EXECUTIVE SUMMARY

The City of Cottage Grove has two water treatment plants. The older plant is located approximately 21 miles east of the city on Layng Creek and has a capacity of 1.6 MGD. The newer plant is adjacent to the Row River east of the City and has a capacity of 2.0 MGD. The two plants, together, produced an average flow of 1.5 MGD during 1999, but the City will need 2.5 MGD by the year 2022. The City consumption from the two plants during the maximum week was 2.4 MGD in 1999 and is expected to reach 4.9 MGD by the year 2022.

The Layng Creek plant historically, was not able to consistently meet drinking water requirements of the Oregon Health Division for turbidity prior to replacing the filter media in January of 2000. In addition, the condition of the transmission pipeline from the dam sites to the City has deteriorated since it was installed in 1947. In an agreement signed in February of 2000 the City authorized LDC Design Group, Inc. to review the condition of the Layng Creek system and its ability to meet future needs through the planning year of 2022.

There are two significant issues addressed in this report. The first was to determine the conditions of the facilities and the costs of repairs and/or replacements to maintain service for the City. The second was to consider alternative solutions and propose a plan for the City to meet its needs for water.

The transmission pipeline was analyzed and the costs of maintaining and repairing it were estimated so that it could continue in service. The treatment plant was also analyzed and, since it is not expected to meet future needs, the costs of new treatment facilities were estimated. Seven alternative plans were considered, including replacing the Layng Creek system with an immediate expansion of the Row River plant, a variety of treatment processes that might be used to replace the Layng Creek plant, reducing the number of customers served, and replacement of badly deteriorated pipelines.

Costs were compared and a decision, based on costs over the planning period, favors expanding the Row River plant to serve the City and the outside customers between the City and Dorena Lake, ceasing to provide service east of the Dorena Mobile Home Park and closing the existing Layng Creek Plant and facilities. It is recommended that the City review these findings and, if approved, proceed with a phased program to secure additional financial assistance, and to expand the Row River Plant to replace the supply from the Layng Creek plant and to abandon the system's facilities east of the Dorena Mobile Home Park. The cost of improvements over the next three years would be approximately $3.6 million dollars. If no new financial assistance were to be obtained, the annual debt service cost for this alternative, at normal interest rates, would be expected to increase approximately 70 percent in 2005. Annual operating costs would be expected to increase only by about four percent per year.

If sufficient additional revenue and grants can be obtained to pay the additional cost of service to the customers along the to-be-abandoned section of pipeline, then the City should instead install a storage tank, repair the transmission pipeline and replace the Layng Creek treatment plant with either slow sand filtration or the “package” filtration facilities. The cost of improvements over the next three years for these alternatives would be approximately $6.3 million dollars. The annual debt service cost would be expected to increase approximately 120 percent in 2005 if either type of filtration is selected with financing at normal interest rates. The annual costs for operation and maintenance would be expected to increase by about four percent per year, but the increase would be nearly double that rate during the year the package plant was to be completed.

Table 1 shows the several alternatives, advantages, disadvantages, issues, and costs.

TABLE 1 – COMPARISON OF ALTERNATIVES

Alternatives	Advantages	Disadvantages	Issues	Costs[1]
1 **Disconnect Customers 2 MGD**	1. Eliminates costs for: • Dams • Diversion pipelines • Layng Creek Site • Transmission main 2. Eliminates remote sites. 3. Eliminates existing filters	1. No service to extraterritorial customers. 2. Loss of revenue. 3. Requires early expansion of R.R. Plant. 4. Requires demolition of dams, Layng Cr. Plant and suspension bridge.	1. Can City stop serving existing customers? 2. Is City willing to stop serving existing customers? 3. What level of demolition will be required? 4. Who will own the abandoned sites? 5. What is the cost for expansion of the R.R. Plant?	$10,642
2 **Pump From Row River 2 MGD**	1. Continues service to all customers. 2. Eliminates costs for: • Dams • Diversion pipelines • Treatment plant, both sites. 3. Eliminates remote facility. 4. Eliminates facilities at Layng Creek sites.	1. Requires improvements to transmission main. 2. Requires new pump station. 3. Requires new storage reservoir. 4. Requires demolition of dams, Layng Creek Plant, and the suspension bridge.	1. What level of demolition will be required? 2. Who will own the abandoned sites? 3. Where should pump station and reservoir be constructed? 4. What is the cost for the R.R. Plant expansion? 5. What is the cost of transmission main repairs? 6. There may be a concern of stale water in the trans. main.	$15,500
3 **Slow Sand Filters 2 MGD**	1. Continues service to all customers. 2. Continues to use facilities at Layng Creek Plant. 3. Provides a new plant adaptable to automation. 4. Minimizes costs for new treatment facilities. 5. Defers expansion of R.R. Plant.	1. Continues remote facilities. 2. Improvements are required for: • Dams • Diversion pipeline • Treatment plant @ lower site. • Transmission main. 3. Requires new storage reservoir. 4. Requires additional land @ lower site. 5. Requires continued maintenance of upper site.	1. Land acquisition. 2. Costs for probable fish passage requirements. 3. Continued remote operations. 4. Long term costs associated with remote operations. 5. Requires occasional “emergency visit”.	$14,162
4 **Package Plant 2 MGD**	1. Continues service to all customers. 2. Combines treatment operations into one site. 3. Provides new plant adaptable to automation. 4. Defers expansion of R.R. Plant.	1. Continues remote operations. 2. Requires improvements to: • Dams • Diversion pipeline • Treatment plant @ lower site. • Transmission main. 3. Requires new storage reservoir. 4. Requires demolition of upper site. 5. Requires additional land @ lower site.	1. Continued remote operation 2. Requirement for occasional “emergency visit” 3. Fish passage. 4. Land acquisition.	$$14,858
5 **Cartridge Filters 2 MGD**	1. Continues service to all customers. 2. Combines treatment operations into one site. 3. Provides new plant adaptable to automation. 4. Defers expansion of R.R. Plant.	1. Continues remote operations. 2. Improvements are required for: • Dams • Diversion pipeline • Treatment plant @ lower site. • Transmission main. 3. Requires new storage reservoir. 4. Requires demolition of facilities at upper site. 5. Requires additional land @ lower site.	1. Continued remote operation 2. Requirement for occasional “emergency visit” 3. Fish passage. 4. Land acquisition.	$15,041
6 **Membrane Filters 2 MGD**	1. Continues service to all customers. 2. Combines treatment operations into one site. 3. Provides new plant adaptable to automation. 4. Defers expansion of R.R. Plant.	1. Continues remote operations. 2. Improvements are required for: • Dams • Diversion pipeline • Treatment plant @ lower site. • Transmission main. 3. Requires new storage reservoir. 4. Requires demolition of facilities @ uppr site. 5. Requires additional land @ lower site.	1. Continued remote operation 2. Requirement for occasional “emergency visit” 3. Fish passage. 4. Land acquisition.	$16,560
7 **Pump from Row River 3 MGD**	1. Continues service to all customers. 2. Eliminates cost for: • Dams • Diversion pipeline • Treatment plant @ both sites. 3. Eliminates remote operations. 4. Eliminates facilities at the Layng Creek sites. 5. Avoids the need for an additional plant expansion. 6. Reduces required units @ R.R. Plant and reduces operation costs. 7. Provides a plant that is adaptable to automation.	1. Requires improvements to the transmission main. 2. Requires new pumping facilities. 3. Requires new storage reservoir. 4. Requires demolition of dams and suspension bridge. 5. Requires additional land @ lower site.	1. What level of demolition is required? 2. Who will own abandoned sites? 3. Where should new pumping facilities & reservoir be constructed? 4. What is cost for R.R. Plant? 5. Land acquisition.	$15,638

(1) Costs in thousands, year 2000-dollar value

BACKGROUND INFORMATION

PURPOSE OF STUDY

The Layng Creek plant has been unable to comply with the turbidity limits during periods of high raw water turbidity. Also, the supply pipelines between the diversion points on Prather Creek and Layng Creek and the treatment plant, and the transmission main between the treatment plant and the city reservoirs are aging and require significant ongoing maintenance.

This study is to present a plan and estimate the costs that would:

- Enable the plant to meet established turbidity limits, and
- Estimate the remaining service life of the pipelines and repairs anticipated necessary to keep them in service to carry water from the plant to the reservoirs.

Several project alternatives are to be developed and considered. Plan development will also consider present and future regulatory requirements, environmental impacts of the alternatives, and both capital and operating costs.

DESCRIPTION OF SYSTEM

The Layng Creek system includes diversion dams, pipelines and treatment facilities. The locations of these facilities are shown on Figure 1 following this page.

<u>Pipelines</u>
Water appears to have been first taken from Layng Creek, possibly also from Prather Creek, following the construction of the diversion dam in 1912. There is no record of a pipeline being constructed to the city at that time but it is reported by City personnel to be a 12-inch diameter wood stave pipe. This line was abandoned in-place and replaced in 1947.

In 1947 approximately 105,600 lineal feet of new pipe was installed from the City's reservoirs to the second intake dam on Layng Creek (constructed around 1924). The new pipe, a 14-inch steel pipe, was installed generally along the same alignment of the original 12-inch wood pipe. A portion of the pipe (approximately 33,000 feet) may have been either constructed or funded by the U.S. Army Engineers.

Continuing line maintenance through the years initiated the need for several sections of line replacement in 1978. The pipeline consisted of 14-inch spiral welded steel

Figure 1 – Existing Layng Creek Water Supply

pipe in 40-ft. pipe lengths. The pipe was coal tar coated and wrapped with positive contact connections welded across pipe joints. Eugene Sand and Gravel from Eugene, Oregon performed the construction. Since the 1978 construction, the old spiral welded steel pipe has continuously presented the City with maintenance problems. Small pinhole corrosion leaks are repaired with steel tapered plugs. Larger leaks are repaired with various sizes of repair clamps. This maintenance has become so commonplace that often clamps are found to abut each other or even overlap. Where sections of pipe are severely in need of repair, the damaged pipe is removed and replaced with ductile iron pipe.

Layng Creek Treatment Plant

The Layng Creek plant was built in two phases. The four filters were constructed in 1977 at the lower site with an alum house 0.7 miles upstream (upper site) to house alum and polymer feed for floc formation in the pipeline to the filters. A cyclone separator was also installed at the upper site to remove sand, gravel and silt from the raw water. The filters are Permutit valveless filters and originally had dual media (sand on the bottom and anthracite on top) but the anthracite was removed and replaced with sand, probably when the filters were resanded in 1984. The filters were again resanded in January 2000. The original design capacity was 1600 gpm (2.3 MGD) at a filter rate of 3 gpm/sf with all four units in service. Gas chlorine is used for disinfection with contact provided in the pipeline upstream of the first customers. Standby power is available at both sites.

The plant was not able to maintain its production during periods of high raw water turbidity, and chemical treatment facilities were added at the upper site in 1984. Those facilities include lime, alum, and polymer storage and feed, rapid mix, baffled tank flocculation, and sedimentation. Sludge is drawn off to a lagoon downhill of the sedimentation tank and decanted to the creek. Lime treatment and disinfection were also added at the lower site at that time.

The 1983 CH2M Hill report also proposed a fifth valveless filter and a finished water storage tank at the lower site. The tank was designed but these facilities were not constructed.

Row River Treatment Plant

This 2.0 MGD plant was constructed in 1993 to supplement the Layng Creek plant, bringing the City's total treatment capacity to approximately 4.0 MGD. An analysis of the process and facilities was not in the scope of this study, but reports in the files of the Oregon Division of Health and the daily operating reports from the city do not indicate any record of problems with performance. The plant is attractive, appears well designed, constructed, and operated.

The plant is located east of the city adjacent to Row River and draws water from either an infiltration gallery or a surface water intake. The system includes influent pumping, chemical coagulation, upflow clarification and rapid sand filtration, disinfection and pumping to the city storage system on Knox Hill. Chemicals used include alum and polymer for flocculation, lime and soda ash for pH control, and gaseous chlorine for disinfection. Wash water and sludge are discharged to a holding pond on site. Sludge is periodically land applied on site. A pre-sedimentation pond had been planned for the facility but was deleted before construction.

The facilities, except for disinfection and high service pumping, are located within a pre-engineered metal building, as well as maintenance, storage, laboratory and system controls. The disinfection and high service pumping facilities are located near the building at the same site, as is the holding pond. The building, power and control facilities were designed and constructed for eventual expansion in two stages from 2.0 to 4.0 to 6.0 MGD.

WATER RIGHTS

The City has existing water rights for withdrawal for both the Layng Creek and the Row River plants. The rights were reviewed by the 1998 Balfour Water System Master Plan and that summary is included for reference.

CITY WATER RIGHTS

Source	Water Right		Priority Date
	cfs	MGD (1)	
Layng Creek	6.0	3.88	6/12/1909
Dinner Creek-Tributary to Layng Creek	4.0	2.58	4/28/1925
Prather Creek – Tributary to Layng Creek	4.0	2.58	11/28/1928
Coast Fork Willamette River	4.5	2.91	4/6/1928
Unnamed Stream – Tributary to Silk Creek	1.0	0.65	7/12/1934
Well/Horizontal Collection – from Row River	3.1	2.00	9/22/1977
Row River	6.2	4.01	9/22/1977

(1) Water rights are specified in cubic feet per second (cfs) but are also listed here in their approximate equivalent flow rate of millions of gallons per day (MGD) for convenience.

The Balfour plan noted that the rights on the Coast Fork Willamette and Silk Creek had not been used for over 30 years and recommended transferring some or all of these rights to either the Row River or Layng Creek water intakes.

The sum of rights to water above the intakes is 14 cfs, or 9 MGD, yet the available flow during summer months is frequently between 2 & 3 mgd.

WATER USE

The historical water use in millions of gallons per 24 hours:

	1997	1998	1999	2000
City System, Total				
Annual average day	1.30	1.38	1.49	1.39
Average day, wet month (1)	1.02	1.07	1.20	1.26
Average day, dry month (2)	1.78	1.93	1.94	-
Average day, max. month	2.08	2.37	2.15	-
Average day, max. week	2.56	2.64	2.42	-
Annual maximum day	2.82	2.92	2.61	2.69
Layng Creek WTP Production				
Annual average day	1.10	1.15	1.09	-
Average day, wet month (1)	1.00	1.02	1.02	1.03
Average day, dry month (2)	1.30	1.31	1.18	-
Average day, max. month	1.33	1.40	1.29	-
Average day, max. week	1.42	1.45	1.43	-
Annual maximum day	1.43	1.69	1.46	-
Consumption along 14-inch Transmission line (3)				
Annual average day	0.060	0.075	0.100	-
Average day, wet month	0.042	0.054	0.061	.062
Average day, dry month	0.085	0.098	0.167	-
Average day, max. month	0.087	0.173	0.203	-
Average day, max. week	0.204	0.455	0.236	-
Annual maximum day	0.680	0.574	0.353	-

(1) Winter months are considered Nov. to April based on rainfall and relative water use.
(2) Summer months are considered June to September based on rainfall and relative water use.
(3) Use along the transmission line has been calculated as the difference between the flow from the filters and the flow through the flume as reported on the Water Department daily monitoring sheet. Consumption along the transmission line is included in the recorded Layng Creek WTP production.

Previous Projections of Water Production Needs.
The populations and water consumption estimates for the service areas have been estimated as presented below: Data points from the census and from the previous Balfour Report have been plotted and fitted to curves in Figure 2, showing a higher growth rate, a lower growth rate and a probable growth rate. The probable growth rate corresponds to Balfour's projection. This projection indicates a probable 2022 population of 15,000 persons.

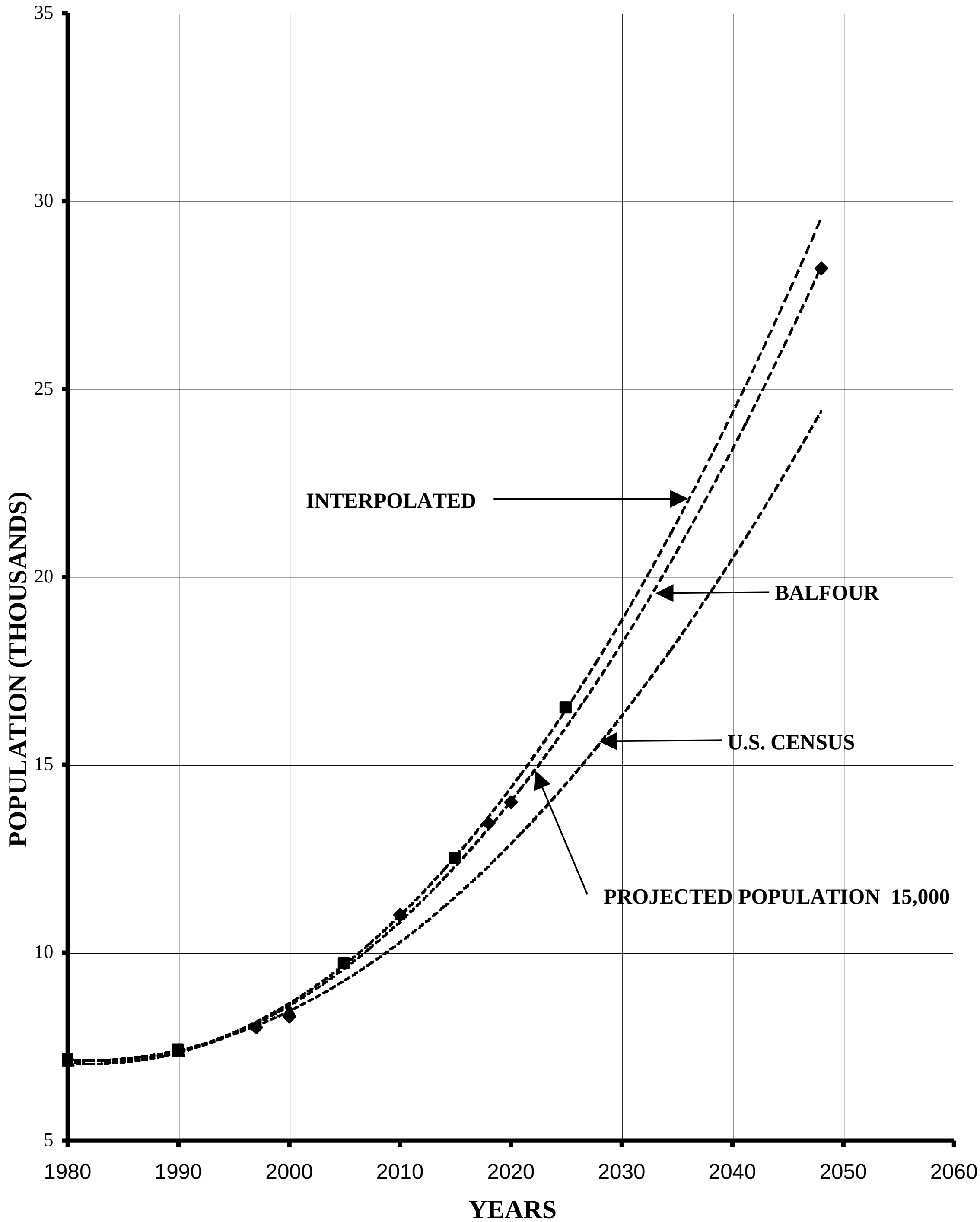
Year	Population		Water Consumption	
	Transmission	City	Average day	Maximum day
1980	Not recorded	7,148		
1983	Not recorded	7,300 (1)	1.36 MGD (1)	3.40 MGD (1)
1990	Not recorded	7,403		
1997	Not recorded	8,005 (2)	1.34 MGD (2)	3.86 MGD (2)
2000		8,300 (2)		
2000	550 (5)	8,445 (4)	1.39 MGD (4)	2.69 MGD (4)
2005		9,700 (6)		
2010		11,000 (2)		
2015		12,500 (6)		
2018		13,445 (2)	2.26 MGD (2)	6.48 MGD (2)
2020		14,000 (3)		
2022		15,000 (7)		
2025	550	16,500 (6)	3.12 MGD (6)	8.97 MGD (6)
2048		28,202 (2)	4.74 MGD (2)	13.59 MGD (2)

(1) CH2M-Hill, Water Source Study, April 1983.
(2) Balfour, Water System Master Plan, May 1998.
(3) Balfour, Water system Master Plan data extrapolated.
(4) Data from Year 2000 census and City records.
(5) Estimated population based on 284 residences at 2 persons per residence.
(6) Interpolated from the other reference data.
(7) From Figure 2.

LDC Projections:	2005	2010	2015	2022
City System, Total				
Annual average day	1.7	1.8	2.1	2.5
Average day, wet month (1)	1.4	1.5	1.7	2.1
Average day, dry month (2)	2.4	2.5	2.9	3.6
Average day, max. month	2.7	2.4	3.4	4.0
Average day, max. week	3.3	3.5	4.1	4.9
Annual maximum day	3.5	4.0	4.5	5.2
Layng Creek WTP Production				
Annual average day	1.2	There are no changes predicted yet, as the flow from Layng Creek WTP will depend on the extent to which it will be economically feasible to upgrade and expand these facilities. That decision depends upon the balance of this study.		
Average day, wet month (1)	1.0			
Average day, dry month (2)	1.4			
Average day, max. month	1.4			
Average day, max. week	1.5			
Annual maximum day	1.5			
Consumption along the 14-inch Transmission line (3)				
Annual average day	0.10	0.10	0.10	0.10
Average day, wet month	0.06	0.06	0.06	0.06
Average day, dry month	0.16	0.20	0.25	0.32
Average day, max. month	0.22	0.25	0.30	0.44
Average day, max. week	0.25	0.30	0.40	0.54
Annual maximum day	0.6	0.6	0.6	0.6

(1) Winter months are considered Nov. to April.
(2) Summer months are considered June to September. Growth is expected to be due to recreational use at Dorena Lake.
(3) Maximum daily flow is expected to be due to maintenance and/or main breaks

FIGURE 2 - PROBABLE POPULATION CURVE



RAW WATER QUALITY

The quality of treated water from both Layng Creek and Row River plants is generally good. The only quality parameter of historic concern has been turbidity.

Turbidity is not actually a chemical or physical material, but it is rather an empirical measure of the optical property that causes a light beam to be scattered by the particles of soil, finely divided organic and inorganic components, microorganisms, soluble colored organics, diffused bubbles of gases and even any film on the sides of the sample container. Turbidity is measured relative to the light scattered from a specific tungsten-filament bulb by a standard organic polymer, and measured in "nephelometric turbidity units," as NTU.

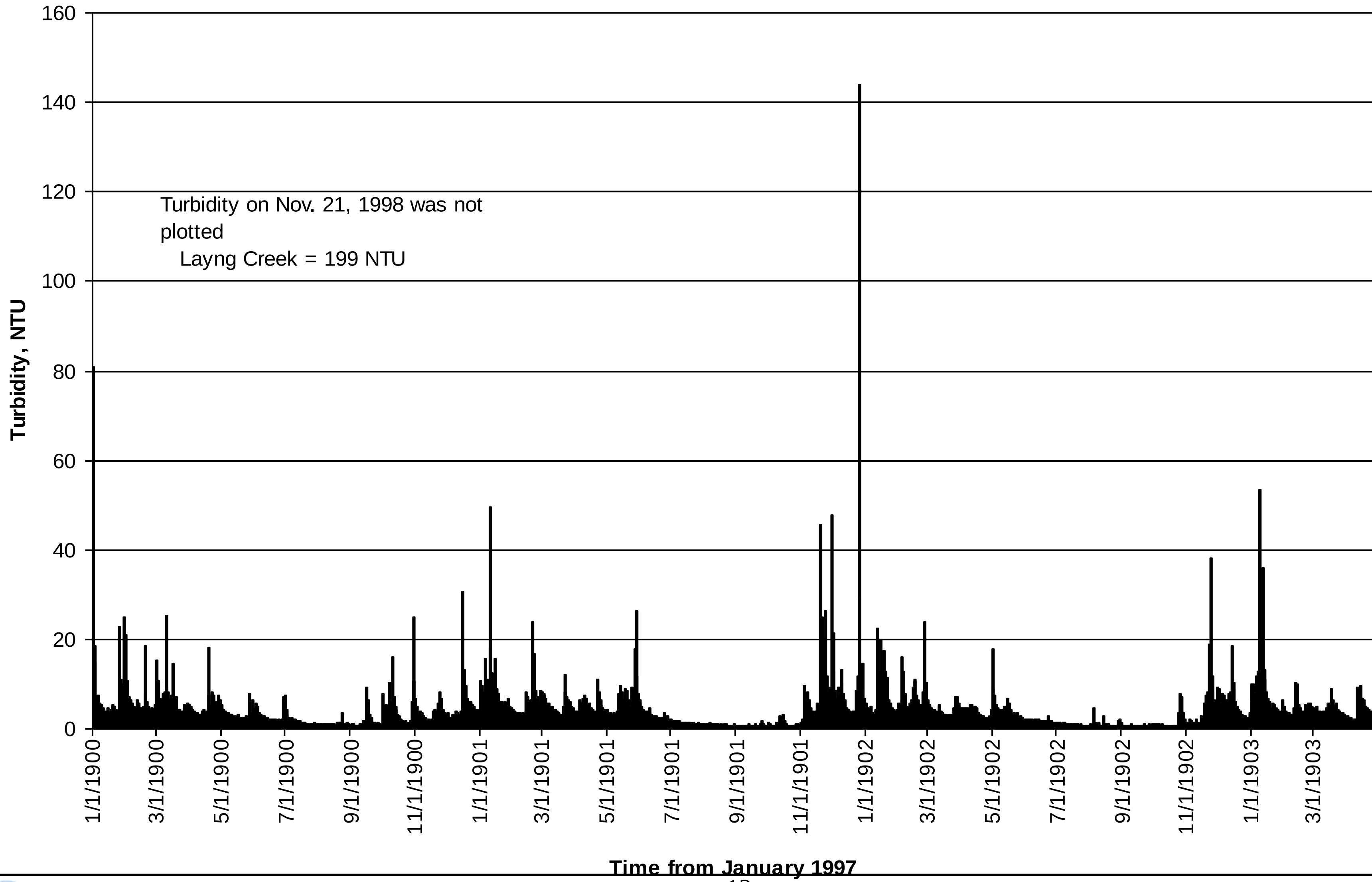
Normal turbidities in the raw water to the Layng Creek plant are below 10 NTU and below five during dry weather periods. Peak turbidity levels over the past four years, however, have reached levels of about 200 following heavy runoff from the watershed areas and as high as nearly 4,000 during the flood of 1996. A plot of turbidity in Layng Creek is presented in Figure 3 on the following page. The Layng Creek plant cannot respond to these changes automatically and the operator must drive from the City to the plant sites to learn what has caused the turbidity of the finished water to rise (equipment failure, one of the raw water sources, both of the raw water sources, or other cause?), decide on a remedial action (repair equipment, take raw water from the other creek, change the rates of chemical addition, or other solution?), and wait to observe the effect of the action while the changes to the treated raw water pass through the successive treatment units and piping over a theoretical flow time of over three hours. The raw water quality continues to change through this period and so the operator must continue to observe and modify adjustments to the corrective actions.

The other raw water parameters change more slowly than does turbidity and are not analyzed as frequently. They have also not been observed to be in violation.

SYSTEM PROBLEMS

The pipelines and plants at the two Layng Creek treatment plant sites have not functioned properly in the best of times and not satisfactorily during the worst of times. Maintenance problems with the pipelines have included washouts of the Prather Creek supply line and corrosion leaks in 14-inch steel pipeline between the Layng Creek plant and the city reservoirs.

FIGUER 3 SOURCE WATER TURBIDITY



Several portions of the pipeline are inaccessible and the alignments of other portions are unknown. System problems include but are not limited to the following:

- Inadequate hydraulic capacity:
  The transmission pipeline was to carry 2.2 MGD, but can carry only 1.9 MGD due to filter head losses. During peak turbidity periods, (particularly when the event occurs suddenly and chemical dosing is not adjusted in time) operators must program the filters to go into a "continuous backwash" and the filters use more of the water they produce, leaving as little as 50 percent of production for customers. The maximum output of the plant is approximately 1.6 MGD due to the time filters are out of service for backwashing and due to the volume of filtered water needed for backwashing.
- Violation of turbidity limits, generally the requirement that the turbidity of treated water meet a limit of 0.5 NTU at least 95 percent of the time and, on occasion, 5.0 NTU. The plant has been meeting the drinking water limits, however, since the media was replaced in January 2000.
- The plant is located 21 miles from the city and staff must go to the plant and manually adjust chemical feed rates to compensate for changing water quality when flash storm events cause rapid changes in raw water quality.
- The plant has not been amenable to improvements due to: age and types of equipment which do not permit automation, the distance between sites which results in floc destruction in the pipeline, lag time, and in difficulty in coupling equipment and operator efforts.

The total capacity of the system is also becoming limited in two ways. First, the Layng Creek plant cannot be relied upon to comply with regulations for drinking water quality. The plant will need to be modified or replaced, as discussed later in the report, to supply the capacity of this plant. Second, the condition of the Layng Creek plant and pipeline is such that they cannot be relied upon physically to continue supplying the city and customers along the transmission line.

The total capacity of the Cottage Grove water system is still adequate for the projected summer demands through the year 2015, but peak demand days are expected to exceed the treatment capacity and additional storage will be needed for the City as described in the Balfour Water System Master Plan. In addition to that storage, additional storage should be provided on the Layng Creek line as soon as feasible to provide:

- Temporary supply to the city and customers along the transmission main while the existing plant is unable to satisfy turbidity requirements and volume.
- Supply to customers along the transmission main while sections of pipeline are under repair or maintenance.

- Supply to customers along the transmission main while the Layng Creek plant is being modified or replaced by one of the alternatives considered later in this report.

Additional storage to supply the City during peak use periods. The Balfour report recommended an additional 3 to 3.5 MG of storage by the year of 2018, preferably on the western edge of the service area.

EXISTING FACILITIES

INTAKE AND PIPELINE FACILITIES

Layng Creek and Prather Creek Intake Structures

Water for the City of Cottage Grove is taken from two creeks within the Row River tributary system. Intake structures are located on Layng Creek and Prather Creek, located approximately 21 miles east of the City. An original intake dam was constructed around 1912 and located adjacent to the Upper Site of the Water Treatment Facility. This early dam remains in-stream today. The present Layng Creek Diversion Dam, constructed about 1924, is now located approximately one-half mile upstream of its original site.

The construction date for the Prather Creek diversion dam is unknown, but it is believed to have been constructed within the same time frame as the present Layng Creek Structure. It is located on Prather Creek approximately 2,600 feet north of the confluence of Layng and Prather Creeks.

The Layng Creek and Prather Creek intake structures consist of reinforced concrete dams, water intake chambers and control boxes connected by an 18-inch steel pipe. The structures span the creek channels and are embedded into the creek streambed. Each dam has a sloping upstream face (1/4:1), 2 feet wide crest and a sloping downstream face (1:1). Corrugated pipes were constructed under the dam to allow for low flow, but have become inoperable due to sedimentation. Later modifications installed low flow gates that receive wooden stop logs to direct water into the intake chamber. Water passes through a coarse screen before entering the intake chamber. An 18-inch pipe connects the control chamber and the control box. The water is filtered through a 1/2-inch mesh screen before entering the supply pipe. Excess water not entering the pipeline releases back into the creek downstream of the dam structure.

Layng Creek and Prather Creek Water Supply Lines

The water supply lines consist of 14-inch and 12-inch spiral welded steel pipe with a tar wrap. These pipelines originate at the Layng Creek and Prather Creek intake structures, respectively, and normally discharge separately into the inlet-mixing basin at the Layng Creek Water Treatment Plant (Upper Site). The two raw water supply lines can also be redirected into the single supply line outside of the mixing basin. After preliminary treatment (see Treatment Plant), the water is conveyed approximately 3,400 feet to the Filtration Facility at the lower site.

The Layng Creek supply pipe (approximately 2,600 feet) follows adjacent to and north of the stream channel for several hundred feet before it traverses overland to the Layng Creek Treatment Plant. This pipeline was initially placed in approximately 1924. In 1999 approximately 200 feet of pipe, downstream from the intake structure, was replaced with 14-inch ductile iron pipe.

The Prather Creek supply line (approximately 2,600 feet) follows outside of the east bank of the stream channel. Approximately midway along the pipeline, it enters into the access road to the Prather Creek Dam. It remains along the west shoulder of the road to near the access gate, turns westerly and crosses Prather Creek. This crossing in exposed through the creek. The original pipe at this crossing has been replaced with 3 sections of 12-inch ductile iron pipe. The pipeline crosses under the roadway and joins with the Layng Creek supply pipe east of the treatment plant.

Transmission Main

After preliminary treatment at the upper site of the Layng Creek Treatment Plant, the water is transported by gravity to the Filtration Facility at the lower site. The pipeline between these locations generally follows along the northern shoulder of the roadway, a length of approximately 3,400 feet. The treated water flows to the City reservoirs through approximately 100,000 feet of transmission main. The pipeline generally follows Lower Brice Creek Road, Shoreview Road and Row River Highway to the City. In many cases, the pipeline is located either within the asphalt shoulder of the highway or under concrete barriers, which makes access and maintenance difficult. The pipeline also crosses the Row River and several creeks, either hanging beneath highway bridges, by suspension over the river or by burying the pipeline under the stream channel. Where the pipeline deviates from roadway access, it traverses across private property some of which are without easements or is located within heavily forested areas. There are sections of pipeline where only its general location is known and actual inspection has not been accomplished for many years.

The original pipeline below the 1912 intake structure was a wood-stave pipe. It was abandoned in-place and replaced in 1947 with a tar coated and wrapped, 14-inch spiral welded steel pipe. Leaks and constant maintenance on the pipeline forced the City to undergo a replacement program in 1978. Eugene Sand and Gravel from Eugene, Oregon performed replacement at selected locations. Construction specifications are unavailable, but it is believed that a minimum of 10-gauge pipe was specified. The pipeline consisted of a coal tar coated and wrapped, 14-inch spiral welded steel pipe in 40-ft. pipe lengths. Positive contact connections between pipe sections were welded across pipe joints for a cathodic protection system, but there is no indication of either sacrificial anode or impressed current systems being installed.

The pipe between the filtration plant and the City reservoirs also serves as a source of potable water for a number of residential, recreational and commercial users. This pipeline serves the town of Dorena, Dorena Elementary School, a

State Park, U.S. Forest Service, mobile home parks, church summer camps, as well as numerous individual customers. There are currently 196 customers along the pipeline. The first serviceable customer is located in Culp Creek (east of Culp Creek School), approximately 5.2 miles west of the Lower Site (Water Filtration Plant). Although there are other homes closer to the plant, services are either not provided or water pressure is not adequate for proper service.

Meter records were obtained from the City for the months of January through March, 1999 and July through September, 1999. These records were evaluated to obtain the total water usage by the customers. Total metered water usage is 6.1 million gallons for 1999 winter months and 12.1 million gallons for the 1999 summer months. The daily "Water Production Department" records for the water system indicate water conveyance and pipeline loss through the 14-inch transmission main to be 3.7 million gallons for the same winter 1999 months and 17.3 million gallons for the summer 1999 months. The 14-inch "cons" (consumption) rate represents the water usage plus water lost from valve, meter, and pipe leaks. The fact that the calculated winter usage is less than the metered usage is a result of reverse flow up the transmission line when the Row River plant is in operation.

The transmission pipeline is a gravity system that experiences high pressure in some sections. Falling in elevation from 1180 feet at the Filtration Facility to a low elevation of 670 feet along the base of Knox Hill, pressures can exceed 220 pounds per square inch. Water level at the City's reservoir is maintained at an elevation of 846 feet. The hydraulic gradient from the Filtration Facility to the reservoir is 0.0035 ft/ft producing a carrying capacity of the transmission main of 2.8 cubic feet per second (cfs) or 1.8 million gallons per day MGD).

Pipe flow generally is controlled by use of regulating (throttling) valves. There are two regulating valves along the transmission main, generally located near Dorena Dam and north of the town of Dorena. According to the "Water System Supply Hydraulic Gradient, Plate III" accompanying the 1977 Water System Improvements plan, these valves were intended to throttle back the carrying capacity of the pipeline to 1.0 MGD at a hydraulic gradient of 1 ft. of fall per 1000 ft. Actual reports from the flume at the City's reservoir indicate peak daily flows in excess of 1.3 MGD. It is likely that the valves have been reset.

ELEMENT OBSERVATION, ANALYSIS AND RECOMMENDATIONS

Layng Creek and Prather Creek Intake Structures

The intake structures are presently functioning adequately to provide the required flow of water. City personnel state that the intake screens require daily maintenance and annually the sediment behind the dams requires excavation.

A minor amount of seepage is observed in the area of the exposed gate valve at the Prather Creek structure. This appears to be of no major concern to the operation or stability of the structure, but should be monitored over the next several years.

Water Supply and Transmission Mains

The old spiral welded steel pipe presents the City with continuous and increasing maintenance problems. Figure 4 on the next page shows locations along the supply lines and transmission main that quantifies and dates areas of repair over a period of approximately twenty-years. Small pinhole corrosion leaks are repaired with steel boiler tapping plugs inserted into the hole and banded. Larger leaks are repaired with variously sized repair clamps. Often clamps are found to abut each other or even overlap. Where sections of pipe are severely in need of repair, lengths of pipe are removed and replaced with sections of ductile iron pipe.

The thickness and class of the existing steel pipe could not be documented as the records of the original construction and the subsequent modifications have been lost or destroyed. It is possible, however, to make a reasonable presumption based on a comparison of the observations and measurements taken in April 2000 with specifications of steel pipe used commercially at the times of the pipeline construction. On that basis, it appears that the pipe used was tar coated, spirally welded, carbon steel pipe with a minimum wall thickness of 10-gauge (0.135 inches). Other pipe materials and pipe wall thickness were used in different locations, principally where the existing pipe has been repaired or sections of it have been replaced. Cast or ductile iron has been used below the intakes on Layng Creek and Prather Creek.

<u>April 2000 Testing</u>

During the month of April, LDC, Geotechnical & Environmental Consultants, Inc. (GRI) and their subcontractor PSI Environmental Geotechnical Construction (PSI) conducted site reconnaissance to determine the locations for testing of the existing waterline. GRI and PSI exposed the pipe at these locations to evaluate the condition of the pipe and the thickness of material.

The testing was done using an ultrasound method, which allowed the pipe wall to be measured without shutting down the pipe and cutting the pipe for physical measurements. The ultrasound procedure determines the thickness of the pipe wall by accurately measuring the time required for a short ultrasonic pulse (high-frequency sound waves) generated by a transducer to travel through the thickness of the material, reflect from the inside surface, and be returned to the transducer. The measured two-way transit time is divided by two to account for the down-and-back travel path, and then multiplied by the velocity of sound in the test material.

Figure 4 – System Repair Locations

The pipeline testing in April 2000 consisted of exposing the pipe in 33 locations believed to be representative of its overall condition. The locations are indicated on Figure 5. The coating and pipe conditions were observed and the wall thickness was measured at 0, 120 and 240 degrees around the pipe to determine if there were differences in wall thickness due to corrosion or pitting. The analysis sequence included:

1. List measured pipe wall thickness around pipe circumference.
2. Establish probable original wall thickness.
3. Compare the "worst case" pipe wall test result (indication of pitting or deterioration of pipe wall) against the original pipe wall thickness.
4. Establish the static pressure at the test location.
5. Allow for a surge pressure of 60 psi, as observed by the City staff, to the static pressure.
6. Calculate the minimum wall thickness of pipe based on combined static and system pressures within the pipe.

After the measurement of the wall thickness, an estimate was made as to the pipe placed during the construction of 1947 and 1948. It is assumed to be a 10-gauge (0.135-inch) steel spiral welded plate, which was the minimum gauge of pipe for 14-inch welded steel water pipe. That thickness was assumed for reference only, as the certainty of the pipe characteristics are not known. Small gauge (thicker walled) pipe may have been placed in areas of higher internal pressures. This appears to be true by the remaining thicker wall of the pipe in the lower elevations.

The reduction in pipe wall thickness at the test locations is a result of either of a corrosive environment surrounding the pipe or corrosive water being transported through the pipe. Pipe pitting or tuberculation identifies this reduction. A comparison was made to evaluate loss of material within the pipe wall to the referenced (assumed) minimum wall thickness of a 10-gauge pipe. Table 2 and Figure 5 following, provides this comparison and indicates locations where the pipe thickness may no longer provide adequate service. It also identifies areas where a different pipe gauge or material may have been used. Ductile Iron pipe was placed during subsequent construction or pipe repairs.

Figure 5 – System Test Locations

TABLE 2: SUMMARY OF TESTING

Test Location	EXISTING PIPE (IN FIELD TEST)(in)					Results
	0^o	120^o	240^o	Average Thickness (t_{AVE})	Worst Case (t_{wc})	
U – 1	0.625	0.640	0.650	0.638	0.625	Taken on 1999 repair – DIP
U – 2	0.400	0.393	0.387	0.393	0.387	$T_{WC} > 0.135$
U – 3	0.128	0.128	0.129	0.128	0.128	$T_{AVE} < 0.135$
U – 4	0.574	0.574	0.574	0.574	0.574	DIP
U – 5	0.102	0.121	0.124	0.116	0.102	$T_{AVE} < 0.135$
U – 6	0.117	0.111	0.087	0.105	0.087	$T_{AVE} < 0.135$
U – 7	0.102	0.112	0.124	0.113	0.102	$T_{AVE} < 0.135$
U – 8	0.118	0.110	0.112	0.113	0.110	Prather Creek Crossing $T_{AVE} < 0.135$
U – 9	0.132	0.145	0.142	0.140	0.132	$T_{WC} < 0.135$
U – 10	0.101	0.130	0.130	0.120	0.101	$T_{AVE} < 0.135$
U – 11	0.148	0.132	0.128	0.136	0.128	$T_{WC} < 0.135$
U – 12	0.122	n/a	n/a	0.122	0.122	$T_{AVE} < 0.135$
U - 13	0.165	0.167	0.182	0.171	0.165	OK
U - 14	0.125	0.138	0.138	0.134	0.125	$T_{AVE} < 0.135$
U - 15	0.127	0.129	0.132	0.129	0.127	$T_{AVE} < 0.135$
U - 16	0.168	0.178	0.184	0.177	0.168	OK
U - 17	0.133	0.143	0.153	0.143	0.133	$T_{WC} < 0.135$
U - 18	0.167	0.171	0.174	0.171	0.167	OK
U - 19	0.183	0.173	0.172	0.176	0.172	OK
U - 20	0.167	0.172	0.171	0.170	0.167	OK
U - 21	0.159	0.163	0.163	0.162	0.159	OK
U - 22	0.171	0.171	0.175	0.172	0.171	OK
U - 23	0.171	0.179	0.175	0.175	0.171	OK
U - 24	0.180	0.186	0.182	0.183	0.180	OK – Historical Pipe Repairs
U - 25	0.171	0.178	0.177	0.175	0.171	OK
U - 26	0.172	0.172	0.179	0.174	0.172	OK
U - 27	0.158	0.167	0.158	0.161	0.158	OK
U - 28	0.184	0.189	0.180	0.184	0.180	OK
U - 29	0.180	0.178	0.178	0.179	0.178	OK
U - 30	0.192	0.195	0.190	0.192	0.190	OK
U - 31	0.176	0.179	0.180	0.178	0.176	OK
U - 32	0.162	0.166	0.132	0.153	0.132	$T_{WC} < 0.135$ – Moderate Historical Repairs
U - 33	0.177	0.183	0.184	0.181	0.177	OK

Test locations U-1 through U-8 are located along the Prather Creek and Layng Creek supply lines. Both water supply lines need to be improved except for the section of pipeline immediately downstream of the Layng Creek intake. Approximately 200 lineal feet of this pipe was replaced with ductile iron pipe in 1999.

Areas that show aggressive pipe deterioration, test locations U-2 through U-17 are located in the upper reaches of the transmission main and water supply lines. During testing it was observed that sections of the Prather Creek pipe supply line were generally close to the surface, in some areas exposed to the surface, and the tar coating was removed. It is recommended that this section U-2 through U-17 (approximate area of 1978 replacement) be completely removed and replaced with new pipe.

Test locations U-13 and U-16 exhibit adequate wall thickness, but also thickness readings around the pipe are consistently greater than adjacent testing locations. This may be a result of initial thicker pipe or a test location performed on a repaired section of pipe (non-original pipe).

Test locations U-18 to U-33 indicate a greater initial thickness in the pipe wall. The degree of deterioration and pitting is significantly less and structural integrity is greater. This may be a result of an initial increase in pipe wall thickness to compensate for higher internal working pressures. Within the areas of increased pressure, the remaining wall thickness is sufficient to continue to provide service.

Corrosion is the deterioration of the pipe because of reactions with its environment. Soil resistance is a measure of the corrosiveness of the soil as a function of pipe deterioration. Soils of low resistance result in high corrosion capability. An analysis was performed at two testing locations (U-14 and U-25) to determine soil pH and the corrosiveness of the soil or soil resistivity. The results indicate the soils do not exhibit corrosive tendencies.

ELEMENT REPLACEMENT/REHABILATION ALTERNATIVES

Layng Creek and Prather Creek Intake Structures

Recommended improvements at the intake structures include reconstruction of the intake screens to facilitate easier cleaning. Slanted bar screens over a larger intake area along with an area to discard debris would improve this maintenance function.

Water Supply and Transmission Mains

Due to the high maintenance of the water supply lines and the loss of pipe thickness, especially along the Prather Creek line, it is recommended that the entire length of both lines be replaced or rehabilitated.

Testing results (Table 3) indicate that from the Upper Site (Layng Creek Water Treatment Facility) to approximately 20,050 feet downstream, the water transmission main will need to be replaced or rehabilitated.

It is generally agreed that any construction on the pipeline will require the disruption of normal service to the pipeline customers. The degree of disruption will be dependent on the amount of work to be completed and the method of construction. Alternate methods of providing water to customers will need to be determined before that work can be initiated. It is a major consideration of the City that the disruption to customers be limited in both time of service disruption and cost.

1) Pipe replacement is the most disruptive alternative of construction practices that will be presented. Pipe replacement would also be disruptive to the environment, traffic patterns and residents. Much of the pipe replacement would either parallel or encroach into street traffic or trespass into forested areas. It would include excavation and removal of the existing pipe or excavation and placement in a new alignment. Either location would create trench spoils that must be protected from entering streams and rivers.

2) Rehabilitation is a means by which the original pipe may be saved. It provides trenchless alternatives to open excavation by using the original pipe to provide the open space through the soil and to add structural strength and support to the liner pipe. Excavation points must be created for access (insertion and withdrawal of the liner).

   A thorough inspection of the pipe would be needed to be completed, including television inspection and marking locations of services and boiler plug repairs. Scraping and cleaning of the interior of the pipe would remove any debris and protruding tubercles. Boiler plugs would be needed to be located and removed.

   When a pipe is lined, its interior cross sectional area is decreased, but this reduction is generally compensated by the decrease in friction through the length of the pipeline. Several methods by which the pipelines could be rehabilitated are listed below.

   a) <u>Sliplining</u> is a method by which a pipe of a smaller diameter is drawn through the larger original pipe. Generally, as the high-density polyethylene is pulled through the old pipe, each section is heat fused to the preceding section to create a long continuous conduit. Because of this, long reaches may be created without disturbing the environment.

   b) <u>Cured-in-place pipe</u> is thermoplastic pipe. These pipes usually include a fabric media such as polyester, fiberglass or a combination of both which is either coated or encased with a waterproof membrane such as polyurethane or other plastic material. The fabric material is saturated with a thermoset resin material such as polyester, vinylester, epoxy or polyurethane. The combination of the materials is then pulled or inverted into the host pipeline using either air or water pressure. The pipe allowed to cure, or the cure of the thermo set resin material is accelerated using hot water or steam. A cured-in-place pipe conforms to the inside of the host pipe. The process can place cured-in-place pipe in lengths up to 500 feet.

c) U-Liner is a high-density polyethylene that is deformed at the manufacturer. It is pulled into the host pipe and reformed to the inside shape of the original pipe using heat and pressure.

d) Cement lining of the pipe will extend the life of deteriorating pipes by applying and toweling cement mortar to the interior walls without removing the pipe. This is done by centrifugally casting a sand/cement mortar mixture against the pipe wall. Cleaning the pipe will initially remove tubercles. This process prevents further interior tuberculation and corrosion while blocking leakage through holes in the pipe and leaking joints.

Replacement Advantages

- Old pipe replaced with new pipe.
- New pipe has lower pipe friction.
- New pipe may be relocated to a new, more accessible alignment.
- Non-existent easements may be obtained for City access.
- There is an opportunity to increase pipeline diameter and capacity.

Replacement Disadvantages

- Open trench excavation is required.
- It is necessary to provide alternate sources of water to pipeline customers during construction.
- Disposal of old pipe is required if it is removed from the trench.
- New alignment may encounter construction obstacles (forested areas, possible rock excavation).
- Environmental impact (erosion control, wetland mitigation, forest protection) are greatest.
- New or needed easements (if none exists) must be obtained.
- New pipe bedding and backfill material is required.
- Saw cutting, removal and replacement of pavement at crossings

Rehabilitation Advantages

- Less trenching is required as access is necessary only at the ends of the old pipe.
- Rehabilitated pipe decreases pipe friction
- Long lengths of pipe rehabilitated without open trenching

- Avoids pavement cutting, removal and replacement

<u>Rehabilitation Disadvantages</u>

- Existing pipe needs cleaning and television inspection
- Need to locate and remove pipe obstacles (tubercles, boiler plugs)
- Inability to upsize pipe
- Provide alternate source of water to pipeline customers
- Limited number of experienced contractors
- Special design needed for pressure and construction considerations

<u>Issues</u>

- Special issues relating to the replacement or rehabilitation of the transmission main include:
- Identification of design pressure (static and dynamic system pressures).
- Relocation or rerouting of the pipeline to accessible, constructible locations.
- Providing right-of-way or easements where none currently exist.
- Reducing environmental impact.
- Impact of customers and City residents.
- Federal, State, County and City regulations.

TABLE 3: SUMMARY OF PIPE CONDITION

From	To	Approximate Length (ft)	Useful Life Remaining (1)	Comments
Water Supply Line				
U – 1	U - 2	210	>20 Yrs	Test taken on 1999 DIP replacement - No replacement needed within approximately 210 lf below dam
U - 2	Pipe inter-section	2400		Downstream of U-2 Pipe thickness < 0.135"
U - 4	U - 5	530	None	Prather Creek - Below U-4 pipe thickness < 0.135" (Small stream & Wetland crossing)
U - 5	U - 6	580	None	Prather Creek - multiple repairs
U - 6	U - 7	530	None	Prather Creek - multiple repairs
U - 7	U - 8	690	None	Prather Creek - multiple repairs
U - 8	U - 3	260	None	Prather Creek - multiple repairs (Prather Creek Crossing)

MEASURED PIPE WALL THICKNESS (inches)				
From	To	Approximate Length (ft)	Remaining Useful Life (1)	Comments
Transmission Line				
Pipe Intersection	U – 3	210	None	Transmission line – replacement needed
U - 3 (upper site)	U - 9	1800	None	Transmission line - replacement needed
U – 9	U - 10	4860	None	Transmission line - replacement needed
U – 10	U – 11	1370	None	Transmission line - replacement needed
U – 11	U - 12	1800	None	Transmission line - replacement needed
U – 12	U - 14	790	None	Transmission line - replacement needed
U – 14	U - 15	950	None	Transmission line - replacement needed
U – 15	U - 13	3800	None	Transmission line - replacement needed
U – 13	U - 16	12360	> 25 Yrs	
U – 16	U - 17	9660	> 20 Yrs	
U – 17	U - 18	3480	None	Transmission line - replacement needed
U – 18	U - 19	5700	> 25 Yrs	
U – 19	U - 20	2530	> 25 Yrs	
U – 20	U - 21	2430	> 25 Yrs	
U – 21	U - 22	3640	> 20 Yrs	
U – 22	U - 23	2640	> 25 Yrs	Test taken within 1991 repair
U – 23	U - 24	2750	> 25 Yrs	
U – 24	U - 25	4960	> 25 Yrs	Pipe wall thickness OK but historical information shows multiple repairs
U – 25	U - 26	2430	> 25 Yrs	
U – 26	U - 27	6230	> 25 Yrs	
U – 27	U - 28	1430	> 15 Yrs	
U – 28	U - 29	2220	> 25 Yrs	
U – 29	U - 30	3120	> 15 Yrs	
U – 30	U - 31	5070	> 25 Yrs	
U – 31	U - 32	7340	None	Transmission line - replacement needed
U – 32	U - 33	4330	None	Isolated pitting - moderate historical repair
U - 33	Reservoirs	5410	None	Transmission line - replacement needed

Useful life of pipe 0.001" of wall thickness reduction per year (based on mean reduction in thickness between 1948 – 2000)
Rating based on historical repair data at approximate area
Repair numbers may be result of damaged pipe coating during construction

The locations where the pipeline should be replaced, under the several project alternatives, are shown in the Figure 8 in the chapter on alternatives. The costs of the work and the scheduling are included in the chapter on project costs.

LAYNG CREEK TREATMENT PLANT

Description of Facilities

The Layng Creek plant was built in two phases, in 1977 and in 1984, to treat the previously unfiltered water from Prather and Layng Creeks.

The original facilities at the upper site included a cyclone separator to remove sand, gravel and silt from the raw water and a small building to store and house an alum feed pump to cause the solids in the raw water to attach in a chemical floc as the water moved through the pipeline to the filters at the lower site. The four filters installed at the lower site are Permutit valveless filters. They originally had dual media (sand on the bottom and anthracite on top) but the anthracite was removed and replaced with sand when the filters were resanded in 1984. The original design capacity was 1600 gpm (2.3 MGD) at a filter rate of 3 gpm/sf with all four units in service. The current maximum filter rate is 2.1 gpm/sf and the plant capacity is 1.6 MGD with all four filters in operation. Gas chlorine is used for disinfection with contact provided in the pipeline upstream of the first customers. Standby power is available at both sites.

The plant was not able to maintain its production during periods of high raw water turbidity, and additional chemical treatment facilities were added at the upper site in 1984. Those facilities included lime, alum and polymer storage and feed, and tanks for rapid mix, flocculation and sedimentation. Sludge is drawn off to a lagoon downhill of the sedimentation tank and decanted to the creek. Lime and the chlorine facilities were also added at that time at the lower site for pH adjustment and disinfection, respectively.

The 1983 CH2M Hill report also proposed a fifth valveless filter and a finished water storage tank at the lower site. The tank was designed but neither of these facilities were constructed.

Facility identification:

Plant identification number	PWS ID 41 00236
Rated plant capacity	2.3 MGD, Original design
	1.6 MGD, Current design
1997-9 Normal operating rates	Annual Average 1.2 MGD
	Peak 1.7 MGD

<u>Upper site</u>

The upper site is on lands reported owned by US Forest Service and enclosed by a fence containing an area of about 210-ft by 130-ft (variable). The site is sloped and includes two small buildings, a “port-a-potty,” concrete structure forming the mixing, flocculation and settling tanks, and a settling pond. Sludge is drawn off to a lagoon located downhill of the sedimentation tank and decanted to the creek. A portion of the principal building and preliminary treatment facilities were constructed in 1977 to house alum and polymer feeders and a cyclone separator to remove sand, gravel and silt from the raw water. That separator is no longer at the plant. The majority of the present facilities were constructed in 1984 to improve the performance of the filters at the lower site.

Inlet Mixing Basin:

Raw water from one or both of Layng and Prather Creeks flows by gravity (pumped during very low flow periods) from an inlet area to a mixing zone where liquid alum is added. Lime, alum and polymer solution lines enter the pump pit area ahead of the pump. The alum was formerly added after the pumping area but that piping has been abandoned. The inlet and mixing areas can be drained to the east sedimentation tank when that tank is empty, normally once a year. The pumping area is cleaned by pumping it out to the sedimentation tank when it is empty. The butterfly valve on the Prather Creek pipeline is defective and in need of repair or replacement.

Dimensions:	
Pump pit	7'-6" wide, by 8'-0" long, and approx. 12' SWD (1)
Inlet area	7'-6" wide, by 5'-0" long, and approx. 11.3' SWD
Mixing basin	7'-6" wide, by 11'-0" long, and approx. 11.3' SWD
Calculated volume:	
Pump pit	720 cubic feet, or 5,386 gallons in pump pit.
Inlet & mixing tank	1,360 cubic feet, or 10,173 gallons
Calculated detention time:	
Pump pit:	4.9 minutes at 1.6 MGD.
Inlet and mixing tank	9.1 minutes at 1.6 MGD

1. Side wall depth (SWD)

Flocculation:

Flow is from the mixing basin into the flocculation zone through a 12-inch propeller meter at approximately mid-depth. The tank can be drained to the east sedimentation tank when that tank is empty, normally once a year.

Dimensions	7'-6" wide, by 32'-4" long, and approx. 11.3' SWD
Calculated volume	2,747 cubic feet, or 20,548 gallons
Calculated detention time	18.5 minutes at 1.6 MGD
Mixing	2"x6" wood, "over & under" baffle walls, 3' on center

Sedimentation:

The flocculated water flows through a 2'-6" wide concrete channel, approximately 42-in. deep across the south ends of the two parallel settling tanks. Inlets to the tanks are 14-inch diameter pipe through the channel wall with upstream sluice gate control. The pipes discharge against wood baffle diffusion walls approximately 3'-3" inside the tank. Outlets are surface overflow weirs connected by individual 14-inch diameter ductile iron pipes to the transmission main. The floors of the tanks are sloped to the center and toward the floor drains. They are manually cleaned normally three to four times a year, by flushing the accumulated sludge to the drainage pit and piped downhill to the pond. The inlet valves for the eastern tank are defective and the eastern-most hose faucet is also inoperable. Both are in need of repair or replacement. The outlet weirs are not level and also reduce the allowable response time in operating the plant, so the tanks are normally operated with the water surface above the weirs.

View of inlet end of settling tanks

Dimensions, ea.	18'-0" wide by 54'-0" long by 12.0' SWD
Calculated volume, ea. (1)	10,962 cubic feet, or 82,000 gallons
Calculated detention time	147 minutes at 1.6 MGD with both tanks in service
Surface loading rate	823 GPD/SF at 1.6 MGD
Weir length, ea. (2)	102 feet
Weir overflow rate (2)	15,700 gallons per foot per day at 1.6 MGD

(1) Not including inlet baffle zone.
(2) Weirs are generally submerged and not effective.

Settling Pond:

Sludge from the flocculation and sedimentation basins flows by gravity to the unlined settling pond excavated into rock at the southwest corner of the fenced site. Decanted overflow drains to Layng Creek through a 6-inch drain. Sludge is hauled, on an as- needed basis, to the Sawtooth Rock Quarry. The approximate storage dimensions and volume are 35-ft. by 45-ft. at the top of the banks with nearly vertical sides and with 3-ft. operating depth. The calculated volume is 4,700 cubic feet, or 35,000 gallons. The elevation of the settling pond is near the water table, however, and the solids remain too wet for proper handling to the disposal site. The sludge in the bottom of this pond was sampled April 28, 2000 and analyzed for heavy metals as recommended for the disposal of biosolids on land. The analytical results were all within the maximum pollutant concentrations for the tested elements. The MCL for lead was 300 mg/kg though not listed in that report. Annual and cumulative pollutant loading limits for the disposal site have not been checked.

Equipment:

Inlet Pump
5 HP propeller pump, 1335 gpm @ 6-ft. TDH, and baffle wall.

Hydrated lime feed, from 50 lb. bags
Torit Div, Donaldson Company Model 54-DH dust collector with loading hatch, ½ HP motor.
3-ft. cylindrical converging hopper.
Wallace & Tiernan Model 32-050 volumetric feeder with 0.50 CF/hr. screw feeder and manual control from 1-100 percent of capacity.
35-gallon fiberglass solution tank with hydraulic mixing.
Lime slurry is delivered to the mixing area of the raw water inlet pipe by one of three pumps:

Teal Upright sump pump (2), Model 4P902 with ½ HP motor.
Wallace & Tiernan Model 44-12 diaphragm pump.

Liquid alum system, with bulk truck delivery
5,000-gallon polyethylene vertical, flat-bottom storage tank with access manhole.
Wallace & Tiernan Model 44-212 pumps (2) with head arrangement 4B 0.5-5.0 gph with manual stroke adjustment.

Liquid polymer system, from 500 lb. barrels
Stanco Polyblend Model AP51-86PB, 0.02 to 1.0 gph rated capacity with up to 75,000 cps viscosity and 10-100 gph water supply.
Currently used polymer is Cylec Superfloc 573C polyquaternary amine in water.

Soda ash system, from 50 lb. bags
100-gallon open top polyethylene mixing/day tank for mixing to 2 percent solution.
Wallace & Tiernan Model 44-212 pump, 0.5-5.0 gph with manual stroke adjustment.

Sample water pump, from Layng Creek supply line
Baldor CJL1306A, ¾ HP.

Buildings
The chemical addition building is a 21'x42'x10' side height insulated wood frame building with plywood siding and composition roof shingles, heated and running non-potable water. There is also a water supply from a well belonging to the US Forest Service. Sanitary facilities provided by on-site "port-a-potty." This building houses the chemical storage and feed facilities (except for lime), the laboratory, office area and shop area.

A second, smaller, wood-frame building is at the site for storage of lime and lime feed equipment.

Power supply
120/230 volt, single-phase power is provided by Lane Electric Cooperative Inc.

Standby power is provided from a on-site, diesel-powered Kohler Model 40ROZJ61, Serial No. 392393, generator with a 37 KW/KVA capacity and an automatic transfer switch. The fuel for the Detroit diesel engine is from a 125-gallon tank built into the equipment base.

Instrumentation
12-inch propeller meter, Water Specialties, 0-4 MGD, located in inlet to flocculation basin. This meter is used for recording the flow into the upper site facilities and was rebuilt in April 1999.

Hach "Surface Scatter 6" turbidimeters (2). One is connected on a sampling line from the Layng Creek inlet and the other to a sampling line from the Prather Creek inlet.

Taylor Circular chart recorders (3)

1. Red pen, Prather Creek turbidity
   Green pen, not used
   Blue pen, Layng Creek turbidity

2. Red pen, Finished water flow, signal from lower site
   Green pen, Chlorine residual analyzer, signal from lower site
   Blue pen, Finished water turbidity, signal from lower site

3. Red pen, Raw water flow, signal from upper site
   Green pen, Not used
   Blue pen, Not used

Raco Chatterbox telephone dialer. Signals are:

1. Chemical Feed Shut-Down
2. Telemetry Failure
3. Filter Plant Shut-Down
4. Intrusion at Either Site
5. Finish Water High NTU
6. Low Chlorine Residual
7. Emergency Generator is in Operation
8. Raw Water High Turbidity
9. Power Failure at Either Site.

Output calls are to, in order:

1. Row River WTP
2. City Hall

3-8. Operators pagers and home phones

Lower site

The lower site is in a fenced area of approximately 160'x270' owned by the City of Cottage Grove. There are four filters, three small buildings and two settling ponds at this location. Gas chlorine is used for disinfection with contact provided in the pipeline upstream of the first customers. Flow from the upper site to the lower site is through 3,300-ft. of 14-inch asphalt wrapped steel transmission main. There is telemetry, but no control connection between the sites.

Filters:

The four filters are Permutit "valveless" filters, constructed in 1977, and originally had dual media (sand on the bottom and anthracite on top) but the anthracite was removed and replaced with sand, probably when the filters were resanded in 1984. The filters were again resanded in January 2000. The original design capacity was 1600 gpm (2.3 MGD) at a filter rate of 3 gpm/sf with all four units in service, but the 1985 design

Filters at lower site

recommended considering them as having a capacity of 1.9 MGD at a filter rate of 2.5 gpm/sf. The filters are now rated as having a capacity of 1.6 MGD at a filter rate of 2.1 gpm/sf. The filters are reported to have been previously owned by City of Roseburg and sold to Cottage Grove when they were phase out of service in Roseburg.

Water is distributed between the four filters by gravity splitting from a 12-in. header along the 14-in. transmission main that is shut-off by a valve southeast of the filters. Filtered water is discharged from the individual filters to a second 12-in. header north of the line from the upper site and reconnects to the 14-in. transmission main near the chlorine building. Backwash water from the filters discharges to an open flume and the pond behind the filters.

	1977-1984	1984-2000	2000-
Diameter	14-ft.	No change	No change
Filter media	24-in.	24-in.	27-in.
Media	Dual	Sand	Sand
Effective size	Unk.	0.45-0.55 mm	0.45-0.55 mm
Uniformity coeff.	Unk.	1.4	1.5
Underdrain space	18-inches	No change	No change
Backwash supply	9'-4"	No change	No change
Available volume	10,000 gal, ea.	No change	No change
Est. flow rate	-	-	6.5 gpm/sf
Approx. duration	-	-	6-7 minutes

Backwash Ponds:

The filter backwash is discharged to a concrete flume that flows to Pond No. 1. The pond is unlined with approximate dimensions of 130-ft. by 45-ft. The reported operational depth of Pond No. 1 is two feet due to the lack of equipment capable of cleaning the pond to its original design depth of 3.5 feet. The pond is drained periodically and the accumulated sludge is transferred to Pond No. 2 where it is dried and periodically hauled to the Sawtooth Rock Quarry. The approximate storage dimensions of Pond No. 2 are 80-ft. by 65-ft. at the top of the banks.

Equipment:

Gas chlorine, from one-ton cylinders (3)
No scales.
Budget electric 2-ton monorail hoist with hand propelled trolley
Chlorinator water supply. (See sample water pump description.)
Wallace & Tiernan Pennwalt V-100 gas chlorinator with 50 lb. tube
Hach Model CL-17 chlorine residual analyzer, with 4-20 ma output to upper site
No chlorine leak detectors or alarms.

No emergency ventilation or exhaust fans.

Sample water pumps (2)
Grundfos CR4 chlorinator water supply pumps, 1-1/2 HP, primary and standby. The supply water is from the backwash chamber of Filter No. 4. An alternate supply is from 14-in. filtered water transmission line leaving the filter plant site. This line is subject to low flow conditions that could cause the supply pumps to lose prime. Water is discharged to the chlorinator and the backwash pistons in the filters.

Hydrated lime feed, from 50 lb. bags
Site assembled tank and mixer arrangement, consisting of a 300-gallon polyethylene tank with a hinged plywood cover and a Lightnin Model E78R2558T-QZ mixer, .43 HP.
Wallace & Tiernan Model 44-122 diaphragm pump.

Buildings
The chlorine building is the principal building at this site, housing controls, lab, records, and the chlorination equipment. It has light, heat and both potable (though the filtered water has not yet had sufficient contact time for adequate disinfection) and filtered water supply. There are no rest-room facilities at this site.

The corrosion-control building is a wood frame building at the southwestern corner of the site. It is used to house the lime storage and feeding equipment, storage, and cover the 8-ft. diameter circular access pit to the 14-in. transmission line flow meter. This building has light and heat.

The storage shed is a former truck box measuring approximately 7-ft. by 20-ft. It was moved next to the corrosion-control building from another city site in March 2000 for additional material storage at this site. The building has power for lighting and convenience receptacles.

Power supply
120/230 volt, single-phase power is provided by Lane Electric Cooperative Inc. Standby power is provided from a on-site, diesel-powered, Army-surplus generator with a 15 kW capacity and an automatic transfer switch. The fuel for the diesel engine is from a 15-gal. tank built into the equipment. The supplier identification is for J.R. Hollingsworth Co., Model MEP-004A, and Serial # 02037, with a date of “1/85.”

Instrumentation
12-inch propeller meter, Water Specialties, 0-4 MGD, in the 14-in. transmission main at the corrosion control building. This meter is used for recording the

filtered flow from the plant into the transmission line and was tested in April 1999. The meter sends a 4-20 ma signal to upper site.
Hach Model 1720C turbidimeter measures the blended finished water turbidity; of all four filters. A Hach Model CL-17 residual analyzer also sends a 4-20 ma signal to upper site.
Four used Hach Model 1720C turbidimeters have been installed and connected to the four individual filters. A 12 channel paperless recorder is on order to record and report data.
Time clock for each filter to initiate backwash based on run time selected by operator.
Equipment is in place to shut off an in-line valve to the filters in case of high finished water turbidity or low residual. This motor operated valve has never been put into service because the storage tank proposed in 1985 was not built.

SUMMARY OF OPERATION

The plant and pipelines are well maintained and carefully operated. However, the plant has not worked perfectly in the best of times and not satisfactorily during the worst of times. Specific problems have included:

1. Violation of turbidity limits, generally the requirement that the turbidity of treated water meet a limit of 0.5 NTU at least 95 percent of the time and, on occasion, 5.0 NTU.

2. The plant is located 21 miles form the city and staff must go to the plant and manually adjust chemical feed rates to compensate for changing water quality when flash storm events cause rapid changes in raw water quality.

3. The filters may be placed into “continuous backwash” during peak turbidity periods, (particularly when the event occurs suddenly and chemical dosing is not adjusted in time) and the filters use much of the water being produced, leaving as little as 50 percent of production for transmission to customers along the transmission line or city.

4. The plant has not been amenable to improvements due to:
   a) Age and types of equipment which to not permit automation,
   b) The distance between sites which results in floc destruction in the pipeline, lag time, and in difficulty in coupling equipment and operator efforts.
   c) There is no space at the upper site for expansion.

5. Filters 3 and 4 are loosing sand around the filter bottom nozzles (January to April, 2000) and it is accumulating in the filter bottoms.

6. At low flow, the transmission line away from the plant does not have sufficient positive pressure to maintain a flow to the sample water pump that supplies water to the chlorinator. When Filter No. 4 is out of service, the chlorinator can be out of service due to the low line pressure though operators are on-site during those periods to correct any loss of supply to the chlorinator.

ANALYSIS OF OPERATION

Raw Water Quality

The staff has previously recognized that the raw water quality is generally related to heavy rainfall in the watershed. Although the raw water turbidity is often related to the peak recorded precipitation at the Rujada rain gauge the relationships are not proportional or even directly predictable due to differences in the reporting day for rainfall (total precipitation in 24 hours) and the sampling time at the upper treatment plant site. The sample may be taken during a storm whose water may not yet have reached the sampling point, or it may have been taken after much of the storm water has already passed the site. Further, precipitation may have also occurred in parts of the drainage area other than Rujada. More representative gauging would be helpful, but "real time" reporting of the Rujada data would be more valuable to alert the water department staff to the amount of rainfall that has occurred. This would permit earlier warning of the staff that chemical system adjustments may be needed at the treatment plant and permit them to respond more rapidly. Generally, precipitation of less than 1-inch at Rujada does not cause high turbidity in the raw water to the Layng Creek treatment plant, but precipitation greater than 1-inch may.

The turbidity of Prather Creek has historically exceeded that of the Layng Creek watershed since the timber in the Prather Creek watershed was harvested. This study was limited to reviewing data from January 1997- December 1999 and, during that period, the turbidity of the raw water of these two creeks exceeded levels of 5, 10 and 20 NTU for the number of days shown in the table below.

		Layng Creek	Prather Creek
1997	> 5NTU	99 days	155 days
	> 10 NTU	20 days	30 days
	> 20 NTU	7 days	5 days
1998	> 5NTU	143 days	241 days
	> 10 NTU	34 days	96 days
	> 20 NTU	11 days	13 days
1999	> 5NTU	84 days	203 days
	> 10 NTU	20 days	51 days

> 20 NTU	4 days	14 days

These turbidity levels are significant in selection of alternative types of filtration processes. During this time, the turbidity of Prather Creek was lower than that in Layng Creek only 80 days, only 40 of which occurred after March 1997.

Finished Water Quality

The finished water turbidity is only sometimes related to raw water quality. The staff has usually been able to adjust the intake valving to select the better source quality and to adjust the chemical feed rates for lime, alum and polymer to maintain treated water within the allowable limits. The past violations of the turbidity limit have been due not just to the raw water quality but to lack of knowledge about storm conditions in the watershed, travel time to the plant site and the slow and sometimes unpredictable response of the plant to changes in the water and treatment chemicals. An analysis of the continuous charts of filtered water turbidity indicates that the finished water turbidity over the period of January 1998 to December 1999 was less than 0.5 NTU for 96.9 percent of the time, between 0.5 and 1.0 for 2.2 percent of the time, between 1 and 5 NTU for 0.8 percent of the time, and over 5 for 0.1 percent of the time.

Treatment Processes

The quality of the raw water is generally beyond the control of the City except when to close the supply from one intake, and so the plant facilities must be able to treat the water sufficiently to meet local and regulatory requirements. At present, one intake must be left open at all times due to the lack of storage in this system to provide water to the customers along the transmission line above Dorena Mobile Home Park.

The upper site is relatively new, in good condition, and appears to be satisfactory except for its lack of automatic control and remote location. Chemical storage is adequate. Chemical feeding is satisfactory except that duplicate pumps should be provided for all systems, especially lime. The mixing area has been satisfactory though it could be improved with mechanical mixing. The flocculation chamber is satisfactory though it too could be improved by mechanical mixing in place of the baffled chamber, and with some additional detention time. The settling tanks are also generally satisfactory though they presently must be operated with the weirs submerged to provide more head to the filters and reduce surges in flow as the water level would rise and flood the weirs as rates are increased through the plant. An alternative, if the upper site were to be used in the future, would be to modify the tanks to (1) add either Plate settlers or Tube settlers to increase solids removal, and (2) reconfigure the effluent weirs to better utilize the volume of the existing tanks. Settleable turbidity remaining after passage through the settling tanks flows to the downstream filters but is subject to breakup and re-solution in the pipeline before it can be removed.

The filter plant is older than most of the facilities at the upper site. Though the staff has spent considerable effort and expense, the filters are not in as satisfactory condition as the equipment at the upper site due to age, materials of construction and poor accessibility to the inside of the units.

Space Below Filter Bottom

The steel surface in the bottom of Filter No. 4 was visually inspected in April 2000. We estimate that approximately five percent of the coating on the surface had failed leaving the steel exposed to rust as shown in the photograph. The filter underdrain nozzles had also worked loose and allowed sand to pass into the bottom compartment.

The sand media in these filters have been reported to form “mud balls,” accumulations of sand grains which have individually and collectively become coated with filtered solids. Mud balls are usually not a significant problem if a filter is adequately backwashed as the turbulence of the flow breaks and washes these solids out. The Cottage Grove filters, however, have typically accumulated these mudballs even though the sand has been annually removed and washed . The sand was completely replaced in January 2000, improving effluent water quality briefly. Comparison of filtered water quality test results of December 1999 with those from February through May 2000 indicate the effluent turbidity is statistically better in February through May than before the sand was replaced.

The backwashing operation is limited by two factors: the rate of flow is limited by the available elevation between the storage tank and the filter, and by the size of pipeline. The volume of backwash is also limited by the size of the backwash storage compartment. Both of these factors, rate and volume, are fixed and cannot be varied. The rate at which the filters backwash was measure on April 4, 2000 at 1,000 gpm, or at 6.5 gpm per square foot of sand surface area. This is far less than the minimum required rate of 15 to 23 gpm per square foot for new filters today. The duration of flow is reasonable, but the frequency of backwash is such that the filters use much of the water they produce under severe conditions leaving as little as 50 percent of production for the City and its customers. Under normal conditions, the backwash used approximately 25 percent of the filter output that is far above the 2 to 5 percent standard in the water works field. The filters are also severely limited by not having a means of prewashing and breaking up the crusted surface (a “surface wash”).

The filters could be rehabilitated to overcome several of these problems. The filters could be taken out of service, one at a time, cleaned and fitted with internal piping for a surface wash and an increased rate of backwash, a new filter bottom below the media to enable the increased backwash flow rate to pass, and the media replaced. The inside of the filters and underdrain compartment could also be cleaned and recoated at the same time to protect the steel surfaces against corrosion. A storage tank and pumping system could also be constructed to provide the water necessary for the surface wash and increased backwash flow.

In spite of the several modifications to improve the effectiveness of the backwash process and restore the steel coatings, however, the data on filter performance during March and April 2000, following media replacement, indicate that the filters, in their present condition, are at this time marginally capable of treating the water to the future turbidity standard of less than or equal to 0.3 NTU 95 percent of the time, and less than or equal to 1 NTU 100 percent of the time. It is recommended that these filters be considered at the end of their useful life. The principal effort of the City's continued planning should be directed at how best to maintain economic service to the City and its customers without relying on repair of these existing filters.

REGULATORY REQUIREMENTS

COMPLIANCE OF EXISTING FACILITIES

The only compliance issue with the Oregon Health Division (OHD) has been due to turbidity present in the finished water produced by the Layng Creek Water Treatment Plant. As a result of the December 1996 Bi-lateral Compliance Agreement with the Health Division and subsequent revision of compliance dates, the City must:

1) Notify the OHD of any violations within 24 hours of turbidity violations throughout the term of the agreement. The City staff is doing this.

2) Provide monthly monitoring reports to the OHD throughout the term of the agreement. The City staff is doing this.

3) Issue public notices of the violations and send copies to the OHD within 10 days of publication. The City staff is doing this.

4) Submit an "Interim Operations Plan" to the OHD for approval explaining how the City will optimize the performance of the Layng Creek facilities until they are modified or replace by March 1, 1997. The City staff did this.

5) Submit a water system facilities plan that evaluates the existing transmission line for hydraulic capacity, condition and useful life; evaluates potential alternative solutions to resolve the conditions resulting in treatment violations; and evaluates the costs and benefits of all feasible alternatives. This was to have been completed by November 30, 2000.

6) Submit engineering plans that implement the solution chosen by the City from the water system facilities plan by July 1, 2002. Compliance with this date is unlikely, as the City has not yet reached a conclusion on its proposed plan. This delay will also affect compliance with succeeding compliance dates.

7) Complete project bidding and award for a construction contract for the plan chosen by the city by February 1, 2003.

8) Complete construction of improvements and needed facilities by August 1, 2005.

9) The treatment plant is to achieve compliance with applicable treatment techniques and maximum contaminant levels by February 1, 2005.

NEW REQUIREMENTS

The Layng Creek plant produces water for the City public water supply under the regulations of the US Environmental Protection Agency (USEPA) and the Oregon Health Division (OHD) of the Oregon Department of Human Resources. Those regulations are administered through the OHD office in Portland. The principal law is the federal "Safe Drinking Water Act Amendments of 1996," though numerous federal and state regulations extend and regulate details within the general goals of that law. The principal state regulation is OAR Chapter 333, Division 061, and "Public Water Systems." Additional laws and regulations also affect details of plant facilities due to the presence of the upper site on land belonging to the US Forest Service, land use policies of the Bureau of Land Management, the federal and state laws affecting safety in the workplace, and restrictions on the location and maintenance of facilities in easements and public rights-of-way. Except as may be specifically noted otherwise, this discussion relates primarily to the production of water.

The existing regulations on the Layng Creek plant apply because:

1. The plant provides water for public use.
2. There are more than 15 service connections used by year-around residents, or which regularly serves 25 or more year-around residents.
3. The source of the water is from surface water sources.
4. The treatment processes include rapid sand filters for removal of turbidity by conventional filtration.
5. The treated water is disinfected with chlorine.
6. There are fewer than 10,000 people served by the system.

None of these factors is expected to change in the next 10 years, though it is possible that the population could grow faster than expected. Another change would be in the laws and subsequent regulations, a situation which is difficult to predict and especially so with the changes in the national administration.

The plant is meeting the existing regulations for water quality with an occasional exception of those for turbidity. Turbidity is a measure of the cloudiness of water caused by suspended particles, measured in nephelometric turbidity units (NTU). Turbidity is not a health risk as such but it can harbor bacteria and therefore require the use of more chlorine during disinfection, or react with chlorine to form harmful by-products. It has been used throughout most of the period of modern drinking water treatment as a standard by which the appearance of water is judged and whether the treatment processes are working properly. The standards in the present law require "the turbidity level of representative samples of filtered water to be less than or equal to 0.5 NTU in at least 95 percent of the measurements taken each month, except that if the Division determines that the system is capable of achieving at least 99.9 percent removal and or inactivation of Giardia Lamblia cysts at some turbidity level higher than 0.5 NTU in at least 95 percent of the measurement taken each month, the Division may substitute this higher turbidity limit for that system. However, in no case may the Division approve a turbidity limit that allows more than 1 NTU in more than 5 percent of the samples taken each month. The turbidity level of representative sample must at no time exceed 5 NTU."

The Oregon Health Division and City have agreed that there have been violations of the maximum contaminant level for turbidity at several times due to the remote location of the plant, the need to continuously deliver water for customers along the transmission line and in the city, the separation between the upper and lower treatment plant sites, and the severe fluctuations in raw water quality with weather conditions in the watershed.

The other existing water quality standards applying to this supply are being met, but there are new standards being proposed by the USEPA, which the OHD will be required to administer. In some cases, draft rules have been proposed. In others, ideas have only been discussed and in still other cases, there is so much controversy over whether to regulate a substance that there is no clear idea as to what may be safe. A discussion of some of these possible new standards is presented below according to the regulation or the parameter that has been discussed.

Interim Enhanced Surface Water Treatment Rule

Presently this rule applies only to systems supplying 10,000 residents or more. The City of Cottage Grove has a population of approximately 8,445 and is not expected to exceed 10,000 until sometime prior to the formal census of 2010 or the year 2004. The principal impact of this rule will be initially to be applied to the plant, would be initially to require additional monitoring (which will impact the operating budget, but to an extent which cannot be estimated prior to data collection) and to require a plant using conventional filtration, such as both the existing City plants, to achieve some level of removal of naturally present organic materials (NOM) in the water. Neither plant had monitoring for NOM, most easily represented as total organic carbon (TOC) until initial monthly testing began in August of 2000. Testing for alkalinity was already being performed on a daily basis. Testing for TOC and for alkalinity (which is related to the need for removing the TOC) in the plant's raw water supplies, the inlet and outlet of the flocculation/settling tank, and the filter effluent should be carried out on a monthly basis until some pattern is apparent and then might be reduced to quarterly. This parameter is discussed again in this chapter under the subject of the Disinfection/Disinfection By-products (D/DBPs) Rule.

New rules, published in the Federal Register, April 16, 2000, will also require the plant to produce finished water with a turbidity of less than or equal to 0.3 NTU in at least 95 percent of measurements taken each month (sampling at 4 hour intervals) and not exceed 1.0 NTU at any time. The rule is expected to be effective in January 2004 for the City of Cottage Grove. The turbidity limits for slow sand filtered water are to remain the same as now in effect, requiring a finished water with a turbidity of less than or equal to 1.0 NTU in at least 95 percent of measurements taken each month (sampling at 4 hour intervals) and not exceed 5.0 NTU at any time.

The goal for finished water turbidity, proposed by the American Water Works Association, is 0.1 NTU at any time. This goal has not been adopted in regulations and is not expected to be adopted within the planning period.

Disinfection/Disinfection By-products (D/DBPs) Rule

The disinfection of public drinking water has been one of the most successful achievements in public health, reducing death from water borne disease from the No. 1 cause of death in the early 20th century to such a low rate that such an occurrence became national news by the 1990's. As health has improved and the public becomes more interested in health statistics, however, by-products of chlorine's use were recognized to be of concern. Initially, the entire class of organic compounds, "Trihalomethanes," was limited to no more than 0.100 mg/L. Results from the January 3, 2000 samples were:

	TTHM (1)	Chloroform	Bromo.	Dibromo.	Bromoform
Layng Creek	(2)	(2)	(2)	(2)	(2)
Prather Creek	(2)	(2)	(2)	(2)	(2)
Gowdyville Rd. BO	0.0332	0.0303	0.0021	0.0008	$\leq$ 0.0005
MCL, currently	0.100				

(1) All analyses are reported in mg/L. The full names of the five substances that are currently tested are:

Total trihalomethanes (TTHM)
Chloroform
Bromodichloromethane (Bromo.)
Dibromochloromethane (Dibromo.)
Bromoform

(2) None detected at 0.0005 mg/L.

New draft regulations were published on April 14, 2000. The proposed regulation is to be effective on June 13, 2000 unless EPA receives adverse comment by May 15, 2000.

	TTHM	HAA5	Bromate	Chlorite
MCL, currently	0.100 mg/L	-	-	-
MCL, April 14, '00	0.080 mg/L	0.060 mg/L	0.010 mg/L	1.0 mg/L

1) The full names of the substances that are abbreviated are:
Total trihalomethanes (TTHM)
The sum of five specific haloacetic acids (HAA5)

An additional parameter, total organic carbon (TOC), is also to be regulated under the disinfection/disinfection byproducts rules. TOC is a measure of a variety of organic compounds present in water. Some of these compounds are biodegradable, but others (such as humic substances left from decomposition of forest products) are nearly stable. These substances can, however, react with chlorine and other disinfecting chemical to form disinfection byproducts. Because of this, and because some water treatment methods can be modified to remove greater percentages of the raw water TOC, the D/DBPs regulation requires conventional treatment to meet specified levels.

Source water TOC (mg/L)	required removal, at given alkalinity, to meet or exceed:		
	0-60 mg/L	>60-120 mg/L	>120 mg/L
>2.0 to 4.0	35.0 percent	25.0 percent	15.0 percent
>4.0 to 6.0	45.0 percent	35.0 percent	25.0 percent
>6.0	50.0 percent	40.0 percent	30.0 percent

1) TOC is measured as mg/L carbon in the CO_2 produced by the reaction of the oxidizing chemical with organic carbon.
2) Alkalinity is measured in mg/L as calcium carbonate.

These rules apply to treatment by conventional filtration, such as that at the existing Cottage Grove plants which use coagulation, settling, and filtration where modification of the coagulation process often will enhance the removal of TOC. The rules would not apply to alternative processes that do not use coagulation, such as slow sand filtration, diatomaceous earth filtration or membrane filtration if coagulation and settling are not used. There are also six alternative compliance criteria that may be used should the conventional filtration process not meet the levels above. Both the Layng Creek and Row River plants appear to be meeting the required removals at this time, however, based on the limited testing during the summer of 2000. The results from tests in August and September, 2000 are shown.

	Removal at Given Alkalinity					
	August 13, 2000			September 10, 2000		
	TOC (mg/L)	Alkalinity	TOC Removal	TOC (mg/L)	Alkalinity	TOC Removal
Layng Creek Plant						
Intake	0.1 *	33	-	2.7	32	-
Sed. Basin Eff.	0.8 *	32	-	1.5	31	44
Plant Eff.	0.1 *	29	-	0.9	35	67
Row River Plant						
Intake	1.2	23	-	1.6	32	-
Plant Eff.	0.1 *	22	33	1.0	22	38

* These results appear to be too low to be reasonable.

The operations of these plants have not been optimized for high TOC removal and produce results comparable to the requirement. Compliance with the rule is not expected to be a problem.

Arsenic, Radon and other Radionuclides

These compounds are present in drinking water primarily from contact with the water underground and prior to it seeping into the creeks from which the plant receives its supplies. They are not usually of concern in surface water supplies such as those used by the LCWTP. The existing plant effluent monitoring has indicated the concentrations are:

	Arsenic	Radon	Other radionuclides		
			Alpha Emit.	Beta Emit.	Ra 226+228
Layng Creek	≤ 5 ug/L (1/29/99)	-	ND (1/29/99)	-	-
Prather Creek	(1)	-	(1)	-	-
Plant effluent	(2)	-	(2)	-	-
MCL, currently	50 ug/L	300 pCi/L	15 pCi/L	4 mrem	5 pCi/L
MCL, anticipated	10 ug/L	300 pCi/L	15 pCi/L	4 mrem	5 pCi/L

(1) The Umpqua Research Company report of 2/8/99 does not differentiate between Layng Creek and Prather Creek. It is presumed the sample was mixed.

(2) The regulation does not call for testing at this location.

The significance of the parameter of 5 micrograms in a liter of water (ug/L) can be appreciated better by comparing the diameter of a baseball and that of the planet Earth. The existing water quality parameters are within the MCL's (maximum contaminant level) permitted by the current regulations and are below those expected in the regulation drafts to be published later this year. The proposed new limits for radionuclides were published in the Federal Register, April 21, 2000, but are now under reconsideration by the US EPA.

Other compounds

Nickel, sulfates, and other compounds are also expected to be regulated within the next two years. So far as known from the available testing results and published comments, there will be no impact on the LCWTP. The draft of the regulations is expected in August of 2001 and the final regulations in August 2002. The January 28, 1999 sample taken at Rocky Point, of the treated flow from the Layng Creek WTP, indicated a sulfate concentration of 9.31 mg/L, as compared to a recommended limit of 250 mg/L.

Lead and copper concentrations do not apply to the raw water or plant effluent quality, but at the points of use. The records indicate that most of the samples at points of use are significantly below the action limits and so it appears that the plant effluent is acceptable.

CONCLUSIONS

The Layng Creek plant is presently marginally capable of treating water to the proposed limits. The plant is not expected to be able to comply with the new turbidity limits through the design year of 2020 due to the age and condition of the filters, limitations on the settling facilities and the difficulties of operating the plant with the chemical conditioning and filters so widely separated.

The facilities recommended under this study are expected to meet all the above-mentioned regulations. Although the engineering plans for the solution to be chosen by the City might theoretically be in operation to meet the July 1, 2002 date established by the agreement with the OHD, the implementation would have to be extremely rapid and the City should amend that date.

PROPOSED ALTERNATIVES

OBJECTIVES

The City must soon increase the capacity of one or both plants. The projected system consumption is expected to increase to a daily average of 4.1 MGD during the maximum week by 2015 and to 4.9 MGD by 2022. Peak day demand is expected to reach 5 MGD by 2020, but the additional requirements of the peak day will be satisfied from the City storage reservoirs. The City should have 3.0 MGD additional capacity by the design year of 2022, yet the pipeline from Layng Creek can carry only 1.8 MGD and the existing filters can supply only 1.5 MGD.

The questions raised in this study were to determine:

1. **Question: Can the facilities in the Layng Creek system be repaired and used into the future?**
   Answer: Yes. The dams are in generally good condition, but need some repair. The intake pipeline from Prather Creek is in very poor condition and it, as well as sections of the intake pipeline from Layng Creek and sections of the transmission main in the eastern end of the system need extensive repair. The treatment facilities at the upper site could be used in spite of being difficult to attend, but the facilities at the lower site need to be replaced. The costs for the necessary work are presented in the next chapter of this report.

2. **Question: What is the best way to provide for the repair or replacement of the facilities in the Layng Creek system over the period through the year 2022? Should the City abandon them and expand the Row River plant now, or should the City repair them and delay the expansion of the Row River plant?**
   Answer: If we are to consider only what the City should do to meet the conditions of the year 2022, then the answer is clear and has been determined by the capacity of the existing transmission pipeline. The pipeline cannot supply the entire flow needed by the City for the year 2022 and it would cost approximately $7.6 million to replace all of the pipeline, at the same capacity, from the dams to the City reservoir. That cost exceeds the cost of plant expansion in all other alternatives and so the answer would be to expand the Row River plant. It may, however, be feasible to replace the Layng Creek plant with a plant of 2 MGD, which is within the capacity of the pipeline, and later expand the Row River plant when the City needs more than 4 MGD.

3. **Question: Should the City repair the Layng Creek system and delay the expansion of the Row River plant, or expand the Row River plant now?**
   Answer: We can consider the costs of repairs to the Layng Creek system against the costs of expanding the Row River plant to provide the comparable capacity of 2 MGD. Those repairs should provide sufficient water to meet the needs of the City through the next 10 to 15 years. The facilities also should be adequate to provide service for 30 years if the deteriorated portions of the pipeline are replaced. The City is expected to need to expand the Row River plant in 10 to 15 years to provide the capacity needed beyond the capacity of the 14-inch transmission pipeline. The decision on which plant should be expanded depends upon costs and other factors presented later in this report.

ALTERNATIVES

Several alternatives were developed during this study. Each provides a way to resolve concerns about the long-term care of the collection and transmission mains between the diversion dams and plant and between the plant sites and City, and to provide satisfactory drinking water to the City. Although most of these alternatives would continue service to all the existing customers of the system, one would sharply affect the customers along the transmission main between the plant and the City.

Each of the alternatives will require the construction of new treatment facilities soon, either through immediate expansion of the Row River plant (Alternatives 1, 2, and 7) or through immediate construction of a new plant adjacent to the lower site of the Layng Creek plant (Alternatives 3, 4, 5, and 6). As the City demand for water continues to increase beyond the year 2014, still more treatment capacity will be needed. That additional capacity will have to be installed at the Row River plant due to the limited capacity of the 14-inch transmission line.

The treatment facilities considered in this study would continue to use the basic treatment processes currently used by the City. Raw water would be obtained through the existing water rights and filtered before being disinfected with chlorine and flowing into the system. These processes provide a safe and reliable supply for the system, the staff is familiar with the equipment and operations, and the costs are low. Four of the alternatives (3, 4, 5 and 6) use somewhat different types of filters but the equipment and operating procedures are similar to those now used.

If the customers along the transmission line east of the Dorena dam are to be served, a new storage tank will need to be constructed near Culp Creek that would allow the plant serving this area to be off-line for up to two days during severe weather or water quality conditions. The tank also would serve to provide additional storage for the City. If these customers are not to be served, the tank would not be necessary.

All alternatives will be subject to permitting requirements for work along highways, in easements, and especially in and along the creeks, river and lake. Endangered Species Act regulations will particularly impact work involving the dams and the Layng and Prather Creek intake line replacements.

Treatment processes

Rapid sand filters (Alternatives 1, 2, 4 and 7)
The rapid sand filters now used at the Layng Creek plant and at the Row River plant share several common features. Both filter systems require the raw water to be treated with chemicals to form a floc with the finely divided solids in the water (turbidity) and some of the dissolved materials. The floc are then separated to leave a cleaner water that is filtered at a rate of approximately five gallons per minute through each square foot of filter surface. The granular filter materials strain and separate the finely divided materials from the water, accumulating them within the spaces between grains of filter material. Over a period of time, the spaces become clogged and the filters are backwashed to clear the filter materials and then put back into operation. Although the spaces between grains become clogged within a relatively short time, ranging from a few hours to two to three days, backwashing is a quick and easily automated way to restore filter capacity and return the filter to regular operation. Backwash water from the filters must be settled in a lagoon before it can be discharged under a discharge permit. Sludge from the settling tanks must also be removed and is usually discharge to a settling pond, and the sludge is removed after it dries. All alternative plans for expansion at the Row River Plant are based on the continued use of rapid sand filter units similar to the unit now at that plant. Alternative 4 proposes use of a package-version of the rapid sand filter process at the lower site of the Layng Creek plant.

The City presently has two rapid sand filter plants and the staff is experienced in their operation and maintenance. Filter maintenance includes periodic replacement of the media. The recommended schedule is at about 12 year intervals though actual conditions may vary.

Slow sand filters (Alternative 3)
When alternatives were first considered, it was expected that the existing filters at the Layng Creek plant would be serviceable for the foreseeable future and would be used in Alternative 3. However, analysis of the filters after they had been resanded in early 2000 revealed that the steel underdrain systems were not in satisfactory condition and that the filter performance was marginal. As a result, there would be no advantage in retaining these filters to pretreat water ahead of a second stage filter system. In place of the earlier Alternative 3 plan

that would have retained the existing filters, another plan was developed in which a set of "slow sand" filters would be considered at the lower site. The settling facilities at the upper site would be retained to pretreat water during periods of high raw water turbidity.

Like rapid sand filters, slow sand filters use granular filter materials to separate turbidity and biological materials from the water, but generally without first adding chemicals to form a floc. This saves on the costs of operating the chemical addition and settling facilities but, because a chemical treatment step is not used, the raw water must be cleaner and water with a turbidity of 10 or greater should be avoided unless it is pretreated. Fortunately, the water supplies to the Layng Creek plant are of satisfactory quality most of the time and have a turbidity of less than five except for very short durations. It is also fortunate that the facilities chemical addition and settling facilities at the upper site are in satisfactory condition and could be used during periods that the raw water did not clear up quickly after storm events. Slow sand filters also have two other significant differences from rapid sand filters, they operate at a very slow rate of about 0.1 GPM per square foot (vs. 5 GPM/SF for rapid sand filters) and they are extremely stable in performance, reducing the time required for operator attention. This stability is recognized by the US Environmental Protection Agency regulations which permit turbidities of up to 1.0 NTU in the product water from slow sand filters as opposed to 0.3 NTU for water from conventional rapid sand filters. Slow sand filter plants are also exempt from the requirements of the Disinfection/Disinfection By-Product regulations for removal of total organic carbon (TOC).

Slow sand filters do require cleaning after several weeks, much less often than for rapid sand filters, because of the low rate water is applied. Cleaning has been historically done with hand labor and mechanized truck or buggy systems to physically remove the top one-quarter to one-half inch of sand from the filter. Newer cleaning methods have been developed which eliminate most hand labor and avoid losing sand with each cleaning event. Both methods work well and can be completed within less than a day with a temporary labor crew. Daily filter operation normally requires only intermittent visits to check disinfection facilities and water sampling. Electrical requirements are also less expensive than for conventional plants as backwash pumps and air compressors are not required and the existing single-phase power supply would be adequate.

Some wastewater is generated during the filter cleaning cycle and it must be settled in a lagoon before it can be discharged under a discharge permit. There is no sludge to be removed. Filter maintenance includes periodic replacement of the media. The schedule depends on the cleaning method and depth of sand media, but a 10-year period is feasible though actual conditions may vary.

Cartridge filters (Alternative 5)
Cartridge filters are a process that was used for swimming pools and in commercial and industrial applications. Depending on the size of the pores in the cartridge material, cartridge filtration can remove solids that contribute to turbidity and some bacteria.

The process generally involves prescreening raw water and pumping it under pressure through a series of cartridges. In addition to feed pumps, the system requires a cleaning tank, automatic backwash system with chemical cleaning, controls, and backwash water supply. Backwashing is automatic and flushes the accumulated materials from the surface. Pretreatment with granular filters is often desirable to reduce the frequency and degree of backwash required.

Backwash water and chemicals need to be collected and settled before discharge under a discharge permit. Little or no sludge is generated.   Cartridges must be replaced as they fail, allowing contaminants to pass through. The cartridges must be replaced at a modest frequency, usually within a year.

Membrane filters (Alternative 6)
Membrane filters, like cartridge filters, are a relative new process that once was used in commercial and industrial applications. Depending on the size of the pores in the membranes and the materials, membrane filtration can remove solids that contribute to turbidity, bacteria, dissolved organics, or even ions. The several types of applications range from "microfiltration," to "ultrafiltration," "nanofiltration" to reverse osmosis. Microfiltration is the method generally used by municipal water supplies. It will remove silt, clay, *Giardia lamblia* and *Cryptosporidium* cysts, algae, and some bacterial species, but is not an absolute barrier to viruses. It does control those microorganisms when used with disinfection, however.

The microfiltration process generally involves prescreening raw water and pumping it under pressure through a membrane. In addition to feed pumps, the system requires a cleaning tank, automatic backwash system with chemical cleaning, controls, and backwash water supply. Backwashing is automatic with membrane filtration systems and flushes the accumulated materials from the surface. Pretreatment is often desirable to reduce the frequency and degree of backwash required.

Backwash water and chemicals need to be collected, settled and neutralized before discharge under a discharge permit. Little or no sludge is generated. Membranes must be replaced as they fail, allowing contaminants to pass through. For a time, failed membrane cartridges can be bypassed and bad fibers removed or sealed. Eventually, however, the membranes must be replaced at a considerable expense and at a frequency estimated at about five years.

Each alternative is presented in the format of a brief description of the major features, followed by a brief listing of the advantages and disadvantages of the alternative, and the issues to be addressed if the alternative is to be considered further. The costs of implementing and operating each alternative are presented in the next section of the report.

Alternative No. 1: Close and Demolish Existing Layng Creek Plant and Replace the Capacity with a 2 MGD Expansion at the Row River Plant

Disconnect all customers that cannot be served from the Row River plant.
Demolish diversion dams.
Remove exposed sections of transmission lines and seal ends.
Transfer Water Rights to Row River plant intake.
Expand Row River facilities by adding a second 2.0 MGD filter unit and associated equipment.

Advantages

- Eliminates costs for improvements to:
  - Dams
  - Diversion pipelines
  - Layng Creek plant sites
  - Transmission main.
- Eliminates work sites distant from City.
- Eliminates filters that are difficult to operate and fail to meet treatment requirements during flash flow periods.

Disadvantages

- Most of the customers outside the City are left to find own water supplies.
- Loss of revenue from customers along the transmission pipeline.
- Requires early expansion of Row River plant.
- Requires demolition of dams, the Layng Creek plant (both sites) and the pipeline suspension bridge.

Issues

- Can City legally stop serving customers along the transmission pipeline?
- Is City willing to stop serving customers along the transmission pipeline?
- What level of demolition and site restoration will be necessary for abandoned sites?
- To whom will abandoned sites be transferred?
- What is the cost for expansion of the Row River plant?

Description

The Row River plant would be expanded from its present capacity of 2.0 MGD by extending the building by 30-feet to the south to house a new package filter similar to the 1992 unit. Additional chemical feed pumps would be installed in the existing chemical equipment rooms to serve the new filter. Piping, electrical and control services would be connected as planned at the time the existing plant was designed. A new chlorine contact tank would have to be constructed adjacent to the existing single tank and new high service pumps would be installed, as on the existing tank, to pump to the Knox Hill Reservoirs.

Services along the Layng Creek transmission main could be served from the Knox Hill system as far as the Dorena Lake Home Park, but the main would be excavated, severed and the ends plugged after that connection. Customers beyond the river crossing would no longer receive service from the City and would have to drill wells or form their own water system.

The dams on Prather Creek and Layng Creek would have to be removed, the pipelines plugged, the Layng Creek plant (both sites) demolished, the pipeline bridge over the river removed and the open ends of all remaining pipelines and service connections sealed.

Applications would be made to transfer water rights for the Prather Creek and Layng Creek intakes to the Row River plant site.

The work included in this alternative is indicated in Figure 6.

Alternative No. 2: Demolish Layng Creek Plant and Serve Transmission Pipeline Area from a 2 MGD Expansion at the Row River Plant

Demolish diversion dams.
Abandon transmission lines between intakes and the first customer.
Modify the existing transmission line and install pumping and 0.75 MG storage tank to serve all customers from the Row River plant.
Transfer Water Rights to Row River plant intake.
Expand Row River facilities by adding a second 2.0 MGD filter unit and associated equipment.

Advantages

- Continues service to all customers along the transmission pipeline.
- Eliminates costs for improvements to:
    - Dams
    - Diversion pipelines
    - Treatment plant, both sites.
- Eliminates treatment operations distant from City.
- Eliminates facilities at the Layng Creek sites.

Disadvantages

- Requires improvements to transmission main.
- Requires new pumping station to deliver water eastward from City.

- Requires a storage tank near the east end of the pipeline.
- Requires demolition of dams, the Layng Creek plant (both sites) and the pipeline suspension bridge.

Figure 6 – Alternative 1 – Close & Demolish Existing Layng Creek Plant

Issues

- What level of demolition and site restoration will be necessary for the remaining site to be abandoned?
- To whom will abandoned sites be transferred?
- Where should the new pumping stations and storage tank be constructed?
- What is the cost for expansion of the Row River plant?
- What is cost of transmission main repairs.
- Potential to develop stale water in the transmission main.

Description

As in Alternatives 1, the Row River plant would be expanded from it's present capacity of 2.0 MGD by extending the building by 30-feet to the south to house a new package filter similar to the 1992 unit. Additional chemical feed pumps would be installed in the existing chemical equipment rooms to serve the new filter. Piping, electrical and control services would be connected as planned at the time the existing plant was designed. A new chlorine contact tank would have to be constructed adjacent to the existing single tank and new high service pumps would be installed, as on the existing tank, to pump back up the existing Layng Creek transmission to a new 0.75 MG storage tank along that line. The pumps would not pump directly to the Knox Hill reservoir, but water from the new filter could be pumped with the existing high service pumps to Knox Hill.

All of the existing services along the Layng Creek transmission main would be served from the Row River plant, but the main would be excavated, severed and the ends plugged after the last connection.

The dams on Prather Creek and Layng Creek would have to be removed, the pipelines plugged, the Layng Creek plant (both sites) and pipeline suspension bridge would have to be demolished and the open ends of all remaining pipelines sealed.

Applications would be made to transfer water rights for the Prather Creek and Layng Creek intakes to the Row River plant site.

The work included in this alternative is indicated in Figure 7.

Alternative No. 3: Renovate Layng Creek Plant with New 2 MGD Slow Sand Filter Plant at the Lower Site

Retain intakes on both creeks.
Retain the existing facilitates at the upper site of the Layng Creek plant.
Demolish the existing filters at the lower site of the Layng Creek plant.
Construct a 2.0 MGD slow sand filter plant at the lower site.
Add a 0.75 MG finished water storage tank near Culp Creek to provide for supply to customers along the transmission line during periods that the plant

may be out of service or producing insufficient water to maintain adequate service pressures.
Repair transmission main.

Figure 7 – Alternative 2 – Demolish Layng Creek Plant and Serve Area From Row River Plant

Add controls and monitoring to the Layng Creek plant to reduce violations and improve operator convenience.
Transfer remaining water rights to Row River plant intake for future expansion Row River facilities.

Advantages

- Continues service to long-term customers along the transmission pipeline.
- Continues to use existing facilities at Layng Creek plant upper site.
- Provides a new filter plant adaptable to semi-automatic operation.
- Minimizes costs for new treatment facilities.
- Defers expansion of Row River plant.

Disadvantages

- Continues treatment operations distant from City.
- Improvements are needed to:
  - Dams
  - Diversion pipelines
  - Treatment plant, lower site
  - Transmission main.
- Requires a storage tank near the east end of the pipeline.
- Require additional land at the lower site.
- Requires continued maintenance of the upper site for intermittent use during periods of high raw water turbidity.

Issues

- Land acquisition
- Costs for fish passage.
- Remote operations.
- Long term costs.

Description

The Layng Creek plant would be replaced with a new plant at its present capacity of 2.0 MGD. Three slow sand filters of approximately 60 by 115 feet would be constructed with an attached underground pipe gallery and a service building on the pipe gallery. Only chlorine disinfection would be required for the treatment process except when raw water quality exceeded a level of approximately 10 to 15 NTU. At such times, the plant inlet valve would be closed and the plant taken off-line and customers would receive service from the new 0.75 MG storage tank to be constructed along that line. Should the operator choose or should the period of high raw water turbidity extend longer than 1 to 2 days, then the existing settling facilities at the upper site would be used to pretreat the raw water, with or without alum addition as might be necessary. The slow sand filters would filter the settled water.

All of the existing customers along the Layng Creek transmission main would be served from the Layng Creek plant.

The dams on Prather Creek and Layng Creek would have to be maintained, the pipelines to the upper site repaired, the Layng Creek plant (upper site) maintained, the facilities at the lower site demolished and the portions of the transmission main that are in poor condition would have to be repaired.

The principal differences between Alternatives 3, 4, 5 and 6 are the type of treatment to be provided at the lower site and do not impact the work required on the transmission pipeline. As a result, the work items on all these alternatives are represented in Figure 8.

Alternative No. 4: Replace the Layng Creek Plant with a New 2 MGD Rapid Sand Filter Plant at the Lower Site

Retain intakes and Water Rights on both creeks.
Repair transmission lines.
Construct a 2.0 MGD conventional rapid sand filter plant at the lower site.
Add a 0.75 MG finished water storage tank to provide for supply to customers along the transmission line during periods that the plant may be out of service or producing insufficient water to maintain adequate service pressures.
Add controls and monitoring to the Layng Creek Plant to reduce violations and improve operator convenience.
Transfer remaining water rights to Row River plant intake for future expansion Row River facilities.

Advantages

- Continues service to all customers along the transmission pipeline.
- Combines treatment operations into one site.
- Provides new plant adaptable to semi-automatic operation.
- Defers expansion of Row River plant.

Disadvantages

- Continues treatment operations distant from City.
- Improvements are needed to:
  - Dams
  - Diversion pipelines
  - Treatment plant, lower site
  - Transmission main.
- Requires a storage tank near the east end of the pipeline.
- Requires demolition of facilities at the upper site.
- Requires additional land at the lower site.
- Requires acquisition of additional land for the storage tank.

Issues

- Occasional “emergency visit”.
- Continued remote operation.
- Fish passage costs.
- Land acquisition.
- ESA issues for pipeline replacement and WTP construction.

Figure 8 – Alternative 3-6

Description

The Layng Creek plant would be replaced with a new plant at its present capacity of 2.0 MGD. Two package filter units of 1.0 MG each, similar to the filter at the Row River plant, would be constructed within a new pre-engineered metal building. The plant would require chemical additions for coagulation and separation of sludge as at the Row River plant and chlorine would be used for disinfection. At such times as the raw water quality deteriorated to such an extent that an emergency visit might be necessary to maintain operation, the plant inlet valve would be closed and the plant taken off-line and customers would receive service from the new 0.75 MG storage tank to be constructed along that line.

All of the existing services along the Layng Creek transmission main would be served from the new Layng Creek plant.

The dams on Prather Creek and Layng Creek would have to be maintained, the pipelines to the upper site repaired, the Layng Creek plant (upper site and lower site) demolished and the portions of the transmission main that are in poor condition would have to be repaired.

The work included in this alternative was indicated in Figure 7.

Alternative No. 5: Replace the Layng Creek Plant with a New 2 MGD Cartridge Filter Plant at the Lower Site

Retain intakes and Water Rights on both creeks.
Repair transmission lines.
Construct a 2.0 MGD new cartridge filter plant at the lower site.
Add a 0.75 MG finished water storage tank to provide for supply to customers along the transmission line during periods that the plant may be out of service or producing insufficient water to maintain adequate service pressures.
Add controls and monitoring to the Layng Creek Plant to reduce violations and improve operator convenience.
Transfer remaining water rights to Row River plant intake for future expansion Row River facilities.

Advantages

- Continues service to all customers along the transmission pipeline.
- Combines treatment operations into one site.
- Provides new plant adaptable to semi-automatic operation.
- Defers expansion of Row River plant.

Disadvantages

- Continues treatment operations distant from City.
- Improvements are needed to:
  - Dams
  - Diversion pipelines
  - Treatment plant, lower site
  - Transmission main.
- Requires a storage tank near the east end of the pipeline.
- Requires demolition of facilities at the upper site.
- Requires additional land at the lower site.

Issues

- Continued remote operation.
- Occasional "emergency visit".
- Fish passage costs.
- Land acquisition.

Description

The Layng Creek plant would be replaced with a new plant at its present capacity of 2.0 MGD. Two package cartridge filter units of 1.0 MG each would be constructed within a new pre-engineered metal building. The plant would require a low level of chemical additions for coagulation and prefiltration to extend cartridge life. Chlorine would be used for disinfection. At such times as the raw water quality deteriorated to such an extent that an emergency visit might be necessary to maintain operation, the plant inlet valve would be closed and the plant taken off-line and customers would receive service from the new 0.75 MG storage tank to be constructed along that line.

All of the existing services along the Layng Creek transmission main would be served from the new Layng Creek plant.

The dams on Prather Creek and Layng Creek would have to be maintained, the pipelines to the upper site repaired, the Layng Creek plant (upper site and lower site) demolished and the portions of the transmission main that are in poor condition would have to be repaired.

The work included in this alternative was indicated in Figure 7.

Alternative No. 6: Replace the Layng Creek Plant with a New 2 MGD Membrane Filter Plant at the Lower Site

Retain intakes and Water Rights on both creeks.
Repair transmission lines.
Construct a 2.0 MGD membrane filter plant at the lower site.

Add a 0.75 MG finished water storage tank to provide for supply to customers along the transmission line during periods that the plant may be out of service or producing insufficient water to maintain adequate service pressures.
Add controls and monitoring to the Layng Creek Plant to reduce violations and improve operator convenience.
Transfer remaining water rights to Row River plant intake for future expansion Row River facilities.

Advantages
- Continues service to all customers along the transmission pipeline.
- Combines treatment operations into one site.
- Provides new plant adaptable to semi-automatic operation.
- Defers expansion of Row River plant.

Disadvantages
- Continues treatment operations distant from City.
- Improvements are needed to:
  Dams
  Diversion pipelines
  Treatment plant, lower site
  Transmission main.
- Requires a storage tank near the east end of the pipeline.
- Requires demolition of facilities at the upper site.
- Requires additional land at the lower site.

Issues
- Continued remote operation.
- Occasional "emergency visit"

Description
The Layng Creek plant would be replaced with a new plant at its present capacity of 2.0 MGD. Two membrane filter units of 1.0 MG each, would be installed within a new pre-engineered metal building. The plant would require a backwash and chemical cleaning system. Chlorine would be used for disinfection. At such times as the raw water quality deteriorated to such an extent that an emergency visit might be necessary to maintain operation, the plant inlet valve would be closed and the plant taken off-line and customers would receive service from the new 0.75 MG storage tank to be constructed along that line.

All of the existing services along the Layng Creek transmission main would be served from the new Layng Creek plant.

The dams on Prather Creek and Layng Creek would have to be maintained, the pipelines to the upper site repaired, the Layng Creek plant (upper site and lower site) demolished and the portions of the transmission main that are in poor condition would have to be repaired.

The work included in this alternative was indicated in Figure 7.

Alternative No. 7: Demolish Layng Creek Plant and Serve Transmission Pipeline Area from a 3.0 MGD expansion at the Row River Plant

Demolish diversion dams.
Abandon transmission lines between intakes and the first customer.
Modify the existing transmission line and install pumping and 0.75 MG storage tank to serve all customers from the Row River plant.
Transfer Water Rights to Row River plant intake.
Expand Row River facilities by adding a second filter unit and associated equipment. Unlike Alternative 2, the expansion unit should have a capacity of 3.0 MGD.

Advantages (*in addition to those of Alternative 2*)
- Continues service to all customers along the transmission pipeline.
- Eliminates costs for improvements to:
  - Dams
  - Diversion pipelines
  - Treatment plant, both sites.
- Eliminates treatment operations distant from City.
- Eliminates facilities at the Layng Creek sites.
- *Avoids the need to expand the plant again as soon as the year 2014 and can be completed in 2023.*
- *Reduces the number of parallel treatment units in the Row River plant from 4-2 MGD units to 3 (one 2.0 MGD and two 3.0 MGD) with reduction in plant complexity and labor required for operation.*

Disadvantages
- Requires improvements to transmission main.
- Requires new pumping stations to deliver water eastward from City.
- Requires a storage tank near the east end of the pipeline.
- Requires demolition of dams, the Layng Creek plant (both sites) and the pipeline suspension bridge.
- Requires additional land at the lower site.

Issues
- What level of demolition and site restoration will be necessary for the remaining site to be abandoned?
- To whom will abandoned sites be transferred?
- Where should the new pumping stations and storage tank be constructed?
- What is the cost for expansion of the Row River plant?

- Land acquisition.

<u>Description</u>
Similar to Alternative 1 & 2, the Row River plant would be expanded from its present capacity by *the addition of a 3.0 MGD unit*, instead of a 2.0 MGD unit, by extending the building by 30-feet to the south to house a new package filter similar to the 1992 unit. Additional chemical feed pumps would be installed in the existing chemical equipment rooms to serve the new filter. Piping, electrical and control services would be connected as planned at the time the existing plant was designed. A new chlorine contact tank would have to be constructed adjacent to the existing single tank and new high service pumps would be installed, as on the existing tank, to pump back up the existing Layng Creek transmission to a new 0.75 MG storage tank along that line. The pumps would not pump directly to the Knox Hill reservoir, but water from the new filter could be pumped with the existing high service pumps to Knox Hill.

All of the existing services along the Layng Creek transmission main would be served from the Row River plant, but the main would be excavated, severed and the ends plugged after the last connection.

The dams on Prather Creek and Layng Creek would have to be removed, the pipelines plugged, the Layng Creek plant (both sites) and pipeline suspension bridge would have to be demolished and the open ends of all remaining pipelines sealed.

Applications would be made to transfer water rights for the Prather Creek and Layng Creek intakes to the Row River plant site.

The work included in this alternative is similar to that in Alternative 2 except that the existing 2 MGD Row River plant would be expanded in two steps of 3 MGD rather than in three steps of 2 MGD as in Alternative 2. That work was indicated in Figure 7.

COSTS

GENERAL

As noted in the previous chapter, seven alternatives were developed during this study. Each provides a way to resolve the long-term care of the collection and transmission mains between the diversion dams and plant and between the plant sites and City, and to provide satisfactory drinking water to the City. General descriptions of the alternatives were also presented in that chapter. Briefly, however, the alternatives are:

1. Close and Demolish Existing Layng Creek Plant, and expand the Row River plant with a second 2.0 MGD unit.

2. Demolish Layng Creek Plant and Serve Transmission Pipeline Area from Row River Plant, and expand the Row River plant with a second 2.0 MGD unit.

3. Replace the Layng Creek Plant with a new 2.0 MGD slow sand filter plant at the lower site.

4. Replace the Layng Creek Plant with a new 2.0 MGD “package” filtration plant at the lower site.

5. Replace the Layng Creek Plant with a new 2.0 MGD cartridge filtration plant at the lower site.

6. Replace the Layng Creek Plant with a new 2.0 MGD membrane filtration plant at the lower site.

7. Demolish Layng Creek Plant and Serve Transmission Pipeline Area from Row River Plant, and expand the Row River plant with a second unit having a capacity of 3.0 MGD.

Opinions of cost have been prepared for each of the project alternatives and are presented in this section of the report. Construction and repair costs are based on data compiled from various sources. Those sources include equipment quotations from the relevant supplier or suppliers, bid quotes from comparable projects or contractors specializing in the type of work, and allowances for types of work that does not have an available database. Operating costs are based on City records for the base year, with adjustments for power (rates from the power companies), chemicals (prices from suppliers),

Both construction and operating costs are based on the year 2000.

CONSTRUCTION AND REPAIR COSTS

Construction costs are based on the year 2000 for which most of the data is available and includes a contingency based on the type of work. Contingencies of 30 percent have been used for demolition work and 20 percent for most other work. A contingency of 50 percent has been allowed on the estimate for one-time emergency repair costs. Total project costs also include an allowance of 25 percent of the estimated construction cost for “associated project costs” which include:

- surveying (1 percent)
- geotechnical site assessment for foundation and building design (1 percent)
- engineering design (10 percent)
- construction services (7 percent)
- City administration expenses (2 percent)
- legal consultation (2 percent), and
- financing assistance (2 percent).

Land acquisition costs are shown separately. Costs for transferring water rights, and the legal and engineering costs for abandoning and demolishing facilities are also shown separately.

Although various portions of the project alternatives may involve more or less of the allowed budget, the use of a common budget items permits a reasonable comparison. Land acquisition costs have been shown where applicable, but the allowance is included only as an indication that there are such costs to be expected and no appraisals have been made.

OPERATING COSTS

Opinions of operating costs have been based on the existing City budgets for operation of the Row River and Layng Creek plants and adjusted for the expected addition or reduction in quantities of chemical use and power. The costs of personnel in the water department are not expected by the City to vary. Variations between alternatives have been estimated accordingly, however, for comparison between alternatives, particularly between those, which do and do not require daily visits to the Layng Creek plant site area. A contingency of 10 percent has been applied to the estimated changes in operating costs, reducing the impact of expected cost reductions and increasing the impact of expected cost increases.

OPINIONS OF COST

The costs of the project portions, such as the storage tank, pipeline work and treatment plants, as included in the several alternatives are presented in Table 4.

The costs of operations and maintenance for the facilities are presented in Table 5. The detailed cost estimates are in the Appendix of the report

TABLE 4: ESTIMATED PROJECT CONSTRUCTION AND REPAIR COSTS.

Alternative	**1**	**2**	**3**	**4**	**5**	**6**	**7**
	Disconnect customers 2 MGD	Pump from Row River 2 MGD	Slow Sand Filters 2 MGD	Package Plant 2 MGD	Cartridge Filters 2 MGD	Membrane Filters 2 MGD	Pump from Row River *3 MGD*
Pipeline replacement, 2002	$415	$4,350	$2,925	$2,925	$2,925	$2,925	$4,350
2005			$510	$510	$510	$510	
2020			$670	$670	$670	$670	
2025			$1,100	$1,100	$1,100	$1,100	
Tank, 2002	$0	$600	$600	$600	$600	$600	$600
Plant, 2004 & Pump Station	$2,550	$2,600	$1,650	$1,650	$2,250	$3,000	$3,100
2014	$2,550	$2,550	$2,550	$2,550	$2,550	$2,550	0
2023	$2,050	$2,050	$2,050	$2,050	$2,050	$2,050	$2,700
Demolition 2005	$525	$525	$150	$300	$300	$300	$525
Permitting 2004	$110	$80	$60	$75	$75	$75	$80
2019	0	0	$10	$10	$10	$10	0
2024	0	0	$10	$10	$10	$10	0

(1) Costs are in thousands, year 2000-dollar value, for the given items to be constructed between the years of 2001 and 2025. Row River plant construction after 2004 is based on Plant Alternatives 1 and 2. Demolition and permitting costs occur according to scheduled work items.

TABLE 5: ESTIMATED CHANGE IN OPERATING COSTS.

	Alternative						
Item	1	2	3	4	5	6	7
	Disconnect Customers 2 MGD	Pump from Row River 2 MGD	Slow Sand Filters 2 MGD	Package Plant 2 MGD	Cartridge Filters 2 MGD	Membrane Filters 2 MGD	Pump from Row River 3 MGD
Pipeline Repairs							
2000 – 2004	$18	$18	$18	$18	$18	$18	$18
2005 – 2009	$3	$6	$6	$6	$6	$6	$6
2010 – 2025	$6	$9	$9	$9	$9	$9	$9
Tank Maintenance	$0	$1	$1	$1	$1	$1	$1
Plant expenses (Phase Completed in 2004)							
Labor	$0	$11	$50	$76	$10	$11	$0
Power	$34	$46	$1	$4	$14	$46	$12
Supplies	($26)	($26)	($4)	($8)	($8)	($8)	($26)
Filter Media / Years	$17/12	$17/12	$225/10	$20/12	$17/1	$300/5	$20/12
Chemicals	($2)	($2)	($17)	$2	($16)	($16)	($2)
Instrumentation	$5	$5	$5	$5	$5	$5	$5
Laboratory	($5)	($5)					($5)
Insurance	$3	$3	$2	$2	$3	$4	$4

(1) Costs are in thousands per year, year 2000-dollar value.
(2) Costs in parentheses are reductions from present budget levels.

Estimated Present Worth Values

The costs of present improvements cannot be directly compared with future costs unless the time-value of money is taken into the consideration. For example, a 100-dollar item costs $100 today, but we would have to invest about $95 at five percent interest to have the $100 in a year. The present worth of the item costing $100 next year is approximately $95 now. Similarly, the present worth of 10 such items bought a year apart over the next ten years is:

Now	$ 100.00
Year 1	95.24
Year 2	90.70
Year 3	86.38
Year 4	82.27
Year 5	78.35
Year 6	74.62
Year 7	71.07
Year 8	67.68
Year 9	64.46
Year 10	61.39
Total present worth is:	$ 872.16

and not $1,000. This would be the total sum of money that the City would need in an account earning five percent interest to buy the $100 items over the 10-year period provided the cost of the items does not change over the ten years.

The present worth of water facility improvements and costs of operation and maintenance can be calculated in a similar manner even though they are planned in one year, designed in another, built in yet another year and operated over a series of years. Also, when the plant is expanded at a later time, the present value of the later expansions can be included into the present worth.

The several project alternatives have been compared by calculating their present worth so that the different costs of yearly operation can be included with the differing costs of construction of the different types of treatment plants and costs of the repair/replacement of the transmission main over the planning period of 20 years. Because of the varying sizes of plant expansions, either 2 MGD or 3 MGD, it is necessary to extend the accounting method to a 25-year period so that the total plant capacity is the same for all alternatives at the end of the time, at 8 MGD. The years during which costs expected to be incurred are presented in Table 6 on the next page.

There are several factors that directly affect the cost calculations.

1) What should be the rate of interest over the period? Presently, the City could borrow money to finance the costs at approximately 4.75 percent and this rate has been used for calculating the interest on bonds to finance construction. That rate is slightly below market rates due to the low median household income within the service area. The regular rate is 5 percent and that rate has been used for the present worth factor calculations.

2) What is the annual increase in the cost of construction? This is currently estimated by the FW Dodge/McGraw-Hill construction cost index at 3.2 percent for the past year. We have used a rate of 3.5 percent for the coming years.

3) What is the annual inflation rate for supplies? We have used 3.5 percent for the coming years.

4) What is the annual rate of increase for labor? We have used 4.0 percent for the coming years, but new hires would be at the present rate as they would be expected to come in at an entry level.

5) What is the annual rate of increase for electrical power? This is a difficult question considering recent concerns about energy availability and cost, but we have used 5.0 percent. This rate can, like all the others, be readily changed in the computer program and the results compared.

Table 6: ESTIMATED PROJECT SCHEDULE AND EXPENDITURES.

Year	Actions	Expenditures
2000	Basis for cost estimates	
2001	City to make decisions, initiate tank design.	Land acquisitions, half of assoc. project costs, permitting for pipeline demolition and disconnecting "outside" customers
2002	Construct tank, design pipeline and treatment plant	Rest of tank cost, half of assoc. project costs on pipeline and plant.
2003	Construct "immediate" pipeline sections, start plant at LC or RR.	Rest of pipeline costs, half of plant costs. Start tank maintenance cost.
2004	Complete plant Design 2005 pipeline replacement and permitting.	Rest of plant costs. Start tank maintenance cost. Half of assoc. project costs on pipeline, permitting on pipeline.
2005	Demolition of existing Layng Creek system facilities Construct pipeline	Rest of costs. Rest of pipeline costs.
2009	Design 2010 pipeline replacement and permitting	Half of assoc project costs on pipeline, permitting on pipeline
2010	Construct pipeline	Rest of pipeline costs.
2012	Design treatment plant expansion at RR WTP.	Half of assoc. project costs on plant, permitting on plant.
2013	Start plant.	Half of plant costs.
2014	Complete plant Design 2015 pipeline replacement and permitting	Rest of plant costs. Start tank maintenance cost. Half of assoc. project costs on pipeline, permitting on pipeline.
2015	Construct pipeline	Rest of pipeline costs.
2019	Design 2020 pipeline replacement and permitting.	Half of assoc. project costs on pipeline, permitting on pipeline.
2020	Construct pipeline	Rest of pipeline costs.
2021	Design treatment plant expansion at RR WTP.	Half of assoc. project costs on plant, permitting on plant.
2022	Start plant.	Half of plant costs.
2023	Complete plant	Rest of plant costs. Start plant maintenance cost.
2024	Design 2025 pipeline replacement and permitting	Half of assoc. project costs on pipeline, permitting on pipeline.
2025	Construct pipeline	Rest of pipeline costs.

The present worth analysis results are presented in Table 7 for the given rates.

TABLE 7: ESTIMATED PRESENT WORTH OF CAPITAL AND OPERATING COSTS, 2000-2025.

Alternative	1	2	3	4	5	6	7
	Disconnect customers 2 MGD	Pump from Row River 2 MGD	Slow Sand Filters 2 MGD	Package Plant 2 MGD	Cartridge Filters 2 MGD	Membrane Filters 2 MGD	Pump from Row River 3 MGD
Pipeline repairs	$158	$158	$209	$209	$209	$209	$158
Permitting	$108	$78	$73	$88	$88	$88	$78
Tank	$0	$583	$583	$583	$583	$583	$583
Pipeline replacement	$397	$4,165	$4,507	$4,507	$4,507	$4,507	$4,165
Plant replacement / expansions	$4,275	$4,327	$3,511	$3,511	$4,082	$4,795	$4,884
Plant operations	$5,217	$5,686	$5,124	$5,666	$5,278	$6,084	$5,267
Tank maintenance	$0	$16	$16	$16	$16	$16	$16
Demolition	$487	$487	$139	$278	$278	$278	$487
Total present worth, Year 2000 dollars	$10,642	$15,500	$14,162	$14,858	$15,041	$16,560	$15,638

(1) Costs are in thousands, year 2000-dollar value.

The least expensive alternative to the City, based on costs, would be Alternative 1, to abandon the Layng Creek system, yet this alternative would also result in the loss of revenue along the eastern portion of the pipeline. The revenue from the 110 accounts in that area is currently approximately $54,000 per year. The present worth of that income over 25 years, with a fifty-percent allowance for rate increases after 2002, is only $1,100,000. This amount is not sufficient to pay for the repairs necessary to keep the transmission pipeline east of Dorena Lake in service.

The least expensive alternative to the City of the alternatives which maintain service to the customers along the transmission pipeline is Alternative 3, the replacement of the Layng Creek filters with slow sand filters. Alternative 4, the replacement of the Layng Creek filters with a "package" rapid sand filter plant, would have an initial cost only slightly higher than for Alternative 3. Operating expenses for Alternative 4, however, would be higher due to chemicals, power, and labor requirements.

If the Row River plant is to be expanded, then the City might want to consider expanding that plant with filter units of 3 MGD capacity, as in Alternative 7, rather than with filter units of 2 MGD as in Alternative 2. The larger filter units would eliminate one expansion phase and would also reduce the number of parallel chemical feed systems and pumps and also reduce the number of additional operating persons needed at full capacity.

IMPACTS ON WATER RATES

Although the overall project costs, including construction and operation, may indicate the lower cost alternatives over a period of years, local water customers are more concerned with the more immediate costs of the rates paid for water. Other sources of income include water revenues from grants, loans, and reserves. The City "System Development Fund" for water also accumulates money from new development for projects benefiting the system as a whole. The City had approximately $170,000 in the Water Operations Enterprise Fund (for annual operating expenses), $608,000 in the Water Reserve Fund (for future capital improvement projects), and $255,000 in the System Development Charges Fund at the end of Fiscal year 2000.

Two alternatives have been selected by the City to illustrate the effects of project costs on water rates. The two are:

1. Alternative 1 - Close and Demolish Existing Layng Creek Plant, and expand the Row River plant with a second 2.0 MGD unit.

4. Alternative 4 - Replace the Layng Creek Plant with a new 2.0 MGD "package" filtration plant at the lower site.

Alternative 1 - Close and Demolish Existing Layng Creek Plant, and expand the Row River plant with a second 2.0 MGD unit

The anticipated schedule for expenditures and grant/special revenue income are presented in Table 8. The costs in this table have also been inflated at 3.5 percent annually from the base year of 2000 to the proposed year of expenditure. The final column summarizes the funds to be financed by the sale of bonds. The interest rates for year 2005 bonds are based on the current rate for Rural Development loans. Rates for later issues are at the rates for last year before the current recession intensified.

Expenditures for debt service on existing and proposed bonds, existing and estimated Layng Creek operating expenses, and undefined additional City expenses for the water system are presented in Table 9. The volumes of water sold have been adjusted by the loss of the customers along the eastern end of the transmission pipeline. The net cost of water, per 1000 gallons and for an average residential customer (6,000 gallons per month), is in the final two columns of the table. The actual water rates in a particular year, however, would be "averaged" by the use of

TABLE 8
Schedule of Project Expenses
Alternative 1

Year	Pipeline Repairs	Permitting	Pipeline Replaced	Storage Tank	Plant	Demolition	Plant Operation	Tank Operation	Total Expenses	CDBG Grant	Net Local Share	From URA	From Reserves	Net Local Cost	To Be Financed
										$750		16%	$380		
2000	$18.0														
2001	$18.6	$113.9							$132.5	122.1					
2002	$19.3		$37.5		$235.7				$292.4	292.4					
2003	$20.0		$419.1		$1,291.7				$1,730.7	335.5	$1,395.2	$223.23	380	$791.98	
2004	$20.7				$1,336.9		$283.0		$1,357.5		$1,357.5	$217.20		$1,140.32	
2005	$3.6		$29.7			$623.5	$295.0		$656.8		$656.8	$105.09		$551.70	$2,484.00
2006	$3.7						$307.0		$3.7		$3.7	$0.59		$3.10	
2007	$3.8						$320.0		$3.8		$3.8	$0.61		$3.21	
2008	$4.0						$333.0		$4.0		$4.0	$0.63		$3.32	
2009	$4.1						$347.0		$4.1		$4.1	$0.65		$3.43	
2010	$8.5						$361.0		$8.5		$8.5	$1.35		$7.11	
2011	$8.8						$376.0		$8.8		$8.8	$1.40		$7.36	
2012	$9.1				$332.4		$392.0		$341.5		$341.5	$54.64		$286.86	
2013	$9.4				$1,431.0		$478.0		$1,440.4		$1,440.4	$230.46		$1,209.94	
2014	$9.7				$1,481.1		$495.0		$1,490.8		$1,490.8	$238.53		$1,252.29	$2,749.09
2015	$10.1						$516.0		$10.1		$10.1	$1.61		$8.44	
2016	$10.4						$537.0		$10.4		$10.4	$1.66		$8.74	
2017	$10.8						$559.0		$10.8		$10.8	$1.72		$9.05	
2018	$11.1						$582.0		$11.1		$11.1	$1.78		$9.36	
2019	$11.5						$607.0		$11.5		$11.5	$1.85		$9.69	
2020	$11.9						$632.0		$11.9		$11.9	$1.91		$10.03	
2021	$12.4				$453.1		$651.0		$465.4		$465.4	$74.47		$390.96	
2022	$12.8				$1,950.3		$741.0		$1,963.1		$1,963.1	$314.10		$1,649.02	
2023	$13.2				$2,018.6		$762.0		$2,031.8		$2,031.8	$325.09		$1,706.74	$3,746.72
2024	$13.7						$786.0		$13.7		$13.7	$2.19		$11.51	
2025	$14.2						$830.0		$14.2		$14.2	$2.27		$11.91	

(Costs to be expected, inflated dollars, thousands)

TABLE 9
Projected Annual Cost of Water
Alternataive 1

Annual Budget	Existing Debt	$2,500 20-yr Loan 4.50%	$2,800 20-yr Loan 4.75%	$3,800 20-yr Loan 4.75%	Total Debt Service	Operating Cost	Debt & Operating	Other Costs	Total Costs	Non-volume Revenue	Volumetric Revenue	Wat.Sold (1000 gal)	Cost $/1000 gal	Cost $/6000 gal
2000	$268.0				$268.0	$262.0	$530.0	$330.0	$860.0	$436.0	$424.0	423,300	$1.00	$6.01
2001	$268.0				$268.0	$271.2	$539.2	$341.6	$880.8	$451.3	$429.5	439,200	$0.98	$5.87
2002	$268.0				$268.0	$280.7	$548.7	$353.5	$902.2	$445.5	$456.7	435,400	$1.05	$6.29
2003	$268.0	$192.2			$460.2	$290.5	$750.7	$365.9	$1,116.6	$461.1	$655.5	451,300	$1.45	$8.71
2004	$268.0	$192.2			$460.2	$283.0	$743.2	$378.7	$1,121.9	$477.2	$644.7	467,200	$1.38	$8.28
2005	$268.0	$192.2			$460.2	$295.0	$755.2	$391.9	$1,147.2	$493.9	$653.2	483,100	$1.35	$8.11
2006	$268.0	$192.2			$460.2	$307.0	$767.2	$405.7	$1,172.9	$511.2	$661.7	499,000	$1.33	$7.96
2007	$268.0	$192.2			$460.2	$320.0	$780.2	$419.9	$1,200.1	$529.1	$671.0	514,900	$1.30	$7.82
2008	$268.0	$192.2			$460.2	$333.0	$793.2	$434.5	$1,227.8	$547.6	$680.1	530,800	$1.28	$7.69
2009	$268.0	$192.2			$460.2	$347.0	$807.2	$449.8	$1,257.0	$566.8	$690.2	546,700	$1.26	$7.57
2010	$268.0	$192.2			$460.2	$361.0	$821.2	$465.5	$1,286.7	$586.6	$700.1	562,600	$1.24	$7.47
2011	$268.0	$192.2			$460.2	$376.0	$836.2	$481.8	$1,318.0	$607.2	$710.9	578,500	$1.23	$7.37
2012		$192.2	$219.9		$412.1	$392.0	$804.1	$498.7	$1,302.8	$628.4	$674.3	594,400	$1.13	$6.81
2013		$192.2	$219.9		$412.1	$478.0	$890.1	$516.1	$1,406.2	$650.4	$755.8	610,300	$1.24	$7.43
2014		$192.2	$219.9		$412.1	$495.0	$907.1	$534.2	$1,441.3	$673.2	$768.1	626,200	$1.23	$7.36
2015		$192.2	$219.9		$412.1	$516.0	$928.1	$552.9	$1,481.0	$696.7	$784.2	642,100	$1.22	$7.33
2016		$192.2	$219.9		$412.1	$537.0	$949.1	$572.2	$1,521.3	$721.1	$800.2	658,000	$1.22	$7.30
2017		$192.2	$219.9		$412.1	$559.0	$971.1	$592.2	$1,563.3	$746.4	$817.0	673,900	$1.21	$7.27
2018		$192.2	$219.9		$412.1	$582.0	$994.1	$613.0	$1,607.1	$772.5	$834.6	689,800	$1.21	$7.26
2019		$192.2	$219.9		$412.1	$607.0	$1,019.1	$634.4	$1,653.5	$799.5	$854.0	705,700	$1.21	$7.26
2020		$192.2	$219.9		$412.1	$632.0	$1,044.1	$656.6	$1,700.7	$827.5	$873.2	721,600	$1.21	$7.26
2021		$192.2	$219.9	$298.5	$710.6	$651.0	$1,361.6	$679.6	$2,041.2	$856.5	$1,184.7	737,500	$1.61	$9.64
2022		$192.2	$219.9	$298.5	$710.6	$741.0	$1,451.6	$703.4	$2,155.0	$886.5	$1,268.5	753,400	$1.68	$10.10
2023			$219.9	$298.5	$518.4	$762.0	$1,280.4	$728.0	$2,008.4	$917.5	$1,090.9	769,300	$1.42	$8.51
2024			$219.9	$298.5	$518.4	$786.0	$1,304.4	$753.5	$2,057.9	$949.6	$1,108.3	785,200	$1.41	$8.47
2025			$219.9	$298.5	$518.4	$830.0	$1,348.4	$779.9	$2,128.3	$982.8	$1,145.4	801,100	$1.43	$8.58

(Costs to be expected, inflated dollars, thousands.)

fund balances and by the actual minimum monthly charges and rates set by Board action.

Alternative 4 - Replace the Layng Creek Plant with a new 2.0 MGD "package" filtration plant at the lower site.

The anticipated schedule for expenditures and grant/special revenue income for this alternative, retaining all the outside customers along the transmission pipeline, are presented in Table 10. The costs in this table have also been inflated at 3.5 percent annually from the base year of 2000 to the proposed year of expenditure. The final column summarizes the funds to be financed by the sale of bonds.

Expenditures for debt service on existing and proposed bonds, existing and estimated Layng Creek operating expenses, and undefined additional City expenses for the water system are presented in Table 11. The net cost of water, per 1000 gallons and for an average residential customer (6,000 gallons per month), is in the final two columns of the table. The actual water rates in a particular year, however, would be "averaged" by the use of fund balances and by the actual minimum monthly charges and rates set by Board action.

If outside customers are to stay connected to the system, the outside customers should need to justify the extra costs through higher rates or increased grants from outside sources.

Summary

The conclusions are that the costs for water will increase within two years by approximately 40 percent under Alternative 1 and by 60 percent under Alternative 4 if the fixed income from the minimum charges for water service and the "non-consumption" services are not changed and if additional grant assistance is not received.

The increases in the debt service are significant and the City should begin searching for financial assistance.

The timing of project phases will be important at three points in the 25 year period considered. The project needs to be implemented almost immediately to provide a continuing supply of water for the city as its demand is increasing above its safe capacity. At the second point, it is very beneficial to the city water rates that the next phase of treatment plant expansion does not occur until the existing bonds are retired in 2011. The third point would occur in the year 2021 if the final phase of treatment plant expansion must occur before the bonds on the Year 2003 phase have not been retired, causing costs to rise by about 25 percent for a two year period. The timing of that expansion phase should be adjusted to avoid that that overlapping period of debt payment.

TABLE 10
Schedule of Project Expenses
Alternative 4

Year	Pipeline Repairs	Permitting	Pipeline Replaced	Storage Tank	Plant	Demolition	Plant Operation	Tank Operation	Total Expenses	CDBG Grant	Net Local Share	From URA	From Reserves	Net Local Cost	To Be Financed
										$750		16%	$380		
2000	$18.0														
2001	$18.6	$36.2		$67.3					$122.1	111.8					
2002	$19.3	$32.1	$267.8	$573.1	$160.7			$1.0	$1,053.0	292.4					
2003	$20.0		$2,965.8		$831.5			$1.1	$3,817.3	335.5	$3,481.8	$557.09	380	$2,544.73	
2004	$20.7	$11.5	$57.4		$860.6		$311.0	$1.1	$950.1		$950.1	$152.02		$798.13	
2005	$7.1		$546.3			$356.3	$324.0	$1.2	$909.8		$909.8	$145.56		$764.20	$4,107.06
2006	$7.4						$337.0	$1.2	$7.4		$7.4	$1.18		$6.20	
2007	$7.6						$351.0	$1.3	$7.6		$7.6	$1.22		$6.41	
2008	$7.9						$365.0	$1.3	$7.9		$7.9	$1.26		$6.64	
2009	$8.2						$380.0	$1.4	$8.2		$8.2	$1.31		$6.87	
2010	$12.7						$396.0	$1.5	$12.7		$12.7	$2.03		$10.66	
2011	$13.1						$412.0	$1.6	$13.1		$13.1	$2.10		$11.04	
2012	$13.6				$332.4		$429.0	$1.6	$346.0		$332.4	$53.19		$279.25	
2013	$14.1				$1,822.0		$516.0	$1.7	$1,836.1		$1,836.1	$293.77		$1,542.31	
2014	$14.6				$1,885.8		$534.0	$1.8	$1,900.3		$1,900.3	$304.06		$1,596.29	$3,417.85
2015	$15.1						$556.0	$1.9	$15.1		$15.1	$2.41		$12.67	
2016	$15.6						$614.0	$2.0	$15.6		$15.6	$2.50		$13.11	
2017	$16.2						$602.0	$2.1	$16.2		$16.2	$2.58		$13.57	
2018	$16.7						$627.0	$2.2	$16.7		$16.7	$2.67		$14.04	
2019	$17.3	$19.2	$134.6				$653.0	$2.3	$171.1		$171.1	$27.38		$143.73	
2020	$17.9		$1,193.9				$679.0	$2.4	$1,211.8		$1,211.8	$193.89		$1,017.90	$1,347.7
2021	$18.5				$453.1		$701.0	$2.5	$471.6		$471.6	$75.46		$396.15	
2022	$19.2				$1,950.3		$793.0	$2.7	$1,969.5		$1,969.5	$315.12		$1,654.39	
2023	$19.9				$2,018.6		$816.0	$2.8	$2,038.4		$2,038.4	$326.15		$1,712.30	$3,762.84
2024	$20.5	$22.8	$228.3				$843.0	$2.9	$271.7		$271.7	$43.47		$228.24	
2025	$21.3		$2,363.2				$884.0	$3.1	$2,384.5		$2,384.5	$381.52		$2,002.99	$2,614.4

(Costs to be expected, inflated dollars, thousands)

TABLE 11
Projected Annual Cost of Water
Alternative 4

Annual Budget	Existing Debt	$4,100 20-yr Loan 4.50%	$3,420 20-yr Loan 4.75%	$1,160 20-yr Loan 4.75%	$3,800 20-yr Loan 4.75%	$2,200 20-yr Loan 4.75%	Total Debt Service	Operating Cost	Debt & Operating	Other Costs	Total Costs	Non-volume Revenue	Volumetric Revenue	Wat.Sold (1000 gal)	Cost $/1000 gal	Cost $/6000 gal;
2000	$268.0						$268.0	$262.0	$530.0	$330.0	$860.0	$436.0	$424.0	423,300	$1.00	$6.01
2001	$268.0						$268.0	$271.2	$539.2	$341.6	$880.8	$451.3	$429.5	439,200	$0.98	$5.87
2002	$268.0						$268.0	$280.7	$548.7	$353.5	$902.2	$467.1	$435.1	455,100	$0.96	$5.74
2003	$268.0	$315.2					$583.2	$290.5	$873.7	$365.9	$1,239.6	$483.4	$756.2	471,000	$1.61	$9.63
2004	$268.0	$315.2					$583.2	$311.0	$894.2	$378.7	$1,272.9	$500.3	$772.6	486,900	$1.59	$9.52
2005	$268.0	$315.2					$583.2	$324.0	$907.2	$391.9	$1,299.2	$517.8	$781.3	502,800	$1.55	$9.32
2006	$268.0	$315.2					$583.2	$337.0	$920.2	$405.7	$1,325.9	$536.0	$789.9	518,700	$1.52	$9.14
2007	$268.0	$315.2					$583.2	$351.0	$934.2	$419.9	$1,354.1	$554.7	$799.4	534,600	$1.50	$8.97
2008	$268.0	$315.2					$583.2	$365.0	$948.2	$434.5	$1,382.8	$574.1	$808.7	550,500	$1.47	$8.81
2009	$268.0	$315.2					$583.2	$380.0	$963.2	$449.8	$1,413.0	$594.2	$818.8	566,400	$1.45	$8.67
2010	$268.0	$315.2					$583.2	$396.0	$979.2	$465.5	$1,444.7	$615.0	$829.7	582,300	$1.42	$8.55
2011	$268.0	$315.2					$583.2	$412.0	$995.2	$481.8	$1,477.0	$636.5	$840.5	598,200	$1.41	$8.43
2012		$315.2	$268.6				$583.8	$429.0	$1,012.8	$498.7	$1,511.5	$658.8	$852.6	614,100	$1.39	$8.33
2013		$315.2	$268.6				$583.8	$516.0	$1,099.8	$516.1	$1,615.9	$681.9	$934.0	630,000	$1.48	$8.90
2014		$315.2	$268.6				$583.8	$534.0	$1,117.8	$534.2	$1,652.0	$705.8	$946.2	645,900	$1.46	$8.79
2015		$315.2	$268.6				$583.8	$556.0	$1,139.8	$552.9	$1,692.7	$730.5	$962.2	661,800	$1.45	$8.72
2016		$315.2	$268.6				$583.8	$614.0	$1,197.8	$572.2	$1,770.0	$756.0	$1,014.0	677,700	$1.50	$8.98
2017		$315.2	$268.6				$583.8	$602.0	$1,185.8	$592.2	$1,778.0	$782.5	$995.6	693,600	$1.44	$8.61
2018		$315.2	$268.6				$583.8	$627.0	$1,210.8	$613.0	$1,823.8	$809.9	$1,013.9	709,500	$1.43	$8.57
2019		$315.2	$268.6	$91.1			$583.8	$653.0	$1,236.8	$634.4	$1,871.2	$838.2	$1,033.0	725,400	$1.42	$8.54
2020		$315.2	$268.6	$91.1			$674.9	$679.0	$1,353.9	$656.6	$2,010.5	$867.5	$1,143.0	741,300	$1.54	$9.25
2021		$315.2	$268.6	$91.1	$298.5		$973.4	$701.0	$1,674.4	$679.6	$2,354.0	$897.9	$1,456.1	757,200	$1.92	$11.54
2022		$315.2	$268.6	$91.1	$298.5		$973.4	$793.0	$1,766.4	$703.4	$2,469.8	$929.3	$1,540.5	773,100	$1.99	$11.96
2023			$268.6	$91.1	$298.5		$658.2	$816.1	$1,474.3	$728.0	$2,202.3	$961.9	$1,240.5	789,000	$1.57	$9.43
2024			$268.6	$91.1	$298.5	$172.8	$831.0	$842.9	$1,673.9	$753.5	$2,427.4	$995.5	$1,431.9	804,900	$1.78	$10.67
2025			$268.6	$91.1	$298.5	$172.8	$831.0	$883.6	$1,714.6	$779.9	$2,494.5	$1,030.4	$1,464.1	820,800	$1.78	$10.70

(Costs to be expected, inflated dollars, thousands.)

FUNDING SOURCES

GRANT AND LOAN PROGRAMS

Some level of outside funding assistance in the form of grants or low interest loans may help assure that the proposed improvement projects are affordable to residents of the City of Cottage Grove. The amount and types of outside funding will dictate the amount of local funding that the City will have to secure. In evaluating grant and local programs, the major objective is to select a program, or a combination of programs, which are most applicable and available to the intended project.

There are several Federal and State funding programs to assist qualifying communities in the financing of improvement programs. Descriptions of the programs are given in this section. Each of the government assistance programs has its own particular prerequisites and requirements. These assistance programs promote such goals as aiding economic development, benefiting areas of low to moderate-income families, and providing for specific community improvement projects. Not all communities or projects may qualify for all programs.

The Oregon Economic Development Department (OEDD) is the most popular source of funding to help finance public improvements and has several separate programs offering funding assistance, including Community Development Block Grants (CDBG), the Special Public Works Fund, the Water/Wastewater Financing Program and the State Safe Drinking Water Revolving Loan Fund (jointly administered by the Oregon Health Division). Funding applications submitted to the OEDD are generally processed and funded in the order they are received, and competition for limited funds is ever increasing. A “One-Stop” meeting is coordinated by the OEDD with each jurisdiction that submits a notice of intent.

A second source of public infrastructure funding is from federal funds available through the U.S. Department of Agriculture, through its Rural Utility Services section often referred to as Rural Development (RD). This program was previously called Rural Economic and Community Development (RECD), and prior to October 1992, was administered by the Department of Agriculture’s Farmers Home Administration (FmHA). Other sources include the Oregon Department of Water Resources and special “non-profit” agencies established to assist communities in particular regional locations or socio-economic situations.

Summaries of these programs are presented below.

OEDD, Community Development Block Grants (Cdbg)

The CDBG program is a federal program administered by the OEDD for non-metropolitan cities and counties. Funds come from the U.S. Department of Housing and Urban Development (HUD) and, under the Public Works category, are targeted to water and wastewater systems. CDBG grants are available for each of three (3) phases necessary to complete water and/or wastewater system improvements:

Phase 1: Planning and Preliminary Engineering.

Phase 2: Final engineering, financial analysis, and environmental review.

Phase 3: Construction.

Grants are limited to $750,000 for the combined total of all phases. Applications may be submitted year round for Public Works grants under the CDBG Program. To be eligible, the benefited area must have at least 51 percent residents with low or moderate incomes, based on the 1990 Census data or local survey. The annual cost of water to an average home using 7500 gal/mo.* must also be higher than 1.75 percent of the median household income. Cottage Grove is eligible on both of these rules.

*Reference to Block grant funding criteria.

OEDD, Lottery-Funded Public Works Fund

This program, formerly the Special Public Works Fund (SPWF) Program, provides financing to local governments and to private for- or non-profit corporations, to construct, improve and repair infrastructure in order to support local economic development and create new jobs, especially above-average wage jobs, and to diversify and strengthen a community's economic environment. The program is capitalized through appropriations from the Oregon Lottery by the Oregon State Legislature, through loan repayments and other interest earnings.

In order to be eligible, the following conditions must be satisfied for infrastructure related projects.

The infrastructure must support strengthen a community's economic environment.

Only the highest priority projects from a local community will be considered.

Funds cannot be used for ongoing services within the budgeted resources of the community, or to pay existing staff except to augment technical assistance consistent with the intent of the Fund.

The following criteria are used to demonstrate project eligibility:

a. Supplemental Commitment: In addition to creating or retaining of permanent jobs as a result of the project, the program funding should be used to supplement local funding resources.

b. Community Development Objectives: There are specific and clearly obtainable economic or community development objectives, including a plan for performance measurement.

c. State of Preparedness: The project is ready to proceed and will completed by within one to two years.

d. Sustainable Project: The proposed facilities are part of a sustainable economic project.

e. *Principal Benefit: All projects must principally benefit industrial or eligible commercial users. The Department will structure a financing package that may include loans and/or grants. Determination of the final amount of financing and the loan/grant mix will be based on the financial feasibility of the project, the individual credit strength of an applicant, the ability of the applicant to afford annual payment on loans, future beneficiaries of the project, and other applicable issues as set by the OEDD.*

Interest rates are no less than 5.46 percent and are set quarterly by the Department; loan terms cannot exceed twenty-five (25) years. The maximum SPWF grant is $500,000 for a construction project and is not to exceed 85 percent of the total project cost. Grants are made only when loans are not feasible.

II. OEDD, Water/Wastewater Financing Program

The Water/Wastewater Financing Program was created to assist communities that must meet Federal and State mandates to provide safe drinking water and adequate treatment and disposal of wastewater. The 1993 Legislature created a Water fund through Senate Bill 81 to provide financing to local governments to construct and improve public drinking water systems. The legislation was primarily intended to assist local governments in meeting the Safe Drinking Water Act and the Clean Water Act. The Oregon State Legislature capitalizes the funding for the program through the biennial appropriation from the Oregon Lottery Economic Development Fund. Program eligibility is limited to projects necessary to ensure compliance with the applicable State regulatory agency standards or rules.

While loans and grants may be awarded, grant funding must be accompanied by loans from the Community Development Program. Loans are based on a municipality's ability to repay. Grant funding is available only if a loan is not feasible. The OEDD will structure a financing package that may include direct loans, bond loans, and/or grants and may include funds from other Community Development programs for which the project is eligible. The mix of loan/grant/bond financing will depend on the financial feasibility of the project and will consider utility rates, per capita income, existing debt, and other factors. Current interest rates on loans are 5.46 percent.

Financing limits are as follows:

Projects financed with bond funds
- Loans - max. $10 million
- Grant – max. $500,000

Projects financed with Water/Wastewater Funds
- Loan – max. $500,000
- Grant – max. $500,000

Technical Assistance (for eligible applicants under 5,000 population)
- Loan – max. $20,000
- Grant – max. $10,000

Communities must be under a state notice of violation for non-compliance and, like CDBG grants, the annual cost of water to an average home using 7,500 gal/month must be higher than 1.75 percent of the median household income.

Interested applicants should contact the OEDD prior to submitting an application. Applications are accepted year-round.

OEDD, Safe Drinking Water Revolving Loan Fund (SDWRLF)

The Federal Congress created a system of revolving loan funds as a part of the 1996 amendments to the Safe Drinking Water Act. Federal funds are appropriated for the states to use, 80-20 with state funds, to finance community and non-profit non-community drinking water systems improvements to correct non-compliance with drinking water standards. The Oregon Health Division and the Oregon Economic Development Department jointly administer the SDWRLF, with the application submitted through OEDD.

Eligible activities include planning, preliminary engineering, design, acquisition of directly related real property, construction of source, treatment, storage, transmission and metering of drinking water systems. Ineligible activities include dams, purchase of water rights, projects needed primarily for fire protection or population growth, administrative costs, costs incurred prior to award, purchase of equipment, operation and maintenance.

OHD, with OEDD assistance, annually prepares an Intended Use Plan for the prospective funding from Letters of Interest submitted by eligible water systems. The letters are rated according to criteria, including risk to human health, compliance with the SDWA, and community affordability, and ranked to form the Project Priority List. The top-ranked communities, in the year they are listed or in the next few years, may submit final applications when they are ready to proceed with planning, design or construction. If they do not use the funds after a reasonable period, they lose their eligibility for funding for that year's fund. Lower-ranked communities may, after the first year, apply for unused funds. Emergency projects may also be added to the list at any time.

Loan rates and terms vary. Bond-funded loans pass through the interest rate on the State Revenue Bonds. Direct loans are at 80 percent of state and local bond rates. Current (January, 2002) municipal bond rates are about 5 percent. Loan rates under this program are being made at 4.21 percent. Loans to Disadvantaged Communities are at 1 percent, but City of Cottage Grove is not eligible for this rate. Loan terms are 20 years, except that Disadvantaged Communities can get an extension to 30 years. Projects with bond funds may go up to $10 million in bond proceeds and up to $1 million in SDWRLF funds per project. Projects with SDWLF funds only are limited to $2 million per project.

Publicly owned systems are considered for credit using an analysis of three years of audits, three years of revenue and expense projections, and other commonly accepted fiscal and demographic ratios. Loan amounts are set after considering revenues and expenses, debt service coverage, water cost per household compared to the 7,500 gal/month and higher than 1.75 percent of the median household income, and loan-to-value ratios for private systems.

Oregon Department Of Water Resources (ODWR), Water Development Loan Program (WDLF)

The WDLF uses Oregon general obligation bond moneys to make low-interest, long-term, fixed rate loans for water development and watershed improvement projects which further the state's long-term management goals. These projects specifically include community water supply projects, including dams, storage reservoirs, well systems, treatment and pumping facilities, pipelines, and all structures, facilities, real property and methods for supplying water. The loans are available to municipalities, districts, for- and non-profit corporations or partnerships whose principal income is from farming in Oregon, or individuals. There is no grant money available from this source. As of January, 2002, there is no money available from this source and no bond issues have been planned to acquire funds.

Applications are made to the Oregon Water Resources Department following a pre-application meeting. Project construction plans must have been approved by the Oregon Health Division before WDLF disburses any loan proceeds. All loans must be repaid, plus a $100 non-refundable application fee, a one percent loan processing fee on the requested loan amount, closing costs and bond issuance costs. The interest rate is based on the rate paid on the bonds by OWRD and the WDLF operating costs. The term of the loan is up to 30 years.

Rural Development (RD), formerly Farmers Home Administration. Water and Waste Disposal Loans and Grants

RD has the authority to make loans to public bodies and non-profit corporations to construct or improve essential community facilities, including water and wastewater systems. Grants are also available to applicants who meet the median household income (MHI) requirements. While eligible applicants must have a population less than 10,000, priority is given to public entities in areas smaller than 5,500 people. Preference is also given to requests that involve the merging of small facilities and those serving low-income communities, as well as communities that have existing violations.

In addition, borrowers must meet the following stipulations:

1. Be unable to obtain needed funds from other sources at reasonable rates and terms.

2. Have legal capacity to borrow and repay loans, to pledge security for loans, and to operate and maintain the facilities or services.

3. Be financially sound and able to manage the facility effectively.

4. Have a financially sound facility based on taxes, assessments, revenues, fees, or other satisfactory sources of income to pay all facility costs including O&M, and to retire the indebtedness and maintain a reserve.

Loan and grant funds may be used for the following types of improvements:

1. Construction costs.

2. Legal and engineering costs connected with the development of facilities.

3. Other costs related to the development of the facility including the acquisition of right-of-way and easements, and the relocation of roads and utilities.

4. Finance facilities in conjunction with funds from other agencies or those provided by the applicant.

The loans have a 40-year term with no pre-payment penalties and the reserve can be funded at 10 percent per year over a ten-year period. Interest rates are set quarterly and are based on current market yields for municipal obligations. The following rates apply to those loans, effective January 1, 2001.

Market Rate:
The market rate is paid by those applicants who MHI of the service area is more that the $27,756 Oregon non-metropolitan MHI. The market rate is currently 5.125 %.

Intermediate Rate:
The intermediate rate is paid by those applicants whose MHI of the service area is less than $27,756. The current interest rate for qualified applicants is 4.750 %.

Poverty Line Rate:
The lowest rate is paid by those applicants whose MHI of the service area is below $22,205 (80 percent of the non-metropolitan MHI) and the project is needed to meet the regulatory agency health and sanitary standards. The poverty rate is currently 4.5 %.

Maximum grant amounts, based on MHI, are provided in Table 12. The grants are calculated on the basis of eligible costs that do not include the costs attributable to reserve capacity or interim financing.

TABLE 12: MAXIMUM RD GRANT FUNDS
Based on Median Household Income

Median Household Income (MHI)	Maximum Grant
<$22,205	75% of eligible project cost
$22,205 to $27,756	45% of eligible project cost
>$27,756	0% of eligible project cost

Eligibility for the RD grants and loans are currently based on 1990 Census data, and the City does qualify for this assistance. The MHI for households in Cottage Grove based on 1990 Census data is $21,384. At this MHI, the City is eligible for a maximum grant of up to 75% and a loan at the “poverty line” rate of 4.5

percent. Final grant amounts are based on repayment ability and fund availability, and typically consist of a 50/50 mix of grants and loans.

Grant funds cannot be used to reduce total user costs below that of comparable communities funded by RD, which are currently about $35 per month.

There are other restrictions and requirements associated with these loans and grants. If the City becomes eligible for grant assistance, the grant will apply only to eligible project costs. Grant funds are only available after the City has incurred long-term debt resulting in an annual debt service obligation equal to one-half percent of the MHI. In addition, an annual funding allocation limits the RD funds. To receive an RD loan, the City must secure bonding authority, usually in the form of general obligation or revenue bonds.

LOCAL FUNDING SOURCES

Local revenue sources for capital expenditures include ad valorem taxes, various type of bonds, water service charges, connection fees, and system development charges. Local revenue sources for operating costs include ad valorem taxes, and water service charges. The amount and type of local funding obligations required for water system improvements will depend, in part, on the amount of grant funding anticipated and the requirements of potential loan funding. The following sections identify those local funding sources and financing mechanisms that are most common and appropriate for the improvements in this study.

The municipal bond market is the source of most loans for municipalities in the United States, including Oregon. The municipal bond market will purchase one of two types of bonds from the City – a general obligation bond or a revenue bond. The two types of bonds differ in how the City chooses to repay the loan, and are discussed in more detail below.

III. General Obligation Bonds

General obligation (G.O.) bonds are backed by the City's full faith and credit, as the City pledges to assess property taxes sufficient to pay the annual debt service. This tax is exempt from the State's constitutional limit of $10/$1,000 of assessed value. The City may, at its discretion, use any other source or revenue, including water rate revenues, to repay the bonds. If it uses these other sources, it then reduces the amount to be collected from taxes.

Oregon Revised statutes limit the maximum bond term to forty (40) years for cities. Except in the event that RD will purchase the bonds, the realistic term for which G.O. bonds should be issued is fifteen (15) to twenty (20) years. Under the present economic climate, the lower interest rates will be associated with the shorter terms.

Financing of water system improvements by G.O. bonds is usually accomplished by the following procedure:

1. Determination of the capital costs required for the improvement.
2. An election by the voters to authorize the sale of bonds.
3. The bonds are offered for sale.
4. The revenue from the bond sale is used to pay the capital costs associated with the project(s).

General obligation bonds are preferable to revenue bonds in matters of simplicity and cost of issuance. Since the bonds are secured by the power to tax, these bonds usually command a lower interest rate than other types of bonds. G.O. bonds lend themselves readily to competitive public sale at a reasonable interest rate because of their high degree of security, their tax-exempt status, and public acceptance.

These bonds can be revenue-supported wherein a portion of the user fee is pledged toward payment of the debt service. Using this method, the need to collect additional property taxes to retire the bonds is eliminated. Such revenue-supported G.O. bonds have most of the advantages of revenue bonds, plus lower interest rate and ready marketability.

General obligation bonds are normally associated with the financing of facilities that benefit an entire community and must be approved by a vote. The disadvantage is that the vote must be by a double majority and often necessitates an extensive public information program.

The disadvantage of G.O. bond debt is that it is often added to the debt ratios of the underlying municipality, thereby restricting the flexibility of the municipality to issue debt for other purposes.

Revenue Bonds

For revenue bonds, the City would pledge the net operating revenue of the utility to repay the bonds. The primary source of the net revenue is user fees, and the primary security is the City's pledge to charge user fees sufficient to pay all operating costs and debt service. The lender would require the City to provide two additional securities for the revenue bonds that are not required by a G.O. bond. First, the City must establish a bond reserve fund equal to the lesser of maximum annual debt service or 10% of the bond amount. Second, the City must increase user fees such that the net cash flow from operations plus interest earnings are equal to or greater than 125% of annual debt service, known as a 1.25 debt coverage ratio.

The general shift away from ad valorem property taxes and toward a greater reliance on user fees makes revenue bonds a frequently used option for payment of long term debt. Many communities prefer revenue bonding, because it insures that no tax will be levied. In addition, debt obligation will be limited to system users since repayment is derived from user fees. An advantage with revenue bonds is that they do not count against a municipality's direct debt, but instead are considered "overlapping debt." This feature can be a crucial advantage for a municipality near its debt limit. Rating agencies evaluate closely the amount of direct debt when assigning credit ratings. Revenue bonds also may be used in financing projects extending beyond normal municipal boundaries. These bonds may be supported by a pledge of revenues received in any legitimate and ongoing area of operation, within or without the geographical boundaries of the issuer.

Successful issuance of revenue bonds depends on the bond market evaluation of the revenue pledged. Revenue bonds are most commonly retired with revenue from user fees. Recent legislation has eliminated the requirement that the revenues pledged to bond payment have a direct relationship to the services financed by revenue bonds. Revenue bonds may be paid with all or any portion of revenues derived by a public body or any other legally available monies. If additional security to finance revenue bonds is needed, a public body may mortgage grant security and interests in facilities, projects, utilities or systems owned by a public body.

Normally, there are no legal limitations on the amount of revenue bonds to be issued, but excessive issue amounts are generally unattractive to bond buyers because they represent high risks. In rating revenue bonds, buyers consider the economic justification for the project, population of the borrower, methods and effectiveness for billing and collecting, rate structures, provision for rate increases as needed to meet debt service requirements, track record in obtaining rate increases historically, adequacy of reserve funds provided in the bond documents, supporting covenants to protect projected revenues, and the degree to which forecasts of net revenues are considered sound and economical.

Municipalities may elect to issue revenue bonds for revenue producing facilities without a vote of the electorate (ORS 288.805-288.945). Certain notice and posting requirements must be met and a sixty (60) day waiting period is mandatory. A petition signed by five percent of the municipality's registered voters may cause the issue to be referred to an election.

Improvement Bonds

Improvement (Bancroft) bonds can be issued under an Oregon law called the Bancroft Act. The bonds are an intermediate form of financing that is less than full-fledged G .O. or revenue bonds, but are quite useful especially for smaller issuers or for limited purposes.

An improvement bond is payable only from the receipts of special benefit assessments, not from general tax revenues. Such bonds are issued only where certain properties are recipients of special benefits not occurring to other properties. For a specific improvement, all property within the improvement area is assessed on an equal basis, regardless of whether it is developed or undeveloped. The assessment is designed to apportion the cost of improvements, approximately in proportion to the afforded direct or indirect benefits, among the benefited property owners. This assessment becomes a direct lien against the property, and owners have the option of either paying the assessment in cash or applying for improvement bonds. If the improvement bond option is taken, the City sells Bancroft improvement bonds to finance the construction, and the assessment is paid over 20 years in 40 semiannual installments with interest. Cities and special districts are limited to improvement bonds not exceeding three percent of true cash value.

With improvement bond financing, an improvement district is formed, the boundaries are established, and the benefited properties and property owners are determined. The engineer usually determines an approximate assessment, either on a square foot or a front-foot basis. Property owners are given an opportunity to object to the project assessments. The assessments against the properties are usually not levied until the actual cost of the project is determined. Since this determination is normally not possible until the project is completed, funds are not available from assessments for the purpose of making monthly payments to the contractor. Therefore, some method of interim financing must be arranged, or a pre-assessment program, based on the estimated total costs, must be adopted. Commonly, warrants are issued to cover debts, with the warrants to be paid when the project is complete.

The primary disadvantage to this source of revenue is that the property to be assessed must have a true cash value at least equal to 50 percent of the total assessments to be levied. As a result, a substantial cash payment is usually required of owners of undeveloped property. In addition, the development of an assessment district is very cumbersome and expensive when facilities for an entire community are contemplated. In comparison, G.O. bonds can be issued in lieu of improvement bonds, and are usually more favorable.

Capital Construction (Sinking) Fund

Sinking funds are often established by budget for a particular construction purpose. Budgeted amounts from each annual budget are carried in a sinking fund until sufficient revenues are available for the needed project. Such funds can also be developed with revenue derived from system development charges or serial levies.

Connection Fees

Most utilities charge connection fees to cover the cost of connecting new development to water systems. Based on recent legislation, connection fees can no longer be programmed to cover a portion of capital improvement costs.

System Development Charges

A system development charge (SDC) is a fee collected as each piece of property is developed. The SDC is used to finance the necessary capital improvements and municipal services required by the development. Such a fee can be used to recover the capital costs of infrastructure. Operating, maintenance, and replacement costs cannot be financed through SDC's.

The Oregon System Development Charges Act was passed by the 1989 Legislature (HB 3224) and governs the requirements for systems development charges effective July 1, 1991. Two types of charges are permitted under this act: 1) improvement fees, and 2) reimbursement fees. SDC's charged before construction are considered improvement fees and are used to finance capital improvements to be constructed. After construction, SDC's are considered reimbursement fees and are collected to recapture the costs associated with capital improvements already constructed or under construction. A reimbursement fee represents a charge for utilizing excess capacity in an existing facility paid for by others. The revenue generated by this fee is typically used to pay back existing loans for improvements.

Under the Oregon System Development Charges Act, methodologies for deriving improvement and reimbursement fees must be documented and available for review by the public. A capital improvement plan must also be prepared which lists the capital improvements that may be funded with improvement fee revenues, and the estimated cost and timing of each improvement. Thus, revenue from the collection of SDC's can only be used to finance specific items listed in a capital improvement plan. SDC's cannot be assessed on portions of the project paid with grant funding.

Ad Valorem Taxes

Ad valorem property taxes are often used as a revenue source for utility improvements. Property taxes may be levied on real estate, personal property or both. Historically, ad valorem taxes were the traditional means of obtaining revenue to support all local governmental functions.

A marked advantage of these taxes is the simplicity of the system; it requires no monitoring program for developing charges, additional accounting and billing work is minimal, and default on payments is rare. In addition, ad valorem taxation provides a means of financing that reaches all property owners that benefit from a system, whether a property is developed or not. The construction costs for the project are shared proportionally among all property owners based on the assessed value of each property.

Ad valorem taxation, however, is less likely to result in individual users paying their proportionate share of the costs as compared to their benefits.

User Fees

User fees can be used to retire G.O. bonds and are commonly the sole source of revenue to retire revenue bonds and to finance Operation and Maintenance (O&M) costs. User fees represent monthly charges to all residences, businesses, and other users that are connected to the water system. These fees are established by resolution and can be modified, as needed to account for increased or decreased operating and maintenance costs. The monthly charges are usually based on the class of user and the quantity of water through a user's connection.

Assessments

Under special circumstances, the beneficiary of a public works improvement may be assessed for the cost of a project. For example, the City may choose to assess the industrial or commercial developers to provide up-front capital to pay for the improvements directly benefiting them.

RECOMMENDATIONS

OBJECTIVES

Based on the costs of the alternatives, we recommend the City expand the Row Rivers plant by at least 2 MGD and abandon the existing Layng Creek plant, intakes and pipeline east of the Dorena Mobile Home Park. Service would be maintained from the expanded Row River plant and City reservoirs to the City and only those outside customers between the City and Dorena Lake.

We recognize the long time service to outside customers by the City and the reliance by outside customers on that service, but the cost of repairs and replacement to the pipeline facilities cannot be justified by the income received for that service. Should sufficient additional revenue or grants be provided to match the differences in cost between the alternatives, then our recommendation would be to replace the existing filter system at the Layng Creek Treatment Plant with a new 2 MGD plant to meet the needs of the City and its customers along the Layng Creek transmission pipeline. New facilities should include a 0.75 MG storage tank along that pipeline to allow intermittent operation of the plant and to provide storage during pipeline repairs between the City and the storage tank. This storage would also add to the effective storage available to the City-wide system.

Several types of filtration might be used at the Layng Creek site to meet the filtration requirements of the Oregon Division of Health and the US EPA regulations. The selection of process should be made, however, after pilot testing of at least two types of filtration, such as slow sand filtration and a "package" rapid sand filtration system, to provide assurance the process would meet treatment requirements and to provide the City with experience using that technology.

IMPLEMENTATION

There are many issues and factors involved in implementing such a project. Many are interrelated and will have to be considered over the same time period. Some of these are:

1. Shall the City adopt this recommendation as its plan for the water system?

The City should review these recommendations with its staff, submit this document to the Oregon Division of Water for review and discussion, and to the Oregon Department of Water Resources for review and discussion. Issues to be resolved include:

A. Long term planning for the City's two plant sites. Should both sites be used for the future? We believe that they could but that the cost of repairs to the Layng Creek facilities will exceed the costs of the alternative serving the City and just those outside customers between the City and Dorena Lake. The Layng Creek site would permit continued service to the customers along the full length of the service area and use the higher raw water quality, but the Layng Creek supply and the pipeline would be capable of providing only less than 2 MGD during low flow periods.

B. Level of service to be provided to customers along the transmission pipeline. Should service be continued? We believe that continued service could be provided but the costs of this service should be paid by the customers in this area through a differential rate and should not be subsidized by the City.

C. Is this plan acceptable to the State Health Division? Can the deadline in the Bilateral Compliance Agreement be extended to provide time for this plan to be implemented? We believe both of these questions can be answered in the affirmative.

2. What are the steps and time schedules that should be considered to implement this plan?

   A. The first step is to be certain that the plan is appropriate and in the best interests of the City. We believe that it is. The review steps already planned by the City staff and Council will test and determine if that is true. Review by the Oregon Division of Health, the public, the customers along the transmission pipeline, and other City advisors will also be welcomed by us.

   B. While the Layng Creek plant operation continues, the City should begin to transfer water rights from the Layng Creek system to the Row River plant site and to begin arrangements for termination of the service east of Dorena Mobile Home Park.

   C. Initiate engineering selection procedures for a preliminary design report on additional filtration capacity at the Row River site. The report should be completed by the fall of 2002, with detailed design to follow during the winter of 2002-3, and the construction could be begun in the summer of 2003 and completed in 2005.

   D. Upon completion and start-up of the expanded facilities at the Row River plant, the Layng Creek facilities should be closed, demolished and sites restored to a condition satisfactory to the Forest Service and other regulatory agencies.

E. If it were decided to maintain service to all customers along the length of the Layng Creek transmission pipeline, then the implementation steps listed above should be modified and, after Step 1), the Steps would include:

F. While the Layng Creek plant operation continues, the City should begin to make improvements necessary for reducing periods that poor raw water quality may cause poor plant performance. We recommend the site for a 0.75 MG storage tank be selected and design initiated for that tank along the transmission main at a point between the eastern-most customers and the City. The tank should be located on a site above the valley floor so that the elevation of the tank would be matched to the pressure gradient of the planned "Layng Creek service area." The tank should be constructed in 2002. This will permit the Layng Creek plant to be turned-off during periods of poor water quality, allow operators to make plant adjustments during times more convenient to other system operations, not require operators to make emergency visits at night or during storm periods, and provide additional storage to the City.

G. Initiate pilot plant testing of the water at the Layng Creek site for selection of a filtration process. Pilot testing of slow sand filters is a low-cost procedure but should be in place for a 12-month period to cover seasonal conditions. Pilot testing of other filter types can be completed in a period of a few weeks, but should be carried out during the period when the filters would be receiving the lowest quality raw water.

H. Initiate engineering selection procedures for a preliminary design report on a new storage tank and replacement of sections of the existing transmission pipeline. The detailed design should be completed during the winter of 2001-2 with construction in the summer and fall and completed by December 2002.

I. Initiate engineering selection procedures for a preliminary design report on a new filtration plant at the Layng Creek site. The report should be completed by the fall of 2002, with detailed design to follow during the winter of 2002-3, and the construction could be begun in the summer of 2003 and completed under cover during the fall and winter.

J. The Layng Creek intakes and plant sites would be in operation through the winter of 2002-3 and 2003-4. Upon completion and start-up of the new Layng Creek plant, unused facilities should be removed and sites restored to a condition satisfactory to the Forest Service.

K. All work could be completed by the fall of 2004 if work is begun on planning and the storage tank this winter.

3. How do we pay for it all?

Applications will need to be made to the several agencies and departments assisting water supply projects. This question will continue to be addressed after the final phase of this study. It is certain, however, both that the City must undertake the expansion of the water system and that it will need financial assistance to pay for the costs of implementation.

End of Report