Water Treatment
Plant Analysis
for *Stayton, Oregon*

January 2006

KELLER ASSOCIATES

Project #103002

TABLE OF CONTENTS

Introduction 1-1
- 1.1 Introduction
- 1.2 History
- 1.3 Existing Facilities
- 1.4 Plant Production and System Demands
- 1.5 Purpose of Study

Source Water 2-1
- 2.1 Source Water
- 2.2 Drainage Basin Characteristics
- 2.3 Shallow Wells

Finished Water and Regulatory Compliance 3-1
- 3.1 Finished Water Characteristics

Process Evaluation 4-1
- 4.1 Plant Design Capacity
- 4.2 Raw Water
- 4.3 Filtration
- 4.4 Chemical Feed
- 4.5 Clearwell
- 4.6 Finished Water Conveyance and Pumping
- 4.7 Plant Instrumentation and SCADA
- 4.8 Plant Electrical System

Operational Analysis 5-1
- 5.1 Administration
- 5.2 Current Water Utility Staffing
- 5.3 Recommended Staffing
- 5.4 Operation and Maintenance Procedures

Recommended Improvements 6-1
- 6.1 Regulatory Compliance
- 6.2 Maintenance / Rehabilitation / Upgrades
- 6.3 System Reliability
- 6.4 Capacity Expansion

Capital Improvements Summary 7-1
- 7.1 Regulatory Compliance
- 7.2 Maintenance / Rehabilitation / Upgrades
- 7.3 System Reliability
- 7.4 Capacity Expansion
- 7.5 Recommendation Summary
- 7.6 Funding and Implementation

Tables:

1.1 – Water Demand Projections
2.1 – Water Rights Summary
2.2 – Raw Water Quality
3.1 – City of Stayton Consumer Confidence Report Summary
4.1 – Seasonal WTP Production
4.2 – WTP Design Capacity by Unit Process
4.3 – Filtration Loading Rates
4.4 – Tracer Test Results
7.1 – WTP Improvements, Opinion of Most Probable Cost

Appendix A:

Figure 1.1 – Facility Location Map
Figure 1.2 – Existing WTP Facilities
Figure 1.3 – WTP Process Flow Diagram
Figure 2.1 – River Basin Correlation (inside Chapter 2)
Figure 2.2 – Turbidity Entering Main Fork of the Santiam River (inside Chapter 2)
Figure 4.1 – WTP Hydraulic Profile
Figure 4.2 – WTP Facilities Layout and Yard Piping
Figure 4.3 – Filter Plan and Profile
Figure 4.4 – Control Building / Finished Water Pump Station
Figure 6.1 – Future Supply Alternatives
Figure 6.2 – Potential Future Water Supply Improvements
Figure 6.3 - WTP and New Filter Bed Alternatives
Figure 6.4 – Recommended Future Improvements

Appendix B:

CT Calculations

Appendix C:

Santiam Water Control District Agreement

Appendix D:

Cost Estimates

CHAPTER 1.0 – INTRODUCTION

1.1 INTRODUCTION

The City of Stayton Oregon operates a Surface Water Treatment Plant (WTP) to supply potable water to its residents. Treated water from the plant is Stayton's primary source of potable water, with an emergency inter-tie with Salem acting as the secondary supply. The plant is located along the Santiam River (see Figure 1.1) south of the City of Stayton. The plant is a variation of a conventional treatment facility utilizing slow sand filters in a direct filtration mode to achieve the City's treatment goals and to comply with State and Federal Drinking Water Regulations.

1.2 HISTORY

The Stayton WTP was constructed in 1971. The original plant included two slow sand filters, the steel clearwell, the raw water intake structure, and the chlorination, finished water pumping and control building. The plant operated with two filter beds until 1987 when filter bed #3 was constructed. The plant has remained at the same capacity since 1993 to the present, with subsequent modifications addressing plant deficiencies and regulatory compliance issues. See Figure 1.2.

In 1993 filter beds #1 & #2 were rehabilitated, and a high-density polyethylene liner was installed. A soda ash feed facility was constructed in 1999 to mitigate high levels of copper and lead in compliance with the Federal Copper and Lead Rule.

1.3 EXISTING FACILITIES

The City of Stayton maintains and operates a Surface Water Treatment Plant (WTP) as its primary supply of potable water. The WTP is a direct filtration plant utilizing slow-sand filtration as its primary treatment mechanism. Figure 1.3 is a process flow diagram of the WTP.

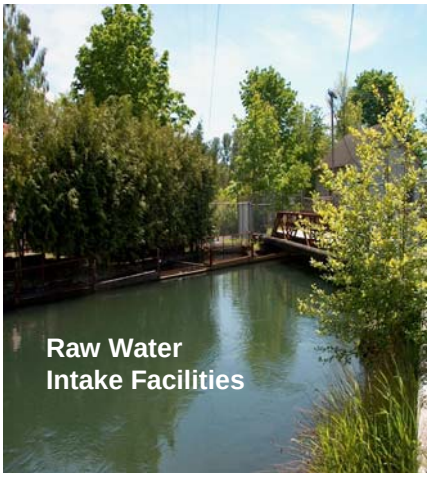
City of Stayton - Water Treatment Plant

The direct filtration approach relies solely on the filtration process to accomplish the necessary treatment of the water. The plant does not employ pretreatment processes to

accomplish its treatment goals such as coagulation, flocculation, or sedimentation. Traditionally, direct filtration plants have been used to successfully treat water that is very stable with very low turbidity loadings, such as water supplied from a large reservoir or lake. However, Stayton's main supply comes directly from the Santiam River. This application works successfully due to the quality of the source water and the source water characteristics, which are presented in a later chapter.

The raw water supply from the plant relies on two primary sources, the Santiam River and a pair of shallow collector wells. Water is withdrawn from the river at a diversion point approximately 1 mile north east of the WTP site. The water is then transported to the plant via a privately owned canal system, known as the Power Canal. The canal system is owned and operated by the Santiam Water Control District. The primary function of the canal is to supply water for irrigation, and to a hydro-power facility located adjacent to and just north of the City of Stayton WTP.

The City maintains a diversion structure on the Power Canal just upstream of the hydro-power plant (see Figure 1.2.) Raw water is diverted from the Power Canal through the City's grated intake where it flows into a settling vault and through several parallel well screens. Flow then enters the raw water pipeline that conveys water to the plant. The raw water pipeline is split evenly for distribution to the filters by a raw water splitter box located at the west end of the Control and Finished Water Pumping Building. The splitter box splits the incoming raw water flow evenly to each of three slow-sand filter beds for treatment.


Raw Water
Intake Facilities

The raw water flows on to the top of the slow-sand filters and percolates down through the bed's biologically active sand layers. The particulate and nutrients in the raw water are removed through physical filtering and biological uptake of the nutrients. The clean water is collected on the bottom of the bed in a lateral collection system, which conveys the water to the filtered water pumping wet wells. Each filter has its own pumping wet well and filtered water pump. The filtered water pumps deliver the water from the filters to the clear well, which consists of a 0.5 million gallon welded steel tank.

Prior to entering the clear well, two chemicals are injected into the filtered water. The first is a chlorine solution for disinfection; the second is a soda ash solution for pH stabilization. The chemically treated water then enters the clear well. The clear well provides the newly injected chemicals the

necessary contact time (CT) to ensure the water is stable and fully disinfected before it is delivered to the customers.

The finished water pumping station, located in the southern half of the control and finished water pumping building, withdraws the water from the clear well and pumps the finished water into the City's transmission system.

1.4 PLANT PRODUCTION AND SYSTEM DEMANDS

A detailed water demand summary has been presented in the *Water Distribution Facilities Planning Study* completed by Keller Associates in conjunction with this report. The following information has been copied from the referenced Study and included here for the benefit of the reader.

Water demands were calculated by adding the existing water usage recorded at the WTP and future demands projected for currently undeveloped land inside the Stayton study area. In an effort to project future water demands, the existing water usage was categorized into residential, non-residential, Norpac, and water loss. The non-residential category includes commercial, industry excluding Norpac, WWTP consumption, and public water demand. For comparative purposes, the demand for each of these categories was averaged over Stayton's population to allow demands to be compared and projected on a per capita basis.

Future water projections assume existing demands remain constant for existing development. This provides for some conservatism in future projections if the City pursues an aggressive leak detection and repair program. The projected demands for 2015, 2025, and build-out are summarized in Table 1.1.

The projected 2025 peak day demand of 10.35 MGD is 93% of the existing summer water right of 11.16 MGD. When the Stayton urban growth boundary is at build-out, peak day demands are projected to be about 12.45 MGD, which exceeds the existing 11.16 MGD summer water right. However, Stayton is in the process of acquiring an additional 10 cfs (6.5 MGD) of year-round water rights, which will satisfy build-out peak day demands.

Table 1.1
Water Demand Projections

	Evaluation Flows in MGD				
Yearly Statistics	**New Development (gpcd) (4)**	**2003 Demands (MGD) (2,3)**	**2015 Flow (MGD)**	**2025 Flow (MGD)**	**Build-out Flow (MGD)**
Stayton Population (1)	N/A	7,300	10,800	15,000	19,200
Average Day	210	2.71	3.45	4.33	5.21
Peak Day (5)	500	6.50	8.25	10.35	12.45
Dry Weather (May-Oct)	270	3.75	4.70	5.83	6.96
Wet Weather (Nov-Apr)	160	1.65	2.21	2.88	3.55

Notes:

(1) Population data developed with 3.35% population growth (rounded to nearest 100).

(2) Existing system includes residential and non-residential demands. Future demands from the existing system users are assumed to remain constant.

(3) Non-residential flow per capita per day excludes Norpac demand.
(4) New development includes residential and non-residential flows plus 5% water loss (which is substantially less than observed in the existing system). Some additional industrial demand (50 gpcd) but not to the magnitude of Norpac, was also assumed. Actual future demands will be a function of the type of future industry that locates within Stayton.

(5) In determining peak day demand for new development, a peak day factor (peak day divided by average day) of 2.4 was used. This is consistent with the existing peak day factor (890/371 = 2.4).

1.5 PURPOSE OF STUDY

The purpose of this study is to provide an assessment of the existing water treatment plant and to develop a master plan and capital improvement plan that address:

- Compliance with existing and future Drinking Water Regulations
- Plant and process performance and potential improvements
- Condition of existing facilities and equipment
- Staffing requirements and Operation and Maintenance requirements
- Process monitoring and recording requirements
- Capacity evaluation and development of future facility needs
- Development of a capital improvements plan

This analysis of the WTP is being completed in conjunction with the City's water distribution system master planning efforts. The water distribution system master plan is bound in a separate document. Some of the population, growth, and demand data developed in the distribution system master plan has been used in this study.

CHAPTER 2.0 – SOURCE WATER

2.1 SOURCE WATER

The City of Stayton draws its raw water from two sources: the North Santiam River, via the Power Canal; and two shallow collector wells (see Figure 2.2). The WTP utilizes the Power Canal river intake for all but a few days a year. The City's ability to utilize the Santiam River for the majority of the year is a direct indication of the river's high quality even during periods of high precipitation and spring snowmelt, which would produce higher turbidities.

When the Santiam River becomes turbid due to heavy precipitation or some other disturbance of the watershed, the City utilizes two shallow collector wells. The wells are constructed within the gravel river alluvium adjacent to the river to take advantage of bank filtration to reduce the turbidity of the river water.

2.2 DRAINAGE BASIN CHARACTERISTICS

The Santiam River is part of the Willamette River Basin structure draining approximately 790 square miles (500,000 acres) of the western slope of the Eastern Cascade Mountains (NSWC, 2004), Figure 2.1. This unique water-way remains pristine for the majority of the year, with raw water turbidities averaging less than 10 NTU (Uhrich, 2003). According to City staff the turbidity on the river may spike during the rainy season (October through March) to as high as 50 NTU, but these spikes typically don't last more than 1-3 days. The Santiam River is also the main raw water supply for the City of Salem's Garrin Island WTP.

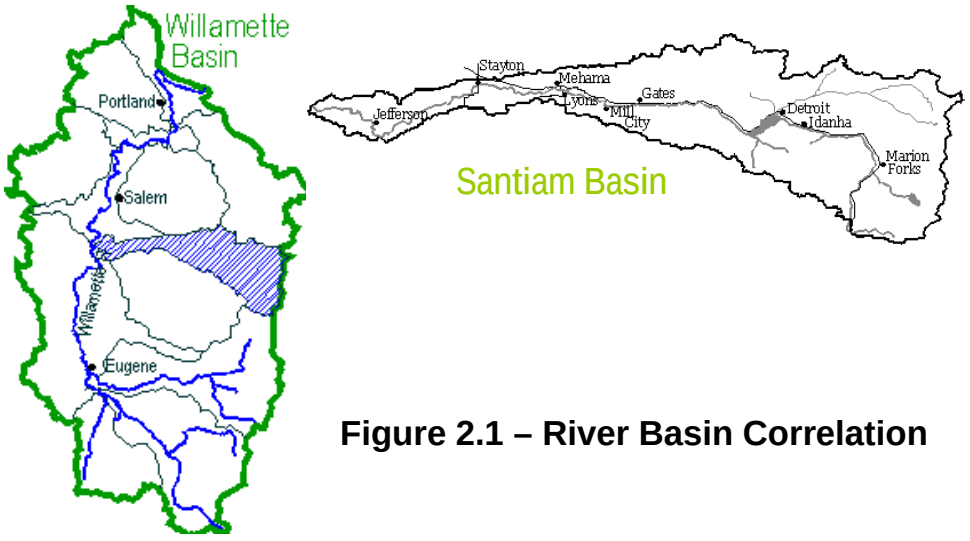


Figure 2.1 – River Basin Correlation

2.2.1 Water Rights

The City of Stayton has an entitlement to approximately 52.26 cfs of water from both the Santiam River (46.59 cfs) and groundwater sources (5.67 cfs) (S. Applegate, Report, May 28, 2005). Table 2.1 summarizes the City's Santiam River Water Rights as prepared in a memo by Mr. Steven Applegate.

Through these water rights the City has negotiated an agreement with the Santiam Water Control District to deliver up to 21.59 cfs of water to the City's raw water intake via the Power canal.

Table 2.1
Water Rights Summary

Appl	Permit	Cert.	Source	Q (cfs)	POD	Prior.	Remarks
T-5883		80346	N. Santiam	2.78+	Power Canal	1909	779.5 AF annual limit
T-5884		80347	N. Santiam	0.82+	Salem Ditch *	1911	230.6 AF annual limit
T-5885		80348	N. Santiam	0.39+	Power Canal	1909	78.5 AF annual limit
T-8771		80349	N. Santiam	0.6~	Power Canal	1907	No annual limit
T-9192	12033		N. Santiam	10~	Salem Ditch	1923	Comp. Date – 10/2011
39297	29266	57094	N. Santiam	7~	Power Canal	1963	
71584	52447		N. Santiam	25#	Power Canal	1991	Extension pending to 2060
		Subtotal-Surface Water		46.59			
GR-145	Gr-139		Inf. Trench	2.67~	NWNE Sec 15	1930	Groundwater adjudication
G-270	G-173	24587	Well 2	3~	NENE Sec 15	1956	
		Subtotal-Groundwater		5.67			
		TOTAL WATER RIGHTS		52.26			

***** Salem Ditch and Stayton Power Canal assume in the record to be the same point of diversion-1800 feet South and 2830 feet East from the West ¼ Corner Section 11.
+ May through September only 3.99 cfs;
~ Year around use-23.27 cfs;
# October through April only-25 cfs;

2.2.2 Chemical Composition

Generally the raw water received from the Santiam River is described as being clean and clear, having very low turbidity. This is in stark contrast to the surface water typically found in the rest of the United States. Table 2.2 summarizes the raw water chemistry data available at the time this study was completed. This data was provided by the City of Stayton.

Even though the Santiam River has very low turbidity most of the year, it is susceptible to turbidity spikes due to spring run-off and large rainstorm events. Figure 2.2 is a photo taken by City of Salem staff of a main tributary feeding into the Santiam River after a rainstorm event. The turbidity plume is easily recognizable as the tributary and main river channel combine.

Table 2.2
Raw Water Quality

Constituent	Range	Units
Turbidity	<10 – 50	NTU
pH	6.3 – 7.5	
Temperature	7.0 – 16.5	°C

2.3 SHALLOW WELLS

In addition to the raw water supplied by the Santiam River, the City of Stayton operates two shallow collector wells. One of the wells is located within the plant while the other is located approximately 400 feet southeast of the plant site adjacent to the river (see Figure 1.2). These wells draw their water from the shallow subsurface water adjacent to the river.

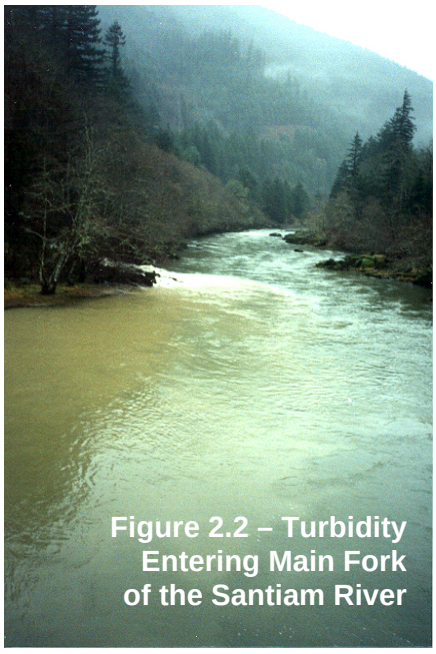


Figure 2.2 – Turbidity Entering Main Fork of the Santiam River

Due to their depth, proximity to the river, and the composition of the river alluvium (coarse sand and gravel) the water contains total coliform and other contaminants that are indicative of ground water under the direct influence (GWUDI) of surface water. With this designation, the water pumped from these wells must meet the same treatment requirements as surface water as defined by the Surface Water Treatment Rule. Therefore, all of the water pumped from these wells is treated by the WTP.

The City utilizes the two wells when the turbidity in the river becomes too high to feasibly be treated by the slow sand-direct filtration process (turbidity > 10 NTU). Although the wells are under the influence of the river, they are not affected by significant increases in the turbidity of the river. This apparent immunity to the high turbidity is due to riverbank filtration from native soils. As the water from the river flows to the wells, it passes through the deposited soils between the river and each well filtering the turbidity and some of the other contaminants.

The 75 well, as referred to by the City, consists of a pump casing, and a line shaft turbine pump fed by an infiltration lateral that lies adjacent to the riverbank and. The well was constructed and placed in operation in 1930,

and provided water directly to the City prior to the construction of the WTP. The production of this well has diminished since its construction, and is now only utilized by the City in emergency situations.

The 50 well consists of a line shaft turbine pump and a perforated pump chamber. This well produces approximately 800 gpm, however the well will be removed from service when the City of Salem constructs its finished water pipeline through Stayton's Plant site.

2.3.1 Water Rights

The City of Stayton has water rights to pump 5.67 cfs of water from the wells. See Table 2.1 for a summary of the City's water rights.

2.3.2 Chemical Composition

Due to the influence of the Santiam River on the wells, the water chemistry of the wells is very similar to that of the river. The only parameter that is different is the turbidity of the raw water. This is due to riverbank filtration that occurs as the water moves through the gravels and sands that comprise the geologic formation along the Santiam River. If the water were being drawn from a deeper aquifer, one might expect to see a variation in the water's chemical characteristics.

Because the water chemistry in the wells is similar to the river, during high turbidity events the wells can be brought on-line with very little operational process changes required. This is different from most surface waters, where it would be normal to expect to have to make significant adjustments to the chemical feed systems and unit processes when transitioning to a new water source.

One drawback of the proximity of the supply sources is if a contamination event were to occur upstream of the City of Stayton and the river were to become contaminated, the City's secondary raw water source would also be in danger of becoming contaminated.

CHAPTER 3.0 – FINISHED WATER AND REGULATORY COMPLIANCE

3.1 FINISHED WATER CHARACTERISTICS

3.1.1 Current Finished Water Characteristics

The City of Stayton produces a high quality water that meets all of the requirements for potable water as mandated by the Oregon Department of Health and the United States Environmental Protection Agency (USEPA). Table 3.1 presents information from the City's Consumer Confidence Reports for the years of 2001, 2002, and 2003.

Table 3.1
City of Stayton Consumer Confidence Report Summary

Year	Regulated Constituent (1)	City Water	MCLG	MCL (2)	Sample Date	Violations
2001						
	Cadmium	2.4	5	5	1/17/01	No
	Turbidity	0.30	n/a	≤1.00	Daily	No
	Copper	0.209	1.3	1.3	n/a	No
	Lead	0.0	0	1.5	n/a	No
2002						
	Cadmium	2.4	5	5	1/17/01	No
	Turbidity	0.30	n/a	≤1.00	Daily	No
	Copper	0.209	1.3	1.3	n/a	No
	Lead	0.0	0	1.5	n/a	No
2003						
	Cadmium	2.4	5	5	1/17/01	No
	Turbidity	0.25	n/a	≤1.00	Daily	No
	Copper	0.390	1.3	1.3	n/a	No
	Lead	2.3	0	1.5	n/a	No

(1) The listed constituents are those required for sampling in the specified year.
(2) For Copper and Lead the reported MCL is actually an action limit (AL).

3.1.2 Drinking Water Regulations

The regulation of the water industry as we know it today began a quarter century ago with the passing of the Safe Drinking Water Act. The following paragraph describes the history of water regulations to the present. This description is as it appears on the USEPA's website.

The Safe Drinking Water Act (SDWA) was originally passed by Congress in 1974 to protect public health by regulating the nations public drinking water supply. The law was amended in 1986 and 1996 and requires many actions to protect drinking water and its sources; rivers, lakes, reservoirs, spring, and ground water wells. (SDWA does not regulate private wells, which serve fewer than 25 individuals.) SDWA authorizes the United States Environmental Protection Agency (USEPA) to set national health-based standards for drinking water to protect against both naturally-occurring and man-made contaminants that may be found in drinking water. USEPA, states, and water systems then work together to make sure that these standards are met. Millions of Americans receive high quality drinking water every day from their public water systems, (which may be publicly or privately owned). Nonetheless, drinking water safety cannot be taken for granted. There are a number of threats to drinking water: improperly disposed of chemicals; animal wastes; pesticides; human wastes; wastes injected deep underground; and naturally-occurring substances can all contaminate drinking water. Likewise, drinking water that is not properly treated or disinfected, or which travels through an improperly maintained distribution system, may also pose a health risk. Originally, SDWA focused primarily on treatment as the means of providing safe drinking water at the tap. The 1996 amendments greatly enhanced the existing law by recognizing source water protection, operator training, funding for water system improvements, and public information as important components of safe drinking water. This approach ensures the quality of drinking water by protecting it from source to tap.

The State of Oregon's Department of Health (DOH) has drinking water primacy and therefore is responsible for the enforcement of the drinking water regulations. The USEPA Region 11 oversees Oregon DOH in the enforcement of the drinking water regulations.

Regulatory Requirements. All water treated and delivered for potable use must meet, as a minimum, the stringent requirements of the USEPA's Drinking Water regulations. These regulations can be broken into two major categories: Primary Drinking Water Standards and Secondary Drinking Water Standards. The Primary Drinking Water Standards are legally enforceable standards that apply to public water systems. The Secondary Drinking Water Standards are non-enforceable guidelines that regulate contaminants that may have cosmetic effects (such as skin or tooth discoloration) or aesthetic effects (such as taste, odor, or color) in drinking water.

Primary standards protect public health by limiting the levels of contaminants in drinking water. The primary standards can be broken into six major categories; Microorganisms, Disinfection By Products, Disinfectants, Inorganic Chemicals (IOCs), Organic Chemicals, and Radionuclides. The following sections discuss each of these categories in further detail.

Microorganisms. This subcategory of the primary standards focuses on microbiological contaminants that pose a health threat to humans. The specific microbes that are currently regulated under the primary standards include; *Cryptosporidium*, *Giardia lamblia, Legionella,* Total Coliforms (including Fecal Coliforms and *E. Coli*), Turbidity (this is a measure of the cleanliness of the water), and Viruses.

Disinfection By Products. The DBP subcategory regulates the level of a specific class of chemicals allowed in a finished drinking water system. The chemicals that are regulated under this rule have known carcinogenic health effects, and are formed from the oxidation of organic materials by water treatment chemicals. Two major families of chemicals are regulated under this subcategory: the haloacetic acids (HAA5) and the Trihalomethanes (TTHM). All of the chemicals within these families are by-products of the reaction of strong oxidants, such as chlorine or bromine, with organic material in the water. The resulting chemical compounds, TTHM's of HAA5's, are known carcinogens and therefore regulated due to their risk to humans.

Disinfectants. The disinfectants required by the regulations are also themselves regulated due to their nature as oxidants and the adverse affect they have on humans. Regulated disinfectants include chloramines, chlorine, and chlorine dioxide. As strong oxidants, these chemicals are very effective at inactivating microbial contaminants by disrupting the cellular structure of the microbe or virus. This same reaction occurs with all mammalian life including humans. If ingested in high quantities, the regulated disinfectants can cause stomach discomfort, anemia, and skin and eye irritation.

Inorganic Chemicals. Inorganic chemicals can be naturally occurring or manmade and are regulated due to their adverse effect on human health. They include numerous metals and earth elements that if ingested in high quantities have been found to be carcinogens or to be toxic such as chromium and arsenic. The toxicity of these chemicals typically cause severe long term organ and tissue damage.

Organic Chemicals. Like the inorganic chemicals, the organic chemicals have been found to have adverse human health effects. These chemicals include numerous manufactured chemicals that have found their way from manufacturing, petroleum, and agricultural applications into the watershed. These compounds include herbicides and pesticides, and typically cause damage to the organs of the gastrointestinal system. The most recent discovery of pharmaceuticals in the water supply has led USEPA to begin to research and regulate the fate of pharmaceuticals in the environment.

Radionuclides. This subcategory regulates naturally occurring radioactive material, which typically occurs in the groundwater. The regulated contaminants include alpha and bets emitters, radium, and uranium all of which are known to cause cancer with prolonged exposure.

The National Secondary Drinking Water Standards (secondary standards) as discussed previously are non-enforceable guidelines. EPA recommends secondary standards to water systems but does not require systems to comply. However, states may choose to adopt them as enforceable standards. The secondary standards include contaminants such as Aluminum, Chloride, Color, Corrosivity, Fluoride, Foaming Agents, Iron, Manganese, Odor, pH, Silver, Sulfate, Total Dissolved Solids, and Zinc.

3.1.3 Future Regulatory Requirements

Under the Safe Drinking Water Act, the USEPA is mandated to regulate a specified number of health contaminants each year based on their risk to human health and their social and economic impact. The constituents to be considered for regulation are placed on a proposed regulated contaminant list. One of the most recent regulations generated from this list is Arsenic. The contaminants on the list undergo a thorough evaluation as to their health effects and the social and economic effects of treatment for the contaminant if it were to be regulated. Once the analysis has been completed a cost-to-benefit analysis is completed, and if the benefits outweigh the cost of treatment the contaminant is regulated under the primary standards of the SDWA.

Several standards addressing contaminants on the candidate list are currently being refined by the USEPA, having already gone through the comment period. These include include the Drinking Water Contaminant Candidate List 2 (a list of chemicals proposed

for regulation), the Radon Rule, and the Ground Water Rule. Of these proposed regulations, only the Contaminant Candidate List 2 may have implications for the City of Stayton. Currently it is unclear exactly which chemicals of those proposed will be retained on the list and which may be removed. The list is relatively extensive, with over 50 contaminants, many of which are synthetic manmade chemicals. Most of these chemicals are unlikely to be found in the City's raw water supply. The City could be proactive and run an analysis of their raw water source for these contaminants to see if any appear. If so, the contaminant might be controlled at its source, or the City would need to formulate a plan for treatment.

CHAPTER 4.0 – PROCESS EVALUATION

This chapter presents the evaluation of each of the process components of the plant on an individual basis as well as an overview of the entire treatment system. The evaluation progresses through the plant following the flow path of the water as it proceeds through the plant. Figure 4.1 has been provided to illustrate the plants hydraulic flow profile while Figure 4.2 illustrates the plants general process arrangement and yard piping. The figures have been provided for clarification throughout this chapter and following chapters.

4.1 PLANT DESIGN CAPACITY

The water treatment plant (WTP) operates as a direct filtration slow sand filter plant. Based on flow meter data provided by the City, the WTP currently produces an annual average of 2.6 MGD of treated water. The plant production data for the last several years is summarized in Table 4.1. Existing and future system demands have been presented in Chapter 1 of this study as a summary from the *Water Distribution System Master Plan*.

Table 4.1
Seasonal WTP Production

Year	Average Day (MGD)	Minimum Day (MGD)	Peak Day (MGD)
2002	2.60	1.64	5.07
2001	(Incomplete Data)		
2000	2.50	1.58	4.88
1999	2.76	1.74	5.38
1998	2.71	1.71	5.28
1997	2.50	1.58	4.88
1996	2.07	1.30	4.04

(1) Minimum and Peak Day values were calculated using peak month peaking factors. These factors were calculated by averaging 6 years of data based on average daily production. The minimum factor was calculated to be 0.63 and the peak factor 1.95.
(2) MGD = million gallons per day

The plant's various unit process capacities have been summarized in Table 4.2. These capacities are actual operating capacities and are estimates based on either theoretical hydraulic calculations or in-field testing and measurements. The industry acceptable loading rate for the

direct filtration slow sand filter process varies over a range of 45 to 150 gallons per day per square foot (gpd/ft^2) of filter area.

Table 4.2
WTP Design Capacity by Unit Process

Unit Process	Design Capacity		
	Number of Units	Total Estimated Capacity	Units
Raw Water (RW)			
Power Canal/River Intake (1)	1	~7,000	gpm
Collector Wells (2)	2	800 - 1200	gpm
30-inch Pipeline (3)	1	HWL=13,888	gpm
		LWL=10,900	gpm
Weir Box (1)	1	~ 7,000	gpm
Slow-Sand Filtration (4) (5)			
Filter #1		3346	gpm
Filter #2		3282	gpm
Filter #3		3292	gpm
Chemical Feed			
Chlorine Disinfection	1	200	lbs/day
Soda Ash (pH Adjustment)	2	Max. Liq. 77	gph
	1	Max. Dry 50	cu. ft.
Clear Well	1	0.5	MG
Finished Water Pumping			
200-hp	2	3,000	gpm
100-hp	1	1,750	gpm

(1) The capacity is unknown; the flow is estimated from operations experience. The exact capacity of the structure has not been tested.
(2) The well capacity varies with the level of the ground water.
(3) The canal raw water (RW) capacity was considered at two canal operating levels, high water level (HWL) and low water level (LWL). The capacity is directly related to the available operating head.
(4) The noted capacity of the filter beds are as reported by operations staff. The capacities are based on peak filter performance as determined through actual operations of the beds by City staff.
(5) The capacities reported for each filter include all filtration components (RW pipeline, filter bed, filtered water pump, and filtered water pipeline).

4.2 RAW WATER

The City of Stayton currently gets its raw water from three sources, the Power Canal and two shallow wells. The main source is the Power Canal, which is supplied directly by the Santiam River. Through an agreement between the City of Stayton and the Santiam Water Control District, raw water is withdrawn via an intake structure from the District's canal. It is

then delivered to the plant through a 30-inch raw water pipeline to a raw water weir box. At the weir box the water is split and conveyed to the filters.

4.2.1 Power Canal Intake Structure

The existing raw water intake structure, which is located along the Power Canal, was constructed with the original water treatment facility in the early 1970's. This structure diverts water from the power canal through a manually cleaned coarse bar screen with 2-inch openings.

The water is then conveyed down a channel through a slide gate valve into a vault with three stainless steel wire-wrapped fine well screens mounted horizontally. The fine screens are 10-foot long, 24-inch diameter well screens with 1/8-inch slots. The intake vault has a shear gate at the bottom of an internal sump to facilitate cleaning of the vault. In case of a floating contaminant spill such as oil or fuel, the City utilizes floating absorbent socks to help protect the intake and the plant from contamination.

The overall condition of the intake facility appears to be good and should continue to serve the City for at least the next 20 years. Hydraulically, the existing intake structure is adequate to meet a flow of 12.45 MGD at build-out conditions. Recommended improvements will be addressed in later chapters.

The City of Stayton and the Santiam Water Control District recently entered into an agreement for the delivery of raw water from the Santiam River to the City's diversion structure via the Power Canal. As part of this agreement the City is required to pay the District $1,120 per cfs delivered or $24,180.80, whichever is greater. This equates to an equivalent flow of 21.59 cfs or 13.59 MGD. Stayton's projected peak day demand at the build-out condition is 12.45 MGD.

Alternative raw water delivery systems have been considered, and will be discussed in more detail in subsequent chapters of this study.

4.2.2 30-inch Raw Water (RW) Pipeline

From the intake at the Power Canal, water is delivered to the plant via a 30-inch wrapped steel pipeline. According to City staff the raw water pipeline appears to be in good condition. It has been reported that when work has been performed on the pipeline, no noticeable

corrosion was observed. It appears the pipeline has a remaining life of 20 years or more. The capacity of the pipeline appears to be sufficient to meet the future demands of the City of Stayton (see Table 4.2).

4.2.3 Raw Water Weir Box

The 30-inch raw water pipeline delivers water through a 20-inch butterfly control valve to a raw water weir box located at the west end of the existing operations building. The control valve was originally air-actuated, but due to failure of the aging air actuation system the actuator was removed and the valve is currently operated by hand. From the valve, the pipeline opens into a weir control box. The box has two baffle walls upstream of the weir. The baffle walls are constructed of two wooden planks with openings oriented at right angles to each other, to prevent the water from surging over the raw water weir.

The water entering the box is forced to a laminar plug flow condition through the baffles, and then rises over a broad-crested weir. The original design included a bubbler tube type level-measuring device. The level measurement along with the equation for the broad crested weir allowed the operations staff to compute the raw water flow coming into the plant.

The raw water flows over the weir and into a splitter assembly where the individual raw water filter lines carry the water onto the filters. This configuration is designed to provide each filter with an even flow split of raw water.

4.2.4 Alternative Shallow Well Source

In addition to the water delivered via the canal, the City operates two shallow wells adjacent to the water treatment plant. The wells are identified by their respective pumping horsepowers as the 50 well and 75 well. The wells are equipped with line-shaft vertical turbine pumps. The 50 well, located near the raw water pipeline, is the more reliable of the two wells. It has been reported to produce approximately 800 gpm (both wells combined produce 1,100 gpm). The 50 well, however, will be removed from service during construction of the new Salem finished water pipeline.

The 75 well is the older of the two wells. Historic photos show the well is constructed of corrugated steel pipe. It has been reported by operations staff that the well production capacity has declined over time, and it is suspected that the well is on the verge of failure. It is

theorized that part of the well's decrease in capacity came when the City stopped pumping water into the natural pond adjacent to filter bed #3.

Due to the condition and future status of Stayton's shallow wells, alternatives should be considered to replace the lost capacity. The shallow wells serve two critical functions to the City. They provide an alternative water source during periods when the turbidity of the Santiam River is higher than can be reasonably treated by the slow sand filtration process (greater than 10 ntu).

The wells also provide some level of protection for the City in the event of a spill or contamination of the river or failure of the Power Canal. If the river were to become contaminated due to an accidental or intentional release of a chemical the City would withdraw water from the shallow wells to meet demands until the spill had passed the Power Canal diversion. (This assumes that the spill does not infiltrate the shallow aquifer that the wells draw their water from. Due to the well location and the geologic structure of the river basin, it is possible that the wells could see some effect of a chemical spill or release depending on the nature of the chemical, though it is unlikely due to the speed of the river and the depth of the wells. In order for the shallow wells to be significantly impacted, the chemical release would likely have to occur over a prolonged period of time (most likely over several years) allowing the chemical to slowly migrate into the aquifer.)

The City should consider replacing the shallow wells adjacent to the plant with a series of wells south of the plant site. Alternatives for replacement of the wells were considered in a supply analysis titled *Stayton Water Treatment Plant Supply Alternatives*.

In addition, the City should consider the possibility of constructing a deep aquifer well that is not influenced by the river as an emergency water supply in the event the river and the shallow wells are unusable for an extended period of time. This would not replace the emergency inter-tie with Salem, but would afford protection from a catastrophic environmental disaster on the river. If such an event occurred, the City of Salem may not be able to provide the City of Stayton water through the inter-tie since water from the City of Salem's water treatment facility is also from the river just upstream of the City of Stayton's facility.

4.3 FILTRATION

The City's water treatment facility is a direct filtration slow sand filter system. The City operates 3 slow sand filters to polish the raw water and bring it to potable water standards. Filter beds #1 and #2 were constructed with the original plant in the early 1970's and were rehabilitated in 1993. Filter bed #3 was constructed in 1987 and has not undergone any significant modifications since that time. The filtration system can be broken into three basic components: raw water conveyance, filtration, and filtered water conveyance.

4.3.1 Raw Water Inlet Pipeline

Raw water is delivered to each of the three filter beds via a 16-inch raw water filter pipeline from the raw water weir box. The pipelines that feed filters #1 and #2 are steel, and were installed when the plant was originally constructed in the early 1970's. Both pipelines are reported to be in good condition with no known repair history. The operations staff inspected a portion of the pipeline when it was uncovered during the 1993 filter rehab project and found no signs of deterioration. The pipeline feeding filter #3 is ductile iron and was installed when the filter was constructed in 1987. The pipeline is reported to be in good condition.

The flow from the raw water weir box is evenly split to each filter by throttling a 16-inch butterfly valve. The valves also serve as isolation valves for the filter beds. During a seepage test that was performed on each of the three filter beds, filter #1 gained in water elevation. It is suspected that the raw water valve on the inlet line may be leaking. It is recommended that the valve be rechecked, and if it is indeed leaking that it be removed and serviced.

4.3.2 Slow Sand Filtration

The slow sand filter beds are comprised of a raw water inlet pipe; the filter bed; a collection lateral system, to collect the filtered water; and a filtered water sump and filtered water pump. The basins are uncovered earthen berm construction lined with either a geo-textile membrane or concrete. Each

Filter Basins

bed has an inlet and overflow that penetrate the filter media.

The filter beds are mono-media with underlying support gravel. A layer of coarse gravel (approximate grading ¾-inch to 1½-inch) is placed at half the depth of the collection lateral system (6-inches). A second 6-inch layer of intermediate support gravel is placed to the top of the collection piping (approximate grading ¼-inch to ¾-inch). The final layer of support gravel consists of a 6-inch layer of fine gravel (approximate grading No. 10 to ¼-inch). These layers of support gravel are covered with a 3-foot layer of filter sand. This arrangement is typical of a slow sand filter design.

The following table gives an estimate of each filter bed's filter-loading rate against industry accepted loading rates as well as Oregon Department of Health recommended loading rates. The rates presented in Table 4.3 indicate that the City's existing filter beds are operating at or near the recommended maximum loading rate for a slow sand filter.

Table 4.3
Filtration Loading Rates

	Filter Loading Rate (gpd/ft^2)	Filter Area (ft^2)	Filter Operating Rate (gpd)
Industry Standard (1)	57.6-144		
Ten State Standards	45-150	-	-
Oregon Department of Health	(2)	-	-
Filter #1 (3)	147.8	32,604	4,818,240
Filter #2 (3)	145.0	32,604	4,726,080
Filter #3 (4)	145.4	32,604	4,740,480

(1) The industry design standard is referenced from a filtration rate of 0.04 to 0.10 gpm/ft^2. This rate is referenced from "Water Treatment Plant Design Standards, 3rd Edition" by the American Water Works Association.
(2) The State of Oregon Department of Health does not identify an acceptable design standard for filter loading rates. Rather they reference (OAR 333-061-0050(4)(d)(E) "Ten State Standards" for new construction and rely on an existing systems ability to meet the turbidity standard for the technology being used.
(3) Filter bed dimensions are as specified on plant as-built drawings dated 1972 by CH_2M and verified on filter re-construction drawings dated 1993 by Boatwright Engineers.
(4) Filter bed dimensions are as specified on filter #3 construction drawings dated 1987.

The water enters the filter through the inlet pipe above the filter medi, filters by gravity through the bed, and is collected in the support gravel and collection lateral system. The collection laterals

consist of 6-in perforated pipe. See Figure 4.3 for the configuration of the filters. Once the water has filtered through the sand and collected in the collection laterals, the water flows to the manifold and is conveyed to the filtered water pump vault.

The filtered water is boosted via a vertical turbine pump into the filtered water line and to the clearwell. Each filter has its own dedicated filtered water pump. The filtered water pumps are capable of delivering the following flows from each respective filter: filter pump #1 = 3346 gpm; filter pump #2 = 3282 gpm; and filter pump #3 = 3292 gpm. The reported value for filter pump #3 is through a throttling valve. The pump is throttled because it is capable of pumping more water than the filter bed can provide; in other words, the pump is capable of pumping the filter bed dry.

4.3.3 Filtered Water Pipeline

The final portion of the filtered water system consists of the filtered water pipelines. The filtered water lines for filters #1 and #2 are steel, while the pipe material of the #3 pipeline is ductile iron. These pipelines are sized appropriately to convey the full flow of the filter beds to the clearwell (see Figure 4.2 for the piping configuration of the filtered water pipelines). A filtered water flow meter is located downstream of the interconnection of all three filtered water pipelines. The purpose of this flowmeter is to provide a flow signal to the chemical feed systems for flow pacing and to measure combined filter water flow rate.

4.4 CHEMICAL FEED

The Stayton Water Treatment Plant feeds two chemicals to meet their treatment goals. The main chemical that is fed is chlorine, as a disinfectant as well as for algae control. The first chlorine dosing point is in the raw water weir box ahead of the filters. The purpose of this chlorine dose point is to control algae growth within the filter beds. Because the filter beds are shallow and exposed to sunlight, they would have a tendency to become overgrown with algae if a control dose of chlorine were not added to the raw water.

The second chlorine dose point occurs prior to the 0.5 MG clearwell, and is for disinfection of the treated water. The operations staff maintains a chlorine dose rate that provides a free chlorine residual of 0.7 mg/l at the end of the clearwell. This dose combined with the clearwell residence time combine to meet the required CT value as determined for the water and treatment characteristics for the Stayton water treatment plant. The

chlorination system flow paces based on the filtered water flow meter to ensure the correct dose of chlorine is delivered to the filtered water.

Chlorination Facilities

The second chemical fed at the Stayton WTP is soda ash. The soda ash feed system was constructed in 1999 in response to a corrosion control study, to control the levels of copper and lead within the distribution system. The facility includes a building, a screw-fed Wallace & Tiernan (W&T) dry chemical feed system and a W&T package solution feed system (day tank and metering pumps).

The dry chemical is stored in a hopper that penetrates the roof of the building. The hopper is filled from the top, above the roofline of the building. The hopper is fitted with a shaker which is used during filling to prevent soda ash from blowing outside the hopper. The hopper is attached to a screw conveyor system that sits inside the soda ash room in the chemical feed building. The screw conveyor measures an amount of soda ash into a day tank based on an input signal from the filtered water flowmeter. Water to make a soda ash solution is added to the tank through a simple float valve, which maintains the tank at a predetermined level.

Soda Ash Facilities

The solution is then pumped via chemical metering diaphragm pumps to the injection point in the filtered water line ahead of the clearwell. One of the chemical metering pumps is an Encore 700 diaphragm pump as manufactured by W&T. The second pump is an LMI Milton Roy diaphragm pump, which was installed to replace one of the W&T pumps which failed. The metering pumps are constant flow. Due to the configuration of the system, the feed solution varies widely in strength making it difficult to accurately control dosage.

4.5 CLEARWELL

The existing clearwell at the plant is comprised of a 0.5 MG welded steel storage reservoir. The reservoir was constructed with the original plant project in the early 1970's and had not undergone any significant modifications since its construction.

On October 5th, 2004 the City of Stayton completed a tracer study on the existing clearwell reservoir. The measured residence time for the reservoir was 8 minutes with a 200-hp and the 100-hp pump running simultaneously. Given the pH, temperature and chlorine residual, the corresponding CT value required a residence time of 41.4 minutes. This was significantly more than had been measured by the tracer study, and was an indication that water was being delivered to customers that did not meet the required CT value. CT values are established to predict a log removal or percent confidence that the biological contaminants in the water that are not removed by the filtration process have been inactivated, leaving the water safe for consumption.

In light of this discovery, the City of Stayton immediately implemented a tank-baffling project. The proposed alternative was to install a series of membrane sheets inside the existing clearwell to create a tortuous flow path and eliminate the short-circuiting that was occurring in the reservoir, thus increasing the calculated CT value of the reservoir. After the baffles had been installed, a new tracer test was performed. The results of this test can be found in Table 4.4.

Table 4.4
Tracer Test Results

Pumping Configuration	Flow Rate (gpm)	Measured Residence Time (min)
100-hp	1,800	92
200-hp	3,500	41
100 + 200-hp	4,900	35

The data from the post-baffling tracer test indicates that the goal of extending the residence time was achieved. The required residence time based on the pH and temperature of the water varies based on three primary factors: free chlorine residual at the end of the contact period, the pH of the water, and the temperature of the water. Due to this variation, a set of tables were prepared to assist in quickly calculating required residence times and chlorine dose based on the seasonal variations of Stayton's raw water and state CT requirements. These calculations and reference tables have been included in Appendix B of this study.

The plant-specific CT calculations indicate that during the winter season when lower flows are experienced, a residence time of 64.3 minutes is required to meet the target CT value with a chlorine residual of 0.7mg/L. The required residence time decreases to 56.3 minutes at a residual of 0.8 mg/L. For the required residence time to be less than the residence time measured by the tracer study, a free chlorine residual of 1.1 mg/L would have to be fed. Based on the above discussion, clearwell alternatives will be discussed in more detail in later chapters.

4.6 FINISHED WATER CONVEYANCE AND PUMPING

The final stage of the water treatment facility is conveyance and delivery of the finished water. At this point the water has been fully treated and meets the regulations for delivery as potable water to the public. The finished water pumping facility is comprised of three main components: the suction header, finished water pump station, and the discharge header. Each of these will be discussed in the following sections.

4.6.1 Finished Water Pump Station – 30-inch Suction Header

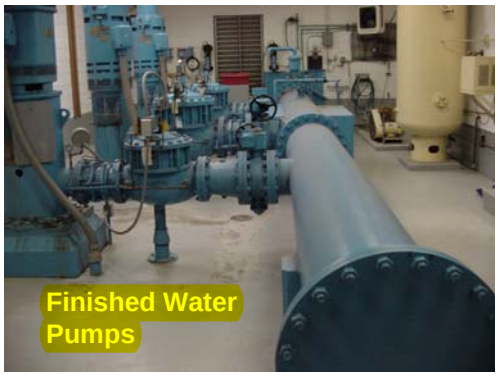
The finished water is conveyed from the clearwell to the finished water pump station via a 30-inch steel pipeline. The pipeline is sized to reduce the water velocity and thus minimize the headloss in the header. As the header approaches the finished water pumping room in the control building, 14-inch suction legs tee off the line to feed the individual finished water pump vaults, see Figure 4.4.

The 30-inch header was evaluated to determine the peak water velocity that would be experienced under the peak day build-out demand of 12.45 MGD. The anticipated velocity within the pipe during the peak day event at build-out is 4.1 ft/sec. The 30-inch pipeline is approximately 50 feet long, with two 45° bends and a series of four 14-inch tees to the pump intakes. The estimated headloss within this header under the build-out flow conditions is approximately 4 feet, which is well within the available head of the system. Therefore, it appears that the finished water header is adequately sized to meet the future flows to the established build-out condition of 12.45 MGD.

4.6.2 Finished Water Pump Station - Pumping

The finished water pump station consists of a series of three vertical turbine pumps that are set over 24-inch pump cans below the finished water pump station floor. The three pumps consist of two high-volume service pumps and one lower volume service

pump. The measured and estimated pumping capacities of these pumps were summarized in Table 4.2. A space was provided in the original plant design for the addition of a future fourth pump.


Finished Water Pumps

Each pump draws its water from a 24-inch diameter pump can. The pump discharges the water through a 14-inch Cla-Val pump control valve to a 24-inch finished water header. The pumps, last rebuilt in 1989 (due to damage from an electrical fire in the finished water pump station), are reported to be in good condition by operations staff.

The operations staff has indicated a desire to have the Cla-Val pump control valves reconditioned. These valves have rubber diaphragms that should be replaced as part of a maintenance schedule, but according to the plant staff these valves have not been serviced since their installation. The valves, other than requiring some recommended maintenance, appear to be in good condition and are reported to be operating correctly.

4.6.3 Finished Water Pump Station – 24-in Finished Water Header

Each of the finished water pumps pump into a 24-in finished water header. In addition to conveying the finished water from the water treatment plant to the distribution system, the finished water header acts as a measuring point for several pieces of critical plant instrumentation.

The header appears to be sized large enough to accommodate the future build-out flowrate of 8,650 gpm (12.45 MGD). The water velocity within the header under the build-out flow condition was estimated at approximately 6.4 fps. This velocity is slightly higher than the recommended typical design velocity of 5 fps, but is well within allowable velocities for the peak flow event that 8,650 gpm represents. Therefore the header appears to be adequately sized to meet the future peak day build-out demand.

The parameters that are monitored along the header include temperature, pH, chlorine residual, turbidity, and flow. Over the years two different flow-measuring devices have been installed along the finished water header. The first flow meter included an orifice plate and a differential pressure cell. This meter was

replaced with a more modern turbine flow meter. It is our understanding that the orifice plate for the original flow meter is still in place. Since this plate no longer serves its intended purpose and acts as a flow restriction, it should be removed.

Upon review of the plant flow records, it was discovered that neither meter was measuring the finished water flow accurately. The primary problem with both meters is not the actual accuracy range for the particular type of meter, but the installation. Both meters are installed directly downstream of the finished water pump discharge into the 24-inch header. In order for the meter to read the flow accurately, the flow profile cannot have disturbances in it caused by pipe fittings or pumps. This is the reason for meter manufacturers requiring a straight pipe run both upstream and downstream of the flowmeter installation point.

4.7 PLANT INSTRUMENTATION AND SCADA (SUPERVISORY CONTROL AND DATA ACQUISITION)

The existing water treatment plant has very limited plant instrumentation and SCADA capability. The existing systems will be discussed in this section. Generally the instrumentation and SCADA can be divided into three distinct but overlapping categories. The use of these categories as they relate to this study are described in the following paragraph.

Instrumentation is the use of devices throughout the plant to measure, detect or monitor certain processes, functions or operations. In contrast, plant SCADA systems are various systems within the plant that receive data from a system monitoring, measuring or detecting device and use the data received to control or report some plant function. Plant record keeping consists of data monitoring and storage systems used to continually store a multitude of data from all in plant monitoring and detecting systems.

4.7.1 Instrumentation

The existing plant currently has limited instrumentation installed on key systems to measure critical plant functions. The following is a list of the existing plant instrumentation systems and a description of their function.

1. Clearwell Level – measures the level in the clear well at the treatment plant; used to control the filter effluent pumps and maintain the clear well level.

2. Finished Water Pressure – measures and indicates the discharge pressure of the finished water booster station as it is delivered to the City's distribution system.

3. Finished Water Turbidity – measures and indicates the turbidity of the finished water as it is delivered to the City's distribution system.

4. Chlorine Residual – measures and indicates the chlorine residual of the finished water as it is delivered to the City's distribution system.

5. Chlorine Cylinder Weight – indicates the weight of the gas chlorine cylinder that is in use in the chlorine room. This weight is then compared with the empty weight of the empty cylinder, allowing the staff to determine the amount of chlorine remaining in the cylinder. This weight is also used to monitor the plant chlorine usage based on pounds of chlorine used per day.

6. Finished Water Flow Meter – indicates the flow of finished water from the plant into the distribution system. It appears that the existing flow meter is not measuring the flow rate of the finished water accurately due to the meter installation condition.

7. Level of Soda Ash Storage – indicates the dry chemical storage level in the bulk storage bin for the dry soda ash storage.

8. Feed Water to the Soda Ash Day Tank – indicates the flow rate of water to the soda ash day tank. The water source is utilized on a batch basis as a new batch of liquid chemical is required.

9. Flow Meter to Clearwell – measures the flow rate from the filters to the clear well. The Soda Ash feed system uses this information to control the dosing rate of Soda Ash solution to the process stream.

4.7.2 Control Systems

When the WTP was constructed in the early 1970's, several control systems were in place to control or monitor the filter levels, loss through the filter beds, and various other process functions. The original control system used compressed air to measure plant functions and operate equipment to control plant processes. The main plant compressed air system is no longer in use, and the air piping throughout the plant has been abandoned. The control systems in the existing plant that are currently in use are discussed in the following paragraphs.

A new SCADA system was included in the addition of the soda ash feed facilities. This system monitors and controls the rate of soda ash feed to the process. The control system uses flow-paced chemical metering pumps to control the feed the required soda ash solution dose to the finished water process stream.

The clearwell level controls the filtered water pumps, located at the end of each filter. This control system uses the level in the clearwell to control the on and off operation of the filtered water pumps to keep the clearwell within an operator determined normal operating range.

The finished water pumps are controlled by the water level of the storage reservoirs in the distribution system, utilizing a SCADA system. The Pine Street Tank is the primary reservoir that controls the finish water pumps. Remote signals from the Pine Street Tank are sent to the plant by way of telephone telemetry. Level in the Regis Tank is also communicated to the plant via telephone. These tank levels provide start and stop signals to the plants finished water pumps to maintain the levels within the reservoirs.

In addition to the SCADA systems described, the plant main control room houses a programmable logic controller (PLC). The PLC is programmed to control the on/off operation of the finished water pumps, operation of the 50-well pump and the 75-well pump, and operation of the filtered water pumps. The clearwell, Pine Street reservoir, and Regis reservoir all provide level signals to the PLC. The PLC uses these signals to control the on/off operation of the finished water pumps based on a comparison of the level signals being provided to an operator-determined set-point.

4.7.3 Plant Operation

The majority of the plant is operated manually. This is due primarily to the failure and abandonment of the original compressed air control and monitoring system. The compressed air system was a popular and widely used control and monitoring approach during the time of the plant's design and construction. The following sections describe the current manual or semi-automatic operation of the plant. Descriptions of the process components configurations can be found in previous sections of this chapter.

Raw Water Intake. Raw water enters the plant through a manual butterfly valve and flows into a weir box where pre-chlorination occurs before the raw water flows into the filter ponds. The raw water is sampled and measured for turbidity at the weir box by a Hach online turbidity meter.

The plant staff manually adjusts the intake butterfly valve to control flow into the plant. The staff visually monitors the water level in the filter basins and adjusts the raw water valves to balance the raw water flow rate with the bed filtration rates. As water demands change in the system, the operator attempts to keep the operating level of the filter at or slightly below the overflow level without allowing too much water to spill into the overflow. Excessive overflow is not desirable since the raw water is continually bringing sediment load into the filters, and excessive overflow adds to the sediment accumulation in the filters without being used as finished water.

The pre-chlorination system used at the intake weir box is manually adjusted using a gas rotometer in the chlorine room. When the operation staff adjusts the raw water butterfly valve they also must adjust the chlorine rotometer on the pre-chlorination feed system. This adjustment ensures the addition of chlorine is adequate to control the algae in the filter basins without adding excessive chlorine, which would cause disinfection-by-products in the finished water and interfere with the development of the biologically active layer within the filter bed.

Filtered Water Pumps. There are three filtered water pumps, one pump for each filter basin. The programmable logic controller (PLC) in the plant control room controls the on/off cycling of the filtered water pumps. The water level in the clearwell is used to determine the on/off operation of these pumps. As the clearwell fills, a set-point turns the pumps off to prevent the clearwell from overflowing.

As the level drops, a set-point turns the pumps on to refill the clearwell.

Each filtered water pump sump has a manually read float in the sump to indicate the water level within the sump. This float reading can also be utilized to calculate the headloss through the filter bed connected to the respective pump. The operator reads the float in the sump to determine when the headloss through the filter has reached the point where the filter needs to be skimmed to remove the layer of dirty sand from its surface.

Soda Ash Feed. Soda ash solution is added to the water stream between the filtered water pumps and the clearwell as described in preceding sections. The soda ash feed system is comprised of an automated dry chemical feed system, a dry/liquid blending system, and a liquid chemical feed system. The dry powder is mixed with water in a controlled rate-mixing tank where water and dry powder are mixed to form the injection solution. Two chemical metering pumps feed the solution to the injection point in the filtered water pipeline prior to the clearwell.

A controller in the soda ash building controls the feed rate of dry chemical to the mixing tank based on the flow rate of water into the clearwell as measured by the filtered water flow meter. The rate of flow of water into the mixing tank is controlled by the depth of the solution in the tank through a float-controlled valve. Since the dry powder is added at a variable rate the concentration of the solution varies with the flow of water read by the filtered water flow meter.

The chemical feed pumps have a variable stroke length, but run a constant speed. The operator determines the pH of the finish water by taking a sample of the water at the plant effluent. This operation condition makes is difficult to add the most effective amount of soda ash to the process stream.

Chlorination System. Gas chlorine is delivered to the plant in one-ton cylinder containers. The cylinder is placed on a load cell in the chlorination room to monitor the weight of the chlorine in the container, which is a mixture of liquid and gas. The liquid chlorine evaporates inside the container, and is withdrawn under a vacuum through a vacuum valve to the chlorinators. The plant utilizes two chlorinators with controllable flow.

One Ton
Chlorine Cylinder

One chlorinator feeds chlorine to the raw water intake weir box for prechlorination, and the other chlorinator feeds chlorine to the filtered water pipeline prior to the clearwell.

The chlorinators feed chlorine at a rate that is manually set by the operator. The operator reads the rate of flow on a gas rotometer and makes adjustments to set the desired rate of gas flow. The chlorine gas is fed from the rate controller to an injector that mixes the chlorine with water.

The rate of feed of the chlorine is manually set at the rotometers for each chlorinator. (An automatic system used to control the chlorine feed rate in proportion to the flow rate and the residual chorine in the finished water malfunctioned years ago and is no longer used.) The operators set the chlorine rate based on their judgment and experience, and monitor the chlorine residual in the finished water and at the remote monitoring sites to make adjustments to the setting of the rotometers. The on/off cycling of the finished water pumps and variations in the water demands throughout the day can cause the chlorine residual in the finished water to oscillate from high to low concentrations.

4.7.4 Alarm Systems

The existing alarm system for the plant is through the telephone system. When an alarm in the plant is detected, the alarm system automatically dials to a central location to indicate an alarm condition has occurred. The central dispatch then calls the on-duty operator to notify them of the alarm so they may investigate the cause of the alarm. Various alarm conditions, including power outage, finished water pump failure, low or high level in the Regis, Pine Street or Clearwell reservoirs, can initiate an alarm.

4.7.5 Record Keeping

The current record keeping process is primarily manual. However, there are two circular chart recorders located in the plant control room. One circular chart records the water level in the Pine Street reservoir, and the other records both the finished water discharge pressure and the finished water flow rate. The remainder of the regulatory and operations required records are kept by hand in log format entered by the shift operator. Hand-recorded records include raw water and finished water turbidity, finished water chlorine residual, finished water pH, chlorine cylinder weight and pump run times.

4.8 PLANT ELECTRICAL SYSTEM

Pacific Power and Light supply electric power to the treatment plant through a service transformer near the control building. The incoming power is a 480-volt, 3 phase, 4 wire service. The service is metered at the control building using a current transformer type meter.

The power distribution system consists of a 1,600 amp main service disconnect and a series of modular motor control sections mounted in a floor-standing master Motor Control Center. The Motor Control Center is located on the east side of the main finished water pumping room. The Motor Control Center consists of individual motor control modules with a feeder breaker and a magnetic motor starter for each motor. A dry transformer provides 120/240-volt single-phase power to a lighting panel. The lighting panel has individual circuit breakers for each of the feeder circuits. Electric unit heaters throughout the control building are supplied through the motor control center by individual feeders and circuit breakers as well.

Motor Control Center

CHAPTER 5.0 – OPERATIONAL ANALYSIS

5.1 ADMINISTRATION

The City has a water utility, which is responsible for the operation of the City's water infrastructure. This includes the Raw Water System, WTP, Transmission and Distribution Piping, and Storage. The water utility is overseen by the Public Works Director (PWD).

It is the duty of the PWD to coordinate system improvements and annual budgets with the council and mayor, who approve the annual operating budgets and capital improvements. The PWD also coordinates the water utility's activities with those of other operating groups within the City such as planning, zoning and inspection, wastewater, parks, streets, etc.

The water utility is managed by a Water Supervisor. The role of the water supervisor is to coordinate the operation of the water utility and plan the daily, weekly, monthly, and annual activities occurring within the utility. The most important role the supervisor fills is the production and distribution of safe drinking water to the City of Stayton. The supervisor is responsible for the operation of the water system including the raw water facilities, the WTP, and the transmission, distribution, and storage system. To assist the Supervisor in accomplishing his duties are a current staff of 4 full- time and 1 employee assigned to both the water and wastewater utilities.

Water System Monitoring

The operations and maintenance personnel comprise the crews that handle the day-to-day operation of the water system. They are made up of certified operators and technicians whose job it is to operate the facilities efficiently and correctly, while complying with all of the regulatory requirements, to meet the water needs and demands of the City of Stayton. Their activities include operational oversight and adjustment to the WTP to ensure the processes perform as intended. This staff is also responsible for balancing water production with system demands to ensure a safe and secure water supply at all times.

5.2 CURRENT WATER UTILITY STAFFING

The water utility is comprised of 5 full-time and one part-time employee assigned 50% to the water utility and 50% to the wastewater utility, for a total of 5 ½ individuals (including the supevisor). Their responsibilities include operation of the plant, distribution system, and providing assistance to some of the other City groups as needed. The plant operators duties include maintenance and mowing of the plant grounds in addition to operations and daily monitoring. At the plant, the staff have daily operations, which tie up at least one person for an 8-hour shift. The daily monitoring of the plant takes approximately 4 hours, assuming no problems are discovered. (Daily monitoring consists of inspecting the operations equipment, reading and recording equipment run times, chemical weights, and chemical dosages.) In addition the daily monitoring includes completion of sampling and testing of the water in various stages of the treatment plant. The daily sampling allows the operator to determine if changes are required to keep the plant at an optimum operating point, and provides data for the daily monitoring logs for regulatory reporting.

In addition to the daily operation of the plant, the staff is responsible for cleaning the filter beds when required. Based on operational experience one filter bed is cleaned approximately every 6-weeks. The cleaning requires 2 people about 8 hours, after the bed is cleaned it is leveled. Leveling of the bed requires one person an additional 4 hours. Once a year the edges of the filter bed are cleaned to remove weeds and mud this activity requires two men an additional 8 hours.

The distribution system has a single individual dedicated to turn-ons and shut-offs, 8 hours per day. According to City personnel, the high demand for this service has caused this operation to become a bottleneck. This affects not only the water utility but also City Hall and other City operating groups.

The water utility staff is also responsible for the monthly meter reading. If a problem is detected with a specific water meter, the meter is removed and a new meter is installed. Because of the already busy schedule of the water utility, the City does not currently test or repair the meters if they are inoperable.

In addition to the duties listed above, it is our understanding that an individual from the water utility is attached to the street group assisting with street repairs and another individual is attached to the parks group and is responsible for two seasonal employees.

The following summarizes the above discussion on staffing based on the specific tasks described above.

1 - Operation of the WTP
1 - Turn-on, Shut-off
1 - Streets
1 - Parks
0.5 - Back-up operations on weekends

This leaves one individual to complete all the system maintenance and repairs that are required. This workload division also assumes the supervisor is available to perform one of the above identified tasks. Note that the water supervisor is also only funded 80% to the water utility.

Based on the above, the City water utility appears to be understaffed.

5.3 RECOMMENDED STAFFING

Based on the above discussion of the water utility's responsibilities, we have drawn the following conclusions about the staffing level at the water plant and for the water utility in general.

The plant should be staffed with two individuals on overlapping shifts 7-days per week. The shifts could run from 6 am to 2 pm and from 12 pm to 8 pm. The two-hour overlap allows for turnover of the plant to the new operator. Due to the critical importance of the water treatment plant, it is recommended that two operators be provided as soon as possible.

For additional staffing recommendations refer to the *Water Distribution System Master Plan Study*.

This staffing includes the supervisor; however, as the utility staff increases the supervisor will become more heavily involved in management and will have significantly less time to assist in day-to-day operations.

5.4 OPERATION AND MAINTENANCE PROCEDURES

The plant currently uses a manual system for scheduling and logging equipment maintenance. In addition, a significant amount of specialized electrical and mechanical maintenance is contracted on an as needed basis. Based on present staff levels as indicated above, general maintenance duties such as painting, cleaning, and landscaping are performed as time allows.

Most water treatment facilities are beginning to utilize computerized O&M management tools, which greatly facilitate scheduling, and record keeping

of O&M requirements. The electronic system allows for logging of equipment information, spare parts inventory, prompting for scheduled maintenance, printout of maintenance instructions, record keeping, budgeting, summary reports, etc. There are numerous O&M software packages on the market ranging in cost from less than $1,000 to greater than $25,000 depending on the amount of information and the level of detail desired. It is recommended that the City convert to a computerized O&M system in conjunction with the SCADA and control improvements described in the following chapter. Keller Associates can assist the City in searching for a software package to meet its needs.

CHAPTER 6.0 – RECOMMENDED IMPROVEMENTS

The initial chapters of this study assess the existing facilities condition, efficiency, capacity, and effectiveness. These chapters identify deficient areas and future needs to meet federal drinking water requirements as well as Stayton's future demands as growth occurs into the future. The recommended improvements to achieve a facility with adequate capacity that produces water that meets or exceeds federal regulations and that is properly operated and maintained are addressed in this chapter.

The improvements and alternatives have been organized into four categories of decreasing importance. The first three categories are very close in importance because they address the City of Stayton's ability to provide a safe and reliable potable water supply for the existing residents and customers whom rely on the water source today.

- Regulatory Compliance (6.1) – the first category addresses immediate and future needs to comply with federal, state and local regulations for the production and delivery of potable drinking water for a community drinking water system.

- Maintenance / Rehabilitation / Upgrades (6.2) - The second category considers maintenance related improvements to bring the plant into sound working order at a level consistent with available modern technologies.

- System Reliability (6.3) - The third category addresses the issue of system reliability.

- Capacity Expansion (6.4) - The final category addresses plant improvements and expansion to allow the City to continue to provide water to a growing customer base into the future.

Each category contains recommendations for improvements and their associated alternatives. Recommended alternatives with their corresponding costs have been presented in Chapter 7 rather than within Chapter 6 due to its breadth.

The improvements identified in each category walk through the plant starting at the raw water (head) end of the plant and proceed to the treated water (tail) end of the plant. The improvements are summarized as previously discussed in the chapter following this chapter. The estimated costs are included in Chapter 7 for each improvement, detailed analysis of these costs are included in Appendix D of this report.

6.1 REGULATORY COMPLIANCE

These upgrades address existing or anticipated regulatory requirements. The assessment considers the existing plant condition against known or anticipated regulatory changes.

6.1.1 Power Canal Raw Water Intake

The existing raw water intake appears to be in good condition. The City should consider securing the immediate intake area with additional fencing across the foot bridge access to the intake to prevent vandalism of the facility. The intake sets at a remote site removed from the plant site. This is not a water quality based regulatory recommendation, rather, this recommendation is based on new regulations governing the security of the nations water supply. It should be recognized that limiting access to the facility will minimize public contamination, however, there is no fail safe means at a reasonable cost of preventing access to the canal or intake structure by a determined intruder.

6.1.2 Filtration

The filters are comprised of three distinct components the raw water inlet pipeline, the filter, and the filtered water pipeline. Each of these three components will be considered in this section.

The raw water (RW) pipeline as discussed previously has been reported to be in good condition. However, it is recommended that each of the RW filter pipelines be fitted with individual flowmeters. These flowmeters would allow plant staff to accurately track and log the RW flow of each filter for regulatory reporting purposes. In addition, the individual flow metering would allow plant staff to more accurately balance the RW flow that each filter bed receives preventing overloading of individual filters.

Currently, regulations are pending that would require the City to report filtered water turbidity data for each filter independently. In addition, the State of Oregon requires new plants to monitor and report filter turbidities individually (OAR 333-061-0050, 4, d, F). At this time the City reports filtered water turbidity as a composite sample of all filtered water. Individual turbidity monitoring equipment should be considered for each filtered water pipeline. The turbidity monitoring will allow the City to report individual filter bed performance. In addition, the turbidity monitoring will provide operations staff with data to bench mark each individual filter for

filtration performance. This will allow the operators to more effectively track and operate the filters to optimize their performance.

As discussed in previous sections the leakage of Filter #3 poses the potential for unfiltered water to enter the filter bed under the filter media. The unfiltered water could then enter the filtered water system without having undergone filtration. As discussed previously, the seepage test confirmed that the leakage is occurring below the level of the sand. This was confirmed by the fact that while the seepage test was being conducted the bed drained below the surface of the filter media. It is recommended that this bed be removed from service and that the bed be relined. The original lining material used in Filter #3 is gunite. The operations staff has reported that while the existing liner was being placed the quality of the project was in question leading one to believe that the gunite is likely cracked. The gunite material should be overlaid with a thick geotech fabric and rough protrusions removed to prevent it from damaging the new liner and the filter should be relined with a synthetic membrane such as High Density Polyethylene (HDPE) geo-membrane. This project addresses the health risk of unfiltered water entering the system.

6.1.3 Clearwell

The next process in the plants flow scheme that requires improvement is the 0.5 MG clearwell. During the course of this study the City performed a tracer study to determine the actual residence time of their existing clearwell. The tracer study indicated that the clearwell was experiencing severe short-circuiting. Due to this short-circuiting the clearwell did not provide the required residence time to meet the regulatory stipulated CT value for inactivation of biological contaminants.

Options were considered which included increasing the chlorine dose, paralleling the existing clearwell, and installing baffle curtains within the existing clearwell to improve the flow characteristics of the clearwell and thus increase the residence time. Because of the immediate need to bring things into compliance, it was recommended that the clearwell be modified to increase the residence time by installing baffle curtains. This project was completed in 2004.

Following the installation of the baffles, additional tracer tests were performed on the clearwell. The new tracer studies indicated that at the City's preferred chlorine dose the clearwell now meets the

required CT values under average flow conditions. However, at existing peak flow conditions, which occur during the summer months, the chlorine dose should be raised from 0.7 mg/L to 1.0 mg/L to ensure the required CT values are met.

With the newly installed baffling it is estimated that the clearwell will meet the City's CT requirements through the 2009 projected demand scenario under average day conditions. However, the chlorine dose will need to be increased to an estimated 1.5 mg/L during the summer months to meet the required CT value. As demands exceed 2009 projected summer demands, additional clearwell capacity will be required.

6.2 MAINTENANCE / REHABILITATION / UPGRADES

These improvements address deficiencies within the plant that will give the operations staff added operator flexibility to improve the efficiency of the plant. The assessment considers the existing plant condition against known maintenance issues and operation inefficiencies due to outdated or failing equipment.

6.2.1 Power Canal Raw Water Intake

The raw water (RW) intake structure was constructed in the channel of the power canal in 1971 with the construction of the original water treatment plant. Since this time the intake has undergone very few modifications and basically exists as it did in 1971. The operations staff have observed that over time due to the shape of the intake and its position in relation to the canal flow path that sediment and debris, particularly leaf debris, tends to accumulate in front of the intake structure slowly infilling the channel prior to the coarse bar screens. Several attempts have been made to redirect the flow to prevent this build-up from occurring but none have been successful.

Currently, the City maintains the intake by hand shoveling the debris from the intake and removing it in buckets. This process is extremely labor intensive and inefficient. Several options were considered by this study including reconstruction of the intake as well as annual maintenance schemes. After reviewing the potential cost factors and the impact to the canal and water plant it was determined that the best available alternative was to schedule the intake for cleaning. The best apparent cleaning method appears to be pumping. A contractor with specialized pumping equipment should be contacted to pump the material from in front of the screen as needed. The plant staff will monitor the intake to

determine the required frequency of this operation for future planning and budgeting purposes.

The pumping operation will consist of lowering a pump that is specifically designed to pump high solids slurries into the area before the coarse bar screen. The cleaning activity should be performed without crossing the canal bridge which cannot support heavy truck loads. The water and debris that are removed from the channel will be pumped to a filter bag and allowed to drain. Once the excess water has drained from the bag the silt and organic material will be hauled away and disposed of by the City. Arrangements were being made to complete the first such cleaning of the RW intake structure at the time this study was written. Plant staff will monitor the rate at which debris re-deposits in the intake and will develop a cleaning schedule accordingly.

Another dredging alternative would be to use a vacuum truck backed up close to the intake and suck debris into the truck. However, to do that would require that the canal bridge be beefed up to support the truck and its load. It is estimated that it would cost approximately $40,000 to provide additional beams and supports for the bridge.

As the cleaning is accomplished a determination of the benefit of the steel and wood structure that was added to the head of the intake will be evaluated. The purpose of this structure was to provide a silt stop and floatables skimmer in an attempt to redirect the debris and keep it from depositing in the intake channel. This apparatus has only been marginally successful and as the cleaning operations are undertaken the structure may prove difficult to work around.

A self cleaning screen could be used to remove leaves and small floating debris, however, the high cost of $50,000 - $75,000 for an automatic screen is not worth the minor labor effort to accomplish the same task. Also, the screen would not mitigate the sediment issue which is the most critical problem.

With the cleaning having been identified as the best option to deal with the debris build-up the existing skimmer structure may become obsolete. If it is deemed to be no longer useful it is recommended that the structure be removed to facilitate future cleaning operations. If however, it is decided that the structure still provides some benefit in preventing the sediment build-up it is recommended that the deteriorating wooden skimmer boards be

replaced with a non-degradable HDPE sheet skimmer board to prolong the longevity of the structure.

6.2.2 30-inch Raw Water Pipeline

All raw water flow is delivered to the head of the plant via the 30" RW pipeline. Currently the flow through this pipeline is not metered. Due to the recent agreement between the City and the Santiam Water Control District it has become essential that the City have the capability to measure and record flow through this pipeline to account for the amount of raw water that is delivered to the plant via the power canal.

Raw Water Pipeline

Several locations were reviewed for the placement of this meter. Ultimately a location directly in front of the RW diversion or weir box was selected. The recommended flow meter for this location is a magnetic type flow meter. The magnetic flowmeter is recommended because it is a more accurate flowmeter with less required maintenance. This installation should include by-pass capability to allow the City to remove the meter from service for maintenance without completely stopping the RW flow to the plant.

6.2.3 Raw Water Weir Box

The raw water (RW) weir box baffles the incoming RW flow and allows the flow to be evenly split between the various filter beds. The box contains two sets of wooden baffle walls to eliminate short-circuiting. The baffles are reported to be original to the plant and are in need of replacement. Several materials have been considered for the baffles replacement including aluminum and stainless steel elements. However for longevity concrete is the preferred building material.

6.2.4 Raw Water Filter Inlet Pipelines

The RW is conveyed to each of the three filters via 16-inch raw water pipelines. As discussed earlier the pipelines are reported to be in good condition. Each pipeline has its own RW inlet valve, which isolates the filter bed as well as controls the rate of flow of

the raw water onto the filter bed. These valves are currently manually operated each time the filter is taken off-line for cleaning and maintenance. When the filter is put back into service the valve is reopened and then adjusted to rebalance the inlet flow rate of raw water onto the filter bed. It is recommended that automatic electric actuated motors for the RW inlet valves be considered. Automatic actuation of these valves would the operations staff to efficiently isolate a filter bed as well as restart a filter bed without having to readjust the valve each time the bed is taken off-line and then restarted. These valves in combination with the recommended flow metering from the previous section will the operators the ability to balance the flow to each filter optimizing the filters performance.

6.2.5 Filter Beds

A number of improvements, upgrades, and maintenance needs should be addressed with the filter beds as folliows:

1. Currently, the filter beds are operated by manually manipulating the RW inlet valves and manually turning the filtered water pumps on. It is recommended that the filtered water pumps be SCADA controlled. This improvement will be discussed in greater detail under the SCADA improvements portion of this study.

2. In addition to adding remote control capabilities to the valving and pumping of the filters, level monitoring should be added to the filters and filtered water pumping wet wells to allow the operators to monitor the filter headloss throughout the filter run. Providing this information to the operations staff will help them better plan when to remove a filter from service for cleaning. This improvement is discussed in further detail in the SCADA improvements portion of this chapter.

3. Another filter improvement that should be considered is covering the filters. This is not a requirement of an existing water treatment plant however any new filter beds that are constructed will need to be covered per the “Recommended Standards for Water Works” also known as “Ten States Standards”. In addition to being a requirement for new filters the existing filters could benefit from the added security that covering the beds would afford. City staff has expressed concern with the uncovered filters due to their vulnerability to potential contamination. The existing filters are uncovered HDPE lined earthen ponds that are vulnerable to

contamination from waterfowl as well as other animals that may fall into the filters. In addition the filters are vulnerable to intentional contamination by humans.

Due to the size of the filters, covering the beds would be economically unfeasible ($9,889,000). In addition, the cover needs to be designed with enough headroom and ventilation to allow the operations staff to access the beds for cleaning. An alternative to covering the beds would be to adjust the perimeter fencing of the facility such that it would reduce the risk to contamination from something being thrown over the fence. Because it is likely cost prohibitive to cover the existing filter beds the best option would be extending the distance between the fence and the filter beds.

4. One additional option that should be considered is replacing the slow sand filtration process with a new conventional treatment facility. This would provide some additional benefits of treatment flexibility and would eliminate the need for the shallow wells due to turbidity concerns. A conventional process would however be more costly to operate and would require significantly more operator attention. It would also be very costly to construct at an average of $0.90 to $1.10 per gallon treated to construct the facility and an additional 40% for professional services, contractor overhead, and permitting. This would equate to a capital investment of approximately $9.04 million to provide a facility capable of meeting the City's current peak demand with an additional investment of $2.03 million to expand the plant to meet the 2025 peak demands.

   Keller Associates recommends that the City continue to operate the existing slow sand filters. When the 2025 capacity expansion is needed the City should consider expanding using a conventional treatment plant.

5. Slow sand filtration requires a significant amount of maintenance. Approximately once or twice per year the top 1.2 to 1-inch of sand media must be scrapped off and removed to prevent clogging. Approximately every 10-20 years, the entire media bed may need to be replaced as a result of deep contamination of the filter bed. Yearly maintenance for sand removal and replacement is estimated at $8,000 to $10,000. Complete media removal of sand for each filter (3) is estimated at approximately $150,000 every 10 to 20 years. The mechanized scraper mechanism also

requires replacement approximately every 20 years at a cost of approximately $50,000. Including engineering and contingencies, $650,000 should be budgeted.

6.2.6 Filtered Water Pumping

As previously discussed, it is recommended that the filtered water pumps have the capability to be monitored and controlled remotely. Additionally, it is recommended that the filter #3 pump be replaced with a pump that is appropriately sized to match the filtered water production of the filter bed. The existing pump is reported to pump more water than the filter can produce this allows the pump wetwell to pump dry. It also would allow the pump to dewater the filter bed causing air binding in the bed. This condition significantly reduces the filtration rate of the filter until the air dissolves back into solution.

Throttling the downstream filtered water valve to induce an artificial headloss is currently the method the operators employ to control the filter #3 pump. This practice causes undue wear on the valve as well as wasting energy. If the pump were sized to more closely meet the operating rate of the filter an energy savings would be realized. Keller Associates recommends that at the end of the pumps useful life it be replaced with a pump that is more closely matches the filters production rate.

6.2.7 Clearwell Maintenance

The existing clearwell is a 0.5 MG welded steel tank that was installed in the early 1970's. During the installation of the new baffles it was observed that the interior of the tank was in need of recoating. At the time this study was written a project had been commissioned by the City to repaint the tank. In addition to the costs of repainting there is an associated cost to purchase water from the City of Salem while the clearwell reservoir is out of service.

6.2.8 Finished Water Pump Station

As described in a previous chapter the finished water pump station is in relatively good condition. The following maintenance and operational improvement items have been identified for completion.

The Cla-Val pump control valves allow the vertical turbine pumps to start against a closed valve, which slowly opens to prevent a pressure surge from being released into the distribution system. The operations staff has indicated that these valves have not had any significant maintenance completed on them since they were

installed. In discussions with the operations staff the need to perform maintenance on the pump control valves has been identified. These valves contain a flexible valve seat that over time can become worn. Rehab kits for these valves are available from the manufacturer.

Pump Control Valves

Any outdated or malfunctioning monitoring instrumentation that is still installed on the finished water header should also be removed these item include the orifice plate and a differential pressure cell from the original flow meter. The existing turbine flow meter and any pilot line that are no longer being used. These maintenance items can be carried out by the operations staff at minimal cost therefore an estimate to make these improvements includes materials only.

6.2.9 Soda Ash Feed System

The soda ash feed system was installed as part of a corrosion control project in 1999. The feed system consists of a Wallace and Teirnan 32-055 volumetric feeder, day tank, and chemical metering pumps. The volumetric feeder has a 12-ton bulk storage hopper that feeds a screw conveyor. The screw conveyor feed system delivers the dry soda ash to the day tank at a rate that is preset by the operations staff. The day tank batches soda ash solution on an as needed basis. The level in the day tank starts the screw conveyor t feed the dry soda ash into the tank. Water is added and the mixer in the day tank thoroughly mixes the dry soda ash and water to make a solution. Two diaphragm style chemical metering pumps then dose the solution to a feed point ahead of the clearwell. The dosing rate is flow paced via the filtered water flow meter and a hydroranger PLC.

The bulk feed hopper protrudes through the roof of the soda ash building exposing the top of the hopper to the elements and particularly the rain that is characteristic of the Stayton area. The moist air and rain have caused bridging problems within the feed hopper. Currently the plant staff has covered the top of the feed hopper with a tarp to mitigate the rain intrusion into the hopper. After discussions with plant staff a permanent cover over the soda ash feed hopper has been identified. This cover should be well

ventilated and provide operator access to perform and maintenance or repairs that may need to be done of the volumetric feed system. A copula style louvered cover has been identified as the best alternative for permanently covering the bulk storage hopper.

In addition to the trouble experienced with the bulk chemical storage system, the configuration of the feed system may cause inconsistent chemical dosing. It is Keller Associates' understanding that the volumetric feed system is paced based on flow by varying the speed of the screw conveyor that feeds the dry chemical. This dry chemical dose is fed to a mixing tank with a constant volume of dilution water, which makes a varying strength solution that is then dosed to the process stream at a constant rate. This system does not allow the chemical to be dosed accurately under a flow pacing condition. The operation causes a lag in the amount of time between the increase in the chemical dose and the change in water chemistry. A more efficient and precise way of controlling the chemicals dose is to batch mix a consistent chemical concentration and vary the volume of the chemical dosed based on changes in flow rate. This allows the system to immediately respond to flow variations and would allow the City to make adjustments in the chemical dose based on pH monitoring as well.

If the operations staff continues to have trouble with the dry volumetric feeder conversion to liquid lime should be considered as an alternative to the dry feed system. The liquid system has the advantage of being lower maintenance and more reliable than the dry feed system.

The Soda Ash feed system uses two diaphragm pumps to deliver the liquid lime to the chemical dosing point. The plant staff has replaced one of the original Encore 700 pumps with a Milton-Roy LMI pump. The plant staff has had difficulty with the diaphragm pumps leaking around the pump head. If the problem persists the pumps can be replaced with a peristaltic style Watson-Marlow pump. The peristaltic pump uses feed tubing placing the chemical in a sealed environment and isolating the pump feed head from the chemical being fed.

6.2.10 Chlorine Feed System

Currently, the City operates a gas chlorine feed system utilizing 1-ton chlorine cylinders to accomplish their disinfection goals. The system was originally designed and constructed as part of the early 1970's construction of the water treatment facility. Since its original construction the feed facility has undergone modifications as more

accurate and reliable equipment has been used to replace outdated and failing feed equipment. The existing system is comprised of Wallace & Teirnan gaseous chlorine feed equipment. The chlorine gas and feed equipment are stored in the chlorination room adjacent to the operations and finished water pumping rooms.

Due to the inherent risk of storing, handling, and protecting large volumes of chlorine gas it is recommended the City consider replacing the existing chlorine gas feed system with an on-site sodium hypochlorite generation system. While the generation system will be slightly more costly to operate than a gaseous system when direct costs are considered, the indirect cost savings are what make liquid chlorine appealing. When comparing gaseous vs. on-site generation the hazardous materials training and maintenance costs for a hazardous materials response team are often overlooked. In addition, the indefinable cost associated with reduced risk to plant staff and the community is very difficult to define.

A new on-site generation feed facility could be installed in the currently unfinished portion of the soda ash building. It is estimated that the unit would need to be capable of producing 103 pounds of free chlorine per day to meet the plants needs through the 2009 peak day at a dose of 1.5 ppm until clearwell capacity is expanded as discussed in Section 6.1.3. After clearwell capacity is expanded, the system would be sufficient to provide a dose of 1.1 ppm through buildout. Hypochlorite generation facilities are typically sized to operate approximately 2/3 of the time at peak use, which results in a nominal module size of 150 lbs/day. This would consolidate the City's chemical feed facilities in one building separate from the main operations and pumping building. This affords the benefit of reducing the potential risk of exposure of the sensitive electronics equipment that is housed in the operations room and finished water pumps stations to corrosive chemicals. In the interim, it is recommended that the City inspect the existing chlorination room and ensure that all potential penetrations through to the operations area and finished water pump station have air tight seals. This includes often overlooked electrical conduits. If chlorine gas is released within the existing chlorine room and the gas escapes into the control or finished water pumping rooms it could pose a health risk to an unsuspecting operator. In addition, the chlorine would likely have a severe negative impact on the electrical equipment in these spaces. Chlorine gas tends to attack and rapidly corrode copper and other electrical connections. A severe release could render the finished water pumps as well as any electrical controls inoperable until they were replaced.

In conjunction with verifying the air-tight seal between the chlorine room and operations and finished water pumping rooms, two additional intermediate improvements should be considered. The first is the installation of an air-tight window between the control room and the chlorine room. This window should be located to give operations staff a clear line of sight to the chlorination valves on the chlorine cylinders. This will provide operators the ability to visually inspect the cylinders before entering the room. Along with the window a switch should be installed that allows the operations staff to turn the lights on within the chlorine room to make visual inspections prior to entering the room. The second intermediate safety improvement is the installation of a chlorine leak detection system.

At the present the only means of detecting a leak within the chlorine room is through visual inspection. This places an unsuspecting operator at risk to chlorine gas exposure if the operator is not attentive before entering the chlorine room. It is standard practice to provide chlorine leak detection systems within gaseous chlorine feed facilities. The leak detection system consists of a chlorine detection probe. The probe sends a signal to a control box that is typically located outside the chlorine room. If chlorine is detected a signal is sent to the control box and the chlorine level is displayed. If the chlorine level within the room exceeds a predetermined set-point the control portion of the detection system has the ability to send an alarm signal. The recommended alarm signals should include a visual light mounted on the exterior of the control building and a signal generation that contacts the appropriate response personnel; this typically consists of the plant operations staff or police department.

6.2.11 Miscellaneous Plant Improvements

The plant improvements and upgrades presented within this section are to systems that are independent of a particular process within the plant. This should not preclude them from serious consideration nor is it meant to identify them as any less critical as the improvements presented within this section prior to this point.

Currently, the plant staff store and maintain several pieces of the plant equipment in an open shed. This structure serves the purpose of keeping the weather off of the filter bed cleaning equipment but makes servicing the equipment difficult particularly during the winter months. It also does not afford storage for spare parts that the operations staff keeps on hand for the water plant. The lack of a

central spare parts storage has caused operations staff to have to store system parts at various points around the Plant rather than in one central inventory. Finally, the existing storage shed and storage building at the plant lie within the alignment of the City of Salem's new transmission pipeline. The structures are scheduled for demolition to allow the new Salem finished water pipeline to be constructed in the near future.

It is recommended that a new maintenance shop facility be constructed to replace the facilities being demolished by the Salem pipeline project. Figure 6.4 shows a proposed location for the facility. The shop should contain three to four unheated storage bays that are enclosed with garage doors. These bays will house the plant's filter bed cleaning equipment and plant vehicles. One additional heated bay should be provided independent of the storage bays; this area should be configured and sized to allow plant maintenance personnel to work on plant equipment as needed. In addition to the equipment bays, the new maintenance facility should contain a spare parts storage area to store the necessary service parts required to maintain and operate the water treatment facility. The proposed maintenance shop is estimated at approximately 2,300 square feet.

Currently the perimeter of the plant is fenced on the west with 8-ft chain link fencing to provide security of the plant site. The north side of the plant is bounded by the Power Canal and the south and east sides do not have fencing. On the west perimeter of the plant the fencing has been constructed relatively close to the facilities. It is recommended that the fence be relocated on the west side of the plant to provide increased security and protection of the plant site from the adjacent roadway. It is also recommended to fence the south and east sides of the plant. Figure 6.4 illustrates proposed fencing modifications. One major area of concern is the fences close proximity to the filter beds. As discussed in previous sections the current standard for slow sand filter bed construction is to cover the beds, making them less vulnerable to contamination due to vandals, waterfowl, etc. The figure also indicates relocation of the entrance to the plant. This entrance has been proposed to accommodate the new maintenance facility. The new entrance should include new security measure to control access to the plant. An electronic identification card system would allow the City to restrict access to authorized personnel only and would give the added benefit of being able to log and track who enters the plant site with date and time data.

Site lighting should also be improved. Additional security lighting should be added throughout the plant to allow law enforcement and City personnel to easily make a visual inspection of the plant for suspicious activities.

Finally, as recommended in the Vulnerability Assessment, a closed circuit television (CCTV) system should be installed to monitor the plant site. The following list of recommendations was made for camera placement.

1. Exterior of Operations Building
2. Front Gate
3. Exterior of Soda Ash Building
4. Exterior of new Shop Building

The interiors of the buildings should be monitored with sensors on the doors and windows that report back to a main security panel located in the main operations building. The security panel should be tied to the plant SCADA and should trigger an alarm if the plant is disturbed. Window and door contact sensors are recommended rather than motion or heat sensors due to the nature of the equipment within most of the buildings. The equipment within the buildings may start automatically and produces heat making the motion and heat sensors impractical.

6.2.12 Plant Instrumentation and SCADA System

This section has been presented in three sections, these sections are consistent with those identified in Chapter 4 of this study. Some of the improvements identified in this section have been identified in preceding sections of this Chapter. They are discussed in detail in the following section. The three main function categories of instrumentation, operation control systems and records keeping are the basis of the recommendations for the Plant control system improvements. The City should consider these improvements with some of the preceding improvements as specific processes are upgraded; however the basic infrastructure of PLC's and computers should be installed first to allow the process improvements to function at their peak efficiency. By approaching these improvements in this manner the City can select improvements that match the available funds over a period of time to complete the improvements.

The current Plant condition doesn't have a specific area where significant deficiencies exist. Most of the equipment where improvements are needed is due to the age and functional

obsolescence of the existing control systems. Many systems have been taken out of service due to these obsolete conditions or have been modified to work under a temporary condition. These temporary conditions have become permanent in many cases.

The main improvements are installation of in plant instrumentation, conversion to a computerized plant control system, and installation of automated plant operating equipment. In addition, records keeping has been considered, this is an important part of the treatment process and should be improved as part of the control system upgrade. Improvements in record keeping will occur when the computerized Plant control system is installed. Additional records keeping improvements will be made when the remote sampling system is implemented.

Installation of Instrumentation:

Finished Water Flow Meter. Currently there is a water meter installed in the discharge pipe carrying finished water from the plant to the distribution system. The meter is installed in a location that makes the meter inaccurate. The existing meter location should be abandon and a new meter installed. This meter is proposed for the finished water line as the water flows to the distribution system. The finished water meter should be installed on the 24-in finished water pipeline at a point outside the finished water pump room with a remote monitor. The remote monitor should be mounted in the plant control room where it is easily read by operators. Indication of plant flow and totalization of flow are necessary to provide the plant staff with the necessary historical data to track water production trends.

Raw Water Flow Meter. The plant does not currently measure the raw water flow rate. Raw water from the Power Canal and the wells is fed through the raw water pipeline to the raw water weir box. Under most conditions the plant uses water from the Power Canal. In light of the current agreement the City has with the Water Control District it is imperative that the raw water be measured accurately. A water meter should be installed on the raw water pipeline near the raw water weir box.

Filtered Water and Finished Water pH Meters. The plant operations staff currently samples the finished water manually to determine the pH of the finished water. The addition of Soda Ash is used to control the pH of the finished

water. A pH meter should be installed on the finished water line so the pH of the finished water will be continuously monitored. A pH meter should also be installed at the Clear Well to monitor the pH of the filtered water directly after chemical addition. When the computerized control system is added to the plant, the pH of the finished water will be continuously recorded for record keeping. The pH meter at the Clear Well will be used as part the Soda Ash feed system to allow the rate of Soda Ash to be controlled accurately.

Filter Level Transducers. The plant operation doesn't currently have a good way to control the wasting of surplus water over the filter overflow. To control this condition when the computerized control system is installed, submersible level transducers should be installed in each filter basin to detect the level of the water in the filter. The filter level transducers will also be used in conjunction with a filter pump level transducer to calculate the head loss through the filter. This will allow the plant operators to maximize the production of the filter beds.

Filtered Water Pump Level Transducers. Each filter has a filtered water pump that is set in a sump connected to the filter underdrain piping. As filtered water is pumped from the filtered water sump, there is a headloss created across the filter media bed. This headloss provides valuable information to the plant operators in determining the amount of sediment accumulation that has occurred in the filter bed. A level transducer should be installed in each filtered water pump sump so the headloss through the filter can be monitored by the plant control system.

Filtered Water Pump Pressure Transducers. A pressure transducer should be installed on the filtered water pump discharge line so as to monitor discharge system pressure.

Filtered Water Turbidity Meters. Currently turbidity is monitored by on-line turbidity meters at the plant raw water weir box and at the plant finished water discharge. There is no measurement of turbidity in the process stream within the plant. The installation of turbidity meters at each filtered water pump will provide valuable operations data on the filtered water turbidity from each filter. This monitoring will provide valuable information for the operation of the filters and for scheduling filter cleaning and maintenance. In

addition, it is now preferred that the filtered water quality of each filter be monitored and reported for regulatory compliance.

Plant Operation Control System. The control system will replace the entire control panel within the control room at the treatment Plant. All functions currently being managed and completed by the existing programmable controller and other panel functions will be converted to a computerized system. The computer will receive data from all in plant sensors and instruments and perform record keeping functions on the Plant's operation.

Outdated Monitoring

Signals from existing instrumentation as well as new instrumentation will be connected to the computer system so the instruments and the computer work as a coordinated system. The computer will have the capability of allowing operations staff to set various plant operating parameters and print plant operation records for numerous selected data sets. All plant control operations will have the capability of being performed through the plant control system computer.

Any number of special plant control functions can be programmed into the plant operation computer to perform plant operation functions. As an example, starting one of the filtered water pumps after cleaning the filter can be initiated automatically. A second example would be flow-paced control of the chlorination system. Currently, when the filtered water pumps are running the chorine feed system injects chlorine into the system at a pre-determined rate. At certain times the filtered water pumps need to run without chlorine injection. This occurs when the newly cleaned filter is being re-started and the filtered water pumps are pumping to waste. This condition can be programmed to occur without chlorination preventing wasting of chlorine by preventing chlorine addition during the filter to waste cycle.

When the remote reservoir and booster station site control systems are complete as recommended in the Distribution system master plan including their proposed control upgrades, operation staff will have access to all reservoir and booster pump operation data at the computer located at the water treatment plant.

Installation of In-Plant Automation Equipment. Automated equipment utilizes the plant control system to form a complete in plant control and automated operation system. Many plant operating functions that are currently manual will be controlled by the computerized control system. This system will reduce manpower requirements for plant operation and provide very efficient operation of the plant. The increased efficiency is due to the systems ability to continuously monitor the plant operating parameters and automatically makes process adjustments regardless of plant staffing levels day or night.

The existing programmable controller controls a few of the plants existing functions automatically. These are start and stop operations the filtered water pumps and the finished water pumps. These pump operation sequences will be converted to the new computerized system. In addition to the pumps, the following in plant operation system will be included in the automated control system.

Raw Water Intake. This system will control the raw water intake to the plant. This control system will limit the flow of water to the filter basins reducing the amount of excess water that is wasted through the overflow of the filter basins. Additionally, by monitoring the raw water turbidity against predetermined maximum turbidity set-points the use of high turbidity water will be reduced by automatically switching the source water to the wells during times when the turbidity in the river is high. By adding this type of automated control to the raw water intake the amount of sediment deposited on the filter bed unnecessarily will be reduced. This has the advantage of increasing filter run times. This control will be accomplished by allowing automatic control of the raw water intake valve.

To automatically control the flow of water to the plant an electric motor operator will need to be added to the plant intake control valve. This valve is a butterfly valve that is situated in the raw water intake pipe to the plant. The existing turbidity meter on the raw water line will also be used in the control of the raw water intake.

Chlorination Control. Currently chlorine is added to the process stream in two locations. The first location is the raw water intake to control growth of algae in the filter basins. The second location is in the filtered water pipeline immediately before the clearwell. The existing system does

not utilize automation to adjust and control the chlorine dose rates at these two locations. The residual chlorine analyzer measures the residual chlorine in the finished water. This information will be used along with filtered water flowmeter information to allow the plant control computer to automatically control the feed rate of chlorine to maintain the correct chlorine residual. The automatic chlorine feed system will have the advantages of adjusting the chemical feed rate without requiring the operator to set the feed rate of chlorine system. This will ultimately help prevent under and overdosing of chlorine optimizing the use of the chemical.

Soda Ash Control. The soda ash feed system feeds a soda ash solution into the filtered water pipeline prior to the clear well. The flow meter at the clear well controls the feed rate of the dry soda ash into the soda ash solution tank. The chemical feed pumps do not flow pace with the changes in the filtered water flow rate. By feeding the chemical in this manner any variation in solution strength can cause the soda ash addition to change. The pH monitor proposed for the clear well will be used for the plant control computer to adjust the soda ash feed to better control the addition of soda ash. It is also recommended that the chemical metering pumps be flow paced by the filtered water flowmeter. The soda ash control system will use a combination of solution strength and solution feed rate to accurately control pH adjustment. The addition of chlorine also affects the pH of the finished water. The plant control computer will use the pH and the chlorine residual of the finished water to adjust the soda ash feed to control the pH with minimum usage of soda ash.

6.2.13 Plant Electrical System

The City has preformed maintenance tests on the individual motor control modules. The maintenance tests included infrared testing to locate areas where wire, connections, or other electrical components have developed deterioration or loose connections that can lead to overheating and eventual failure of the component. The maintenance testing in the past has not located any areas where such deterioration has occurred.

The main incoming service disconnect has a 1,600 amp circuit breaker installed in the plant service disconnect. The disconnect and breaker are about forty years old and service parts are not

available for the disconnect. A failure of the incoming service disconnect would completely shut down power to the plant and would require considerable time to make arrangements to temporarily by-pass power until the entire service disconnect is replaced.

It is recommended that the incoming service disconnect and breaker be replaced with a new device with installation and automatic transfer switch at the same time as the new service disconnect and breaker. The automatic transfer switch is part of the standby power system also being recommended in a later section of this chapter. The standby power system will consist of a standby generator. The transfer switch is required as part of the standby power system to allow the switch over from utility power to standby power. Installation of the new service disconnect and transfer switch will require a temporary shut down of power to the plant while the service equipment is being changed. The current location of the incoming service disconnect is not suitable for the new equipment since the clearance in front of the existing disconnect is not likely to meet current code requirements.

The proposed location for the new service disconnect and transfer switch is on the north wall of the control building pump room. The north wall is currently covered with a massive control panel for the plant. The control panel is an antiquated system that is planned for replacement as described in the preceding SCADA section of this chapter. The new SCADA system will be computer based and will require very little space which will free up the north wall of the pump room when the old control panel is removed.

The installation procedure for the new service disconnect and transfer switch should include provisions to install the majority of the electrical equipment in the pump room before the power is shut off to the plant. In the final phase of installation, a scheduled shut down of the power will allow a reasonable time for the electrical contractor to pull the main feeder conductors from the service transformer to the new service disconnect and to the main bus in the motor control center. After the power changeover is complete the existing service disconnect and breaker would be bypassed and removed without interfering with plant operation. The existing individual motor control center modules will continue to be used into the future. There is no indication at this time that the entire motor control center should be replaced. The motor starter system used for the motors in the motor control center is a relatively simple system and they could be replaced on an individual basis in the

future without affecting the other facilities within the plant other than the one being replaced.

Installing the new service disconnect and transfer switch will provide the plant with higher reliability than currently exists. The addition of an automatic transfer switch and the addition of the standby generator will add a new level of redundancy in the treatment plant and the capability to continue to treat and supply water during emergency conditions that has not been available in the plant in the past.

6.3 SYSTEM RELIABILITY

These improvements address deficiencies in critical system redundancy within the plant. The recommended improvements are designed to provide, in most cases, emergency redundancy that does not currently exist.

6.3.1 New Raw Water Intake Facility

As discussed in Chapter 4 of this study, raw water is currently delivered to the plant through an agreement with the Santiam Water Control District. The water is delivered via a river intake structure and the Power Canal. This agreement has proven successful since the plants construction over 30-years ago. In October of 2003 the City renegotiated the agreement with the District. Through this negotiation process it was determined that the City is solely tied to the District for their water production.

As part of this study several raw water supply options were considered in an independent study document, Stayton Water Treatment Plant Supply Alternatives. One of the options identified as a supply alternative is construction of a river diversion for the City of Stayton that is independent of the Water Control District.

An independent raw water diversion system provides the City with the ability to control its own raw water system. The independent diversion would not be subject to District maintenance and improvement shutdowns. The independent diversion also has the benefit of not being financially tied to the Water Control District. Currently the City operates under a negotiated agreement that is subject to renegotiation at the District's request. This takes the cost for raw water delivery out of the City's hands.

In addition, the existing raw water intake is easily accessed and subject to vandalism and vulnerable to contamination, which is in

conflict with the nation's efforts to provide improved security for municipal water supplies.

The new diversion has been preliminarily located by this study in an undeveloped area to improve security as shown on Figure 6.2 and to allow gravity flow to the WTP. This will require crossing the Power canal. The location of the intake where shown on Figure 6.2 will improve security and allow gravity flow, but is still within the jurisdiction of the Santiam Control District. The estimated cost of water supply facilities at the location shown is $2,250,000. To locate the intake above the Santiam Control District jurisdiction, would require another 3,000 feet of pipeline and a second canal crossing and would have an estimated cost of $2,850,000.

At one time it was thought that once the new Salem finished water pipeline was completed the existing finished water pipeline that passes through treatment plant's site may be abandoned and that the City could possibly negotiate ownership of this pipeline and associated easement for potential future use. The pipeline could be used as a raw water source or as a carrier pipe (i.e. especially for a river crossing). This would significantly reduce the cost of constructing a new raw water pipeline by eliminating a difficult river crossing. However, at this time it is our understanding the City of Salem plans to retain ownership of the existing easement and pipeline. Thus, a new easement and pipeline route will be required.

The new intake facility would consist of an intake structure, fish screen, debris screen, valving, and a raw water pipeline to the plant. One advantage of a new diversion is that control and operation of Stayton's raw water supply rests solely within the City's control. Other advantages of a new intake include security (current intake is within 100 feet of a residence), and the City would not be obligated to pay the annual fee to the District.

At this time it is less expensive to pay the annual fee to the District than to pay the annual loan payment that would be required to fund a new intake and delivery pipelines. However, simply having an easement and option for a future gravity fed intake provides the City with negotiating power in establishing future rates with the District.

6.3.2 Shallow Well Field

The City relies heavily on the River for its raw water supply, however due to the type of treatment that the plant uses to treat its raw water high turbidities cannot be treated. During periods of high

turbidity the City utilizes shallow ground water as its raw water source. The shallow ground water is supplied by two shallow wells that have been discussed in previous chapters. As discussed in the previous chapters the wells need to be replaced for numerous reasons.

In addition to protecting the City from the high turbidity events, the wells also provide a certain amount of protection from potential contamination of the river. It is recommended that a new shallow well field be constructed as described in the Plant Supply Alternatives document. This well field would consist of a series of shallow wells, 30-35 feet deep that would be outfitted with submersible pumps and pitless adapters. It is anticipated that approximately 4 wells would need to be constructed as a first phase to replace the loss of the existing shallow wells. Figure 6.4 shows a preliminary layout of the proposed shallow well field. The phase one wells would provide the City with a reliable raw water supply to be utilized during infrequent times when the river may be unusable. The well field would be configured in such a manner to make it expandable to meet future heeds as the City grows. This will allow additional well capacity to be added in phases as required by demands. One important consideration for the first phase of construction is sizing of the main well field collection pipeline. This pipeline should be constructed to convey a flow of 12.45 MGD of raw water. This corresponds with peak day demand at the build-out condition as determined through this master planning effort.

A second alternative to shallow well fields for treatment of seasonal high turbidity river water is to provide pretreatment consisting of flocculation and sedimentation. Comparing the cost of pretreatment, approximately $6.0 million versus shallow wells at $716,000, pretreatment is not an economically viable alternative.

6.3.3 Deep Well

Currently the City draws all of its water from the Santiam River through two systems, the Power canal or shallow wells. As discussed in a previous chapter although highly unlikely the potential exists for a major spill to contaminate the river and render it untreatable. If this occurs the City of Stayton may be vulnerable to loosing its entire water supply.

To mitigate the possibility of a contamination event affecting Stayton's ability to provide potable water, a deep aquifer well has been proposed. This well would provide the City with an emergency source of water that is unrelated to the Santiam River and the

shallow aquifers adjacent to the river. Currently Stayton maintains an inter-tie with Salem for providing treated water in emergency situations. This water is supplied from the finished water pipeline from Salem's Garren Island Facility. This inter-tie supply is also susceptible to a contamination event because the river supply's water to Salem's facility as well.

The deep well should be constructed to provide emergency water assuming that irrigation and other non-essential water uses are stopped. This will allow the well to be sized at less than the City's average day demand.

Discussion with the Oregon Department of Water Resources indicates that the City cannot transfer surface water rights for a groundwater right, and would need to apply for a new groundwater right even for an emergency well. In addition, the City of Stayton falls within a groundwater limited area as imposed by the Department of Water Resources. It may be difficult to obtain a water right for a deep well near the treatment plant site. However, the area south of the river is not groundwater limited, so a deep well could be drilled there as shown on Figure 6.2. Unfortunately, a review of well logs for wells drilled south of the river provides limited data. There are many shallow wells drilled, but no deep wells. Prior to drilling a well, a hydrologic study of the deep aquifer is necessary. It is recommended that a small exploratory well be drilled and tested for specific capacity and yield prior to drilling a full production well. In addition, a transmission line would be required crossing the river to the City's WTP site.

An alternative to drilling a deep well would be to purchase an existing well along with its water rights as shown on Figure 6.2. The high school has a deep well with significant production. The City could enter into negotiation with the school for that well for use in event of an emergency.

A future inter-tie with the City of Sublimity could also be considered as an alternative source of additional emergency supply. The City of Sublimity is currently served by deep wells.

6.3.4 Emergency Power Source

The plant receives its power from a single Pacific Power and light service. Currently, if this service losses power for any reason the plant does not have the ability to produce and convey water to the system. Several potential scenarios exist that could render the plant without power for extended periods of time. In order to protect the

plant and City from the vulnerability of a long-term power outage an emergency power generator is recommended. As discussed in the electrical upgrades section previously in this chapter the emergency generator would be connected to the plants power supply through an automatic transfer switch. This switch in conjunction with the plant SCADA system will allow the generator to be automatically started in the event of a loss of power without operator intervention. The generator should be located in the general vicinity of the plants main service connection and transfer switch without being placed over the top of underground piping that may need to be accessed. Figure 6.4 shows a proposed location for this equipment.

It is anticipated the following equipment would be put on emergency power:

- Two 200 Hp finished water pumps.
- The equivalent of 400 Hp of shallow well field pumps. Note that these pumps would not operate simultaneously with the filtered water pumps. They could be used to fill the filter beds and then emergency power switched to the finished water pumps for delivery to the system.
- The hypochlorite generation system and metering pumps.
- The soda ash system and metering pumps.
- The SCADA monitoring and control facilities.

The above equipment will require approximately a 600 KW engine generator.

6.4 CAPACITY EXPANSION

The improvements presented in this section are to accommodate the continued growth of Stayton. This section considers necessary improvements to expand the production capacity of the plant as demands increase. The demand scenarios that are considered follow those developed in the Distribution System Master Plan as presented in Chapter 1 of this study.

The order of recommended improvements are presented in the same order as the flow path of water through the plant. The improvements are ranked in order of importance in the following Capital Improvements Summary Chapter.

6.4.1 Shallow Well Field

As presented in section 6.3.2 and shown on Figure 6.4, the shallow well field should initially be designed and constructed to accommodate future expansion due to increases in future demands. The expansion of the well field will be modular in nature with wells being constructed and connected to the system as needed. Prior to construction of each well a hydrogeologist should be consulted to interpret the drawdown data from the existing wells to prevent a new well from interfering with the operation of the rest of the well field. Once a site has been selected and the new well has been constructed and test pumped a well pump and the interconnecting piping to connect the new well to the main raw water transmission pipeline should be designed and constructed.

6.4.2 Treatment Capacity

The City has a rated treatment capacity with two filters in operation of 8.7 to 8.9 MGD depending on which set of filter beds is in operation. This capacity will meet the City's demands through the projected 2018 peak day. At some point between 2018 and the projected build-out scenario the City will have to expand its treatment capacity. Currently the City relies on slow sand filtration for its water treatment.

Slow sand filtration is a straightforward approach to water treatment that is easy and inexpensive to operate compared to more conventional treatment approaches. Slow sand filtration does have some significant drawbacks however. Slow sand filtration is incapable of treating water that contains high turbidity. The recommended limit for turbidity is 10 NTU. Above this limit the slow sand filters plug too quickly making them inefficient due to the frequency of cleaning.

Employing an operational approach to reduce the turbidity of the water being delivered to the filters can mitigate problems created by high turbidity. Several options exist to reduce turbidity prior to filtration. These are also standard steps in conventional treatment. These options include pretreatment (flocculation, sedimentation) or supply of a raw water that is not susceptible to increases in turbidity. A potential location for pretreatment facilities is shown on

Figure 6.1. Currently Stayton is implementing the latter through shallow wells.

The second major drawback to slow sand filtration is the space required to construct additional filter capacity. At a filter-loading rate of 145 gpd/ft^2 the filter bed would need to be 32,600 ft^2 or approximately the same size as one of the existing beds to achieve the build-out capacity.

Compounding the beds size is a requirement for all slow sand filter beds to be covered to protect them from potential contamination. The existing filter beds are not covered however a variance would have to be sought from the Oregon Department of Health to eliminate the cover on a new filter. Even considering the potential problems with additional slow sand filtration capacity the Santiam River provides a unique source that is conducive to this treatment approach and the process is appealing due to its low operating costs and relative ease of operation. Addition of a fourth 4.8 MGD filter without cover is estimated at a project cost of $750,000 and with a cover $4,167,000. A potential location for a fourth filter bed is shown on Figure 6.4.

If it is determined that a new filter and/or the existing filters also need to be covered or if space is not available to construct the additional filter capacity a conventional treatment approach could be considered. Conventional treatment employs a series of processes including a high rate filtration process to treat the water. The conventional process differs from the slow sand process in its loading rates (i.e. size) and its required operator attention. Where a slow sand filter bed operates with very little operator attention being required a higher rate conventional process may require almost continuous monitoring by the operations staff depending on the process selected. Plant staff may need to be onsite 16 hours per day and be reachable by dialer the other 8 hours.

One potential process for consideration may be membrane filtration. Membrane filtration has proven to be a viable alternative for high quality waters such as the Santiam River. Additionally, membrane technologies are continually to evolve, resulting in less expensive and more reliable membranes. By the time that the City needs to expand their water treatment plant capacity, it is possible that membrane filtration will be a viable alternative to a more conventional treatment plant expansion. If membrane filtration is added, it should be pilot tested. It will also require pretreatment consisting of flocculation and sedimentation if higher turbidity water

during the spring is treated. Or, the membrane plant could go offline and shallow wells used similar to the current operation.

In addition to membrane filtration, several other conventional processes should be considered including adsorption clarification and high-rate sedimentation in conjunction with rapid gravity filters. The estimated project cost for a 4.8 MGD conventional package plant (comparable to adding one filter) utilizing adsorption clarifiers and rapid gravity filters is $2,029,000. A location for a 4.8 MGD expansion is shown on Figure 6.3. The mechanical plant would require considerably less space than a fourth filter.

The final benefit that conventional treatment offers over slow sand filtration is its flexibility to meet changing regulatory requirements. Due to the chemical addition conventional treatment takes advantage of both chemical and physical processes to provide treatment of the water. In contrast slow sand filtration relies on a physical biological process that is more difficult to adjust to target specific contaminants. This flexibility allows conventional treatment to be adapted more easily to new or additional treatment requirements. Should DEQ not allow an additional filter to be constructed without covering of all filters, it may be necessary to build a complete new conventional plant at a cost of approximately $12,000,000 for a capacity of 12.45 MGD.

At this time, Keller Associates recommends that the City continue with its slow sand filters and reserve land or space to retain this as an option for a future expansion as shown on Figure 6.4. As the City's demands exceed 2018 projected demands and approach build-out, Keller Associates recommends that the City give consideration to the benefits and draw backs of each treatment alternative approach. By the time that an expansion will be needed, it is likely that there will be significant changes in regulatory requirements and treatment technologies.

6.4.3 Clearwell Capacity

As discussed in previous sections of this chapter the City has installed baffling within the existing 0.5 MG clearwell. The installation of this baffling mitigated the short-circuiting that was occurring and increased the residence time within the clearwell significantly. It is anticipated that with an increased chlorine dose during the summer months the clearwell will be adequate until the projected 2009 demands are reached. At this time the City will need to consider adding additional clearwell capacity.

Two options were considered to expand the clearwell capacity at the plant both require construction of additional storage at the plant. The first option is construction of a new steel reservoir. The required baffled capacity would has been estimated at 1.0 MG which would likely allow the City to reduce their chlorine dose during the summer months back to 0.7 mg/L. the new reservoir should be constructed adjacent to the existing clearwell to reduce the amount of modifications required to the plants piping and pumping systems.

The second option that was identified is moving the existing Schedule "M" reservoir to the plant site and utilizing its capacity for clearwell storage. After further consideration it appears that relocating the existing reservoir is a lower cost alternative than construction of a new reservoir. The distribution system master plan has reviewed the impact of removing the Schedule "M" reservoir from service as a finished water storage reservoir and ahs determined that it will not significantly impact the City's distribution and storage system. A location for the relocated Schedule "M" reservoir is shown on Figure 6.4.

Relocating the Schedule "M" reservoir would require disassembling the reservoir and transporting the pieces to the treatment plant site for reassembly. Once the reservoir has been reassembled at the plant a new high performance coating should be applied. A baffle curtain assembly should also be added to prevent the same short-circuiting that was experienced in the 0.5 MG reservoir and allow the treatment staff to optimize the chlorine feed to reach the required CT value.

6.4.4 Finished Water Pumping

The firm pumping capacity of the finished water pumping station was presented in Chapter 4 to be 8,000 gpm. This capacity assumes all three of the finished water pumps are in operation representing the gross pumping capacity of the finished water pump station. In retrospect the City's net rated pumping capacity is 4,850 gpm. The net rated capacity considers the pump stations pumping capability with the largest unit out of service, which is the worst-case operating condition.

When the pump station was originally designed and constructed space for a future pump was included, see Figure 4.4. Currently the pump station is comprised of 2-200 hp and 1-100 hp pumps with space for a future fourth pump. Based on the growth scenarios

presented in Table 1.1 the demands will exceed the net pumping capacity of the existing pump station by the year 2008.

It is recommended that additional pumping capacity be installed when the demands on the system reach the level that is predicted under the 2008 growth scenario, 4,850 gpm.

It is expected that the existing inefficient 100 Hp pump will be replaced in 2005 with a similar sized pump.

The recommended approach is to install a new 3,000 gpm (200 Hp) VFD controlled pump when the 2008 peak demand is reached. This replacement will provide a firm net pumping capacity that will meet the City's needs to beyond the projected 2025 peak demand but will not meet the anticipated demands projected for build-out. At a point between the 2025 and the build-out projection the City will need to replace the 1,750 gpm pump with a larger 3,000 gpm pump. Through all of these pumping capacity increases it is estimated that the 30-inch suction header and 24-inch discharge header will be adequately sized to support the increased pumping capacity.

CHAPTER 7.0 – CAPITAL IMPROVEMENTS SUMMARY

Chapter 6 describes the recommended improvements to provide a facility with adequate capacity that produces water that meets or exceeds federal regulations and that is properly operated and maintained. This Chapter provides a summary of the identified capital improvements with associated costs. It is organized to present Keller Associates' recommended approach to the improvements. This approach is phased to allow the City to plan for the improvements over time.

The concepts established in Chapter 6 were ranked according to their benefit and need. In some cases, lower priority improvements are recommended for completion in conjunction with critical improvements to take advantage of a system shutdown or on-site construction capabilities. The improvement phases have been identified as 1A, 1B, 2, or 3. These phases represent the critical nature of the improvements and have been defined as follows.

- 1A = Needed Immediately
- 1B = Recommended Immediately, but can be delayed 2-4 Years depending on availability of funds
- 2 = Medium Priority
- 3 = Low Priority

The estimated costs of the improvements that are presented in this chapter are planning level project estimates. They include an opinion of probable construction cost as well as professional services costs and contingency. The construction estimates are based on general improvement concepts rather than detailed engineering design.

7.1 REGULATORY COMPLIANCE

As described in previous chapters these improvements address deficiencies related to regulatory compliance or finished water quality. The improvements are generally considered Phase 1A or 1B as ranked in the summary table at the end of this chapter.

- Power Canal Raw Water Intake Additional Fencing
- Individual Filter Raw Water Flow Meters
- Individual Filtered Water Turbidity Monitoring
- Replace Filter #3 Gunite Liner
- 0.5 MG Clearwell Baffling

7.2 MAINTENANCE / REHABILITATION / UPGRADES

These improvements generally address the replacement of old, inoperable, or obsolete equipment. In general the improvements will increase the operation efficiency of the plant while reducing the amount of manual labor required. The improvements are generally considered Phase 1B, 2, or 3 as ranked in the summary table at the end of this chapter.

- Sediment Removal From Power Canal Diversion
- Removal of Skimmer Structure or Skimmer Board Replacement
- Raw Water Weir Box Baffle Replacement
- Perform Service of Raw Water Filter Inlet Valves (Filter 1 is Leaking)
- Actuate Raw Water Filter Inlet Valves
- Remote Start, Stop Control of Filtered Water Pumps
- Cover Filters or Increase Buffer Zones Around Filters
- Replace Existing Treatment with Conventional Treatment
- Repaint 0.5 MG Clearwell
- Perform Maintenance on Finished Water Cla-Val Pump Control Valves
- Remove Outdate Monitoring Equipment from Service
    - Old Finished Water Flow Metering Equipment
- Cover Soda Ash Feed Hopper
- Modify Soda Ash Dosing Scheme
- Replace Gas Chlorine System with On-Site Hypochlorite Generation
- Intermediate Gas Chlorine Improvements
    - Seal exiting chlorine room to an air-tight seal
    - Install window that provides a clear view of chlorine cylinders
    - Install chlorine leak detection system
- New Plant Maintenance Shop
- Relocate Plant Entrance and Add Card Reader Entrance Control
- Complete Plant Security Fencing

- Plant Security Lighting
- CCTV Monitoring
- Building Security Systems
- Plant Instrumentation
    - Raw Water Flow Meter
    - Finished Water Flow Meter
    - Raw and Finished Water pH Monitoring
    - Raw water Turbidity Meter
    - Soda Ash Dry Storage Level
    - Filter Level Transducers
    - Filtered Water Pump Level Transducers
- Plant Operation Control System – PLC
- In-Plant Automation Equipment
    - Raw Water Intake Valve Control
    - Filter Raw Water Valve Control
    - Filtered Water Pump Control
    - Finished Water Pump Control
    - Chlorination Flow Pacing
    - Improved Soda Ash Flow Pacing
- Plant Electrical Service Disconnect Replacement

7.3 SYSTEM RELIABILITY

These improvements address identified concerns related to the water treatment plants ability to provide uninterrupted service to the City. The improvements are considered Phase 2 as ranked in the summary table at the end of this chapter.

- New Raw Water Intake Facility
- Shallow Well Field
- Deep Aquifer Well
- Emergency Power Source

7.4 CAPACITY EXPANSION

As described in previous Chapters the improvements described in this section of the study are required to accommodate future demands as the City grows. The improvements are considered Phase 3 as ranked in the summary table at the end of this chapter.

- Shallow Well Field

- Raw Water Weir Box Expansion
- Treatment Capacity
  - New Slow Sand Filter (3,300 ft^2 filter surface area)
  - Conventional Pretreatment System
  - Conventional Treatment System
  - Chemical Feed Expansion
- Clearwell Capacity
- Finished Water Pumping
- Finished Water VFD

7.5 RECOMMENDATION SUMMARY

A summary of recommended improvements, their associated cost, and priority are shown in Table 7.1. As discussed earlier in this chapter the improvements have been designated utilizing the following system.

- 1A = Needed Immediately
- 1B = Recommended Immediately, but can be delayed 2-5 Years depending on availability of funds
- 2 = Medium Priority
- 3 = Low Priority or As Needed (These improvements represent considerations for plant capacity expansion.)

Table 7.1
City of Stayton WTP Improvements, Opinion of Most Probable Cost

Priority	Improvements Description	Project Classification	Estimated Total Project Cost (2005)	Timing
Raw Water Intake (Power Canal):				
1A	Additional security fencing	Regulatory Compliance	$3,200	Present
1A	Sediment removal from diversion	Maint/Rehab/Upgrade	20,000	Present
1A	Remove skimmer structure (or) Replace skimmer board	Maint/Rehab/Upgrade	1,200 700	Present
Raw Water Intake (New River Diversion):				
3	New independent intake facility and pipeline	System Reliability	2,250,000	When funding allows

Raw Water (Shallow Well Field):				
1A	Construct a shallow well field	System Reliability	716,000	Present
3	Shallow well field expansion per additional well	Capacity Expansion	79,000	As required
Deep Aquifer Well:				
3	Construct or purchase back-up supply	System Reliability	1,333,000	10 – 20 years
Raw Water Weir Box:				
1B	Baffle replacement	Maint/Rehab/Upgrade	5,800	2 – 4 years
3	Box expansion to support future treatment	Capacity Expansion	29,700	When required
Filter Raw Water:				
2	Individual flow metering	Regulatory Compliance	72,000	3 – 5 years
Slow Sand Filters:				
1A	Replace filter #3 liner	Regulatory Compliance	542,000	Present
2	Increase buffer zone	Maint/Rehab/Upgrade	81,000	2 – 5 years
3	Replace Filter Media (3) & Scraper Mechanism	Maint/Rehab/Upgrade	650,000	Every 10 - 20 years
3	Add new filter (2)	Capacity Expansion	750,000	2018
Filtered Water:				
1A	Filter Turbidimeters	Regulatory Compliance	56,000	Present
Soda Ash Feed:				
1B	Cover feed hopper	Maint/Rehab/Upgrade	25,000	1 – 3 years
1B	Modify chemical dosing scheme	Maint/Rehab/Upgrade	14,500	Present-2 years
3	System expansion	Capacity Expansion	29,000	When required
Chlorine Feed:				
1A	On-site hypochlorite generation (150 lbs)(1)	Maint/Rehab/Upgrade	220,000	Present
Clearwell:				
1A	Existing clearwell baffling	Regulatory Compliance		Complete 2004
1A	Refinish 0.5 MG clearwell (interior and exterior)	Maint/Rehab/Upgrade	94,000	1 – 3 years
2	Additional clearwell capacity (relocate Schedule "M")	Capacity Expansion	510,000	2009
Finished Water Pumping:				
1B	Rehab kits for pump control valves	Maint/Rehab/Upgrade	5,200	2 – 4 years
1B	Remove obsolete monitoring equipment	Maint/Rehab/Upgrade	1,500	Perform this task with installation of FW flowmeter
3	FW VFD	Capacity Expansion	46,000	With Regis Tank Abandonment
2	Additional FW pump with VFD (200 hp)	Capacity Expansion	170,000	2008
3	Replace existing 100 hp with 200 hp	Capacity Expansion	115,000	2030

Plant Maintenance:				
1B	New maintenance shop	Maint/Rehab/Upgrade	294,000	1 – 3 years (3)
1B	Plant entrance	Maint/Rehab/Upgrade	65,000	With New Shop
Plant Security / Vulnerability:				
2	Plant entrance security (card reader entrance)	Maint/Rehab/Upgrade	44,000	3 – 8 years (4)
2	Plant security fencing	Maint/Rehab/Upgrade	113,000	3 – 8 years
2	Plant security lighting	Maint/Rehab/Upgrade	50,000	3 – 8 years
2	CCTV monitoring	Maint/Rehab/Upgrade	65,000	5 – 10 years
2	Building security system	Maint/Rehab/Upgrade	15,000	5 – 10 years (4)
Plant Instrumentation: (5)				
1A	RW flowmeter	Maint/Rehab/Upgrade	30,900	Present (5)
1A	FW flowmeter	Maint/Rehab/Upgrade	25,200	Present (5)
1B	FW Pressure Transducer	Maint/Rehab/Upgrade	10,000	2 – 5 years (5)
1B	RW and FW pH monitoring	Maint/Rehab/Upgrade	21,800	2 – 5 years (5)
1B	Filter level transducer	Maint/Rehab/Upgrade	31,900	2 – 5 years (5)
1B	Filtered water wetwell level transducer	Maint/Rehab/Upgrade	10,000	2 – 5 years (5)
Plant Operation Control System:				
1B	Plant PLC and Operator Interface System	Maint/Rehab/Upgrade	65,000	2 – 5 years (5)
In-Plant Automation Equipment:				
1B	RW intake valve control	Maint/Rehab/Upgrade	19,000	2 – 10 years (5)
1B	Filter RW valve control	Maint/Rehab/Upgrade	19,000	2 – 10 years (5)
1B	Filtered water pump control	Maint/Rehab/Upgrade	10,000	2 – 10 years (5)
1B	FW Pump Control	Maint/Rehab/Upgrade	11,000	2 – 10 years (5)
1B	Cl flow pacing	Maint/Rehab/Upgrade	11,000	2 – 10 years (5)
1B	Soda Ash flow pacing	Maint/Rehab/Upgrade	26,000	2 – 10 years (5)
1B	Soda Ash Level Monitor	Maint/Rehab/Upgrade	10,000	2 – 10 years (5)
Plant Electrical System:				
1B	Electrical service disconnect	Maint/Rehab/Upgrade	116,000	1 – 3 years
1B	Emergency power system (600 kw)	System Reliability	169,000	2 – 5 years

Total Cost By Priority:				
1A			1,708,500	Immediate
1B			940,700	2 – 5 Years
2			1,120,000	See above
3			5,281,000	See above
	Total Improvements Cost		$ 8,050,900	

Abbreviations:

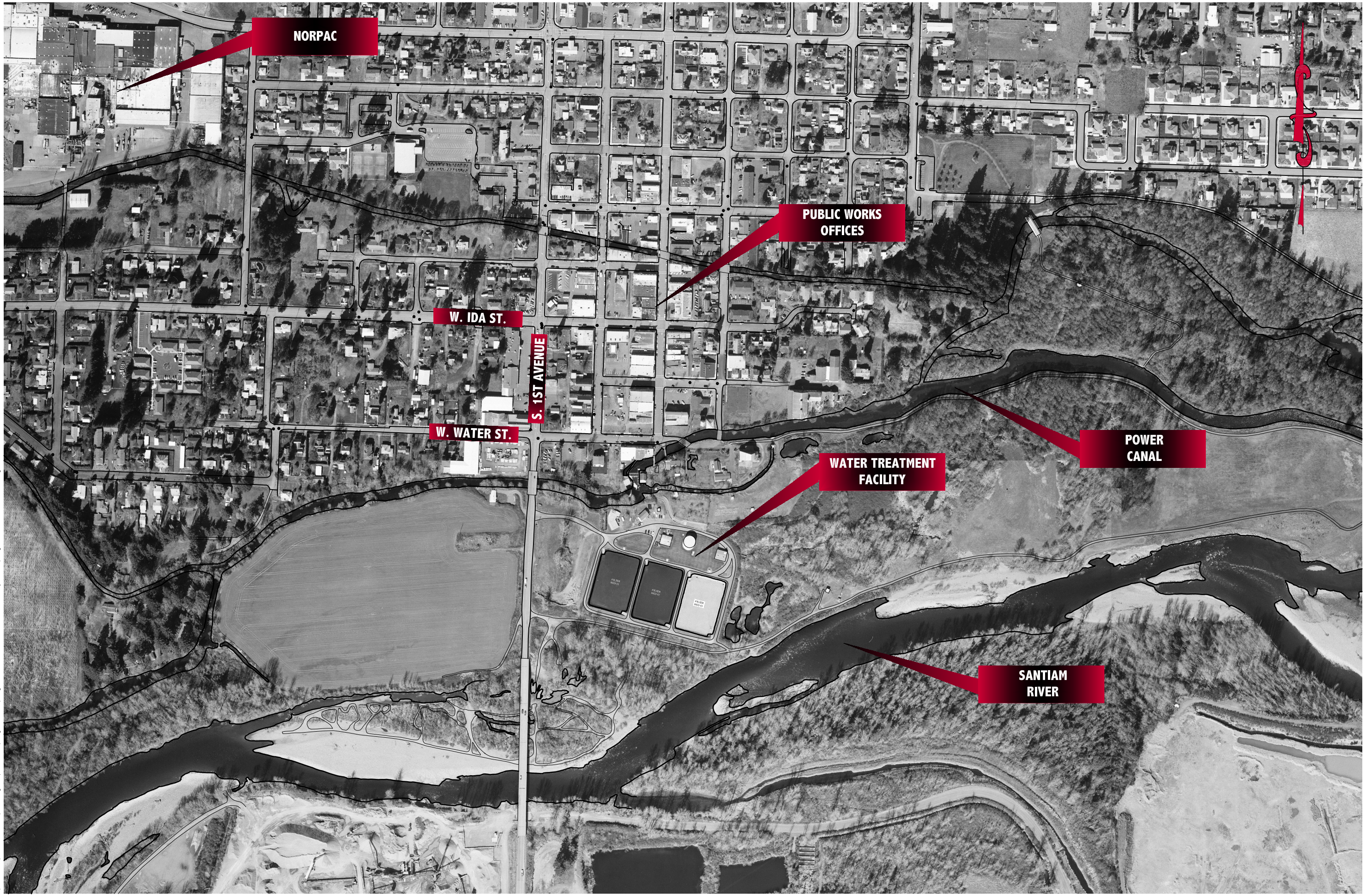
RW = Raw Water
Cl = Chlorine
MG = Million Gallons
FW = Finished Water
PLC = Programmable Logic Controller
HMI = Human Machine Interface (Desktop computer system to access control system)

(1) If the hypochlorite generation system facilities are not added in the short-term, gas chlorination system improvements as discussed in Chapter 7 should be provided in the interim at an estimated cost of $5,000.
(2) Assumes filter covers will not be required by DEQ. If covers are required, conventional treatment will be a lower cost expansion alternative.
(3) The new shop should be considered prior to the construction of the new Salem transmission pipeline, which will demolish the existing equipment storage, shed at the plant.
(4) These improvements should have the capability to connect to and interface with the proposed plant operation control system. They can be installed prior to the system but should be connected to the system once it is installed.
(5) These improvements should be phased over the next 8 – 10 years. As improvements are completed throughout the plant related items can be added to the improvement projects. All instrumentation and equipment that is installed should be connected to the plant operation control system or be provided with the capability to interface with this system if they are installed prior to the system.

7.6 FUNDING AND IMPLEMENTATION

To accommodate the recommended system improvements, a financing plan was developed with the aid of Ray Bartlett with Economic and Financial Analysis. The results of the analysis are summarized in the Executive Summary, and a detailed evaluation can be found in the Appendix of the Water Distribution Facilities Plan Study.

Appendix A Figures



Water Treatment Plant Analysis

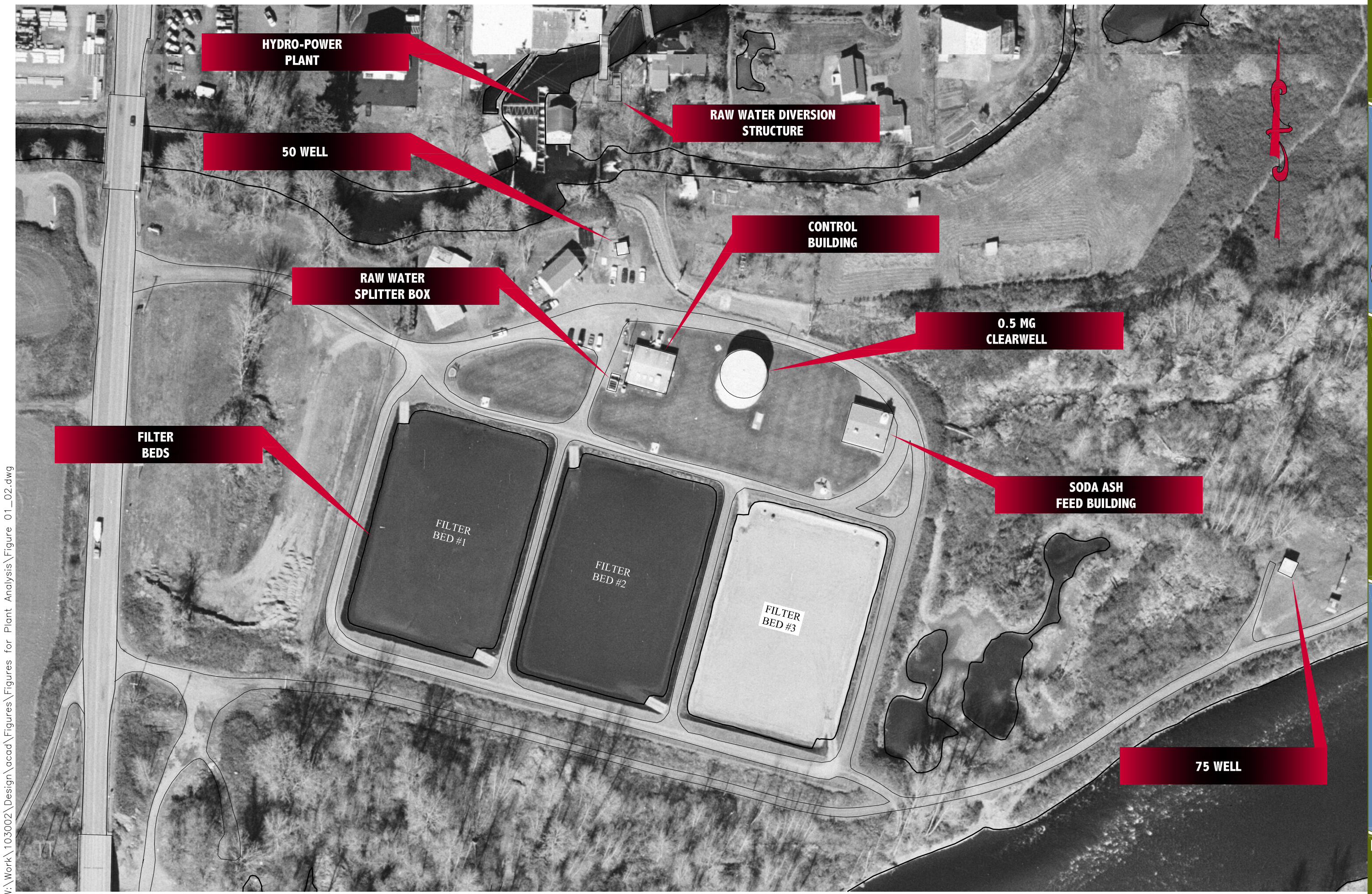
Facility Location Map

1.1

KA:103002

Figure 01_01.dwg

W:\Work\103002\Design\acad\Figures\Figures for Plant Analysis\Figure 01_01.dwg



W:\Work\103002\Design\acad\Figures\Figures for Plant Analysis\Figure 01_02.dwg

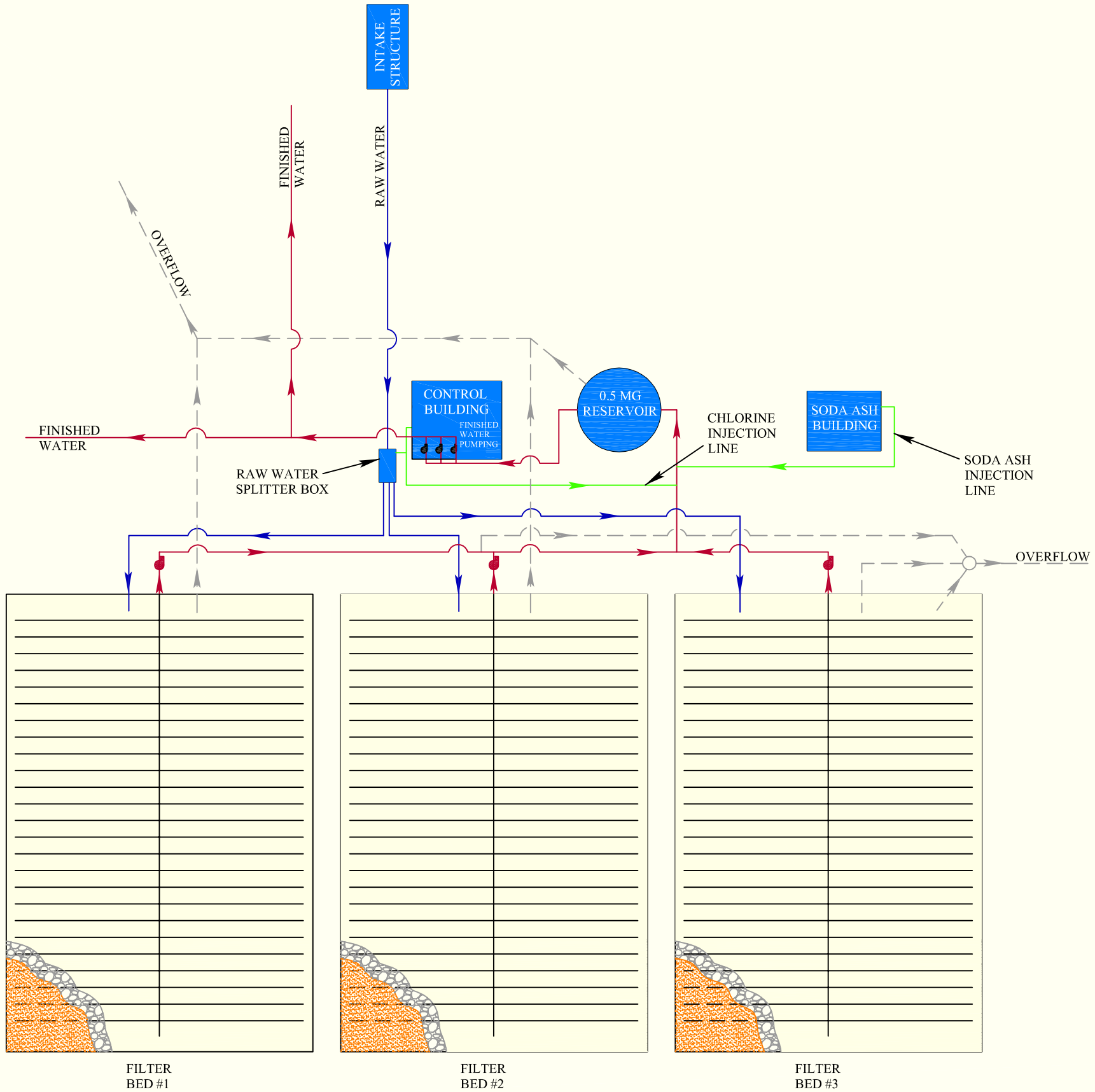
KA:103002
Figure 01_02.dwg

KELLER ASSOCIATES

Water Treatment Plant Analysis

Existing WTP Facilities

FIGURE 1.2



W:\Work\103002\Design\acad\Figures\Figures for Plant Analysis\Figure 01_03.dwg

KA:103002
Figure 01_03.dwg

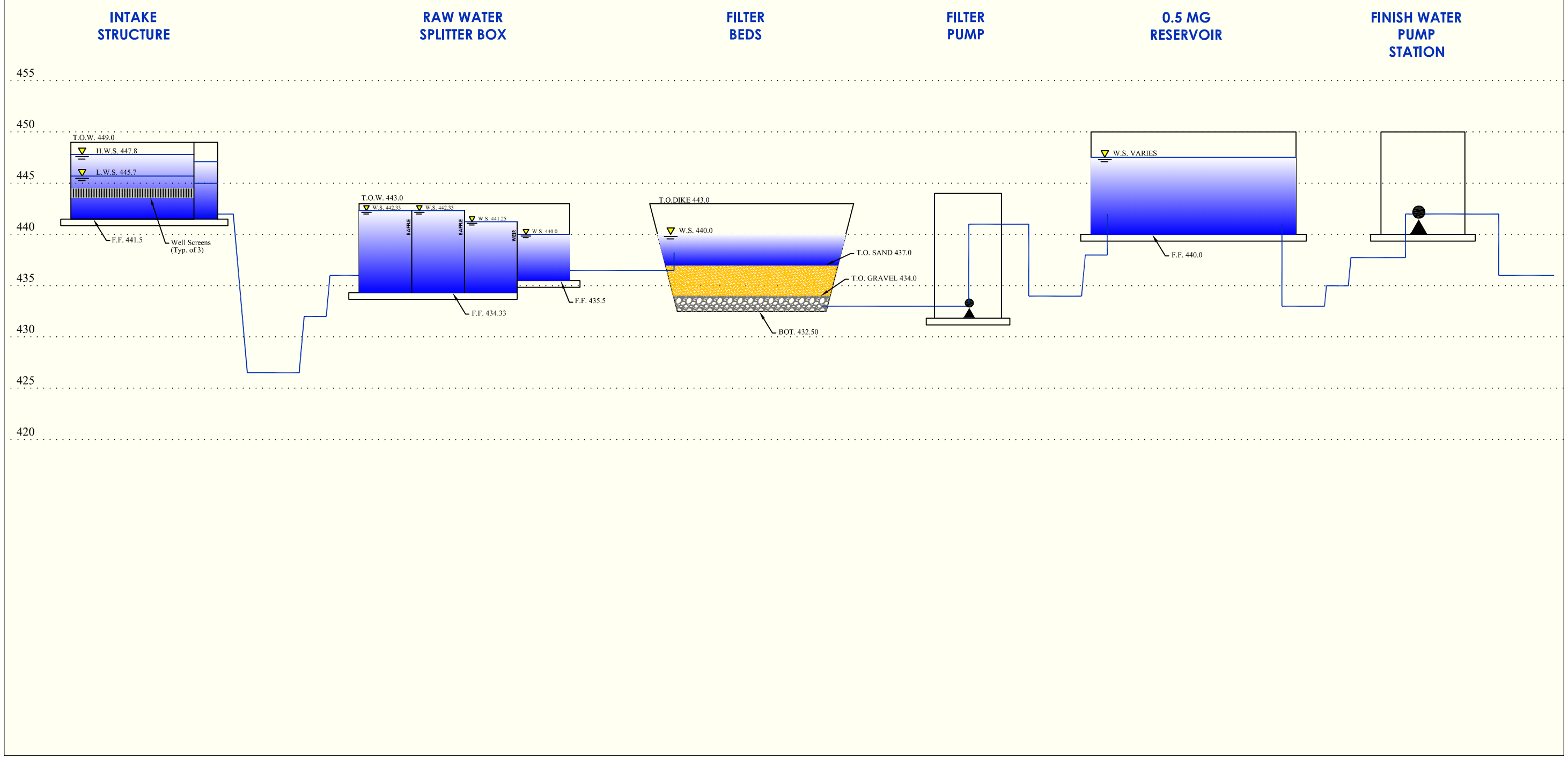
KELLER ASSOCIATES

Water Treatment Plant Analysis

WTP Process Flow Diagram

FIGURE 1.3

EXISTING PLANT HYDRAULICS



W:\Work\103002\Design\acad\Figures\Figures for Plant Analysis\Figure 04_01.dwg

KA:103002
Figure 04_01.dwg

KELLER ASSOCIATES

Water Treatment Plant Analysis

WTP Hydraulic Profile

4.1

W:\Work\103002\Design\acad\Figures\Figures for Plant Analysis\Figure 04_02.dwg

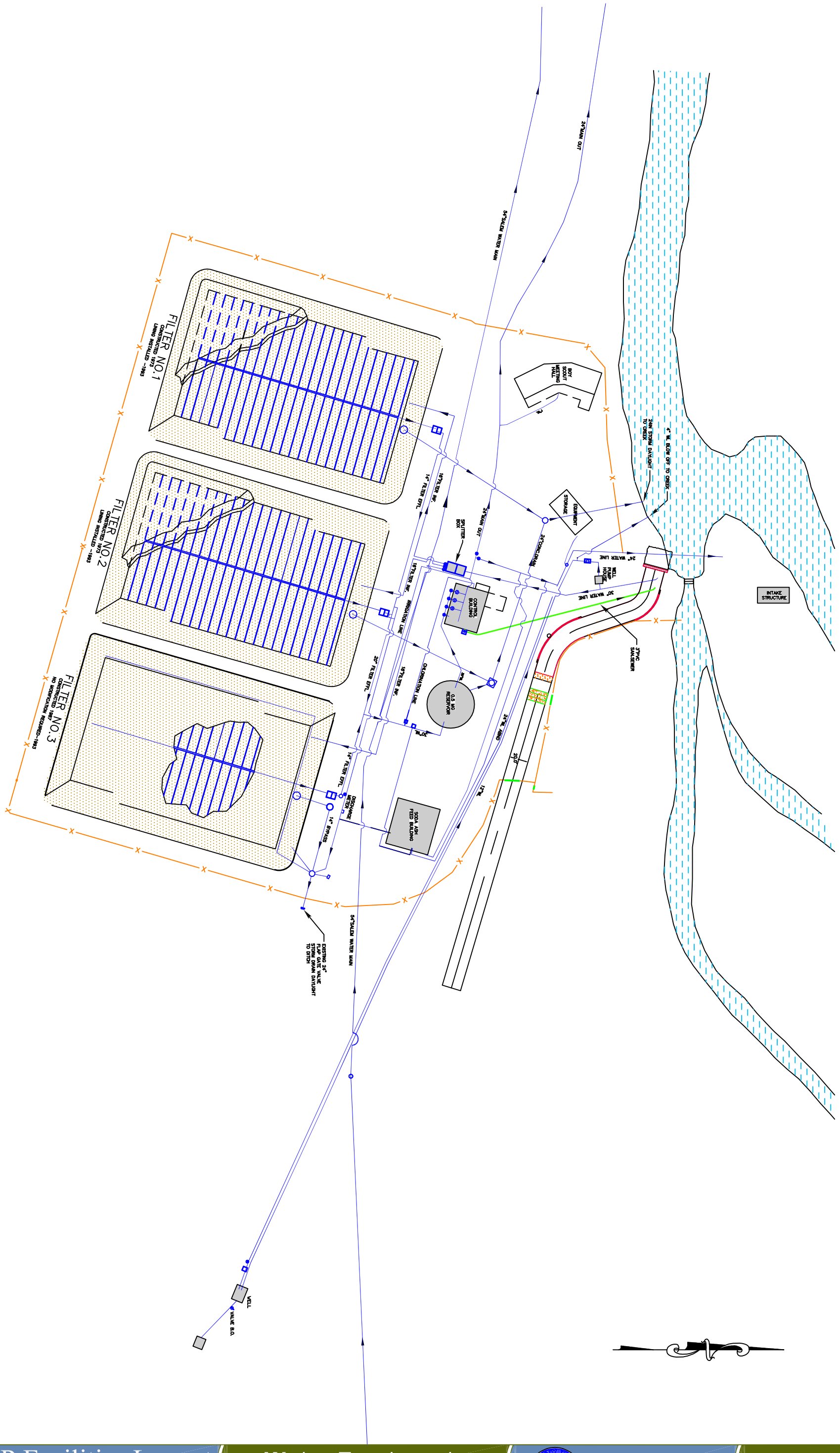


FIGURE 4.2

WTP Facilities Layout And Yard Piping

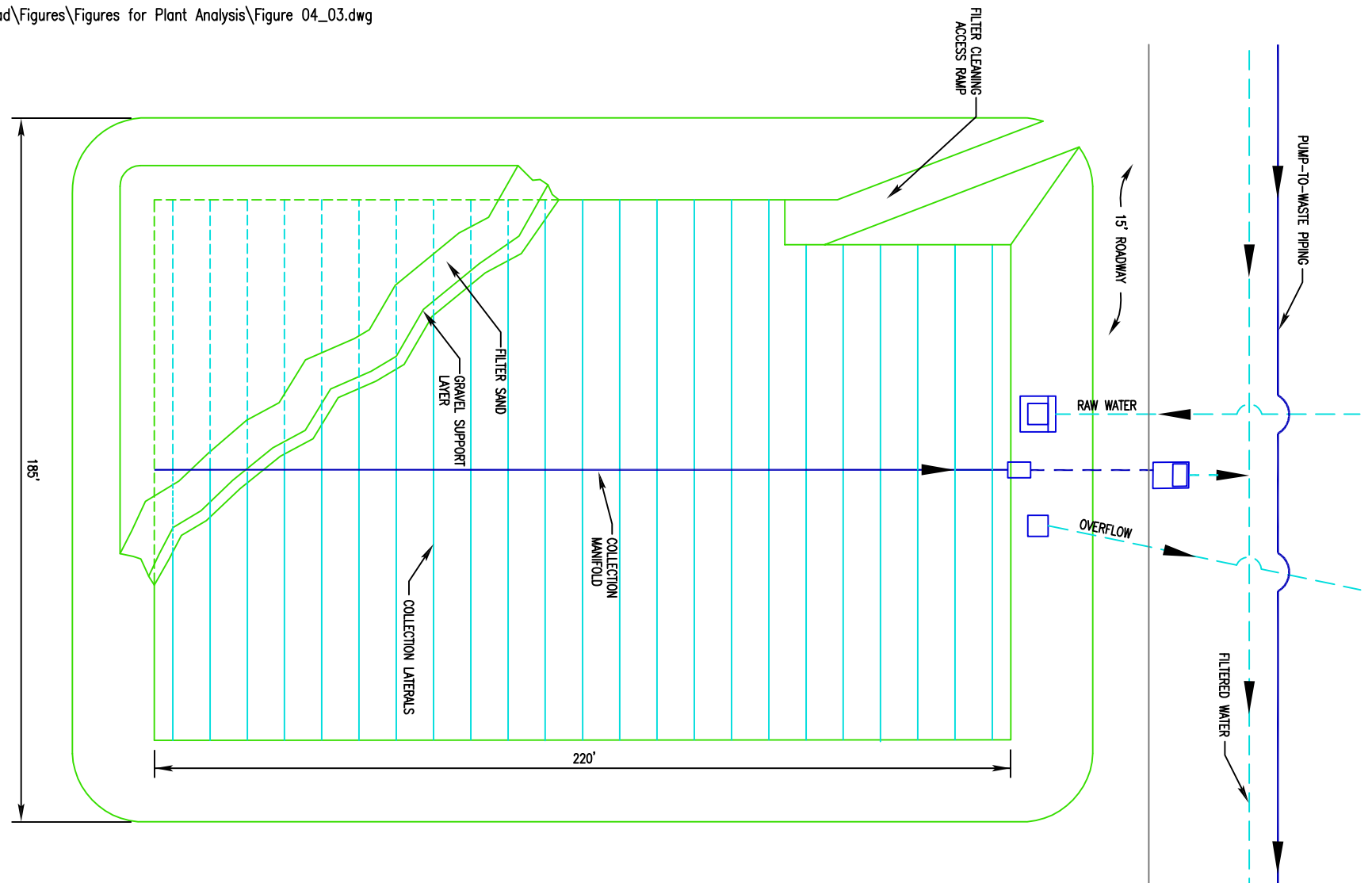
Water Treatment Plant Analysis

KELLER ASSOCIATES

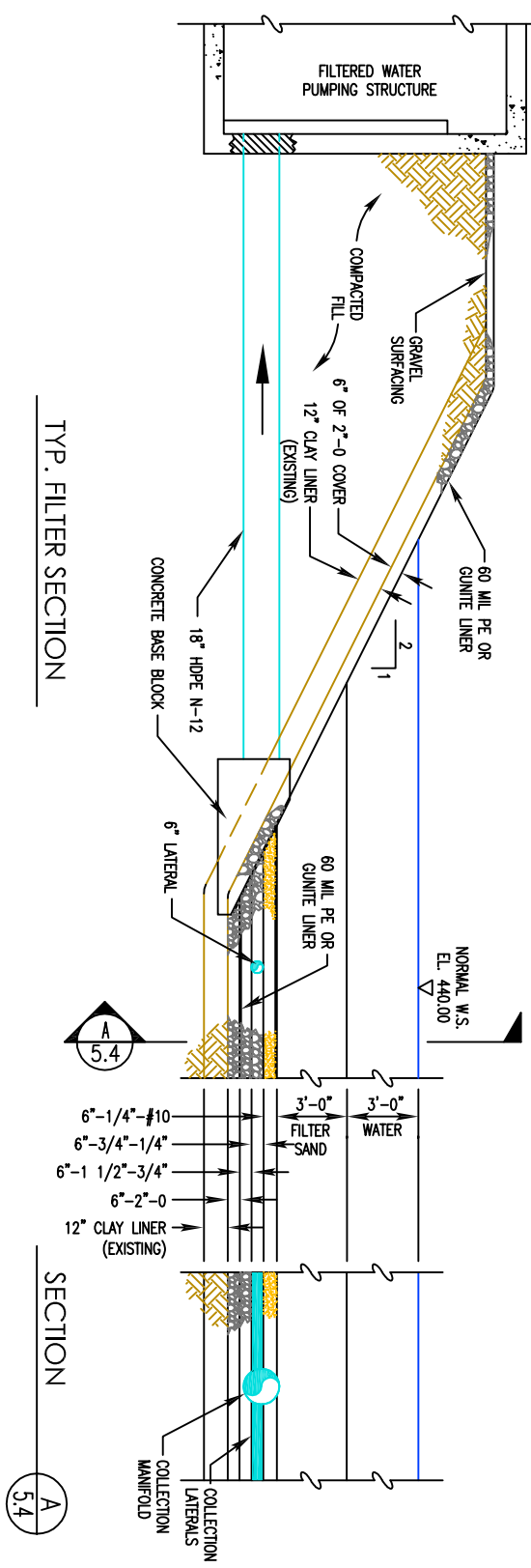
KA:103002

Figure 04_02.dwg

W:\Work\103002\Design\acad\Figures\Figures for Plant Analysis\Figure 04_03.dwg



TYP. FILTER PLAN VIEW



TYP. FILTER SECTION

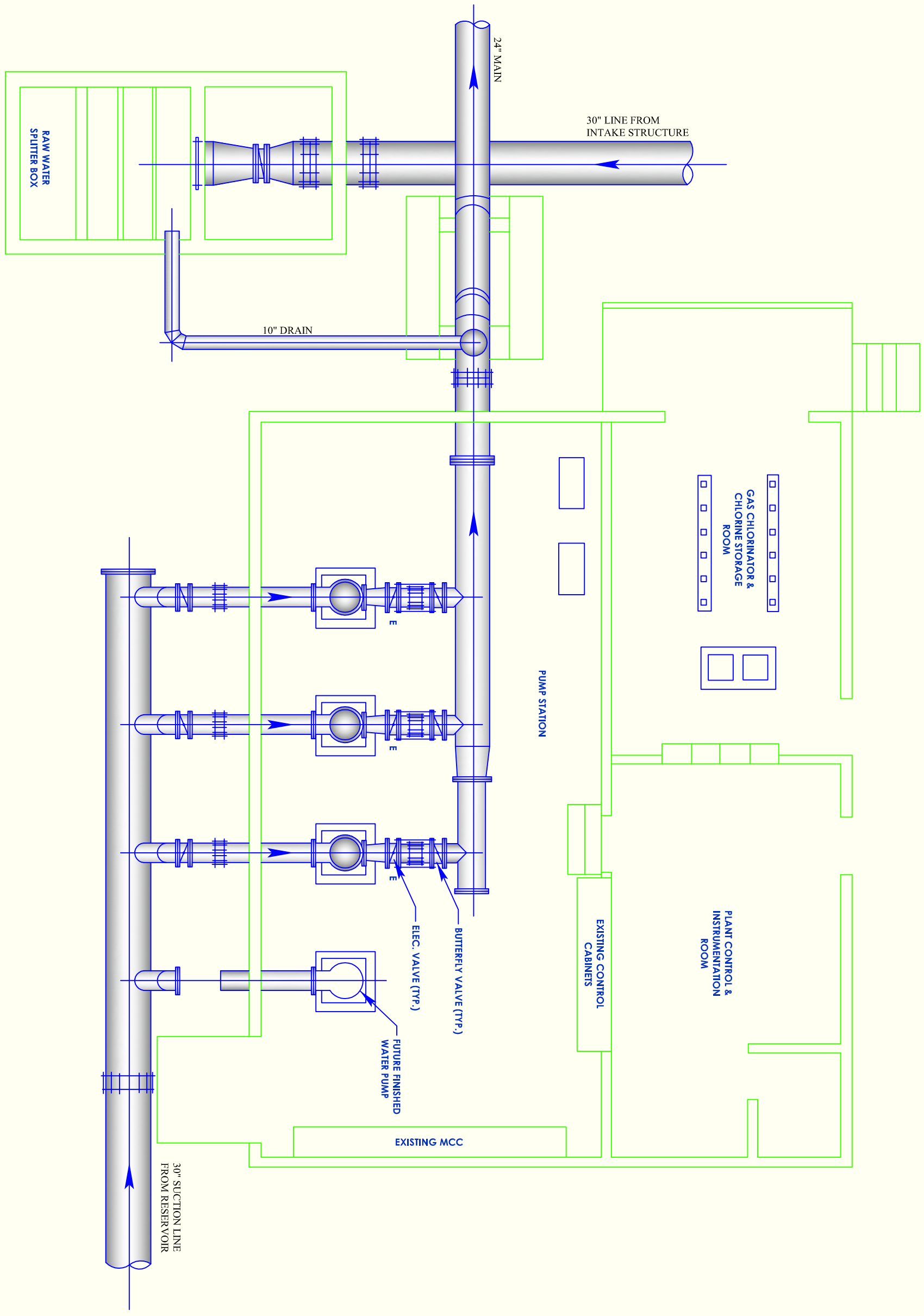
A 5.4

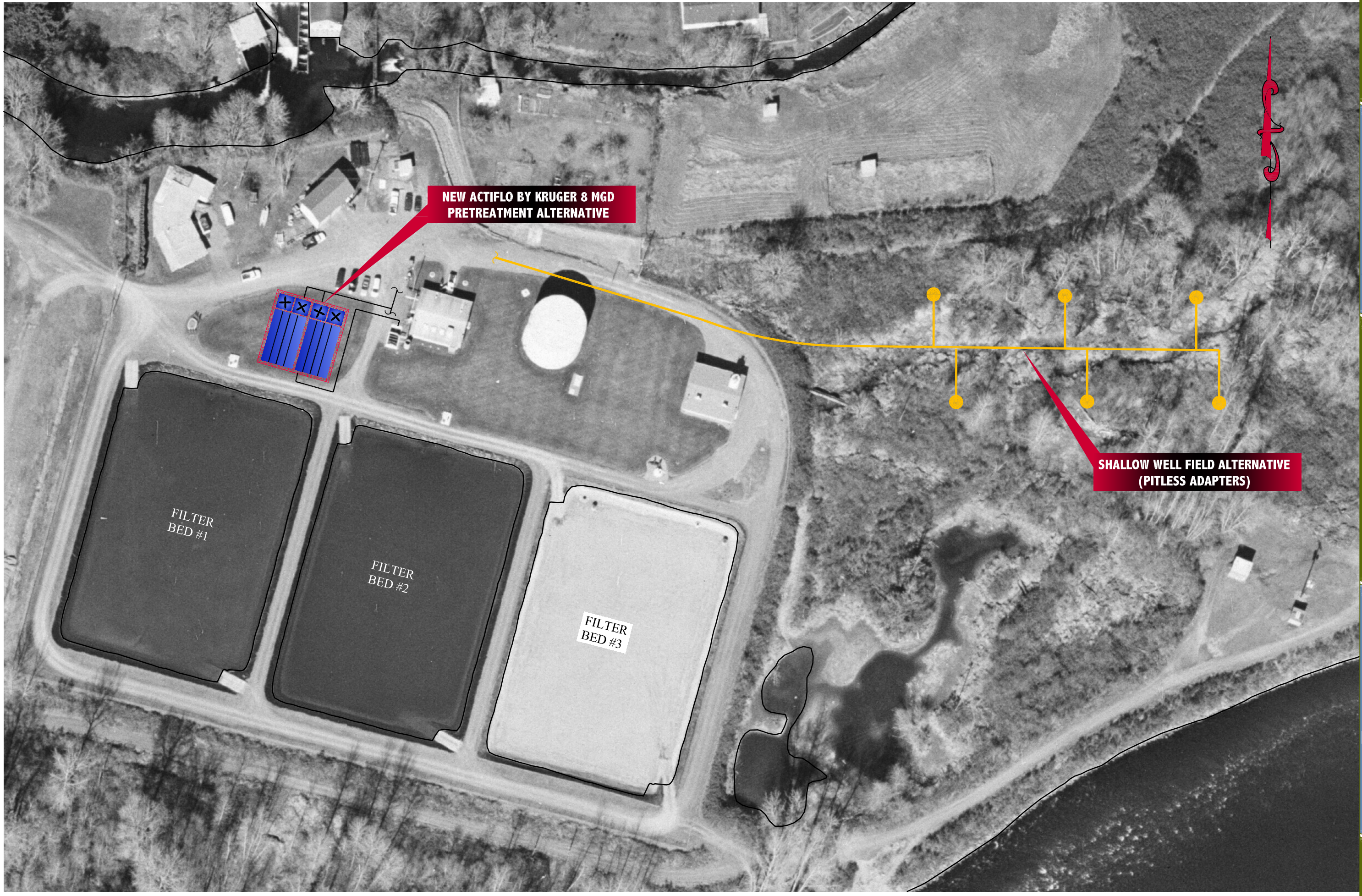
NOTES

-FILTERS 1 & 2 - 60 MIL HDPE LINER

-FILTER 3 - 4" THICK WIRE REINFORCED GUNITE LINER

W:\Work\103002\Design\acad\Figures\Figures for Plant Analysis\Figure 04_04.dwg





KA:103002
Figure 06_01.dwg

KELLER ASSOCIATES

Water Treatment
Plant Analysis

Future
Supply Alternatives

FIGURE
6.1

W:\Work\103002\Design\acad\Figures\Figures for Plant Analysis\Figure 06_01.dwg

W:\Work\103002\Design\acad\Figures\Figures for Plant Analysis\Figure 06_02.dwg

WASTE WATER TREATMENT PLANT

SCHEDULE 'M' RESERVOIR AND BOOSTER STATION
150 HP DIESEL MOTOR BACK-UP

SOUTHERN PACIFIC RR.

GOLF CLUB ROAD

WILCO RD.

WASHINGTON ST.

IDA ST.

GARDNER RD.

LOCUST ST.

REGIS ST.

PURCHASE EMERGENCY DEEP WELL SUPPLY

NORTH SANTIAM HIGHWAY

CASCADE HIGHWAY

HIGHWAY 22

1ST AVE

NORTH SANTIAM RIVER

DRILL EMERGENCY DEEP WELL SUPPLY

WATER TREATMENT PLANT

NEW RAW WATER DIVERSION FACILITY

REGIS RESERVOIR and BOOSTER STATION
50 HP GAS MOTOR BACK-UP

FERN RIDGE RD.

SANTIAM ST.

UPPER SERVICE AREA

12" (DRY LINE)

BOEDIGHEIMER RD.

STAYTON MEHAMA RD

PINE STREET RESERVOIR and BOOSTER STATION
2 - 15 HP SUBMERSIBLE PUMPS

LEGEND

EXISTING FACILITIES

POTENTIAL WATER SUPPLY IMPROVEMENTS

FIGURE 6.2

Potential Future Water Supply Improvements

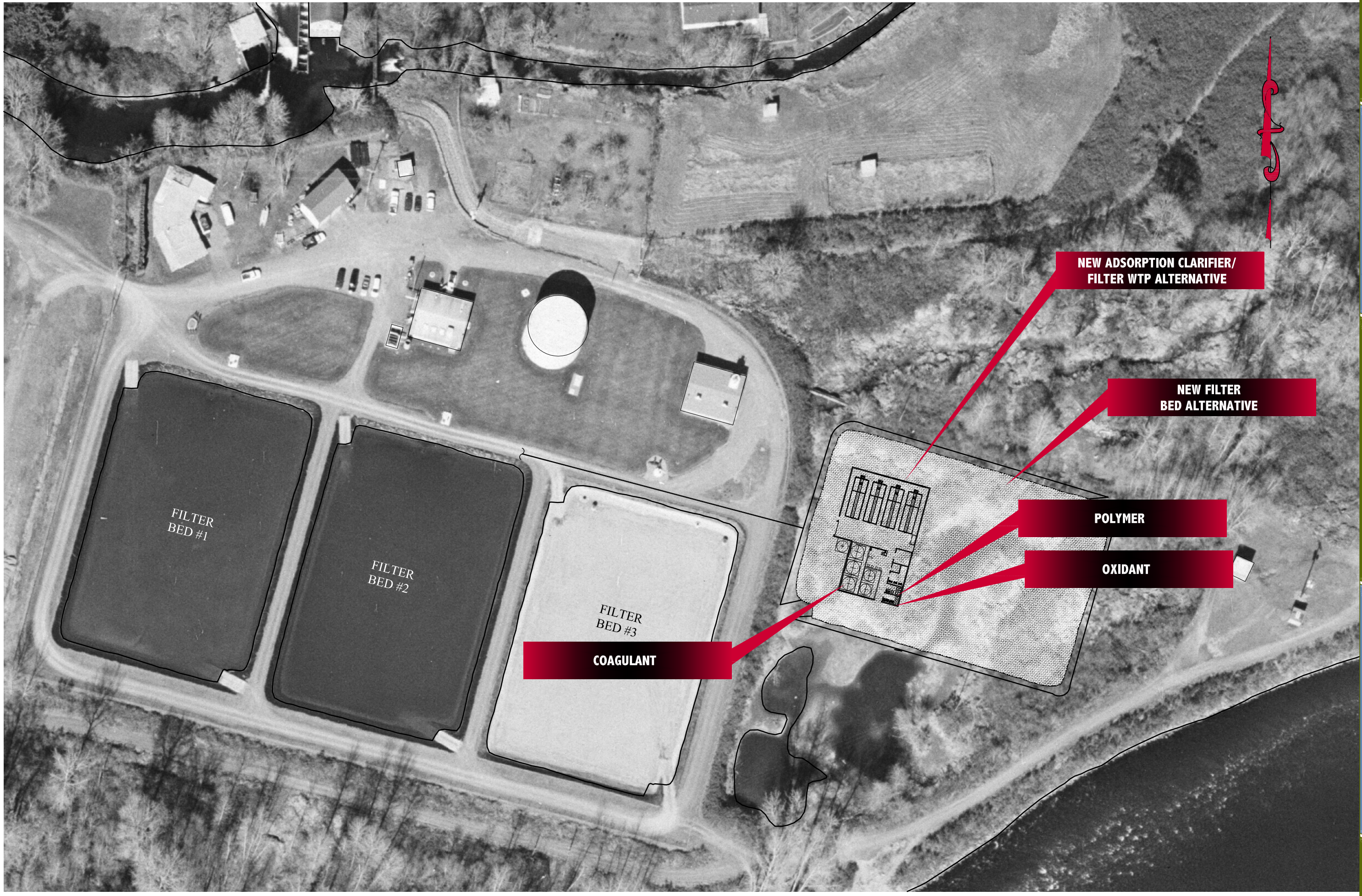
Water Treatment Plant Analysis

CITY OF STAYTON

KELLER ASSOCIATES

KA:103002

Figure 06_02.dwg



W:\Work\103002\Design\acad\Figures\Figures for Plant Analysis\Figure 06_03.dwg

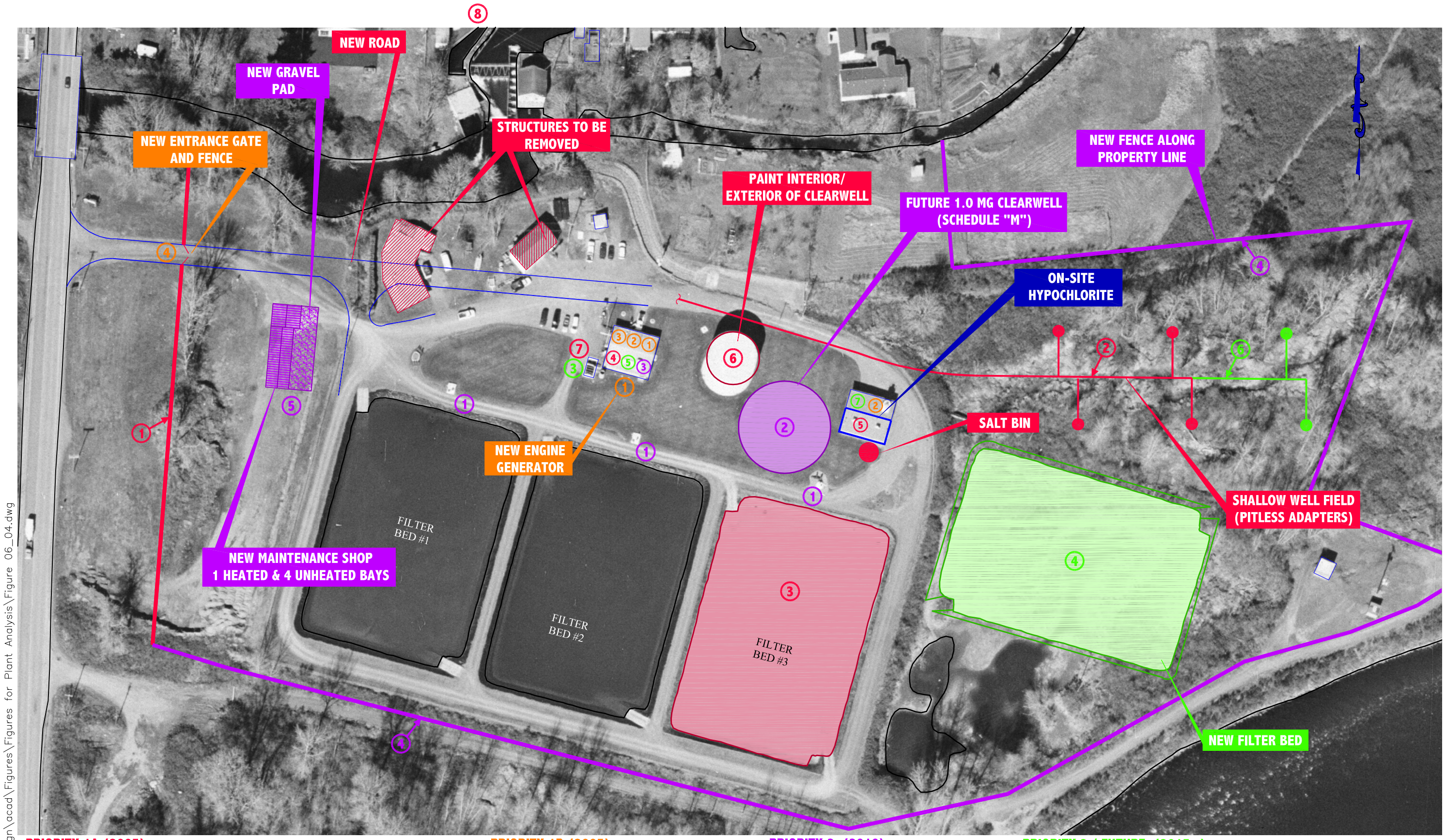
KA:103002
Figure 06_03.dwg

KELLER ASSOCIATES

Water Treatment
Plant Analysis

WTP And New Filter
Bed Alternatives

6.3



PRIORITY 1A (2005)

1. Setback Entrance Fencing
2. Shallow Well Field
3. Replace Filter Liner
4. Add Filter Turbidimeters
5. Add Hypochlorite Generation System
6. Refinish 0.5 MG Clearwell
7. Add Finish Water Flow Meter
8. Intake Improvements

PRIORITY 1B (2005)

1. Upgrade Plant Electrical/ SCADA System
2. Chemical Feed Improvements
3. Rehab Pump Control Valves
4. Upgrade Plant Entrance

PRIORITY 2 (2010)

1. Meter Each Filter
2. Add Clearwell Capacity
3. Add Finished Water Pump with VFD
4. Improve Plant Security
5. Add Maintenance Shop

PRIORITY 3 / FUTURE (2015+)

1. New Intake Facility (See Figure 6-2)
2. Construct / Obtain Deep Well (See Figure 6-2)
3. Weir Box Expansion
4. Add New Filter
5. FW Pump Improvements
6. Shallow Well Field Expansion
7. Soda Ash Expansion

KA:103002
Figure 06_04.dwg

KELLER ASSOCIATES

Water Treatment Plant Analysis

Recommended Future Improvements

FIGURE 6.4

W:\Work\103002\Design\acad\Figures\Figures for Plant Analysis\Figure 06_04.dwg

Appendix B

CT Calculations

Stayton CT Calculations

I have taken a look at the 0.5 MG clearwell at the plant with the baffle curtains installed and have reached the following conclusions.

When the residence time vs. required CT is considered two major factors come into play. The first is the time of year that is being considered. For instance a shorter time is required when the water temperatures and pH are higher. This is due to the reaction rates and speciation of chlorine in solution. The warmer the temperature and lower the pH the less chlorine that is required and the shorter the time of required contact. The second item to consider is the demand. As the demand increases the residence time decreases.

In this analysis four flow rates were considered, the first was the existing peak day condition. The second was the projected 2025 peak day condition assuming a lower growth rate. The third production rate that was considered was the 2025 peak day condition assuming a higher growth rate. Finally a build-out condition was considered. The corresponding flow rates for these conditions have been included in the back up documentation that is provided with this memo. For each of the four design periods three distinct flows were considered. As discussed all four conditions were considered at peak day demand. This represents the worst case demand condition for each of the four conditions. However, it also represents the best case scenario when considering the impacts of temperature on the CT requirements. The additional flow conditions that were considered included the average day demand and the minimum day demand.

To calculate the average day and minimum day demands historic plant production records were compiled. Six years worth of data was compiled to generate a peaking factor for each month of the year, from these peaking factors the average and minimum demands were calculated using the projected peak day demands previously discussed.

Finally, the chlorine dose and its effect on the required CT value was considered. The higher the chlorine dose the lower the required contact time to achieve the desired CT value. The plant currently feeds chlorine to a residual dose of approximately 0.7 mg/L. Using this as the base dose the required contact time by season ranged from 38.6 minutes to 64.3 minutes with the best and worst case scenarios occurring in the summer and winter respectively. The required contact time has been included as an attachment to this document.

A summary of the correlating chlorine doses, seasonal required contact times and flows has been included in the attached summary table. This table indicates that the current clearwell size is adequate for all flow conditions through the spring, fall and winter through the proposed build-out demands with only slight dosage increases once the build-out demand has been reached. During the peak summer demands however, the existing clearwell becomes too small when the demand reaches approximately 4,300 gpm at a chlorine dose of 0.7 mg/L and 4,900 gpm at a chlorine dose of 1.0mg/L. We do not

recommend that the City feed a chlorine dose higher than 1.0 mg/L due to the increased potential for the formation of taste and odor problems.

Therefore, it is anticipated that with the City's water characteristics the plants clearwell capacity will need to be increased when the demands reach a summer peak of 4,900 gpm. At 4,900 gpm the summer chlorine dose will need to be 1.0 mg/L.

Bryan Phinney
February 2005

Exisitng	Clearwell Residence Time minutes	Required Chlorine Dose mg/L
Peak	35.1	0.8
Average	76.4	0.7
Minimum	93.4	0.7

2025 Low Growth	Clearwell Residence Time minutes	Required Chlorine Dose mg/L
Peak	16	Cl2 dose too high - 1
Average	66.6	0.7
Minimum	87.4	0.7

2025 High Growth	Clearwell Residence Time minutes	Required Chlorine Dose mg/L
Peak	Not Feasible	Cl2 dose too high - 1
Average	36.6	0.7
Minimum	76.6	0.7

Build-Out	Clearwell Residence Time minutes	Required Chlorine Dose mg/L
Peak	Not Feasible	Cl2 dose too high - 1
Average	36.6	0.8
Minimum	69.1	0.7

Season	**Chlorine Dose, 0.7 mg/L Required Contact Time minutes**	**Chlorine Dose, 0.8 mg/L Required Contact Time minutes**
Spring	61.4	53.8
Summer	38.6	33.8
Fall	41.4	36.3
Winter	64.3	56.3

Assumptions

Peak Day occurs during the summer season.
Minimum Demand occurs during Winter.
Spring and Fall represent Average demand.
1 - required chlorine dose too high, additional storage required.

City of Stayton, OR By: BRP
Water Treatment Plant Clearwell Baffling/CT Evaluation Date: 2/3/2005
CT Calculations

Assumptions

Assumed months representative of seasons:

Spring	March
Summer	July
Fall	October
Winter	December

2002 plant data was used for seasonal pH and Temp variation for this evaluation.

Target Free Chlorine Residual = 0.7 mg/l

Seasonal pH and Temp

	pH	Temp, C
Spring	7.4	9.7
Summer	7.6	17.36
Fall	7.4	14.5
Winter	7.5	9.6

CT* Values (based on Temperature and pH)

Spring	43
Summer	27
Fall	29
Winter	45

* Values were interpolated from CT charts found in EPA Handbook "Optimizing Water Treatment Plant Performance Using the Composite Correction Program. (EPA/625/6-91/027)

Required Residence Time (0.7)

CT = Time * Free Chloring Residual

Free Cl =	0.7	mg/l
Spring	61.4	minutes
Summer	38.6	minutes
Fall	41.4	minutes
Winter	64.3	minutes

Required Residence Time (0.8)

CT = Time * Free Chloring Residual

Free Cl =	0.8	mg/l
Spring	53.8	minutes
Summer	33.8	minutes
Fall	36.3	minutes
Winter	56.3	minutes

Required Residence Time (0.9)

CT = Time * Free Chloring Residual

Free Cl =	0.9	mg/l
Spring	47.8	minutes
Summer	30.0	minutes
Fall	32.2	minutes
Winter	50.0	minutes

Required Residence Time (1.0)

CT = Time * Free Chloring Residual

Free Cl =	1	mg/l
Spring	43.0	minutes
Summer	27.0	minutes
Fall	29.0	minutes
Winter	45.0	minutes

Required Residence Time (1.1)

CT = Time * Free Chloring Residual

Free Cl =	1.1	mg/l
Spring	39.1	minutes
Summer	24.5	minutes
Fall	26.4	minutes
Winter	40.9	minutes

Required Residence Time (1.2)

CT = Time * Free Chloring Residual

Free Cl =	1.2	mg/l
Spring	35.8	minutes
Summer	22.5	minutes
Fall	24.2	minutes
Winter	37.5	minutes

Required Residence Time (1.3)

CT = Time * Free Chloring Residual

Free Cl =	1.3	mg/l
Spring	33.1	minutes
Summer	20.8	minutes
Fall	22.3	minutes
Winter	34.6	minutes

Required Residence Time (1.4)

CT = Time * Free Chloring Residual

Free Cl =	1.4	mg/l
Spring	30.7	minutes
Summer	19.3	minutes
Fall	20.7	minutes
Winter	32.1	minutes

City of Stayton, OR By: BRP
Water Treatment Plant Clearwell Baffling/CT Evaluation Date: 2/3/2005
3 Baffle Curtains

Flow Rates		**MGD**	**GPD**	**GPM**
Qpe =	Existing Peak Day Flow	6.50	6,500,000	4,514
Qplg =	2025 Peak Day at Low Growth Rate	7.96	7,960,000	5,528
Qphg =	2025 Peak Day at High Growth Rate	10.60	10,600,000	7,361
Qbo =	Peak Day a minutes	12.44	12,440,000	8,639

Assumptions

Baffled tank achieves superior flow characteristics as defined by EPA Guidance Manual "Disinfection Profiling and Benchmarking"
T10/T = 0.7

Tank Operating Depth = 25 ft

Td = clear well residence time.
Tdavg = residence time assuming a flow path down the center of the baffled channel.
Tdmin = residence time assuming the shortest flow path possible through the baffled channel.

Lavg = 172.34 ft
Lmin = 115.76 ft

Area of Flow Path, Average

331.25 sq. ft.

Existing

Peak		
Q =	4513.89	gpm
Td =	35.05	minutes
Average		
Q =	2314.81	gpm
Td =	76.39	minutes
Minimum		
Q =	1412.04	gpm
Td =	93.36	minutes

2025 (Assuming Low Growth Rate)

Peak		
Q =	5527.78	ft/min
Td =	15.99	minutes
Average		
Q =	2834.76	ft/min
Td =	66.62	minutes
Minimum		
Q =	1729.20	ft/min
Td =	87.40	minutes

2025 (Assuming High Growth Rate)

Peak		
Q =	7361.11	ft/min

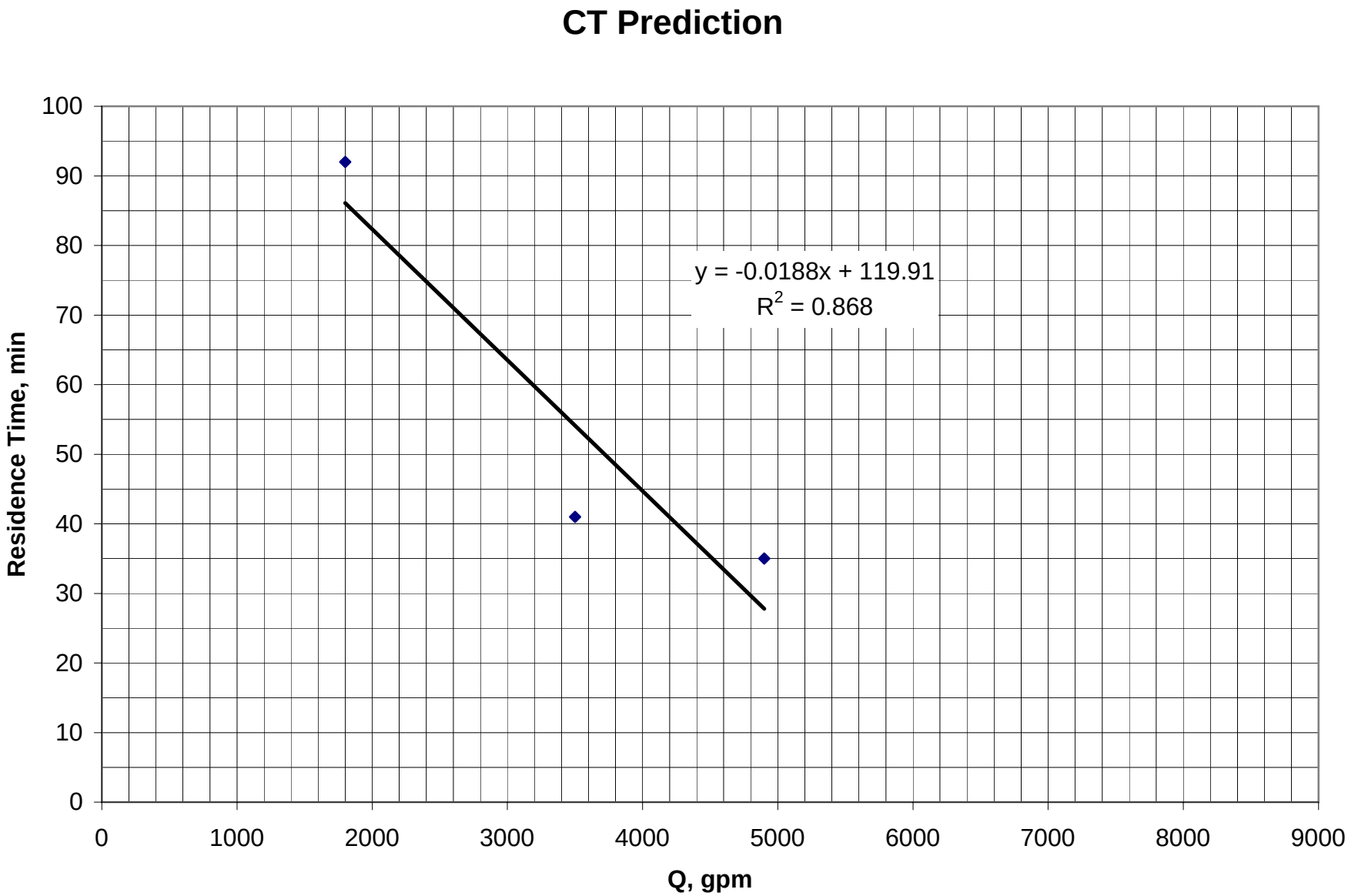
Td =	-18.48	minutes
Average		
Q =	3774.93	ft/min
Td =	48.94	minutes
Minimum		
Q =	2302.71	ft/min
Td =	76.62	minutes

Build-Out

Peak		
Q =	8638.89	ft/min
Td =	-42.50	minutes
Average		
Q =	4430.20	ft/min
Td =	36.62	minutes
Minimum		
Q =	2702.42	ft/min
Td =	69.10	minutes

Measured Values

Pumps	Q, gpm	Td, min
100-hp	1800	92
200-hp	3500	41
100 + 200-	4900	35


CT Prediction
Residence Time, min
Q, gpm
y = -0.0188x + 119.91
R2 = 0.868
100
90
80
70
60
50
40
30
20
10
0
0
1000
2000
3000
4000
5000
6000
7000
8000
9000

Appendix C Water Control Dist. Agreement

SANTIAM WATER CONTROL DISTRICT
MUNICIPAL WATER DELIVERY AGREEMENT

COPY

THIS AGREEMENT is made effective October ___, 2003 and becomes retroactive to January 1, 2003, by and between the Santiam Water Control District, herein referred to as "District," and the City of Stayton, herein referred to as "the City."

RECITALS:

A. District is a public body, corporate and politic, exercising public powers pursuant to Oregon Revised Statute Chapter 553.

B. City is a public body, corporate and politic, exercising public powers pursuant to Oregon Revised Statute Chapter 221.

C. District owns and operates a water control system, which delivers irrigation water to approximately 16,800 acres of land generally located between Stayton, Oregon and Salem, Oregon. In addition, District delivers water for municipal, hydroelectric, and commercial uses. District owns and operates the facilities that deliver water from the North Santiam River to the City's water treatment facilities. In addition, District owns and operates the Salem Canal and delivers water to the City of Salem through said canal under a perpetual contract.

D. City is the owner and operator of a community water system that supplies safe drinking water to customers in the Stayton area. The primary source of water for the City is surface water withdrawn from the North Santiam River, downstream of Geren Island, which water is delivered through the District's power canal.

E. The City is in the process of receiving an additional 10 cfs of water rights from the City of Salem under cert. # 12033. District is currently working with numerous state and federal agencies to obtain the approval and funding of the final design and permits required to install a fish screen and fish bypass facilities at the head of the power canal, which provides water to the City. Said fish screen and bypass facilities will be located at the point of diversion on the North Santiam River. The fish screen and bypass facilities are required by State law, and in order for the District to comply with the requirements of the Federal Endangered Species Act.

F. District's canal and the design of the fish screen and bypass facilities and head works provide limited capacity, and the additional delivery of ten cubic feet of water per second from the North Santiam River to the city's water treatment facility may require the District to limit future deliveries of water to other water users or to alter the design and operation of its facilities to accommodate this additional supply.

G. On or about February 4, 1971, the City and the District entered into a Water Delivery Contract for the delivery of municipal water from the North Santiam River through the District's power canal to the City's water treatment facility. Said Contract was amended by Amendment dated August 8, 1988, to reflect changes in the City's water usage. Following the execution of said Amendment to the Contract, the City acquired additional year-round rights and a right of 25 cfs for

delivery from October 1 to May 30. District was not aware of the City's acquisition of these rights until recently, and the Agreements between the parties do not provide for the delivery by the District of said additional water.

H. The parties, by this Agreement, desire to replace their existing Contract and Amendment for water delivery and to provide for the delivery by District to City of the additional water described above, including the said proposed transfer of ten cubic feet per second of water from the City of Salem to the City.

AGREEMENT

NOW, THEREFORE, the parties mutually and severally covenant and agree as follows:

1. City agrees to pay to District the sum of $100,000 upon execution of this Agreement as a contribution to the design and construction of the fish screen and bypass facilities for the District's power canal.

2. City agrees to pay to District, annually, an operation and maintenance charge. The charge payable by the City will be determined prior to November 15 of each calendar year from metered measurements made by the City. The charge will be based on the minimum usage of 21.59 cubic feet of water per second or actual use, whichever is greater, and the charge shall be effective on the first day of January of the next succeeding year. The City's "actual use" shall be based on the average used during the calendar month of the current year in which the greatest quantity of water was used by the City. The operation and maintenance charge payable by the City for 2003 is $24,180.80. Said charge was computed by multiplying 21.59 cfs by $1,120 per cfs = $24,180.80.

The base rate charged per cfs will be adjusted annually by the change in the consumer price index, using the CPI-W Index for the period of time between September 30 of the prior calendar year and September 30 of the current calendar year.

3. The City agrees to install, operate, and maintain a water-flow meter that keeps a continuous record at its point of diversion from the District's canal. The City shall cause said meter to be independently inspected and recalibrated, if necessary, annually. The City shall provide to the District a true copy of the record of usage during the preceding 12 months on November 1 of each year, commencing November 1, 2005. The parties agree and acknowledge, however, that the City will require a reasonable period of time to acquire, install, and calibrate the meter. Therefore, the record provided November 1, 2005 will not include a full 12 months. However, the City shall insure that the meter is fully operational on or before April 1, 2005.

4. Transportation: The District shall transport for the City and deliver to the City water intake through the District's power canal, all cubic feet per second of surface water rights currently owned or under permit including 10 cfs of water rights from the City of Salem under cert. # 12033. (See attached list of water rights.)

5. The District shall apply the payment provided under paragraph1., above, to the design and construction of the fish screen and bypass facilities. The District shall insure that the fish screen

and bypass facilities, as installed, shall be capable of providing not less than 46.59 cubic feet of water per second through the District's power canal to the City's water treatment plant on a continuous basis. Said amount of water is the maximum amount of water that the District is obligated to deliver to the City under the terms of this Agreement.

6. The District agrees that it shall use its best efforts to maintain and keep the canal, dams that provide the water to the District's diversion point, the trash racks, fish screens, bypass facilities, and all other facilities required for the delivery of water, free of debris and other impediments, and in a condition that will reasonably insure its ability to deliver such water to the City. The City shall have no obligation to operate and maintain any District-owned facilities. The City shall, however, be solely responsible for the operation and maintenance of its point of diversion from the District's canal and for the operation and maintenance of the flow meter required by this Agreement.

The District has no control over the quality of water in the North Santiam River, and it operates and maintains no water quality facilities, except its trash racks and the fish screens. Therefore, the District, except as to negligence on the part of the District, shall not be liable for defective quality of water delivered through the canal to the City. However, the District will at all times assist the City in maintaining water quality through the delivery system.

7. This Agreement and the rights and obligations of the parties hereto shall, at all times, be subject to the regulatory authority of the state of Oregon, as vested in any duly-constituted agency, the regulatory authority of the United States of America, as vested in any duly-constituted agency, the Water Control District Act, and to all rules and regulations adopted by the Board of Directors of the District in connection with its operation as a public entity.

8. Uncontrollable forces, which in the exercise of due diligence could not have reasonably been avoided, including but not limited to decrees and orders of any court having jurisdiction, lawful orders or directives of any governmental agency or authority, strikes, insurrection, acts of public enemy, fire, flood, earthquake, or other acts of God, negligent or deliberate acts of third parties, mechanical and structural breakdown or failure, shall excuse the affected party from its obligations under this Agreement.

9. Each of the parties hereto agrees to indemnify and hold the other party and its respective officers, employees, and agents, harmless against and from any and all liability and loss for injury to person or damage arising out of its own sole activities hereunder, except such injury or damage that may be caused by the sole or contributing negligence of the other. Each party's liability under this Agreement shall be limited by the "Tort Actions Against Public Bodies" law of the State of Oregon and such further statutory acts that limit liability of public bodies. Neither party, by executing this Agreement, shall be deemed to have waived any statutory limitation of liability.

10. Dispute Resolution

10.1 In the event a dispute arises between the parties as to the terms of this Agreement, the matter shall first be addressed through mandatory mediation.

If not settled by mediation, the parties shall resolve the matter by binding arbitration in accordance with Oregon laws.

10.2 In the event either party initiates arbitration to enforce the terms of this Agreement or to seek damages for its breach, or arising out of any dispute concerning the terms and conditions hereby created, the prevailing party shall be entitled to an award of its reasonable attorney fees in arbitration, or on appeal.

10.3 This Agreement shall be construed according to the laws of the State of Oregon.

11. Survival of Transfer: The parties agree that the City's rights under this Agreement shall survive any transfer of ownership of the diversion and/or canal by any means and whether voluntary or involuntary, from the District to any other person or entity.

12. Upon approval of this Agreement by final action of the City Council of City and its execution by the City's duly authorized officers, the District agrees to withdraw its protest to the transfer of said ten acre feet of water to the City from the City of Salem.

13. Term: The term of this Agreement is 20 years. This Agreement shall automatically be extended for five successive additional years unless the City or the District gives notice one year in advance that it does not intend to renew. All terms of this Agreement shall remain in effect during the five year successive extensions.

14. Claims: The parties agree that the District shall not file complaints, actions, or claims against the City related to evaporation or water loss related to the City's water usage under the Water Delivery Contract.

15. This Agreement supercedes all prior Agreements heretofore entered into between the parties for the delivery of water through the District's power canal to the City's water treatment facility. This Agreement is terminable only by mutual agreement of the City and the District.

16. No changes, modifications, or amendments to or waivers of any of the terms or conditions hereof shall be valid, except as the same are expressed in writing, approved by the City Council of the City and the Board of Directors of the District, and signed by the authorized representative of each of the parties.

SANTIAM WATER CONTROL DISTRICT, "DISTRICT"

By: Steven Kendell
Its President, Board of Directors

Steven Kendell
Print Name

By: Larry Traxi
Its Secretary, Board of Directors

Larry Traxi
Print Name

Date: 11-19-03

CITY OF STAYTON, "CITY"

By: Gerry Aboud
Mayor Gerry Aboud

By: Chris Childs
Chris Childs, City Administrator

Date: 12-2-2003

STATE OF OREGON, County of Marion) ss.

This instrument was acknowledged before me on Nov 19, 2003 by Steven Kendell, as President, and by Larry Traxi, as Secretary of the Board of Directors of the Santiam Water Control District.

OFFICIAL SEAL
LORI HUMPHREY
NOTARY PUBLIC - OREGON
COMMISSION NO. 354464
MY COMMISSION EXPIRES APRIL 16, 2006

Lori Humphrey
Notary Public for Oregon

My Commission Expires: 4/16/2006

City of Stayton Water Rights

Appl	Permit	Cert.	CFS	Source	Use	POD	Priority
T-5883		80346	2.78	N. Santiam	MU	Power Canal	1909
T-5884		80347	0.82	N. Santiam	MU	Salem Ditch	1911
T-5885		80348	0.39	N. Santiam	MU	Power Canal	1909
T-8871		80349	0.6	N. Santiam	MU	Power Canal	1907
39297	29266	57094	7	N. Santiam	MU	Power Canal	1963
71584	52447		25	N. Santiam	MU	Power Canal	1991
			10	of City of Salem Cert. #12033			1923

Appendix D Cost Estimates

KELLER ASSOCIATES

OPINION OF PROBABLE PROJECT COST

Client:	CITY OF STAYTON, OR
Project:	WATER TREATMENT PLANT MASTER PLAN
Item:	CAPITAL IMPROVEMENTS PLAN

Project No: 103002	
Sheet 1 of	
By: BRP	Ckd: DK
Date: 3/6/2005	Date: 3/8/2005

DESCRIPTION	UNIT MEAS.	QTY	UNIT COST	TOTAL COST	COMMENTS
Power Canal Raw Water Intake					
Inlet Structure Skimmer Board (8 ft x 2.5 ft)	LF	50	$15	$800	Material estimated form internet source. Labor estimated.
Removal of Silt Stop Structure	LS	1	$500	$500	
Security Gate Across Bridge	EA	1	$2,113	$2,200	Double swing security gate. RS Means 02820-528-5080. Add 30% for special installation and inflation.
Construction SubTotal				***$3,500***	
Professional Services (20%)				**$700**	Professional Services are calculated based on percentages of construction cost based on industry averages.
Contingencies (30%)				***$1,050***	Accuracy: Planning (-15% to +30%), PreDesign (-10% to +20%), Design (-10% to +10%)
Project Total				**$5,250**	

KELLER ASSOCIATES

OPINION OF PROBABLE PROJECT COST

Client:	CITY OF STAYTON, OR
Project:	WATER TREATMENT PLANT MASTER PLAN
Item:	CAPITAL IMPROVEMENTS PLAN

Project No: 103002	
Sheet 1 of	
By: BRP	Ckd: DK
Date: 3/6/2005	Date: 3/8/2005

DESCRIPTION	UNIT MEAS.	QTY.	UNIT COST	TOTAL COST	COMMENTS
Studies, Approval, and Easement					
Corp of Engineers and USFWS Impact Study	LS	1	$80,000	$80,000	Estimate based on study required for similar construction completed by Salem.
Easement Purchase	LS	1	$200,000	$200,000	
New RW Intake Structure on Santiam River					
24" RW Pipeline	LF	6000	$100	$600,000	Previous bids with applied factor for difficult excavation conditions.
Intake Screens and Structures	LS	1	$500,000	$500,000	Includes coarse bar screen, fines/fish screen, sediment pier.
Flow Control					
Actuated 24" Valve	EA	1	$10,000	$10,000	Estimated based on past experience.
Valve Vault (PreCast)	EA	1	$4,000	$4,000	Estimated based on past experience.
Valve Control (radio telemetry to plant)	LS	1	$3,000	$3,000	Assumes only supplying antanae and equipment at intake. Plant equipment already installed.
Air-Vac Valve Installation	EA	1	$3,000	$3,000	Includes Vault and valve, Past projects
Plant RW Piping Modifications	LS	1			
Power Canal Crossing	LS	1	$100,000	$100,000	
Construction SubTotal				***$1,500,000***	
Professional Services (20%)				**$300,000**	Professional Services are calculated based on percentages of construction cost based on industry averages.
Contingencies (30%)				***$450,000***	Accuracy: Planning (-15% to +30%), PreDesign (-10% to +20%), Design (-10% to +10%)
Project Total				**$2,250,000**	Rounded

Notes:
The estimate of probable cost presented in the " *Stayton Water Treatment Plant Supply Alternatives* " has been updated due to additional information collected through the course of this study.

KELLER ASSOCIATES

OPINION OF PROBABLE PROJECT COST

Client:	CITY OF STAYTON, OR
Project:	WATER TREATMENT PLANT MASTER PLAN
Item:	CAPITAL IMPROVEMENTS PLAN

Project No: 103002	
Sheet 1 of	
By: BRP	Ckd: DK
Date: 3/6/2005	Date: 3/8/2005

DESCRIPTION	UNIT MEAS.	QTY.	UNIT COST	TOTAL COST	COMMENTS
Studies and Approval					
Hydrogeologic Study / Well Siting	LS	1	$20,000	$20,000	
Shallow Well Field					
Well Construction	EA	6	$10,500	$63,000	Assumes average well production per well of 500 gpm, $350/ft depth, Average depth of 30 ft.
Pitless Pumping Facility					Pitless set in vault for security.
Submersible Pump	EA	6	$8,000	$48,000	
Pump Vault	EA	6	$4,000	$24,000	
Pitless Adapter, Check Valve, Flow Meters, Appurt.	EA	6	$6,000	$36,000	
Pipe Network					
18 inch PVC Transmission Main	LF	2000	$100	$200,000	Estimated from RS Means. 18" capable aof delivering build-out avg demand (4,400 gpm) with velocity of 5.55 ft/s
8 inch PVC Well Latteral	LF	900	$40	$36,000	Estimated from RS Means, 8" line per well to connect to the Transmission line.
Plant Modifications	LS	1	$20,000	$20,000	
Well Field Control	LS	1	$30,000	$30,000	Assumes only supplying equipment for well field. Plant equipment already installed.
Construction SubTotal				***$477,000***	
Professional Services (20%)				**$95,400**	Professional Services are calculated based on percentages of construction cost based on industry averages.
Contingencies (30%)				***$143,100***	Accuracy: Planning (-15% to +30%), PreDesign (-10% to +20%), Design (-10% to +10%)
Project Total				**$716,000**	Rounded

Note: Proposed system addresses flow to 2025. Additional wells should be added as demands progress beyond 7.96 MGD.

KELLER ASSOCIATES

OPINION OF PROBABLE PROJECT COST

Client:	CITY OF STAYTON, OR
Project:	WATER TREATMENT PLANT MASTER PLAN
Item:	CAPITAL IMPROVEMENTS PLAN

Project No: 103002	
Sheet 1 of	
By: BRP	Ckd: DK
Date: 3/6/2005	Date: 3/8/2005

DESCRIPTION	UNIT MEAS.	QTY.	UNIT COST	TOTAL COST	COMMENTS
Shallow Well Field					
Well Construction	EA	1	$10,500	$10,500	Assumes average well production per well of 500 gpm, $350/ft depth, Average depth of 30 ft.
Pitless Pumping Facility					Pitless set in vault for security.
Submersible Pump	EA	1	$8,000	$8,000	
Pump Vault	EA	1	$4,000	$4,000	
Pitless Adapter, Check Valve, Flow Meters, Appurt.	EA	1	$6,000	$6,000	
Pipe Network					
18 inch PVC Transmission Main	LF	150	$100	$15,000	Estimated from RS Means. 18" capable aof delivering build-out avg demand (4,400 gpm) with velocity of 5.55 ft/s
8 inch PVC Well Latteral	LF	100	$40	$4,000	Estimated from RS Means, 8" line per well to connect to the Transmission line.
Well Field Control	LS	1	$5,000	$5,000	Assumes only supplying equipment for well field. Plant equipment already installed.
Construction SubTotal				***$52,500***	
Professional Services (20%)				**$10,500**	Professional Services are calculated based on percentages of construction cost based on industry averages.
Contingencies (30%)				***$15,750***	Accuracy: Planning (-15% to +30%), PreDesign (-10% to +20%), Design (-10% to +10%)
Project Total				**$79,000**	Rounded

KELLER ASSOCIATES

OPINION OF PROBABLE PROJECT COST

Client:	CITY OF STAYTON, OR
Project:	WATER TREATMENT PLANT MASTER PLAN
Item:	CAPITAL IMPROVEMENTS PLAN

Project No: 103002	
Sheet 1 of	
By: BRP	Ckd: DK
Date: 3/6/2005	Date: 3/8/2005

DESCRIPTION	UNIT MEAS.	QTY.	UNIT COST	TOTAL COST	COMMENTS
Covnentional Pre-Treatment					This is a replacement option for the Shallow Well Field.
Pre-Treatment Process	GAL	7960000	$0.50	$3,980,000	Assumes productin capacity to meet 2025 peak day demand. Price per gallon includes all site work and existing plant modificaitons to accommodate pre-treatment.
Construction SubTotal				***$3,980,000***	
Professional Services (20%)				**$796,000**	Professional Services are calculated based on percentages of construction cost based on industry averages.
Contingencies (30%)				***$1,194,000***	Accuracy: Planning (-15% to +30%), PreDesign (-10% to +20%), Design (-10% to +10%)
Project Total				**$5,970,000**	

KELLER ASSOCIATES

OPINION OF PROBABLE PROJECT COST

Client:	CITY OF STAYTON, OR
Project:	WATER TREATMENT PLANT MASTER PLAN
Item:	CAPITAL IMPROVEMENTS PLAN

Project No: 103002	
Sheet 1 of	
By: BRP	Ckd: DK
Date: 3/6/2005	Date: 3/8/2005

DESCRIPTION	UNIT MEAS.	QTY.	UNIT COST	TOTAL COST	COMMENTS
Small Exploritory Well	FT	400	$100	$40,000	
Deep Aquifer Well (400-ft)					This is an emergency use well
Upper Level	FT	100	$350	$35,000	Assumes productin capacity to meet 2025 peak day demand. Price per gallon includes all site work and
Lower Level	FT	300	$150	$45,000	existing plant modificaitons to accommodate pre-treatment.
Pumping Facility					
Pump	EA	1	$25,000	$25,000	Assumes submersible with pitless adapter.
Support Equipment	EA	1	$84,000	$84,000	Includes fittings, valves, flowmetering, etc.
Well House (15-ft X 15-ft)	SF	300	$120	$36,000	
Telemetry	LS	1	$15,000	$15,000	Assumes radio telemetry station, base already established under a different improvement.
River Crossing and Pipeline	LS	1	$600,000	$600,000	Assumes well drilled south of river
Construction SubTotal				***$880,000***	
Contractor Mobilization, Bonds, Insurance (15%)				$132,000	
Professional Services					Professional Services are calculated based on percentages of construction cost based on industry averages.
Engineering Design (12%)				$105,600	Pre-Design Reoport, Design, Bidding, Award
Engineering Construction Admin & Inspection (8%)				$70,400	Services During Construction
Additional Services				$50,000	Survey, Easements, Permits, Water Rights, Foundation Investigation, Grant Apps, Funding Admin, User Rates, Ordinances, etc.
Project SubTotal				***$1,238,000***	
Miscellaneous					
Project Contingency (20%)				$247,600	Accuracy: Planning (-15% to +30%), PreDesign (-10% to +20%), Design (-10% to +10%)
Project Total				**$1,486,000**	Rounded

KELLER ASSOCIATES

OPINION OF PROBABLE PROJECT COST

Client:	CITY OF STAYTON, OR
Project:	WATER TREATMENT PLANT MASTER PLAN
Item:	CAPITAL IMPROVEMENTS PLAN

Project No: 103002	
Sheet 1 of	
By: BRP	Ckd: DK
Date: 3/6/2005	Date: 3/8/2005

DESCRIPTION	UNIT MEAS.	QTY	UNIT COST	TOTAL COST	COMMENTS
RW Weir Box					
Actuation of Existing RW Valve (modulation and position)	LS	1	$2,500	$2,500	Assumes plant SCADA is in place to control valve remotely. Includes wiring to deliver signal to PLC.
Concrete Baffles (Replace Existing Wood)	LS	1	$4,000	$4,000	Cast in place with reinforcing doweled into existing walls. Offsetting baffle hole patterns.
Weir Box Expansion (Filter #4 Feed)	LS	1	$18,000	$18,000	Extend exisitng weir box 5.5', Filter 3 & 4 through side wall of new box. Port exisitng wall to baffle flow.
Construction SubTotal				***$24,500***	
Professional Services (15%)				**$3,675**	Professional Services are calculated based on percentages of construction cost based on industry averages.
Contingencies (30%)				***$7,350***	Accuracy: Planning (-15% to +30%), PreDesign (-10% to +20%), Design (-10% to +10%)
Project Total				**$35,525**	

KELLER ASSOCIATES

OPINION OF PROBABLE PROJECT COST

Client:	CITY OF STAYTON, OR
Project:	WATER TREATMENT PLANT MASTER PLAN
Item:	CAPITAL IMPROVEMENTS PLAN

Project No: 103002	
Sheet 1 of	
By: BRP	Ckd: DK
Date: 3/6/2005	Date: 3/8/2005

DESCRIPTION	UNIT MEAS.	QTY.	UNIT COST	TOTAL COST	COMMENTS
Filter Flowmeter					
16" Ultr-Mag Meter	EA	3			Ultra-Mag as manufactured by Marsh-McBirney
Remote Mounted Transmitter	EA	3			
Extra Transmitter Cable	LF	300			
Meter Vault	EA	3			
Tapping Saddle (16") and Mounting Valve	EA	3			
Construction SubTotal				***$49,500***	
Professional Services (15%)				**$7,425**	Professional Services are calculated based on percentages of construction cost based on industry averages.
Contingencies (30%)				***$14,850***	Accuracy: Planning (-15% to +30%), PreDesign (-10% to +20%), Design (-10% to +10%)
Project Total				**$72,000**	

KELLER ASSOCIATES

OPINION OF PROBABLE PROJECT COST

Client:	CITY OF STAYTON, OR
Project:	WATER TREATMENT PLANT MASTER PLAN
Item:	CAPITAL IMPROVEMENTS PLAN

Project No: 103002	
Sheet 1 of	
By: BRP	Ckd: DK
Date: 3/6/2005	Date: 3/8/2005

DESCRIPTION	UNIT MEAS.	QTY.	UNIT COST	TOTAL COST	COMMENTS
Replace Filter #1 Valve					
16" Valve	EA	1	$2,000	$2,000	Based on past bid prices.
Construction SubTotal				***$2,000***	
Professional Services (15%)				**$300**	Professional Services are calculated based on percentages of construction cost based on industry averages.
Contingencies (30%)				***$600***	Accuracy: Planning (-15% to +30%), PreDesign (-10% to +20%), Design (-10% to +10%)
Project Total				**$2,900**	

KELLER ASSOCIATES

OPINION OF PROBABLE PROJECT COST

Client:	CITY OF STAYTON, OR
Project:	WATER TREATMENT PLANT MASTER PLAN
Item:	CAPITAL IMPROVEMENTS PLAN

Project No: 103002	
Sheet 1 of	
By: BRP	Ckd: DK
Date: 3/6/2005	Date: 3/8/2005

DESCRIPTION	UNIT MEAS.	QTY.	UNIT COST	TOTAL COST	COMMENTS
New Conventional Plant					
Plant to Replace Existing Capacity	GAL	6500000	$1.00	$6,500,000	Existing Peak Day = 6.5 MGD
Conventional Plant Expansion					
Plant to Replace Existing Capacity	GAL	1460000	$1.00	$1,460,000	Existing Peak Day 2025 = 7.96-6.5 = 1.46 MGD
Construction SubTotal				***$7,960,000***	
Professional Services (15%)				**$1,194,000**	Professional Services are calculated based on percentages of construction cost based on industry averages.
Contingencies (15%)				***$1,194,000***	Accuracy: Planning (-15% to +30%), PreDesign (-10% to +20%), Design (-10% to +10%)
Project Total				**$10,348,000**	

KELLER ASSOCIATES

OPINION OF PROBABLE PROJECT COST

Client:	CITY OF STAYTON, OR
Project:	WATER TREATMENT PLANT MASTER PLAN
Item:	CAPITAL IMPROVEMENTS PLAN

Project No: 103002	
Sheet 1 of	
By: BRP	Ckd: DK
Date: 3/6/2005	Date: 3/8/2005

DESCRIPTION	UNIT MEAS.	QTY.	UNIT COST	TOTAL COST	COMMENTS
RelineFilter #3					
Demolition					
Media	LS	1			Loader and Truck, RS Means Rental Assuming 2 Days
Collection Latterals	LS	1			Cut and Hauled to Land fill, 2 man crew, dump truck, landfill fees. Assume 2 days.
Gunite Liner	LS	1			Excavator, Truck and 3 man crew. Assume 1 week.
Base Preparation	LS	1			Includes placing new base material, regrading and compaction.
HDPE Liner	SF	53604			Assume 60 mil. Includes material supply and installation.
Support Gravel	CU YD	2415			Includes placement of the material
Under Drain Laterals - 6" SDR 32.5	FT	3220			46 laterals, 70 ft long, 10 ft on center
Caps for 6" Latterals	EA	46			
Under Drain Header - 24" SDR 32.5	FT	228			
Crosses for 6" Latteral Connections	EA	23			24X24X6X6 HDPE cross
Filter Media	CU YD	4492			Includes placement of the material. Material is screened and washed sand.
Miscellaneous Penetrations	LS	1			
Construction SubTotal				***$374,000***	
Professional Services (15%)				**$56,100**	Professional Services are calculated based on percentages of construction cost based on industry averages.
Contingencies (30%)				***$112,200***	Accuracy: Planning (-15% to +30%), PreDesign (-10% to +20%), Design (-10% to +10%)
Project Total				**$542,300**	

KELLER ASSOCIATES

OPINION OF PROBABLE PROJECT COST

Client:	CITY OF STAYTON, OR
Project:	WATER TREATMENT PLANT MASTER PLAN
Item:	CAPITAL IMPROVEMENTS PLAN

Project No: 103002	
Sheet 1 of	
By: BRP	Ckd: DK
Date: 3/6/2005	Date: 3/8/2005

DESCRIPTION	UNIT MEAS.	QTY.	UNIT COST	TOTAL COST	COMMENTS
Cover for Existing Slow Sand Filters					Assume ventilation and headspace to accommodate a 30' clear space. Bed is 13' deep. Cover is 17'tall.
Fitler #1	SF	57000	$40	$2,280,000	
Filter #2	SF	57000	$40	$2,280,000	
Filter #3	SF	76180	$40	$3,047,200	
Construction SubTotal				***$7,607,200***	
Professional Services (15%)				**$1,141,080**	Professional Services are calculated based on percentages of construction cost based on industry averages.
Contingencies (15%)				***$1,141,080***	Accuracy: Planning (-15% to +30%), PreDesign (-10% to +20%), Design (-10% to +10%)
Project Total				**$9,889,000**	

KELLER ASSOCIATES

OPINION OF PROBABLE PROJECT COST

Client:	CITY OF STAYTON, OR
Project:	WATER TREATMENT PLANT MASTER PLAN
Item:	CAPITAL IMPROVEMENTS PLAN

Project No: 103002	
Sheet 1 of	
By: BRP	Ckd: DK
Date: 3/6/2005	Date: 3/8/2005

DESCRIPTION	UNIT MEAS.	QTY	UNIT COST	TOTAL COST	COMMENTS
Increase Filter Buffer Zone					
Chainlink Security Fence	LF	3100	$25	$77,500	Assumed 8' Chainlink with 3 strand barbwire $18. Added $7 due to difficulty to construct.
Construction SubTotal				***$77,500***	
Professional Services (15%)				**$11,625**	Professional Services are calculated based on percentages of construction cost based on industry averages.
Contingencies (30%)				***$23,250***	Accuracy: Planning (-15% to +30%), PreDesign (-10% to +20%), Design (-10% to +10%)
Project Total				**$112,000**	Rounded

KELLER ASSOCIATES

OPINION OF PROBABLE PROJECT COST

Client:	CITY OF STAYTON, OR
Project:	WATER TREATMENT PLANT MASTER PLAN
Item:	CAPITAL IMPROVEMENTS PLAN

Project No: 103002	
Sheet 1 of	
By: BRP	Ckd: DK
Date: 3/6/2005	Date: 3/8/2005

DESCRIPTION	UNIT MEAS.	QTY.	UNIT COST	TOTAL COST	COMMENTS
New Filter Bed					
Site Clearing	SY	5956	$3.10	$18,500	
Embankment / Fill	CY	47710	$3.50	$167,000	37,710 cu yd ebankment fill + 10,000 cu yd leveling fill
Base Preparation	LS	1	$20,000	$20,000	Includes placing new base material, regrading and compaction.
HDPE Liner	SF	53604	$0.55	$29,500	Assume 60 mil. Includes material supply and installation.
Support Gravel	CY	2415	$28	$67,700	Includes placement of the material
Under Drain Laterals - 6" SDR 32.5	FT	3220	$8	$25,800	46 laterals, 70 ft long, 10 ft on center
Caps for 6" Latterals	EA	46	$30	$1,400	
Under Drain Header - 24" SDR 32.5	FT	228	$35	$8,000	
Crosses for 6" Latteral Connections	EA	23	$650	$15,000	24X24X6X6 HDPE cross
Filter Media	CY	4492	$25	$112,300	Includes placement of the material. Material is screened and washed sand.
Miscellaneous Penetrations	LS	1	$8,000	$8,000	
Cover (if variance cannot be obtained)	SF	57000	$40	$2,280,000	Required by OHOD via reference to Ten State Standards.
Filtered Water Pumping Facility	LS	1	$25,000	$25,000	
Construction SubTotal				***$2,778,200***	
Professional Services (20%)				**$555,640**	Professional Services are calculated based on percentages of construction cost based on industry averages.
Contingencies (30%)				***$833,460***	Accuracy: Planning (-15% to +30%), PreDesign (-10% to +20%), Design (-10% to +10%)
Project Total				**$4,167,300**	**$750,000 without cover**

KELLER ASSOCIATES

OPINION OF PROBABLE PROJECT COST

Client:	CITY OF STAYTON, OR
Project:	WATER TREATMENT PLANT MASTER PLAN
Item:	CAPITAL IMPROVEMENTS PLAN

Project No: 103002	
Sheet 1 of	
By: BRP	Ckd: DK
Date: 3/6/2005	Date: 3/8/2005

DESCRIPTION	UNIT MEAS.	QTY.	UNIT COST	TOTAL COST	COMMENTS
Filter Turbidimeters					
Turbidimeters	EA	3	$9,500	$28,500	
Sample pumps	EA	3	$2,500	$7,500	
Construction SubTotal				***$36,000***	
Professional Services (25%)				**$9,000**	Professional Services are calculated based on percentages of construction cost based on industry averages.
Contingencies (30%)				***$10,800***	Accuracy: Planning (-15% to +30%), PreDesign (-10% to +20%), Design (-10% to +10%)
Project Total				**$56,000**	Rounded

KELLER ASSOCIATES

OPINION OF PROBABLE PROJECT COST

Client:	CITY OF STAYTON, OR
Project:	WATER TREATMENT PLANT MASTER PLAN
Item:	CAPITAL IMPROVEMENTS PLAN

Project No: 103002	
Sheet 1 of	
By: BRP	Ckd: DK
Date: 3/6/2005	Date: 3/8/2005

DESCRIPTION	UNIT MEAS.	QTY.	UNIT COST	TOTAL COST	COMMENTS
Soda Ash Improvements					
Feed Hopper Cover	LS	1	$7,000	$7,000	
Modify Chemical Dosing Scheme	LS	1	$10,000	$10,000	
Expansion to meet Future Demands	LS	1	$20,000	$20,000	
Construction SubTotal				***$37,000***	
Professional Services (15%)				**$5,550**	Professional Services are calculated based on percentages of construction cost based on industry averages.
Contingencies (30%)				***$11,100***	Accuracy: Planning (-15% to +30%), PreDesign (-10% to +20%), Design (-10% to +10%)
Project Total				**$53,650**	

KELLER ASSOCIATES

OPINION OF PROBABLE PROJECT COST

Client:	CITY OF STAYTON, OR
Project:	WATER TREATMENT PLANT MASTER PLAN
Item:	CAPITAL IMPROVEMENTS PLAN

Project No: 103002	
Sheet 1 of	
By: BRP	Ckd: DK
Date: 3/6/2005	Date: 3/8/2005

DESCRIPTION	UNIT MEAS.	QTY	UNIT COST	TOTAL COST	COMMENTS
Chlorine Feed Improvements					
Seal Room	LS	1	$550	$600	
Viewing Window	LS	1	$550	$600	
Chlorine Leak Detection	LS	1	$1,750	$1,800	
New On-Site Hypo-Chlorite Generator					
Building Modifications	LS	1	$16,000	$16,000	
Generation System (150 lb/day)	EA	1	$119,000	$119,000	
Installation	EA	1	$10,000	$10,000	
Electrical Service, Miscellaneous Small Piping	LS	1	$21,000	$21,000	
Construction SubTotal				***$169,000***	
Professional Services (15%)				**$25,350**	Professional Services are calculated based on percentages of construction cost based on industry averages.
Contingencies (15%)				***$25,350***	Accuracy: Planning (-15% to +30%), PreDesign (-10% to +20%), Design (-10% to +10%)
Project Total				**$220,000**	Rounded

KELLER ASSOCIATES

OPINION OF PROBABLE PROJECT COST

Client:	CITY OF STAYTON, OR
Project:	WATER TREATMENT PLANT MASTER PLAN
Item:	CAPITAL IMPROVEMENTS PLAN

Project No: 103002	
Sheet 1 of	
By: BRP	Ckd: DK
Date: 3/6/2005	Date: 3/8/2005

DESCRIPTION	UNIT MEAS.	QTY.	UNIT COST	TOTAL COST	COMMENTS
0.5 MG Clearwell Rehab					
	LS	1	$65,000	$65,000	
Construction SubTotal				***$65,000***	
Professional Services (15%)				**$9,750**	Professional Services are calculated based on percentages of construction cost based on industry averages.
Contingencies (30%)				***$19,500***	Accuracy: Planning (-15% to +30%), PreDesign (-10% to +20%), Design (-10% to +10%)
Project Total				**$94,250**	

KELLER ASSOCIATES

OPINION OF PROBABLE PROJECT COST

Client:	CITY OF STAYTON, OR
Project:	WATER TREATMENT PLANT MASTER PLAN
Item:	CAPITAL IMPROVEMENTS PLAN

Project No: 103002	
Sheet 1 of	
By: BRP	Ckd: DK
Date: 3/6/2005	Date: 3/8/2005

DESCRIPTION	UNIT MEAS.	QTY.	UNIT COST	TOTAL COST	COMMENTS
In-Plant Automation Equipment					
RW Intake Valve Control	LS	1	$13,000	$13,000	
Filter RW Valve Control	LS	1	$13,000	$13,000	
Cl Flow Pacing	LS	1	$7,000	$7,000	
Filter Water Pump Control	LS	1	$7,500	$7,500	
Finsih Water Pump Constrol	LS	1	$7,500	$7,500	
Soda Ash Flow Pacing	LS	1	$18,000	$18,000	
Construction SubTotal				***$66,000***	
Professional Services (15%)				**$9,900**	Professional Services are calculated based on percentages of construction cost based on industry averages.
Contingencies (30%)				***$19,800***	Accuracy: Planning (-15% to +30%), PreDesign (-10% to +20%), Design (-10% to +10%)
Project Total				**$95,700**	

KELLER ASSOCIATES

OPINION OF PROBABLE PROJECT COST

Client:	CITY OF STAYTON, OR
Project:	WATER TREATMENT PLANT MASTER PLAN
Item:	CAPITAL IMPROVEMENTS PLAN

Project No: 103002	
Sheet 1 of	
By: BRP	Ckd: DK
Date: 3/6/2005	Date: 3/8/2005

DESCRIPTION	UNIT MEAS.	QTY.	UNIT COST	TOTAL COST	COMMENTS
Finished Water Pumping Improvements					
Maintain Pump Control Valves	EA	3	$1,200	$3,600	
Remove Obsolete Monitoring Equipment	LS	1	$1,000	$1,000	
Install FW VFD	LS	1	$32,000	$32,000	Includes VFD Feeder, Disconnect, Modor Feeder
New 200 HP FW Pump	EA	1	$117,500	$117,500	Includes pump, piping, valves, starter, feeder
Replace 100 Hp w/ 200 HP FW Pump	EA	1	$79,500	$79,500	includes pump, removal of old pump, starer, feeder, piping modifications
Construction SubTotal				***$233,600***	
Professional Services (15%)				**$35,040**	Professional Services are calculated based on percentages of construction cost based on industry averages.
Contingencies (30%)				***$70,080***	Accuracy: Planning (-15% to +30%), PreDesign (-10% to +20%), Design (-10% to +10%)
Project Total				**$338,720**	

KELLER ASSOCIATES

PINION OF PROBABL
PROJECT COST

Client:	CITY OF STAYTON, OR
Project:	WATER TREATMENT PLANT MASTER PLAN
Item:	CAPITAL IMPROVEMENTS PLAN

Project No: 103002	
Sheet 1 of	
By: BRP	Ckd: DK
Date: 3/6/2005	Date: 3/8/2005

DESCRIPTION	UNIT MEAS.	QTY.	UNIT COST	TOTAL COST	COMMENTS
Plant Electrical Ssytem Improvements					
Electrical Service Disconnect	LS	1	$80,000	$80,000	
Construction SubTotal				***$80,000***	
Professional Services (15%)				**$12,000**	Professional Services are calculated based on percentages of construction cost based on industry averages.
Contingencies (30%)				***$24,000***	Accuracy: Planning (-15% to +30%), PreDesign (-10% to +20%), Design (-10% to +10%)
Project Total				**$116,000**	

DESCRIPTION	UNIT MEAS.	QTY.	UNIT COST	TOTAL COST	COMMENTS
Plant Electrical Ssytem Improvements					
Emergency Power Generator	LS	1	$130,000	$130,000	600 kw, 480 volt, 3 phase, diesel driven unit with a 1000 amp automatic transfer switch
Construction SubTotal				***$130,000***	
Professional Services (15%)				**$19,500**	Professional Services are calculated based on percentages of construction cost based on industry averages.
Contingencies (15%)				***$19,500***	Accuracy: Planning (-15% to +30%), PreDesign (-10% to +20%), Design (-10% to +10%)
Project Total				**$169,000**	

KELLER ASSOCIATES

OPINION OF PROBABLE PROJECT COST

Client:	CITY OF STAYTON, OR
Project:	WATER TREATMENT PLANT MASTER PLAN
Item:	CAPITAL IMPROVEMENTS PLAN

Project No: 103002	
Sheet 1 of	
By: BRP	Ckd: DK
Date: 3/6/2005	Date: 3/8/2005

DESCRIPTION	UNIT MEAS.	QTY.	UNIT COST	TOTAL COST	COMMENTS
Plant Maintenance					
Maintenance Shop	SF	2260	$100	$226,000	
New Plant Entrance	LS	1	$50,000	$50,000	
Construction SubTotal				***$276,000***	
Professional Services (15%)				**$41,400**	Professional Services are calculated based on percentages of construction cost based on industry averages.
Contingencies (15%)				***$41,400***	Accuracy: Planning (-15% to +30%), PreDesign (-10% to +20%), Design (-10% to +10%)
Project Total				**$358,800**	

KELLER ASSOCIATES

OPINION OF PROBABLE PROJECT COST

Client:	CITY OF STAYTON, OR
Project:	WATER TREATMENT PLANT MASTER PLAN
Item:	CAPITAL IMPROVEMENTS PLAN

Project No: 103002	
Sheet 1 of	
By: BRP	Ckd: DK
Date: 3/6/2005	Date: 3/8/2005

DESCRIPTION	UNIT MEAS.	QTY.	UNIT COST	TOTAL COST	COMMENTS
Plant Security and Vulnerability					
Plant Entrance Security Reader	LS	1	$30,000	$30,000	
Plant Security Fencing	LF	600	$35	$21,000	
Plant Security Lighting	LS	1	$35,000	$35,000	Assumes 30-ft Aluminum Pole, 1,000 W High Pressure Sodium Bulb
CCTV Monitoring	LS	1	$45,000	$45,000	
Building Security System	LS	1	$10,000	$10,000	
Construction SubTotal				***$141,000***	
Professional Services (15%)				**$21,150**	Professional Services are calculated based on percentages of construction cost based on industry averages.
Contingencies (30%)				***$42,300***	Accuracy: Planning (-15% to +30%), PreDesign (-10% to +20%), Design (-10% to +10%)
Project Total				**$204,450**	

KELLER ASSOCIATES

OPINION OF PROBABLE PROJECT COST

Client:	CITY OF STAYTON, OR
Project:	WATER TREATMENT PLANT MASTER PLAN
Item:	CAPITAL IMPROVEMENTS PLAN

Project No: 103002	
Sheet 1 of	
By: BRP	Ckd: DK
Date: 3/6/2005	Date: 3/8/2005

DESCRIPTION	UNIT MEAS.	QTY.	UNIT COST	TOTAL COST	COMMENTS
Raw Water Flow Meter					
30" Ultr-Mag Meter	EA	1	$8,495	$8,500	Ultra-Mag as manufactured by Marsh-McBirney
Extra Transmitter Cable	LF	130	$2.25	$300	
Meter Vault	EA	1	$5,000	$5,000	
Tapping Saddle (30") and Mounting Valve	LS	1	$3,000	$3,000	
Miscellaneous	LS	1	$4,500	$4,500	
Finished Water Flow Meter					
30" Ultr-Mag Meter	EA	1	$8,495	$8,500	Ultra-Mag as manufactured by Marsh-McBirney
Extra Transmitter Cable	LF	130	$2.25	$300	
Meter Vault	EA	1	$4,000	$4,000	
Tapping Saddle (30") and Mounting Valve	LS	1	$3,000	$3,000	
Miscellaneous	LS	1	$1,534	$1,600	
Raw & Finished Water pH Monitoring					
	EA	2	$6,000	$12,000	Ultra-Mag as manufactured by Marsh-McBirney
	LS	1	$3,000	$3,000	Conduit and Wiring
Filter Level Transmitter					
	EA	3	$6,000	$18,000	Ultra-Mag as manufactured by Marsh-McBirney
	LS	1	$2,500	$2,500	Conduit and Wiring
	LS	1	$1,500	$1,500	Mounting
Filter Pump Level Transmitter					
	EA	3	$6,000	$18,000	Ultra-Mag as manufactured by Marsh-McBirney
	LS	1	$2,500	$2,500	Conduit and Wiring
	LS	1	$1,500	$1,500	Mounting
Filter Pump Level Transmitter					
	LS	1	$6,900	$6,900	Ultra-Mag as manufactured by Marsh-McBirney
Construction SubTotal				***$97,700***	
Professional Services (15%)				**$14,655**	Professional Services are calculated based on percentages of construction cost based on industry averages.
Contingencies (30%)				***$29,310***	Accuracy: Planning (-15% to +30%), PreDesign (-10% to +20%), Design (-10% to +10%)
Project Total				**$141,665**	

KELLER ASSOCIATES

OPINION OF PROBABLE PROJECT COST

Client:	CITY OF STAYTON, OR
Project:	WATER TREATMENT PLANT MASTER PLAN
Item:	CAPITAL IMPROVEMENTS PLAN

Project No: 103002	
Sheet 1 of	
By: BRP	Ckd: DK
Date: 3/6/2005	Date: 3/8/2005

DESCRIPTION	UNIT MEAS.	QTY.	UNIT COST	TOTAL COST	COMMENTS
Plant Operation Control System					
Plant Computer and Software	LS	1	$25,000	$25,000	
Programming	LS	1	$20,000	$20,000	
Construction SubTotal				***$45,000***	
Professional Services (15%)				**$6,750**	Professional Services are calculated based on percentages of construction cost based on industry averages.
Contingencies (30%)				***$13,500***	Accuracy: Planning (-15% to +30%), PreDesign (-10% to +20%), Design (-10% to +10%)
Project Total				**$65,000**	Rounded