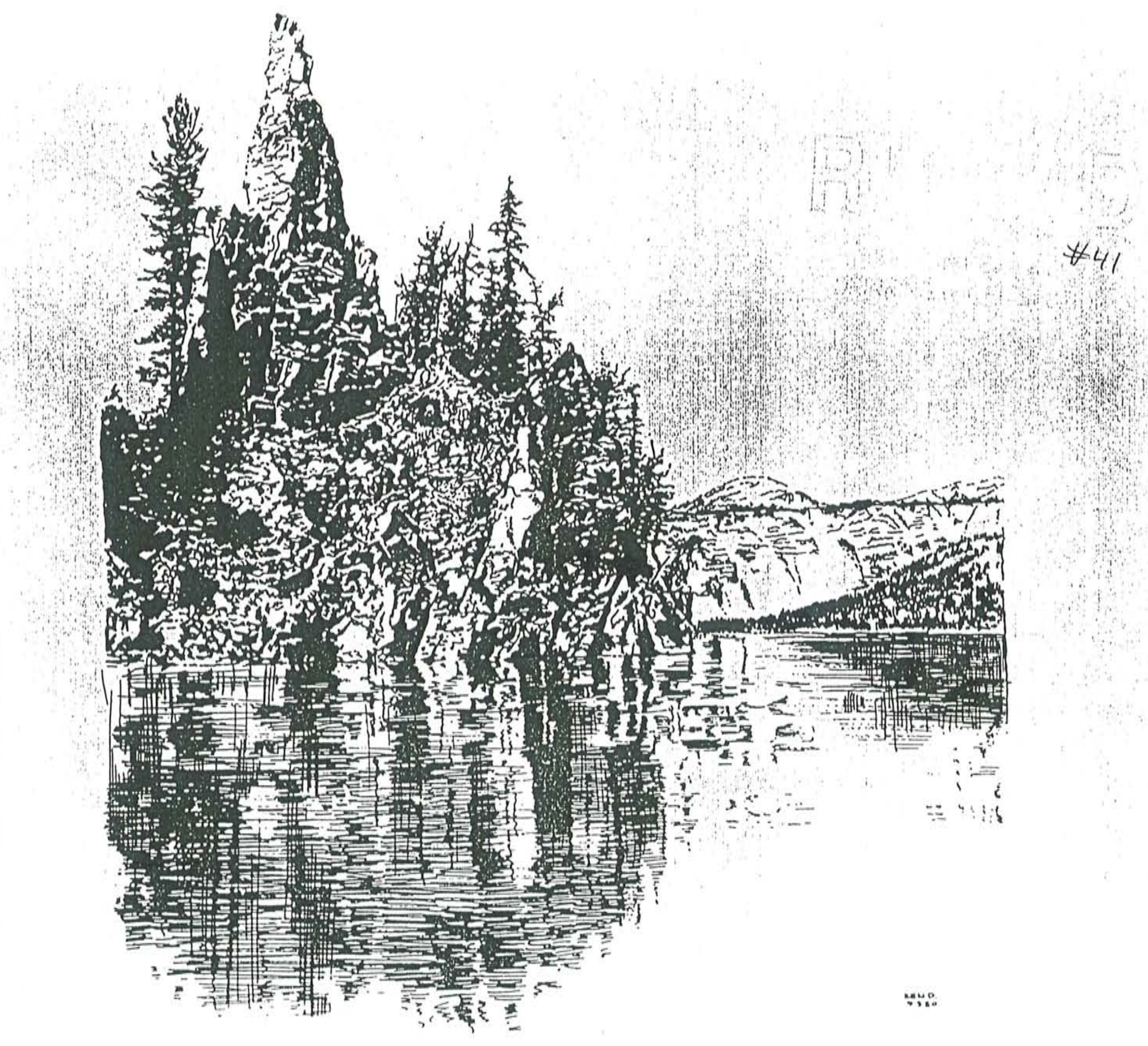
MADRAS

WATER SYSTEM MASTER PLAN

CENTURY WEST ENGINEERING CORPORATION



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MADRAS WATER MASTER PLAN

Acknowledgement

In the process of compiling this report, many people on the Madras staff helped play an integral part in putting together the final plan. We would like to give special thanks to Bud Miller, Sumner Rodriguez, and Gene Ward for their time and effort in giving valuable input to various parts of this report. In addition, the Madras City Council gave much of their time in reviewing and commenting in the formative stages of the report.

REGISTERED PROFESSIONAL ENGINEER
9074
FEB. 18, 1977
JEFF M. DAGGETT

INTRODUCTION

Introduction

In April of 1980, the City of Madras retained the services of Century West Engineering Corporation to research and evaluate the City's existing domestic water system and to make recommendations regarding the future of the water system. This report is the product of that investigation.

The objectives of the report includes the following:

a. Investigate past, present and projected land use and population as they impact the water system.

b. Evaluate the City's existing facilities as regards to reliability, water quality and adequacy of fire protection.

c. Consider present and future impacts of the surrounding private utility, Deschutes Valley Water District.

d. Make recommendations for future improvements and expansion of the water system facilities.

Recommendations and projections are given for the period from 1980 to the year 2000. As the variables involved in such long range projections are unlimited, this study should be periodically reevaluated and readjusted to correspond to the present realities at intervals throughout the next 20 years.

System Development and Existing Facilities

Over the years, the City of Madras has obtained its water supply from a number of sources. Wells alone have generally been unable to supply all of the water needs of the area. In the past, well sources were augmented by water purchased from Deschutes Valley Irrigation District, originating from Opal Springs on the Crooked River Gorge. Since 1955, Madras has utilized water obtained from the North Unit Irrigation District canal to supplement its well sources during the high summer demand months. This water is treated by means of a packaged treatment plant of 0.6 (MGD) capacity.

The wells in current use consist of Well No. 2 (constructed in 1966, static water at 375 feet, yield of 400 gpm), and Well No. 3 (constructed in 1972, yield of 300 gpm). One storage facility is presently utilized. This is a one million gallon steel reservoir which was built in 1950.

The majority of the distribution layout was originally constructed around 1930. Since that time, most of the mainlines have been replaced at least once during the system's history. The current system includes approximately eleven miles of pipe four to ten inches in diameter.

Location and Climate

The City of Madras is located approximately 30 miles east of Mt. Jefferson in the Cascade Range and occupies a moderately sloping portion of a lava plateau in the Deschutes River drainage basin. It straddles the junction of U.S. Highways 26 and 97 and is centrally located in Jefferson County. Madras is the largest city in the county and serves as the county seat.

Located just east of the Cascade Range, Madras experiences the low rainfall and four season climate common to the rain shadow area adjacent to the mountains. Annual precipitation averages approximately 10 inches while evaporation is nearly 50 inches. The growing season is short and dry. The average period between killing frosts is about 100 days with rainfall of less than two inches during the three summer months. Snowfall averages about 15 inches per year.

The historic mean temperatures and precipitation on a monthly and annual basis are tabulated below:

TABLE I-1

HISTORIC TEMPERATURES AND PRECIPITATION
CITY OF MADRAS

Month	Mean Temperature	Precipitation Normals In Inches
January	31.1°F.	1.33
February	36.9	0.83
March	39.8	0.69
April	45.5	0.53
May	52.7	1.04
June	59.2	1.10
July	65.5	0.33
August	64.0	0.34
September	57.8	0.48
October	47.9	0.80
November	39.1	1.41
December	34.1	1.31
Annual	47.8	10.19

SUMMARY OF RECOMMENDATIONS

Summary of Recommendations

On the basis of this report, we recommend the following:

1. That the City of Madras and all reviewing agencies adopt the plan for water distribution system improvements outlined in this report.

2. That this plan be periodically reviewed with particular attention to the needs and changing conditions of the study area.

3. That the City of Madras begin negotiations with Deschutes Valley Water District with regards to annexation.

4. That the City begin with the construction program as outlined herein.

Note: It should be noted that a computer analysis is recommended in many different sections of the report. The initial setup for this analysis is $1900, and is a one time cost. Subsequent runs would be approximately $350, and these runs would address the specific problem area e.g.; (1) new main sizing, (2) treatment plant restriction.

Reference Section	Year	Item	Cost (1980 Dollars)
Existing System Components	1980	Recorder (Well #2)	$ 2,500
Existing System Components	1980	Recorder (Well #3)	$ 2,500
Existing System Components	1980	Computer Analysis	$ 1,900
Existing System Components	1980	Reservoir Recoating	$ 35,000
Future System Design	1981	Geological study	$ 150,000
Future System Design	1981	New well (600 gpm)	$ 340,000
Future System Design	1984	New reservoir (1 mg)	$ 280,000
Future System Design	1990	New reservoir (1 mg)	$ 250,000
Future System Design	1995	New well (600 gpm)	$ 250,000
Future System Design	1980-1985	Install 15 fire hydrants at locations shown in Figure 1	$ 1,000/Hydra
Future System Design	1985-1990	Install 10 fire hydrants at locations shown in Figure 1	$ 1,000/Hydra
Future System Design	1980-1990	Mainline segment 1 thru 5 (as shown in Figure 2)	$1,011,000
Future System Design	1990-2000	Mainline segment 6 thru 11 (as shown in Figure 2)	$ 894,000

LAND USE AND CONSUMPTION

Land Use

An integral part of any master plan is a projection of future population growth and community water needs. In order to predict water needs for the City of Madras, historic population growth was obtained and analyzed, land use and planning trends were examined and an analysis made using this information.

Historic population growth for Madras and Jefferson County appear in the Table III-1:

TABLE III-1

POPULATION GROWTH (MADRAS & JEFFERSON COUNTY)
(1960-1980)

	Madras	Jefferson County
1960	1,515	7,130
1961	1,614	8,126
1962	1,737	9,873
1963	1,814	11,190
1964	1,814	10,376
1965	1,750	10,000
1966	1,800	10,300
1967	1,800	10,200
1968	1,870	9,530
1969	2,000	9,040
1970	1,689	8,548
1971	1,690	8,700
1972	1,805	8,980
1973	1,910	9,090
1974	1,945	9,490
1975	1,970	9,690
1976	2,055	9,900
1977	2,090	10,100
1978	2,180	10,200
Average Annual Growth 1970-1978	3.3%	3.2%

These figures show a steady growth for both the City of Madras and Jefferson County that ranges from about 2% to 3.3% per year in recent years. Recently, preliminary results from the 1980 U.S. Census have become available. This data indicates that the Madras area has continued its growth, with the current preliminary county total at 11,112 persons while the City of Madras shows 2,163. These figures are expected to increase slightly when the final census report becomes available due to vacancies, absentee residents and other factors.

In formulation of a projection for the City of Madras, a number of variables come into play. The comprehensive planning process, zoning and land use trends figure heavily in this determination. In the case of Madras, the growth potential within the existing city limits is quite limited. This is due to the fact that the majority of available land within the city limits is already occupied with dwellings, commercial buildings or other occupants. There are currently less than 500 vacant building lots inside the city limits. However, over half of these are considered unbuildable due to flood plain problems. There are approximately 140 acres of unplatted land remaining, of which only 40 acres are considered suitable for development. Thus, there is little room for future densification within the existing city limits.

In contrast, the area between the existing city limits and the urban growth boundary is targeted to experience heavy growth during the next twenty years. These outlying areas encompass approximately 1,400 acres (nearly twice as much area as that within the city limits). As these areas are developed and eventually annexed into the City, they will provide the majority of the City's increase in population.

It is anticipated that this development and annexation process will occur in a gradual fashion, resulting in a fairly steady population growth for the City over the next 20 years. Taking the above factors into consideration, it is projected that the yearly rate of growth for the City of Madras will average 3% per year. The future populations resulting from such a growth rate are indicated in the following table:

TABLE III-2

PROJECTED POPULATION GROWTH
CITY OF MADRAS

Year	Population
1980	2,163
1985	2,508
1990	2,906
1995	3,370
2000	3,907

Water Usage and Requirements

The subject of water requirements is a broad and complex one. There is the matter of basic annual requirements which vary widely, particularly by uses such as domestic, commercial, industrial, recreational, and fire protection. Each type of usage also varies in monthly, weekly, daily, hourly and instantaneous requirements. Additionally, there are variations in each of the foregoing from year to year, due to weather conditions and other factors. Available information in the City records, together with information from adjacent and similar communities, were studied to determine the quantitative and qualitative figures and factors presented in the report.

Domestic Water Usage

Domestic water usage is that water used in connection with a home. This includes water used for cooking, drinking, washing, bathing, sanitary purposes, and cooling devices in the home; and water used for lawns, garden, car washing, etc., outside the home. The amount of water used for domestic purposes varies with the home and the people within it. Extensive garden or lawn areas require a substantial amount of water. Newer homes generally use more water because of additional bathrooms, garbage disposals, etc.), than older homes with limited water using facilities.

Water usage also varies with the density of development. Generally, the per capita requirement decreases as the density increases.

Commercial Water Usage

The amount of water used in commercial establishments varies greatly from one place to another due to the variety in type, size, and design of the business. Comparisons of even the same type of commercial enterprises show wide variations in water usage, due to differences in equipment, method of operation, irrigated area, and cleanup procedures.

Industrial Water Usage

Industrial water usage varies even more widely than commercial usages. Each type of industrial activity is completely individual and often the quantity of water used is much more than is ordinarily realized. A reasonable basis for planning water requirements would allow about 2 MG per year per light industry, when the actual industries are not defined.

Irrigation Water Usage

Practically all of the irrigation water requirements in the study area have been and are anticipated to be for lawns. Lawn planting requires large volumes of water. The nature of the proposed land use plan will not diminish the quantity of water required for irrigation.

Fire Protection Usage

The water necessary for fire protection is more in the nature of capacity to deliver than an actual quantity of water. Water must be available at sufficient rates as required by the fire hazard conditions.

Unaccounted-for Water

The term "unaccounted-for water" includes that water which has been delivered into a water works system and has not been sold or otherwise accounted for. This includes water lost through hydrant testing, fire fighting, main flushing, leaks and slow metering. Some of these are legitimate uses of water, but the fact that they are quantitatively unknown leads to the question as to what proportion of the unaccounted-for water is actually wasted. As a result, the extent of this element is often referred to as a good index of water system operation.

With a good operation under normal circumstances, the category of unaccounted-for water should not exceed 10 percent of water production.

For the City of Madras, it has been assumed that "unaccounted for water" comprises 10% of the total water produced.

Rates of Water Demand

The rate of water demand over various time intervals is one of the major considerations in planning a water works system. The quantity of water used varies widely from one time of year to another, from day to day, and from hour to hour. Patterns of water use also vary according to the size of the service area and the type of use (e.g., domestic, commercial, industrial). The water works system must be designed with these considerations in mind.

Past Consumption

Historically, the City of Madras has had high consumption for a metered utility east of the Cascades. In a report done in 1975 by the Oregon State Health Division, metered use east of the Cascades averaged 650 GPD/service with a range of 340 to 930 GPD/service. Peak day demand averaged 1,500 GPD/service with a range of 850 to 2100 GPD/service. Table III-3 shows consumption on a monthly basis for the years 1970-79 for the City of Madras. More significant is the peak day consumption since this is the usual parameter that is used to design source and storage facilities. Table III-4 shows past peak day consumption with Table III-5 projecting the peak day consumption for the City of Madras through the year 2000. Table III-6 gives present consumption data for the City.

TABLE III-5

FUTURE PEAK DAY CONSUMPTION
CITY OF MADRAS* (1980-2000)

Year	Consumption (MGD)
1980	1.53
1985	1.77
1990	2.05
1995	2.33
2000	2.76

*Assumes 3% population growth.

Source of Supply

Source capacity and supply pipelines should be able to refill the system at a rate equal to that of the maximum day flow rate. Table III-7 shows source capacity requirements for the next 20 years.

TABLE III-3

ƆN FOR THE CITY OF MADR/ (1970-79)

ɔers in Millions of Gallons)

July	Aug.	Sept.	Oct.	Nov.	Dec.	Total	Annual Average Daily Consumption
25.4	24.1	11.0	7.6	5.5	5.6	140.6	.39
28.1	26.9	11.5	8.0	5.6	5.5	146.2	.40
27.7	24.9	14.3	6.8	5.7	6.9	151.4	.41
29.1	22.9	11.8	7.8	6.4	6.2	159.0	.44
25.8	26.4	19.3	10.7	6.8	6.8	166.8	.46
27.4	21.5	17.0	8.8	6.3	6.7	154.7	.42
27.3	16.1	15.2	11.1	7.8	8.0	157.7	.43
29.3	26.8	13.3	9.5	7.5	7.7	171.2	.47
28.2	21.1	13.2	7.6	7.5	9.7	161.2	.44
34.0	23.8	17.3	13.7	8.3	8.6	184.3	.51

Peaking Storage is for use during the periods of peak hour demands when storage provides a portion of the supply, serving as equalizing or peaking storage.

Peaking storage is usually determined from the area under the peak day demand curve and above the peak day average flow rate curve. Since this information was not available for the City of Madras, percentages were used which are similar to other Central Oregon cities. In Madras' situation, this percentage turns out to be 18%.

Emergency Storage is for use in case of power failures, pipeline breaks, supply line failures, treatment plant shut downs and other similar emergencies. A reasonable emergency for the City of Madras would be to assume that during a peak day, the canal becomes contaminated or breaks and is out of service for 24 hours. During a situation such as this, the amount of emergency storage needed is approximately 25% of the maximum day consumption. This assumes that if this emergency occurred peak day consumption could be reduced to wintertime demand in four to eight hours.

Fire Flow Storage readily provides water for fire fighting requirements. For the City of Madras, a basic fire flow of 4,000 GPM for a duration of four hours has been used. The basic fire flow is the parameter used when evaluating fire flow storage requirements.

Table III-8 summarizes the storage for the City of Madras for the next twenty years. Location and timing of future storage facilities is also discussed in Section V (Future System Improvements).

EXISTING SYSTEM COMPONENTS

TABLE III-3

ION FOR THE CITY OF MADR′ (1970-79)

nbers in Millions of Gallons)

July	Aug.	Sept.	Oct.	Nov.	Dec.	Total	Annual Average Daily Consumption
25.4	24.1	11.0	7.6	5.5	5.6	140.6	.39
28.1	26.9	11.5	8.0	5.6	5.5	146.2	.40
27.7	24.9	14.3	6.8	5.7	6.9	151.4	.41
29.1	22.9	11.8	7.8	6.4	6.2	159.0	.44
25.8	26.4	19.3	10.7	6.8	6.8	166.8	.46
27.4	21.5	17.0	8.8	6.3	6.7	154.7	.42
27.3	16.1	15.2	11.1	7.8	8.0	157.7	.43
29.3	26.8	13.3	9.5	7.5	7.7	171.2	.47
28.2	21.1	13.2	7.6	7.5	9.7	161.2	.44
34.0	23.8	17.3	13.7	8.3	8.6	184.3	.51

TABLE III-4

PEAK DAY CONSUMPTION
CITY OF MADRAS (1970-79)

Year	Peak Day (MGD)	Population	Per Capita Consumption (GPCPD)
1970	1.15	1,689	680
1971	1.27	1,690	751
1972	1.25	1,805	692
1973	1.31	1,910	685
1974	1.21	1,945	622
1975	1.23	1,970	624
1976	1.23	2,055	598
1977	1.32	2,090	631
1978	1.27	2,180	582
1979	1.53	2,165	706

Peak day consumption was estimated using the average daily consumption during the peak month and multiplying this average consumption by a peaking factor (1.4). This peaking factor was determined by averaging peaking factors of other Central Oregon communities.

TABLE III-6

CITY OF MADRAS
PRESENT CONSUMPTION DATA
(1979)

Present Population (1979)	2,165
Number of people per dwelling unit	3
Yearly Consumption (1979)	184.34 MG
Maximum monthly consumption (July 1979)	33.98 MG
Maximum daily consumption (1979)	1.53 MG
Peak hour consumption rate (1979)	2.14 MG
Average daily consumption (1979)	.51 MG
Average monthly consumption (1979)	15.36 MG

TABLE III-7

FUTURE SOURCE REQUIREMENTS
CITY OF MADRAS

Year	Total Source Capacity Required (MGD)
1980	1.53
1985	1.77
1990	2.05
1995	2.33
2000	2.76

As can be seen from the above table, the City is close to utilizing all its available source capacity of 1.59 MGD at the present time. Actual timing and location of source facilities are discussed in Section V (Future System Improvements).

Storage

Storage is one of the most important features of any water works system. It provides water for use in the distribution system when needed during peak demands or emergencies at much higher rates than would otherwise be economical. The economy is best exemplified by those cities that have no storage and therefore require huge pumps having a maximum capacity for both peak domestic demand and fire together with a minimum capacity for night time flow. Storage is intended for daily variations, emergencies, and fire protection. Because it is not economical, storage is not intended to compensate for long-term water shortages. Long-term storage must be provided for from an increased supply rate from the source.

TABLE III-8

ɿAGE REQUIREMENTS
:ITY OF MADRAS
(1980-2000)

aking orage (MG)	Emergency Storage (MG)	Fire Storage* (MG)	Total Storage (MG)	Physical Volume** (MG)
.28	.38	.96	1.62	2.03
.32	.44	.96	1.22	2.15
.37	.51	.96	1.84	2.30
.42	.58	.96	1.96	2.45
.50	.69	.96	2.15	2.69

ı of four hours.
ıysical volume of tanks. (ISO considers tanks 80% full for municipal grading purposes.)

Well #2

Well #2 was constructed in 1966. It has a 12" casing to a depth of 425 feet and static water is at approximately 375 feet below ground level. The water rights which were appropriated in 1967 amount to 1.3 CFS (582 GPM).

The wellhouse is concrete block construction and was built by the City of Madras. The well pump is a Berkley model with a 100 horsepower U.S. motor. The pressure at the well head is approximately 100 PSI and the discharge flow rate is 385 GPM under normal conditions. The well is controlled either manually (the hand position of the selector switch) or automatically (by level in the 1 MG reservoir). Additionally, it can be designated as either the "lead" or "lag" pump. That is, if well pump #2 is designated as "lead" pump (by selector switch in well #3) it would come on when the level in the reservoir drops to approximately three feet below the top of the reservoir. If the level continues to drop to five feet below the top of the reservoir, then well #3 will come on as the lag pump. Both pumps will continue to run until they get to the upper float level at which time they will shut off simultaneously.

The well itself, according to the chief operator, performs adequately at its design flow rate of 385 GPM.

There is adequate physical space in the well house for removing the well pump and accessing the manifolding.

Currently the master meter is read on a monthly basis. We would recommend that the meters be read on a daily basis during the peak months (June, July, August and September). Reading the meters on a daily basis (during peak months) would be beneficial because the peak day consumption is a parameter that is most often used in designing components for water systems. The meters could also be read automatically by installing strip chart type recorders that could be changed every two weeks.

Estimated Cost (recorder)	$2500
Year	1980

Well #3

Well #3 was constructed in 1972. The well is cased with 16" steel casing to a depth of 155' and 12" casing to a depth of 477'.

The well pump is capable of delivering 270 GPM into the system at a discharge pressure of approximately 110 PSI. At higher flow rates, drawdown is a problem and air gets in the lines. This well pump is a Berkley with a 75 horsepower G.E. motor. The manifolding has a Sparling master meter in the discharge line and is read monthly. This building that houses the well pump was constructed of concrete block by the City of Madras Water Department. This pump is also controlled by reservoir level (see well #2). The water rights for this well were applied for in 1975, in the amount of 1.5 CFS (675 GPM).

The well itself performs adequately and, like well #2, we would recommend installing a two-week recorder so that the meter totals could be tabulated on a daily basis.

Estimted Cost (recorder)	$2500
Year	1980

Filtration Treatment Plant

The Madras Water Filtration Plant utilizes the coagulation filtration process to remove suspended solids and organics from surface water delivered by the North Unit Irrigation District. Prechlorination is used to supply the necessary chlorine residual for disinfection and prevent algae growth in the process equipment. Postchlorination is also used at time when the necessary residual is not adequate. The treatment process consists of feeding alum, lime and activated carbon to influent waters. The alum coagulates finely divided solids in a medium where pH is controlled by lime addition. The activated carbon removes organics, particularly algae, by an absorption process.

The sedimentation process consists of one basin of approximately 60,000 gallons capacity. There is no solids removal mechanism in the present sedimentation process; settled solids are manually removed after the plant is put out of operation in the fall. The detention time in the sedimentation basin is approximately 2.5 hours at a process water flow of 400 GPM. Current practice of the industry is to provide at least 1.0 hour of settling time prior to filtration.

The water filtration plant has two filters which are each 11' x 13' or 286 square feet of total surface area. The mixed media employed consists of a layer of anthracite coal, sand and carborundum. Filters are presently backwashed once a day. Backwash water is supplied from the 100,000 gallon clear well below the plant. The backwash wastewater discharges to a lagoon which is cleaned periodically. The surface design loading rate is 1.75 GPM/Ft.^{2}.

The water filtration plant is in excellent condition, considering the age of the equipment. This is undoubtedly due to a high degree of maintenance on the part of operating personnel. However, all equipment deteriorates with time, and replacement and improvements are a necessity. The plant will continue to operate for many years if the high degree of maintenance is continued with probably no major expenditures for equipment replacement.

Plant capacity could be increased to approximately 500 GPM with no major capital expenditures. The only restriction at this time appears to be in the distribution system downstream of the clear well. The line size should be increased in order to accommodate the higher flow rate. In order to most effectively size this line, a computer analysis should be made simulating peak day demands.

Recommendation: Perform a computer analysis of system in order to most efficiently size pipe from treatment plant to distribution system.

Estimated Cost	$1900
Year	1980

Reservoir

The City of Madras has one storage tank which is located south of town. The tank was constructed in 1950, and has a capacity of one million gallons. The tank's interior was originally coated with red lead, and this was subsequently replaced with a coal tar enamel coating in 1956.

The tank is 40 feet high and has a ground elevation of 2393 feet above mean sea level. In the summer of 1979, there was a blow out about 25 feet above ground level. The blow out formed a leak of approximately 10 GPM and was probably due to internal corrosion. The exterior appears to have suffered extensive rock damage to the bottom two courses. The tank's exterior other than the bottom two courses is judged to be in fair condition.

Steel tank manufacturers generally recommend complete recoating every 10-20 years. Considering the period of time since the last recoating (24 years) and the present condition of the tank, it is recommended that the tank be completely recoated (interior and exterior) as soon as possible in order to maintain the integrity of the structure.

Estimated Cost	$35,000
Year	1980

ISO Evaluation

The fire protection aspects of water distribution facilities are a broad field, hence, this discussion will limit itself to the Insurance Services Office evaluation of the Madras Water System.

Water utilities generally accept the need or obligation to provide water distribution systems that will be capable of conveying a reasonable amount of water to fight fires in addition to satisfying customer requirements. Empirical formulas exist for determining arbitrary fire flow rates and duration, but no precise formulas exist to determine the exact amount of water needed to extinguish a fire. The fire flow requirement for a given fire area is the rate of flow in gallons per minute (GPM) or million gallons per day (MGD) for a given duration estimated by accepted methods for fire fighting purposes to confine a major fire to the structures within the area. Theoretically, this amount of water should control and extinguish the conflagration in the fire area under a specific set of conditions.

The information contained in this section is a result of discussions with ISO officials in Portland and analysis of the most current ISO evaluation for the City of Madras (August 1976).

The current cycle for ISO evaluation of a city is seven to ten years. The basic thrust of an ISO evaluation is to investigate reliability and adequacy of a community's fire defense. There are four areas of investigation: (1) water supply, (2) fire department, (3) fire service communication, and (4) fire safety control. Since this report concerns itself with the water system, the first area (water supply) will be investigated in-depth.

Each of these areas is assigned a deficiency number related to a number of areas within each category. The following tables are taken from the Grading Schedule for Municipal Fire Protection. The various possible deficiency points that can be assigned to municipalities are shown in Table IV-1.

TABLE IV-1

RELATIVE VALUES AND MAXIMUM DEFICIENCY POINTS

Feature	Percent	Maximum Points
Water Supply	39	1,950
Fire Department	39	1,950
Fire Service Communications	9	450
Fire Safety Control	13	650
	100	5,000

Madras, 1976 Rating

Appendix A shows the most current evaluation of fire protection facilities in the City of Madras (August, 1976). Protection class 6 was authorized. Of general interest are the deficiency points assigned to the various categories shown in Table IV-2.

TABLE IV-2

1976 ISO EVALUATION
CITY OF MADRAS (1976)

Category	Deficiency Points	Total Possible Deficiency Points	%
Water Supply	865	1950	44%
Fire Department	1,259	1950	65%
Fire Service Communications	245	450	54%
Fire Safety Control	431	650	66%
Additional Deficiencies	87		

As can be seen from the above table, the water supply was responsible proportionately for the least amount of deficiency points.

TABLE IV-3

WATER SUPPLY
CITY OF MADRAS (1976)

	Item	Assigned Deficiency Points
1.	Adequacy of Supply Works	12
2.	Reliability of Source Supply	44
3.	Reliability of Pumping Capacity	47
4.	Reliability of Power Supply	23
5.	Condition, Arrangement, Operation, and Reliability of System Components	45
6.	Adequacy of Mains	276
7.	Reliability of Mains	51
8.	Installation of Mains	26
9.	Arrangement of Distribution System	53
10.	Additional Factors and Conditions Relation to Supply and Distribution	142
11.	Distribution of Hydrants	78
12.	Hydrants - Size, Type and Installation	15
13.	Hydrants - Inspection and Condition	13
14.	Miscellaneous Factors and Conditions	40
	Total	865

Table IV-3 shows the actual deficiency points assigned to the water supply section of the ISO grading. Items 6, 9, 10 and 11 merit further discussion because of the high number of deficiency points assigned to these areas.

Item 6 - Adequacy of Mains

This is one of the most important items in the water supply section of the grading schedule. It is concerned with the actual rate of delivery of water from hydrants for use in combatting fires. Deficiencies are calculated using the fire flow and duration requirement at each tested location. Table IV-4 shows the actual results of nine fire flow tests. In order to improve fire flows at the tested locations, major transmission mains will have to be added.

Recommendation - (See Figure 2 for Distribution Layout)

TABLE IV-4

RESULTS OF FIRE FLOW TESTS
CITY OF MADRAS (1976)

Number	Location	Recommended (GPM)	Actual (GPM)
1	6th & C	3,000	1,900
2	6th & Oak	4,500	1,560
3	Bluff St. E. End	3,500	1,300
4	10th & F	6,000	1,100
5	10th & D	4,500	1,100
6	*12th & A	3,000	1,820
7	4th & E		2,350
8	5th & Cherry	3,000	1,150
9	4th & I	2,000	2,400
10	2nd & B	2,000	2,000

*Deschutes Valley Water System.

Item 9 - Arrangement of Distribution Systems

The general reliability of the arrangement of the mains in the distribution system is evaluated in this item. The adverse effect of poor or wide gridiron and 4" and 6" dead end mains supplying hydrants are also considered under this item.

Recommendations - Install hydrants in priority and locations shown on Figure 1.

Recommendations - (See Figure 2 for distribution layout.)

Item 10 - Additional Factors and Conditions Related to Supply and Distribution

ISO water supply items 1, 2, 3, 4, 5, 7 and 8 consider the adequacy and reliability of the supply to deliver the maximum consumption rate plus the basic fire flow. Item 10 evaluates, for the same factors, the ability of the supply facilities to deliver the maximum daily consumption rate plus the maximum required fire flow and any conditions that will occasionally reduce the fire protection created in the other items of the grading schedule.

The maximum required fire flow for Madras is 6000 GPM at 10th and F Streets. (See ISO report in Appendix). The peak day flows for the City (1980) are 1060 GPM (See Table III-6). These two flows totaled together (6000 GPM + 1060 GPM) = 7060 GPM. Improving the distribution and supply facilities to the degree needed to supply 7060 GPM would require significant capital expenditures for storage facilities, which would prove economically unfeasible at the present time.

Item 11 - Distribution of Hydrants

The ability of the distribution system to deliver adequate rates of flow for fire protection to various locations of the municipality does not alone provide good fire protection. There should also be sufficient hydrants to allow the required rate of flow to be delivered to fire department pumpers and these hydrants should be well spaced in order to keep the length of fire department hose lines short. Item 11 compares the existing hydrant spacing with the hydrant spacing needed for the various districts within the municipality.

Figure 1 shows the location of additional hydrants and the priority of their installation. Table IV-5 shows what ISO considers standard hydrant distribution.

TABLE IV-5

STANDARD HYDRANT DISTRIBUTION

Fire Flow Required, gpm	Average Area per Hydrant, square feet
1,000 or less	160,000
1,500	150,000
2,000	140,000
2,500	130,000
3,000	120,000
3,500	110,000
4,000	100,000
4,500	95,000
5,000	90,000
5,500	85,000
6,000	80,000
6,500	75,000
7,000	70,000
7,500	65,000
8,000	60,000
8,500	57,500
9,000	55,000
10,000	50,000
11,000	45,000
12,000	40,000

As shown in Table IV-4, in all but two of the locations tested, the fire flows were far below the recommended fire flows. This is due to the distribution system pipeline diameters being too small and inadequate hydrant spacing.

Recommendations - (See Figure 2 for distribution layout and Figure 1 for hydrant locations.)

The distribution layout in Figure 2 in some cases gives a range of diameters for certain pipes. In order to effectively size these pipes, it is suggested that a computer analysis be done with two or three different size pipes and the smallest diameter pipe that will not exceed a design velocity of 7'/second (under fire flow and peak day conditions) should be selected.

Estimated Cost (computer analysis)	$1900
Year	1980

FUTURE
SYSTEM
IMPROVEMENTS

Future System Improvements

A number of recommended improvements to the existing city system are presented herein.

Mainline Improvements

In order to improve fire flows and overall reliability of the existing system, a series of additional mainlines are proposed. These are presented below in a prioritized order; that is, the section of mainline listed as No. 1 is recommended to be installed first. The second portion of mainline would be constructed next and so on, as budgets allow. As a general guideline, it is recommended that mainline segments 1 through 5 be constructed by 1990 with the remainder (6 through 11) to be added from 1990 to the year 2000. The recommended improvements are listed in Table V-1 and shown on the Figure 2 map.

TABLE V-1

RECOMMENDED MAINLINE IMPROVEMENTS
(1980-2000)

	Length	Diam.	Estimated Costs
1.	4,000 LF	12"-14"	$229,400*
2.	5,000 LF	14"-18"	331,250
3.	1,750 LF	12"-14"	100,362
	400 LF	10"	19,800
	1,300 LF	8"	58,916
4.	1,200 LF	8"	54,384
5.	4,000 LF	10"-14"	217,000*
6.	6,350 LF	10"-12"	329,438*
	850 LF	8"	38,522
7.	3,250 CF	8"-10"	154,082*
8.	900 LF	8"-10"	42,669*
9.	3,650 LF	10"-12"	189,362*
10.	400 LF	10"	19,800
	900 LF	8"	40,788
11.	1,750 LF	8"	79,310

*In cases where the mainline diameters are given as a range of sizes, the estimated costs are given for the "average" size recommended (i.e., where the diameter recommended is 10" to 14", the estimated cost is given for a 12" mainline).

Note that the recommended pipe diameters shown are given as a range of possible sizes in many cases (i.e. 14"-18"). These sizes were determined on the basis of general engineering experience, but a complete computer analysis of the distribution system is recommended to identify the most economical and efficient pipeline size prior to installation.

The costs shown are estimates of the cost to construct the given section of mainline, including engineering, surveying, and pavement surface restoration. The estimates are given in terms of 1980 dollars and should be adjusted to account for inflation in the case of future construction.

An additional group of mainlines are indicated on the Figure 2 map. These are the basic skeleton mains intended to serve outlying areas within the Urban Growth Boundary as they develop. Since the timing of such development is unknown at this time, no schedule for these improvements was developed. These mains are noted on the map as "Major Future Mains" with a 12" minimum diameter indicated. Again, a computer analysis would be recommended to accurately size the most economical and efficient pipeline size prior to construction. Also, the pipeline routes shown on the map are approximate in many cases. The exact locations can be determined later depending on future road alignments and other variables that are unknown at this time.

Fire Hydrants

Additions of fire hydrants to the existing system are shown on Figure 1. These proposed improvements are intended to improve the hydrant coverage in areas of sparse coverage or inadequate existing fire flows. The general guideline of one hydrant per 160,000 square feet in residential areas and one hydrant per 90,000 square feet in commercial and industrial areas was utilized in determining hydrant coverage. The additions are presented in these classes. A group of 12 proposed hydrants are recommended to be added to existing mains in areas of inadequate coverage. These 12 are further divided into two groups of six. Group "E-I" is recommended for installation as soon as practicable. Group "E-II" hydrants can be installed over the period of a few years according to available funds.

The third group of hydrants, noted "C" on map, are recommended for installation when the appropriate section of new mainline, discussed above and illustrated in Figure 1 is installed. Nine such hydrants are proposed.

A fourth group of four hydrants, noted as "D" on the map, are identified to be installed as the surrounding area develops and densifies. These are situated in areas that are sparsely occupied at present, but are expected to be "built-out."

Reservoirs

Three proposed reservoir locations and ground elevations are shown in Figure 2. These are intended as alternate sites for either of the two reservoirs proposed. In the interest of total system reliability, it is recommended that the first reservoir be located at one of the two northerly sites identified. For the purpose of estimating construction costs, it was assumed that the first reservoir constructed, and its associated mainline, would be located at the northwest Madras site off Poplar Street, formerly Elm Street. It should be noted that for purposes of this report, future development in Madras is assumed to take place within the first pressure level. There is an area , the industrial site in the north, that is in the second level. This area is currently served by Deschutes Valley Water District, hence and reservoirs were sited for distribution in this zone.

The sites shown are general locations only. The precise location may be determined at the time the reservoir is required, taking into account property availability and costs, street locations, and other such considerations.

Future Source Capacity

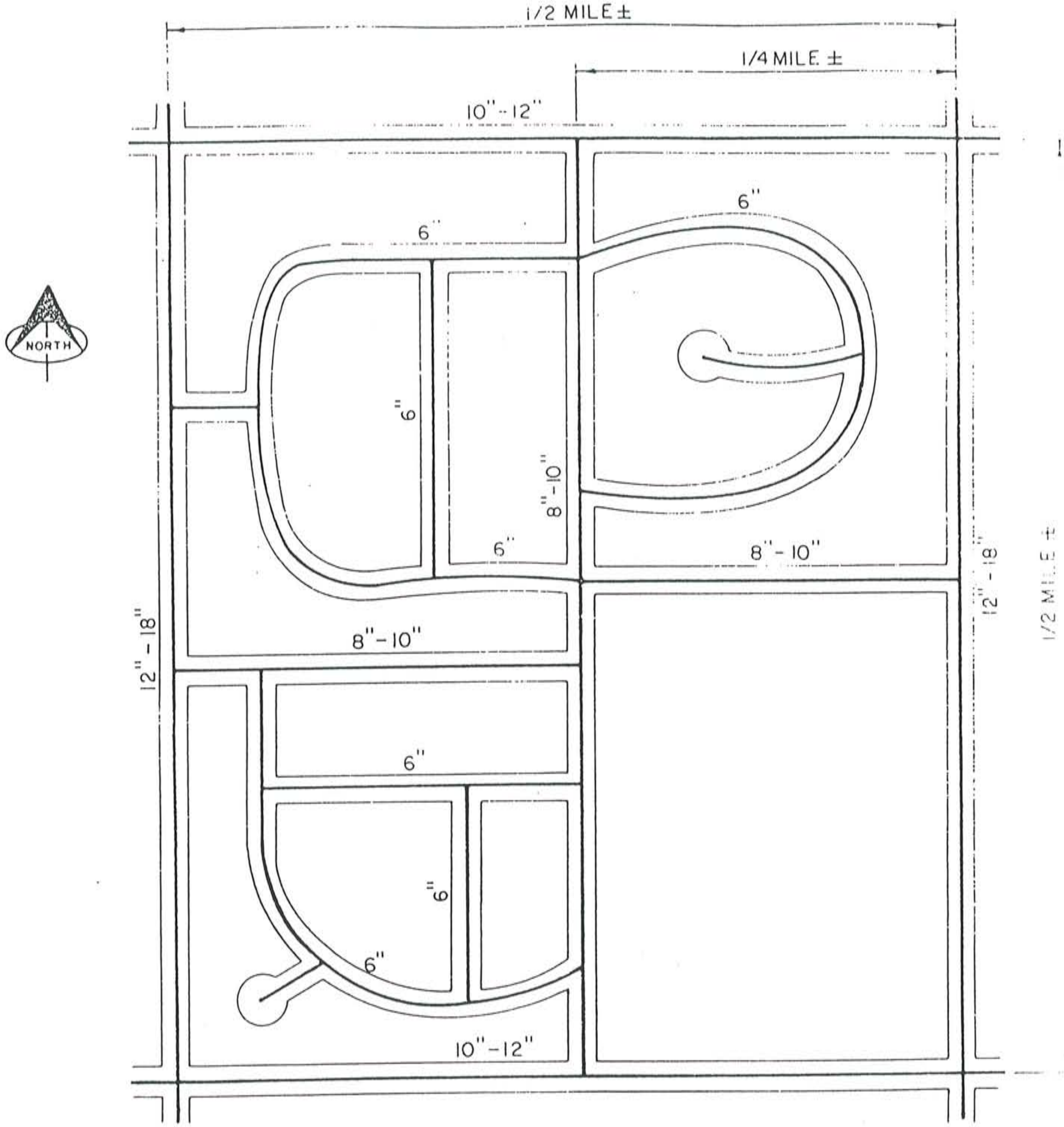
Currently, the City has two different source inputs, treated surface water from the North Unit Canal and groundwater from wells 2 and 3. The City also has water rights from Round Butte Springs, which is north of Lake Chinook and approximately eight miles west of the City, and from Rimrock Springs, which is located close to the north end of Lake Simtustus and is approximately the same distance as Round Butte Springs from the City.

In analyzing additional source of supply, two alternatives were analyzed in-depth. First, additional surface water can be obtained in conjunction with a filter treatment plant and, secondly, groundwater can be pumped from wells. The costs for each of these alternatives is shown in the appendix. As can be seen, the first cost for a treatment plant ($675,000) is almost twice that of a new well ($340,000). The annual costs for both alternatives are approximately equal. With the foregoing in mind, we would recommend at this time that, when major increments of source capacity are needed, new wells be drilled. Before drilling new wells an extensive hydrogeologic study should be made to determine the most feasible sites. The timing of these new wells and hydrogeologic study is shown in the summary of recommendations. Before proceeding with obtaining additional source capacity, the current restriction at the existing treatment plant should be analyzed (see Existing System Components), and a computer analysis made. The design capacity of the existing plant is approximately 420 gpm or design surface loading rate of 1.46 gpm/ft.^{2} (of filter area). It is the current practice of the industry to provide 2.0 gpm/ft.^{2}. With the foregoing in mind, the treatment plant flow rate could probably be expanded to 550 gpm with no major modifications. If the plant flow is increased, attention should be paid to the length of backwash cycles because operating personnel should be present when are backwashed.

Future Developments

Numerous areas exist ouside the present city limits, but within the urban growth boundary, which are targeted to experience heavy development in the future. No attempt was made to design the future distribution systems for these areas at this time, except for the basic skeleton mains discussed previously, but general guidelines for system improvements to accommodate such development follow.

Figure 3 shows the type of distribution grid that the City of Madras should attempt to implement. As can be seen, the basic grid layout is a general guideline rather than a specific recommendation. There will be exceptions to the general guidelines in many cases, but transmission mains, lateral mains, and feeder mains should be laid in the directions indicated as often as possible.



TYPICAL DISTRIBUTION GRID FOR THE CITY OF MADRAS

Transmission mains basically North, South, 12"- 18"
Laterals basically East, West, 8"- 12"
Service mains basically North, South, 6"- 8"

FIGURE 3

Where subdivisions use short deadend streets, the waterline serving the deadend street should be extended to an existing pipeline, if feasible. Where a specific pipeline size is proposed for construction on a particular street, the intent is to provide sufficient pipeline capacity to satisfy a demand for water. Pipeline sizes and routes indicated may be changed if the demand for water supply can be satisfied without sacrificing adequate system pressures.

Although each deviation from the recommendations should be individually analyzed, the following equivalent pipe relationships generally will provide approximately equal capacity:

One 16-inch pipe	=	two 12-inch pipes
	=	four 10-inch pipes
	=	six 8-inch pipes
One 12-inch pipe	=	two 10-inch pipes
	=	three 8-inch pipes
	=	six 6-inch pipes
One 10-inch pipe	=	two 8-inch pipes
	=	four 6-inch pipes
One 8-inch pipe	=	two 6-inch pipes
	=	six 4-inch pipes
One 6-inch pipe	=	three 4-inch pipes

These ratios are based on approximately equal headloss characteristics. Small pipelines constructed in parallel can be effective for supplying a particular location with a specific amount of water. However, this may not be the most economical use of funds. The installed cost of the several small pipelines necessary to equal the carrying capacity of the single large pipeline will usually exceed the cost of the larger pipeline. If the small pipelines are integrated into the distribution system of the service level rather than used merely to convey water to a specific area, the higher construction cost may be justified. For system reliability, it is preferable to have parallel smaller pipelines, assuming that they are not too small, rather than a single, large pipeline.

Valves should generally be spaced no further than 600 feet apart in a looped distribution system. Each pipeline intersection should have two to four valves, corresponding to a tee or cross connection, to minimize the areas out of service during a pipeline failure, repairs, or extensions.

PRIVATE WATER UTILITY ANALYSIS

Introduction and History

Deschutes Valley Water District and the City of Madras have a long-standing relationship. In a report done in February of 1950 by the Bureau of Land Reclamation, rehabilitation of the entire domestic water system for the North Unit Irrigation District was addressed. Since Deschutes Valley Water District served a portion of the area within the Irrigation District, and the City of Madras lies within the Irrigation District, domestic water systems for both of these utilities were examined. This report concluded that with adequate transmission and storage facilities, Opal Springs could supply the domestic water needs for the study area for the next 40 years (1950-1990). A second report submitted by CH2M Hill in April of 1952 analyzed Opal Springs as a source of supply for Deschutes Valley Water District and the City of Madras. The primary purpose of this study was to determine the economic feasibility of a joint water supply for these two water distribution agencies. The conclusion reached in this report was that the most economical way of providing water for the City of Madras and Deschutes Valley Water District was by a combined supply.

Analysis

The following parameters were used in evaluating the effect of annexation of the City of Madras Water System by Deschutes Valley Water District: (1) monthly rates, (2) ISO evaluation, (3) water quality, (4) hydraulic effects and (5) future source requirements.

If Madras residents continue to consume at their present level and were charged Deschutes Valley rates, then the difference on a yearly basis would be $79 or $6.58 per month, as Table VI-2 shows.

1. Monthly Water Bills - The following data was taken from calendar year 1979 and was provided by the City of Madras and Deschutes Valley Water District. As can be seen from the two tables, VI-1 and VI-2, the difference is approximately $59 per year or $4.91/month. This difference is based on the assumption that City of Madras residents would reduce their consumption to approximately that of Deschutes Valley customers.

TABLE VI-1

CONSUMPTION AND MONTHLY BILLINGS
DESCHUTES VALLEY WATER DISTRICT (1979)

Month	Consumption (MG) (Total)*	Consumption (CF) (Per Service)**	Bill($)
January	23.59	1477	12.30
February	31.31	1961	15.30
March	25.90	1621	13.50
April	25.19	1577	12.90
May	42.14	2639	19.50
June	57.68	3600	24.90
July	58.91	3690	25.50
August	51.53	3227	23.10
September	36.47	2283	17.10
October	31.13	1950	15.30
November	20.31	1272	11.10
December	24.33	1524	12.90
Total	428.49	26821	203.40

*Actual total billed
**Assumes 2135 total services

TABLE VI-2

CONSUMPTION AND MONTHLY BILLINGS
CITY OF MADRAS (1979)

Month	Consumption (MG) (Total)*	Consumption (CF) (Per Service)**	Bill($)	
January	11.80	2217	11.00	(17.10)
February	8.81	1682	10.10	(13.50)
March	8.03	1533	9.95	(12.90)
April	8.90	1699	10.10	(13.50)
May	18.20	3475	12.80	(24.30)
June	23.00	4392	14.15	(29.70)
July	33.98	6489	17.30	(42.30)
August	23.78	4541	14.45	(30.90)
September	17.26	3296	12.50	(23.10)
October	13.73	2622	11.60	(19.50)
November	8.26	1577	9.95	(12.90)
December	8.59	1640	10.10	(13.50)
Total	184.34	35163	$144.00	(232.00)

*Total amount produced
**Assumes 700 total services
( ) Amount that City of Madras residents would pay if their consumption remained the same, and were charged Deschutes Valley Water District rates.

2. ISO Evaluation - The current City of Madras ISO rating has already been evaluated in a previous section (see Existing System Components section). This part of the analysis will not attempt to evaluate either utility's specific rating, but rather it will address the effect of annexation on the City of Madras' rating. Assuming that if annexation takes place and Deschutes Valley Water District continues to use the City of Madras' facilities, i.e., storage tank and the two wells, then according to ISO officials there would be no effect on the City's existing class six rating. Deschutes Valley has indicated that they would continue to use the two wells on an as-needed basis, and would essentially put the filter treatment

plant on emergency standby. Any effect of not utilizing the filter treatment plant as available source capacity would be more than compensated for by the addition of Opal Springs as available source capacity.

3. Water Quality - Included in the appendix to this report are the latest chemical reports on Opal Springs. Both the upper and lower springs were tested and, as can be seen, both reports indicate that all tests were well within EPA's maximum allowable concentrations. Additionally, frequent bacteriological tests have indicated outstanding source quality.

4. Hydraulic Effects - It appears from a cursory examination that the physical connections between the two systems would pose no substantial problems. There are presently numerous locations where the two systems are in close proximity and could be interconnected. The east end of Bluff Street, east of 12th Street and adjacent to the existing reservoir are a few of the locations where the two systems could be interconnected. As indicated before, if the existing two wells were still used in conjunction with the reservoir and clearwell at the filter treatment plant, then annexation of the two systems should not cause any significant differences in water pressure and fire flows within the City. To determine the exact hydraulic effects, such as control settings, pressure reducing valves required, and exact pressure and fire flow at specific locations would require a computer analysis.

5. Source Capacity - As shown in a previous section (Land Use and Consumption), the City of Madras is at a point where it must consider finding additional source capacity.

The source capacity for both systems is shown below in Table VI-3.

TABLE VI-3

SOURCE CAPACITY

1980

City of Madras	
. Available Source Capacity	1100 GPM
. Required Source Capacity	1100 GPM
Deschutes Valley Water District	
. Available Source Capacity	3900 GPM
. Required Source Capacity	1800 GPM
Combined Systems	
. Available Source Capacity	4600 GPM
. Required Source Capacity	2900 GPM
. Excess Source Capacity	1700 GPM

As can be seen from the above table, if the two systems combine there is presently enough source capacity for both systems. This available source capacity should meet the combined system's requirements well into the future. Because Opal Springs' ultimate capacity is 108,000 GPM, transmission and pumping facilities would be the only constraint in procuring additional capacity.

*Assumes filter treatment plant would not be used if two systems were combined.

Summary

The following is a breakdown of the costs for City of Madras residents. Alternative I shows the costs if the City elects to maintain control of their own system and Alternative II shows the costs if the City elects to annex to Deschutes Valley Water District. It should be noted that these costs are for purposes of analysis and comparison and are not actual costs consumers would see on an annual basis. That is, many of the improvements shown in the analysis would be staged and hence costs associated with these improvements would be phased in over a period of time. The following costs are source, storage, and transmission costs through the year 2000 for the two utilities. A detailed breakdown of these costs can be found in the appendix.

Alternative I - City of Madras Maintains Its Own System

Assumptions

1.	Number of services (1980)	700
2.	Number of services (2000)	1265*
3.	Cost of capital is 8%	
4.	Average number of services during the study period	982
5.	Study period duration	20 yrs.

Costs

1.	Wells (2) 600 GPM @ 800' depth	680,000
2.	Geological study	150,000
3.	1.5 MG reservoir	370,000
4.	Transmission mains	331,500

Total	$1,531,500
Debt Service (20 yrs, 8%)	156,011/yr.
Cost/Service/Year	159
Monthly Rate Total (See Table VI-2)	144
Total (Service/Year)	$303

*Assumes a 3% growth

Alternative II - City of Madras Annexes to Deschutes Valley Water District

Assumptions

1.	Number of services (1980)	2135
2.	Number of services (2000)	3577*
3.	Average number of services during study period	2856
4.	Study period duration	20 yrs.
5.	Cost of capital	8%

Costs

1.	Reservoirs (4 MG)	$ 545,520
2.	Transmission mains	2,273,790

Total	$2,819,310
Debt service (20 years, 8%)	287,152
Cost/Service/Year	100
Monthly rate total (see Table VI-2)	$232
Total (Cost Per Service/Year)	$332

*Assumes a 3% annual growth rate

Conclusions

It can be seen from the above analysis that the two annual costs ($332.00/yr/service for Deschutes Valley Water District and $302.00/yr/service for the City of Madras are very close. It should also be noted that at present the City of Madras charges $250 for new hookups to the system while Deschutes Valley charges $1,300. With this high connection fee for Deschutes Valley, a much bigger portion of their connection fee could be applied to debt service thus reducing the difference between the yearly costs for the two utilities even further.

With the above in mind, it is this firm's recommendation that the City of Madras pursue negotiation with Deschutes Valley Water District for annexation. In these negotiations consideration should be given to the following: (1) water pressure, (2) fire flow capability, (3) representation on the Deschutes Valley Water Board (4) debt service payback for capital improvements, and (5) possible relocation of City of Madras Water Department employees with the Deschutes Valley Water District.

APPENDIX

WATER SYSTEM COSTS

Wells

. Depth - 800'	
. Drilling @ $195/ft. =	$156,000
. Wellhouse complete with pump, mechanical, electrical, and site work	105,000
. Subtotal	261,000
. Engineering, contingencies and admin. @ 30%	78,300
Total - (600 GPM, 500' deep well)	$340,000

Reservoir

. 1 million gallon steel ground storage tank complete including painting, foundation and site work	
. Subtotal	$214,800
. Engineering, contingencies and Admin. @ 30%	78,300
Total	$280,000

Distribution System

Pipe Dia.	Cost/L.F.	Engineering Contingencies Admin. @ 30%	Total/L.F.
6"	$31.50	$ 9.45	$40.95
8"	34.86	10.46	45.32
10"	38.08	11.42	49.50
12"	41.75	12.52	54.25
14"	46.50	13.95	60.45
16"	50.96	15.29	66.25
18"	56.00	16.80	72.80

All costs for distribution system piping were made using the following assumptions:

- Material for all pipe was black steel.
- Rock was assumed to be 50% of the trench depth.
- Surface restoration was included for the full length of the pipeline.
- Prices are mid-1980 costs.

Water Treatment Plant Costs

- 700 GPM Neptune Microfloc AQ-150 packaged treatment plant.
- Includes clear well, modular steel building, mechanical electrical, and AQ 150 complete.

. Subtotal	$520,000
. Engineering, contingencies and admin. @ 30%	155,000
Total	$675,000

INSURANCE SERVICES OFFICE

OF OREGON

421 S. W. 6TH AVENUE, PORTLAND, OREGON 97204
TELEPHONE (503) 226-2651

GARY L. ARTHINGTON, MANAGER

May 20, 1980

Century West Engineering Corp.
1444 N. W. College Way
Bend, Oregon

Gentlemen:

We are enclosing a number of fire insurance classification improvement statements and a copy of the detailed grading in response to your recent request. These statements cover some of the grading items which are of considerable importance in determining your fire insurance classification.

As you may know, the public fire protection insurance classification number is used by ISO as only one of several elements in developing some individual property fire insurance rates. Individual property fire rates are also dependent upon specific construction, occupancy, private protection and exposure from adjacent buildings.

These improvement statements refer only to the fire insurance rating classification of your city. Our comments are not for property loss prevention or life safety purposes, and no life safety or property loss prevention recommendations are made.

Please contact us if you have any questions concerning the enclosed material or if you want our comments on any proposed improvements.

Very truly yours,

INSURANCE SERVICES OFFICE

Daniel R. Locey
Field Rating Representative
Public Protection Department

DRL:vn
Enclosures

FIRE INSURANCE
CLASSIFICATION IMPROVEMENT STATEMENTS
FOR
MADRAS, OREGON

Prepared by
INSURANCE SERVICES OFFICE OF OREGON

AT THE REQUEST OF CENTURY WEST ENGINEERING

May 20, 1980

The following statements are based upon the criteria contained in our grading schedule and upon conditions in Madras on August, 1976. They indicate the action that can be taken to remove deficiency points from the current grading. The number of points that can be removed is given in the parenthesis after each statement. Partial action will result in removing part of the total points indicated. These statements relate only to the fire insurance classification as it pertains to insurance rating, and no representations or warranties of any kind are intended or made.

WATER SUPPLY

IMPROVEMENT STATEMENT 1

Item 3.

Sufficient supply facilities should be provided so that when the two most important pumps are out of service the supply facilities will be able, in conjunction with available storage, to deliver 3500 gpm for three hours at any time during a period of five days with the consumption at the maximum daily rate. (47 points)

IMPROVEMENT STATEMENT 2

Item 6.

The distribution system should provide adequate fire flows throughout the city. (276 points)

IMPROVEMENT STATEMENT 3

Item 7.

The piping should be arranged so that with a break in any main, the supply facilities will be able, in conjunction with available storage, to deliver 3500 gpm for three hours at any time during a period of three days with consumption at the maximum daily rate. (51 points)

IMPROVEMENT STATEMENT 4

Item 11a.

For commercial* districts there should be one or more hydrants at each street intersection, depending on the required fire flow, with intermediate hydrants so that they are not over 300 feet apart. (56 points)

Item 11a. (cont'd)

*Commercial districts include business, industrial, warehouse, institutional, educational, hotel and apartment occupancies.

IMPROVEMENT STATEMENT 5

Item 11b.

For residential districts there should be a hydrant at each street intersection with intermediate hydrants so that they are not over 500 feet apart. (22 points)

IMPROVEMENT STATEMENT 6

Item 12.

All hydrants should conform to American Water Works Association hydrant standards: have at least two outlets, one a pumper outlet and the other not less than 2½-inch nominal size; and have at least a 6-inch valved street connection. (15 points)

IMPROVEMENT STATEMENT 7

Item 14b.

All alarms for fires in buildings should be received by the water department. A well-equipped emergency crew should respond to all second alarms of fire. (20 points)

INSURANCE SERVICES OFFICE

OREGON
STATE OFFICE

SUMMARY OF GRADING

GRADING SCHEDULE FOR MUNICIPAL FIRE PROTECTION
(1974 Edition)

Date Graded: August 1976 City or District: Madras

Total Deficiency: 2887 Points. Graded by: A. Nisbet Engineering Representative

Protection Class 6

WATER SUPPLY

Item	Assigned Points
1. Adequacy of Supply Works	12
2. Reliability of Source Supply	44
3. Reliability of Pumping Capacity	47
4. Reliability of Power Supply	23
5. Condition, Arrangement, Operation, and Reliability of System Components	45
6. Adequacy of Mains	276
7. Reliability of Mains	51
8. Installation of Mains	26
9. Arrangement of Distribution System	53
10. Additional Factors and Conditions Relating to Supply and Distribution	142
11. Distribution of Hydrants	78
12. Hydrants - Size, Type and Installation	15
13. Hydrants - Inspection and Condition	13
14. Miscellaneous Factors and Conditions	40
Total	865

FIRE DEPARTMENT

1. Pumpers	
2. Ladder Trucks	
3. Distribution of Companies and Type of Apparatus	
4. Pumper Capacity	
5. Design, Maintenance, and Condition of Apparatus	
6. Number of Officers	
7. Department Manning	
8. Engine and Ladder Company Unit Manning	
9. Master and Special Stream Devices	
10. Equipment for Pumpers and Ladder Trucks	
11. Hose	
12. Condition of Hose	

Item		Assigned Points
13.	Training	
14.	Response to Alarms	
15.	Fire Operation	
16.	Special Protection	
17.	Miscellaneous Factors and Conditions	
	Total	

FIRE SERVICE COMMUNICATIONS

1.	Communication Center	
2.	Communication Center Equipment and Current Supply	
3.	Boxes	
4.	Alarm Circuits and Alarm Facilities Including Current Supply at Fire Stations	
5.	Material, Construction, Condition, and Protection of Circuits	
6.	Radio	
7.	Fire Department Telephone Service	
8.	Fire Alarm Operators	
9.	Conditions Adversely Affecting Use and Operation of Communication Facilities and the Handling of Alarms	
10.	Credit for Boxes Installed in Residential Districts	(-)
	Total	

FIRE SAFETY CONTROL

1.	Flammable or Compressed Gases	
2.	Flammable or Combustible Liquids	
3.	Special Hazards	
4.	Miscellaneous Hazards	
5.	Supplemental Fire Prevention Activities	
6.	Building Laws	
7.	Electricity	
8.	Heating and Ventilating Installations	
	Total	

ADDITIONAL DEFICIENCIES

1.	Adverse Climatic Conditions	
2.	Other Adverse Conditions or Occurrences	
3.	Divergence Between Water Supply and Fire Department	
	Total	

SUMMARY OF DEFICIENCY POINTS

WATER SUPPLY	865
FIRE DEPARTMENT	1259
FIRE SERVICE COMMUNICATIONS	245
FIRE SAFETY CONTROL	431
ADDITIONAL DEFICIENCIES	87
Total Deficiency	2887

INSURANCE SERVICES OFFICE of OREGON

FIRE FLOW TESTS

a Graded: MADRAS County: Deschutes State: Oregon

er: A. Nisbet Date: 9-1-76

Pumps and tanks operating during high value flow tests: Trtmt Plant = 500 gpm

Pump #2 = 400 gpm + Pump #4 = 300 gpm

D tests: System consumption rate during tests 0.8 MGD; Time of day 9:00 to 12:00 am

	LOCATION	PRESSURES-Lbs. Sq. In. Static	Resid.	Pitot	ORIFICE	DISCHARGE-G. P. M. Observed	Rec.	20 lbs.	.. lbs.	DISTI
	5th & D			15/15	2-2½	1300				
	6th & D			2/2	2-2½	480				
	6th & C	78	27			1780	3000	1900		C
2	6th & Oak			15/14½	2-2½	1290	4500	1560		C
	7th & Oak	70	35							
	Bluff St. E. End *	175	60	10½/11	2-2½	1100	3500	1300		I
	10th & F	78	35	7½/7½	2-2½	920	6000	1100		I
	10th & D	78	28	9½/9	2-2½	1020	4500	1100		I
5	12th & 12th Drive	58	19	8½/7½	2-2½	950	3000	930		I
6	12th & A *	160	20	6½/7½	2-2½	890		890		
7	4th & G			9/9	2-2½	1000				
	4th & F			10/10	2-2½	1080				I
	4th & E	74	30			2080	4000	2350		
8	5th & Cherry	87	24	10/11	2-2½	1090	3000	1150		C

* Deschutes Valley Water System

"Static" pressure indicates normal pressure in main at time of test.
"Residual" pressure indicates pressure in main during flow at hydrant.
"Pitot" pressure indicates measured velocity head of stream at hydrant outlet.
Column headed "Orifice," shows number and size of outlets opened.
"Observed" discharge shows flow computed from noted pressures.
Recommended" discharge is the flow considered for fire insurance grading purposes.
"Discharge — 20 lbs.," is computed flow available for pumping engines.
"Discharge — ... lbs.," is computed flow available for direct hydrant streams.

*DISTRICTS.

C — Commercial
SC — Shopping Center
IND — Industrial
RES — Residential
INS — Institutional
** — Single Risk (use with one of above)

All comments and recommendations made by the Insurance Services Office relate solely to fire insurance rating or grading considerations; no representations or warranties of any kind are intended or made.

INSURANCE SERVICES OFFICE of OREGON

FIRE FLOW TESTS

..a Graded: MADRAS County: ______ State: ______

..er: ______ Date: ______

Pumps and tanks operating during high value flow tests: ______

..D tests: System consumption rate during tests ______ MGD; Time of day ______ to ______

LOCATION	PRESSURES-Lbs. Sq. In.			ORIFICE	DISCHARGE-G. P. M.				DISTR
	Static	Resid.	Pitot		Observed	Rec.	20 lbs.	... lbs.	
4th & I St.	62	44	21/21	2-2½	1540	2000	2400		C
2nd & B	80	40	21/23	2-2½	1580	2000	2000		C

*DISTRICTS.

"Static" pressure indicates normal pressure in main at time of test.
"Residual" pressure indicates pressure in main during flow at hydrant.
"Pitot" pressure indicates measured velocity head of stream at hydrant outlet.
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C — Commercial
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File: Water (Master Plan)

Oregon
Theodore R. Kulongoski, Governor

Department of Human Services
Health Services
800 NE Oregon Street
Portland, OR 97232-2162
(503) 731-4030 - Emergency
(503) 731-4899
(503) 731-4077 - FAX
(503) 731-4031 - TTY-Nonvoice

Rec'd 2-28-05

February 24, 2005

City of Madras
Keith Bedell
800 SE Grizzly Road
Madras OR 97741

Dear Water District;

RE: Water System Master Plan

Our records show that we have no current Master Water Plan for your system. OAR 333-061-0060 (5) requires community water systems with 300 or more service connections to maintain a current master plan that has been reviewed and approved by the Health Department.At this time our records show that your System is **OUT OF COMPLIANCE.**

The Plan shall evaluate the needs of the water system for at least a twenty year period, be prepared by a professional engineer registered in Oregon, and shall include (but not limited to) the following items:

1. A summary of the overall plan.
2. A description of the existing system, including water usage patterns, water quality, and regulatory compliance issues, if any.
3. An estimated of projected growth, future water needs, system deficiencies, and remedies for addressing those deficiencies.
4. An evaluation of financing options.
5. A recommended program of improvements, including associated costs and a proposed schedule for construction projects.

The master plan is an important planning document for any water system. Please respond to this letter and inform us of the status for your master plan by July 1,2005.

Sincerely,

Tom Charbonneau, P.E.,
Drinking Water Section

cc: Kari Salis, Department of Human Services

Portland Water

1. The City assumes all water deliveries and management within the city limits. As the City limits expands, so does our territory. PUC would simply read the meter on their water main and invoice the City accordingly. To soften the impact on PUC we could contract with PUC for construction/installation and repair.

2. PUC takes over all delivery of water within the City, including the old portion of Town that we deliver to, and simply pays the City some sort of agreed "privilege" fee (i.e. 3 to 5% of gross sales).

3. We maintain the status quo, but PUC pays a privilege fee for the areas within the City it sells to.

4. We maintain the status quo, but at a discounted rate for City purchase because PUC has no system maintenance cost (in our area) and reads only one meter.

5. We maintain the status quo.

6. The City assumes all water deliveries and management within the city limits. As the City limits expands, so does our territory. City would read the meter's at the service for the individual property owners. The PUC would get a percentage of the revenue from the individual meters. To soften the impact on PUC we could contract with PUC for construction/installation and repair of the existing water system.

Oregon
Theodore R. Kulongoski, Governor

Department of Human Services
Health Services
800 NE Oregon Street
Portland, OR 97232-2162
(503) 731-4030 - Emergency
(503) 731-4899
(503) 731-4077 - FAX
(503) 731- 4031 - TTY-Nonvoice

July 9, 2004

Faxed to Weir per Craig 7-9-04

City of Madras
Keith Bedell
800 SE Grizzly Road
Madras OR 97741

Dear Water District: **RE: Water System Master Plan**

Our records show that we have no current Master Water Plan for your system. This puts your system **Out of Compliance** with OAR 333-061-0060 (5) that requires community water systems with 300 or more service connections maintain a current master plan that has been reviewed and approved by the Health Department (see attached).

The Plan shall evaluate the needs of the water system for at least a twenty year period, be prepared by a professional engineer registered in Oregon, and shall include (but not limited to) the following items:

1. A summary of the overall plan.
2. A description of the existing system, including water usage patterns, water quality, and regulatory compliance issues, if any.
3. An estimated of projected growth, future water needs, system deficiencies, and remedies for addressing those deficiencies.
4. An evaluation of financing options.
5. A recommended program of improvements, including associated costs and a proposed schedule for construction projects.

The master plan is an important planning document for any water system. Please respond to thi letter and inform us of the status for your master plan by September 1,2004.

Sincerely,

Tom Charbonneau, P.E.,
Regional Manager, Drinking Water Section

cc: Kari Salis, Department of Human Services

61-0060(5) Master plans:

(a) Community water systems with 300 or more service connections shall maintain a current master plan. Master plans shall be prepared by a professional engineer registered in Oregon and submitted to the Department for review and approval.

(b) Each master plan shall evaluate the needs of the water system for at least a twenty year period and shall include but is not limited to the following elements:

(A) A summary of the overall plan that includes the water quality and service goals, identified present and future water system deficiencies, the engineer's recommended alternative for achieving the goals and correcting the deficiencies, and the recommended implementation schedule and financing program for constructing improvements.

(B) A description of the existing water system which includes the service area, source(s) of supply, status of water rights, current status of drinking water quality and compliance with regulatory standards, maps or schematics of the water system showing size and location of facilities, estimates of water use, and operation and maintenance requirements.

(C) A description of water quality and level of service goals for the water system, considering, as appropriate, existing and future regulatory requirements, nonregulatory water quality needs of water users, flow and pressure requirements, and capacity needs related to water use and fire flow needs.

(D) An estimate of the projected growth of the water system during the master plan period and the impacts on the service area boundaries, water supply source(s) and availability, and customer water use.

(E) An engineering evaluation of the ability of the existing water system facilities to meet the water quality and level of service goals, identification of any existing water system deficiencies, and deficiencies likely to develop within the master plan period. The evaluation shall include the water supply source, water treatment, storage, distribution facilities, and operation and maintenance requirements. The evaluation shall also include a description of the water rights with a determination of additional water availability, and the impacts of present and probable future drinking water quality regulations.

(F) Identification of alternative engineering solutions, environmental impacts, and associated capital and operation and maintenance costs, to correct water system deficiencies and achieve system expansion to meet anticipated growth, including identification of available options for cooperative or coordinated water system improvements with other local water suppliers.

(G) A description of alternatives to finance water system improvements including local financing (such as user rates and system development charges) and financing assistance programs.

(H) A recommended water system improvement program including the recommended engineering alternative and associated costs, maps or schematics showing size and location of proposed facilities, the recommended financing alternative, and a recommended schedule for water system design and construction.

(I) If required as a condition of a water use permit issued by the Water Resources Department, the Master Plan shall address the requirements of OAR 690-086-0120(Water Management and Conservation Plans).

(c) The implementation of any portion of a water system master plan must be consistent with OAR 333-061 (Public Drinking Water Systems, DHS), OAR 660-011 (Public Facilities Planning, DLCD) and OAR 690-086(Water Management and Conservation Plans, WRD).

City of Madras 2004 Water Use

Month/Year	South Tie in Usage	North Tie in Usage	Lincoln Tie in Usage	Combined Usage in CF	Usage in Million Gallons	Well #3 Daily Average
Jan 2004	1421700	2400	0	1424100	10.65	0.0000
Feb 2004	1376000	2700	0	1378700	10.31	0.0000
Mar 2004	1639300	5100	0	1644400	12.30	0.0000
Apr 2004	2048100	48300	0	2096400	15.68	0.0014
May 2004	2523900	179300	0	2703200	20.22	0.0000
June 2004	2824600	461300	0	3285900	24.58	0.0003
July 2004	4368800	1041600	0	5410400	40.47	0.0007
Aug 2004	3785400	964200	0	4749600	35.53	0.0041
Sep 2004	3176000	330700	0	3506700	26.23	0.0029
Oct 2004	2744800	152500	0	2897300	21.67	0.0000
Nov 2004	1450300	5100	0	1455400	10.89	0.0000
Dec 2004	1422600	3300	0	1425900	10.67	0.0000
Total Usage for 2004				31978000	239.1954	0.0094

3 UTILITIES

3-1 SOLID WASTE MANAGEMENT
(Ordinance No. 416 - Repealed by Ordinance No. 532))

3-2 CROSS CONNECTIONS
(Ordinance No. 470 as amended by 471)

3-3 WATER SYSTEM
(Ordinance No. 484)

includes any receiver, special master, trustee, assignee or other similar representative thereof.

(n) "Potable Water" means safe drinking water.

(o) "Public Works Director" means the public works director for the city of Madras or the public works director's designee.

(p) "Reduced Pressure Principle Backflow Prevention Device (R.P. Device)" means a device approved by the Oregon State Health Division for preventing backflow which has two check valves, a differential relief valve located between the two check valves, two shut-off valves, one on the upstream side and the other on the downstream side of the check valves, and four test cocks for checking the water-tightness of the check valves and the operation of the relief valve.

(q) "Service Connection" means the piping connection by means of which water is conveyed from a distribution main of a public water system to a customer's premises. The portion of the service connection which conveys water from the distribution main to the customer's property line, or to the service meter where provided, is owned by and under the jurisdiction of the water supplier.

(r) "Water System" means a system for the provision of piped water for human consumption.

Section 2. Cross-Connection Control Requirements.

(a) Whenever a water user or the owner of the premises obtaining water from the city water system treats the water in any way or adds any chemical or substance to the water, and such treated water is susceptible to a backflow, such person shall immediately notify the public works director.

(b) Backflow prevention device assemblies for protecting the city water system shall be installed on the owner's side of the service connection to premises where an approved air gap does not exist when there is an auxiliary water supply which is connected to the potable water piping; or

(1) There is intricate plumbing which makes it impractical to ascertain whether or not cross-connections exist; or

(2) There is unprotected back-siphonage potential; or

(3) Unprotected cross-connections exist; or

(4) There is an auxiliary water supply which could be connected to the potable water piping, or potential cross-connections exist unless all of the following requirements are met:

(a) The owner(s) makes written request for a variance.

(b) The owner(s) has signed an affidavit stating that there is no cross-connection with the city water system, and that if ownership of the property changes, the new owner(s) will install the required device unless the new owner(s) obtains a variance prior to receiving water from the city.

(c) The owner(s) has obtained an inspection of the plumbing by the public works director, and the public works director has approved the variance, in writing, setting forth any reasonable requirement for protecting the safety and integrity of the city water system.

Should the public works director deny the variance, the owner(s) may, within sixty (60) days, submit a written appeal to the Public Works Committee and request a hearing. Upon hearing the appeal, the Public Works Committee shall either grant a variance subject to whatever conditions it may require, or deny the variance.

Should the Public Works Committee deny the variance, the owner(s) may, within thirty (30) days submit a written appeal to the city council and request a hearing. Upon hearing the appeal, the city council shall either grant the variance subject to whatever conditions it may require, or deny the variance. The decision of the city council shall be final.

[Section 2 amended by Ordinance No. 471, passed February 27,1990.]

Section 3. Notices. Any notice required or permitted under this ordinance shall be deemed given upon mailing to the address of the premises served or to the billing address of the water user listed with the city water department.

Section 4. Discontinuance of Service (Shut-Off). The public works director may shut off the water service to any premises when:

(a) A violation of this ordinance continues after the expiration of any notice period provided under this ordinance; or

(b) Immediately, upon determination that an emergency exists or that a substantial hazard exists due to the potential for backflow of hazardous substances; or

(c) Immediately upon the refusal of any water user or owner of premises to permit inspection, or if the public works director is unable to contact the water user or owner to arrange for an inspection, and has given notice of such request prior to shutting off the water service.

Section 5. Inspections. All water users and owners of premises served by the city water system shall permit inspections by the public works director, at such times as the public works director may designate, for purposes of determining whether the water user or owner is in compliance with this ordinance.

Section 6. Penalties. Violation of this ordinance shall be punishable by a fine not to exceed $300.

Oregon Department of Human Services

Drinking Water Program

00500 **MADRAS, CITY OF** Classification: **COMMUNITY**

Contact: KEITH BEDELL 800 SE GRIZZLY RD MADRAS, OR 97741	**Phone:** 541-475-7259 **County:** JEFFERSON **Activity Status:** ACTIVE
Population: 3,435	**Number of Connections:** 970
Operating Period: January 1 to December 31	**Regulating Agency:** DHS DWP, Eastern Region
Certified Operator(s)	**Owner Type:** LOCAL GOVERNMENT
Required: Y	**Licensed By:** N/A
Distribution class: 2	**Approved Drinking Water Protection Plan:** No
Treatment class: None	**Source Water Assessment:** No
Filtration Endorsement Required: No	**Last Sanitary Survey Date:** Oct 29, 2002

Sources

ID	Facility Name	Activity Status	Availability	Source Type	Sampling Point?
EP-A	**EP FOR DESCHUTES VALLEY WATER DIST.,**	**A**		**GW**	**Yes**
SRC-AA	DESCHUTES VALLEY WATER DIST.,	A	permanent	GW	Yes
EP-B	**EP for WELL #2**	**I**		**GW**	**Yes**
SRC-BA	WELL #2	I	emergency	GW	Yes
EP-C	**EP for WELL #3**	**A**		**GW**	**Yes**
SRC-CA	WELL #3	A	seasonal	GW	Yes

Treatment

State ID	Facility Name	Treatment Process	Treatment Objective

Consumer Confidence Reports

For Year	Date Received	Date Certified
2004		
2003	Dec 08, 2004	Dec 08, 2004
2002	May 27, 2003	May 27, 2003
2001	Jun 12, 2002	May 12, 2002

For further information on this public water system click on the area of interest below.

Lead & Copper .. Corrosion Control(LCR) .. SWTR .. Nitrates .. TTHM Summary
System Info .. Report for Lenders .. Violations .. SNC History .. Enforcements .. Contacts .. Public Notice .. Alerts
Coliform Summary .. Coliform Results .. Sampling Schedule-Coliform .. Coliform Sample Archives (pre 2002)
Chemical Test Summary. . Latest Chemical Results. . Chemical Detections . . Sampling Schedules-Chemicals.. Single Analyte Results For a System
DBP/TOC/Bromate/Chlorine Monitoring

Info by county: Sanitary Surveys .. Alerts. .Violations .. SNCs .. Open Enforcements .. Inventory. .Surface Water Systems

Inventory List for all Oregon Drinking Water Systems in Excel or printable screen format