyance infrastructure. It will be necessary to identify the appropriate and most cost-effective pipe routing along RWCD property and across the EMF channel to the site if this option is determined to be viable.
        - RWCD representatives indicated that an order-of-magnitude cost for drilling the new well is approximately $500,000 + approximately $200,000 for a new well pump and instrumentation. The cost of conveyance piping will be dependent on size and length of pipe required and could not be estimated at this time.
    - Should the Town decide to proceed with this option, further investigation by both parties regarding permitting and cost evaluation will be required as it relates to the viability of this strategy.
- RWCD representatives inquired about the potential volume of water required for irrigation at the project site
    - Aqua Engineering provided an updated preliminary worksheet that describes estimated irrigation demand based on the three preliminary design concepts that have been developed by Kimley Horn based on public meetings and site programming priorities. A copy of that worksheet is attached to this memorandum for reference.
    - Using the three preliminary concepts from Kimley Horn, Aqua Engineering estimates the peak season daily irrigation demand to range between 967,000GPD and 1,085,000 GPD.
    - RWCD representatives indicated that the capacity of the existing well is approximately 2,500,000 GPD and therefore capable of accommodating the anticipated peak season irrigation demands for the site.
- According to Kimley Horn meeting notes from a meeting on 1/20/16 referencing the Greenfield Water Treatment Facility, *last year, reclaimed water demands on their highest day in July used all but 300,000 gallons of the reclaimed water available, therefore, 300,000 GPD is the reclaimed water volume that is potentially currently available for Town of Gilbert use. Queen Creek is currently not utilizing any of its 1,000,000 GPD allotment of reclaimed water from the Greenfield plant; Mesa and Gilbert have been splitting this available 1,000,000 GPD. At the point in time that Queen Creek has infrastructure in place to utilize its 1,000,000 GPD allotment, which is anticipated to be the near future, Gilbert's available allotment from Greenfield will be reduced by 500,000 GPD.* This represents a potential additional 200,000 GPD deficit in the current available supply from the Greenfield plant. The supply volume from Greenfield will likely increase as the area develops, but currently is not sufficient by itself to supply the anticipated build-out demand for any of the three park concepts, and a supplementary water source will be required.
- Town of Gilbert representatives indicated a desire to pursue the possibility of developing an Aquifer Storage Recovery (ASR) well to service a portion of the irrigation demands for the site.
    - This type of well may provide the required supplementary daily demand to the lake storage facility from the groundwater source (using Town of Gilbert storage credits) during peak season months when the reclaimed water system is not capable of providing the anticipated build-out demand, and partially or fully offsetting the volume water that was drawn from the aquifer during peak season

months by providing reclaimed water into the aquifer during off-peak months when the irrigation demand is significantly lower.

- Further investigation of this strategy will be required by the design team to determine the costs and feasibility of this strategy.

The foregoing is our understanding of the issues discussed during this meeting. Please contact Doug Macdonald (970.372.6123) immediately should you have any revisions or clarifications.

APPENDIX C

Aqua Engineering Inc.
Innovative Water Solutions

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MEMORANDUM

April 12, 2016

TO: Sean Wozny
Kimley-Horn

FROM: Doug Macdonald
Cullen Kinoshita

RE: **Gilbert New Regional Park Master Plan**
Chandler ASR Well Site Tour

The following represents a summary of our notes from the site tour that was conducted on April 5, 2016 at the City of Chandler Airport Water Reclamation Facility (WRF):

In Attendance:

- John Pinkston, Gregg Capps; **City of Chandler**
- Eric Braun, Mark Horn, Patty Jordan; **Town of Gilbert**
- Robert Lyons; **Kimley-Horn**
- Doug Macdonald, Cullen Kinoshita; **Aqua Engineering**

Town of Gilbert representatives have indicated a desire to investigate the possibility of developing an Aquifer Storage Recovery (ASR) well to service a portion of the irrigation demands for the Gilbert New Regional Park site as an alternative to the RWCD water source. This type of well may provide the required supplementary daily irrigation water supply to the lake storage facility from the groundwater source (using Town of Gilbert storage credits) during peak season months when the reclaimed water system is not capable of providing the anticipated build-out demand, and partially or fully offset the volume of water drawn from the aquifer during peak season months by providing reclaimed water into the aquifer during off-peak months when the irrigation demand is significantly lower.

The purpose of this meeting was to tour two examples of active sites in Chandler to gain a greater understanding of the operation and maintenance requirements, order-of-magnitude construction costs, site footprint, and the value that this type of facility brings to City of Chandler in order to determine if an ASR well site is a viable option to explore for the Gilbert New Regional Park site as part of the irrigation water resource master planning process.

The basic functions of an ASR well are to provide a means of providing water into an underground aquifer for storage purposes when suitable water is available from surface sources (recharge function) and drawing water from the aquifer when it is needed for beneficial use such as for irrigation (recovery function). City of Chandler operates several active ASR wells, two of which were observed during this meeting; one well is developed below grade in a vault enclosure and one well is developed at the surface within a fenced enclosure.

City of Chandler provides treated effluent water into the aquifer using a pressurized (approx. 54 PSI) pipe conveyance network that is connected to the observed ASR well sites from their Airport WRF. The same wells are equipped with pumps that enable City of Chandler to draw water from the aquifer for beneficial use, and to purge the water contained within the well casing on a regular basis for maintenance purposes. At the below-ground ASR, the pump runs for 70 minutes three times per day to purge the water in the piping network.

The following photos provide examples of the below grade and surface well sites that were toured on this date

Below Grade Well Pump Installation

Below Grade Vault Entry Hatch and Ventilation

Reclaimed Water Recharge (top) and Purge (bottom) Lines

Well Pump and Recharge/Purge Line (flow in both directions)

Recharge/Purge Line (flow in both directions)

ASR Well Monitoring and Control Panel

Surface Well Pump Installation

Well Pump and Recharge/Purge Line (flow in both directions)

Reclaimed Water Recharge and Purge Lines

According to City of Chandler representatives, the order of magnitude cost range for each of the well and pumping systems is approximately $1.0M to $1.5M, and the cost range for the below grade vault installation is estimated to be approximately $500,000 more than the above-ground well and pumping system. Annual maintenance costs for either solution are approximately $20,000 (not including labor).

The City of Chandler has experienced two floods within the below-ground ASR facilities over the last twelve (12) years. This has not been an issue or concern with the above-ground facility.

The City has experience a decline in capacity of 10% to 12% over the last eight to ten years at the below-ground ASR. At the above-ground ASR, there has been no reduction in capacity since the facility was constructed.

The Arizona Department of Water Resources (ADWR) visits each site approximately once per week for permitting purposes.

Town of Gilbert representatives in attendance at this meeting expressed this solution as a preferred option over the RWCD water source to supplement the available reclaimed water supply during peak season irrigation demand conditions. The Gilbert New Regional Park site represents a significantly large site area, therefore either the surface or below grade alternative would be feasible, largely based on budgetary constraints. The below grade solution will likely require supplementary permitting due to the confined space requirements. If this solution is determined to be financially feasible for the park project, it is recommended that the well site be developed on the Town of Gilbert “high and dry” property, and the vault or equipment contained adjacent to the irrigation pumping system within a secured maintenance yard.

The foregoing is our understanding of the issues discussed during this meeting. Please contact Doug Macdonald (970.372.6123) immediately should you have any revisions or clarifications.

APPENDIX D

PRELIMINARY IRRIGATION WATER USE SUMMARY

BY: JHK/EGK

DATE: 3-14-2016

= Input Required

INPUT:

Note: Below tabular information is in the Water Use per Acre spreadsheet

Landscape Type	Peak Demand per Acre (GPM/Acre)	Peak Daily Requirement per Acre (Gallons/Day per Acre)	Seasonal Irrigation Requirement per Acre (Acre-Feet per Acre)
Ballfields	35	11,586	6.0
Turf Areas	28	9,269	4.8
Plantings	18	5,793	3.0

8 = Assumed usable average lake depth, ft

6.3 = Estimated annual lake evaporation, ft

OUTPUT:

	Irrigated Areas (acres)**			Peak Demand	Peak Daily Requirement*	Seasonal Requirement*	Lake Area	Usable Pond Storage**	Days of Storage for Current Lake
Landscape Concept	Ballfields	Turf Areas	Plantings	(GPM)	(Gallons/Day)	(Acre-Feet per Year)	(Acres)	(Acre-Ft)	Concept*
1	24.8	45.2	36.9	2,794	1,085,404	571.7	15.46	107.4	32
2	40.3	13.7	41.6	2,535	967,107	508.4	12.4	85.0	29
3	18.0	39.5	32.8	2,323	993,446	528.8	21.34	155.2	51

*Including evaporation from lake

**Calculated using CAD tools (Areas.dwg)

Pond Storage Requirement for the Followings Days of Storage (Acre-Ft):					
2	3	5	7	10	14
6.7	10.0	16.7	23.3	33.3	46.6
5.9	8.9	14.8	20.8	29.7	41.6
6.1	9.1	15.2	21.3	30.5	42.7

APPENDIX E

Chandler New Regional Park

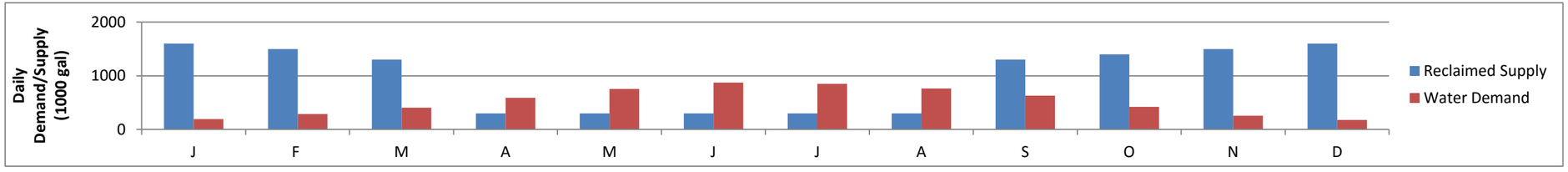
FIGURE 5 - Irrigation Reclaimed Water Supply & Demand Balance Study - DRAFT (Revised 5/18/16)

5/18/2016

Daily Supply and Demand

	J	F	M	A	M	J	J	A	S	O	N	D		TOTAL
Reclaimed Supply (1000 gal)	1600	1500	1300	300	300	300	300	300	1300	1400	1500	1600		11,700
Irrigation Demand (1000 gal)	172	258	362	530	675	780	758	681	561	374	225	160		5,537
Lake Evaporative Loss (1000 gal)	21	31	43	63	79	92	92	83	70	48	30	21		673
Irrigation and Evaporation Demand (1000 gal)	193	289	405	592	755	872	850	765	632	422	255	180		6,210
Surplus or Deficit (1000 gal)	1,407	1,211	895	-292	-455	-572	-550	-465	668	978	1,245	1,420		5,490

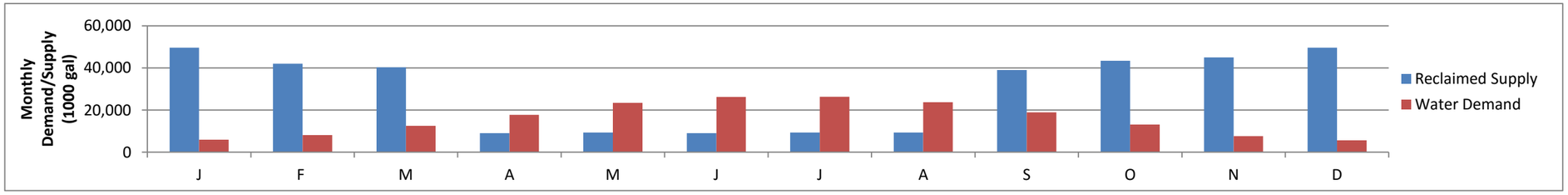
Surplus or Deficit Graph



Monthly Supply and Demand

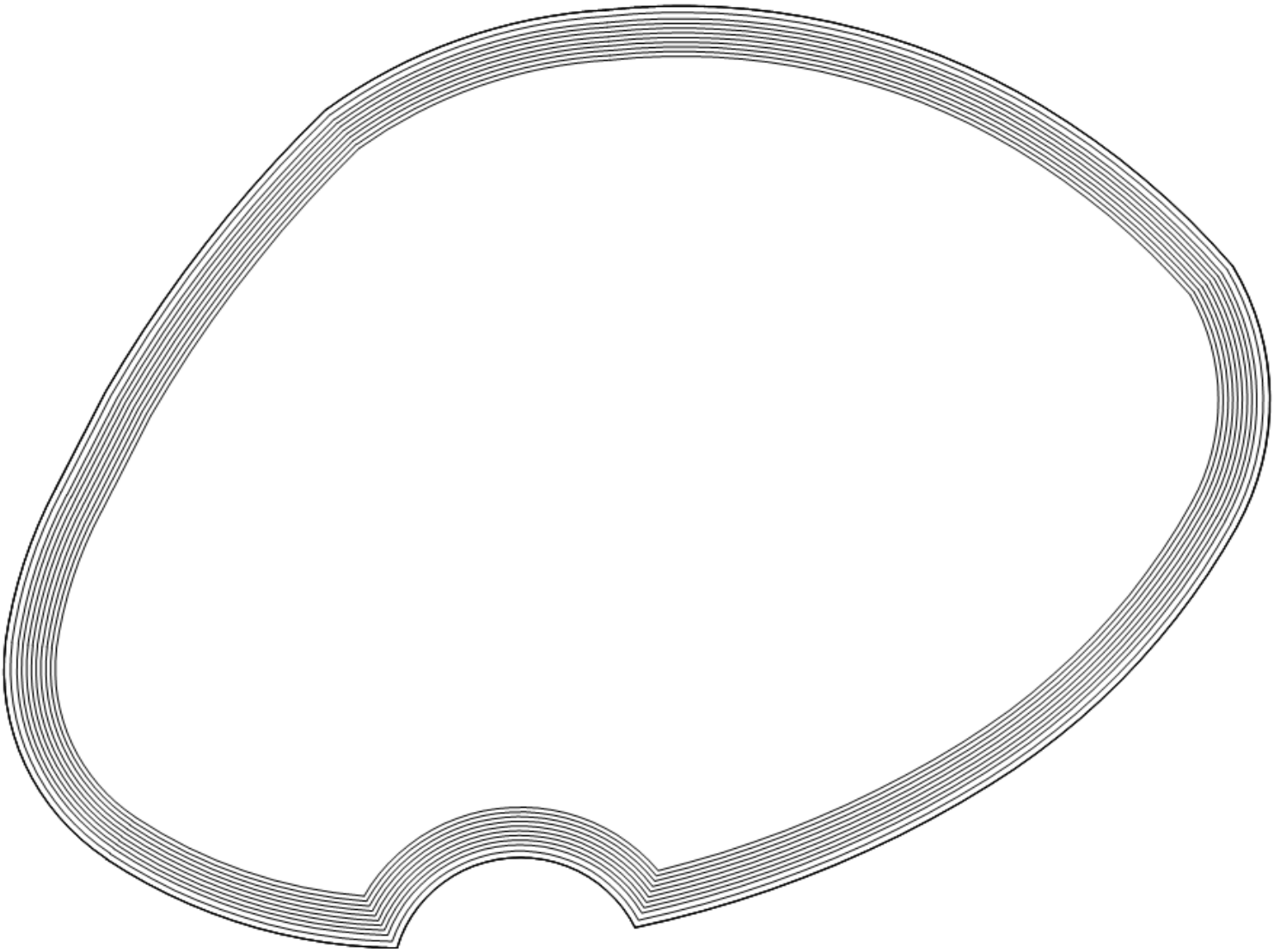
	J	F	M	A	M	J	J	A	S	O	N	D		TOTAL
Reclaimed Supply (1000 gal)	49,600	42,000	40,300	9,000	9,300	9,000	9,300	9,300	39,000	43,400	45,000	49,600		354,800
Irrigation Demand (1000 gal)	5,328	7,231	11,227	15,889	20,931	23,405	23,500	21,122	16,840	11,607	6,755	4,947		168,783
Lake Evaporative Loss (1000 gal)	658	873	1,327	1,877	2,461	2,752	2,846	2,579	2,105	1,479	902	643		20,503
Irrigation and Evaporation Demand (1000 gal)	5,986	8,104	12,554	17,766	23,393	26,157	26,346	23,700	18,945	13,087	7,657	5,590		189,286
Surplus or Deficit (1000 gal)	43,614	33,896	27,746	-8,766	-14,093	-17,157	-17,046	-14,400	20,055	30,313	37,343	44,010		165,514

Surplus or Deficit Graph

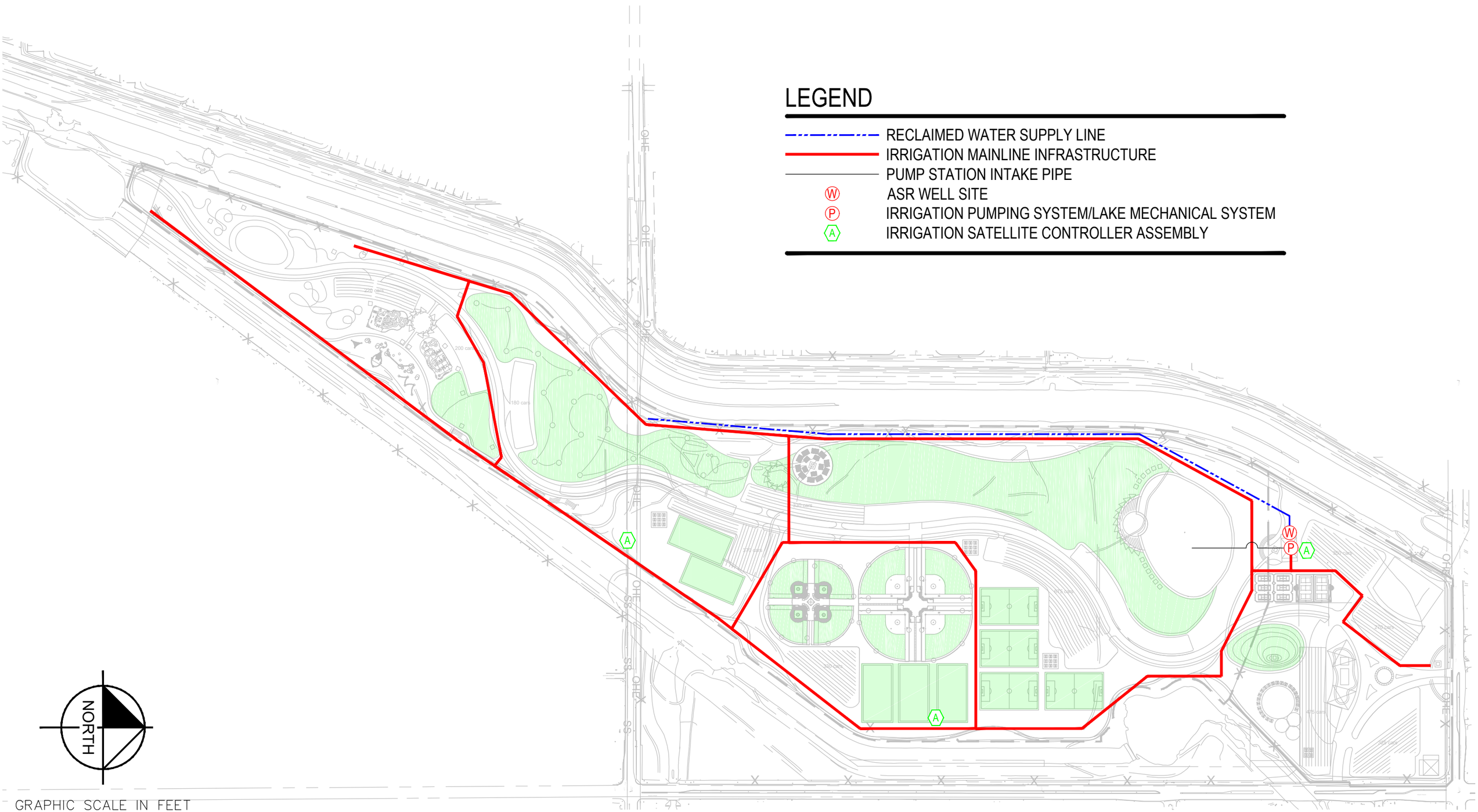


APPENDIX F

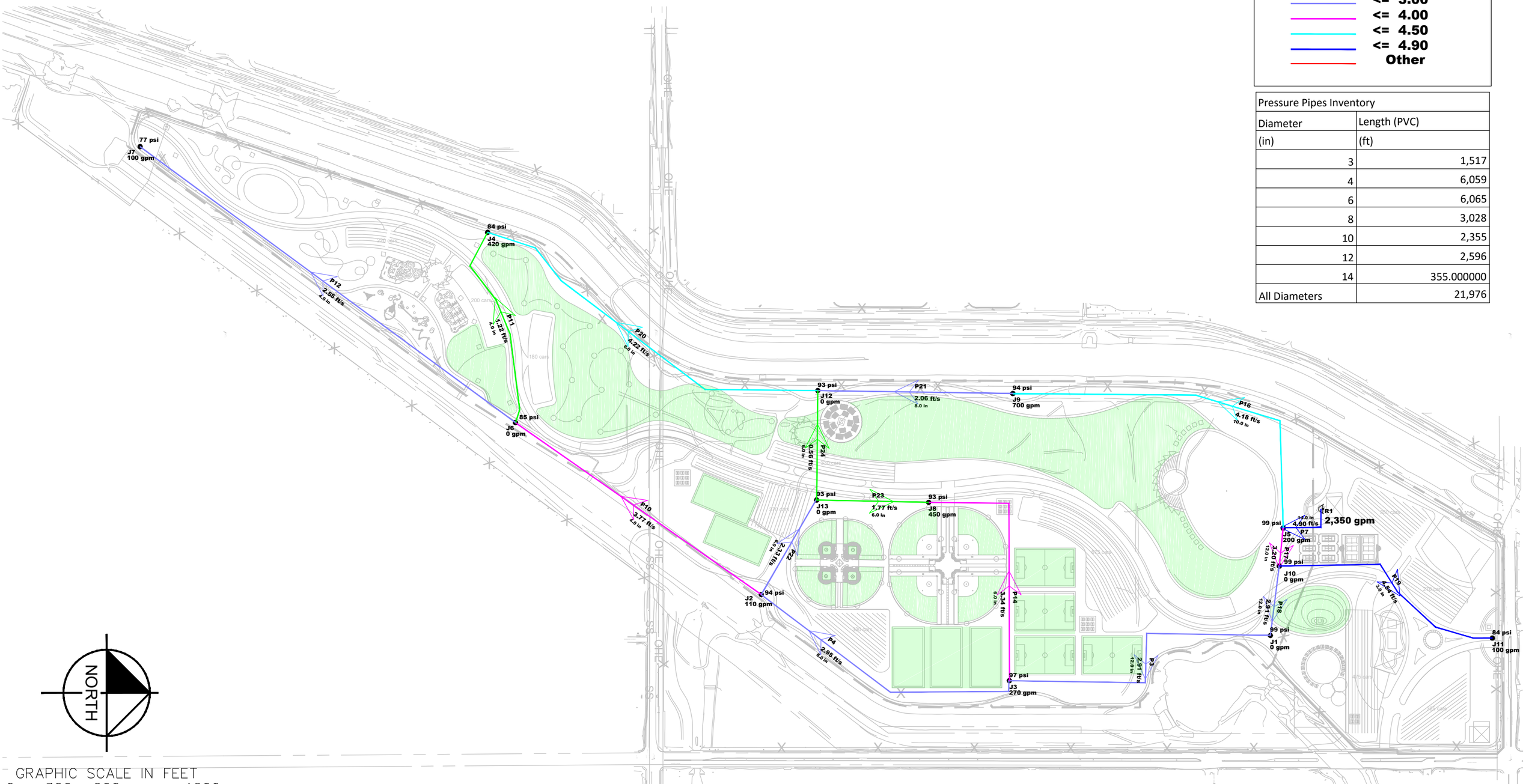
Figure 6 Lake Grading & Volume Calculations									
Depth	Average Slope X:1	Cubic Feet	Acre Feet	Cubic Yards	Gallons	Liner Area	Surface Area	Perimeter	% of Total Volume
12	0	348696.19	8.00	12914.67	2608428.68	2229.04	348807.09	2218.31	9.13
11	0	348474.43	8.00	12906.46	2606769.77	2228.36	348585.30	2217.64	9.12
10	4.00	343956.56	7.90	12739.13	2572973.73	9085.28	348363.57	2216.96	9.00
9	4.00	335196.19	7.70	12414.67	2507441.63	8974.68	339549.55	2190.07	8.77
8	3.00	327612.88	7.52	12133.81	2450714.52	6809.34	330842.83	2163.31	8.58
7	3.00	321182.92	7.37	11895.66	2402615.11	6746.19	324382.92	2143.31	8.41
6	3.00	314812.80	7.23	11659.73	2354963.25	6683.21	317982.92	2123.37	8.24
5	3.00	308502.34	7.08	11426.01	2307757.79	6620.39	311642.67	2103.48	8.07
4	3.00	302251.43	6.94	11194.50	2260997.69	6557.70	305362.02	2083.63	7.91
3	3.00	296059.92	6.80	10965.18	2214682.01	6495.14	299140.84	2063.83	7.75
2	3.00	289927.71	6.66	10738.06	2168809.89	6432.70	292979.01	2044.07	7.59
1	3.00	283854.69	6.52	10513.14	2123380.53	287203.32	286876.42	2024.34	7.43
Totals	32.20	3820528.06	87.71	141501.04	28579534.59	356065.36	3854515.13	25592.32	100.00



APPENDIX G


LEGEND
RECLAIMED WATER SUPPLY LINE
IRRIGATION MAINLINE INFRASTRUCTURE
PUMP STATION INTAKE PIPE
W ASR WELL SITE
P IRRIGATION PUMPING SYSTEM/LAKE MECHANICAL SYSTEM
A IRRIGATION SATELLITE CONTROLLER ASSEMBLY
NORTH
GRAPHIC SCALE IN FEET
0 300 600 1200

APPENDIX H



Color Coding Legend
Pipe: Velocity (ft/s)

	<= 2.00
	<= 3.00
	<= 4.00
	<= 4.50
	<= 4.90
	Other

Pressure Pipes Inventory	
Diameter	Length (PVC)
(in)	(ft)
3	1,517
4	6,059
6	6,065
8	3,028
10	2,355
12	2,596
14	355.000000
All Diameters	21,976

APPENDIX I

Gilbert New Regional Park
Irrigation Master Plan Opinion of Probable Construction Cost
Town of Gilbert, Arizona

REV1 DRAFT for client review and comment

May 18, 2016

No.	Description	Units	Number	Unit Cost	Total Cost
Irrigation Water Supply					
1	Reclaimed Water Meter w/ CMU Enclosure (6" Turbine Meter) NIC plant investment fees	LS	1	$18,000.00	$18,000.00
2	Reclaimed Water Supply Line to Lake (10" Class 200 PVC)	LF	4,750	$30.00	$142,500.00
3	Reclaimed Air Gap Wet Well Assembly at Lake	LS	1	$12,000.00	$12,000.00
4	ASR Well Equipment & Controls (assumes above grade installation in maintenance yard similar to Chandler ASR)	LS	1	$1,300,000.00	$1,300,000.00
5	Potable water back-up supply (for short-term emergency only, 2" Meter & supply line, Air Gap Assembly) NIC plant investment fees	LS	1	$7,500.00	$7,500.00
	Subtotal Irrigation Water Supply Construction Costs			**Subtotal**	**$1,480,000.00**
Lake					
1	Excavation of Lake (assumes 24" vertical wall, 4:1 recovery shelf, 3:1 slope to 12' depth at bottom)	CY	141,501	$5.00	$707,505.00
2	Stock Pile Excavated Soil On Site	per 10 CY truckload	14,150	$18.00	$254,701.80
3	Lake Edge Treatment (assumes combination shotcrete edge and structural edge)	LF	2,400	$75.00	$180,000.00
4	Lake Liner (Inludes fine grading, 30 mil PVC Liner, 8 oz geotextile, 12" soil cover and compaction)	SF	352,000	$1.75	$616,000.00
5	Soils & Liner Testing	LS	1	$7,500.00	$7,500.00
6	Pond Aeration System with Diffusers	LS	1	$45,000.00	$45,000.00
7	Overflow Pipe to Sewer (18" PVC)	LF	400	$45.00	$18,000.00
8	Recirculation Piping (avg 6" PVC)	LF	3,100	$18.00	$55,800.00
9	Recirculation Balance Valves (2" gate valve)	EA	22	$400.00	$8,800.00
10	Lake Level Controls	LS	1	$10,000.00	$10,000.00
11	Fish Habitat Allowance	LS	1	$50,000.00	$50,000.00
	Subtotal Lake Construction Costs			**Subtotal**	**$1,953,306.80**
Irrigation Pump System & Enclosure					
1	4" CL200 PVC Filter Backwash Pipe to Lake	LF	450	$12.00	$5,400.00
2	36" HDPE Pump System Intake Pipe (incl intake screen)	LF	600	$200.00	$120,000.00
3	96" diam x 30' deep Wet Well	EA	1	$40,000.00	$40,000.00
4	Pre-fabricated Irrigation Pump System Skid with Automatic Filtration	EA	1	$285,000.00	$285,000.00
5	Pump Station Electrical	LS	1	$65,000.00	$65,000.00
6	Pump Station CMU Enclosure with Shade Structure	LS	1	$75,000.00	$75,000.00
	Subtotal Pump & Enclosure Construction Costs			**Subtotal**	**$590,400.00**
Irrigation System					
1	14" C900 PVC w DI Fittings	LF	360	$42.00	$15,120.00
2	12" C900 PVC w DI Fittings	LF	2,600	$36.00	$93,600.00
3	10" CL200 PVC w DI Fittings	LF	2,400	$30.00	$72,000.00
4	8" CL200 PVC w DI Fittings	LF	3,100	$24.00	$74,400.00
5	6" CL200 PVC w DI Fittings	LF	6,200	$18.00	$111,600.00
6	4" CL200 PVC w DI Fittings	LF	6,200	$12.00	$74,400.00
7	3" SCH40 PVC w PVC Fittings	LF	1,600	$9.00	$14,400.00
8	2" SCH40 PVC w PVC Fittings	LF	8,000	$6.00	$48,000.00
9	12" Gate Valve	EA	2	$3,000.00	$6,000.00
10	10" Gate Valve	EA	4	$2,400.00	$9,600.00
11	8" Gate Valve	EA	6	$1,800.00	$10,800.00
12	6" Gate Valve	EA	8	$1,500.00	$12,000.00
13	4" Gate Valve	EA	8	$1,000.00	$8,000.00
14	3" Gate Valve	EA	4	$800.00	$3,200.00
15	2" Gate Valve	EA	12	$400.00	$4,800.00
16	2" Air/Vac Relief Valve	EA	6	$800.00	$4,800.00
17	1" Quick Coupling Valve	EA	155	$350.00	$54,250.00
18	Irrigation Satellite Controllers w Central Communication	EA	10	$8,500.00	$85,000.00
19	Sprinkler Irrigation in Sportsturf Areas (inc RCV, wire, lateral, sprinkers)	SF	1,151,703	$0.65	$748,606.95
20	Sprinkler Irrigation in Passive Turf Areas (inc RCV, wire, lateral, sprinkers)	SF	2,109,764	$0.55	$1,160,370.20
21	Drip Irrigation in DG Areas (30% canopy cover, inc RCV, wire, lateral, emitters)	SF	522,720	$0.35	$182,952.00
22	Contigency for Rock Trenching & Bedding	LS	1	$50,000.00	$50,000.00
	Subtotal Irrigation Construction Costs			**Subtotal**	**$2,843,899.15**
Miscellaneous					
1	Allowance for Incidentals	LS	1	$100,000.00	$100,000.00
2	Mobilization & General Conditions (7.5%)	LS	1		$522,570.45
3	Contingency (10%)	LS	1		$749,017.64
	Subtotal Miscellaneous				**$1,371,588.09**
	Total Construction Costs				**$8,239,194.04**

NOTES:

1. This Opinion of Probable Construction Cost is not intended for use in bidding or ordering of equipment. Aqua Engineering will not be responsible for differences between this information and actual project equipment quantities or construction costs.
2. This Opinion of Probable Construction Cost does not include design and consulting fees or other soft cost items.

Kimley»Horn

In collaboration with

Aqua Engineering Inc.

Fucello Architects

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