City Of Richland
Irrigation Water System Plan

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1.0 BACKGROUND

The City of Richland currently has five (5) separate irrigation systems:

1. Columbia Point – located in the area called Columbia Point. This area is served by a pump station located on the Columbia River. The irrigation system serves the Columbia Point Golf Course and multi-family housing units located along the river and adjacent to the golf course and river.
2. Horn Rapids – located in the Horn Rapids Triangle. This area is served by a pump station on the Columbia River. The system serves the Horn Rapids Golf Course, an extensive residential subdivision, sports complex, ORV Park, City Landfill complex and a farming enterprise.
3. Research District – located in the north Richland research district. This system is served by two wells owned by the City. The system serves commercial and light industrial customers.
4. Richland School District – located on the grounds of Carmichael Middle School. This system is served by a well. The system serves Carmichael Middle School and Richland High School.
5. Willowbrook – located in south Richland, adjacent to the City's Claybell Park and south of Broadmoor Street. This system is served by a well that was originally a potable water source for the City. Use of the well as a potable source was stopped due to odor and temperature problems.

The City of Richland sought a qualified firm to develop an irrigation water system plan. The firm selected was IRZ Consulting of Hermiston, Oregon. For each of the systems the plan was to document existing deficiencies in service delivery, anticipated service growth demands, recommended capital improvements to support planned system expansions, and recommended system expansions based on optimal use of existing City-owned water rights. This plan was to be completed by August 31, 2011.

The preliminary project Scope of Work proposed by the City was to include, but not be limited to:

1. Scoping and Coordination Meetings – This task was to include scoping meetings with City staff to discuss project goals and objectives, schedule, deliverables, level of detail, planning concepts and evaluation procedures. The consultant was to propose Coordination Meetings as considered necessary to complete the work.
2. Hydraulic System Modeling – The consultant was to develop and calibrate hydraulic system models for each of the distinct distribution systems noted above. The models were to be used to identify system deficiencies, to analyze corrective improvements, and to design improvements for planned system expansion.
3. Re-deployment of Existing Water Rights – The consultant was to review the City's inventory of water rights to determine those best suited for re-deployment. The consultant was to analyze current turf irrigation demands served by potable water to determine those best suited for development of a replacement non-potable irrigation source. The consultant was to meet with managers of the current turf areas, including the City's Park Department staff, Richland School District staff, and private property owners. The consultant was then to develop a plan for converting from the potable to non-potable water source for the irrigation demands. The plan was to include necessary modifications to water right permits and certificates, the required capital improvements, and timelines. The consultant was to rank the conversion opportunities via a matrix that would include cost-benefit to the customer, feasibility of water right changes, impact to potable system revenues, and other factors as recommended by the consultant and agreed to by the City. The plan was also to consider policy alternatives for funding the initial capital investments.

4. Reporting and Technical Documentation – The results of the work were to be summarized in a report that would be reviewed by City staff, the City's Utility Advisory Committee, and the City Council. Every effort was to be made to provide an easy to read document that could be understood by all readers.
5. Presentations – The consultant was to be prepared to make at least one presentation of the plan findings to the City's Utility Advisory Committee.

1.1 Scope of Work

Based on meetings with City staff a revised Scope of Work was developed; attached to the Work Order as Exhibit A. The first general effort was to address the five identified irrigation water systems. For four of the five irrigation systems; the Columbia Point, Horn Rapids, Research District, and Willowbrook systems; the work included:

1. Gathering and reviewing available information about each system.
2. Develop a Geo-Referenced map of each system in AutoCAD.
3. Develop or update a hydraulic (WaterCAD) model of each system.
4. And utilize the model to evaluate operational scenarios to identify system constraints for future use and expansion of service.

For the Horn Rapids system the first three of the above tasks had already been completed under a previous contract. For two of the systems, the Columbia Point and Research District (K Well), an additional task was to conduct a basic test to determine the operational performance of each system's pump. And for the Willowbrook System an additional task was to size and develop preliminary specifications for a storage pond.

For the fifth system, the Richland School District System, the task was simply to write a letter explaining how the existing well on the Carmichael Middle School grounds would be connected to the Richland High School system and operated to serve both grounds. To do additional work would require a revised scope.

A second general effort was to review and evaluate the potential for re-deployment of the City's existing water rights. The specific tasks proposed were to:

1. Conduct an initial review and mapping of each water right.
2. Draft an Application for Change/Transfer for each water right.
3. Provide technical information to the Conservancy Board for each application.
4. Provide impairment analysis for each proposed new well for the Conservancy Board.

A third effort was to develop a Capital Improvement List based on the assessment of each of the five irrigation system. This effort was expanded to include the development of new wells to serve schools and parks that are currently using potable water for irrigation.

A fourth effort was to review the existing standards used by the City for irrigation water systems.

And a fifth effort was to develop a policy for the level of irrigation service provided by the City.

2.0 IRRIGATION WATER SYSTEMS

2.1 Irrigation Water Requirements

Part of the assessment for the irrigation systems as well as for the water rights is the required irrigation rates, that is the design rate per area irrigated. The required rate of irrigation will depend on the crop (in this case turf), the area (in this case Richland), the irrigation application efficiency, the net irrigation, and the irrigation interval. From the Washington Irrigation Guide; the net monthly irrigation requirement for turf in the Richland area is 10.31 inches in the month of July. Based on the methodology in the NRCS National Engineering Handbook the daily peak requirements for different net irrigation amounts were calculated; see Table 2.1-1. Also presented are the associated irrigation intervals based on the net irrigation and the daily peak usage.

Given the net irrigation the required capacity, rate per unit area, can be calculated for an application efficiency and irrigation interval. For properly design, installed, and maintained underground systems the application efficiency can be from 75% to 90%. For this analysis an application efficiency of 80% was assumed. Present in Table 2.1-1 are the required system unit capacities for the specified net irrigation and five irrigation durations.

Table 2.1-1 Calculated Daily Peak Irrigation Requirements for Specific Net Irrigation Depths Based on the NRCS National Engineering Handbook for Turf in the Richland Area along with Associated Irrigation Intervals and the Required System Rates per Acre for Different Irrigation Durations.

Net Irrigation (inches)	Daily Peak (in/day)	Irrigation Interval (days)	Rates per Acre for Irrigation Durations in Hours				
			6 (gpm/ac)	8 (gpm/ac)	12 (gpm/ac)	16 (gpm/ac)	24 (gpm/ac)
0.46	0.46	1.0	43.7	32.8	21.9	16.4	10.9
0.67	0.45	1.5	63.4	47.5	31.7	23.8	15.8
0.87	0.44	2.0	82.4	61.8	41.2	30.9	20.6
1.08	0.43	2.5	101.4	76.0	50.7	38.0	25.3
1.27	**0.42**	**3.0**	**119.6**	**89.7**	**59.8**	**44.9**	**29.9**
1.46	0.42	3.5	137.9	103.5	69.0	51.7	34.5
1.65	0.41	4.0	155.8	116.8	77.9	58.4	38.9
2.03	0.41	5.0	191.4	143.6	95.7	71.8	47.9

As an example from Table 2.1-1, an irrigation interval of three days would require a net irrigation of 1.27 inches every third day. And to irrigate one acre in an eight hour period of time would require a system capacity of 90 gpm. To irrigate the same acre in a twenty-four hour period would require a system capacity of 30 gpm. If the acre were divided into three equal blocks, each block could be irrigated in successive days (or nights) using one third of the required capacity; 30 gpm for eight hours each day or 10 gpm for twenty-four hour a day operation.

A three day irrigation interval is desirable for turf to help promote proper root development. Daily irrigation keeps the surface moist which discourages the downward movement of root. On the other hand, turf typically does not have a deep enough root system to go more than three days between irrigation.

The Washington Irrigation Guide tends to provide a very conservative number. If the average daily peak is calculated from the monthly peak irrigation requirement the rate is 0.33 inches per day. This approach may underestimate the rate for daily irrigation, but is a reasonable assumption for longer irrigation intervals. Table 2.1-2 presents the same calculations as in Table 2.1-1 using this singular irrigation requirement.

Table 2.1-2 Calculated Average Daily Peak Irrigation Requirements in July for Specific Net Irrigation Depths Based on an Average Daily Peak Rate of 0.33 inches along with Associated Irrigation Intervals and the Required System Rates per Acre for Different Irrigation Durations.

Net Irrigation (inches)	Average Daily (in/day)	Irrigation Interval (days)	Rates per Acre for Irrigation Durations in Hours				
			6 (gpm/ac)	8 (gpm/ac)	12 (gpm/ac)	16 (gpm/ac)	24 (gpm/ac)
0.33	0.33	1.0	31.4	23.5	15.7	11.8	7.8
0.50	0.33	1.5	47.0	35.3	23.5	17.6	11.8
0.67	0.33	2.0	62.8	47.1	31.4	23.5	15.7
0.83	0.33	2.5	78.5	58.9	39.3	29.5	19.6
1.00	**0.33**	**3.0**	**94.2**	**70.6**	**47.1**	**35.3**	**23.5**
1.17	0.33	3.5	109.8	82.4	54.9	41.2	27.5
1.33	0.33	4.0	125.4	94.1	62.7	47.0	31.4
1.66	0.33	5.0	156.8	117.6	78.4	58.8	39.2

As an example from Table 2.1-2, an irrigation interval of three days would require a net irrigation of 1.00 inches every third day. And to irrigate one acre in an eight hour period of time would require a system capacity of 71 gpm. To irrigate the same acre in a twenty-four hour period would require a system capacity of 23.5 gpm. If the acre were divided into three equal blocks, each block could be irrigated in successive days (or nights) using one third of the required capacity; 23.7 gpm for eight hours each day or 7.8 gpm for twenty-four hour a day operation.

In order to determine the required capacities of the City of Richland irrigation systems it was assumed that the values in Table 2.1-2 are reasonable. For convenience of calculations the unit rates were rounded up to <u>8 gpm per acre for a twenty-four hour application every day</u>, <u>16 gpm per acre for a twenty-four hour application every other day</u>, or <u>24 gpm per acre for a twenty-four hour application every third day</u>. For large systems, such as parks and schools, it was further assumed that one-third of the system could be operated each day. For an eight hour daily duration this would mean that the required capacity would be 24 gpm per acre for the entire property resulting in a system rate of 72 gpm per acre for the third being irrigated. Similarly, for a two day irrigation interval, 24 gpm per acre for the entire property would cover half the area in an eight hour daily application every other day.

For smaller systems, such as individual residences, the same results can be achieve by utilizing an irrigation schedule where one-third or one-half of the residences in a zone are irrigated every third or every other day, respectively.

2.2 Report for Each Irrigation System

A report of the work done for each of the five systems is provided below.

2.2.1 Columbia Point: The City provided a map of the Columbia Point Irrigation System as a PDF file. This map showed the alignment and sizes of the pipelines and the points of delivery. Also provided were records of total water usage by month for the past several years. These water use records provided no breakdown of individual deliveries.

On September 8th a basic test of the pump serving the residential and park areas was conducted. The pump is a Berkeley Model B2ZPH driven by a 30 horsepower 3,525 rpm motor controlled by a Variable Frequency Drive (VFD). This test included measuring flow rates at two different operational conditions. For both conditions the VFD was maintaining the discharge pressure at around 54 psi. Initially the discharge was 117 gpm at a speed of 2,332 rpm. After a city employee opened another service valve the discharge was increased to 300 gpm at a speed of 2,967 rpm. Accounting for the lift from the Columbia River's water surface to the pressure gauge and for the friction losses through the piping from the intake to the point where the pressure was measured, the total dynamic head for the operational conditions was calculated; 138 feet and 155 feet, respectively.

Figure 2.1-1 is the pump curve with the measured operational points plotted. Also plotted are the measured points adjusted to a full speed condition (3,325 rpm). The curve placed through these two adjusted points is just below the design curve for the pump; this is because the curve is for a full speed of (3,600 rpm). The point along this curve that is the "Best Efficiency Point" (B.E.P.) is also shown.

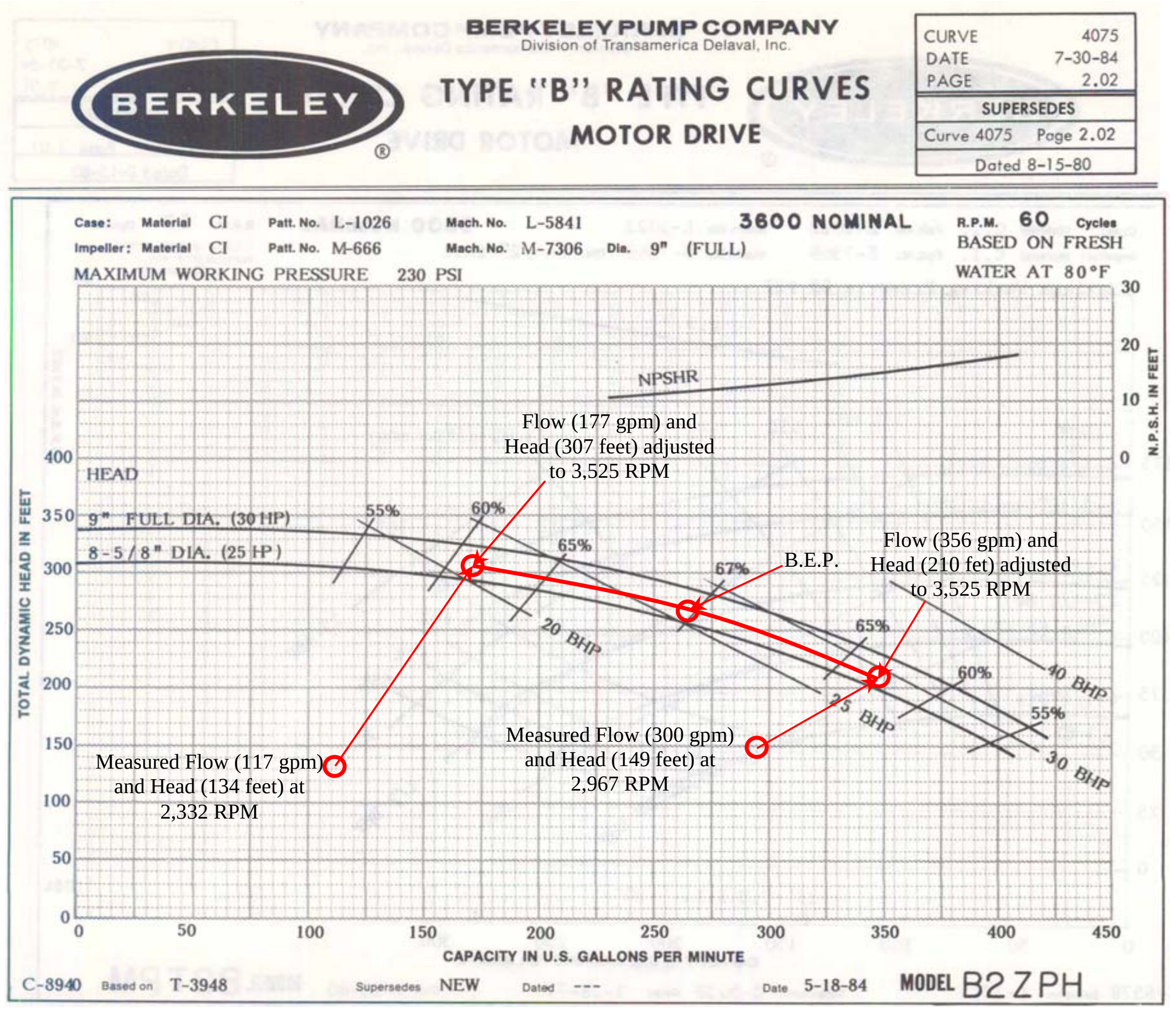
Utilizing high resolution, geo-referenced aerial imagery obtained from the USDA National Agriculture Imagery Program and the maps provided by the City, an AutoCAD map was developed. Using the AutoCAD map as a base, a hydraulic model in WaterCAD was created. The pump curve from Figure 2.1-1 was used to develop the pump definition for this model. Also, the detailed pump station piping plans, as confirmed during the pump test, were incorporated into the model.

Based on the pump specifications and the pump station piping plans it was determined that the maximum capacity of the system is around 300 gpm. Various delivery scenarios were modeled to distribute the 300 gpm. It was determined that the pipeline network can easily handle 300 gpm when distributed somewhat uniformly throughout the system. In fact, the pipeline network, as installed, has the capacity to handle twice the total flow rate.

The singular constraint with this system is the pump and the pump station piping. From the curve it can be seen that the limit of the existing pump is around 350 gpm. An even bigger limitation is the piping. The intake pipe is reduced from a 10 inch to a 2.5 inch several feet before the intake into the pump. This last section of pipe should be at least a 6 inch reduced to the 2.5 inch pump suction right at the pump through a reducing cone. And on the discharge side of the pump the first 18 inches is a 2 inch pipe that is connected to a 4 inch pipe through a sudden expansion. From the discharge side of the pump a gradual expansion cone from the 2 inch to at least a 4 inch pipe should be used. The 300 gpm through a 2 inch pipe would have a flow velocity of around 31 feet per second while through a 4 inch pipe would have a flow velocity of around 8 feet per second. The issue is the head losses through the undersized piping. Replacing the pipe and fittings for this pump should cost around $1,500.

The existing pump and piping can deliver the 300 gpm. Using the average required system capacity of 24 gpm per acre identified in Section 2.1 means that the 300 gpm could irrigate 12.5 acres of lawn assuming that one third of the area is irrigated for eight hours once every three days or that one half of the area is irrigated for eight hours every other day. This seems adequate for the apparent extent of landscaping, both current and future for the Columbia Point area. A scheduling system between areas and blocks and/or extending the period of irrigation daily would help ensure the complete and adequate irrigation of all areas.

Figure 2.1-1 Pump Curve for the Columbia Point Pump



In 2011 the rotating drum screens serving the pumps associated with this station were inspected by a diver and several issues were documented by video recording. The screen serving the irrigation system was intact, but was coated with aquatic growth. The drum rotated freely with little manual force applied to it. The screen was not operating at the time of the dive, and so it is unknown why the aquatic growth covered the screen. The potential causes could be that the valve on the feed line to the screen was inadvertently closed, the filter in the feed line was plugged, the nozzles in the screen were plugged, or simply that the system had not been operated for a long enough period allowing for the aquatic growth to take place. It is recommended that the valve and filter be checked, and that a diver clean and inspect the screen during operation to see if the nozzles are plugged. If the nozzles are plugged the screen will need to be repaired or replaced. Additionally, this screen requires that the water running back to the screen be at 60 – 100 psi. During the pump test of this system the system operating pressure was at approximately 54 psi. This lack of pressure may also be an issue. This system has the capacity to operate at higher pressure. It is recommended that the pressure be increased to a minimum of 65 psi.

The second rotating drum screen at this station, the one that serves the golf course, was discovered to be extensively damaged. The screen itself was totally absent, and the main frame of the intake was bent badly making it so the drum could not rotate. It appears in the video that the screen was violently struck. Being located in a boat basin perhaps a sailboat keel could have struck the intake, bent the frame and stripped the screen off. Effectively the intake is now a simple open pipe end. It is recommended that the rotating drum screen be replaced. It is recommended that a drum screen with perforated plate be utilized. One similar to those manufactured by CTC of Yakima would effectively meet the needs of this system. A slightly smaller screen could be utilized than what is currently in place, but would still have nearly double the capacity that is needed to meet system requirements.

Back-flush water for the screens is provided through 2 inch galvanized pipes running from the pump station back to the screens. The video suggests significant corrosion on these lines. It is recommended that a new 1 ½", 160 psi rated HDPE line be run to each of the drum screens. This will prevent future failure of these critical lines. Strapping the new line to the existing galvanized line will provide a simple method of maintaining its position.

The replacement of the one drum screen, the inspection of the other drum screen and the installation of the HDPE lines will require the services of a diver. It is estimated that this will cost approximately $4,000 for one day of dive services time. The new screen will cost approximately $2,500, and the HDPE lines will cost around $300. Additionally, it is recommended that a navigation buoy be placed above the screens to prevent future boat collisions with the screens. This buoy would cost approximately $700.

2.2.2 Horn Rapids: The Horn Rapids Irrigation System has been mapped, modeled, and analyzed several times over the last few years. This work has coincided with changes that have been made to the system (removal of a control valve, further completion of the build-out, and addition of another booster pump station) as well as proposed changes (complete build-out and addition of a pond).

The existing main delivery system can supply around 5,400 gpm continuously to the Horn Rapids area south of Highway 240. The golf course takes around 900 gpm of this flow leaving 4,500 gpm continuous capacity. Using the average required system capacity of 24 gpm per acre identified in Section 2.1 means that the available 4,500 gpm could irrigate 188 acres of lawn assuming that one third of the area is irrigated for eight hours once every three days or that one half of the area is irrigated for eight hours every other day. The current build-out is less than 100 acres of lawn. For a complete build-out of residential development, the assumed worst case scenario, the total area of turf would be around 260 acres. Again, using the average required system capacity of 24 gpm per acre means that the 260 acres of lawn could be irrigated with 6,240 gpm. Therefore, in order to meet the 6,240 gpm requirement during the eight hour irrigation period a small storage pond is need.

The worst case scenario was a total flow from the river of 19,200 gpm (discharge pressure of 95 psi), a total flow through the main booster station of 18,300 gpm (incoming pressure of 54 psi and discharge pressure of 117 psi), and a total flow through the existing Horn Rapid's branch to the full build-out of the existing development of 5,360 gpm (of which 900 gpm was going to the golf course). The remaining 13,800 gpm is available for utilization north of SR 240. The new development was drawing 1,980 gpm from the proposed new pond. At this rate the proposed pond would need a storage capacity of 950,400 gallons beyond dead storage. During the other 16 hours of each day this pond would require an average inflow of 990 gpm to refill. The proposed pond pumping station should be equipped with a Variable Frequency Drive (VFD) thereby allowing it to be operated over a range of conditions. The worst case scenario required a total discharge of 1,980 gpm at a total head of 240 feet (requiring a 150 horsepower pump.) The estimated cost for designing, permitting, and constructing this pond with pumping station would be $250,000. This cost would include the earthwork, liner, fence, and pumping station.

One additional pipeline that will need to be installed is a 4,500 foot long 10 inch line feeding the proposed new pond. This line will run from where the main 18 inch pipe crosses Highway 240 northwest along Highway 240 to where the new pond will be constructed. This line could also be connected back to the northwest end of the lines through the Eaglewatch and Sandpiper sub-divisions through a 330 foot long 6 inch line. During the irrigation period water would flow through the 10 inch line back to these sub-divisions through the 6 inch line. Then during the rest of the day this 10 inch line will be used to refill the new pond. A pressure sustaining valve on the 10 inch line located past where the 6 inch line tees-off, can be used to facilitate this switch. This valve would be set at around 70 psi. There will also need to be a float control valve on the end of the 10 inch pipe to insure that the pond does not fill beyond a set level. The estimated cost of the 4,500 foot long 10 inch pipeline with appurtenance would be around $60,000. The estimated cost of the 6 inch pipeline with appurtenance would be $3,000.

In 2011 the screens at the river pump station serving this project were also inspected by a diver. Significant issues were discovered with several damaged screens, as well as several having significant aquatic growth on them. When the screens are impacted with aquatic growth a hydraulic gradient is created when pumping takes place and the existing screens do not have enough structural integrity to prevent collapse. This allows for juvenile fish to enter the pump bays.

The construction of the existing pump station and the associated barge terminal does not allow for installation, and easy maintenance of passive screens. The pump station is not in compliance for fisheries as the screens currently exist (several collapsed). In order to get the pump station back into compliance it is recommended that a two stage approach be taken. New screens can be installed in the existing structure that have greater structural strength, and that are more resistant to aquatic growth fouling. The installation of these new screens does not require a permit, and could be accomplished this year. It is recommended that reinforced perforated plates be installed as the intake screens. These plates would need to be custom fabricated to fit in the existing structure. One entity that is capable of providing these screens is CTC out of Yakima. The estimated cost to supply the 28 screen panels would be approximately $12,000. There will be additional repair work on the station that will be required. This may require the use of divers to assist in the removal of the existing screens, check and repair the slots that the new screens would slide down, as well as any other repairs that would be needed to make the screens seat and operate properly. It is estimated that this would cost an additional $4,000 - $5,000 for one day of dive services time depending upon the need for any welding work. This would be considered a short term fix until the second phase screens could be installed.

The second phase of taking care of this screen issue is to work with the Port of Benton on modifying the existing structure to allow for screens that would be much easier to clean and maintain. This would also allow for the screens to be brought up to current fisheries standards while not interfering with the facilities operation. This would require going through the permitting process, and subsequent construction of the new facilities in the future during the time of year that minimizes impacts. Since this would entail a modification to the existing structure a Joint Aquatic Resources Permit Application (JARPA) would be required. Along with this application other actions that may be triggered are a Biological Assessment (BA), Cultural Resource Survey, Sediment Analysis Plan (SAP), and a State Environmental Protection Act (SEPA) checklist. Concurrent with the permitting process the design of the new intake screen structure will take place. It is anticipated that the new structure would extend and enclose the existing intake structure, and include new flat panel or cylindrical screens that would be significantly more efficient, meet current fisheries standards, and be much easier to clean. Depending upon the final design, and the current Port of Benton leased area, additional property easements may be required.

Going through the permitting process will take significant time and expertise. An additional issue that will need to be considered is the proximity to the Hanford project. That proximity may add to the assessments required. The new structure will also need to be designed and constructed. Table 2.2.2-1 shows a breakdown of the estimated costs of going through permitting, design and construction of the new structure.

Table 2.2.2-1 Estimated Costs for Modification of River Pump Station Fish Screening.

Item	Description	Estimated Cost Range
1.	**Obtaining Permits**	
	Preliminary Design	$5,000 to $10,000
	Joint Aquatic Resources Permit Application	$2,000 to $4,000
	Biological Assessment	$5,000 to $40,000
	Cultural Resource Survey	$3,000 to $5,000
	Sediment Analysis Plan	$10,000 to $15,000
	State Environmental Protection Act Checklist	$1,000 to $2,000
	SUB-TOTAL	**$26,000 to $76,000**
2.	**Design**	
	Bathometric Survey	$2,000 to $4,000
	Engineering	$20,000 to $30,000
	Legal	$0 to $10,000
	SUB-TOTAL	**$23,000 to $44,000**
3.	**Construction**	
	Materials	
	Structural Steel	$15,000 to $20,000
	Steel Pipe	$10,000 to $15,000
	Screens, Cylindrical Tee	$65,000 to $80,000
	Air Burst System	$35,000 to $45,000
	Miscellaneous	$10,000 to $15,000
	SUB-TOTAL	**$135,000 to $175,000**
	Labor and Equipment	
	SUB-TOTAL	**$75,000 to $150,000**
	TOTAL	**$258,000 to $445,000**

Another issue at this pump station is the issue of flooding of the station during times of high water. During those times the building for the switch gear can become flooded, with the potential for serious damage to the switch gear a major concern. Additionally, this poses a serious risk for workers needing to work in this area. The motors on the pumps are also placed in jeopardy during these high water events. If the water reaches them, shorting of the motors is inevitable causing significant monetary damage, and again posing a serious risk to workers. Finally, the transformer serving this station can and has been exposed to standing water during these events. The solution for these issues is to raise all of the electrical components in elevation.

The City has contacted the Port of Benton and discussed this issue. The Port of Benton subsequently contacted the crane company that operates the crane that serves as the entity that unloads barges at this facility. The crane company indicated that as long as any structure does not extend higher than 8 feet above the upper pad, no interference with the crane operation would take place.

Owing to the limited space available to construct a new building on the upper level of the existing facility it is recommended that the existing building be raised a minimum of 3 feet at its current location. This would entail removing the roof, front wall, and all equipment out of the building. Forming and pouring a concrete stem wall across the front of the building whose top elevation is 3 feet higher than the existing floor elevation. The switch gear conduit would be extended, then a gravel base and concrete floor would be installed to the new higher elevation. The switch gear would be reinstalled, and new wire ran to the pumps and transformer. Wood stud side and back walls would be extended a minimum of 3 feet, along with a new front wood stud wall with door. A new roof would be installed, and the entire wood structure insulated and siding and roofing installed.

To access the building at its new higher elevation, when water is high, a new elevated walkway from the existing stairs to the new door is needed. It is anticipated that metal beams would be run from the existing stairs to a new platform located at the door, with a metal grating walkway placed on top of the beams. A set of steps would than run from the new platform at the building, down to the existing lower level.

It is recommended that the transformer be raised in place 3 feet with the existing conduit extended and new wires run. This will keep the transformer above the high water level. Also, all of the pump motors need to be raised to insure that they are above any potential high water. Raising these motors can be accomplished by installing spacers between the discharge head and the motor and new shafts in the motors. This will require that the conduit be extended and new wire ran from the switch gear. Table 2.2.2-2 shows a breakdown of the estimated costs associated with doing all of this work.

Table 2.2.2-2 Estimated Costs for Raising Electrical Equipment at the River Pump Station.

Item	Description	Estimated Cost Range
1.	**Raising Transformer**	
	Materials and Labor	$7,000 to $14,000
	SUB-TOTAL	**$7,000 to $14,000**
2.	**Raising Building and Switch Gear**	
	Demolition	$2,000 to $4,000
	Earthwork and Concrete Stem Wall	$10,000 to $15,000
	Electrical Conduit and Wire Extension	$20,000 to $40,000
	Gravel and Concrete Slab	$3,000 to $6,000
	New Construction – Walls, Roof, and Walkway	$15,000 to $25,000
	SUB-TOTAL	**$50,000 to $90,000**
3.	**Raising the Motors**	
	Spacers and Shafts (7)	$7,000 to $14,000
	Labor	$1,000 to $2,000
	Electrical Conduit and Wire Extension	$4,000 to $9,000
	SUB-TOTAL	**$12,000 to $25,000**
	TOTAL	**$69,000 to $129,000**

2.2.3 Research District (K Well): The City provided a map of the Irrigation System supplied by the K Well as a PDF file. This map showed the alignment and sizes of the pipelines. Also provided was a profile drawing of the system.

On September 8th a basic test of the K Well pump was conducted. The make and model of the pump was unknown. The motor for this pump is also controlled by a Variable Frequency Drive (VFD). This test included measuring flow rates at two different operational conditions. Initially, with water being delivered to the upper area for irrigation, the discharge was 109 gpm, with a lift of around 10 feet, and a discharge pressure of 75 psi (TDH of 185 feet) at a speed of 2,463 rpm. After a city employee opened the valve to dump water into the storage pond the discharge was increased to 552 gpm, with a lift still around 10 feet, and a discharge pressure of 45 psi (TDH of 115 feet) at a speed of 3,430 rpm. The full speed of the motor was indicated at 3,450 rpm.

The difference in elevation from the well head to the end of the pipeline is approximately 35 feet, or a head difference of 15 psi. The pump and pipeline seem to be capable of supplying 400 gpm to any point in the system.

Using the average required system capacity of 24 gpm per acre identified in Section 2.1 means that the 400 gpm could irrigate 16.7 acres of lawn assuming that one third of the area is irrigated for eight hours once every three days or that one half of the area is irrigated for eight hours every other day. This seems adequate for the apparent extent of landscaping, both current and future for the Columbia Point area. A scheduling system between areas and blocks and/or extending the period of irrigation daily would help ensure the complete and adequate irrigation of all areas.

Utilizing the high resolution, geo-referenced aerial imagery obtained from the USDA National Agriculture Imagery Program and the map provided by the City, an AutoCAD map was developed. This map is very simple because of the limited nature of the system. But it can now be used to look at expansion of the system.

Using the AutoCAD map as a base, a hydraulic model in WaterCAD was created. A pump curve based on the measured operational points was used to develop the pump definition for this model. Also, the detailed pump station piping plans were incorporated into the model. As with the map, this model is very simple, but it can be used to evaluate any specific expansions proposed.

Without a specific plan for expansion of this system there were no identified costs associated with it at this time.

2.2.4 Richland School District: An issue for the Richland School District is that grounds around a number of schools are currently being irrigated using potable water. This is a costly option for the District. One particular area includes the football field and baseball field to the east of Richland High School. There are approximately 12.4 acres associated with this use.

Using the average required system capacity of 24 gpm per acre identified in Section 2.1 means that the 12.4 acres of lawn could be irrigated with 298 gpm assuming that one third of the area is irrigated for eight hours once every three days or that one half of the area is irrigated for eight hours every other day. By doubling the flow to 600 gpm would allow for the area to be irrigated in a four hour period.

The Carmichael Middle School across Lee Blvd has a lawn area of around 26.2 acres. Using the average required system capacity of 24 gpm per acre identified in Section 2.1 means that this area could be irrigated with 630 gpm assuming that one third of the area is irrigated for eight hours once every three days or that one half of the area is irrigated for eight hours every other day. A well on the property has the capacity to meet this requirement.

An option for these two properties would be to interconnect them and utilize the existing well to supply both systems. This could be facilitated by utilizing a 6 inch crossing under Lee Blvd that is shown on system plans, if it indeed exists. This would require an irrigation duration of twelve hours every day. This would, however, be during the peak use period in the summer when the schools were not open. During the periods when the schools were open, in the spring and fall, the required irrigation duration would be shorter and would not need to interfere with school related activities.

If this option were considered, the plans for the two systems would need to be carefully reviewed to determine what, if any additions would be required and a cost developed.

2.2.5 Willowbrook: The Willowbrook area has also been mapped, modeled, and analyzed several times over the last few years. The proposed development plans for this area have changed during this time. Less of the total potential area is now planned for development. But in the place of some of the residential development will be the expansion of the Claybell Park. The residential development has been reduced to a total area of around 117 acres of which 81.4 acres would be irrigated. The planned expansion of the Claybell Park would results in a total irrigated area of around 21.8 acres. Figure 2.2.5-1 is a map from the WaterCAD model showing the proposed development of irrigation system.

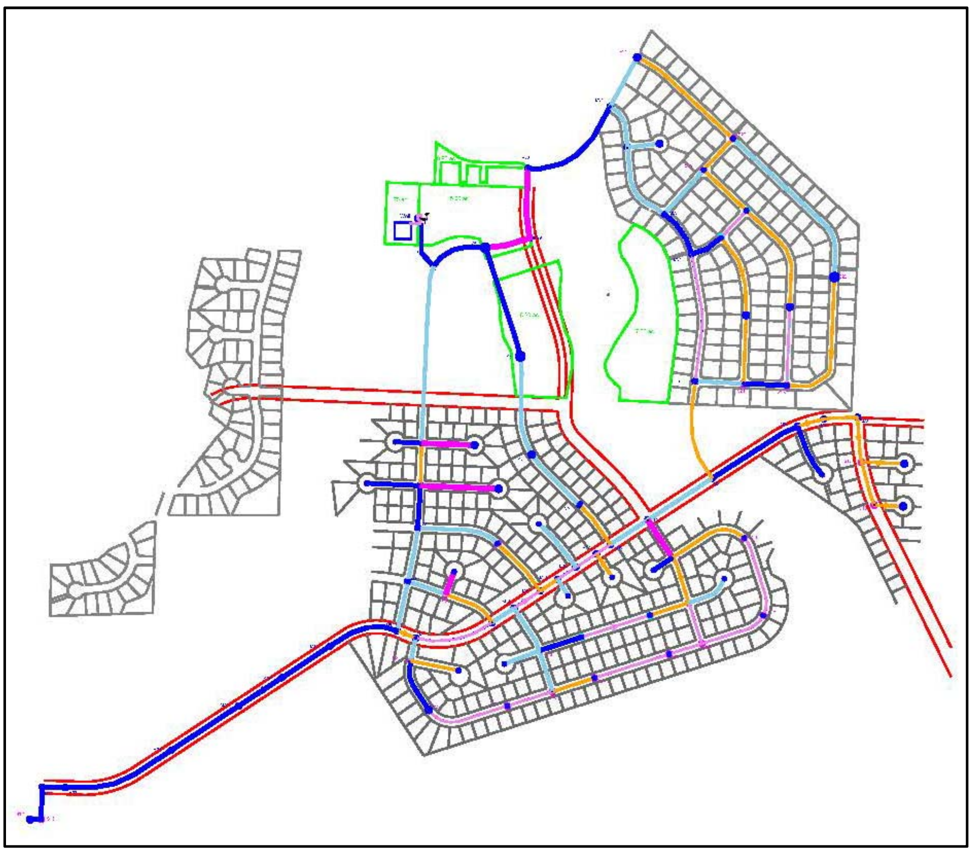


Figure 2.2.5-1 Map of the Proposed Willowbrook Development as Modeled.

Using the average required system capacity of 24 gpm per acre identified in Section 2.1 means that the total of 103.2 acres of lawn could be irrigated with around 2,500 gpm assuming that one third of the area is irrigated for eight hours once every three days or that one half of the area is irrigated for eight hours every other day.

The existing well supplying the area has a sustainable rate of around 800 gpm to 850 gpm. Therefore, to facilitate the complete development of the planned expansions will require either a second and third well or a storage pond. Because of the existing certificated water right a change would need to be made to add the additional points of appropriation. These new wells would need to be comparable to the existing one which is over 1,200 feet deep, mostly through basalt.

The expanded development will require an additional 1,700 gpm from a pond. At this rate the proposed pond would need a storage capacity of around 816,000 gallons beyond dead storage. During the other 16 hours of each day this pond would require an average inflow of 850 gpm to refill.

The proposed pond pumping station should be equipped with a Variable Frequency Drive (VFD) thereby allowing it to be operated over a range of conditions. The worst case scenario required a total discharge of 1,700 gpm at a total head of 240 feet (this would be a 125 horsepower pump.) The estimated cost for designing, permitting, and constructing this pond with pumping station would be $250,000. This cost would include the earthwork, liner, fence, and pumping station. The required wells would probably cost two to three times the cost of this pond each.

3.0 WATER RIGHT RE-DEPLOYMENT

A report looking at the potential re-deployment of city water rights to irrigate turfed areas with non-potable water is provided below. Initially that report was to review all the city's groundwater rights, and provide input on which rights were best suited for re-deployment along with the amounts of water that would be required by the various turfed areas. Additionally, costs were to be established associated with providing this non-potable water supply for irrigating these turfed areas. Subsequently, the scope was reduced to reviewing specific water rights provided by the City of Richland to determine face plate, current use and available volumes associated with each of those rights. Specific turfed areas were identified to be reviewed for required water requirements. Additionally, locations, sizes and cost estimates of wells, pumps, panels, and other basic facilities required to serve the turfed areas were identified.

3.1 Water Right Review

The purpose of this report is to review the groundwater rights that the City of Richland (City) holds that may be utilized in irrigating several turfed areas within the city's municipal boundary with new groundwater sources. The City holds several groundwater rights that have potential for being utilized. Any right that is selected to be used will be required to go through the water right change process with the Benton County Water Conservancy Board or the Washington State Department of Ecology.

The City provided a listing of the groundwater rights that it holds. They also provided a listing of the rights that it would like to have reviewed, along with the water use records associated with those rights. The following is a breakdown of those individual rights.

3.1.1 G4-23944: This right is associated with the landfill, and its associated use is for domestic supply, irrigation and dust control. This right has not been beneficially utilized for a number of years. It's authorized for a withdrawal of 100 gpm instantaneously, and 80 ac-ft annually, and could irrigate 100 acres. Since there is no current use those volumes would theoretically be available to be utilized elsewhere. The purpose of use, place of use and points of withdrawal would need to be changed. With no current history of use this right is in jeopardy of relinquishment.

3.1.2 G4-28642: This right is associated with the ORV park, and its associated use is for irrigation and dust control. This right has not been beneficially utilized for a number of years. It's authorized for a withdrawal of 275 gpm instantaneously, and 20 ac-ft annually for irrigation, and 90 ac-ft annually for dust control, and could irrigate 5 acres. Since there is no current use those volumes would theoretically be available to be utilized elsewhere. The purpose of use, place of use and points of withdrawal would need to be changed. With no current history of use this right is in jeopardy of relinquishment.

3.1.3 G4-28554: This right is associated with the ORV park, and its associated use is for domestic supply, irrigation and dust control. This right has not been beneficially utilized for a number of years. It's authorized for a withdrawal of 310 gpm instantaneously, and 20 ac-ft annually for irrigation, 93 ac-ft annually for dust control, and 11.3 ac-ft annually for domestic supply, and could irrigate 5 acres. Since there is no current use those volumes would theoretically be available to be utilized elsewhere. The purpose of use, place of use and points of withdrawal would need to be changed. With no current history of use this right is in jeopardy of relinquishment.

3.1.4 G4-2995: This right is associated with the Horn Rapids Triangle, and its associated use is for irrigation and industrial supply. A portion of this right is being beneficially utilized. It's authorized for a withdrawal of 1,100 gpm instantaneously, and 520 ac-ft annually, and could irrigate 130 acres. Current records show a recent annual use of 14.8 ac-ft. This would theoretically allow for the transfer of 505.2 ac-ft. The instantaneous volume being utilized is unknown, and as such there is a question to the amount of instantaneous volume that would be available to be utilized in other locations. The purpose of use, place of use and points of withdrawal would need to be changed. Proof of appropriation has been filed on this permit, but a certificate has not been issued as of this date. With limited history of recent use this could become an issue and place a portion of this right in jeopardy of relinquishment.

3.1.5 G4-28515: This right is associated with the Duke Wellfield, and its associated use is for municipal supply. This right has been beneficially utilized in some capacity for a number of years. It's authorized for a withdrawal of 1,400 gpm instantaneously, and 1,228 ac-ft annually. Current records show a recent annual use of 126.4 ac-ft. This would theoretically allow for the transfer of 1,101.6 ac-ft. The instantaneous volume being utilized is unknown, and as such there is a question to amount of instantaneous volume that would be available to be utilized in other locations. Additional points of withdrawal would need to be added to this right. Since this is a municipal right this is a good candidate to serve the parcels being considered.

3.1.6 G4-28516: This right is associated with the Wellsian Wellfield, and its associated use is for municipal supply. This right has been beneficially utilized in some capacity for a number of years. It's authorized for a withdrawal of 2,125 gpm instantaneously, and 3,422 ac-ft annually. Current records show a recent annual use of 1,043 ac-ft. This would theoretically allow for the transfer of 2,379 ac-ft. The instantaneous volume being utilized is unknown, and as such there is a question to amount of instantaneous volume that would be available to be utilized in other locations. Additional points of withdrawal would need to be added to this right. Since this is a municipal right this is a good candidate to serve the parcels being considered.

3.1.7 G4-24264: This right is associated with Columbia Park, and its associated use is for irrigation. This right has not been beneficially utilized for a number of years. It's authorized for a withdrawal of 200 gpm instantaneously, and 93 ac-ft annually, and could irrigate 17.95 acres. Since there is no current use those volumes would theoretically be available to be utilized elsewhere. The place of use and points of withdrawal would need to be changed. With no current history of use this right is in jeopardy of relinquishment.

3.1.8 G4-24265: This right is associated with Columbia Park, and its associated use is for irrigation. This right has not been beneficially utilized for a number of years. It's authorized for a withdrawal of 200 gpm instantaneously, and 93 ac-ft annually, and could irrigate 17.95 acres. Since there is no current use those volumes would theoretically be available to be utilized elsewhere. The place of use and points of withdrawal would need to be changed. With no current history of use this right is in jeopardy of relinquishment.

3.1.9 G4-25960: This right is associated with Willowbrook, and its associated use is for municipal supply. This right has not been beneficially utilized in some capacity for a number of years. It's authorized for a withdrawal of 1,000 gpm instantaneously, and 1,606 ac-ft annually. Current records show no recent annual use. Since there is no current use those volumes would theoretically be available to be utilized elsewhere. The points of withdrawal would need to be changed. Since this is a municipal right this is a good candidate to serve the parcels being considered. The existing points of withdrawal under this right may be considered to be located in a different water body than the points of withdrawal that are being considered under this proposal. As such further consideration may be needed before pursuing this right under this proposal.

3.1.10 Conclusion: The City of Richland holds several water rights that have the potential to be utilized to provide groundwater to the several green areas it has identified within the municipal boundary. A number of those rights have conditions that need to be considered before pursuing applications for change. 2 of the rights have conditions that are clearly conducive to moving forward with them; those rights are G4-28515 and G4-28516. They have considerable annual volumes that are available, and from that it can be assumed that instantaneous volumes, though it isn't know how much is currently being utilized, would be available also.

In looking at the available information it clearly appears that there should be adequate available permits to serve many if not all the identified turfed areas with new groundwater sources. Table 3.1-1 summarizes this information.

Table 3.1-1 Summary of Reviewed City of Richland Ground Water Rights as Permitted.

Number	Location	Type of Use	Permitted Rate (gpm)	Permitted Volume (ac-ft)	Permitted Area (acres)	Status	Currently Used Rate (gpm)	Available Rate (gpm)	Currently Used Volume (ac-ft)	Available Volume (ac-ft)
G4-23944	Landfill	Domestic, Irrigation, & Dust	100	80	100	No Use	0	100	0	80
G4-28642	ORV #2	Irrigation & Dust	275	20 Irrigation & 90 Dust	5	No Use	0	275	0	110
G4-28554	ORV #1	Domestic, Irrigation, & Dust	310	11.3 Domestic, 20 Irrigation, & 93 Dust	5	No Use	0	310	0	124
G4-29925	Horn Rapids Triangle	Irrigation & Industrial	1,100	520	130	Active	?	?	14.8	505.2
G4-28515	Duke	Municiple	1,400	1,228		Active	?	?	126.4	1,101.6
G4-28516	Wellsian	Municiple	2,125	3,422		Active	?	?	1,043	2,379
G4-24264	Columbia	Irrigation	200	93	17.95	No Use	0	200	0	93
G4-24265	Columbia	Irrigation	200	93	17.95	No Use	0	200	0	93
G4-25960	Willowbrook	Municiple	1,000	1,606		Active	?	1,000	?	1,606

3.2 Well Location, Design, & Costs

Twelve turfed park/playfield/cemetery areas have been identified by the City of Richland as being currently irrigated with municipal culinary quality water, or from sources that are not reliable. The City provided a photo map locating these 12 areas. The City is hopeful that these areas could be irrigated utilizing new wells whose purpose would be solely to irrigate these areas. The purpose of this report is to determine the number of grassed areas, irrigated acres within each of those areas, determine the associated instantaneous and annual water requirements of each area, determine the approximate horsepower that would be required to irrigate each of those parcels, and develop the associated well designs and costs of those wells.

In order to determine acreages each of the 12 areas had current photos interpreted and potential irrigated turf areas identified. Utilizing digital photographic tools acreages were determined within each of those 12 areas.

To determine the maximum instantaneous water requirements associated with each area, the

24 gpm per acre, for a twenty-four hour period, every third day, irrigating for 8 hours a night, established in Section 2.1will be utilized. Additionally, the average daily application rate at 8 gpm per acre utilized over a 24 hour period will be determined for permitting purposes. If longer sets are utilized there would be a reduction in peak instantaneous flows required.

To determine the annual water requirement for grass in Richland the Washington Irrigation Guide was utilized. That Guide indicates that 41.75 net inches of water are required to fully irrigate the grassed areas. Utilizing the 80% application efficiency the gross amount of water required is 52.19 inches annually.

Several of the areas identified lie adjacent to each other, but are managed by different entities. This report assumes that common wells could be shared at these locations, the combined areas match up the volumes associated with one well. The total number of wells that would then be required to serve all the areas would be 10 wells. The approximate horsepower associated with each of those wells has been determined under this report. Those horsepowers are based upon the following assumptions:

1. Other shallow wells in the area have been very productive yielding 35 gpm or more per foot of drawdown. This value will be assumed as the yield for the wells to be constructed at each of the areas.
2. The existing shallow wells have static water levels that match closely to the elevation of the Columbia River water surface, and those elevations have been utilized in this analysis
3. It is assumed that at each area 100 psi will be required to effectively operate the irrigation system
4. It is assumed that the pumps will operate at 85% efficiency

In order to determine the design of the wells several factors were looked at in determining the optimum construction of each well. In looking at existing well logs in the general vicinity of the wells that would potentially be drilled it is clear that the new wells that will be constructed will be shallow water table wells completed into the alluvial sands and gravels. It is critical for this type of well to be constructed properly to prevent them from producing sand during pumping, and still yield as high of a volume of water as possible. This requires that the wells utilize properly sized stainless steel well screens along with properly sized and graded gravel pack material. Additionally, the installation of the screen and gravel pack must be done by qualified personnel, along with the proper development of the well. This is specifically true given the fact that we are dealing with wells of 60 to 100 foot depths that limit their drawdown capability.

There are a number of factors associated with the cost of constructing these wells. The main one being the type of drill rig utilized to drill them. The two types of drill rigs that we have looked at are Dual

Rotary and Cable Tool. Both are very capable of drilling the wells. The mob/demob costs of the Dual Rotary drill rig are considerably higher than those of the Cable Tool rig. Additionally, the operational and set up costs are much higher for the Dual Rotary rig as well. The Dual Rotary rig would be able to drill the wells in a more timely fashion, but given that there would be significant down time required to properly determine the optimum well screen and gravel pack, order those items and then receive them, the faster drilling time of the Dual Rotary rig is somewhat offset. Another significant factor would be whether multiple wells could be drilled under a contract. Significant savings would be realized if this could take place. For this report only individual wells will be considered. For these reasons we are providing a range of costs that we feel the actual well construction costs will fall within.

The following is a listing of each of the 12 parcels:

3.2.1 Parcel 1 Hanford High School: Parcel 1 is managed by the Richland School District. This parcel has 77.8 acres of turfed area. This area will have a peak irrigation demand of 1868 gpm, with an annual requirement of 318.5 acre-feet per year, and an average 24 hour flow of 622 gpm. Given the nature of the wells in the area it is assumed that 2 wells will be required to meet these requirements. The wells would be operated 8 hours a night during the peak summer months. It is assumed that two properly designed and constructed wells could supply the water for this parcel. The estimated horsepower requirement to operate the wells at peak capacity is 81 horsepower at each well based upon the above noted volume, and a total dynamic head requirement of 291'.

These wells would be 60 to 100 feet deep, have 20' of 12" stainless steel screen, and cost within a range of $50,000 to $125,000 for each well depending on construction methods and depths, totaling to $100,000 to 250,000. Significant savings would be realized if the wells were included in a multiple well contract. It is estimated that to have the two pumps and panels installed at an individual cost of $55,000 with a total cost of approximately $110,000. After the pumps and panels are installed a small building enclosing the panels will be required. It is estimated that this will cost approximately $2,000 per building totaling to $4,000. In order to connect the new pumps to the existing irrigation infrastructure basic discharge components including valves and fittings are needed. It is estimated that this would cost approximately $5,000 per well, totaling to $10,000. There would be additional costs associated with making the new pumps operational. Power would need to be run to the pumps, and pipes would need to be run to the existing Points of Connection. The location of the POCs and available power were not readily available, and as such no cost estimate can be made. Owing to the scope of the project these costs are anticipated to be a fairly small percentage of the total cost. The approximate total cost for wells, pumps, panels, buildings and discharge valves and fittings would be within a range of $224,000 to $374,000. Additional costs for power and tying into the existing system would add to that total.

3.2.2 Parcel 2 Sacagawea Elementary School: Parcel 2 is managed by the Richland School District. This parcel has 12.5 acres of turfed area. This area will have a peak irrigation demand of 300 gpm, with an annual requirement of 51.2 acre-feet per year, and an average 24 hour flow of 100 gpm. The well would be operated 8 hours a night during the peak summer months. It is assumed that one properly designed and constructed well could supply the water for this parcel. The estimated horsepower requirement to operate the well at peak capacity is 23 horsepower based upon the above noted volume, and a total dynamic head requirement of 263'.

The well would be 60 to 100 feet deep, have 20' of 8" stainless steel screen, and cost within a range of $41,000 to $111,000 depending on construction methods and depths. Significant savings would be realized if the wells were included in a multiple well contract. It is estimated that to install the pump and panel it will cost approximately $22,000. After the pump and panel is installed a small building enclosing the panels will be required. It is estimated that this will cost approximately $2,000. In order to connect the new pump to the existing irrigation infrastructure basic discharge components including valves and fittings are needed. It is estimated that this would cost approximately $2,000.

There would be additional costs associated with making the new pumps operational. Power would need to be run to the pump, and pipe would need to be run to the existing Points of Connection. The location of the POCs and available power were not readily available, and as such no cost estimate can be made. Owing to the scope of the project these costs are anticipated to be a fairly small percentage of the total cost. The approximate total cost for the well, pump, panels, building and discharge valves and fittings would be within a range of $67,000 to $137,000. Additional costs for power and tying into the existing system would add to that total.

<u>3.2.3 Parcel 3 Chief Jo Middle School</u>: Parcel 3 is managed by the Richland School District. This parcel has 15.2 acres of turfed area. This area will have a peak irrigation demand of 365 gpm, with an annual requirement of 62.2 acre-feet per year, and an average 24 hour flow of 122 gpm. The well would be operated 8 hours a night during the peak summer months. It is assumed that one properly designed and constructed well could supply the water for this parcel. The estimated horsepower requirement to operate the well at peak capacity is 29 horsepower based upon the above noted volume, and a total dynamic head requirement of 263'.

The well would be 60 to 100 feet deep, have 20' of 8" stainless steel screen, and cost within a range of $41,000 to $111,000 depending on construction methods and depths. Significant savings would be realized if the wells were included in a multiple well contract. It is estimated that to install the pump and panel it will cost approximately $27,000. After the pump and panels are installed a small building enclosing the panels will be required. It is estimated that this will cost approximately $2,000. In order to connect the new pump to the existing irrigation infrastructure basic discharge components including valves and fittings are needed. It is estimated that this would cost approximately $2,500. There would be additional costs associated with making the new pump operational. Power would need to be run to the pump, and pipe would need to be run to the existing Points of Connection. The location of the POCs and available power were not readily available, and as such no cost estimate can be made. Owing to the scope of the project these costs are anticipated to be a fairly small percentage of the total cost. The approximate total cost for the well, pump, panels, building and discharge valves and fittings would be within a range of $72,500 to $142,500. Additional costs for power and tying into the existing system would add to that total.

<u>3.2.4 Parcel 4 Jason Lee Elementary School</u>: Parcel 4 is managed by the Richland School District. This parcel has 9.8 acres of turfed area. This area will have a peak irrigation demand of 235 gpm, with an annual requirement of 40.1 acre-feet per year and an average 24 hour flow of 78 gpm. The well would be operated 8 hours a night during the peak summer months. It is assumed that one properly designed and constructed well could supply the water for this parcel, and parcel 5 that is managed by the City of Richland. The estimated horsepower requirement to operate the joint well at peak capacity is 29 horsepower based upon the above noted volume, plus the volume required for parcel 5, and a total dynamic head requirement of 290'.

The well would be 60 to 100 feet deep, have 20' of 8" stainless steel screen, and cost $41,000 to $111,000 depending on construction methods and depths. Significant savings would be realized if the wells were included in a multiple well contract. It is estimated that to install the pump and panels it will cost approximately $27,000. After the pump and panels are installed a small building enclosing the panels will be required. It is estimated that this will cost approximately $2,000. In order to connect the new pump to the existing irrigation infrastructure basic discharge components including valves and fittings are needed. It is estimated that this would cost approximately $2,500. There would be additional costs associated with making the new pump operational. Power would need to be run to the pump, and pipe would need to be run to the existing Points of Connection. The location of the POCs and available power were not readily available, and as such no cost estimate can be made. Owing to the scope of the project these costs are anticipated to be a fairly small percentage of the total cost. The approximate total cost for the joint well, pump, panels, buildings and discharge valves and fittings would be within a range of $72,500 to $142,500. Additional costs for power and tying into the existing system would add to that total. It is assumed that a portion of the total costs would be split between the City of Richland and the Richland School District.

3.2.5 Parcel 5 April Loop Park: Parcel 5 is managed by the City of Richland. This parcel has 4.4 acres of turfed area. This area will have a peak irrigation demand of 106 gpm, with an annual requirement of 18.0 acre-feet per year, and an average 24 hour flow of 35 gpm. The well would be operated 8 hours a night during the peak summer months. It is assumed that one properly designed and constructed well could supply the water for this parcel along with Parcel 4 that is managed by the Richland School District. The estimated horsepower requirement to operate the joint well at peak capacity is 29 horsepower based upon the above noted volume, plus the volume required for parcel 4, and a total dynamic head requirement of 290'.

The joint well would be 60 to 100 feet deep, have 20' of 8" stainless steel screen, and cost within a range of $41,000 to $111,000 depending on construction methods and depths. Significant savings would be realized if the wells were included in a multiple well contract. It is estimated that to install the pump and panel it will cost approximately $27,000. After the pump and panels are installed a small building enclosing the panels will be required. It is estimated that this will cost approximately $2,000. In order to connect the new pump to the existing irrigation infrastructure basic discharge components including valves and fittings are needed. It is estimated that this would cost approximately $2,500. There would be additional costs associated with making the new pump operational. Power would need to be run to the pump, and pipe would need to be run to the existing Points of Connection. The location of the POCs and available power were not readily available, and as such no cost estimate can be made. Owing to the scope of the project these costs are anticipated to be a fairly small percentage of the total cost. The approximate total cost for the joint well, pump, panels, buildings and discharge valves and fittings would be within a range of $72,500 to $142,500. Additional costs for power and tying into the existing system would add to that total. It is assumed that a portion of the total costs would be split between the City of Richland and the Richland School District.

3.2.6 Parcel 6 Jefferson Elementary School: Parcel 6 is managed by the Richland School District. This parcel has 13.6 acres of turfed area. This area will have a peak irrigation demand of 326 gpm, with an annual requirement of 55.7 acre-feet per year, and an average 24 hour flow of 109 gpm. The well would be operated 8 hours a night during the peak summer months. It is assumed that one properly designed and constructed joint well could supply the water for this parcel along with Parcel 7 that is managed by the City of Richland. The estimated horsepower requirement to operate the joint well at peak capacity is 31 horsepower based upon the above noted volume, plus the volume required for parcel 7, and a total dynamic head requirement of 252'.

The joint well would be 60 to 100 feet deep, have 20' of 8" stainless steel screen, and cost within a range of $41,000 to $111,000 depending on construction methods and depths. Significant savings would be realized if the wells were included in a multiple well contract. It is estimated that to install the pump and panel it will cost approximately $30,000. After the pump and panels are installed a small building enclosing the panels will be required. It is estimated that this will cost approximately $2,000. In order to connect the new pump to the existing irrigation infrastructure basic discharge components including valves and fittings are needed. It is estimated that this would cost approximately $2,500. There would be additional costs associated with making the new pump operational. Power would need to be run to the pump, and pipe would need to be run to the existing Points of Connection. The location of the POCs and available power were not readily available, and as such no cost estimate can be made. Owing to the scope of the project these costs are anticipated to be a fairly small percentage of the total cost. The approximate total cost for the joint well, pump, panels, buildings and discharge valves and fittings would be within a range of $75,500 to $145,500. Additional costs for power and tying into the existing system would add to that total. It is assumed that a portion of the total costs would be split between the City of Richland and the Richland School District.

3.2.7 Parcel 7 Jefferson Park: Parcel 7 is managed by the City of Richland. This parcel has 3.6 acres of turfed area. This area will have a peak irrigation demand of 86 gpm, with an annual requirement of 14.7 acre-feet per year, and an average 24 hour flow of 29 gpm. The well would be operated 8 hours a night during the peak summer months. It is assumed that one properly designed and constructed well could supply the water for this parcel along with Parcel 6. The estimated horsepower requirement to operate the joint well at peak capacity is 31 horsepower based upon the above noted volume, plus the volume required for parcel 6, and a total dynamic head requirement of 252'.

The joint well would be 60 to 100 feet deep, have 20' of 8" stainless steel screen, and cost within a range of $41,000 to $111,000 depending on construction methods and depths. Significant savings would be realized if the wells were included in a multiple well contract. It is estimated that to install the pump and panel it will cost approximately $30,000. After the pump and panels are installed a small building enclosing the panels will be required. It is estimated that this will cost approximately $2,000. In order to connect the new pump to the existing irrigation infrastructure basic discharge components including valves and fittings are needed. It is estimated that this would cost approximately $2,500. There would be additional costs associated with making the new pump operational. Power would need to be run to the pump, and pipe would need to be run to the existing Points of Connection. The location of the POCs and available power were not readily available, and as such no cost estimate can be made. Owing to the scope of the project these costs are anticipated to be a fairly small percentage of the total cost. The approximate total cost for the joint well, pump, panels, buildings and discharge valves and fittings would be within a range of $75,500 to $145,500. Additional costs for power and tying into the existing system would add to that total. It is assumed that a portion of the total costs would be split between the City of Richland and the Richland School District.

3.2.8 Parcel 8 Liberty Christian School: Parcel 8 is managed by the Liberty Christian School. This parcel has 12.4 acres of turfed area. This area will have a peak irrigation demand of 298 gpms, with an annual requirement of 50.8 acre-feet per year, and an average 24 hour flow of 99 gpms. The well would be operated 8 hours a night during the peak summer months. It is assumed that one properly designed and constructed well could supply the water for this parcel. The estimated horsepower requirement to operate the well at peak capacity is 27 horsepower based upon the above noted volume, and a total dynamic head requirement of 301'.

The well would be 60 to 100 feet deep, have 20' of 8" stainless steel screen, and cost within a range of $41,000 to $111,000 depending on construction methods and depths. Significant savings would be realized if the wells were included in a multiple well contract. It is estimated that to install the pump and panel it will cost approximately $27,000. After the pump and panels are installed a small building enclosing the panels will be required. It is estimated that this will cost approximately $2,000. In order to connect the new pump to the existing irrigation infrastructure basic discharge components including valves and fittings are needed. It is estimated that this would cost approximately $3,000. There would be additional costs associated with making the new pump operational. Power would need to be run to the pump, and pipe would need to be run to the existing Points of Connection. The location of the POCs and available power were not readily available, and as such no cost estimate can be made. Owing to the scope of the project these costs are anticipated to be a fairly small percentage of the total cost. The approximate total cost for the well, pump, panels, buildings and discharge valves and fittings would be within a range of $73,000 to $143,000. Additional costs for power and tying into the existing system would add to that total.

3.2.9 Parcel 9 Sunset Memorial Gardens: Parcel 9 is managed by the Sunset Memorial Gardens. This parcel has 18.7 acres of turfed area, with assumed expansion capabilities. This area will have a peak irrigation demand of 449 gpm, with an annual requirement of 76.5 acre-feet per year, and an average 24 hour flow of 150 gpm at the current configuration. The well would be operated 8 hours a night during the peak summer months. It is assumed that one properly designed and constructed well could supply the water for this parcel. The estimated horsepower requirement to operate the well at peak capacity is 39 horsepower based upon the above noted volume and a total dynamic head requirement of 289'.

The well would be 60 to 100 feet deep, have 20' of 8" stainless steel screen, and cost within a range of $41,000 - $111,000 depending on construction methods and depths. Significant savings would be realized if the wells were included in a multiple well contract. It is estimated that to install the pump and panel it will cost approximately $30,000. After the pump and panels are installed a small building enclosing the panels will be required. It is estimated that this will cost approximately $2,000. In order to connect the new pump to the existing irrigation infrastructure basic discharge components including valves and fittings are needed. It is estimated that this would cost approximately $3,500. There would be additional costs associated with making the new pump operational. Power would need to be run to the pump, and pipe would need to be run to the existing Points of Connection. The location of the POCs and available power were not readily available, and as such no cost estimate can be made. Owing to the scope of the project these costs are anticipated to be a fairly small percentage of the total cost. The approximate total cost for wells, pumps, panels, buildings and discharge valves and fittings would be within a range of $76,500 to $146,500. Additional costs for power and tying into the existing system would add to that total.

3.2.10 Parcel 10 Columbia Playfield: Parcel 10 is managed by the City of Richland. This parcel has 16.8 acres of turfed area. This area will have a peak irrigation demand of 403 gpm, with an annual requirement of 68.8 acre-feet per year, and an average 24 hour flow of 134 gpm. The well would be operated 8 hours a night during the peak summer months. It is assumed that one properly designed and constructed joint well could supply the water for this parcel along with Parcel 11 managed by the Richland School District. The estimated horsepower requirement to operate the joint well at peak capacity is 57 horsepower based upon the above noted volume, plus the volume required for parcel 11, and a total dynamic head requirement of 273'.

The joint well would be 60 to 100 feet deep, have 20' of 12" stainless steel screen, and cost within a range of $50,000 - $125,000 depending on construction methods and depths. Significant savings would be realized if the wells were included in a multiple well contract. It is estimated that to install the pump and panel it will cost approximately $35,000. After the pump and panels are installed a small building enclosing the panels will be required. It is estimated that this will cost approximately $2,000. In order to connect the new pump to the existing irrigation infrastructure basic discharge components including valves and fittings are needed. It is estimated that this would cost approximately $4,000. There would be additional costs associated with making the new pump operational. Power would need to be run to the pump, and pipe would need to be run to the existing Points of Connection. The location of the POCs and available power were not readily available, and as such no cost estimate can be made. Owing to the scope of the project these costs are anticipated to be a fairly small percentage of the total cost. The approximate total cost for the joint well, pump, panels, buildings and discharge valves and fittings would be within a range of $91,000 to $166,000. Additional costs for power and tying into the existing system would add to that total. It is assumed that a portion of the total costs would be split between the City of Richland and the Richland School District.

3.2.11 Parcel 11 Richland High School: Parcel 11 is managed by the Richland School District. This parcel has 12.4 acres of turfed area. This area will have a peak irrigation demand of 298 gpm, with an annual requirement of 50.8 acre-feet per year, and an average 24 hour flow of 99 gpm. The well would be operated 8 hours a night during the peak summer months. It is assumed that one properly designed and constructed well could supply the water for this parcel along with Parcel 10 managed by the City of Richland. The estimated horsepower requirement to operate the joint well at peak capacity is 57 horsepower based upon the above noted volume, plus the volume required for parcel 10, and a total dynamic head requirement of 273'.

The joint well would be 60 to 100 feet deep, have 20' of 12" stainless steel screen, and cost within a range of $50,000 - $125,000 depending on construction methods and depths. Significant savings would be realized if the wells were included in a multiple well contract. It is estimated that to install the pump and panel it will cost approximately $35,000. After the pump and panels are installed a small building enclosing the panels will be required. It is estimated that this will cost approximately $2,000. In order to connect the new pump to the existing irrigation infrastructure basic discharge components including valves and fittings are needed. It is estimated that this would cost approximately $4,000. There would be additional costs associated with making the new pump operational. Power would need to be run to the pump, and pipe would need to be run to the existing Points of Connection. The location of the POCs and available power were not readily available, and as such no cost estimate can be made. Owing to the scope of the project these costs are anticipated to be a fairly small percentage of the total cost. The approximate total cost for the joint well, pump, panels, buildings and discharge valves and fittings would be within a range of $91,000 to $166,000. Additional costs for power and tying into the existing system would add to that total. It is assumed that a portion of the total costs would be split between the City of Richland and the Richland School District.

3.2.12 Parcel 12 Howard Amon Park: Parcel 12 is managed by the City of Richland. This parcel has 19.1 acres of turfed area. This area will have a peak irrigation demand of 458 gpm, with an annual requirement of 78.2 acre-feet per year, and an average 24 hour flow of 153 gpm. The well would be operated 8 hours a night during the peak summer months. It is assumed that one properly designed and constructed well could supply the water for this parcel. The estimated horsepower requirement to operate the well at peak capacity is 34 horsepower based upon the above noted volume, and a total dynamic head requirement of 252'.

The well would be 60 to 100 feet deep, have 20' of 12" stainless steel screen, and cost within a range of $50,000 - $125,000 depending on construction methods and depths. Significant savings would be realized if the wells were included in a multiple well contract. It is estimated that to install the pump and panel it will cost approximately $30,000. After the pump and panels are installed a small building enclosing the panels will be required. It is estimated that this will cost approximately $2,000. In order to connect the new pump to the existing irrigation infrastructure basic discharge components including valves and fittings are needed. It is estimated that this would cost approximately $3,500. There would be additional costs associated with making the new pump operational. Power would need to be run to the pump, and pipe would need to be run to the existing Points of Connection. The location of the POCs and available power were not readily available, and as such no cost estimate can be made. Owing to the scope of the project these costs are anticipated to be a fairly small percentage of the total cost. The approximate total cost for wells, pumps, panels, buildings and discharge valves and fittings would be within a range of $85,500 to $160,500. Additional costs for power and tying into the existing system would add to that total.

3.3 Conclusion

The water requirements, number of wells, construction of those wells, and their associated costs have been determined to provide the water to the turfed areas of the 12 parcels that have been identified. These wells would provide the water to irrigate the turfed areas replacing the culinary water currently being utilized, or water supplies that are not reliable. Several assumptions have been made to arrive at the numbers presented. These assumptions have been based upon the best available information. The actual volumes that would be produced from any well is dependent upon the type, and depth of materials actually encountered during well construction. Determinations at the time of construction will optimize the production from the individual wells at that time. Yields may be higher or lower than those estimated based upon actual conditions.

Costs associated with the well construction is very variable based upon type of drilling method utilized, number of wells contracted for at one time, the actual depths of the completed wells, and the type of materials actually encountered. This provides the reasoning behind the broad range of costs that are presented. The cost estimates for pumps and panels have been based on estimates received from potential suppliers. Other cost estimates have been based upon personal experience dealing with similar items. The other costs are assumed to be a fairly small percentage of the overall project costs based upon personal experience.

The relatively low project costs along with the low horsepower requirements associated with pumping these shallow, high yielding wells appears to confirm that utilizing these wells to irrigate these turf areas could be a cost effective alternative to utilizing treated culinary water.

4.0 SUMMARY OF CAPITAL IMPROVEMENT PROJECTS

In Sections 2.0 and 3.0 a number of potential Capital Improvement Projects have been identified. In this section is provided a summary of these projects in Table 4.0. Note that these cost are estimated, but should be conservative. They include a contingency and sales taxes.

Table 4.0 Summary of Capital Improvement Projects

Item	Project Name	Description	Estimated Cost
1	Columbia Point	Pump Station Piping Modifications Replacement of Damaged Screen Installation of a Navigational Buoy	$1,500 $6,800 $700
2	Horn Rapids	Pond (1,000,000 gallons) Pipelines (to pond and connecting to system.) River Pump Station: Screen Replacement for 2012 Screen Replacement for Future Raising Electrical Equipment	$250,000 $63,000 $16,000 to $17,000 $258,000 to $445,000 $69,000 to $129,000
3	Willowbrook	Pond (900,000 gallons)	$250,000
4	Hanford High School	Developing two wells	$224,000 to $374,000
5	Sacagawea Elementary	Developing one well	$67,000 to $137,000
6	Chief Jo Middle School	Developing one well	$72,500 to $142,500
7	Jason Lee Elementary and April Loop Park	Developing one well - Shared	$72,500 to $142,500
8	Jefferson Elementary and Jefferson Park	Developing one well - Shared	$75,500 to $145,500
9	Liberty Christian	Developing one well	$73,000 to $143,000
10	Sunset Memorial Gardens	Developing one well	$76,500 to $146,500
11	Richland High School and Columbia Playfield	Developing one well - Shared	$91,000 to $166,000
12	Howard Amon Park	Developing one well	$85,500 to $160,500

5.0 IRRIGATION SYSTEM STANDARD DRAWINGS AND NOTES

The City of Richland has established standard drawings and notes associated with installing irrigation systems that will become owned and operated by the City. It is our understanding that the systems being looked at are stand alone irrigation systems not being tied to potable water, and as such no backflow prevention is required. The purpose of this report is to determine if there are things that should be **modified, changed or clarified in those drawings and notes to assure that systems are constructed** appropriately to meet the long term needs of the City. Additionally, they are being scrutinized to determine if there are things being required that would be considered well in excess of industry standards, or that do not make logical engineering sense.

5.1 Notes

There are 10 bulleted notes that are currently the standards that are being reviewed. Each bullet was looked at, and the following is a review of each of those notes:

5.1.1 Pipe Cover: 30” minimum cover over the top of pipes is an accepted industry standard, and no change is recommended.

5.1.2 Pipe Type And Class: The use of purple pipe for non-culinary water supplies is not required at this time, but is becoming the standard for re-used waste water. This requirement would be a safe way to go to prevent potential tapping into a non-potable water supply. The notation of glued versus gasket pipe is a reasonable one. It should be noted that many type fittings larger than 3” may require that they be glued. The C900 and Schedule 40 designations are understandable in matching up with other City owned pipelines. It is recommended that the wording on glue be changed to state that only two part glue shall be utilized.

5.1.3 Backfill: When utilizing PVC pipe having high quality bedding material is essential, and no change is recommended.

5.1.4 Identification Tape: Being able to protect pipelines safely after burial is essential and no change is recommended.

5.1.5 Tracer Wire: Being able to locate pipelines safely after burial is essential. It is recommended that this note be clarified to state that tracer wires be run continuously along with the pipelines, and be attached to the pipelines every 10’ with duct tape.

5.1.6 Gate Valves: Having quality valves and operators is essential to long term operation of a system. 2” square nut operators on valves 4” and below may lead to valve breakage. It is recommended that for valves 4” and under that brass female threaded 1/4 turn 200 psi rated valves with tee operators be considered.

5.1.7 Valve Boxes: Being able to access valves after installation is essential, and though this type valve box is not standard for the irrigation industry it is standard for municipalities, and no change is recommended.

5.1.8 Thrust Blocks: Thrust blocks are an important component in piped systems. They are most important in the gasketed portions of irrigation systems 4” and larger. However, they are not required at all fittings. They should be located at all horizontal or vertical angle and tee type fittings, as well as at any inline valve that might be closed causing a pressure surge.

5.1.9 Fittings: Utilizing proper fittings is important to maintain the integrity of the system. It is the industry standard to utilize PVC fittings in irrigation systems. It is recommended that Schedule 80 PVC fittings, glued or gasketed, be required for all PVC to PVC connections, and that cast iron dresser to flange fittings be utilized to make any flange type connections. If gasketed fittings are utilized proper thrust blocking is very important.

5.1.10 Pressure Testing: Pressure testing is important to insure that the system has been installed properly without leaks, and no change is recommended.

5.2 Additional Recommended Notes

5.2.1 Metering: In order to monitor these separate irrigation systems metering of some kind is required. It is recommended that an additional item be added to the notes to provide guidance in placing and describing the type of meter that will be required to provide this monitoring.

5.2.2 AWWA Standards: It is recommended that an overriding statement be added that specifies that all irrigation systems shall be constructed to meet American Water Works Association standard C605.

5.3 Standard Drawings

Along with the Irrigation Distribution Notes there were 6 standard drawings that were provided for review. The following are the comments associated with those drawings:

5.3.1 2” Irrigation Distribution Blow Off: It is recommended that this drawing be modified to show a female threaded brass curb stop type of valve replacing the 2”flanged gate valve. This is would be the industry standard. Additionally in the note the period should be removed after the 300’ to clarify the statement.

5.3.2 Irrigation Distribution Valve Assembly: It is recommended that a note be added that indicates that valves 4” diameter and less be 200 psi rated 1/4 turn female threaded brass ball valves with tee handles. These are the standard in the industry.

5.3.3 2” Irrigation Distribution Drain: The industry standard for a 2” valve would be a 2” female threaded brass curb stop type valve for this application. It is recommended that this drawing be modified to show this type of valve. Additionally thrust blocks should be added at the 45^{o} elbow and tee.

5.3.4 2” Irrigation Distribution Drain (To Storm Drain System): The fourth drawing is titled “2” Irrigation Distribution Drain (To Storm Drain System)”. The industry standard for a 2” valve would be a 2” female threaded brass curb stop type valve for this application. It is recommended that this drawing be modified to show this type of valve. Additionally thrust blocks should be added at the 45^{o} elbow and tee.

5.3.5 Irrigation Distribution Service Riser: The fifth drawing is titled “Irrigation Distribution Service Riser”. We are unclear what the purpose of this drawing is for. It is recommended that a drawing showing the connection to the main distribution system with isolation valve and meter be shown. It appears that the structure associated with this drawing may be beyond the normally associated ownership of the City.

5.3.6 Irrigation Distribution Air/Vac Connection: The sixth drawing is titled "Irrigation Distribution Air/Vac Connection". The setup shown certainly meets the needs where the mainline being vented is 6" or greater. For mainlines 4" or smaller it is recommended that the service saddle be changed to an inline tee with the 2" take off being female threaded. The male 90^{o} bend would be schedule 80 PVC. A stainless steel reinforced bushing would then be connected to the bend and the galvanized nipple. From that point on there would be no changes needed.

5.4 Standard Drawings and Notes Conclusion

The Irrigation Distribution Notes and associated standard drawings were reviewed, and several additions, modifications and clarifications have been recommended. With these recommended changes implemented irrigation systems installed based upon them will be installed to meet or exceed industry standards, as well as being compatible with existing city water systems. This will insure longevity of the system, and ease of operation.

6.0 IRRIGATION SYSTEM SERVICE POLICY

The water requirements of a private yard are similar to that of city parks. As noted in Section 2.1, the average in July is 0.33 inches per acre per day. In order to meet this need it has been assumed that the optimum schedule is to irrigate a set every third day, and split the area up into 3 sets or irrigate a set every other day and split the area into 2 sets. Under these scenarios the required supply would be 24 gpm per acre. In looking at standard home, small area turf designs, sets are normally established utilizing volume ranges between 5 gpm and 10 gpm per set. Utilizing the same rates as previously utilized for parks the 5 gpm to 10 gpm rates would provide water for 0.2 acres to 0.4 acres. Based upon that information it is recommended that the following policy be considered:

6.1 Minimum Pressure

The City of Richland will provide a minimum of 40 psi at all Points of Connection. (Note: At certain lower elevations in the system, pressure reducing valves may be required.)

6.2 Minimum Flows Large Lots

The City of Richland will provide a minimum of 24 gpm per acre to all lot sizes larger than 0.2 of an acre.

6.3 Minimum Flows Small Lots

The City of Richland will provide a minimum of 5 gpm to all lot sizes less than 0.2 acres.

6.4 Flow Control

Flow restrictors may be installed to limit the flows to those established for each lot.

EXHIBIT A.

Scope of Work

SCOPE OF WORK

Based on meetings with City staff the following Scope of Work was developed. The time required for each task is an estimate.

For the Columbia Point System

Task / Description		Time (hours)
1.	Gather and review existing information, including system map, for the system serving the multi-family housing units.	2
2.	Conduct a test of the pump to determine operational performance.	4
3.	Develop a geo-referenced map of the system.	2
4.	Develop a hydraulic model of the system.	6
5.	Utilize the model to evaluate operational scenarios and identify system constraints for existing and future usage.	10
	Total Estimated Time:	**24**

For the Horn Rapids System

Task / Description		Time (hours)
1.	Gather and review existing information, including system maps.	Completed
2.	Develop a geo-referenced map of the system.	Completed
3.	Develop a hydraulic model of the system.	Completed
4.	Utilize the model to evaluate operational scenarios and identify system constraints for future usage.	16
	Total Estimated Time:	**16**

For the Research District System

Task / Description		Time (hours)
1.	Gather and review existing information, including system maps served by the K-Well.	2
2.	Conduct a test of the K-Well pump to determine operational performance.	4
3.	Develop a geo-referenced map of the system.	2
4.	Develop a hydraulic model of the system.	6
5.	Utilize the model to evaluate operational scenarios and identify system constraints for existing and future usage.	10
	Total Estimated Time:	**24**

For the Richland School District System

Task / Description		Time (hours)
1.	Initially write a letter explaining how the existing well on the Carmichael Middle School grounds would be connected to the Richland High School system and operated to serve both grounds. Additional work would require a revised scope of work.	1
	Total Estimated Time:	**1**

For the Willowbrook System

Task / Description		Time (hours)
1.	Gather and review existing information, including system map.	2
2.	Revise the geo-referenced map of the system.	2
3.	Revise the hydraulic model of the system.	6
4.	Utilize the model to evaluate operational scenarios and identify system constraints for existing and future usage.	10
5.	Size and develop preliminary construction specifications for a storage pond.	12
	Total Estimated Time:	**32**

Develop Capital Improvement List

Based on the assessment of each of the five irrigation systems, a list of required/recommended capital improvements will be complied. Collaboration with City staff will be sought in developing and prioritizing this list. The total time to complete this task will be approximately **10 hours**.

For Re-deployment of Existing Water Rights

The following is an estimate of the time it will take to review, draft applications and provide the required information and associated impairment analysis to the Benton County Water Conservancy Board. There are up to 7 rights that are being considered for change under this proposal. The actual hours spent will depend upon the number of rights actually worked on, and how complex the rights are. This estimate is based upon the worst case scenario. The estimated hours are as follows:

Task / Description		Time (hours)
1.	Initial review and mapping of each water right – 2hour review and 2 hour mapping per water right.	28
2.	Drafting of Application for Change/Transfer of Water Right – Template Drafting 3 hours. Filling in each application utilizing template along with maps and well logs – 3 hours per water right.	24
3.	Providing technical information to Conservancy Board assuming filing as a group to minimize time at Board meetings – 2 hours per water right.	14
4.	Providing impairment analysis for each proposed new well for the Conservancy Board – 3 hours per well; assuming 1 well per water right.	21
	Total Estimated Time:	**87**

Additional travel time associated with processing the applications may be incurred on top of this time estimate. There may be some savings associated with this project as there is likely to be some common information that can be utilized on multiple applications.

Irrigation Standards

Review the existing irrigation standards used by the City and recommend changes. The total time to complete this task will be approximately **8 hours**.

Irrigation Service Policy

Develop a policy for the level of irrigation service to be provided by the City. The total time to complete this task will be approximately **1 hour**.

Reporting and Technical Documentation

The results of the work will be summarized in a report that would be reviewed by City staff, the City's Utility Advisory Committee, and the City Council. Every effort will be made to provide an easy to read document that can be understood by all readers. The total time to complete this task will be approximately **32 hours**.

Presentations

Will prepare and make at least one presentation of the plan findings to the City's Utility Advisory Committee. The total time to complete this task will be approximately **5 hours**.

The time required to complete each task is an estimate and may be shifted from one task to another as required to fulfill the request for services. The total estimated time is **240 hours**.