Project Management:

Macro-level Approach to project management:

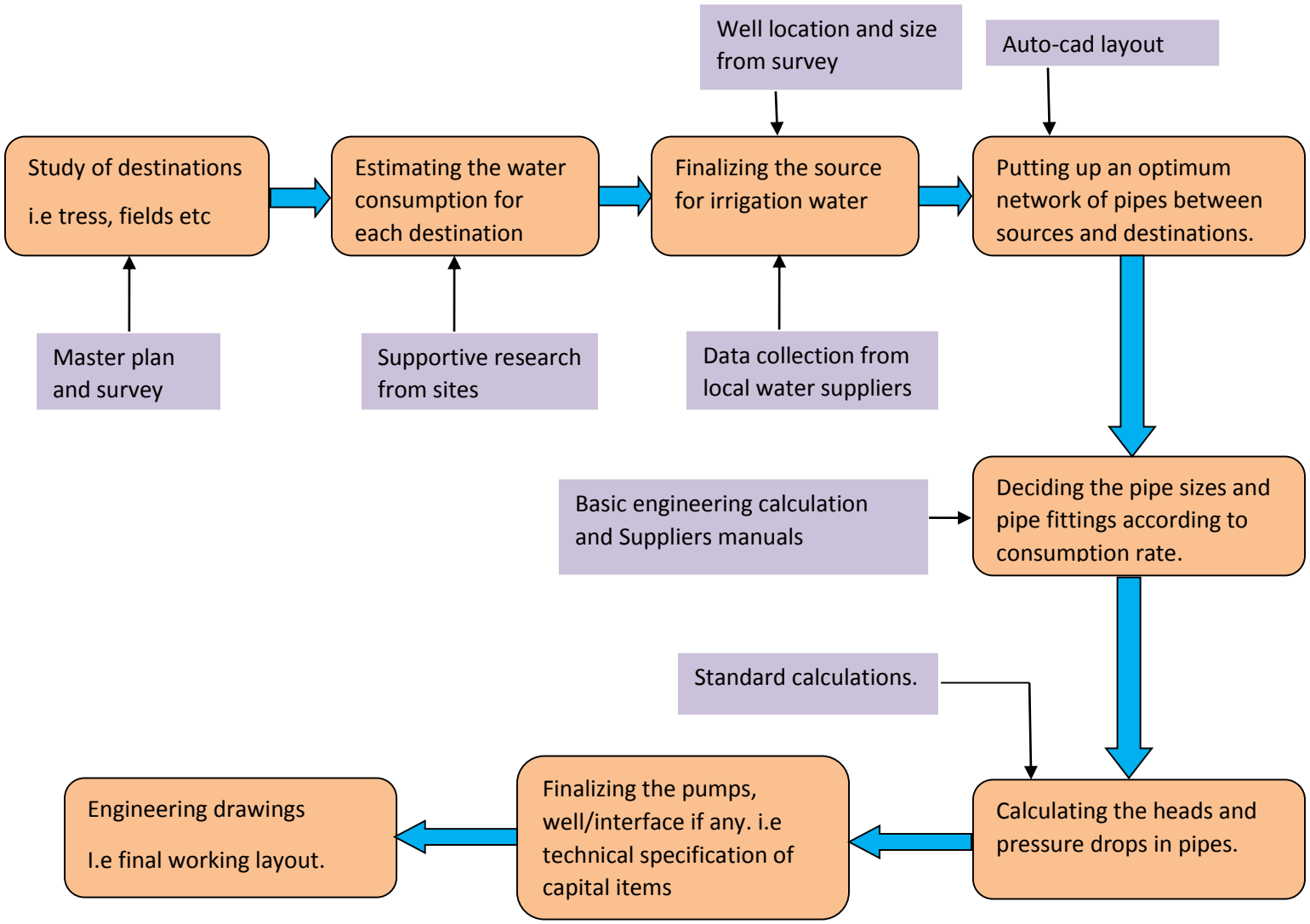
The objective of the project is to design following for the "CAMP VERDE COMMUNITY PARK".

The systems can be decentralized by:

1. Irrigation and watering systems for trees, bushes and the various sports fields to be made available in this park, In addition utility water for wash rooms and bathrooms.
2. Drinking water system for visitors in the various areas of the park.
3. Storm water system in case of heavy rain fall and storm in the area of park.
4. Estimated Costs
5. MAG Regulations

1.0 Irrigation and utility water System

The strategic approach for the irrigation system can be framed according to the required tasks and the inputs. We start with the inputs and end on the final requirement.



The following are the basic steps:

a. Study of destinations:
b. Estimating the water consumption per destination:
c. Finalizing the source for irrigation and utility water:
d. Putting up an optimum network between the finalized source and the destination.
e. Deciding the pipe sizes and pipe fittings according to consumption rate.
f. Calculating the heads and pressure drops in pipes.
g. Finalizing the pumps, well/interface if any. i.e technical specification of capital items
h. Engineering drawings. I.e final working layout.

1.1 Irrigation system Design Notes:

The irrigation water will come from wastewater ponds north of the project site. The wastewater will be pumped from the existing ponds to a holding tank on the highest location on the property. The tank will be need to be 10 foot by 10 foot which will give a holding reservoir of approximately 23,000 Gallons. The mainline pipe will be a 4" PVC class 200 pipe, which will initially be able to supply 1,600 to 1,800 GPM at a nominal psi between 20-100. Sizing the pipe slightly larger than may be need will facilitate the irrigation of the play fields. This size of mainline will allow two sections of each system to be run simultaneously which will allow all irrigation to be done at night without interruption to daytime activities and will reduce water waste due to evaporation in the heat of the day. The irrigation mainline was designed as a loop system around the fields in order to supply an even amount of pressure to all of the irrigation sites and to allow a way to back feed from one end or the other in the event of a pipe breach. Shut off valves will be installed on either end as well as backflow preventers when necessary.

The tank will need to be disinfected by chlorinating it, and then retested once the chlorine is flushed out, to avoid bacteria contamination. This will be done by shock chlorination of the piping systems using a metering pump with high pressures.

The irrigation frequency would be daily depending on the season, as with any other irrigation. The GPD in the design note is based off of the MAG regulations.

1.2 Soccer Fields:

The three soccer fields consist of 259,200 square feet of lawn, which breaks down to 86,400 square feet per field. It was calculated using the MAG Regulations that the grassed area would consume 0.10 gallons of water per square foot. This time the square footage of the three soccer fields gives us a total of 25,920 gallons per day or 8,640 gal per day per field.

Each field has an underground irrigation system consisting of a 2 ½" mainline that is connected to the irrigation mainline. There are backflow preventers and shutoff valves installed at the connection points. The backflow preventers will prevent the reversal of flow and will help

maintain the water pressure in this segment during use. The shut valve will be used to isolate this segment from the main trunk line during maintenance or during the off months to protect employees and the irrigation line in the winter months.

The mainline has a programmable 8-station irrigation controller that will allow only one or two of the six sections of the system to run at a time. Each lateral pipe size starts with a 2" PVC pipe and ends with a 1"pvc pipe. The reason for sizing down the pipe as we go down the line is to maintain the GPM and PSI needed but also maintain a cost efficient system. Using all 2" pipe just to maintain uniformity would increase the cost of the project significantly. Each lateral section contains a remote control valve linked to the irrigation controller, and four full circle sprinkler heads with a radius of 61 feet, that will require a minimum of 65 psi, and a minimum of 14gpm. The total lateral will require 56gpm in order to function fully. The entire system requires a minimum of 75psi downstream of the backflow preventer and a minimum of 56 GPM. At this time the calculations re not finalized and a booster pump may need to be installed in order to maintain the need pressure. In order to adequately water the field this system must run for a total of 2.5 hours per day.

1.3 Baseball Fields:

The four baseball fields consist of 377,133 square feet of lawn, which breaks down to 94,283 square feet per field. It was calculated using the MAG Regulations that the grassed area would consume 0.10 gallons of water per square foot. This time the square footage of the four baseball fields gives us a total of 37,713 gallons per day or 9,428 gal per day per field.

Each field has an underground irrigation system consisting of a 2 ½" mainline that is connected to the irrigation mainline. There are backflow preventers and shutoff valves installed at the connection points. The backflow preventers will prevent the reversal of flow and will help maintain the water pressure in this segment during use. The shut valve will be used to isolate this segment from the main trunk line during maintenance or during the off months to protect employees and the irrigation line in the winter months.

The mainline has a programmable 8-station irrigation controller that will allow up to two of the six section of the system to run at a time. Each lateral pipe size starts with a 2 1/2" PVC pipe and ends with a 1" PVC pipe. The reason for sizing down the pipe as we go down the line is to maintain the GPM and PSI needed but also maintain a cost efficient system. Using all 2 1/2" pipe just to maintain uniformity would increase the cost of the project significantly. Each lateral section contains a remote control valve linked to the irrigation controller, and four to seven full circle and partial circle sprinkler heads with a radius of 59 feet that will require a minimum of 50 psi, and a minimum of 15.4 GPM. The total lateral will require from 77 to 108 GPM in order to function fully. The entire system requires a minimum of 65 psi downstream of the backflow preventer and a minimum of 108 GPM. At this time the calculations re not finalized and a booster pump may need to be installed in order to maintain the need pressure. In order to adequately water the field this system must run for a total of 2.5 hours per day. These numbers are all based on my initial calculations and are subject to change based on the final irrigation design after all other utilities and systems are designed and added to the final plan.

The fields were designed to use Rainbird components. The pipe sizes and sprinkler heads used were recommended by Rainbird engineers to provide the most efficient and cost effective system.

For the turf selection, real grass will be used instead of artificial grass. Although artificial grass saves water, there is an availability of reclaimed water, which produces 250,000 gallons per day to be used. Also, due to high temperatures in Camp Verde, the artificial grass will over heat and will need to be replaced.

The plan view of the irrigation system is found in Appendix D. It shows the irrigation mainline (red lines), which was designed as a loop system around the fields. This design will allow an even supply of pressure to all of the irrigation sites.

2.0 Water System Design Notes:

The current water system will be supplied by a well. Current well data taken from 172 wells in a one mile radius around the project site indicates an average well depth of 104 feet from the surface with an average casing depth of 48 feet, an average casing diameter of six inches and wells hitting water at an average depth of 38 feet (Appendix A). The average depth water is found does not indicate that the water found at that depth is useable or in a quantity that is sustainable for the project. Once water is found during the drilling process the driller will be able to test the well to determine the quality of the water and the approximate gallons per minute the well will be able to sustain.

The well will require a nominal pressure tank and filtration system including a chlorine gas injection system. The casing diameter should be six inches and the casing depth may be set by the county department of Health or the state Department of Ecology when the well permit is applied for.

Using the MAG regulations regarding water usage and flows, the drinking water usage at peak daily rates for all buildings on the complex was estimated to have 637.5 GPD for the complex (Appendix B). This does not take into consideration any extraneous drinking fountains or any other use for fresh potable water other than the buildings listed in the master plan. As such the recommended water pipe size should be 2” sch. 40 HDPE pipe buried at a minimum of 36” to prevent accidental dig-ins and possible freezing temperatures. According to an online source (flexpvc.com), the two-inch line will supply approximately 127 gallons per minute at pressures between 20-100psi. See figure 1 below to compare pipe sizes with the amount of water it supplies. This will allow for future expansion and for the system to be integrated into the city’s water system in the future.

The Tot lot/Splash pad was not included into the water usage plans. However, the water used for the Tot lot/Splash pad should be on a recirculating system that is highly chlorinated. This system could be fed from either the potable water system or from the irrigation system on a closed loop

system from an external valve adding water to the system as needed and preventing backflow with an inline backflow preventer.

Since the groundwater is pretty clean in the area, samples of water will be tested for arsenic twice a year. If needed, it will be treated with filtration.

The plan view of the water system is found in Appendix C. The well location was picked because it does not disturb nearby existing wells, and also because it is relatively close to the Verde River.

			Assume Gravity to Low Pressure. About 6f/s flow velocity, also suction side of pump		Assume Average Pressure. (20-100PSI) About 12f/s flow velocity		Assume "High Pressure" PEAK flow. About 18f/s flow velocity*	
Sch 40 Pipe Size	ID (range)	OD	**GPM** (with minimal pressure loss & noise)	**GPH** (with minimal pressure loss & noise)	**GPM** (with minimal pressure loss & noise)	**GPH** (with minimal pressure loss & noise)	**GPM** (with significant pressure loss & noise)	**GPH** (with significant pressure loss & noise)
1/2"	.50-.60"	.85"	7 gpm	420 gph	14 gpm	840 gph	21 gpm	1,260 gph
3/4"	.75-.85"	1.06"	11 gpm	660 gph	23 gpm	1,410 gph	36 gpm	2,160 gph
1"	1.00-1.03"	1.33"	16 gpm	960 gph	37 gpm	2,220 gph	58 gpm	3,510 gph
1.25"	1.25-1.36"	1.67"	25 gpm	1,500 gph	62 gpm	3,750 gph	100 gpm	5,940 gph
1.5"	1.50-1.60"	1.90"	35 gpm	2100 gph	81 gpm	4,830 gph	126 gpm	7,560 gph
2"	1.95-2.05"	2.38"	55 gpm	3300 gph	127 gpm	7,650 gph	200 gpm	12,000 gph
2.5"	2.35-2.45"	2.89"	80 gpm	4800 gph	190 gpm	11,400 gph	300 gpm	17,550 gph
3"	2.90-3.05"	3.50"	140 gpm	8400 gph	273 gpm	16,350 gph	425 gpm	25,650 gph
4"	3.85-3.95"	4.50"	240 gpm	14,400 gph	480 gpm	28,800 gph	700 gpm	42,000 gph

Figure 1: Water flow based on pipe size

3.0 Storm water:

The purpose of the storm water management and use is to ensure that the Camp Verde Park does not flood. Flooding can result in property damage and/or cause harm to park visitors

Safety Requirement -

The safety of the park during the wet season relies on the parks landscape ability to manage storm water.

Below is a list of the constraints and criteria of the storm water management system for the Camp Verde Park.

Criteria:

- Ensure the safety of the park and its inhabitants

Constraints:

- Use detained storm water for irrigation water during the wet season
- The storm water management solution must be cost effective
- Minimize the amount of water on roadways, parking lots, and playing fields
- Ensure storm water generated by pervious surfaces on the park does not negatively affect the surrounding area
- Ensure onsite buildings are safe from high intensity storm events such as the 100 year storm

Storm water is found in Appendix E. The red arrows show the flow of runoff during a major storm event. And during any small storm event, the water would be absorbed on contact.

The arrows are pointing towards the elevation change and the shape of the contours. The curves in the contours show peaks and valleys as well.

4.0 Estimated costs:

The estimated costs for the irrigation system is between $50,000-$75,000 USD. And the estimated costs for the water system is between 25,000-40,000 USD.

5.0 MAG Regulations:

MAG regulations were used for all components of this design. The regulations do not typically apply to this job because it will not be incorporated into the county or city systems at this time. But being they are the local regulations it was best to use them as guidelines and for best engineering practices.

Reference:

Ref: City of Phoenix - Design Standards Manual for Water and Wastewater Systems

http://flexpvc.com/WaterFlowBasedOnPipeSize.shtml

MAG Regulations

Appendix A:

WELL_DEPTH	CASING_DEPTH	CASING_DIAMETER	WATER_LEVEL	PUMPRATE
410.00	22.00	10.00	67.00	0.00
300.00	74.00	6.00	255.00	0.00
300.00	200.00	6.00	250.00	0.00
270.00	80.00	8.00	150.00	30.00
260.00	40.00	6.00	108.00	32.00
235.00	60.00	6.00	84.00	14.00
235.00	21.00	8.00	73.00	0.00
235.00	60.00	6.00	84.00	0.00
225.00	42.00	6.00	60.00	0.00
220.00	162.00	8.00	98.00	11.00
210.00	42.00	6.00	48.00	0.00
200.00	0.00	10.00	0.00	30.00
200.00	40.00	6.00	90.00	20.00
180.00	45.00	6.00	0.00	0.00
165.00	0.00	6.00	75.00	0.00
156.00	125.00	6.00	16.00	16.00
150.00	20.00	12.00	77.00	190.00
150.00	40.00	6.00	22.00	0.00
150.00	150.00	6.00	19.00	0.00
150.00	150.00	6.00	21.00	0.00
150.00	150.00	6.00	20.00	0.00
150.00	42.00	6.00	21.00	0.00
150.00	53.00	8.00	40.00	0.00
140.00	100.00	6.00	135.00	20.00
140.00	31.00	6.00	88.00	20.00
140.00	40.00	6.00	30.00	30.00
140.00	68.00	6.00	41.00	0.00
135.00	38.00	6.00	10.00	30.00
135.00	63.00	6.00	10.00	0.00
132.00	33.00	6.00	80.00	30.00
130.00	44.00	6.00	45.00	0.00
130.00	43.00	6.00	14.00	16.00
130.00	52.00	6.00	40.00	17.00
130.00	35.00	6.00	80.00	21.00
130.00	40.00	6.00	115.00	24.00
130.00	53.00	6.00	39.00	0.00
130.00	53.00	6.00	17.00	20.00
130.00	47.00	6.00	45.00	15.00
130.00	54.00	6.00	18.00	12.00
130.00	51.00	6.00	23.00	18.00
130.00	20.00	6.00	70.00	15.00
130.00	52.00	6.00	50.00	0.00
130.00	0.00	0.00	0.00	20.00
130.00	120.00	4.00	10.00	13.00
130.00	55.00	6.00	45.00	0.00
125.00	41.00	6.00	30.00	20.00

125.00	60.00	6.00	43.00	15.00
125.00	26.00	6.00	47.00	15.00
120.00	0.00	1.00	0.00	29.00
120.00	60.00	6.00	25.00	20.00
120.00	70.00	6.00	30.00	20.00
110.00	66.00	8.00	25.00	0.00
110.00	110.00	4.00	12.00	0.00
110.00	32.00	6.00	65.00	14.00
110.00	110.00	6.00	35.00	14.00
105.00	105.00	6.00	48.00	14.00
105.00	32.00	6.00	55.00	15.00
105.00	25.00	6.00	47.00	30.00
104.00	37.00	6.00	54.00	12.00
101.00	28.00	6.00	0.00	20.00
100.00	43.00	6.00	28.00	20.00
100.00	42.00	6.00	0.00	0.00
100.00	28.00	6.00	20.00	15.00
100.00	60.00	6.00	50.00	0.00
100.00	40.00	8.00	0.00	35.00
100.00	35.00	6.00	17.00	15.00
100.00	28.00	6.00	50.00	15.00
100.00	45.00	6.00	30.00	15.00
100.00	40.00	6.00	0.00	0.00
100.00	48.00	6.00	28.00	14.00
100.00	85.00	6.00	65.00	22.00
100.00	38.00	6.00	25.00	34.00
100.00	0.00	0.00	0.00	0.00
100.00	49.00	6.00	22.00	35.00
97.00	41.00	6.00	37.00	20.00
95.00	68.00	6.00	0.00	0.00
95.00	37.00	6.00	42.00	13.00
95.00	54.00	6.00	18.00	0.00
95.00	20.00	6.00	45.00	30.00
94.00	49.00	6.00	21.00	25.00
91.00	39.00	6.00	33.00	12.00
90.00	90.00	5.00	19.00	10.00
90.00	90.00	6.00	18.00	25.00
90.00	42.00	6.00	14.00	29.00
90.00	41.00	6.00	47.00	15.00
90.00	44.00	6.00	42.00	14.00
85.00	65.00	0.00	70.00	0.00
85.00	41.00	8.00	29.00	0.00
85.00	67.00	4.00	72.00	0.00
85.00	32.00	6.00	21.00	10.00
85.00	70.00	4.00	75.00	0.00
84.00	84.00	4.00	71.00	0.00
84.00	34.00	6.00	35.00	25.00
84.00	81.00	4.00	69.00	0.00
84.00	84.00	4.00	69.00	0.00
84.00	34.00	6.00	35.00	25.00
84.00	83.00	4.00	69.00	0.00

83.00	83.00	4.00	74.00	0.00
83.00	83.00	4.00	74.00	0.00
82.00	67.00	4.00	75.00	0.00
81.00	19.00	6.00	32.00	15.00
80.00	22.00	6.00	25.00	15.00
80.00	80.00	4.00	70.00	0.00
80.00	44.00	6.00	28.00	20.00
80.00	23.00	6.00	14.00	10.00
80.00	20.00	6.00	25.00	15.00
80.00	34.00	6.00	35.00	0.00
80.00	20.00	6.00	37.00	10.00
80.00	75.00	8.00	50.00	30.00
80.00	21.00	6.00	20.00	35.00
80.00	52.00	6.00	33.00	15.00
80.00	0.00	8.00	40.00	0.00
78.00	0.00	6.00	18.00	0.00
77.00	40.00	6.00	5.00	25.00
76.00	20.00	6.00	0.00	20.00
75.00	25.00	6.00	0.00	0.00
75.00	0.00	0.00	0.00	0.00
75.00	75.00	6.00	30.00	20.00
75.00	31.00	6.00	50.00	10.00
75.00	26.00	6.00	32.00	20.00
75.00	26.00	6.00	20.00	35.00
75.00	42.00	6.00	7.00	16.00
73.00	42.00	6.00	61.00	10.00
72.00	31.00	6.00	65.00	0.00
70.00	26.00	6.00	18.00	15.00
70.00	38.00	6.00	0.00	12.00
70.00	24.00	6.00	24.00	10.00
70.00	29.00	6.00	47.00	0.00
70.00	52.00	8.00	23.00	24.00
70.00	24.00	6.00	25.00	10.00
70.00	27.00	6.00	35.00	35.00
70.00	39.00	6.00	25.00	32.00
70.00	0.00	0.00	0.00	20.00
70.00	40.00	6.00	35.00	15.00
70.00	40.00	8.00	20.00	18.00
69.00	69.00	4.00	51.00	0.00
69.00	50.00	6.00	35.00	1.00
68.00	68.00	8.00	26.00	200.00
68.00	63.00	4.00	46.00	0.00
67.00	48.00	6.00	12.00	0.00
65.00	27.00	6.00	30.00	20.00
65.00	34.00	6.00	22.00	16.00
65.00	38.00	6.00	12.00	24.00
60.00	60.00	8.00	36.00	0.00
60.00	40.00	6.00	20.00	0.00
60.00	28.00	6.00	19.00	0.00
60.00	43.00	6.00	12.00	30.00
60.00	60.00	6.00	0.00	0.00

55.00	25.00	6.00	22.00	20.00
55.00	25.00	6.00	27.00	20.00
53.00	47.00	8.00	48.00	10.00
50.00	47.00	6.00	25.00	24.00
50.00	39.00	6.00	20.00	15.00
50.00	40.00	6.00	40.00	15.00
50.00	36.00	6.00	22.00	20.00
50.00	40.00	6.00	20.00	10.00
50.00	50.00	6.00	40.00	35.00
50.00	34.00	6.00	19.00	16.00
50.00	33.00	6.00	21.00	30.00
50.00	50.00	6.00	14.00	15.00
48.00	44.00	6.00	15.00	12.00
45.00	37.00	6.00	21.00	25.00
45.00	37.00	6.00	26.00	0.00
42.00	39.00	6.00	23.00	17.00
40.00	30.00	6.00	10.00	25.00
37.00	32.00	6.00	20.00	10.00
35.00	0.00	6.00	12.00	35.00
33.00	33.00	6.00	0.00	0.00

Average Well Depth	Average Casing Depth	Average Casing Diameter	Average Water Level
104	48	6	38

Appendix B:

Table 3.3 Water and Sewer Design Flows

Land Use	Unit	WASTEWATER Avg Daily Flow/Unit (gal)	WATER Avg Daily Flow/Unit (gal)
Single Family Residential	dwelling	240	360
Multi-family[2]	dwelling	180	240
Commercial (retail/mall)[1]	1000sq-ft	75	125
Commercial (office)[1]	1000sq-ft	90	115
Warehousing/Big Box Retail[1]	1000sq-ft	25	30
Industrial[1,3]	1000sq-ft	50	65
Schools[1]	student	20	25
Hotel (no restaurant)[1]	room	100	140
Hotel (with restaurant)[1]	room	150	200
Resort[2]	room	210	300
Hospital (all flows)[1]	bed	300	500
LANDSCAPE WATER REQUIREMENTS			
General Landscaping	acre	NA	4,374
Public Right of Way or Streetscape	acre	NA	1,339
Surface Water	acre	NA	5,335

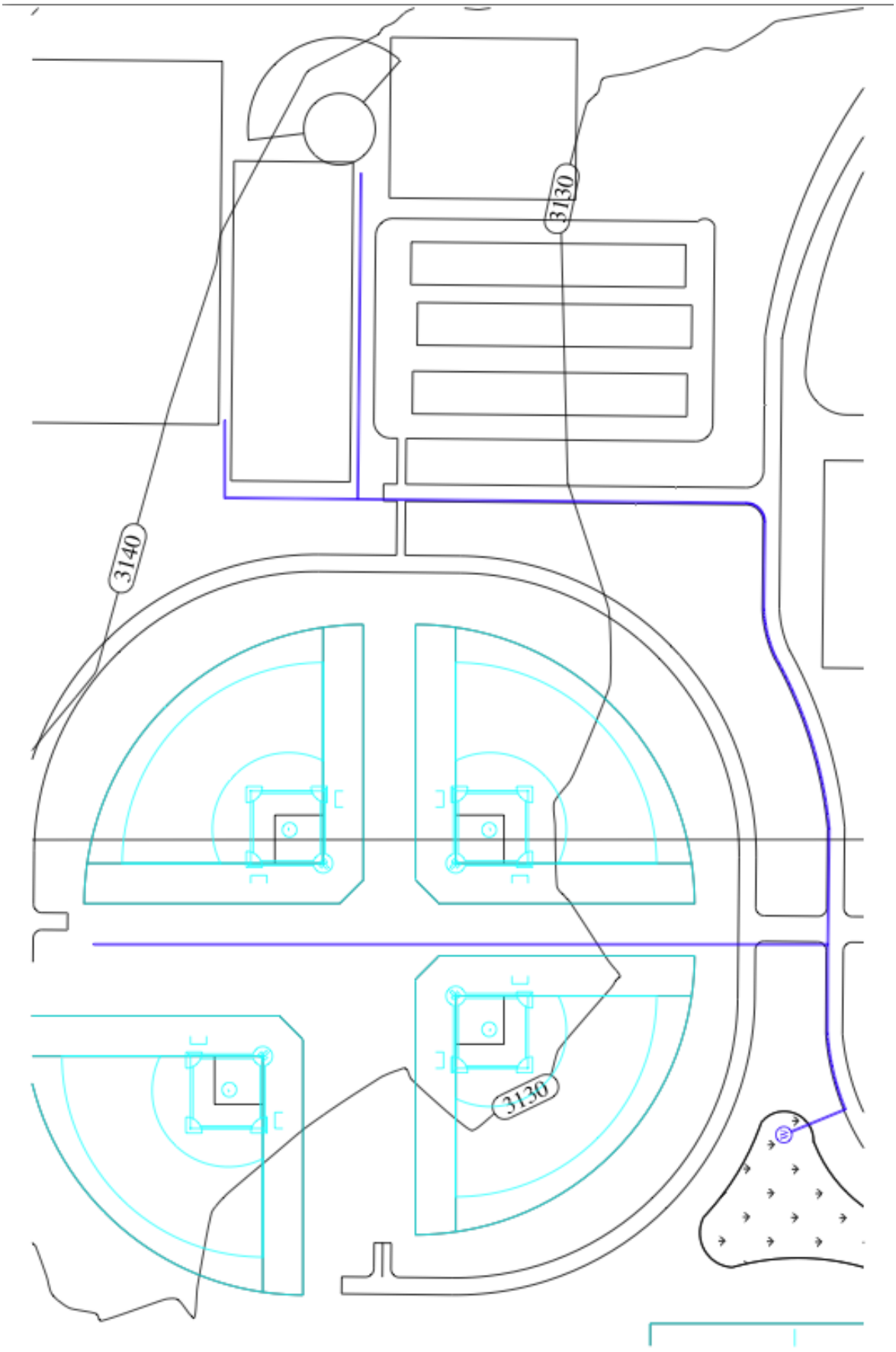
Community bldg: 125gal

Concession building: 125 gal

Comfort station: 125 gal

Equal 375 gal * 1.7 (peak Factor) = 637.5 Peak GDP

Appendix C:



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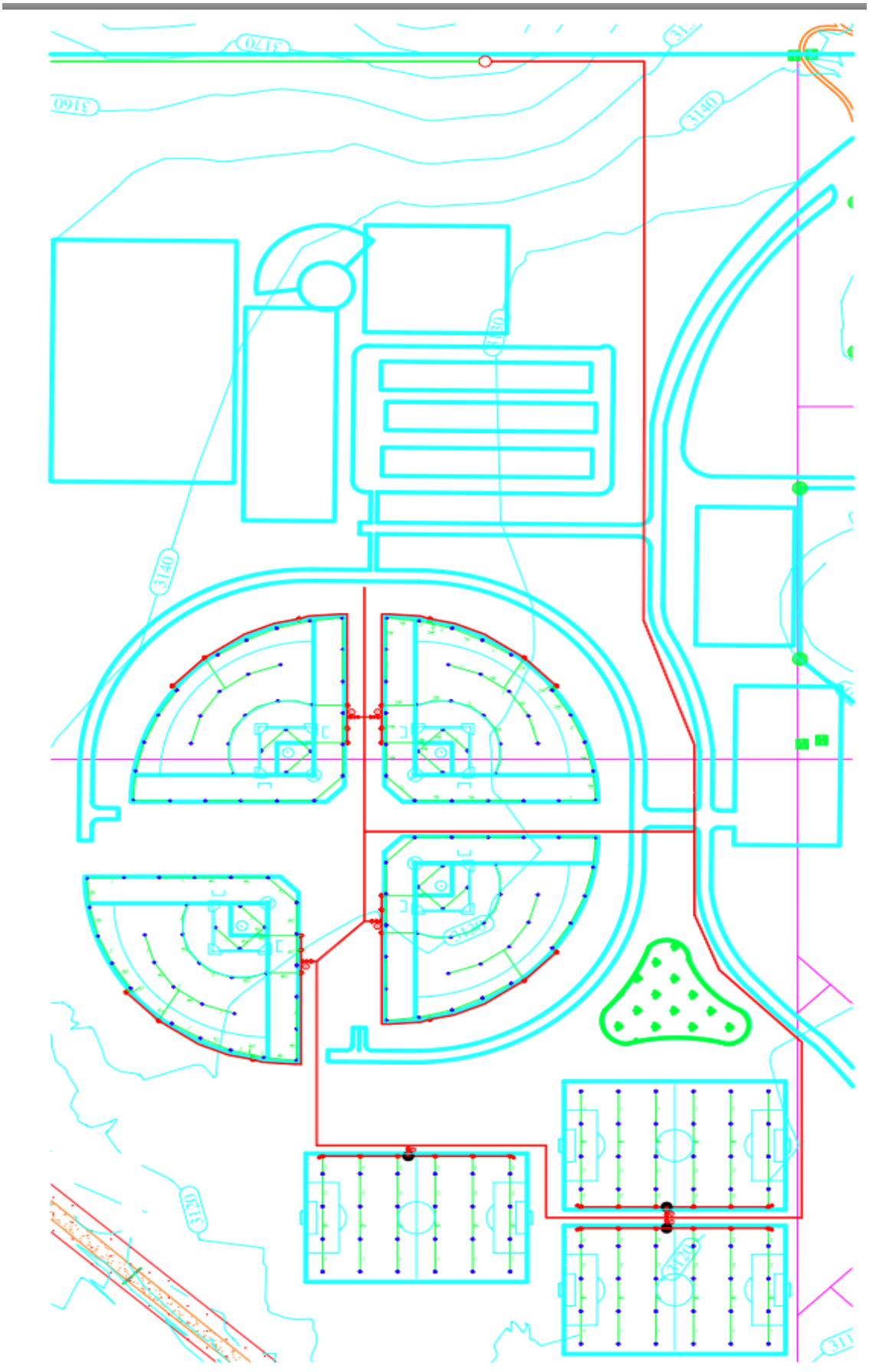

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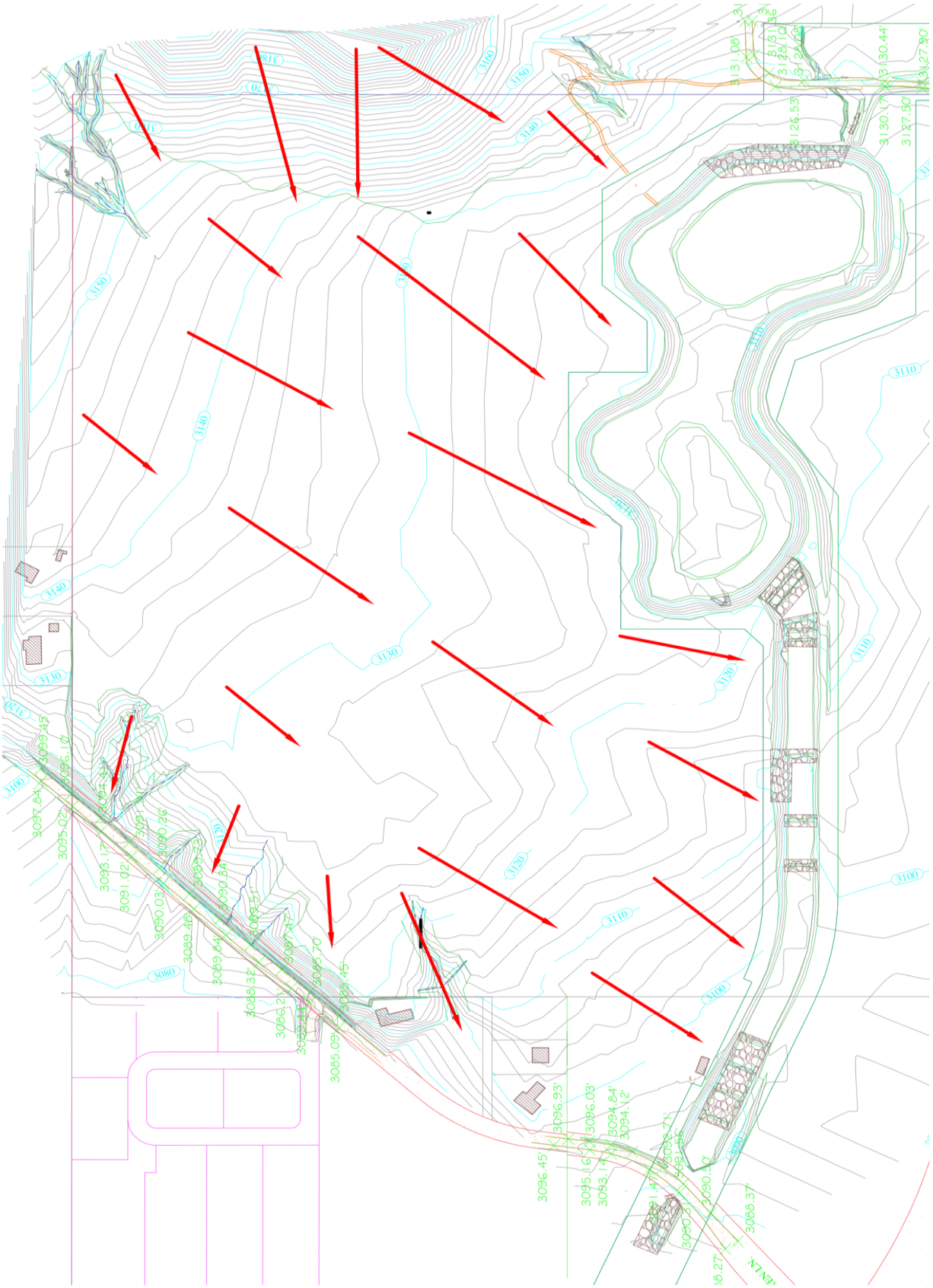


Wastewater- Camp Verde Park

Figure 1- finished wastewater plan view

The client's objective for the wastewater produced by the park is to have the waste collected from all the restrooms and buildings flow through a gravity fed pipeline to a grinder pump located on the lowest elevation of the park at a 1% slope. The waste would be collected at a grinder pump which will then be grinded up and pumped to the local wastewater treatment plant which is over a 60 foot high hill and less than a mile away. There would be two shut off valves they would be located on the base of the grinder pump and the other shut off valve would be located on the edge of the property of the pressure pipe.

Shown in figure 1 is the finished wastewater plan. The circles represent the restrooms and the rectangle on the lower left corner represents the grinder pump and the lift station location. This particular location was selected due to its' relative low elevation and clearance from any other infrastructure on the park such as the drinking water well any fields and/or roads. The other blocks represent the pads of the planned fields that are to be built. Below shown in Figure 2 is the relation of the park boundary to the local sanitary plant.

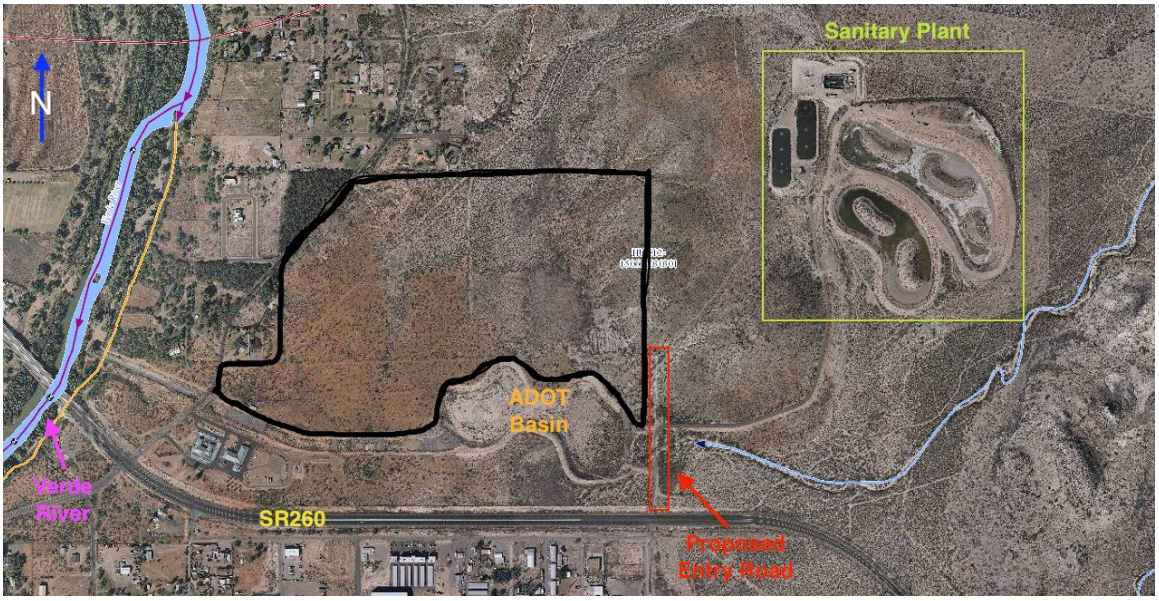


Figure 2- the park in relation to the wastewater plant

The client's tasks for this part of the park is to determine the size and the length of the pipes from each restroom to the grinder pump, determine the pump size to overcome the 60' head, and design a gravity flow system that would transport waste to a grinder pump and to then to the wastewater treatment plant.

Summary of Completed waste water system

The proposed final design computed for the wastewater system was comprised of the following specifications. The specifications were determined from following the Maricopa County MAG regulations and the design parameters. Below are the summarizations of the sewer specifications.

- Gravity pipe length= 5,679.9'
- Pressure pipe length = 3,092.77'
- Gravity flow pipe diameter= 8"
- Pressure pipe diameter= 3"
- Slope = 1 % (gravity feed system)
- Manning roughness coefficient = 0.013
- Five man holes on each intersection
- Service connection every 500 feet per length
- Pipes running along the main road (right of way)
- Peak flow 93 GPM
- Grinder pump 3 hp
- Pump 1.5 to 2 hp

Pipe diameter

The pipe diameter of the system was determined by using the Maricopa County MAG regulations. In the regulations from Appendices C it shows the proper diameter size for the gravity flow pipe systems as

directed by the client. The gravity flow pipe diameter was listed to be 8”. The pressurized pipe was determined to be 3” due to financial constraints. The 3’’ diameter was a size specified specifically by the client.

Pipe length

The pipe was laid out in a manner that would be easily accessible and not interfere with any other park infrastructure like the fields or buildings. Therefore, most of the pipes follow the inner park roadways. The pipe would be laid out on the right of way as determined by the MAG regulations. A typical cross section of the right of way of the pipe is shown in appendix A-1. The gravity flow pipe length came out to be 5,679.9’. The pressurized system length came out to 3,092.77’ this length is from the grinder pump to the edge of the park property. The pressurized pipe that was used was a schedule 80 typical wastewater pipes.

Clean outs and Man holes

There are five pipe intersections in the design and as directed by the client a manhole should be in place at each pipe intersection. This is due to the heightened potential clogging of the pipes at these locations. In the MAG regulations there are also specifications of having cleanouts every 500 feet. In Appendix A-1 it shows a a typical clean out.

Slope

The slope was pre determined to be 1% as requested by the client. The justification for this is that the park area is fairly flat and goes from a subtle high slope to a low slope. The park site contained no high or low abnormities on the site. The client believed that a 1% slope was enough for the wastewater to flow enough so it won't clog.

Peak flow

The peak flow was determined using bases of 400 cars per day with four people per car. That was resulting in 1600 people at the peak time. This number was used in relation to the average wastewater production per person as determined by the EPA. The result was 93 gallons per minute. The client wanted to assume that the flow was continuous for the sake of simplicity of the calculations. Any wastewater flow that is generated in the park would occur mostly in the daytime or mid afternoon. In the night and other times were people aren't less active in parks the flow would be minimal or there wouldn't be a flow all together.

Pump size

The pump size for the lift station was determined to be 1.5 hp. The velocity would be 4.24 ft/s with a specific head loss of 2.1 ft per 100 ft of pipe. The total dynamic head was very small and proved to be irrelevant and this is due to the flow of the pipe being a straight path to the wastewater plant. This size will be able to transport the expected 93-gpm-peak flow comfortably over the 60' head and to the wastewater treatment plant. But the recommended size of pump would be a 2hp pump. This is due to sizing the pump to accommodate an increase of the size of the park due to the growth the town. In Appendix A-3 it shows a typical lift station.

Grinder pump [2]

The grinder pump was sized to accommodate the peak flow discharge. The grinder pump that was chosen was a 3hp KG-31 industrial grade pump. It was a class F motor and has single-phase options. In Appendix B it shows the specifications of the grinder pump.

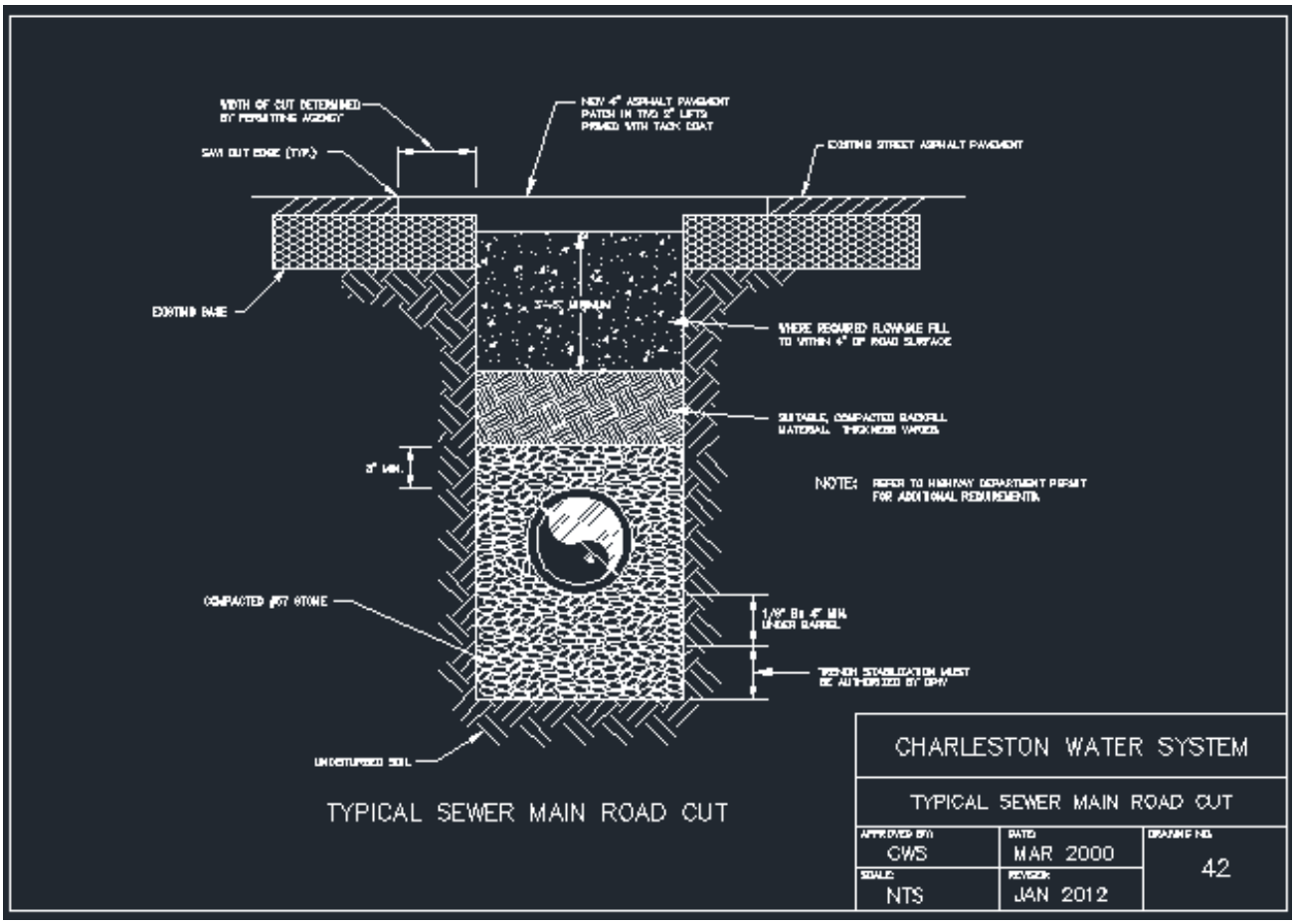
Cost estimation [3]

- Standard PVC pipe 8": $11.95 per foot = $ 67,864
- Standard PVC pipe 80 3": $4.28 per foot = $ 13,233.76
- Pump: $2000 to $3000
- Grinder pump: $2000 to $ 3000
- Total= $85,097.76 to $87,097.76

Conclusion

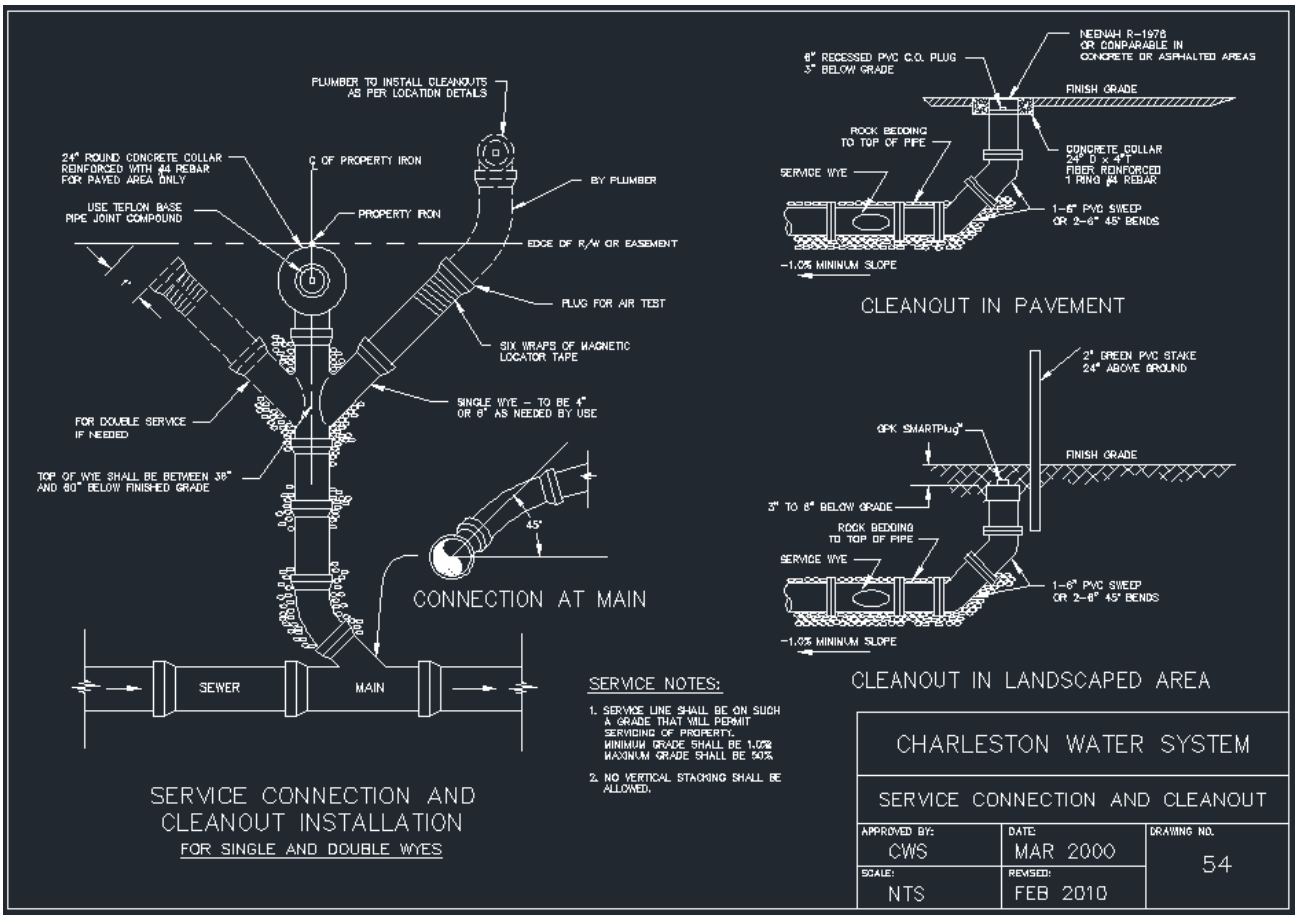
The wastewater system was designed to be the cheapest alternative to direct the wastewater. The client specified to only use one pump and grinder to keep cost down. The use of the gravity feed system is to reduce the chances a system will fail if the system was comprised of many pumps and or grinders.

Appendix A-1:



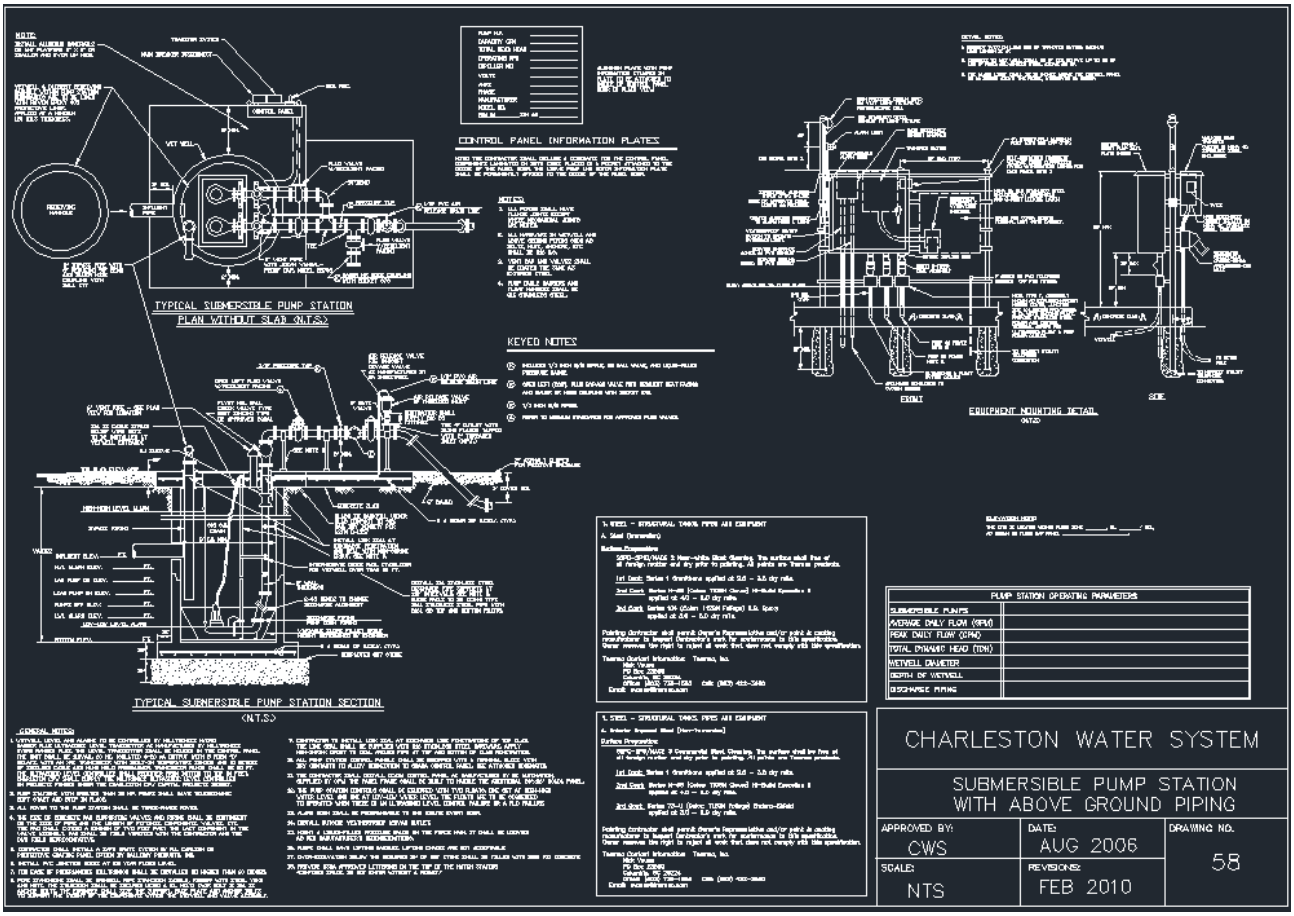
Typical main road cut

Appendix A-2:



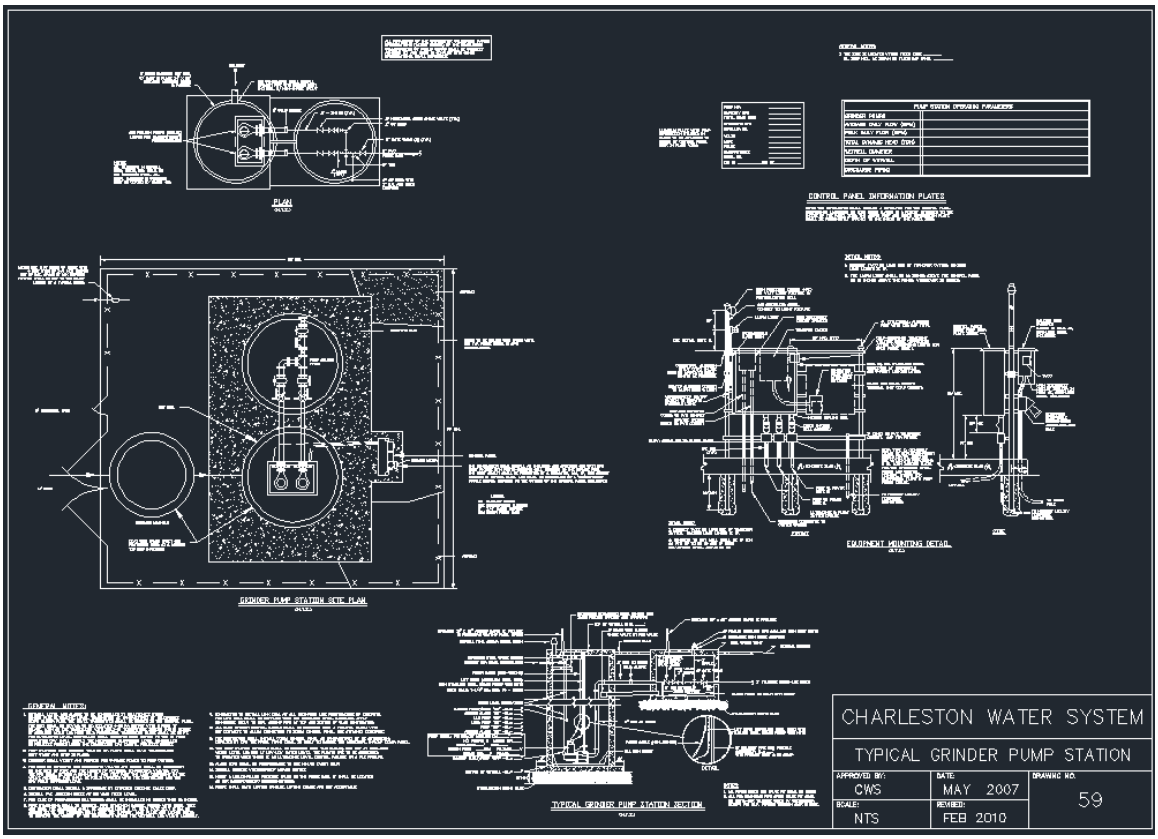
Typical service connection and cleanout

Appendix A-3:



Typical Pump station

Appendix B-1:



Typical Grinder Pump Station

Appendix B-2:

Products: Grinder Pumps

Grinder 3hp KG-31

The KEEN GRINDER PUMP KG-31 series centrifugal grinder pumps easily handle residential, commercial or industrial sanitary waste, reducing it to fine slurry.

The KG-31 pump is designed for use in pressure sewer applications or any piping network.

The recessed vortex impeller design of the KG-31 grinder pump provides trouble free, non-overloading operation over the entire performance curve.

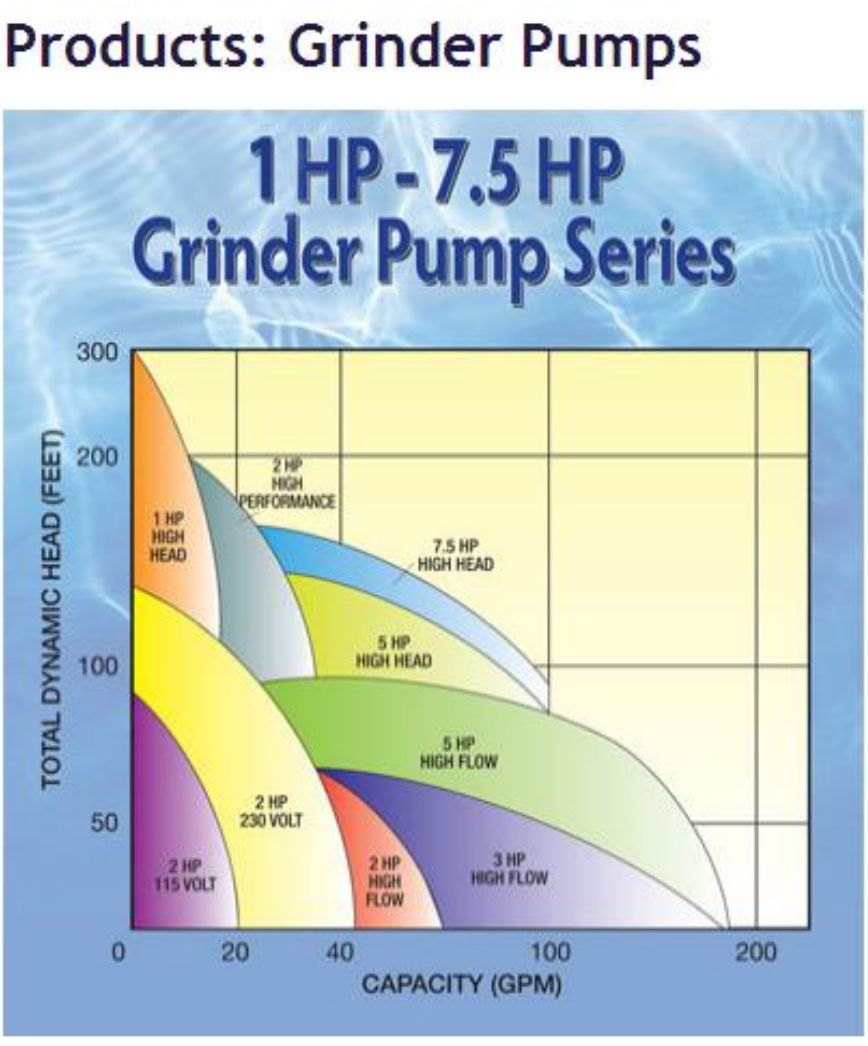
The modular design provides quick and easy serviceability. The hardened stainless steel grinder assembly provides many years of dependable operation.

The KG-31 series grinder pump features:

- 3 support bearings (upper / lower ball, sleeve)
- Dual mechanical seals (silicon carbide)
- Internal moisture detection
- Class F motor, single phase options
    - 208 / 230 volt, 1-phase

Grinder Pump specifications

Appendix B-3:



Pump curve for Grinder pump

Appendix C:

Table 5.1 Design Velocity

PIPE SIZING (inches)	* MINIMUM DESIGN VELOCITY (ft/s)	MINIMUN DESIGN SLOPES (%)	MAXIMUM DESIGN SLOPES (%)
8	2.1	0.380	6.980
10	2.2	0.306	5.121
12	2.3	0.256	3.919
15	2.4	0.205	2.880
18	2.4	0.140	2.390
21	2.5	0.146	1.890
24	2.6	0.127	1.520
27	2.6	0.115	1.378
30	2.7	0.102	1.113
36	2.7	0.085	0.945
42	2.8	0.073	0.754
48	2.9	0.064	0.616
54	3.0	0.058	0.522
60	3.0	0.051	0.430
66	3.1	0.047	0.396
72	3.1	0.043	0.362
78	3.2	0.040	0.316
84	3.2	0.037	0.293
96	3.3	0.032	0.238
108	3.3	0.028	0.208
120	3.4	0.026	0.182

* The velocities are based on the minimum required design shear stress recommendations provided in the American Society of Civil Engineers Manual of Practice No. 69 (MOP 69). These velocities will provide the design shear stress required to transport fine sand and grit particles less than 0.2 mm in diameter. Any slope outside the provided range will require a technical appeal to the Planning and Development Department (P&D) City Managers Representative. The Technical Appeals Procedure (P-107) can be found at the WSD's website shown below:

Shows the pipe size and minimum design velocities [1]

References:

[1] Maricopa Association of Governments: Uniform Standard Specifications and Details for Public Works Construction: Jan 2013

[2] Keen Pump Co.: http://www.keenpump.com: 2013

[3] Charleston Water system: Water system Construction Details:

http://www.charlestonwater.com/dev_contract_construction_details.html