WATER SYSTEM MASTER PLAN

Prepared for

CITY OF MOLALLA, OREGON

December, 1996

Presented To:

Dean Madison, DPW
City of Molalla
117 N. Molalla Ave.
Molalla, Oregon 97038

Presented By:

eas Engineering

and
Balfour Consulting, Inc.
with
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CONSULTING ENGINEER

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December 18, 1996

Mr. Dean Madison, Director of Public Works
City of Molalla
P. O. Box 248
Molalla, OR 97038

Re: Final Water Master Plan

Dear Mr. Madison:

The team of EAS Engineering, Balfour Consulting, Inc., CH2M HILL and deHaas & Associates are pleased to present this completed Water System Master Plan for the City of Molalla. It was completed in conformance with our agreement of May 15, 1995. A draft plan was provided in March 1996 for city review. Following the review, the plan was placed on hold during the attempt to locate a higher quality base map. Not finding the map, the plan was completed with the computer model mapping provided in the draft.

The Water Master Plan contains funding and implementation information in the final chapter of the report, Chapter 7. It provides a recommended capital improvement plan with detailed projects and costs. The cost figures provided are early 1996 costs. The state of Oregon is currently experiencing are rapid acceleration of construction costs, well above national trends. It is advised to increase costs by 10 percent per year for the first three years than reduce to 5 percent per year to the year of construction. We have seen some bids at 50 to 100 percent above the engineers estimate this year. This is due to the heavy workload of most contractors. It must be assumed that costs will soon return to a predictable level in the near future.

The project team wishes to thank you and your staff for the excellent assistance in completing this plan. This has contributed to the preparation of a plan that will guide the expansion of the water system for many years into the future.

We remain ready to assist the City in the implementation of this planning or in any other way we may be of service.

Sincerely,
EAS Engineering

Edward A. Sigurdson, PE, PLS
Project Managaer
eas
mol\WMP-cover ltr.

cc: Marlin deHaas, deHaas & Associates
Erik Coats, Balfour & Associates

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117 N. Molalla Ave.
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Exp. 6-30-98

Exp. 12-31-97

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ACKNOWLEDGEMENT

The consulting team gratefully acknowledges the assistance and cooperation of Dean Madison, Director of Public Works and Keith Stiglbauer in the preparation of this water master plan. They provided needed background information and new data required to prepare the plan. This information was provided on a timely basis and met our needs fully. The support of the City Administrator and City Council is gratefully appreciated.

CHAPTER 1 - INTRODUCTION

1.0 OVERVIEW

The City of Molalla is currently experiencing significant growth. Following are some examples of and reasons for the growth:

- Based on an article in the Oregonian newspaper printed on December 17, 1995, 45 new families moved to Molalla in September through November, 1995, which is an estimated increase in population of 3.4 percent (based on a base population of 4,000) in a three month period.

- Presently there are enough residential development projects approved to increase the population 65 percent when they are completed and occupied.

- Based on the projections of this study, the population could potentially increase threefold in the next twenty years.

- Molalla is close to Portland and has maintained the quality, rural lifestyle that many people desire. Additionally, Molalla housing prices are more affordable than in the metropolitan area.

A reliable water supply is critical to the growth of a community. Based on the projected growth, the existing Molalla water supply will not meet the future residential needs, let alone any heavy industrial or commercial users. The water right currently in use on the Molalla River is fully appropriated during peak summer usage, and the water treatment plant currently operates at peak capacity. During the large wind storm in December, 1995, the City was without power for two days. The reservoirs dropped to levels that raised concerns about adequate potable supplies and fighting fires. Based on this emergency, it was clear that the water supply system was barely capable of meeting the current needs, let alone the future growth. A water system master plan is important to help the City prepare for growth. The most recent water system master plan is over 15 years old, and has nearly reached its design life. Therefore, the City determined that a complete water system master plan must be completed to help prepare for the expected growth.

The purpose of this water system master plan is to:

- Provide the City with an updated description of the existing water supply, treatment and distribution systems.

- Prepare a plan for expansion of these facilities to meet expected growth for the next 20 years.

In addition, the concept of watershed management for protection of waters supplies will be briefly examined, and recommendations will be provided for City action. Specifically, this report will provide the following:

- Update the population projections for the City of Molalla.

- Collect and analyze recent water usage records and project future water demand.

- Evaluate future water supplies, including surface and ground water sources.

- Review existing storage facilities and project future storage needs, including locations and quantities.

- Review the treatment capabilities for present and future needs, and as related to future water supplies.

- Review the existing distribution system, including projecting peak water demands and fire flow requirements.

- Project the needed future expansion of the water supply system.

- Evaluate the hydraulic capabilities of the existing and future systems.

- Develop a capital improvements plan to guide the City in upgrading and repairing the entire water system.

Water purveyors are continually faced with new regulations and controls in providing water in adequate quality and quantity. Water purveyors must control the quality of the water supply to the requirements of the Safe Drinking Water Act (SDWA), which is enforced by the Oregon Health Division (OHD). Another state agency, the Oregon Water Resources Department (OWRD) controls the quantity of water available. The general factors regulated by the OHD and the OWRD that will affect this plan are discussed below. The remainder of the plan will focus on the specific components of the planning process, finishing with the conclusions and recommendations of the study.

Safe Drinking Water Act

The Safe Drinking Water Act (SDWA) and the 1986 Amendments have had far-reaching effects on public water purveyors. The SDWA established comprehensive regulations and standards for drinking water quality. Water quality standards have been established through the primary and secondary standards (as defined below), and are based on maximum contaminant levels (MCL's).

- Primary standards regulate contaminants demonstrated to cause serious health problems to humans.

- Secondary standards regulate contaminants that may be a nuisance to the consumer at high concentrations.

The 1986 amendments to the SDWA reflect the increased awareness of the potential threat facing groundwater resources and surface water users, and include:

- Wellhead protection, where States are required to develop programs for protecting areas around wells supplying public drinking water systems from contamination that endanger the public health. States were given three years to develop these programs, which Oregon has completed.

- Provisions for developing criteria for filtration of surface water supplies.

- Provisions for specifying criteria for disinfection of both surface and certain groundwater supplies.

- Requirements that the EPA regulate numerous new contaminants, with the list expanded with 25 new contaminants every three years.

The SDWA and Oregon Health Division (OHD) regulations will be considered in detail in this master plan to assure the City that implementation of the plan will not be in conflict with any known upcoming provisions of the act. The most important aspects of the act that will affect this plan include:

- **Well Head Protection** - The State and Federal governments have recently adopted tighter standards for well head protection, which are now being implemented. One of the new requirements is for protection of a much larger radius around wells than had been specified in the past. As this plan will consider wells as an option for future water supply, these regulations are very relevant.

- **Surface water** - In researching groundwater supplies, each source must be evaluated to ensure there is no direct connection to surface water. Groundwater under the direct influence of surface water requires much more elaborate treatment, and the water rights are much more difficult to obtain. Wells withdrawing from aquifers below 100 feet are usually safe from the impacts of surface water if they are separated by an impermeable geologic soil layer above the aquifer.

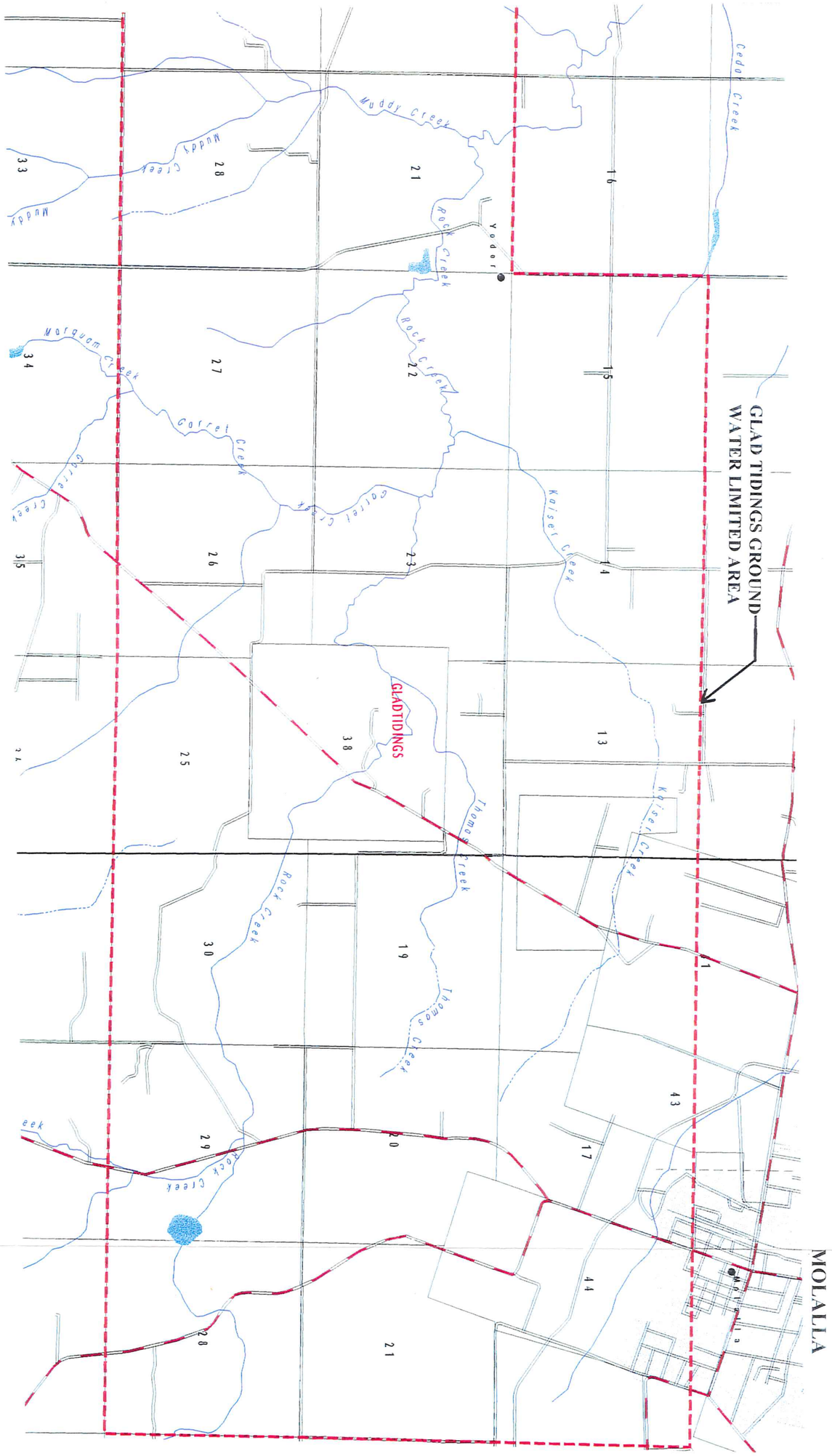
- **Well water quality** will be considered in increasing detail in the coming years. Improved disinfection may be required on some wells, and filtration may become an issue. Iron, manganese, and sulfur are secondary contaminants, and should be avoided, if possible, as treatment of these contaminants is possible, but quite difficult at individual well sites.

- **Increased Testing Requirements** - Increasing refinements in surface water contaminant testing and requirements.

Oregon Water Resources Department

The OWRD regulates the use of both surface and groundwater throughout the state. Over the years, they have begun exercising greater control of water use through closer scrutiny of water rights. In the Willamette Basin Section of the Oregon Water Management Plan, new policies and procedures have been enacted to control the use and allocation of both water sources. In general, groundwater rights are much easier to obtain than surface water rights. However, new stricter controls over groundwater resources, in addition to previously established controls on surface water resources, will greatly impact the City's ability to acquire both new water supplies.

Limited Groundwater Areas - The Willamette Basin Program of the OWRD's administrative rules identify a number of specific areas around the state which are designated "limited groundwater areas". New wells may be prohibited in these areas, or if wells have been drilled, the state can have them taken out of service if the withdrawal is impacting earlier users. The groundwater basin south of Molalla is designated as a limited groundwater area, and is formally known as the Glad Tidings Groundwater Limited Area (see Figures 1-1 and 1-2).



City of Molalla, Oregon
Water Master Plan

GLAD TIDINGS GROUNDWATER LIMITED AREA

FIGURE 1-1

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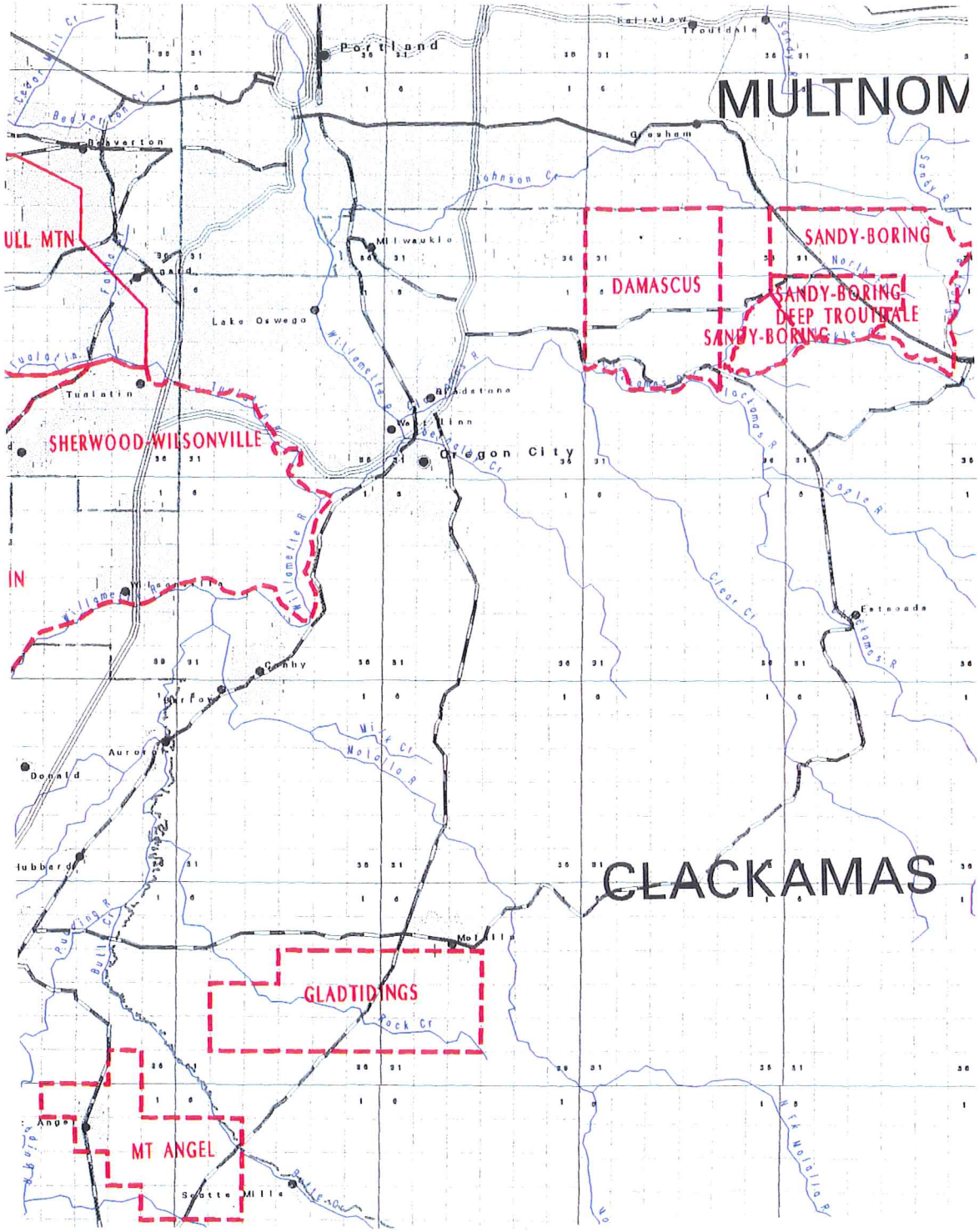

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City of Molalla, Oregon
Water Master Plan

WILLAMETTE BASIN GROUNDWATER LIMITED AREAS

FIGURE 1-2

Surface Water - Water rights have long been used to control the withdrawal of surface water for municipal or agricultural uses. The OWRD is charged with issuing and controlling water rights. They also have extended the definition of surface water to include shallow groundwater near rivers, as that water may be flowing parallel to or into the river.

Water Supply Considerations - The OWRD currently has a backlog of water rights applications with a waiting period of over two years before a new application will be considered. The department no longer take applications out of order unless a municipal user has a major emergency. These, and the other issues in this section, are pointed out not to be discouraging, but to stress the importance of planning well in advance for the water needs due the increasing difficulty in obtaining a suitable supply. To prepare the City for future water needs, this plan will project the supply requirements for a 50 year planning period, and recommendations will be made for obtaining ample rights for a long term source.

2.0 SCOPE OF WORK

The intent of this report is to provide guidelines for improving the present water system serving the area within the City limits, plus the added population that will result from additional land annexation into the Urban Growth Boundary. Since waterworks facilities are durable and long lasting, plans for improvement must consider the future needs for at least a planning period of 20 years. Water supplies should be planned and acquired to meet future needs for at least a 50 year period. This Water System Master Plan will be developed for recommended improvements to the infrastructure for a 20-year period (to 2016), while the water supply will be planned for the 50-year period (to 2046).

Following are the professional services that have been provided to complete this water system master plan for Molalla.

Task 1 - Project Plan

During the early stages of the project, the CONSULTANT prepares a project plan consisting of the scope of work, a task budget, a task schedule, subconsultant agreements and other information that will be of assistance to CONSULTANT in completing the work.

Task 2 - Gather Data

The CONSULTANT shall secure available information to assist with the preparation of the master plan. The CITY will assist with this effort by providing the following information for the CONSULTANT's use during the life of this agreement:

- Comprehensive plan, land zoning and population data.
- Water usage information - both supply and consumption data.
- Source information - Construction plans, well logs, test results, design capacities, "As-built" plans, pump and controls data, power consumption information, etc.
- Distribution system information - any additional reports such as master plans, a water system map, area service boundaries, system elevations, valve and meter data, pressure reducer information, fire flow data, water test data, and any known system deficiencies.
- Any existing mapping plus any mapping needs of the City.

The CONSULTANT will interview City staff and others to learn as much about the condition and operation of the system as possible.

Task 3 - Evaluate Existing Facilities

The CONSULTANT shall review the data collected in Task 2 in detail. An extensive on-site inspection of the entire system, including probable growth areas, will be conducted. The CITY will provide the assistance of the Public Works Director to review the system in the field and office, which will provide valuable information about the system which is not available through a record search.

The initial inspections will be made with the system on-line and in full operation. If specific inspections are needed, individual components may be taken off-line for a more detailed review.

The CONSULTANT will prepare the findings of the research and field evaluation of the existing facilities for inclusion in the master plan.

Task 4 - Water Demand Projections

From the population and demand information available, the CONSULTANT will identify existing average day demand and peak day demand, and project future demands through the 20-year and 50-year planning periods. Land use zoning and planned priority growth areas within the City will be taken into consideration. The City's input will be requested such that these projections will be the best estimate of the combined efforts of the CONSULTANT and the CITY. Outside users will be considered in these projections.

Task 5 - Evaluate Water Supply and Treatment

Water Supply Expansion

Additional water supply is the key issue in preparing this study. The CONSULTANT will review the existing water rights on the Molalla River and examine the water quality, considering the new rules adopted by the federal and state governments. Factors affecting the future water supply will be:

- Available water rights,
- Potential for adding rights, and
- The cost-effectiveness of transmitting the water from the treatment plant to the City's water distribution system.

Alternate supplies will be considered if they appear reasonable, and if the costs are more advantageous to the rate payers.

Well Head Protection. As wells may be considered for future water supply, well head protection will be considered in this plan. The Oregon Department of Environmental

Quality (DEQ) has established a voluntary wellhead protection program (WHP) under the requirements set forth in the 1986 Amendments to the Federal Safe Drinking Water Act (SDWA) and the Oregon Ground Water Protection Act of 1989. The overall objective of the DEQ program is to protect groundwater resources that are relied upon for drinking water.

A previous water system plan indicated that a future well field southwest of the city had been considered for expanding the City water supply, although this area may lie within the "limited groundwater area". The well head protection program will only impact Molalla if additional supply by the use of wells is considered in the master plan. The existing source from the Molalla River will be continued and possibly expanded unless restricted by water rights, river water quality, or cost of transmission.

New Source Water Quality

Each potential water source may have a water treatment requirement. All surface water, plus ground water which can become classified as surface water, must have some amount of treatment. Many approaches to treatment are possible depending upon the particular pollutants to be removed. The SDWA and rules of the DEQ and the OHD apply an ever tightening set of regulations for water purveyors. Following are some of the issues to be considered:

- Surface Water Treatment Rule
- Removal of Pathogens
- Disinfection and disinfection by-products
- Corrosion and lead contamination
- Disposal of waste solids and removed contaminants
- Additional constituents that may be regulated in the future

The Consultant will develop a plan of action under this task in conjunction with evaluation of sources. A cost estimate will be developed for various treatment

alternatives required to meet the regulated contaminant levels, and a recommended alternative will be presented.

Task 6 - Develop Distribution System Hydraulic Analysis Model

A mathematical model of the City's water system has been developed for computerized hydraulic analysis. The CYBERNET program was selected for modeling due to its ability to integrate with AutoCAD.

Once the model is developed and utilized in this master plan, it will be retained by the Consultant for future use if needed. As an example, in the future a large user may be considering location in Molalla. The model can be used to determine the impact of the user on the overall system.

Task 7 - Evaluate the Existing Distribution System

Using the model prepared in Task 6, the Consultant will evaluate the existing water system with regard to meeting the existing water demands. Hydrant flow tests will be used to calibrate the model. The computer model will be used to analyze the following system characteristics:

- Maximum pipeline flow velocities
- Excessive pipeline head loss
- Service pressure during peak flow periods
- Maximum static pressures
- Reservoir storage adequacy
- Fire flow capabilities during maximum day system demands
- Reservoir refill rates

The results of the modeling analysis will help define any existing system problems with the existing system. Specific improvements can be considered to improve

service to the users or to improve fire protection. These improvements will be considered after the future system demands are applied in Task 8.

Task 8 - Evaluate the Future System

Once the hydraulic system model has been developed, calibrated and deficiencies identified within the existing system, recommended improvements will be input into the model to finalize a plan for future upgrades. Evaluation of the future water system will be dependent upon the location and capacity of the new water source(s). Currently the system is supplied by three transmission mains (14-inch, 10-inch and 8-inch). If a major new supply is provided, or if the existing supply is expanded significantly, the transmission lines may need to be upgraded.

In this task, water source alternatives will also be defined and evaluated. After initial screening, the final alternatives will receive estimated costs and cost effective analysis considering the time value of operation and maintenance costs for each source. The lowest cost alternative which meets the City's long term needs will be selected. All options will be reviewed with the City before proceeding.

With the new source identified, the model will be expanded to consider projected growth over the 20 year planning period. The model will be modified to reflect the future service areas and other anticipated changes resulting from 20 years of growth. Through the computer modeling work, system needs will be identified and a specific prioritized list of projects will be produced.

Task 9 - Develop a Capital Improvement Plan

The analysis and modeling from the previous tasks will result in a list of recommended projects. Within the Capital Improvement Program (CIP), these projects will be brought together into an implementation package. Projects will be assembled into a prioritized list which will be formatted in two phases - the first five years and the remaining fifteen years. The projects will be defined and project costs will be provided. Within the CIP, recommendations will also be provided for funding the listed projects.

Task 10 - Maintenance

Through the research in developing this plan, the project team will become quite familiar with the operation and maintenance of the system, and it may be possible to assist the maintenance staff and the rate payers by suggesting approaches to preventive maintenance or other procedures to improve the cost effectiveness of the operation and maintenance being accomplished. It is possible that increased maintenance funding will also be recommended to allow a level of maintenance which will save the rate payers money in the long run or improve their service.

Task 11 - Implementation

Within the final chapter of the plan, all of the recommended actions will be summarized. The CIP will be presented with the respective costs, funding suggestions will be provided and a schedule of recommended actions will be listed. The intent of this chapter is to provide specific direction to the staff and City Council for completing the work outlined in the plan. The study team is prepared to create the design documents, assist with construction observation and administer the implementation of these projects if requested.

CHAPTER 2 - PLANNING AREA DESCRIPTION

1.0 PHYSICAL CHARACTERISTICS

General

The City of Molalla is situated in northwestern Oregon near the Molalla River in Clackamas County. It is positioned 14 miles south of Oregon City on Highway 213, 25 miles northeast of Salem, and 18 miles east of I-5 at Woodburn.

Molalla was settled and farmed in 1840 but was not formally incorporated as a city until 1913 when the railroad came to town and the first Molalla Buckeroo was held. Molalla was named after a small Indian tribe which lived in the area. The center of the town was the intersection of two well used pioneer trails. The town began to grow in 1856 with the construction of a school and general store.

Topography

The urban growth boundary of the City is located on level to gently sloping land with the city center at elevation 365 feet. Elevations within the city range from 365 feet to a high of 374 feet. Ground slopes range from flat to 10 percent. Creamery Creek flows diagonally across the city from the southeast to the northwest, and drains into the Molalla River several miles outside the study area.

Bear Creek is located mostly outside the city limits in the southern portion of the study area and flows generally to the northwest. It eventually flows into the Pudding River. The urbanizing area is separated from the agricultural area on the west by Highway 213.

Lands surrounding Molalla are predominately used for agricultural purposes. Significant stands of timber are located nearby to the east in the Cascade Mountain foothills.

Geology

The Molalla area is predominately characterized by alluvial silt deposits of the Concord-Clackamas-Amity and Briedwell Associations. These soils have high seasonal

water tables and a depth to hard rock of 20 to 40 inches or more. These soils, although classified as silts, contain areas of clay, gravel or loam. All of these soils are somewhat poorly drained. Septic tank limitations in the area are classified as moderate to severe. The soils however are classified as having fair stability for building sites with slight to moderate restrictions. Soils within the study area contain the following classifications:

- Wapato Silty Clay Loam
- Amity Silt Loam
- Dayton Silt Loam
- Clackamas Silt Loam
- Huyberly Silt Loam
- Aloha Silt Loam
- Briedwell Silt Loam

Natural Hazards

Because of the relatively flat topography within the study area, there are no significant natural hazards to be considered in developing the community.

Water Resources

Historically, groundwater has been a most economic source of water supply. However, due to the characteristics of the area in and around Molalla, groundwater has been an elusive and somewhat uncertain resource. Finding groundwater is not enough; it must be found in sufficient quantity and quality to be of substantial value as a municipal water supply. During the 20th century, Molalla has met the growing needs of the municipal water users by withdrawing, treating and distributing water from the Molalla River, and Trout Creek, which is a tributary of the Molalla River. The water is of excellent quality, however, the supply is limited and existing water rights by other users further limits the City's use of this source. Although the City must pursue additional

rights on the Molalla River, groundwater is the only reasonable alternative source to the river.

The City of Molalla lies in the northeast section of the Molalla-Salem Slope area. This area lies along the eastern side of the northern Willamette Valley and extends eastward into the foothills of the Cascade Range. The wells located in the Molalla area tap a variety of rock units and generally yield small to modest quantities of water. Due to the composition of these formations, the water-bearing characteristics of these units vary with location.

The availability of groundwater in the Molalla area is dependent upon geologic formations, which are complex in places and thus groundwater development involves significant risk. While some wells yield water of medium to high quality, others yield water that is relative hard with iron and manganese. Chemical analysis of these groundwaters frequently show concentrations of some elements that exceed the limits recommended by the U.S. Public Health Service and the Oregon Health Division.

The best source of information concerning groundwater is the existing wells. Since the early 1950's, well drillers have been required to submit "well logs" to the office of the State Engineer. These logs are now received and cataloged by the State Department of Water Resources. These logs contain information concerning the location of the well, the depth, the yield and the various geologic layers penetrated during drilling. The logs now also contain depths of the aquifers encountered in the drilling of the well.

A review of the well logs for the area substantiates the geological findings. Most of the high yield wells in the Molalla-Salem Slope area are located approximately 10 miles southwest of Molalla near Mt. Angel. Wells in this area have reported yields to 700 gallons per minute (gpm). The majority of the wells in the vicinity of Molalla are low yielding, with capacities less than 90 gpm. There is one exception to this general rule. The aquifer located to the northwest of the city at the edge of the urban boundary (and to the north) is a high producing aquifer with many producing wells of 700 gpm.

The aquifer at the northwest edge of the urban area has the potential to become a second water source for the city. A number of wells are now producing flows of 500 to 700 gpm with reasonable drawdown. The potential exists for many more such wells.

Water can be found in this aquifer below confining layers of clay soil. This reduces the potential for surface water impacts to this source. This source will be addressed later in this plan, however, a detailed hydrogeological investigation is needed before the city invests too deeply in the assumption that this source will meet the City's growing need for water.

Land Use Planning

As with other cities in Oregon, Molalla has a detailed comprehensive land use plan which was published in 1985. The comprehensive plan is implemented by the City's zone code and other plans and ordinances. The City is primarily zoned residential with a downtown commercial center and an industrial area in the southwest part of the urban area. Wood products mills are the largest industries in Molalla, however, significant industrial land exists for diversified industrial growth in the future. There are no designated flood plains in Molalla, but Bear Creek lies within the urban growth boundary. Bear Creek has a flood plain which has never been defined, as it was outside the corporate limits when the Corps of Engineers last mapped flood plains in Oregon. Bear Creek should be studied in the near future as annexations will bring it within the city within the next few years. See Figure 2-1 for the Molalla Comprehensive Plan map.

Population Analysis

To properly design and size each element of a water system, the service population must be designated. The population is impacted by the design period and the area to be covered by the system. The major objective of a design population for this plan is to provide a basis for predicting the future water usage by the City. The water usage dictates the size of the water treatment plant, the amount of storage required, and the sizing of the distribution lines. The entire water system will be designed for a 20 year population projection to the year 2016, and the water supply will be developed for a 50 year population projection to the year 2046. Major factors that influence the growth projections in this study include:

- The past and current growth rates.

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City of Molalla, Oregon
Water Master Plan

COMPREHENSIVE PLAN

FIGURE 2-1

- Growth in the surrounding communities and other similar areas, including the suburbs of the Portland Metropolitan area.
- Highway access to the City.
- Previous population projections by City staff.
- Available land to develop.

In general, northwest Oregon is experiencing strong growth with a healthy economy. The strongest growth is within the Portland metro area, plus the fringes, including Molalla. Many communities around the metro area are currently experiencing overflow from Portland, with people willing to commute longer to gain a better quality of living. Molalla fits this description, as current growth suggests, and the excellent access to Portland via Highway 213 should lead to increased growth in the future.

To predict future populations, it is necessary to consider current and past growth trends in the area. Molalla is currently experiencing significant development of land within the Urban Growth Boundary (UGB). Figure 2-2 shows the past growth trends for the city. Items of interest from the graph and the current City development include:

- The yearly growth rate in Molalla has increased at a rate ranging from zero to nearly thirteen percent over the last thirty years.
- The population has increased at average annual growth rate of 5 percent over the past 30 years.
- Growth has been relatively significant in this decade. Population increases since 1990 have ranged from no growth in 1991, to 3.8 percent growth 1993, to 12.9 percent growth in 1990.
- The City currently has approved the development of approximately 800 single family lots. This will equate to approximately 2,400 more people within the UGB once the land is completely developed and occupied (assuming 3 people per single family dwelling). This represents a 60 percent population increase over the 6 to 10 years required to complete this growth.

As shown in Figure 2-2, the growth rate has increased appreciably over the last several years, but it would not be proper to extrapolate this curve to find the design

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City of Molalla, Oregon
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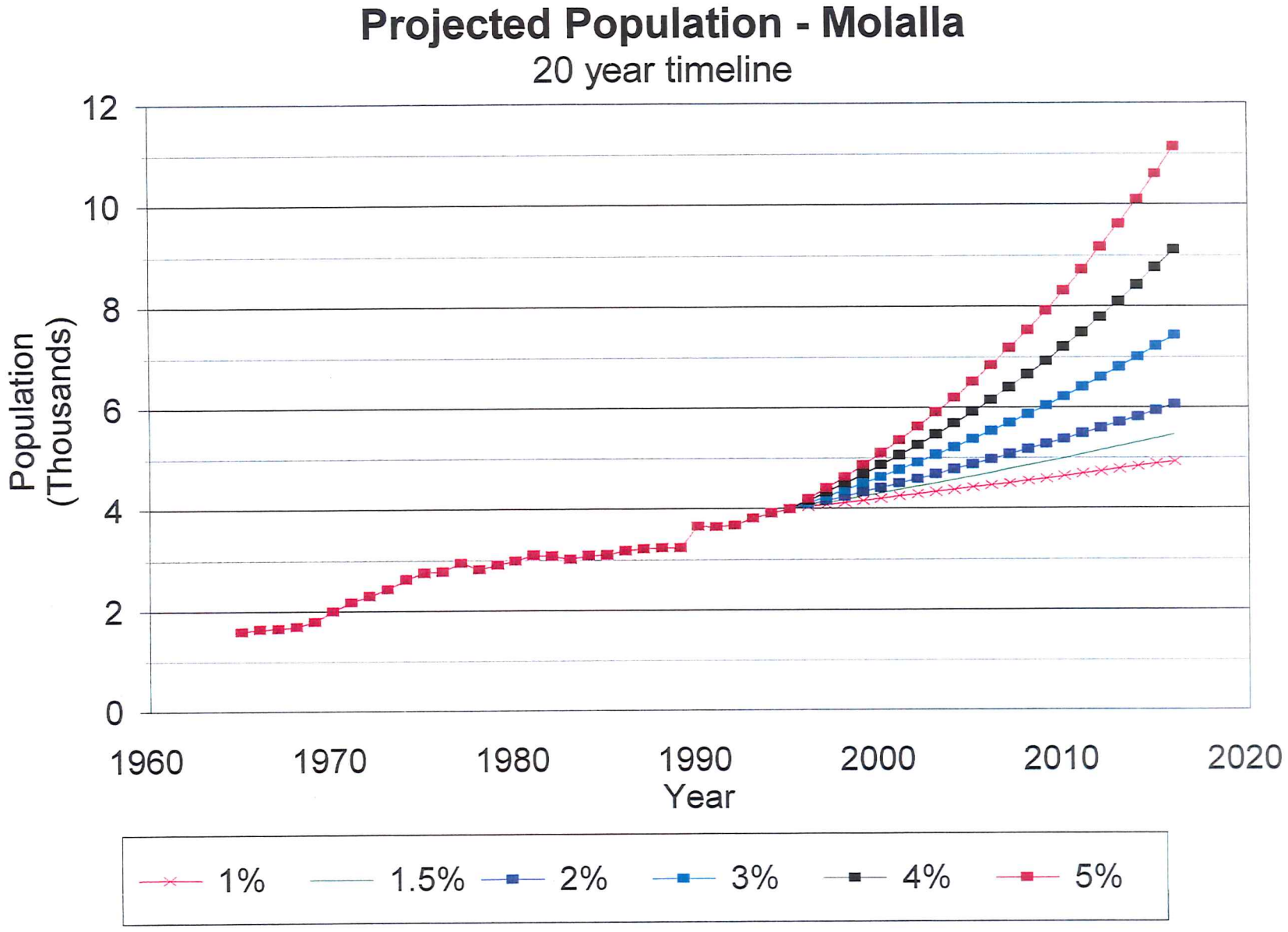
POPULATION PROJECTIONS

FIGURE 2-2



populations, since the present UGB could not absorb the growth. Initially, infilling will fill the undeveloped land within the City limits. Remaining areas within the urban growth boundary will then be annexed to the City and developed. Once the UGB is fully developed, neighborhoods will be redeveloped to greater densities. This process will take several decades to develop, but could occur within the 50-year water source planning period. Within this longer planning period, an expansion of the UGB may occur to accommodate the demand for housing.

Based on these concepts and the available population data, population predictions have been developed. It must be kept in mind that this growth is very dependent on future City annexation. From Figure 2-2, a low growth 2016 population (3% annual growth rate) would be 7,441, and a high growth population (5% annual) would be 11,144. Based on historical data, current development, and discussions with the City, the high growth figure for 20-year facilities planning is certainly a reasonable figure for Molalla. The population estimate for the year 2046 (water source planning) is more of a guess than the 20-year projection due to the significantly longer time span. However, based on past growth, evaluation of available land to develop within the UGB, and discussions with the City on future annexation expectations, moderate to relatively high growth can be expected. For this master plan, the following population projections will be used.

- A growth rate of 5 percent, with a resultant population of 11,144 in the year 2016, will be used for developing a plan to upgrade the water system infrastructure.

- A more moderate growth rate of 4 percent, with a resultant population of 29,564 in the year 2046, will be used to project the future water supply needs.

Industrial development has not been significant recently, nor has it been in the past, with one exception - the Avison lumber mill. The City does not have large tracts of open land zoned for industrial development that are not currently occupied. Additionally, the City does not have the available water supply to allow any industries with high water needs. Therefore, these population projections do not include any major industrial growth. The industrial water use is expected to grow with the population at the same ratio as industrial use to current population.

CHAPTER 3 - THE EXISTING SYSTEM

1.0 BACKGROUND

Initial construction of the City of Molalla's water system occurred over 80 years ago. A basic distribution system within the City was constructed around 1914, at which time water was obtained from wells, and was constructed primarily of wood and steel pipelines. Over the years, the City's network of distribution pipelines, or grid, has been expanded to service the growth as it occurred.

In 1921, the City developed a water intake on Trout Creek, a tributary of the Molalla River, and acquired a water right for 4.0 cfs. A diversion dam was constructed on Trout Creek approximately 6.5 miles southeast of town, at an elevation such that the water could be supplied to the City by gravity, and the City constructed a 6-inch transmission line to a storage tank near the current water treatment plant. Also, a new transmission line was constructed to supply the City grid at this time.

In 1954, the City acquired a water right on the Molalla River and constructed a new intake structure, and the Trout Creek water intake and the 6-inch transmission line were abandoned. A new 0.6 million gallon (MG) storage tank was constructed above the river where the current water treatment plant is located. Eight- and ten-inch diameter transmission lines were constructed from the reservoir site to the City distribution grid. No treatment had yet been required.

In 1973, a water system study was prepared by Clark and Groff Engineers, Inc., which included recommendations that the City construct a new 2.0 mgd water treatment plant and 1.2 million gallon water reservoir adjacent to the 0.6 million gallon reservoir. The recommendations also included installing a new 14-inch transmission line to the City, in addition to the existing 8-inch and 10-inch transmission lines. The new 1.2 MG reservoir was constructed in 1976, and the 0.6 MG reservoir was taken out of service for health concerns. The treatment plant was completed in 1977. The 14-inch transmission line was also constructed. In 1981, a water system evaluation was performed by Westech Engineering, Inc. This study focused on improvements to the water distribution and storage systems. The study also concluded that groundwater would be a viable option for

additional supply in the future, but that the option should be investigated in more detail, and urged the City to develop plans for locating additional water supplies. Recommendations of the study included eleven improvement projects, including installation of a well and a storage tank located southwest of the City, which lies near the Glad Tidings Groundwater Limited Area. Seven of the eleven improvements have been completed to date.

In 1983, the existing 0.6 million gallon reservoir was retro-fitted with a floating fabric cover, which increased the City's overall total storage capacity to 1.8 million gallons.

In 1993, a new water intake structure was constructed on the Molalla River to replace the aging 1954 intake structure. The new structure was constructed on the bank of the main channel, whereas the old structure was in a dredged channel off the river. Two separate intakes were constructed, one a perforated underdrain within the river, and the other an open channel intake located on the bank of the river. Raw water was collected in a wet well and pumped to the treatment plant through a 16-inch diameter pipeline. This new structure was damaged irreparably by floating debris during the major flood in February 1996, and replacement of the system is underway.

Different portions of the water transmission and distribution lines have been upgraded over the years. However, no significant work has been completed on the treatment plant or storage system since 1983. A large diameter pipeline (combination of 14-inch and 12-inch, with some interspersed 10-inch) nearly circles the City, providing the beginning of a good backbone for supplying the current domestic and fire flow needs. Some strengthening of the distribution grid will be required to accommodate the estimated 280 percent population increase projected for the 20-year planning period.

2.0 WATER RIGHTS

The City currently has two water rights, both for surface water sources, as follows:

- A 4.0 cfs (2.6 mgd) water right on Trout Creek, a tributary of the Molalla River, upstream of the current intake.

- A 3.0 cfs (1.95 mgd) water right on the Molalla River.

The City obtained the Trout Creek water right through the Oregon Water Resource Department, and the permit number is 4980, with a priority date of March 11, 1921. The water right was discontinued as a municipal supply in 1954, when the City acquired a new right on the Molalla River.

Currently, the Molalla River water right is used as the City's sole source of water. The permit number is 23158, with a priority date August 17, 1954. Over the years, the City applied to the OWRD for extension of time limits in which to complete the construction and make complete application of the 3.0 cfs, a requirement of the OWRD to generally ensure that the water is being put to beneficial use. In 1985, the City submitted a "Notice of Complete Application of Water to a Beneficial Use" and a "Notice of Completion of Construction" to the OWRD, stating that they were now using the complete 3.0 cfs. In 1988, the OWRD began requiring that all water rights holders begin submitting annual reports of water use. As a result of this new rule, the OWRD determined that the City actually was not using the complete 3.0 cfs, and had inadvertently submitted applications to the contrary. The City then submitted an application for another time extension, and was granted an extension until October 1, 1995.

In December, 1989, the City submitted an application to transfer the Trout Creek water right downstream to the location of their Molalla River water right. In their review of the application, the OWRD was concerned there was not enough water in the creek to satisfy the right. They required the City to install a stream gauging station on the creek to monitor low level summer flows for a period of five years and determine the actual amount of water available. The station was set up in 1992, and data collected to date is included in Appendix H.

We have reviewed the gauging records collected to date. Portions of the summer of 1992 were collected, and some records in 1993 and 1994 were also collected. However, summer 1995 has the most data. The measured flows during May through

September 1995 ranged from 5.0 cfs to over 20 cfs, but the records are not complete for each month. Also, average rainfall for this period was above normal. The data from 1992 is mostly for June, and the flows ranged from 3.2 cfs to over 8.0 cfs. This period was much dryer than 1994 and 1995, and is probably more representative of the low flows in the creek.

Based on discussions with the OWRD, the City will have two options for use of the Trout Creek water right when the data record is complete:

1. The City can maintain the stream gauge at the existing diversion point, and the OWRD will allow the City to use the available water at that location up to 4 cfs.

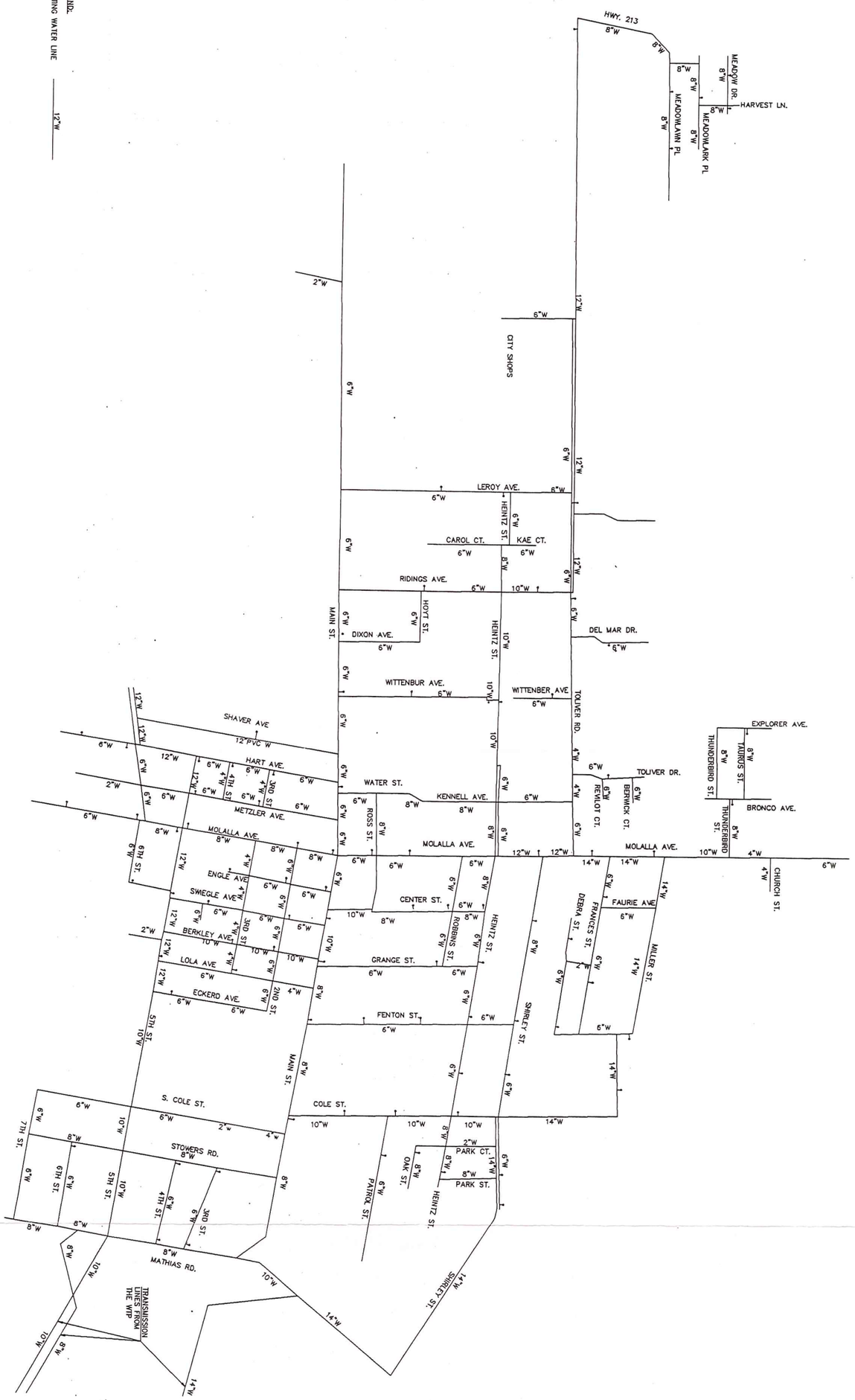
2. The City can choose not to maintain a permanent gauge on the creek, and the OWRD will grant the City a set quantity of water in the transfer, based on flow records obtained from the gauging station. The transfer would likely be significantly less than 4 cfs.

Whatever water the City can transfer will be a considerable help in meeting future needs. Water demand in the summer has currently reached 3.0 cfs (approximately 2.0 mgd, which is also the maximum capacity of the existing WTP). Based on the population projections (Chapter 2) and water demand projections (Chapter 4), the City will use the remainder of its 4.0 cfs Trout Creek water right within the next 20 to 30 years. The city must therefore begin the process of acquiring surface or ground water rights to provide for future demand.

3.0 WATER RECORDS

System Map

The City has a number of partially updated base maps of the water system. The two primary maps include one that was developed with the 1981 water system study, and another that was developed by the city in 1983. Using these maps and historical construction drawings, a comprehensive map of the City's system was developed, as shown in Figure 3-1.



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City of Molalla, Oregon
Water Master Plan

EXISTING WATER SYSTEM

FIGURE 3-1

Flow Records

The City maintains excellent daily records of the water produced and processed at the water treatment plant, and limited water usage records at City Hall. Data from these records was used in evaluating current demands and future water supply needs.

Meter Reading and User Rates

Water service meters are read by City staff and customers are billed on a monthly basis. The monthly usage rate for 100 cubic feet of water is $1.16 for in-city customers, and $1.71 for extraterritorial customers, plus an additional rate which is based on the type of service, as follows:

Table 3-1: Base Monthly Water Rates

Meter Size	Monthly Fee
5/8 to ¾ inch	$7.00
1 inch	$9.45
1-1/2 inch	$12.50
2 inch	$17.40

Water system development charges (SDCs) are currently $1,040. The SDC rates are comparable with many other cities in the valley, but the user rates are 20 to 40 percent of the rates of cities that have completed recent upgrades to their systems.

Water Budget

The water budget for fiscal year 1995/1996 is given in Table 3-2.

Table 3-2: 1995/96 Water Budget Summary

		Annual Budget	Total Budget
REVENUE	Budget Carryover	$49,400	
	Monthly User Fees	$370,000	
	Service Connections	$18,000	
	Interest	$1,000	
	Miscellaneous	$100	
			$438,500
EXPENDITURES	Personnel Services	$174,408	
	Materials and Services	$98,300	
	Equipment	$12,000	
	Water Main Constr.	$15,000	
	Bonded Debt Fund	$55,000	
	Equipment Recovery	$10,000	
	General Fund	$7,000	
	Water System Expense Fund	$66,792	
			$438,500
WATER DEBT	Water Bond		$81,200
WATER RESERVE FUNDS	Water System Expansion Fund	$223,166	
	Water Capital Improvement Fund	$78,900	

4.0 WATER SOURCE

Water Quality

As discussed in section 2.0 of this chapter, the City of Molalla's water system is currently supplied by water from the Molalla River. In general, water quality in the Molalla River is very high. However, there are two general exceptions. During the first winter rains, the color and turbidity in the river increases, but returns to normal quickly. Also, during heavier rainfall, the river carries excess sediment, increasing the turbidity in

the raw water. Average seasonal turbidities are shown in Table 3-3. Peak winter turbidities can exceed 30 NTU.

Table 3-3: Molalla River Raw Water Turbidity

Period	Turbidity (NTU)
Summer	0.4 to 1.5
Winter	0.7 to 10.0

The Molalla River water also is a high quality source beyond turbidity and color issues. The Safe Drinking Water Act requires that public water purveyors test for a number of potential pollutants, including inorganics, nitrates, asbestos, synthetic organics, unregulated SOCs, volatile organics, THMs, and other constituents. Based on recent City records, the raw water quality in the Molalla River meets all requirements for municipal water supply. See Appendix E for a complete list of testing requirements as well as recent analytical testing data. From a water quality perspective, the Molalla River is a very good source, and will likely continue as one in the future.

5.0 RAW WATER INTAKE

The water intake facility was destroyed during the flooding in February 1996. A new intake facility was designed, further away from the river, and construction was to be completed in the fall of 1996. The new intake facility has an estimated capacity of 8.0 mgd. No detailed information was available on the new facility during the completion of this plan, since the design was occurring concurrent with this plan.

Following is a description of the original system. This discussion is pertinent, since the original intake pumps were to be re-used in the new intake facility. The Molalla River intake facility had two separate intake options:

- A filter bed installed beneath the river, set perpendicular to the flow and complete with a 16-inch diameter collection pipe/screen, and
- A gravity intake set against the river bank, complete with two 57-inch by 38-inch corrugated arch intake pipes set side by side and protected with an inclined bar screen.

Raw water was collected in a wet well set below a pump station on the bank of the river. The pump station was equipped with three pumps with the capabilities as given in Table 3-4.

Table 3-4: Water Intake Pumps

Pump Number	Motor Size	Capacity
1	40 HP	450 gpm
2	75 HP	1,000 gpm
3	100 HP	1,440 gpm

The pumps delivered the water through a 16-inch pipeline to the water treatment plant located on a ridge above the river. The water intake facility was sized to handle substantial growth. The velocity in the 16-inch pipeline at the WTP's peak capacity of 1400 gpm is approximately 2.2 fps, well under the maximum recommended velocity of 5.0 fps. At a velocity of 5.0 fps, the capacity in the 16-inch pipeline is approximately 3100 gpm (4.6 mgd or 7.1 cfs), which exceeds the estimated peak flow of 6.65 cfs for the year 2016.

6.0 WATER TREATMENT

General

This section describes the existing water treatment system, the current performance as related to the OHD regulations, and recommended upgrades or improvements to the existing system. The primary objective of water treatment is to take raw water from the source and process it to assure that it is both safe for human consumption and is aesthetically acceptable to the consumer.

OAR Requirements

Based on the current Oregon Administrative Rules (OAR) for water treatment, the City must treat the raw water supplies from the Molalla River to the following minimum levels:

- Per OAR 333-61-036 (4)(b)For systems using conventional filtration or direct filtration, the turbidity level of representative samples of filtered water must 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 measurements 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 samples of filtered water must at no time exceed 5 NTU, measured as specified in OAR 333-61-036 (4)(b).

- Disinfection requirements for systems with filtration are as follows:

  (a) The disinfection treatment must be sufficient to ensure that the total treatment processes of that system achieve at least a 3-log (99.9%) inactivation and/or removal of *Giardia lamblia* cysts and at least a 4-log (99.99%) inactivation and/or removal of viruses as determined by the Division.

  (b) The residual disinfectant concentration in the water entering the distribution system cannot be less than 0.2 mg/l for more than 4 hours, per OAR 333-61-036(4)(b)(B),

  (c) The residual disinfectant concentration in the distribution system, measured as total chlorine, combined chlorine, or chlorine dioxide, cannot be undetectable in more than 5 percent of the samples each month, for any two consecutive months that the system serves water to the public, per OAR 333-61-036(4)(b)(C)

Existing Water Treatment Plant

The existing water treatment plant (WTP), constructed in 1977, is a conventional packaged filtration plant manufactured by Environmental Conditioners, Inc. (ECI), of Vancouver, Washington. Raw water is filtered and chlorinated at the water treatment plant, and then is pumped either to the City through separate 8-, 10- and 14-inch pipelines, or into two water reservoirs (1.2 million gallons and 0.6 million gallons), depending on the system demands. It continues to perform very well in providing a

quality water supply to the City. The facility is located on a ridge above the Molalla River east of town (see Figure 3-2). The WTP consists of the following features:

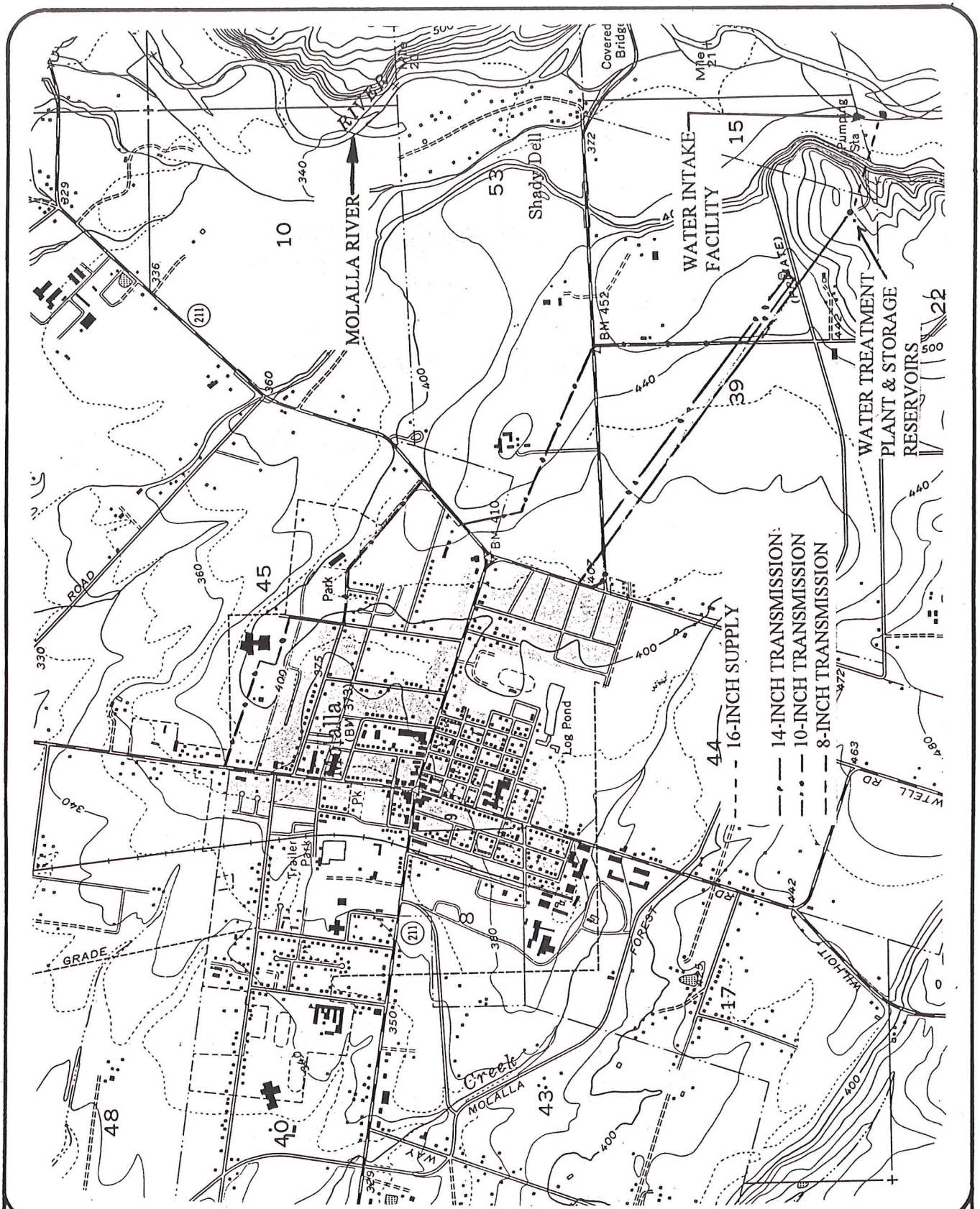
- Pretreatment, in the form of a static in-line mixer, a circular, baffled coagulation basin, and 60-degree tube settlers.
- A mixed-media filter unit.
- Two ponds for backwash discharge.

There are two separate treatment trains, with the exception of the common coagulation basin, each capable of processing up to 1.0 mgd. Alum is added at the in-line mixer to aid coagulation. When this plan started, the WTP operators were using a cationic polymer (NALCO 8102) as a filter aid, at dosing at 0.3 to 0.5 ppm. Generally, cationic polymers are used as coagulant aides, and anionic polymers as filter aides. Filter aides increase the media's properties of attracting the floc particles to adhere to the media. The operators have since switched filter aides, and are now using an anionic polymer (NS 6001), dosing at 0.10 to 0.25 ppm. The filter aid is added in the third chamber of the flocculation basin. Chlorine gas is used for disinfection. Influent and Effluent turbidities are monitored automatically, and recorded on chart recorders.

Pretreatment

The in-line static mixer is located upstream of the flocculation basin to induce coagulation, and alum is added upstream of the mixer as a coagulant aid. The treatment plant operator has been getting adequate mixing with the existing rapid mixer, but overall the mixer will provide variable mixing intensity as a function of plant production (poor mixing occurs at low plant flows). To improve the mixing efficiency, the existing mixer should be replaced with an in-line mechanical blender or jet-injection type mixer. Either would provide the consistent mixing regardless of flow. To prepare for future WTP upgrades, any upgrades to the mixer should be planned such that one common mixer would be utilized for all treatment trains.

Following coagulation, water enters a flocculation basin, which is a 23-foot, 11-inch diameter baffled, 4-chambered flocculation basin. Water is mixed hydraulically



City of Molalla, Oregon
Water Master Plan

SITE MAP
WATER TREATMENT PLANT, STORAGE AND TRANSMISSION LINES

FIGURE 3-2

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through a series of baffles that force the water to flow vertically up and down between each chamber through mixing elbows. The force of the water discharging through the elbows causes a fountain effect which gently mixes all of the water in the chamber. The minor losses between compartments provides the tapered mixing required to form a settleable floc. The flocculation tank provides a detention time of 30 minutes at full plant capacity, which is adequate to build quality floc, but the mixing intensity is suspect. The operators should consider running some benchscale tests to verify the flocculation effectiveness, first measuring the headloss between compartments (tank water levels) to assist in the tests.

The tube settlers appear to be in good condition. Each settling tank has an effective surface area of 11-feet, 3-inches by 25-feet, 6-inches. At an average water temperature of less than 40 degrees F, the loading rates are a little high at 2.46 gpm/sf (recommended loading rates are 2.0 gpm/sf for water less than 40-degrees F, and 2.5 gpm/sf for water over 50-degrees F).

Filters

The filters are a mixed media design, with the following layering (in ascending order):

- 12-inches of #1 gravel.
- 4-inches of #2 gravel.
- 4-inches of #3 gravel.
- 3-inches of garnet gravel.
- 3-inches of garnet sand.
- 10-inches of silica sand.
- 18-inches of anthracite coal.

The filter media was most recently replaced in 1990.

Overall, the filter is operating well, but has reached its design capacity based on hydraulic loading rates. In general, the filter loading rate should not exceed 5.0 gpm/sf, and for a design flow of 1.0 mgd for each filter, the current loading is estimated at 4.8 gpm/sf at full plant capacity. The OHD has pointed out that the WTP has a difficult time meeting the health division goal of 0.1 NTU after backwashing, and records show that during the winter the plant does exceed 0.1 NTU. Review of the WTP records (April 1991 through October 1995) shows the following:

- During the summer months, average effluent monthly turbidities are less than 0.1 NTU, and frequently less than 0.05 NTU. There are only a few days when the effluent approaches 0.5 NTU.

- During the winter, raw water turbidities increase, and effluent turbidities are also higher. The effluent frequently exceeds 0.1 NTU, and occasionally exceeds 0.5 NTU. Averages are near 0.4 NTU.

Based on discussions with the operator, the new filter aid is helping reduce turbidities.

Disinfection

Currently chlorine gas is used for disinfection. Gas is fed at a pre-set, manually adjustable rate. A chlorine solution is injected into the raw water and finished water through 1-inch corporation cocks. The WTP does not include a clearwell, which would normally be used to ensure adequate disinfection of the finished water and as a backwash water supply. Rather, processed water is discharged into the transmission main and either fills the reservoirs or is discharged directly to the end-users.

The disinfection criteria required by the OHD specify a minimum CT value based on water temperature, the chlorine residual at the first user and the pH. The CT value indicates the effectiveness of disinfection, and is the product of the chlorine residual at the first user (C) and the contact time (T). The contact time is dependent on the flow rate. For the current operations, the CT value will likely always be met during lower flow (winter) periods, since treated water is first discharged to the reservoirs, then withdrawn to feed the consumers. However, under peak flow demands, when the water is not

temporarily stored prior to discharge to the City, the CT may be inadequate. Estimated CT values, based on an evaluation of current peak summer usage data (3 mgd, or 2085 gpm), are shown in Table 3-5.

Table 3-5: Estimated Transmission Pipeline Travel Times

Transmission Pipeline Diameter, inches	Pipe Length, feet	Flow, gpm	Pipeline Velocity, feet/second	Travel Time, minutes	CT
8-inch	5,400	315	2.0	45.0	32
10-inch	5,300	570	2.3	38.0	27
14-inch	6,900	1200	2.5	46.0	32

Assumptions used in this evaluation are as follows:

- Water temperature = 16 degrees C
- pH = 7.0
- Chlorine residual at first user = 0.7 mg/l.

The required CT is 12.0 to meet a 0.5 log inactivation, which is the minimum required, since the WTP meets a 2.5 log inactivation (from the OHD's Comprehensive Plant Evaluation). Although the processed water currently meets the required CT without a clear well, increased demand in the future, plus modifications to the transmission lines, could decrease the disinfection efficiency. Therefore, it is recommended that the City eventually add a clearwell. The most appropriate time for this type of upgrade will be during an upgrade to the WTP. Piping treated water through a clearwell, which is a storage tank holding approximately 300,000 to 400,000 gallons of water, will increase the detention time to consistently meet the disinfection requirements, while not providing too much detention time such that there would be inadequate chlorine residual at the first user. A clearwell would also add some operational flexibility, since the water could also be used as a backwash supply. The operators currently use water from the storage tanks to backwash.

Backwash

Backwash of the filters is performed automatically, with controls set at the WTP. One 40-hp backwash pump and one 7.5-hp surface wash pump are used to clean the filters. Backwash water is currently discharged into two holding ponds adjacent to the WTP, where water is eventually discharged to a swale, which eventually becomes a small tributary of the Molalla River. The resulting sludge is stored on site.

The backwash system appears to be adequate. However, the City does not currently have a National Pollutant Discharge Elimination System (NPDES) backwash water permit to discharge the water to the river. The required permit is a NPDES 0200-J permit, which can be obtained through the DEQ in Portland. The City should apply for this permit. An example of the appropriate backwash permit is included in Appendix C.

Oregon Health Division Evaluation

The most recent Comprehensive Performance Evaluation (CPE) of the WTP was performed by the OHD on April 23, 1993 (Appendix I). The CPE gives the City an overview of how well the WTP is able to meet the state and federal regulations on water treatment, and also allows the OHD to determine how effectively the treatment plant is able to remove particulate matter, including Giardia Lamblia cysts, according to the rules.

The requirements of the OHD require that all public water systems supplied by a surface water source provide adequate treatment and disinfection to reliably achieve a total 99.9 percent (3-log) reduction and/or inactivation of Giardia Lamblia cyst. The OHD credited the WTP (coagulation/flocculation, sedimentation, and filtration) with a 2.5-log reduction of particulate matter, and disinfection was credited with a 0.53-log reduction. Overall, the 3.03-log reduction just barely meets the OHD's minimum 3.0-log reduction requirement.

Although the WTP was given a satisfactory review, the OHD did have a few concerns:

1. The amount of disinfection contact time available between the filter effluent and the first user on the transmission line is just barely enough to meet a 0.5-log reduction of Giardia Lamblia. More contact time should be made available. The reservoir piping could be modified to increase the available

disinfection contact time. Once done, a tracer study should be done to determine the amount of actual contact time available. From this information, the actual CT values can be calculated, and then compared to the required CT values.

2. The filters are capable of meeting the minimum treatment level of 0.5 NTU for filtered water after a few minutes following the conclusion of the backwash cycle. However, the filters did not meet the OHD's goal of 0.1 NTU until 45 minutes after the filter was re-started.

The OHD concluded that the level of operator expertise and the amount of time devoted to the treatment plant are two reasons why the plant produces such high quality drinking water.

The City has recently tested the performance of the filters, with the new filter aide polymer in use. The recovery time following backwash has now decreased. To further improve the operator's flexibility for achieving the turbidity goals following a backwash cycle, a filter-to-backwash line should be constructed. This will allow the operator to bypass the clearwell until turbidity decreases to within the permitted limits.

Recommended Improvements

Based on our review of the treatment plant and available records, plus discussions with the WTP operator, we have developed the following list of recommended improvements to the existing water treatment plant. The list does not include recommended improvements for future growth, which are covered are Chapter 7 of this plan.

- Upgrade the in-line mixing to an in-line mechanical blender or a jet-injection type mixer.

- Apply for a NPDES backwash water discharge permit through the Oregon DEQ.

- Add a clearwell, when the WTP is upgraded, to increase the disinfection contact time.

- The filter media should be examined, and possibly replaced. In general, the media should be replaced every 10 years.

- Consider some benchscale tests on the flocculation basin to test the mixing effectiveness.

- With the expected change in rules on chlorine gas storage, evaluate the potential of changing to sodium hypochlorite for disinfection. Also, a chlorine analyzer should be considered to monitor effluent residuals.

- A flow meter should be added on the transmission line to the City. This will help evaluate the CT values, and provide the City with more accurate usage data.

7.0 TRANSMISSION

Three separate transmission lines convey water to the City's distribution grid (see Figure 3-2). Originally, separate 8-inch and 10-inch pipelines were installed, which follow a direct route from the two storage reservoirs to Mathias Road on the eastern edge of the City, where they connect to an 8-inch water line. More recently, a 14-inch transmission line has been constructed connecting to the City grid on North Molalla Avenue.

The 14-inch pipeline was constructed of tar wrapped steel, is not very old and is in good condition. The City services the cathodic protection every year. The 8-inch pipeline is assumed to be asbestos cement, and the pipe type for the 10-inch pipeline is unknown. Both lines were likely installed over 30 years ago, and the City is concerned about the remaining life. A new, larger diameter transmission line should be installed to replace these two smaller lines.

Evaluation of the hydraulic capacity of the transmission lines will be examined in Chapter 6. Any recommendations for upgrades will be discussed in that chapter.

8.0 STORAGE

The original storage reservoir, with a capacity of 0.6 million gallons, was developed at the site of the treatment plant in the 1950's to coincide with the new Molalla River water right and intake facility. This reservoir served the City until 1976, when a 1.2 million gallon concrete reservoir was constructed adjacent to the existing reservoir. The older reservoir was then taken off-line until retrofitted with a new flexible cover and

miscellaneous improvements in 1983. Now, both reservoirs supply the City, each connected directly into the transmission lines (see Figure 3-2). Both reservoirs float on the system, meaning they fill and empty based on line pressure and demands on the grid.

Water from the treatment plant is pumped to a pipe network which allows the water to flow directly to the City, fill the reservoirs, or do both, depending on the reservoir levels and the water demand from the City. During the winter, the reservoirs are used more for meeting the City demands and the treatment plant simply fills the reservoirs. During the summer, both the treatment plant and the storage reservoirs directly feed the City to meet peak demands.

The newer, larger reservoir (1.2 MG) is in good repair. To maintain the existing condition, the tank should be painted soon. The older, smaller reservoir is in poor repair. During the flooding in February 1996, both reservoirs were nearly emptied to provide the City with water while the intake was being repaired. When the smaller reservoir was refilled, the foam under the liner moved out of position, and is now a mess. It would be too difficult and expensive to fix the liner. Therefore, due to the general poor condition of the reservoir, it should be replaced. The size of the new reservoir will be finalized in Chapter 6, with recommendations summarized in Chapter 7. The City would also like the piping between the reservoirs, water treatment plant and transmission lines modified to allow more efficient use of the reservoirs.

Use of the old 0.6 MG reservoir could be considered in lieu of constructing a new clear well. To be used, it would require new piping, complete reconditioning including a permanent lining and a permanent ridged cover. The cost of this renovation will be similar to a new clearwell.

9.0 DISTRIBUTION SYSTEM

System Size, Age and Type

The existing distribution system is a mix of newer and older pipelines. The older lines are comprised of steel and asbestos-cement pipe, primarily 4-, 6-, and 8-inch in diameter. Newer pipes are PVC, in 8-, 10-, and 12-inch diameters, and tar wrapped steel in 14-inch diameters. All the new subdivisions must have PVC pipe per City standards.

The newer 12- and 14-inch pipelines circling the City have been constructed with PVC pipe. Most of the older pipelines serve as the interior branches, feeding the CBD and older residential areas. Figure 3-3 shows the City grid.

Most areas within the CBD and residential areas are looped. Based on the fire flow tests, the available fire flows appear adequate to meet the demands of smaller residential fires throughout the City, but not larger, industrial and commercial fires. The hydraulic evaluation in Chapter 6 will look more carefully at the needs of the existing and future distribution system.

Fire Hydrants

Molalla has standardized on Mueller Centurion hydrants throughout the service area, and most have been upgraded. There is no concern over undersized hydrants. Therefore, no active replacement program is needed.

Existing System Flow Tests

The City Fire Department performed 19 fire flow tests on November 22, 1995. The test results are given in Table 3-6. Fire flow tests are extremely helpful in developing a quality hydraulic model, and these results were used to calibrate the system model. Chapter 6 provides a discussion on the water distribution system modeling.

Table 3-6: Measure Fire Flows

Location	Static Pressure, psi	Residual Pressure, psi	Flow, gpm	Flow @ 20 psi, gpm
5th & Sweigle	69	50	1232	2220
4th & Echerd	61	43	1100	1720
Main & Fenton	61	41	1087	1640
Y-Burger (E. end of Main @ Mathias)	67	55	1034	2160
5th & Stowers	68	45	1138	1690
7th & Cole	70	43	1074	1475
Buckeroo Entrance	70	40	1074	1400
High School (east - Frances St.)	67	47	1087	1690
Shirley (center)	75	41	1138	1320
N. Molalla & Church	81	11	649	N/A
Shelmar Sub. (far NW corner)	86	60	1299	2050
Kennel @ Sr. Center	82	45	1125	1500
7th & hart	71	21	768	765
Shaver (middle)	79	55	1186	1920
Stafford Oil (Main & Dixon)	80	41	1087	1380
Public Works (Toliver, nr. Primary School)	90	29	949	1160
Fire Station	78	45	1162	1590
Toliver @ Hwy. 213	105	70	1423	2290
Heintz @ Ridings	87	65	1100	2025

Water Meters and Services

The system is well metered, with water meters at each service and at all sources. The City does not have a primary meter to measure flows supplied to the system, and relies on treatment plant production values to estimate the quantity of water supplied.

The City uses 3/4-inch copper as standard service pipe, however, there are an estimated 500 to 600 plastic services that need to be replaced. The City should begin a service replacement program to upgrade these plastic connections.

CHAPTER 4 - WATER DEMAND

1.0 GENERAL

Definition of Terms

Water demand is defined as the total quantity of water supplied for a given period of time to meet various required uses, including the following:

- Domestic,
- Commercial,
- Industrial,
- Fire fighting,
- System losses and other unaccounted for water, and
- Miscellaneous applications.

The different levels of water demand used in this analysis are designated as average day demand (ADD), maximum day demand (MDD), and peak hour demand (PHD), defined below:

- Average Day Demand (ADD) - The total volume of water delivered to the system in one year, divided by 365 days (million gallons per day, or gallons per capita per day, gpcd).
- Maximum Day Demand (MDD) - The maximum volume of water delivered to the system in one day, divided by one day (million gallons per day, or gallons per capita per day, gpcd).
- Peak Hour Demand (PHD) - The total maximum volume of water delivered to the system in one hour, divided by one hour (gallons per capita per hour, gpch).

Water is also measured on an annual basis, as total water consumption per year, but this figure is not used for design purposes. The maximum day demand is used in developing the required size of the supply source. The peak hour demand is used for sizing distribution piping, including storage, and for Molalla, the PHD will be primarily for fire fighting requirements.

2.0 EXISTING DEMAND

Annual Water Production

Water supply records are maintained by the WTP personnel, and limited water usage records are maintained by the City for billing. Both sets of data were evaluated as part of this study. The years 1991 through 1995 were used for this study, since the data was most accurate and representative of the current growth the City is experiencing.

Table 4-1 provides water production data from the water treatment plant. The data has been tabulated to show per capita usage, for use in the analysis of the system and in projecting future demands.

Demands and Peaking Factors

The relationships between the ADD and the other flow rate demands for the system represent peaking factors. The historical data presented in Table 4-1 was used to estimate the peaking factors.

The average water usage from 1991 to 1995, based on water treatment plant production records, was estimated to be 180 gpcd, which is typical for this size community. The average MDD from 1991 to 1995 was estimated to be 385 gpcd, yielding a peaking factor of 2.1. Demands for future years are based on these figures.

Large Demand Users

The City staff provided information on the top 10 water users for 1995 (see Table 4-2). Large demand users can create high point loads on the water system, and their demands need to be incorporated into the model to best simulate the system operation and to provide for the most accurate analyses.

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City of Molalla, Oregon
Water Master Plan

WATER PRODUCTION DATA

TABLE 4-1

CITY OF MOLALLA
Water Production Records - 1990 through 1995

Month	1991				1992				1993				1994				1995			
	Maximum Daily		Average Daily		Maximum Daily		Average Daily		Maximum Daily		Average Daily		Maximum Daily		Average Daily		Maximum Daily		Average Daily	
	(gallons)	(gpcd)	(gallons)	(gpcd)	(gallons)	(gpcd)	(gallons)	(gpcd)	(gallons)	(gpcd)	(gallons)	(gpcd)	(gallons)	(gpcd)	(gallons)	(gpcd)	(gallons)	(gpcd)	(gallons)	(gpcd)
Jan	745,000	204	581,000	159	689,000	187	512,000	139	687,000	180	543,000	142	763,000	195	569,000	145	1,066,000	267	567,258	142
Feb	697,000	191	568,000	156	717,000	195	579,000	157	934,000	245	538,000	141	882,000	225	556,000	142	799,000	200	583,821	146
Mar	712,000	195	553,000	152	746,000	203	564,000	153	664,000	174	522,000	137	1,109,000	283	551,000	141	861,000	215	554,894	139
Apr	738,000	202	566,000	155	743,000	202	538,000	146	796,000	208	546,000	143	734,000	187	573,000	146	677,000	169	587,083	147
May	781,000	214	555,000	152	962,000	261	710,000	193	783,000	205	573,000	150	901,000	230	706,000	180	1,018,000	255	705,387	176
June	791,000	217	589,000	161	1,343,000	365	916,000	249	893,000	234	626,000	164	1,120,000	286	759,000	194	1,305,000	326	803,167	201
July	1,287,000	353	933,000	256	1,103,000	300	794,000	216	1,286,000	337	702,000	184	1,434,000	366	1,127,000	288	1,410,000	353	1,063,323	266
Aug	1,282,000	351	916500	251	1,051,000	286	824,000	224	1,197,000	313	834,000	218	1,446,000	369	1,080,000	276	1,539,000	385	961,452	240
Sept	1,220,000	334	815,000	223	920,000	250	604,000	164	1,285,000	336	925,000	242	1,036,000	265	808,133	206	1,079,000	270	782,200	196
Oct	924,000	253	687,000	188	651,000	177	535,000	145	1,034,000	271	698,000	183	834,000	213	652,971	167	889,000	222	621,452	155
Nov	966,000	265	569,000	156	794,000	216	534,000	145	816,000	214	612,000	160	877,000	224	602,100	154		0		0
Dec	884,000	242	599,000	164	723,000	196	545,000	148	952,000	249	602,000	158	1,028,000	263	668,677	171		0		0
Max	1,287,000	353	933,000	256	1,343,000	365	916,000	249	1,286,000	337	925,000	242	1,446,000	369	1,127,000	288	1,539,000	385	1,063,323	266
Min	697,000	191	553,000	152	651,000	177	512,000	139	664,000	174	522,000	137	734,000	187	551,000	141	677,000	169	554,894	139
Avg	918,917	252	660,958	181	870,167	236	637,917	173	943,917	247	643,417	168	1,013,667	259	721,073	184	1,064,300	266	723,004	181

Note:

1. 1991, 1992 were drought years and water usage may have been lower than normal.

Population Data

1990 = 3,651
1991 = 3,650
1992 = 3,680
1993 = 3,820
1994 = 3,915
1995 = 4,000

Table 4-2: Top 10 Water Users, 1995

User	Average Monthly Usage, cubic feet	Peak Monthly Usage, cubic feet	Peaking Factor
Molalla River School District		157,825	
Avison Lumber Co.	63,715	96,940	1.52
Arbor Terrace Apts.	37,660	73,731	1.96
Ridings Terrace I and II	28,452	57,170	2.00
McPike Marketing	27,262	34,460	1.26
Meadow Village, Inc.	25,502	47,890	1.88
Chow's Coin Op	24,682	27,753	1.12
Rondel Court	20,582	31,330	1.52
Grace Manor	19,171	27,620	1.44
Kraxberger Mobile Home Park	18,435	36,830	2.00

Unaccounted Water Use

Unaccounted-for water is the difference between the amount of water produced and the amount consumed. Consumption figures are determined from water meter readings for billing purposes. The unaccounted-for water is the result of leakage losses, meter discrepancies, hydrant and main flushing, operation and maintenance uses, fire flow uses, unauthorized connections and unmetered miscellaneous uses. Such water losses typically range from as low as 2 percent to in excess of 10 percent. Molalla figures are much higher.

Table 4-3 shows data for monthly production at the WTP versus monthly use recorded from meter readings (1994 data), and summarizes the estimated unaccounted-for water. The annual average unaccounted-for water in the Molalla system for 1994 was approximately 37 percent. Water usage and production was closer during high use months, and losses, as a percentage of production, were consistently higher. This would indicate:

- Leakage is a significant portion of the losses. During lower water demand months, when the system pressures would be highest, the losses are high, and as a percentage of production, are the highest. During high demand months, when system pressures are the lowest, the losses do increase, but as a percentage of production, they decrease.

- Losses during the winter could be from overflow at the reservoirs.

- Estimated losses do increase during the hottest part of the summer. This would indicate unmetered users.

- If there non-metered users are drawings large volumes of water consistently year-round, then they are fixed use industrial users, not residential.

Base leakage may be around 4 to 5 MG per month. This leaves unmetered use of 1 to 7 MG per month.

Table 4-3: Estimated Unaccounted-for Water

Month	Monthly Production, gallons	Monthly Usage, gallons	Estimated Losses, gallons	Percent Losses
January	17,643,000	12,313,396	5,329,604	30.2
February	15,577,000	8,733,454	6,843,546	43.9
March	17,089,000	11,640,361	5,448,639	31.9
April	17,178,000	9,531,308	7,646,692	44.5
May	21,887,000	13,082,685	8,804,315	40.2
June	22,759,000	14,285,237	8,473,763	37.2
July	34,948,000	22,940,532	12,007,468	34.4
August	33,400,000	22,697,095	10,702,905	32.0
September	24,244,000	16,070,653	8,173,347	33.7
October	20,200,000	13,261,561	6,938,439	34.3
November	18,063,000	10,505,316	7,557,684	41.8
December	20,700,000	11,275,891	9,424,109	45.5
Total/Average	263,688,000	166,337,487	97,350,513	36.9

These losses are very high and should be a serious concern to the City, since producing and treating the water is very expensive, and water supply is limited. The system should be monitored to ensure that the tanks are not overfilling, and the City should begin a program to identify unmetered usage, leaky meters, and leaky pipelines. A water loss monitoring plan should be developed which includes:

- Additional meters to defined elements of the system.

- Meter tests.

- Field checks for unmetered use.

- A leak detection survey.

Residential/Nonresidential Demand

Molalla is primarily a residential community. The city does have a central business district with general commercial activity, and there is a school system. However, there are no heavy industrial water users, and therefore industrial usage will be blended with other used in projecting future flows and demands for the water system model.

3.0 FORECAST DEMAND

Projected Demand

Future water demands have been projected for the next 20 years to size the water system infrastructure. Additionally, water demands were projected for the next 50 years to estimate water needs for securing water rights. Water supply demands for this study were based on the following per capita requirements:

- Average Daily Demand is 180 gpcd.
- Maximum Daily Demand is 385 gpcd

Estimates of population increases and corresponding projections in water demands, for the 20-year and 50-year planning periods; are summarized in Table 4-4.

Table 4-4: Water Demand Projections

Year	Estimated Population	Average Daily Demand, mgd	Maximum Daily Demand, mgd
1996	4,000	0.72	2.0 (3.1 cfs)
2016	11,144	2.0	4.3 (6.6 cfs)
2046	29,564	5.3	11.4 (17.8 cfs)

Water Conservation

Most communities in Oregon are now developing a water conservation plan in new water master plans. For Molalla, given the current water rights availability, this will

be an important issue the City will need to promote. Available water rights, both for surface and groundwater, are limited for securing future water supplies, and thus growth within the City could be impacted by available water supply. Additionally, conserving water will be a means to reduce the costs of water production and will conserve the water resources for future years.

For a typical City, an aggressive program of Water Conservation will typically reduce projected new water supply needs by up to twenty percent. For Molalla, in projecting water needs until the year 2016, water conservation could reduce the maximum day demand from 4.3 mgd (6.6 cfs) to 3.44 mgd (5.3 cfs), which is an attainable demand assuming the Trout Creek water right can add up to 4.0 cfs. Typical municipal water conservation programs include:

- An on-going public information program. This is done by including flyers with water bills and articles in local newspapers.
- Request residents to use low flow shower heads, sink aerators, and low volume toilet tanks.
- Instruct citizens on how to conserve water by shutting of water while brushing teeth, lathering in the shower, washing the car.
- Encourage dry landscaping ideas.

CHAPTER 5 - WATER SOURCE ANALYSIS

1.0 EXISTING SOURCE

Description of Existing Source

The existing water source for the City's water system is described in detail in Chapter 3. Following is an outline summary of the water source:

- The first formal water supply was from Trout Creek, a tributary of the Molalla River, where the City has a water right for 4.0 cfs. This water source has not been used as a supply for the City since the mid-1950's, and the City is currently attempting to transfer all or a portion of this water right to their current water right on the Molalla River.

- The City obtained a water right for 3.0 cfs on the Molalla River at the current intake location in 1954.

The City is currently meeting their operating needs with the latter water right, but during peak days the demand outstrips the supply, and the storage in the two water tanks is drawn down. Additional water rights or other sources will be needed in the very near future.

Long Term Reliability

The long term reliability of the current Molalla River water right does not appear to be a concern. However, additional water rights in the river during the summer months are no longer available, as all the water is appropriated through other water rights. The Trout Creek right would add additional water supply for the City at the current intake structure, if the transfer is approved, but other options need to be explored, and plans need to be established for continual development of the City's water supply. Also, redundant supplies are often very useful for public water systems. The City needs to take an active approach in securing additional water supplies for the future.

2.0 NEW WATER SOURCES

Evaluation and Recommendations for New Supplies

The City will likely acquire additional surface water rights through the transfer of the Trout Creek water right to the City's current intake on the Molalla River. However, the quantity of water available will be limited during the summer months, dependent on the water available on Trout Creek. As discussed in Chapter 3, the City will have two options in transferring this water right:

1. Alternative #1: Maintain a stream gauge on Trout Creek, and the OWRD will allow the City to use the available water in Trout Creek up to the 4.0 cfs, or

2. Alternative #2: Do not maintain a gauge on the creek, and the OWRD will transfer a finite amount of water, likely significantly less than 4.0 cfs.

One of these approaches must be selected and implemented. Alternative #1 was recommended to Mr. Dean Madison, City Public Works Director, and he has indicated the City will likely choose that route. Regardless of how the City wants to approach the transfer, the total available Trout Creek water will likely be less than 4.0 cfs during some portion of the summer. Also, the 50-year water demand projections of 17.8 cfs far exceed the maximum of 7.0 cfs available from the river. Therefore, additional sources will be needed regardless of how much of the Trout Creek water right actually is transferred to the Molalla River intake.

To identify options for expanding the City's water sources, an extensive water rights research was undertaken to determine water availability from both the Molalla River and aquifers around the City. The OWRD produced a map showing all water rights (surface water and groundwater) in the area, and existing water rights and well logs could be researched utilizing this map. The OWRD databases were studied thoroughly to identify all the water rights (both surface water and groundwater) in the area, and a local well driller was contacted to further evaluate the availability of groundwater. Following is a summary of potential water sources.

Surface Water

One alternative for adding additional water supply would be to acquire more water rights on the Molalla River. However, the river is currently over appropriated during the summer months (June through October), which is the period the City would most need the additional water. To gain additional water rights on the Molalla River, the City would need to acquire another owner's water rights and transfer the right to the current intake location, which is permitted by the OWRD. We researched other surface water rights near the City's current intake, following two primary search criteria:

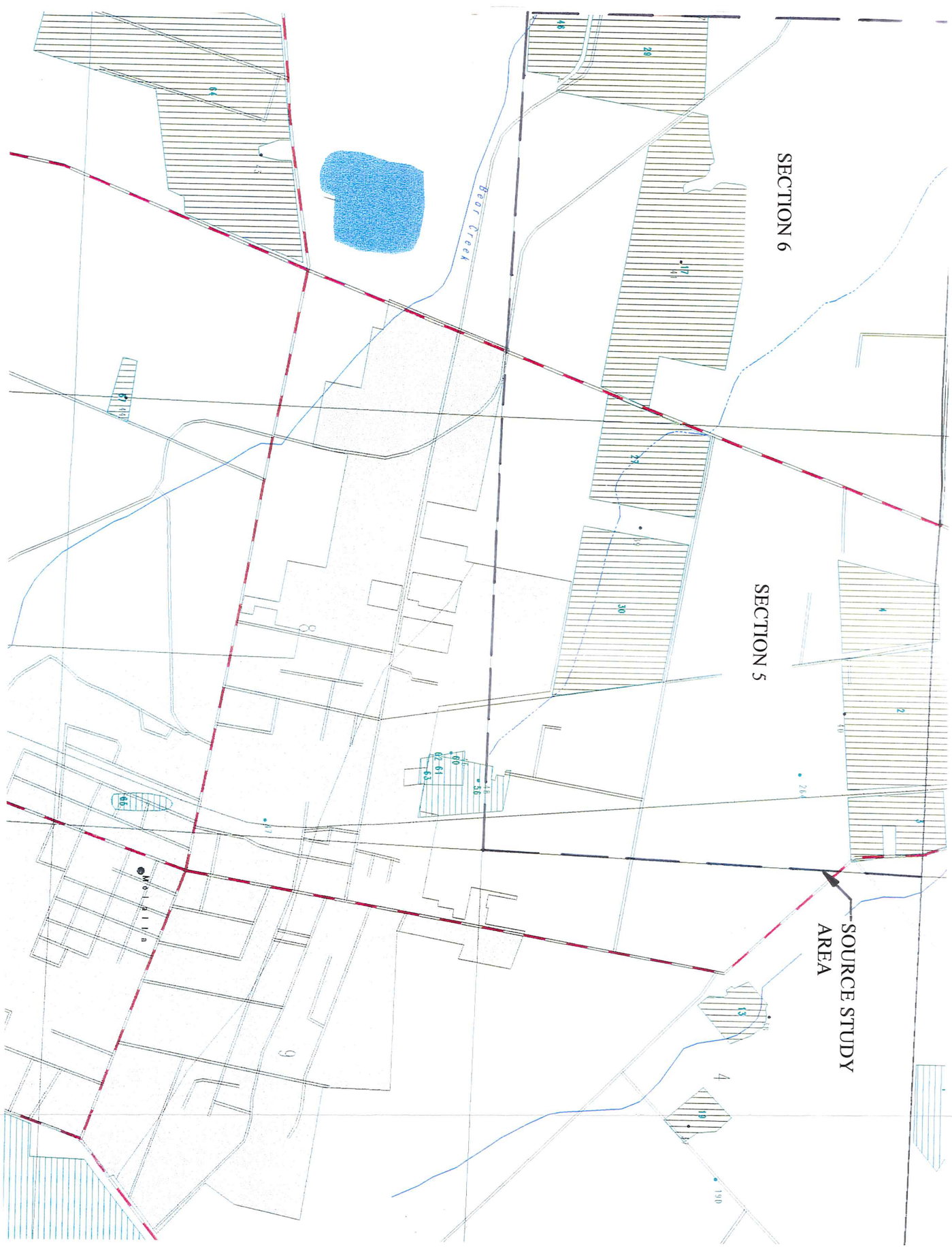
1. Search for water rights in excess of 1.0 cfs. The City will need over 10 cfs more water to meet demands in the year 2046, assuming the total current right is 7 cfs with the Trout Creek transfer complete. The water rights transfer process would be lengthy, and would not be recommended unless the City could potentially acquire a substantial water right.

2. Search for water rights within Township 5 South, Range 2 East, Section 15 first, since the existing Molalla River water right is within this section, then extend the search further downstream if necessary. The water rights transfer process becomes more difficult as the distance between withdrawal locations increases. The water rights upstream and out of Section 15 are limited and small, and therefore were not recommended for potential transfers.

Eleven significant water rights on the Molalla river near the City's current intake were identified that should be explored for potential transfers. Table 5-1 summarizes the water rights information acquired during our investigations. The Girl Scouts water right may be an in-stream right, and therefore unavailable. Under the "Use" column, "IR" means an irrigation water right, and "RC" means a recreation water right. The City will need to contact each of these water users to begin negotiations into potential transfers.

The recommendation on future surface water usage is to continue use of the Molalla River and the current intake facility, especially since the intake facility is currently being reconstructed. The City should proceed as follows:

1. Transfer as much water as possible from the Trout Creek water right. The City will need to maintain a stream gauge at the existing diversion point on the creek. A telemetry system could be installed to monitor creek flows at the water treatment plant, and the City could likely use up to 4.0 cfs, upon final approval by the OWRD, and after meeting all senior water rights on Trout Creek. Data in Appendix H indicates the flow in Trout Creek drops below 4.0



City of Molalla, Oregon
Water Master Plan

GROUNDWATER SOURCES

FIGURE 5-1

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cfs at times during the summer. At these times, the City would not be allowed to withdraw more from this right than is flowing in the creek.

2. Immediately begin exploring options to transfer other surface water rights on the Molalla River. The identified owners should be contacted and the City should inquire into potential transfers. Of particular note would be the 1.3 cfs owned by Ed and Jack Feyrer. The property where this water is permitted to be applied may currently be for sale or recently been sold, and the water right may be available.

Table 5-1: Additional Surface Water Rights on the Molalla River

Water Right Permit #	Owner	Quantity (cfs)	Priority Date	Source	Withdrawal Location	Use
204	Molalla Irrigation Co.	9.072	12/8/09	Molalla R.	Multiple	IR
7852	W.G. Deardorff	1.43	3/16/26	Molalla R.	T5S,R2E,S14	IR
10045	B.O. Cole, C.H. Feyrer	1.92	12/23/30	Molalla R.	T5S,R2E,S36	IR
10767	J.A. Freeman & Sons	3.75	11/9/32	Molalla R.	T4S,R2E,S34	IR
12219	Girl Scouts, Inc. Portland	5.00	6/6/36	Molalla R.	T4S,R2E,S18	RC
20918	Ed & Jack Feyrer	1.3	12/20/51	Molalla R.	T5S,R2E,S26	IR
27820	Harvey Tofte, Maple Cole Beals	1.53	2/1/62	Molalla R.	T4S,R1E,S3	IR
27909	Flendon & Maxine Andrews	2.78	3/22/62	Molalla R.	T5S,R2E,S14	IR
32651	Lowell Bruce Hein	2.50	6/1/67	Molalla R.	T4S,R1E,S13	IR
32741	John & Rueben Fawver	1.92	10/16/67	Molalla R.	T3S,R1E,S32	IR
35062	Ziegler Farms	1.19	5/25/70	Molalla R.	T4S,R1E,S8	IR

Groundwater

A redundant water source using groundwater can be very important to communities relying solely on surface water supplies. The City of Molalla has recently experienced two water shortages during the winter of 1995-96. The flooding in February, 1996, caused significant damage to the intake facility and rendering the water system inactive. The second shortage occurred during a winter storm, when the City lost power

for over two days, and the water treatment plant was shut down. Therefore, the scope of researching groundwater availability increased as part of this study.

Research for groundwater sources focused on an area surrounding the City in Township 5 South, Range 2 East. The City is nearly centered in this area (see Figure 5-1). A survey of current ground water rights in the area surrounding Molalla yielded the following:

- Groundwater is generally available in quantities ranging from 45 gpm to approximately 900 gpm.

- The aquifer south of the City has been identified by the OWRD as a Groundwater Limited Area, and water rights are no longer available (see Figure 1-1). Regardless, based on water rights research for this area, groundwater yields are typically small, ranging from 0.1 to 0.38 cfs per well, which is not enough to supply the City's needs without a large well field.

- The aquifer north and west of the City would produce the highest yields. Based on the water rights survey, and discussions with a local well driller, yields range from 300 gpm to almost 900 gpm per well.

A source northwest of town would serve the City well in meeting expected demands in the area. The northwest corner is currently experiencing the most growth, and is where most of the available and developable land outside the UGB lies.

Data was collected and reviewed on the hydrogeology of the Molalla area. The research included:

- Water well records (well logs) on file with the OWRD.

- Meeting with Mr. Steve Stadeli, Westerberg Drilling, a local well driller with extensive knowledge of the local wells and drilling conditions, to discuss groundwater yields in the area, both from a water quality and quantity perspective.

The wells evaluated were located in Township 5 South, Range 2 East, Sections 4 through 8. There were a number of wells in Section 5, and the data was more recent. The wells in the area also appear to produce the higher yields. Existing irrigation wells are typically drilled to approximately 350 feet. Water bearing zones typically begin at

approximately 50 feet below ground surface, and most aquifers are confined. A typical well log would be as follows (depths given are below ground surface):

- Upper 20 feet to 40 feet is topsoil, underlain with some silty loam, with some intermixed gravel and clay.
- There are usually some thick clay layers below 40 feet.
- Water bearing zones are located in interlayers of gravel and sand.

Based on our research, any wells the City would drill should be cased in the upper 100 feet to prevent surface water from impacting the groundwater. The upper 100 feet is a gravel and sand mix, and the sand is not very clean. The well characteristics would likely be as follows:

- The well yield will be less than those found in the existing irrigation wells, since only the lower portions would be open.
- In general, the wells will continue to yield the initial pump test quantity.
- Quality is unknown, as the wells are for irrigation purposes, and quality has not been an issue. We have not conducted well site inspections, as such investigations would be take place once the City finalized their decisions on future water supply. Additionally, premature contacts can result in unnecessary opposition to the City's search for water

Copies of the wells logs obtained are included in Appendix F.

Wellhead Protection

Wellhead protection is a term used to describe a water safety program outlined in the Safe Drinking Water Act Amendments of 1986. Wellhead protection is predicated on two key principles:

1. Prevention of groundwater contamination is far more cost-effective than cleaning up tainted water and should therefore be encouraged;
2. Because local jurisdictions and citizens have the most at stake in ensuring that their water supply remains pure, wellhead protection is a locally-based program relying on local ordinances and public participation rather than a

general, state-wide effort that may have little real impact or effectiveness at the local level.

The Oregon Department of Environmental Quality (DEQ) is required by the U.S. Environmental Protection Agency (EPA) to submit a plan to EPA Region 10 for implementing wellhead protection in the State of Oregon. The state unsuccessfully attempted to pass legislation to support its planned mandatory wellhead protection program in the 1993 legislative session. Since then, the DEQ has implemented a voluntary program, which, if followed, can reduce the required sampling and analysis frequency of the drinking water sources. Wellhead protection plans generally have four main components, as follows:

1. Delineation of a management area using analytical calculations, analytical computer models, or numerical hydrogeologic models. The management area is the geographic area around a water supply well in which wellhead protection efforts are focused. Commonly, it is the area estimated to supply water to a well over a given period of time. DEQ has identified five delineation techniques that are considered acceptable for delineating management areas for water supply wells. Selection of the minimum acceptable technique is based on the hydrogeologic characteristics of the aquifer and on the population served by the water supplier. Specific criteria for a community the size of Molalla will be established when DEQ releases its guidance document.

2. Identification and evaluation of actual and potential contaminant sources within the wellhead protection management area. This task typically involves the following steps:

    - Identification of past and present land use activities that may affect groundwater quality. This can be accomplished using agency information, aerial photographs, historical land use records, and local knowledge.

    - Assessments of the general level of risk posed by each land use activity of concern. This step may include an inventory of chemicals that are used, stored, or disposed of on a particular property.

3. Implementation of a source management plan that includes:

    - Contingency plans for responding to a contamination incident or to mechanical failure of a well or its pumping equipment.

    - Long-term management tools for controlling or reducing future threats to the water supply. Regulatory management tools may include zoning ordinances, site design standards, or chemical handling standards (also known as best management practices, or BMPs). Non-regulatory management tools may include acquisition of easements, ownership of land, or groundwater monitoring.

4. Public education to increase local awareness regarding the location of the community water supply, its vulnerability, and steps that can be taken by individuals to reduce their impact on groundwater quality.

3.0 WATER TREATMENT ALTERNATIVES

The future water source for the City of Molalla will undoubtedly include withdrawal from the Molalla River, in part or solely. The existing water treatment plant is capable of treating up to 2.0 mgd, which is the current peak demand during the summer months, and the approximate amount of water for which the City has water rights (3.0 cfs). Water rights transferred from the Trout Creek water right could add an additional 2.6 mgd in capacity (4.0 cfs). The possible purchase and transfer of other rights on the Molalla River could further expand the use of this source. Therefore, assuming the water rights will be successfully transferred, additional surface water treatment capabilities will be needed in the near future.

Groundwater sources may eventually be added to the water system as well. Groundwater quality can vary significantly. There was no water quality data available from the wells examined for this report. Without any data, it was assumed that any future groundwater supplies may need to be treated, if only to remove iron and manganese.

In this section, three alternatives are evaluated for future expansions of the water treatment plant, two for surface water treatment and one for groundwater treatment. The following assumptions were made in considering treatment plant alternatives:

- Water quality in the Molalla River will not significantly change.

- The City will transfer at least a portion of the Trout Creek water right to the Molalla River.
- The existing WTP will remain operable for the 20-year planning horizon.
- Other water rights will be investigated and one or more may be transferred to the City intake location.

Surface Water Treatment Alternatives

For treating surface water from the Molalla River, a filtration system will be required. Filter efficiency is primarily affected by the following raw water properties:

- Temperature.
- pH.
- Filterability.
- The size, nature, concentration and adhesive qualities of suspended and colloidal particles.

For a system the size of Molalla's, a packaged treatment plant is the best option. Most packaged water treatment plants include some form of coagulation, flocculation, sedimentation and filtration. However, there are different types of flocculation basins, sedimentation basins and filter beds. As described in Chapter 3, the existing water treatment plant is a packaged multi-media gravity filtration system. The plant has been operating well since the it was built, and appears to have additional life remaining. Packaged plants are an economical approach to water treatment for smaller communities. The system comes complete with flocculation, sedimentation and filtration units, and is typically built with many controls to allow nearly automated operation.

A packaged water treatment plant should be designed to the following specifications:

- Capacity of 2.0 to 2.6 mgd (1,400 to 1,800 gpm).
- Flocculation Basin.
- Settling Basin.

- Multi-media filter.
- Filter design hydraulic loading at 5 gpm/sq. foot.
- Ability to treat water with applied turbidities of up to 50 NTU on a continuous basis, and peaks of 200 NTU.
- Effluent turbidities less than 0.1 NTU.

A packaged water plant could be constructed adjacent to the existing plant. The inline mixer should be used to commonly treat water for both systems. The design would require:

- Additional chlorine systems.
- Modification of the influent and effluent piping.
- Modifications of the controls to add the systems for the new treatment plant, and to update the existing controls.
- Additional storage for chlorine, alum, and coagulant and filter aid polymers.
- Disinfection of both the influent and effluent water. This will help maintain a clean filter.
- Install turbidimeters on both the influent and effluent lines. Turbidimeters have revolutionized the degree of control that can be exercised over filter performance. They can be operated to allow complete shutdown the system if turbidity is too high, and turbidity is constantly recorded, providing a historical record.

An additional consideration would be to consider the operator's concerns regarding similar upgrades to the existing plant. The primary difference in packaged water treatment plant design now focuses on different coagulation-flocculation-sedimentation units. The existing system, with separate coagulation-flocculation-sedimentation processes, is operating well, and should be continued to maintain operational consistencies. In particular would be the sedimentation units. The 60-degree settling tubes in the existing WTP are operating well, and the operator is familiar with their performance as related to the entire treatment system.

Groundwater Treatment Alternatives

The groundwater in the area proposed for wells appears to be of reasonable quality. Based on discussions with Mr. Steve Stadeli, a local well driller, there has been no significant staining of his drilling equipment during the many years he has worked in the area, nor has he heard of any problems with mineral build-up on irrigation equipment in the area. Any of these problems would indicate high Iron and Manganese concentrations, more commonly known as hard water. Additionally, since the available water is withdrawn from a relatively deep aquifer, there is generally less of a potential for hard water. However, there is limited information on the water quality, and it is recommended that the City undertake a water quality testing program prior to investigating these locations as future water sources.

CHAPTER 6 - WATER SYSTEM ANALYSIS

1.0 GENERAL

The Molalla water system consists of the intake on the Molalla River, water treatment and storage on the ridge southeast of town, three transmission lines into the City grid, the distribution system, and the service connections which deliver and meter water to the individual users. Each element of this system has a finite ability to deliver water, and each must have the hydraulic capacity to meet the demand placed by the user, or the ability to withdraw water will be limited.

2.0 RESERVOIR CAPACITY

Finished water storage is an essential element of any public water supply system, and is used to equalize demands on sources of supply, treatment and production facilities, transmission pipelines, and distribution mains. Use of storage to equalize daily demands reduces the design capacities and sizes of these other system components. Storage also makes it easier to maintain uniform pressures throughout the City system.

Required Capacity

There are many demands on a municipal water system. The basic need is for a reliable supply of domestic water to homes, businesses, and industry for normal consumption. Other important needs also exist. Following is a brief description of the most important needs for storage:

In the event of a natural disaster, a major main break, a power outage, or a similar event, there is a need to have an adequate supply of stored water to meet the basic needs of life and safety. An adequate supply of water should be stored in reservoirs to meet this need, which is defined as the **emergency supply**. In general, a two day supply to meet the Average Daily Demand is adequate.

A second need for water storage is the **equalization supply** of the system demand required to meet normal surges in water use. During the morning and evening hours, heavy demands are placed on a typical water system by peaks in domestic use. Showers

are taken, dishes and clothes are washed, and lawns and shrubs are irrigated. These periods of high demand may exceed the production capacity of the water source and treatment system, and water supplied by the reservoirs is required to meet the need. Reservoirs are then filled during the night, or during other times of low demand. The daily balance of demand with supply is called equalization, and reservoirs must be sized to meet these needs. In general, the equalization is 20 to 25 percent of the maximum daily demand for a smaller water system. A 25 percent estimate will be used for this study.

Fire supply water constitutes the third need for reservoirs. Fire pumper trucks can place extremely high demands on a water system, and this demand is normally the highest a small community will experience. The pumper demand may stress the system for several hours, and this demand must be met for success in controlling fires. Residential fires will require a reliable water supply of between 1,500 and 1,800 gpm. For small communities, a hydrant flow as low as 1,200 gpm is often considered adequate. In Molalla, the residential flow should be 1,500 to 1,800 gpm.

Large structure fires, such as schools or buildings in the central business district, may require between 3,500 and 5,000 gpm peak flow. Even a 3,000 gpm demand for four hours requires 750,000 gallons of water. The City's current water system can supply fire flows ranging from an estimated maximum of approximately 2,600 gpm, or 624,000 gallons in four hours, and a minimum of approximately 700 gpm, or 168,000 gallons, based on the following assumptions:

- Maximum daily flow conditions, using a peaking factor of 2.1.
- The reservoirs are full.
- Minimum system pressure of 20 psi.

Existing Storage

The existing storage is a combination of a 1.2 million gallon and 0.6 million gallon reservoir. To determine the current reservoir capacity needed for Molalla, the following analysis for 1995 fire flows need is provided.

1995 Storage, S = Emergency + Equalization + Fire

Emergency = 2 * ADD = 2 * 180 gpcd = 1.44 MG
Equalization = 0.25 * MDD = 0.25 * 385 gpcd = 0.385 MG
Fire = 4 hours @ 3,500 gpm = 0.840 MG

S(required) = 2.665 MG

*flows based on a population of 4,000

This shows that Molalla currently has a storage need of 0.865 million gallons. The current 1.8 MG reservoir capacity meets only 68 percent of the ideal reservoir capacity. This analysis is based on having a commercial structure fire during a high used time of the day, presumably in late summer. This is not an unrealistic assumption, as many major fires occur during the hot days of summer.

Future Storage

Improvements will be proposed in this master plan which will increase the ability of the existing system to provide adequate fire flows throughout the city. Expanded reservoir capacity is needed now and will become much more critical as the city grows. By the year 2016, the reservoir needs will be as follows:

2016 Storage, S = Emergency + Equalization + Fire

Emergency = 2 * ADD = 2 * 180 gpcd = 4.0 MG
Equalization = 0.25 * MDD = 0.25 * 385 gpcd = 1.07 MG
Fire = 4 hours @ 3,500 gpm = 0.840 MG

S(required) = 5.920 MG

*flows based on a population of 11,144

Considering the existing storage volume of 1.8 million gallons, the storage deficit for the year 2016 is 4.12 million gallons. This additional capacity could be achieved by constructing two 2.05 MG, one at the existing site on the ridge, and the other adjacent to a new well field northwest of the City. This decision, together with the timing of this new construction, will depend upon the availability of funding. Recommendations for funding and implementation will be provided in Chapter 7.

At the present time, all of the reservoir capacity for the city is located on the ridge adjacent to the water treatment plant. Although the water is transmitted through three transmission lines to the city, the majority of the water passes through the 14-inch transmission main. If this main were damaged, the other two mains could not meet the existing or future water demands of the city and the reservoir capacity on the hill would be of very limited use. The recommendation is that an additional reservoir be constructed closer to the city, independent of this 14-inch transmission main. The reservoir would be associated with a new well source at the northwest corner of the urban growth boundary. A new 2.0 to 2.5 million gallon reservoir located at the northwest corner of the city will provide an ideal backup, as it is located opposite of the city and will greatly reinforce the total City distribution grid.

The new reservoir capacity should be achieved by construction of a ground level tank near the eventual well site. Since a reservoir at this elevation will not supply the system by gravity, water will need to be pumped from the reservoir into the system at the proper operating pressure of the water system (which would be determined during the design phase). Initially, this pumping will be needed primarily to satisfy peak user demands and to supply emergency storage and fire flow requirements. Since the reservoir would be constructed prior to build-out of the City and need for the water, much of the water from the wells will pass directly from the wells to the users without passing through the reservoir. The flow from the treatment plant and existing reservoirs will continue to supply the city as they do now. However, within a few years the new reservoir will be required to meet the user demands during the morning and evening peak uses during the summer and will be a key element for meeting the high flow demands or the summer high flow period.

Each element of the water system containing potable water must maintain a chlorine residual. During the initial years the new reservoir in service, it will be necessary for the system operator to exercise the reservoir by drawing water from it (pumping water into the system) and refilling with chlorinated water from the wells and distribution system. Chlorine can also be added directly to the reservoir if necessary. The reservoir will require several pumps including a low volume jockey pump and a mid-

range pump capable of pumping approximately 400 gpm, a higher range pump of higher capacity and a high volume fire pump. A standby power source for this pump station will also be needed.

3.0 SYSTEM HYDRAULIC ANALYSIS

Hydraulic System Model

The entire Molalla water system was entered into a hydraulic computer model designed to analyze the capacity of each element of the system and to evaluate how the system reacts under specific demand conditions. The hydraulic model CYBERNET™, by Haested Methods, was used to evaluate the system. The model is an AutoCADD based network model that allows construction of a pressure system graphically and then solves the hydraulics using the embedded KYPIPE™ algorithms. This algorithm uses the Hardy-Cross method, and yields a complete simulation of the system network pressures, pipe flow rates, hydraulic grades and tanks levels.

To develop the model, a database of the system was created, including a schematic map, which is shown in Figure 6-1. The map was digitized into AutoCADD to allow direct computer analysis of the water system. Each water line, reservoir, and water source was numbered, and each element of the system was described, including pipe sizes, lengths, friction factors, elevations, and other information which was needed to run the model.

Once the database was completed and the demand data entered, the model could be used to evaluate the system. The Hazen-Williams formula was used to estimate friction losses in the pipe network. Recent fire flow tests by the City were used to calibrate the model, and model results were compared with the actual data. The input data, such as Hazen Williams 'C' friction factors, was adjusted until the model generated flows approximately close to the measured flows.

Model Analysis Parameters

Certain basic parameters must be established before the hydraulic model can be used to analyze the water system. Following are the basic parameters and assumptions used in the computer simulations:

- Per OAR 333-61-025, the minimum operating pressure in the distribution system should not drop below 20 psi. Therefore, it was assumed that under peak flow demands with an additional fire flow demand, a static operating pressure of 20 psi will be maintained throughout the system.

- Hazen Williams 'C' friction factors of 100 were used for older pipe, and factors of 120 were used for newer pipe, such as recent improvements along Shaver Street, and the extension of 12-inch pipe to Highway 213.

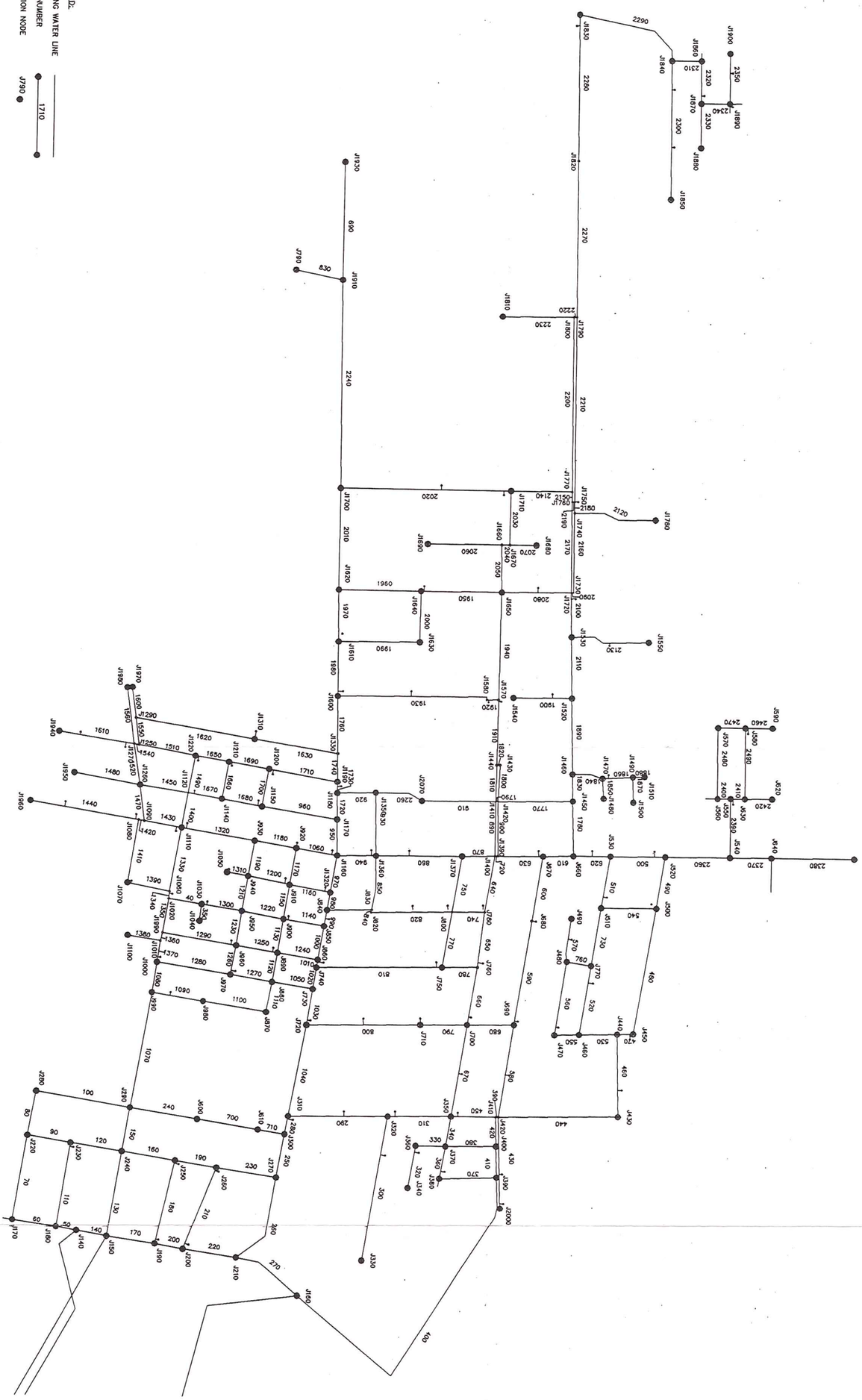
- Population growth of 5% per year, with the demands as given in Chapter 4.

- The existing treatment plant is capable of producing 2.0 mgd, and the combined treatment and storage a total of 3.8 mgd.

Existing System Needs

The existing water system does not have too many deficiencies. The most critical need is for increased water supply, and thus additional treatment. Without additional supply, the City will eventually need to restrict water usage during the summer.

The primary deficiencies in the existing water distribution, transmission, and storage system occur during high fire flow demands. Results from the model are included in Appendix B, with a map showing fire flow contours at a peaking factor of 2.1. A second map in Appendix B is included showing the fire flow contours with the improvements needed to serve the existing population. The problem areas are at shown as shaded areas, and recommended improvements are summarized in Table 6-1. The recommendation for upgrading the transmission system would be to construct a new 14-inch pipeline from the existing WTP to connect to the City grid at the intersection of Mathias Road and 6th Street, near where the existing 8- and 10-inch pipelines connect to the grid, and abandon the existing 8- and 10-inch pipelines. This upgrade will strengthen the grid by connecting to the southern section of the large diameter pipeline circling the City. The recommended upgrades are shown in Figure 6-2.



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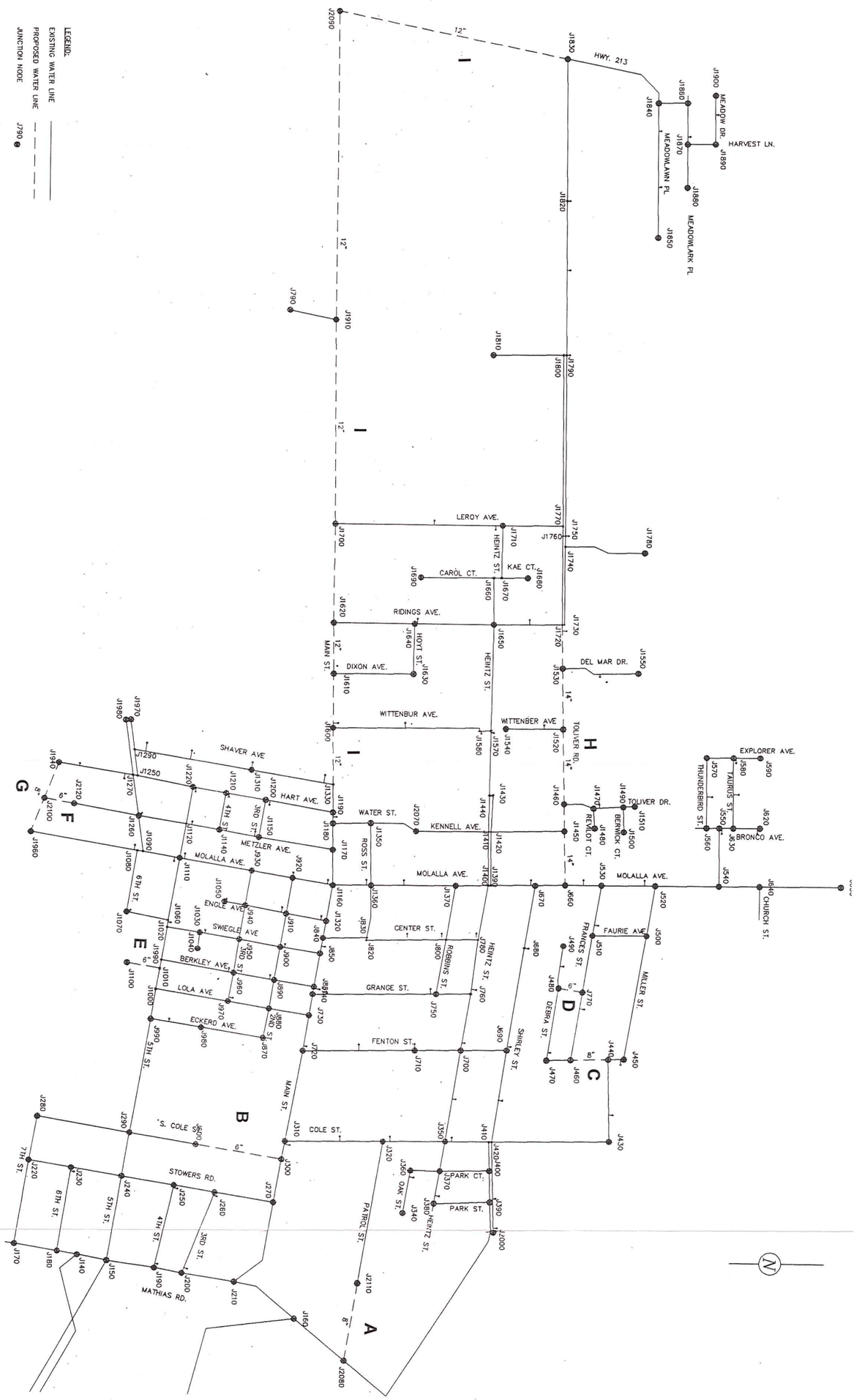
WATER SYSTEM MODEL

FIGURE 6-1



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UPGRADES TO THE EXISTING WATER SYSTEM

FIGURE 6-2

Table 6-1: Upgrades to Existing Water System

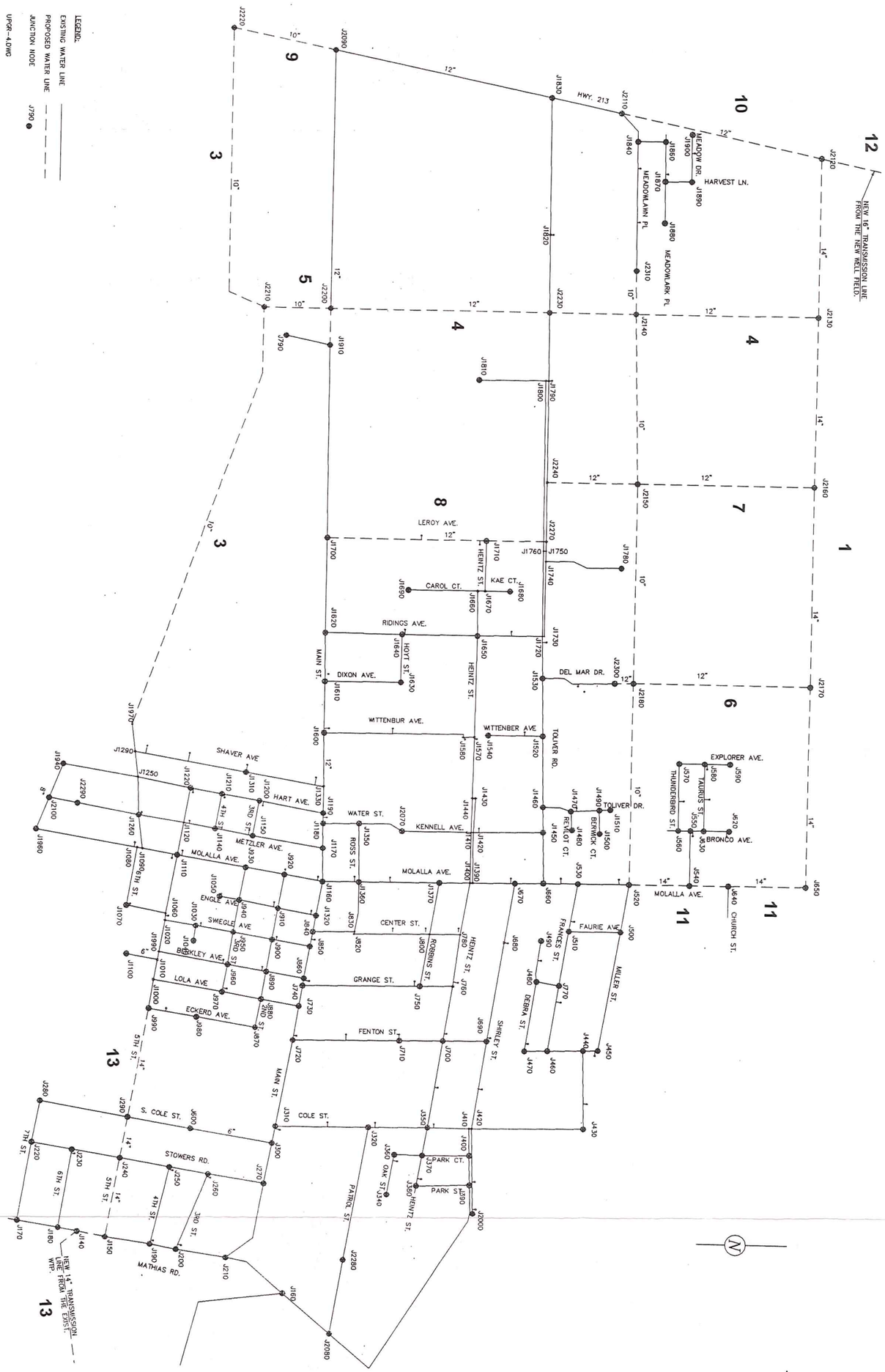
Project No.	Type of Upgrade	Recommended Improvement	Quantity	Size
A	Distribution System	Extend Patrol St. Waterline east to Highway 211	700 ft.	6"
B		Upgrade Existing 2" & 4" Sections on S. Cole St.	750 ft	6"
C		Upgrade Waterline Connecting East End of Frances to the 14" Waterline	350 ft	8"
D		Frances-Christopher Waterline Link Upgrade	200 ft	6"
E		Upgrade Hood St. Waterline, South of 5th St.	300 ft	6"
F		Upgrade Metzler Ave. Waterline, South from Section Ave.	800 ft	6"
G		New Waterline, 8th St., from Hart St. to S. Molalla Ave.	700 ft	8"
H		Upgrade Toliver Ave. Waterline, Ridings Ave. to N. Molalla Ave.	1,850 ft	12"
I		Upgrade & Extend Waterline on Hwy. 211, Shaver to Hwy. 213, North to Toliver	6,350 ft	12"
K	Storage	Add Storage at Existing WTP	1	2.0 MG
L	Water Treatment	Additional treatment capacity at existing WTP	700 gpm	

Future Needs

The recommendation for upgrading the water system for future needs are given in Table 6-2, and shown in Figure 6-3. The modeling results are included in Appendix B, with a map showing the fire flow contours.

Table 6-2: Upgrades for the Future Water System

Project #	Type of Upgrade	Recommended Improvement		Size
1	Distribution System	East-West Waterline, N. Molalla Ave. to Hwy. 213		14"
2		East-West Waterline, N. Molalla Ave. to Meadowlawn Place		12"
3		East-West Waterline, Section St. to Hwy 213		10"
4		North-South Waterline, Hwy 211 north to UGB, east of City shops		10"
5		North-South Waterline, Hwy 211 to new 10" waterline		10"
6		North-South Waterline, Del Mar Dr. to UGB		12"
7		North-South Waterline, Toliver to UGB		12"
8		Upgrade Leroy		12"
9		Hwy. 213, from Hwy. 211 to south UGB		10"
10		Hwy. 213, Toliver north to UGB		12"
11		Molalla Ave., Miller St. north to UGB		14"
12	Transmission	New waterline, well field to grid		16"
13	Transmission Line	Replace Existing 8" & 10" Waterlines with a Single 16" Waterline		16"
14	Storage	New storage at well field		2.0 MG
15	New Source	600 gpm well		
16	Water Treatment	Add on to existing WTP		2.0 MGD
17		Add 0.4 MG Clearwell		



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Water Master Plan

UPGRADES FOR THE FUTURE WATER SYSTEM

FIGURE 6-3

CHAPTER 7- IMPLEMENTATION

1.0 INTRODUCTION

General

This chapter contains a summary of the recommended Molalla water system improvements required to serve the existing and future demands discussed in Chapter 6, along with the estimated costs. A recommended construction program is provided to address the system needs. This chapter will also address funding approaches and alternatives.

This plan recommends several needed improvements to the water system. Several major elements of the water system have reached the end of their design life and are in need of immediate expansion, while some improvements will not be needed for several years. The projects listed in the Capital Improvements Plan (CIP) will be staged over the 20 year planning period, adding components as they are needed. The improvements recommended will be sized to meet the long range growth requirements, up to the 20-year planning period. Some improvements will provide for additional growth and service beyond the 20-year period.

A brief review of the available sources of funding for Molalla reveals few opportunities to receive grant funds. All or most of the cost of the improvements must be borne by the existing and future rate payers. The general approach to funding will be the sale of bonds, which are repaid by monthly user rates. Bonds may also be retired by property taxes, but based on the current tax climate, this approach will not be considered in this plan. The staged approach to implementing a master plan will reduce the immediate financial hardship to the rate payers by delaying some of the costs until all or part of the initial debt is repaid. Future stages may overlap the repayment schedule of the earlier stages, and user rates may be required to increase initially and again in future years. The continually expanding service area will tend to reduce the rates for the existing rate payers. The funding program cannot be established in this plan. It is possible only to present the opportunities available. The actual funding package will

depend upon the city's success in acquiring the needed grants and low interest financing. The cost of financing will be presented later in this chapter.

Capital Improvement Plan

The scheduled projects required to implement this master plan make up the capital improvement plan (CIP). The CIP projects are listed on Table 7-1. Figures 6-2 and 6-3 are maps of the existing system which show the proposed projects. The need for the system improvements is driven both by the identified existing serious needs and by the growth of the community. After the immediate project needs are completed, the Capital Improvement Fund must be strengthened annually to develop the needed cash to fund these projects as they are required.

The need for system improvements is driven both by the existing deficiencies of the water system and by the growth of the community. A majority of the work identified in this plan is required now. The remaining work is staged over the 20-year design period as new projects are needed.

It is anticipated that some projects will arise in the future which are not identified in this master plan. This work consists of replacing damaged or leaking lines, pump and controls repair (or replacement as they wear out), system extensions to respond to development needs, and damage caused by accident or natural disasters. Funds for this purpose should be included both in the Water System Expansion Fund and the Water Capital Improvement Fund (Systems Development Charge fund).

This master plan assumes that the character of the city will remain similar to the existing balance between residential, commercial and industrial land use. If a major water user moves into the community, it will have a major impact on the need for system improvements. The water and sewer impacts of new industrial and commercial developments should be carefully considered in the land use or permit review process.

The improvements outlined in this master plan include the upsizing and replacement of the water mains throughout the city. Lines smaller than 6-inches are shown for replacement. The work also includes adding additional lines at specific locations required to reinforce the water network grid such that the various water

demands can be met. In addition, some renovation of existing facilities is required to allow them to continue to meet the city's needs for the 20-year design period and beyond.

The Molalla water system has a 35 to 50 percent water loss. This is the difference between water produced and metered water sold. This loss is considerably greater than the average water system. It is recommended that a field water leak survey be conducted which uses sophisticated instruments to locate the source of the water losses throughout the system. This is particularly important in light of the limitations of adequate water supply. Reduced leakage saves money in water pumping and treatment but also in stretching the limited water supply and water rights available to the city. Repair and replacement projects will be identified from this survey, and a source of revenue must be anticipated to fund this work. The CIP assumes this will be incorporated in the annual operating budget. However, a program for replacing 600 substandard water services is included in the CIP to reduce system leakage and assure long term reliability of all services.

Molalla has handled growth well over the past three decades. Improvements were implemented 15 to 20 years ago to extend the life of the system, this period is nearing an end and growth is accelerating. Now is the time to begin the next round to improvements to address the new challenges facing the city.

Molalla currently has adequate residential fire flows throughout the entire city. The system does not respond well to the higher level fire flow needs of the commercial and industrial areas. Improvements are detailed in this plan that will allow a minimum 3,500 gpm for all commercial, industrial and schools. Higher flows approaching 5,000 gpm would be available in some areas. A goal of the master plan is bring the city up to ISO standards in all critical areas. This will improve fire response while assuring excellent fire insurance rates for the community.

Cost Estimates

The cost estimates developed for the proposed improvements, as shown in Table 7-1, are budget-level estimates. They should be regarded as such, since they are planning estimates not yet supported by site specific engineering design. The cost estimates were

ESTIMATE OF CONSTRUCTION COST - 1996 COSTS

3-15-98
CIP-2

ESTIMATE OF PROJECT COST						
ITEM	QUANTITY	UNITS	SIZE	UNIT COST	AMOUNT	TOTALS
MOLALLA RIVER INTAKE PUMP STATION REPLACEMENT						
- Pump station and wet well	1	l.s.		$225,000	$225,000	
- River intake structure and pipeline	1	l.s.		$70,000	$70,000	
- Controls and telemetry	1	l.s.		$75,000	$75,000	
- Emergency power	1	l.s.		$75,000	$75,000	
- Site work & piping	1	l.s.		$25,000	$25,000	
Total Source						$470,000
NEW WELL SOURCE						
- Drill 600 gpm Well (others later as needed)	1	ea.		$60,000	$60,000	
- Well House, piping, electrical & Controls	1	ea.		$65,000	$65,000	
- Emergency Power	1	ea.		$40,000	$40,000	
- Well field site - (see land purchase below)	25	ac.		$10,000		
Total Source						$165,000
WATER TREATMENT (Molalla River)						
Improvements to Existing Plant						
- Upgrade the inline mixing	1	l.s.		$15,000	$15,000	
- New clear well (400,000 gal.)	400,000	gal.		$0.50	$200,000	
- Convert disinfection to sodium hypochlorite	1	l.s.		$25,000	$25,000	
- Add influent and effluent turbidimeters	2	ea.		$1,800	$3,600	
- Painting and general site work	1	l.s.		$25,000	$25,000	
Improvements Adding New Treatment Capacity						
- Treatment plant building expansion	5,000	s.f.		$33	$165,000	
- Water treatment package plant	1,400	gpm		$300	$420,000	
- Site piping	1	l.s.		$20,000	$20,000	
- Emergency power	1	l.s.		$65,000	$65,000	
- Control system for entire plant (new & old)	1	l.s.		$40,000	$40,000	
Total Source						$978,600
TRANSMISSION*						
- New 16 Inch Main (well to new grid)	3,000	ft.	16"	$65	$195,000	
- New 16 Inch Main (Plant to grid)	10,000	ft.	16"	$65	$650,000	
- Valving and metering	2	ea.		$20,000	$40,000	
Total Transmission						$885,000
* Assumes well within 3,000 ft. of new 14" grid at NW corner of UGB.						
DISTRIBUTION MAIN IMPROVEMENTS						
- To Reinforce Existing Water Grid						
Patrol St. - dead end east to 14" main @ Hwy. 2	700	ft.	6"	$35	$24,500	
Cole St. - 4th to Main	750	ft.	6"	$35	$26,300	
Debra St. - North from Frances to 14" main	350	ft.	8"	$40	$14,000	
Frances Christopher link - West of Debra	200	ft.	6"	$35	$7,000	
Hood St. - South of 5th.	300	ft.	6"	$35	$10,500	
Metzler Ave. - South of Section St.	800	ft.	6"	$35	$28,000	
8th St. - Hart to Molalla Ave.	700	ft.	8"	$40	$28,000	
Tolivar Rd. - Del Mar to Molalla Ave.	1,850	ft.	12"	$52	$96,200	
Main St. - Hwy. 213 to Shaver	6,350	ft.	12"	$52	$330,200	
Total to Reinforce Existing Grid	12,000				$564,700	
- To Expand Grid for New Development						
E/W -1, North E/W grid main	5,200	ft.	14"	$60	$312,000	
E/W -2, Big Meadow E/W grid main	5,200	ft.	10"	$46	$239,200	
E/W -3, Bear Creek E/W grid main	6,050	ft.	10"	$46	$278,300	
N/S -2, School N/S grid main - north	4,400	ft.	12"	$52	$228,800	
N/S -2, School N/S grid main - south	900	ft.	10"	$46	$41,400	
N/S -1, Western N/S grid main - north	4,400	ft.	12"	$52	$228,800	
N/S -1, Western N/S grid main - south	950	ft.	10"	$46	$43,700	
Del Mar tie to N. UGB	2,450	ft.	12"	$52	$127,400	
Hwy. 213 - Main to Toliver	2,000	ft.	12"	$52	$104,000	
Hwy. 213 - Main to south grid main	1,500	ft.	10"	$46	$69,000	
Bid Meadows Tie - N grid main to Meadow Dr.	1,650	ft.	10"	$46	$75,900	
Molalla Ave. - Miller to N. grid main	1,600	ft.	14"	$60	$96,000	
5th St. - Mathais to Eckerd	1,300	ft.	14"	$60	$78,000	
Total to Expand Grid for Growth	37,600	ft.			$1,922,500	
- Water service upgrade (system wide)	600		3/4"	$500	$300,000	
Total Distribution						$2,787,200
STORAGE						
- Paint Existing Reservoir	1	ls.		$10,000	$10,000	
- New 2.0 MG Reservoir (conc.) NW near wells	2,000,000	gal		$0.38	$760,000	
- Pump station for NW reservoir (expandable)	1	ls.		$250,000	$250,000	
- New 2.0 MG Reservoir (conc.) at treatment pla	2,000,000	gal		$0.38	$760,000	
Total Storage						$1,780,000
TOTAL CONSTRUCTION COST						$7,066,000
Construction Contingencies	18	%			$1,272,000	
TOTAL CONSTRUCTION COST						$8,338,000
NON-CONSTRUCTION COSTS						
- Prelim Design, Final Design, Admin., Legal, Survey, Constr. Observ., Cont.	20.0	%			$1,668,000	
- Land Purchase (well field)	25	ac.		$10,000	$250,000	
- Land Purchase (reservoir)	3	ac.		$20,000	$60,000	
Total Non-Construction Costs						$1,978,000
TOTAL PHASED COSTS						$10,316,000

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CONSTRUCTION COST

TABLE 7-1

developed from the experience of deHaas & Assoc., EAS, BCI and CH2M HILL's cost curves and database's. The costs were based on historical data and past projects by the firms. An *Engineering News-Record* construction cost index (ENR CCI, Seattle) of 5,540 was used in the estimates. More detailed cost estimates will be prepared during final design of the facilities. In addition, costs must be inflated from the values in this master plan to the year the actual construction is to occur.

2.0 RECOMMENDED IMPROVEMENTS

Molalla River Intake and Pump Station Replacement

During the major flood of February 1996, the recently completed pump station and river intake structure was destroyed by the changing river channel. A new facility is currently under construction with completion planned by the end of 1996. The facility is being relocated away from the river such that future floods up to the level of the 1964 100-year flood will not damage it, nor will bank erosion impact the station. Based on discussions with the design engineer, the river channel is not expected to move to the new structure during its design life of over 50 years.

New Well Source

For over half a century, the City of Molalla has relied on water from the Molalla River or Trout Creek (it's tributary) for the municipal water supply. Since the early 1900's, many users have applied for and received water rights on the river, which now total more than the available flow of the river. New rights are not being issued for summer water usage. The city is attempting to transfer 4 cfs from the Trout Creek intake to the new intake on the Molalla River. This transfer is being studied by the State of Oregon and will not be decided for two or three years. It is very unlikely the city will be able to acquire sufficient water rights on the Molalla River to meet their needs for more than ten to twenty years. Following that, a new source will be needed. This master plan recommends that the supplemental source be groundwater, and that this source be developed immediately. This will provide the city with a redundant source, and any problems such as an accidental toxic spill into the river or earthquake damage to the

water intake, water treatment plant, reservoirs or transmission lines would still give the city an alternative supply from the well field.

Water Treatment

The city currently treats Molalla River water in a treatment plant located on a ridge southeast of town, adjacent to the reservoirs. It is a package conventional filter plant manufactured in Vancouver, WA. by Environmental Conditions, Inc. (ECI). The plant is well suited to the water supply and has done an excellent job treating this specific water. The plant is in very good repair and is expected to continue producing high quality water for the 20-year design life of this master plan.

The existing plant is designed to produce water at the rate of 2 MGD. The city's water consumption reaches 2 MGD during the peak demand period of the summer and therefore the water treatment plant is at capacity. To accommodate the projected growth of the city, an additional plant is needed in the immediate future. This master plan recommends that the treatment plant be expanded by another 2 MGD as an immediate project. Expansion of the plant will include the following elements:

- Expansion of the building
- New 2.0 MG package filter plant
- New 0.4 MG clear well
- Site piping to improve operation of reservoirs
- Emergency power
- New control system for entire plant
- New in-line mixer for flocculation in both plants
- Convert disinfection from chlorine gas to sodium hypochlorite
- Influent and effluent automated turbidimeters
- Painting and site work

Reservoirs

Molalla currently has two reservoirs located on the hill southeast of the city near the water treatment plant. The newer reservoir holds 1.2 MG while the older reservoir is 0.6 MG in size. The smaller reservoir is in poor repair and has no rigid cover. The fabric cover floats on the water surface with a layer of closed cell foam to support it. During the recent flood, the loss of supply caused the reservoir to be drained, and the foam is now off-center and is not functioning properly. Correcting this problem is beyond the limits of city staff and will require assistance from the firm that installed it.

The existing reservoir requirement of the city is approximately 2.7 MG, while the 20-year estimated need is 5.9 MG. The actual existing capacity is 1.8 MG. To serve the growth anticipated in this master plan, the city will need an additional 4.1 MG in storage, and 4.7 MG if the existing 0.6 MG reservoir is removed. It is the recommendation of this plan that the existing smaller reservoir be removed and a new 2.0 million gallon covered concrete reservoir be constructed in its place. This will provide a total of 3.2 MG of storage on the hill. The preliminary design or the plant expansion and the new reservoir should consider renovation of the existing small reservoir to be used as a clear well. It will require new piping, permanent liner, structural repair and a permanent dome cover. The cost of reusing this reservoir will be very close to constructing a new 0.4 MG clear well.

This master plan also recommends that the a new well field be developed in the northwest corner of the city's urban growth boundary. This well field should have a reservoir containing the remainder of the needed storage. This reservoir will provide an alternative source of water in the opposite quadrant of the city to meet fire and emergency demand while providing a separate source of stored water in the event of an emergency at the river supply or with the transmission lines from the hill. A reservoir at or near the well field would be constructed at ground level and require a pumping station to introduce water from the tank to the grid. This pump station will require a minimum of four pumps sized for low demand, medium demand and high fire flow demands. This pump station should also be equipped with emergency power. This third reservoir will

provide the city a total of 5.9 MG of storage which will meet the city's storage needs for the 20-year design period and slightly beyond.

Water Master Plan Map

Figures 6-2 and 6-3 are maps of the existing system which show the new proposed projects. The maps graphically show locations of individual facilities including the pipelines, plant, transmission, intake, and the new reservoirs. The staging of these projects is shown on the CIP schedule (Table 7-2). Each of these projects must be designed and final locations will vary from the map. For example, the actual location of the well field will be determined after a predesign hydrogeologic survey of the two square mile area at the northwest corner of the UGB. Several specific parcels will be identified for the well field and negotiations with the property owners will fix the actual parcel upon which a test well is drilled. The purchase or perpetual lease will be finalized after the presence of water is verified by the well. The reservoir can be constructed on several sites. Another example is the specific locations of the new large diameter mains proposed for growth areas. Under ideal conditions, the mains will be constructed as subdivisions or land developments are constructed. In this way, the lines can be constructed in street right-of-way rather than easements which may eventually be inconsistent with specific development projects. However, this will not always be possible, and in many cases, the main must precede the development forcing it to conform with the existing water main.

The examples provided in the paragraph above show that each project will be defined during design. The master plan, however, defines the needed projects, shows the approximate location for each of them and provides a planning-level estimate of cost to construct each project. It also addresses the relative priority of each project and provides a guide of when each project will be needed based on the projected growth of the community.

ESTIMATE OF CONSTRUCTION COST - 1996 COSTS

3-15-96 CIP-2

ESTIMATE OF PROJECT COST							CIP PROJECT STAGING		
ITEM	QUANTITY	UNITS	SIZE	UNIT COST	AMOUNT	TOTALS	IMMEDIATE 0 TO 5 YEARS	STAGE 2 6 TO 10 YEARS	STAGE 3 11 TO 20 YEARS
MOLALLA RIVER INTAKE PUMP STATION REPLACEMENT									
- Pump station and wet well	1	l.s.		$225,000	$225,000		$225,000		
- River intake structure and pipeline	1	l.s.		$70,000	$70,000		$70,000		
- Controls and telemetry	1	l.s.		$75,000	$75,000		$75,000		
- Emergency power	1	l.s.		$75,000	$75,000		$75,000		
- Site work & piping	1	l.s.		$25,000	$25,000		$25,000		
Total Source						$470,000	$470,000	$0	$0
NEW WELL SOURCE									
- Drill 600 gpm Well (others later as needed)	1	ea.		$60,000	$60,000		$60,000		
- Well House, piping, electrical & Controls	1	ea.		$65,000	$65,000		$65,000		
- Emergency Power	1	ea.		$40,000	$40,000		$40,000		
- Well field site - (see land purchase below)	25	ac.		$10,000					
Total Source						$165,000	$165,000	$0	$0
WATER TREATMENT (Molalla River)									
Improvements to Existing Plant									
- Upgrade the inline mixing	1	l.s.		$15,000	$15,000		$15,000		
- New clear well (400,000 gal.)	400,000	gal.		$0.50	$200,000		$200,000		
- Convert disinfection to sodium hypochlorite	1	l.s.		$25,000	$25,000		$25,000		
- Add influent and effluent turbidimeters	2	ea.		$1,800	$3,600		$3,600		
- Painting and general site work	1	l.s.		$25,000	$25,000		$25,000		
Improvements Adding New Treatment Capacity									
- Treatment plant building expansion	5,000	s.f.		$33	$165,000		$165,000		
- Water treatment package plant	1,400	gpm		$300	$420,000		$420,000		
- Site piping	1	l.s.		$20,000	$20,000		$20,000		
- Emergency power	1	l.s.		$65,000	$65,000		$65,000		
- Control system for entire plant (new & old)	1	l.s.		$40,000	$40,000		$40,000		
Total Source						$978,600	$978,600	$0	$0
TRANSMISSION*									
- New 16 Inch Main (well to new grid)	3,000	ft.	16"	$65	$195,000		$195,000		
- New 16 Inch Main (Plant to grid)	10,000	ft.	16"	$65	$650,000		$650,000		
- Valving and metering	2	ea.		$20,000	$40,000		$40,000		
Total Transmission						$885,000	$885,000	$0	$0
* Assumes well within 3,000 ft. of new 14" grid at NW corner of UGB.									
DISTRIBUTION MAIN IMPROVEMENTS									
- To Reinforce Existing Water Grid									
Patrol St. - dead end east to 14" main @ Hwy. 2	700	ft.	6"	$35	$24,500			$24,500	
Cole St. - 4th to Main	750	ft.	6"	$35	$26,300			$26,250	
Debra St. - North from Frances to 14" main	350	ft.	8"	$40	$14,000		$14,000		
Frances Christopher link - West of Debra	200	ft.	6"	$35	$7,000			$7,000	
Hood St. - South of 5th.	300	ft.	6"	$35	$10,500			$10,500	
Metzler Ave. - South of Section St.	800	ft.	6"	$35	$28,000			$28,000	
8th St. - Hart to Molalla Ave.	700	ft.	8"	$40	$28,000			$28,000	
Tolivar Rd. - Del Mar to Molalla Ave.	1,850	ft.	12"	$52	$96,200		$96,200		
Main St. - Hwy. 213 to Shaver	6,350	ft.	12"	$52	$330,200		$330,200		
Total to Reinforce Existing Grid	12,000				$564,700		$440,400	$124,250	$0
- To Expand Grid for New Development									
E/W -1, North E/W grid main	5,200	ft.	14"	$60	$312,000		$156,000	$156,000	
E/W -2, Big Meadow E/W grid main	5,200	ft.	10"	$46	$239,200		$119,600	$119,600	
E/W -3, Bear Creek E/W grid main	6,050	ft.	10"	$46	$278,300			$139,150	$139,150
N/S -2, School N/S grid main - north	4,400	ft.	12"	$52	$228,800		$114,400	$114,400	
N/S -2, School N/S grid main - south	900	ft.	10"	$46	$41,400				$41,400
N/S -1, Western N/S grid main - north	4,400	ft.	12"	$52	$228,800		$114,400	$114,400	
N/S -1, Western N/S grid main - south	950	ft.	10"	$46	$43,700				$43,700
Del Mar tie to N. UGB	2,450	ft.	12"	$52	$127,400		$63,700	$63,700	
Hwy. 213 - Main to Toliver	2,000	ft.	12"	$52	$104,000		$104,000		
Hwy. 213 - Main to south grid main	1,500	ft.	10"	$46	$69,000				$69,000
Bid Meadows Tie - N grid main to Meadow Dr.	1,650	ft.	10"	$46	$75,900		$37,950	$37,950	
Molalla Ave. - Miller to N. grid main	1,600	ft.	14"	$60	$96,000		$48,000	$48,000	
5th St. - Mathais to Eckerd	1,300	ft.	14"	$60	$78,000		$78,000		
Total to Expand Grid for Growth	37,600	ft.			$1,922,500		$836,050	$793,200	$293,250
- Water service upgrade (system wide)	600		3/4"	$500	$300,000		$100,000	$100,000	$100,000
Total Distribution						$2,787,200	$1,376,450	$1,017,450	$393,250
STORAGE									
- Paint Existing Reservoir	1	ls.		$10,000	$10,000		$10,000		
- New 2.0 MG Reservoir (conc.) NW near wells	2,000,000	gal		$0.38	$760,000			$760,000	
- Pump station for NW reservoir (expandable)	1	ls.		$250,000	$250,000			$250,000	
- New 2.0 MG Reservoir (conc.) at treatment pla	2,000,000	gal		$0.38	$760,000		$760,000		
Total Storage						$1,780,000	$770,000	$1,010,000	$0
TOTAL CONSTRUCTION COST						$7,066,000	$4,645,050	$2,027,450	$393,250
Construction Contingencies	18	%			$1,272,000		$836,000	$365,000	$71,000
TOTAL CONSTRUCTION COST						$8,338,000	$5,481,050	$2,392,450	$464,250
NON-CONSTRUCTION COSTS									
- Prelim Design, Final Design, Admin., Legal, Survey, Constr. Observ., Cont.	20.0	%			$1,668,000		$1,096,000	$478,000	$93,000
- Land Purchase (well field)	25	ac.		$10,000	$250,000		$250,000		
- Land Purchase (reservoir)	3	ac.		$20,000	$60,000		$60,000		
Total Non-Construction Costs						$1,978,000	$1,406,000	$478,000	$93,000
TOTAL PHASED COSTS						$10,316,000	$6,887,050	$2,870,450	$557,250

eas ENGINEERING WITH Balfour Consulting, Inc. deHaas & Associates

City of Molalla, Oregon
Water Master Plan

CIP-CAPITAL IMPROVEMENT PLAN

TABLE 7-2

3.0 SCHEDULE

The capital improvements presented in this master plan are phased or staged, which will spread the full implementation of the plan over many years. All improvements will be needed over the 20-year planning period and the majority of the work will be needed immediately if the city is to properly respond to the development pressures being presented.

Table 7-1 presents all of the recommended projects and a current estimate of cost for the total program based on today's construction cost. It will be necessary to inflate the cost of construction to the year anticipated for construction. To assist in scheduling the work, Table 7-2 has been prepared. It shows the relative priority of each project and the projected time for completion.

The city is rapidly moving into a period where it will begin experiencing severe water shortages during the four summer months. Any delay in implementing these improvements will result in severe hardship for the citizens of the community. Delay would soon lead to restrictions for extending service to newly developing properties. The short term outcome would be inadequate domestic water supply requiring summer use restrictions, inadequate fire protection and could eventually lead to a complete restriction of new land development and building permits (growth moratorium). It is therefore recommended that a funding package be assembled and the first stage projects proceed to design within the next three to six months.

4.0 FUNDING

General

This master plan outlines needed improvements which total $10,316,000. If the city moved ahead quickly, selling municipal bonds and constructing all of this work at one time, the cost of the debt service would have a very large user rate impact. Following is an analysis of the existing water fund budget and its impact on user rates. This basic data will be used for further alternative analysis.

- For basis of this analysis, it will be assumed there are 1,435 water customers or accounts for the water system.

- Water revenues for 1995-6 are estimated to be $370,000.
- The current water rates for a typical residential service is $7.00 base charge plus $1.16 per 100 cubic feet of water use.
- An average residential user typically uses 800 c.f./mo., and therefore their monthly bill would average 7+ (1.16)(8) = $16.28 / mo.
- Considering all users on the system, the average water user is estimated as follows $370,000 / 1,435 / 12 = $21.49 per month. This user therefore consumes 1,206 c.f. of water each month (21.49 - 7.5 = 13.99/1.16 = 1,206)
- Number of equivalent residential users (ERU) = 370,000 / 16.28 / 12 = 1,894 ERU's
- $1.00 in rates = $17,220 in revenue per year
- The total water fund revenues are disbursed as shown on Table 3-2

To balance the annual budget, carryover funds are used from the previous year, plus connection fees and interest on the carryover amount. To determine how much of this expenditure budget can be carried from year to year by revenues it is necessary to remove the carryover amount and the interest. This leaves $388,000 in actual revenue. The $388,000 will fund personal services, materials and services, capital outlay, existing debt service, equipment recovery, the transfer to the general fund and $16,300 to the Water System Expenditure Fund.

In addition to the general yearly budget costs discussed above, the city has a current bonded debt to consider. There are two General Obligation Bonds (GO bonds) which are paid by both rate revenues and property taxes. These bonds will be fully paid within the next two years. In 1992 the city sold revenue bonds which are retired by user rates. Debt service for these bonds is currently $29,460 per year and decreases at approximately 1.5 percent per year as the bonds are paid. These bonds must be considered when projecting debt service for the new debt required to fund the CIP.

In general, the existing water rate structure provides a sound basis for funding the existing level of service and a small amount for future capital expenditures. However, the

existing rates will not fund the capital expenditures anticipated in this master plan without a major increase. In the sections which follow, the funding of the CIP will be considered in detail and alternatives developed. The most feasible funding option(s) will be analyzed to determine the impacts on user rates.

Funding with General Obligation Bonds

If the city is unable to secure any funds from state or federal agencies to offset part of the cost of the proposed construction, the city retains the option of funding the work with General Obligation Bonds (GO bonds) or Revenue Bonds. GO Bonds will have the most favorable interest rates, as they typically fall between 0.5 and 1.0 percent below Revenue Bonds. GO bonds require approval of the voters before they can be sold to finance projects because they pledge the full faith and credit of the city. Revenue bonds pledge user rates to repay the bonds and therefore do not require a vote of the citizens of the city. The figures which follow assume the entire first stage of the CIP will be funded with GO bonds and paid by user rates:

- Amount to finance - $6,887,000 (1996 dollars)
- Assumed bond interest rate - 6% at 20 years.
- Debt service - $6,887,000 x 0.04327 x 2 = $596,000/yr. or 49,670/mo.
- Rate Impact

- $596,000 / 17,220	=	$34.61 / mo. debt service
- existing rates	=	16.28 / mo.
- less water system exp. fund		-3.88 / mo.
Total user rate	=	$47.01 / mo.

The impact of funding $6,887,000 in GO bonds will nearly triple the water rates. Rates of $47.01 would be high, nearly the highest in the state. The communities with the highest rates in the state are those which have undertaken major capital improvement projects and funded these improvements with GO bonds or even through federal or state agency grant/loan packages. These agencies require cities using their funding to increase their rates to a minimum of the low $30 range before they will provide grant funds.

Molalla will likely not qualify for grant funds and will have to fund all or most of the improvements with loan money. This will be discussed in detail on the following pages.

Grant / Loan Funding

Opportunities for the grant funding of public works facilities in small cities are possible but not readily available. Molalla has three basic available sources of grant funding:

1. A block grant from the State Department of Economic Development (EDD)

2. A grant from Oregon Lottery funds

3. A RECD (formally Farmers Home Administration - FmHA) grant

The **State EDD** provides grants to cities in Oregon for many types of public works facilities. Water projects qualify and are often funded. Applications for the next round of funding will be received beginning July 1, 1996. To qualify for these funds the city must have over 51 percent low and moderate income. In addition the city must have a declared health hazard to be competitive with the other cities vying for the funds. Although possible, it is not likely the city will secure a Community Development Block Grant.

Loans are also possible from the EDD, however they are normally provided with a combination grant / loan package. In general, this funding source should be considered in developing a funding package, but receiving a favorable package is unlikely.

Oregon Lottery Funds have been used to support public works construction since the lottery was approved by voters many years ago. The funds are available through two programs: the Water/Wastewater Fund and the Special Public Works Fund. All lottery funds are provided to further economic development in the community. If an industry will move into the city, but the needed infrastructure to allow the development is not in place, the funds become readily available. A Water/Wastewater funding package can be all loan funds or a grant/loan package. They are normally extended to help the city resolve a serious compliance issue where the city has been placed on notice by DEQ

or the State Health Division to modify their system so it will meet state or federal law. The focus of the Special Public Works Fund is on creating jobs, and such funds are extended only to attract a specific industry to the city.

The third source of grant funding is the **RECD (FmHA).** This is a federal agency which provides funds to local governments for various purposes, including housing and public works infrastructure. Once again, grant funds will be difficult for Molalla to acquire. RECD prefers that projects draw on all available funding sources and will expect the city to carefully consider other funding sources before approaching them. As with lottery and block grant funds, there is considerable competition for the RECD grant funds. Small cities with very low income citizens which are under order by a regulatory agency to correct an environmental problem or health hazard receive most of the available grant funding. RECD does have an excellent loan program however, and the city should be able to borrow funds from RECD at an interest lower than selling GO bonds directly. This master plan strongly recommends financing the project through RECD. The primary concern may be timing. To fund the amount of construction anticipated in Stage 1 of this plan will likely require more than one federal budget year to complete.

Once the city has reviewed this report and refined the level of Stage 1 construction they wish to implement, applications should be prepared to the funding agencies desired. The applications should stress the following issues:

- Molalla's family income level.
- Molalla has reached the limits of its water supply and water treatment plant capacity during the peak summer demand periods. It must soon ration water during the summer months or pass a moratorium on growth. This will cause extreme hardship to the existing users.
- The lack of supply and fire protection will stop economic development in Molalla and prevent the community from growing through new construction, expanding business/industry and new connections.
- The existing water rights on the Molalla will prohibit additional supply unless the city can secure additional rights.

- The existing collection and storage systems have sufficient capacity to meet residential demand but do not have the capacity to provide adequate fire protection to many commercial and industrial areas.

It is recommended that Molalla initiate funding application activity immediately with RECD for this project. The interest rate will be approximately one percent below GO bonds. Applications are received throughout the year. Due the budget discussions in Congress, RECD has not yet received their full appropriation for the current year. In additional to consulting services, the Council of Governments (COG) can assist the city in the preparation of these funding requests.

Project Funding Package

At this point in time, it is very difficult to project a likely package of grants and loans to fund this project. Currently the city does not have a declared health hazard. No state actions have been placed against the city for declared violations of state law due to its inadequate water system. Because the problems have not been documented by government actions, Molalla will likely not receive grant funding from any of the named agencies. Actions of this type against the city are not likely in the near future.

To allow analysis of the impact of RECD financing of the project, the assumptions listed below were made. There is no way to determine if these assumptions will be valid, however, they should be relatively realistic.

- No EDD grant
- No Oregon lottery grant
- No RECD grant
- A commitment for funding the Stage 1 balance with a RECD 5 percent loan.

Rate Calculations

Total Stage 1 project cost -	$6,887,000
Less grant funds -	0
Remainder to be financed -	$6,887,000

- Assumed bond interest rate - 5% at 40 years

- Debt service - $6,887,000 x 0.02903 x 2 = $399,859 per year.

- Rate Impact

- $399,859 / $17,220	=	$23.22 / mo. debt service
Existing rates	=	16.90 / mo.
Less water exp fund	=	-3.88
Total user rate	=	$36.24 / mo.

It appears that the 1995-96 water fund expenditure budget accurately represents the cost of operating the Molalla water system. This expenditure budget seems consistent with the budgets of other water systems of comparable size to Molalla and therefore it will not be questioned in this plan. From the calculations above, it is reasonable to assume that adjusting the rates to reflect the actual cost of operating the system plus the implementation of the CIP contained in this master plan will have a major impact on user rates. Water rates for a typical user will increase from $16.90 to between $36.24 and $47.01 per month. Anything above $25.00 will place Molalla among Oregon city's with the highest water rates. There are many cities in the state however, with similar rates.

Other Funding Possibilities

The grant and loan funding opportunities discussed above are the basic major options available to the city for implementation of this project. There are other funding approaches which, although small in comparison, may be considered in the total funding package. These options are as follows:

- **SDC's** - The Systems Development Charge (SDC) is a funding mechanism established by the Oregon State Legislature for funding public works facilities which are necessitated by new development or growth within a community. These charges are paid by new developments to the city and, if so established, may assist in funding the expansion of the sewer, water, storm drainage, streets and park systems. Molalla's current SDC for water is $1,040 per new residential home.

  Each new development pays a fee at the time of subdivision or when a building permit is issued. To determine the impact of a SDC on the water fund budget; if growth in Molalla is at 5%, 200 new people will move to the city each year. Assuming 3 people per home, 67 new houses will be required each year. The SDC rate is determined by a cost analysis which estimates the cost required to extend services to the new developments. It was reviewed

within the past two years and the rate was established at $1,040 (typical rate), generating $68,680 per year from this source (currently the city budgets $31,200 from SDC charges). It should be noted that the CIP included in this master plan could justify a higher SDC rate than the current figure. This requires a detailed analysis to fix the higher rate.

Under current Oregon SDC law, it is appropriate to use SDC revenue to retire bonded debt from projects constructed that were listed in the CIP. The $68,700 per year could reduce water rates by up to $4.00 per month 68,700,000 / 17,220). These figures may be slightly conservative as growth will bring commercial and industrial development as well as housing.

It should be cautioned that SDC revenues may not be used for operation and maintenance of the water system. These funds are used only for capital outlay projects which expand or improve the system for the betterment of development of the city. Because SDC funds may be used to service the debt for implementing the CIP in this master plan, it is reasonable to consider that SDC revenues can offset user rates for the debt service. A word of caution, however. Most lenders will not allow SDC revenues to be considered as the basis for paying the bonds for public improvements. The city must have rate authority without the SDC revenues to sell the bonds as SDC revenues can drop to zero if development in the city stops due to an economic downturn.

- **Pipe Replacement Program** - This program is designed to replace the undersized pipes in the system. With the implementation and completion of the CIP contained in this report, the need for these funds each year will be reduced. Other needs will replace them such as extending water service to new developments, paying for oversized facilities when developments pay basic service costs, and other similar projects.

  A distribution pipe replacement program is included in the annual budget under transfer to water reserve fund. This program is currently funded at $81,792 per year. With the majority of the replacement program completed by implementing the CIP, the existing funding level should be adequate.

  It is the opinion of the engineer that approximately half of the needed distribution system improvements should be financed with the Stage 1 project. The remaining stages can be funded from SDC revenues and developers share of the projects constructed in subdivisions and other development projects and the budget appropriation above (inflated over the years.)

- **Other Funding Sources** may also be available. It is recommended that a detailed economic analysis be made for funding the improvements proposed in this master plan.

Implementation

The costs and funding alternatives in this chapter are offered to assist in defining the specific project package the city wishes to pursue. It also presents several opportunities available to fund the selected work. It is recommended that the draft plan be reviewed by the staff followed by a meeting with the consultant to receive comments and discuss the plan. The input from this meeting will generate revisions to the report leading to the final document. The consultant will then present the report to the City Council.

In implementing this approach it is critical to make the citizens aware of the needs within the water system and to seek their comments and support for implementing this plan. The funding applications should be completed soon after the adoption of the master plan. Submitting the applications to the funding agencies starts the review process and places the city on the list to receive funding. In most cases, applications can be modified after filing, so it is not necessary to have the absolute final analysis completed before filing.

APPENDIX A

COMMON ABBREVIATIONS

APPENDIX A
COMMON ABBREVIATIONS

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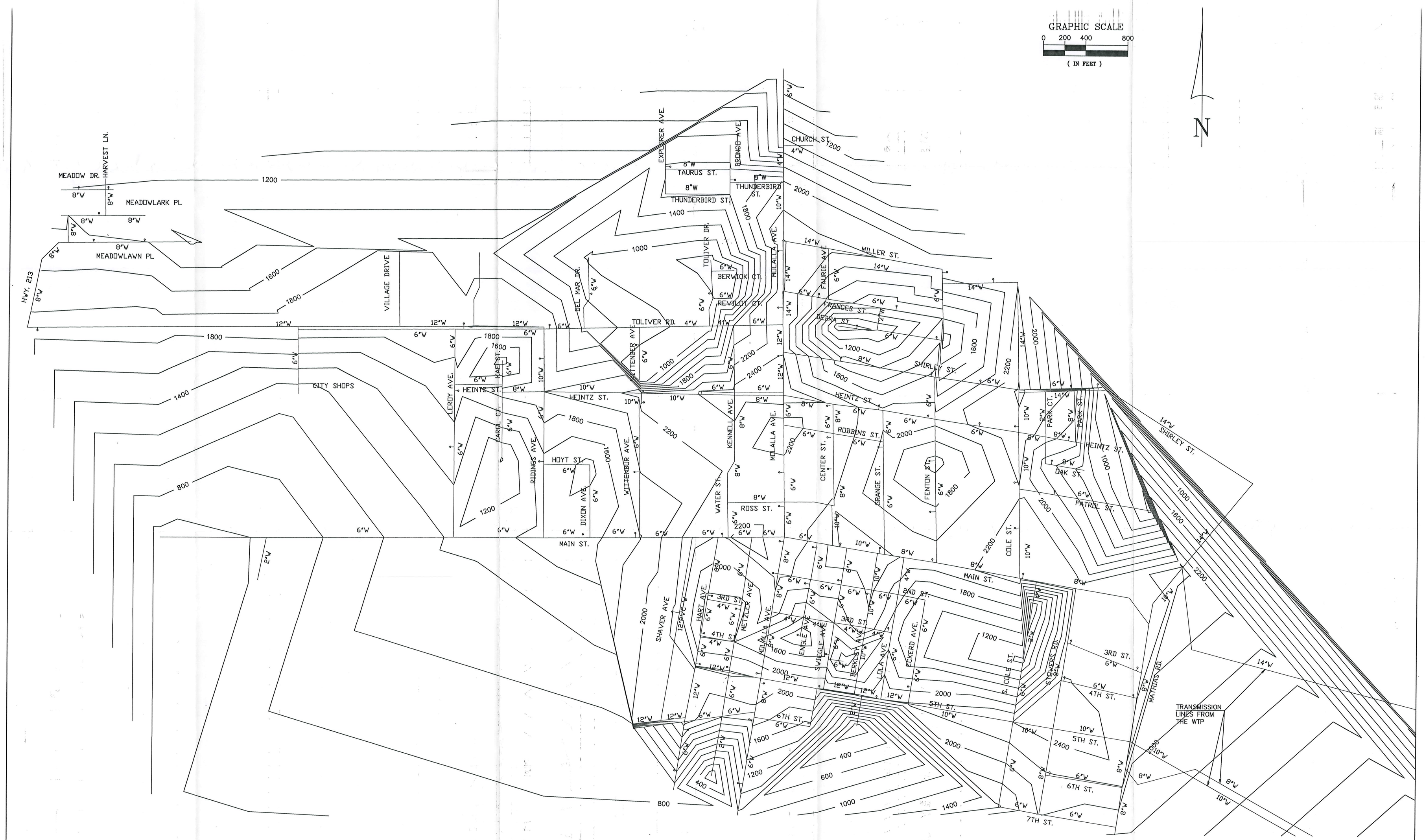
COMMON ABBREVIATIONS

ADD	Average Daily Demand
cfs	cubic feet per second
CIP	Capital Improvement Plan
DEQ	Department of Environmental Quality
ERU	Equivalent Residential User-
FAP	Filter Aid Polymer
gpcd	gallons per capita per day
MDD	Maximum Daily Demand
MG	million gallons
mgd	million gallons per day
NTU	Nephelometric Turbidity Units - a measurement of turbidity
OHD	Oregon Health Division
OWRD	Oregon Water Resource Department
PHD	Peak Hour Demand
ppm	parts per million
psi	pounds per square inch
UGB	Urban Growth Boundary
WTP	Water Treatment Plant

APPENDIX B
CYBERNET RESULTS



NOTE: FIRE FLOW CONTOURS ARE IN GALLONS PER MINUTE @ 20 PSI RESIDUAL PRESSURE.

REVISIONS:			
REV. NO.	DATE	DESCRIPTION	APP'D

eas
CONSULTING ENGINEERS
7851 LIBERTY ROAD SOUTH
SALEM, OREGON 97306
VOICE (503) 362-4983
FAX (503) 370-4329

BCI BALFOUR CONSULTING, INC.
MUNICIPAL ENGINEERING AND LAND DEVELOPMENT SERVICES
18005 WILLAMETTE DRIVE
WEST LINN, OREGON 97068
VOICE (503) 635-0293
FAX (503) 635-0294

DATE:	DEC. 1996
DESIGN:	ERC
DRAWN:	ERC
APP'D:	EAS

WATER SYSTEM MASTER PLAN

CITY OF MOLALLA, OREGON

EXISTING WATER SYSTEM
FIRE FLOW CONTOURS
PEAKING FACTOR = 2.1

JOB NO: 106.01

SHEET 1 / 1

GRAPHIC SCALE
0 200 400 800
(IN FEET)

N

HARVEST LN.
MEADOW DR.
MEADOWLARK PL.
MEADOWLAWN PL.
HWY. 213
CITY SHOPS
TAURUS ST.
THUNDERBIRD ST.
EXPLORER AVE.
BRONCO AVE.
CHURCH ST.
TOLIVER DR.
BERWICK CT.
REVILLO CT.
DEL NAR DR.
TOLIVER RD.
NEW 14" W
MILLER ST.
FAURE AVE.
FRANCES ST.
DEBRA ST.
SHIRLEY ST.
HEINTZ ST.
KAE CT.
CAROL CT.
LEROY AVE.
ROBBINS AVE.
HOYT ST.
DIXON AVE.
WITTENBUR AVE.
KENNELLY AVE.
MOLALLA AVE.
CENTER ST.
ROBBINS ST.
GRANGE ST.
FENTON ST.
WATER ST.
ROSS ST.
PARK CT.
PARK ST.
OAK ST.
PATROL ST.
NEW 8"W
NEW 12" W
MAIN ST.
HART AVE.
METZLER AVE.
SHAVER AVE
12"PVC W
2ND ST.
3RD ST.
4TH ST.
5TH ST.
6TH ST.
7TH ST.
SWIGLE AVE.
BERKLEY AVE.
LOLA AVE.
EPKERD AVE.
COLE ST.
STEWERS RD.
HAYDEN RD.
TRANSMISSION LINES FROM THE WTP

NOTE: FIRE FLOW CONTOURS ARE IN GALLONS PER MINUTE @ 20 PSI RESIDUAL PRESSURE.

REVISIONS:

REV. NO.	DATE	DESCRIPTION	APPV'D

eas CONSULTING ENGINEERS
7851 LIBERTY ROAD SOUTH
SALEM, OREGON 97306
VOICE (503) 362-4983
FAX (503) 370-4329

BCI BALFOUR CONSULTING, INC.
MUNICIPAL ENGINEERING AND LAND DEVELOPMENT SERVICES
18005 WILLAMETTE DRIVE
WEST LINN, OREGON 97068
VOICE (503) 635-6993
FAX (503) 635-6994

DATE: DEC. 1996
DESIGN: ERC
DRAWN: ERC
APPV'D: EAS

WATER SYSTEM MASTER PLAN

CITY OF MOLALLA, OREGON

UPGRADED WATER SYSTEM
FIRE FLOW CONTOURS
PEAKING FACTOR = 2.1

JOB NO: 106.01
SHEET 1 / 1

APPENDIX C

EXAMPLE NPDES BACKWASH PERMIT

GENERAL PERMIT
NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM
WASTE DISCHARGE PERMIT

Department of Environmental Quality
811 S.W. Sixth Avenue
Portland, OR 97204
Telephone: (503) 229-5696

Issued pursuant to ORS 468.740 and The Federal Clean Water Act

---

ISSUED TO:

SOURCES COVERED BY THIS PERMIT:

Discharges of filter backwash water, settling basin, and reservoir cleaning water which have been adequately settled prior to discharge

Lydia R. Taylor
Lydia R. Taylor, Administrator

DEC 2 6 1990
Date

PERMITTED ACTIVITIES

Until this permit expires or is modified or revoked, the permittee is authorized to discharge to waters of the State adequately treated waste waters only from the authorized discharge point or points established in Schedule A and only in conformance with all the requirements, limitations, and conditions set forth in the attached schedules as follows:

Each other direct and indirect waste discharge to waters of the State is prohibited unless covered by another NPDES permit.

This permit does not relieve the permittee from responsibility for compliance with any other applicable federal, state, or local law, rule, standard, ordinance, order, judgment, or decree.

SCHEDULE A

1. Waste Discharge Limitations not to be Exceeded by Facilities Covered by this General Permit

Parameters	Limitations
Settleable Solids	Shall not exceed 0.1 ml/l
pH	Shall not be outside the range 6.0-9.0

2. Notwithstanding the effluent limitations established by this permit, no wastes shall be discharged and no activities shall be conducted which will violate Water Quality Standards as adopted in OAR Chapter 340 Division 41 except in the following defined mixing zone:

   The allowable mixing zone shall not extend beyond a radius of 10 meters from the point of discharge.

3. Receiving Stream Flow

   The receiving stream shall provide a minimum dilution of 30:1 during periods of discharge.

4. Solids, sludges, dirt, sand, silt, and bacterial slime removed from filters, settling basins and reservoirs shall be disposed of in a way which will prevent discharge to public waters and nuisance conditions. They shall be disposed of at a Department permitted solid waste disposal site or by obtaining a Department letter permit issued in accordance with OAR 340-61-020, 027.

5. All filter backwash water shall pass through a settling pond or other approved treatment system and meet the effluent limitations in Condition 1. prior to discharge to waters of the State.

6. All reservoir cleaning waters shall pass through an approved treatment system and meet the effluent limitations in Condition 1. prior to discharge to waters of the State.

SCHEDULE B

Minimum Monitoring and Reporting Requirements (unless otherwise approved in writing by the Department)

Item or Parameter	Minimum Frequency *	Type of Sample
Settleable Solids (ml/l)	2/Month	Grab
pH	2/Month	Grab

Reporting Procedures

Monitoring data shall be recorded each month on EPA Form 3320-1. The data shall be submitted to the Department monthly by the 15th day of the following month. In addition, any violation of permit conditions shall be reported within five (5) days of discovery along with an explanation and correction plan.

* The data shall be collected at the overflow of the settling pond or other treatment device during a filter backwash cycle. If the filters are backwashed less frequently than every two weeks, the data shall be collected during the time backwash occurs. If the settling pond does not overflow during the backwash cycle but is drained or pumped after settling has occurred, the data shall be collected during the draining or pumping.

GENERAL CONDITIONS

SECTION A. STANDARD CONDITIONS

1. Duty to Comply

The permittee must comply with all conditions of this permit. Any permit noncompliance constitutes a violation of the Clean Water Act and is grounds for enforcement action; for permit termination; revocation and reissuance, or modification; or for denial of a permit renewal application.

2. Penalties for Violations of Permit Conditions

Oregon Law (ORS 468.990) classifies a willful or negligent violation of the terms of a permit or failure to get a permit as a misdemeanor and a person convicted thereof shall be punishable by a fine of not more than $25,000 or by imprisonment for not more than one year, or by both. Each day of violation constitutes a separate offense.

In addition to the criminal penalties specified above, Oregon Law (ORS 468.140) also allows the Director to impose civil penalties up to $10,000 per day for violation of the terms or conditions of a permit.

3. Duty to Mitigate

The permittee shall take all reasonable steps to minimize or correct any adverse impact on the environment and human health resulting from noncompliance with this permit, including such accelerated or additional monitoring as necessary to determine the nature and impact of the noncomplying discharge.

4. Individual NPDES Permit Required

Whenever a facility expansion, production increase, or process modification is anticipated which will result in a change in the character of pollutants to be discharged or which will result in a new or increased discharge that will exceed the conditions of this permit, an NPDES application must be submitted together with the necessary reports, plans, and specifications for the proposed changes. No change shall be made until plans have been approved and an individual NPDES permit has been issued.

5. Permit Actions

The Director may revoke a general permit as it applies to any person and require such person to apply for and obtain an individual NPDES permit if:

a. The covered source or activity is a significant contributor of pollution or creates other environmental problems;

b. The permittee is not in compliance with the terms and conditions of this general permit; or

c. Conditions or standards have changed so that the source or activity no longer qualifies for a general permit.

6. General Permit Coverage

a. Any permittee not wishing to be covered or limited by this general permit may make application for an individual NPDES permit in accordance with NPDES procedures in OAR 340-45-030.

b. This general permit does not cover activities or discharges covered by an individual NPDES permit until the individual permit has expired or been cancelled. Any person conducting an activity covered by an individual permit but which could be covered by this general permit may request that the individual permit be cancelled.

c. All persons desiring to be covered by this general permit must register with the Department. For new sources, this can be done by submitting EPA Forms 1 and 2E along with a map showing where the discharge will occur and receiving stream flow information so that available dilution can be calculated. For sources on an existing individual permit, send a letter of request. Send application to:

Department of Environmental Quality
Water Quality Division
811 S.W. Sixth Avenue
Portland, OR 97204

7. Toxic Pollutants

The permittee shall comply with effluent standards or prohibitions established under Section 307(a) of the Clean Water Act for toxic pollutants within the time provided in the regulations that establish those standards or prohibitions, even if the permit has not yet been modified to incorporate the requirement.

8. Property Rights

The issuance of this permit does not convey any property rights of any sort, or any exclusive privileges, nor does it authorize any injury to private property or any invasion of personal rights, nor any infringement of federal, state or local laws or regulations.

SECTION B. OPERATION AND MAINTENANCE OF POLLUTION CONTROLS

1. Proper Operation and Maintenance

The permittee shall at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) which are installed or used by the permittee to achieve compliance with the conditions of this permit. Proper operation and maintenance includes effective performance, adequate funding, adequate operator staffing and training, and adequate laboratory and process controls, including appropriate quality assurance procedures. This provision requires the operation of back-up or auxiliary facilities or similar systems only when necessary to achieve compliance with the conditions of the permit.

2. Duty to Halt or Reduce Activity

Upon reduction, loss, or failure of the treatment facility, the permittee shall, to the extent necessary to maintain compliance with its permit, control production or all discharges or both until the facility is restored or an alternative method of treatment is provided. This requirement applies, for example, when the primary source of power of the treatment facility fails or is reduced or lost. It shall not be a defense for a permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of this permit.

3. Bypass of Treatment Facilities

a. Definitions

(1) "Bypass" means the intentional diversion of waste streams from any portion of a treatment facility.

(2) "Severe property damage" means substantial physical damage to property, damage to the treatment facilities which causes them to become inoperable, or substantial and permanent loss of natural resources which can reasonably be expected to occur in the absence of a bypass. Severe property damage does not mean economic loss caused by delays in production.

b. Bypass not exceeding limitations.

The permittee may allow any bypass to occur which does not cause effluent limitations to be exceeded, but only if it also is for essential maintenance to assure efficient operation. These bypasses are not subject to the provisions of paragraphs c and d of this section.

c. Notice

(1) Anticipated bypass. If the permittee knows in advance of the need for a bypass, it shall submit prior notice, if possible at least ten days before the date of the bypass.

(2) Unanticipated bypass. The permittee shall submit notice of an unanticipated bypass as required in Section D, Paragraph D-5 (24-hour notice).

d. Prohibition of bypass.

(1) Bypass is prohibited and the Director may take enforcement action against a permittee for bypass, unless:

(a) Bypass was unavoidable to prevent loss of life, personal injury, or severe property damage;

(b) There were no feasible alternatives to the bypass, such as the use of auxiliary treatment facilities, retention of untreated wastes, or maintenance during normal periods of equipment downtime. This condition is not satisfied if the permittee could have installed adequate backup equipment to prevent a bypass which occurred during normal periods of equipment downtime or preventative maintenance; and

(c) The permittee submitted notices as required under paragraph c of this section.

(2) The Director may approve an anticipated bypass, after considering its adverse effects, if the Director determines that it will meet the three conditions listed above in paragraph d(1) of this section.

4. Removed Substances

Solids, sludges, filter backwash, or other pollutants removed in the course of treatment of control of wastewaters shall be disposed of in a manner such as to prevent any pollutant from such materials from entering waters of the State.

SECTION C. MONITORING AND RECORDS

1. Representative Sampling

Sampling and measurements taken as required herein shall be representative of the volume and nature of the monitored discharge. All samples shall be taken at the monitoring points specified in this permit and shall be taken, unless otherwise specified, before the effluent joins or is diluted by any other waste stream, body of water, or substance. Monitoring points shall not be changed without notification to and the approval of the Director.

2. Flow Measurements

Appropriate flow measurement devices and methods consistent with accepted scientific practices shall be selected and used to insure the accuracy and reliability of measurements of the volume of monitored discharges. The devices shall be installed, calibrated and maintained to insure that the accuracy of the measurements is consistent with the accepted capability of that type of device. Devices selected shall be capable of measuring flows with a maximum deviation of less than ± 10% from true discharge rates throughout the range of expected discharge volumes.

3. Monitoring Procedures

Monitoring must be conducted according to test procedures approved under 40 CFR Part 136, unless other test procedures have been specified in this permit.

4. Penalties of Tampering

The Clean Water Act provides that any person who falsifies, tampers with, or knowingly renders inaccurate, any monitoring device or method required to be maintained under this permit shall, upon conviction, be punished by a fine of not more than $10,000 per violation, or by imprisonment for not more than 6 months per violation, or by both.

5. Reporting of Monitoring Results

Monitoring results shall be summarized each month on a Discharge Monitoring Report form approved by the Department. The reports shall be submitted monthly and are to be postmarked by the 14th day of the following month unless specifically approved otherwise in Schedule B of this permit.

6. Additional Monitoring by the Permittee

If the permittee monitors any pollutant more frequently than required by this permit, using test procedures approved under 40 CFR 136 or as specified in this permit, the results of this monitoring shall be included in the calculation and reporting of the data submitted in the DMR. Such increased frequency shall also be indicated.

7. Averaging of Measurements

Calculations for all limitations which require averaging of measurements shall utilize an arithmetic mean, except for coliform and fecal coliform bacteria which shall be averaged based on a geometric or log mean.

8. Retention of Records

The permittee shall retain records of all monitoring information, including all calibration and maintenance records of all original strip chart recordings for continuous monitoring instrumentation, copies of all reports required by this permit, and records of all data used to complete the application for this permit, for a period of at least 3 years from the date of the sample, measurement, or report of application. This period may be extended by request of the Director at any time.

9. Records Contents

Records of monitoring information shall include:

a. The date, exact place, time and methods of sampling or measurements;

b. The individual(s) who performed the sampling or measurements;

c. The date(s) analyses were performed;

d. The individual(s) who performed the analyses;

e. The analytical techniques or methods used; and

f. The results of such analyses.

10. Inspection and Entry

The permittee shall allow the Director, or an authorized representative upon the presentation of credentials and other documents as may be required by law, to:

a. Enter upon the permittee's premises where a regulated facility or activity is located or conducted, or where records must be kept under the conditions of this permit;

b. Have access to and copy, at reasonable times, any records that must be kept under the conditions of this permit;

c. Inspect at reasonable times any facilities, equipment (including monitoring and control equipment), practices, or operations regulated or required under this permit, and

d. Sample or monitor at reasonable times, for the purpose of assuring permit compliance or as otherwise authorized by the Clean Water Act, any substances or parameters at any location.

SECTION D. REPORTING REQUIREMENTS

1. Planned Changes

The permittee shall give notice to the Director as soon as possible of any planned physical alterations or additions to the permitted facility.

2. Anticipated Noncompliance

The permittee shall give advance notice to the Director of any planned changes in the permitted facility or activity which may result in noncompliance with permit requirements.

3. Transfers

This permit may be transferred to a new permittee provided the transferee acquires a property interest in the permitted activity and agrees in writing to fully comply with all the terms and conditions of the permit and the rules of the Commission. No permit shall be transferred to a third party without prior written approval from the Director.

4. Compliance Schedule

Reports of compliance or noncompliance with, or any progress reports on interim and final requirements contained in any compliance schedule of this permit shall be submitted no later than 14 days following each schedule date. Any reports of noncompliance shall include the cause of noncompliance, any remedial actions taken, and the probability of meeting the next scheduled requirements.

5. Twenty-Four Hour Reporting

The permittee shall report any noncompliance which may endanger health or the environment. Any information shall be provided orally (by telephone) within 24 hours from the time the permittee becomes aware of the circumstances. A written submission shall also be provided within 5 days of the time the permittee becomes aware of the circumstances. The written submission shall contain:

a. A description of the noncompliance and its cause;

b. The period of noncompliance, including exact dates and times;

c. The estimated time noncompliance is expected to continue if it has not been corrected; and

d. Steps taken or planned to reduce, eliminate, and prevent reoccurrence of the noncompliance.

The Director may waive the written report on a case-by-case basis if the oral report has been received within 24 hours.

The following shall be included as information which must be reported within 24 hours:

a. Any unanticipated bypass which exceeds any effluent limitation in the permit.

b. Any upset which exceeds any effluent limitation in the permit.

6. Other Noncompliance

The permittee shall report all instances of noncompliance not reported under Section D, Paragraphs D-4 and D-5, at the time monitoring reports are submitted unless required otherwise in Schedule B of this permit. The reports shall contain the information listed in Paragraph D-5.

7. Duty to Provide Information

The permittee shall furnish to the Director, within a reasonable time, any information which the Director may request to determine whether cause exists for revoking coverage by this permit, or to determine compliance with this permit. The permittee shall also furnish to the Director, upon request, copies of records required to be kept by this permit.

Other Information: When the permittee becomes aware that it failed to submit any relevant facts in a permit application, or submitted incorrect information in a permit application or any report to the Director, it shall promptly submit such facts or information.

8. Signatory Requirements

All applications, reports or information submitted to the Director shall be signed and certified in accordance with 40 CFR 122.22.

9. Falsification of Reports

The Clean Water Act provides that any person who knowingly makes any false statement, representation, or certification in any record or other document submitted or required to be maintained under this permit, including monitoring reports or reports of compliance or noncompliance shall, upon conviction be punished by a fine of not more than $10,000 per violation, or by imprisonment for not more than six months per violation, or by both.

SECTION E. DEFINITIONS AND ACRONYMS

1. BOD means five-day biochemical oxygen demand.

2. TSS means total suspended solids (non-filterable residue).

3. mg/l means milligrams per liter.

4. kg means kilograms.

5. m^3/d means cubic meters per day.

4. MGD means million gallons per day.

5. Composite sample means a combination of samples collected, generally at equal intervals over a 24-hour period, and apportioned according to the volume of the flow at the time of the sampling.

6. FC means fecal coliform bacteria.

APPENDIX D
NEWSPAPER ARTICLES

Dec. 15, 1995
Oregonian

MOLALLA

Molalla's water reservoir dropped to within a half-foot of trouble Thursday before PGE got the treatment plant operating about 3 p.m.

If the supply of water for the 4,045 residents had dropped any lower, said City Manager Harvey Barnes, the city risked sending tiny bits of sediment (turbidity) into the water lines.

The water would have been safe to drink, he added, but it would have been murky. In addition, the murkiness would have remained until the lines were flushed out.

The wind knocked out electricity to the city's water treatment plant about 12:45 p.m. Tuesday. After officials asked residents to conserve water, Barnes said, "our water consumption dropped like a rock."

Besides drinking water, city officials were worried about retaining enough water to fight fires, especially with a large number of people using candles in their homes.

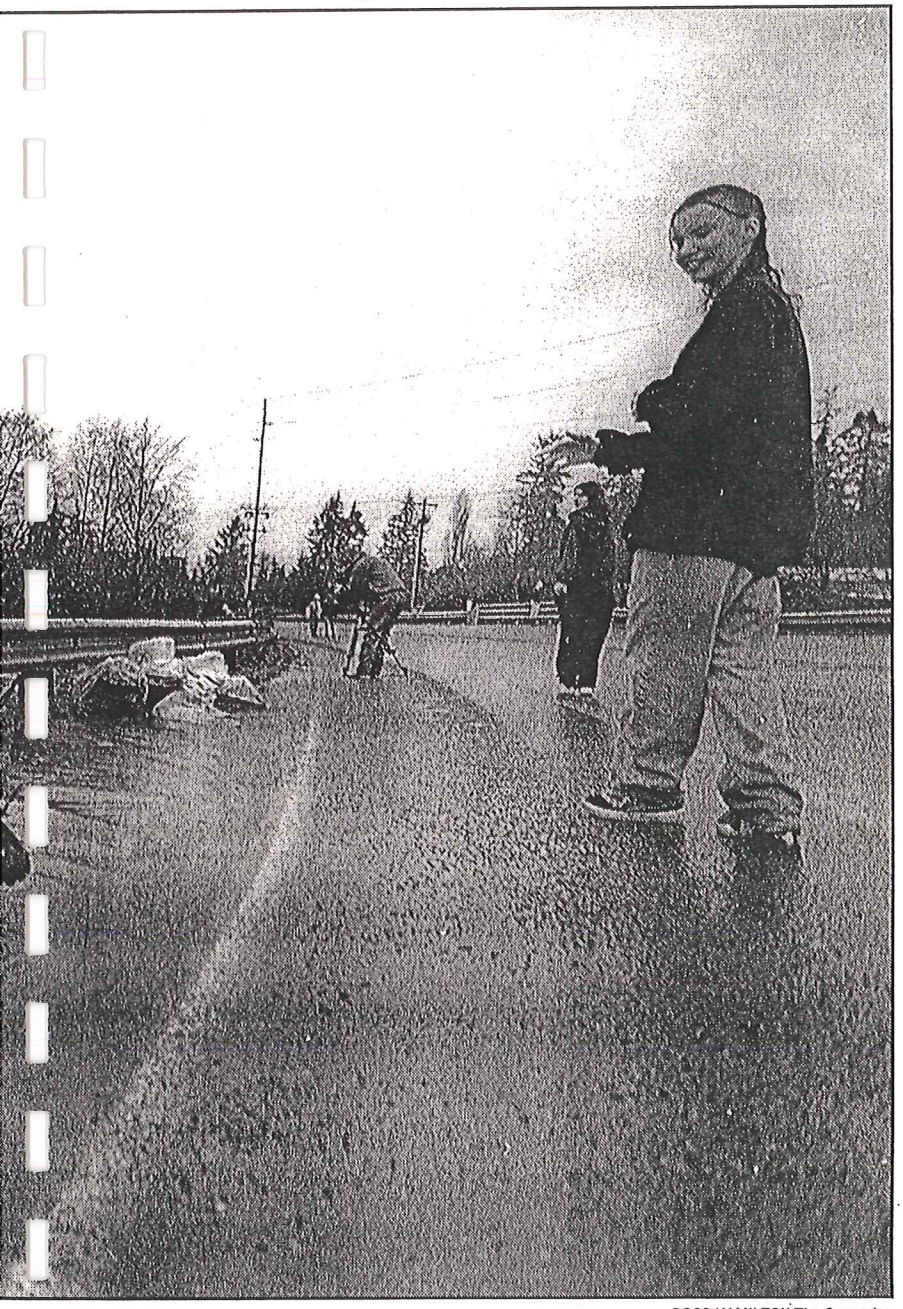
The high school closed as part of the water conservation effort, Barnes said.

off 12:45 Tues
on 3 pm Thurs

the county

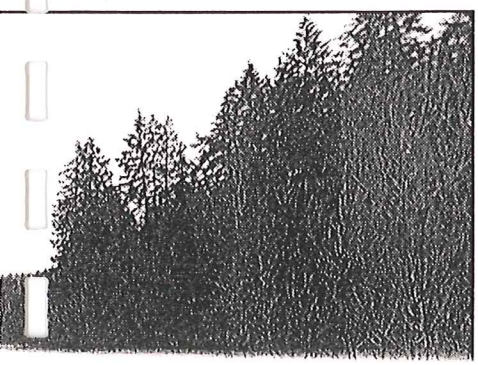
Wed., Feb. 7, 1996 Oregonian

...nd streams surge out of their banks



ROSS HAMILTON/The Oregonian

...ne 15, navigate the sandbags placed in front of their homes.



placed baskets and delicate trinkets as high as they could.

Just in case they had to leave in a hurry, they packed a suitcase with enough clothes to outfit the family.

"It's been close and scary," said Sharon Wallway.

The Wallways and many of their neighbors in the Rusk Road area of Clackamas County spent much of Tuesday trying to keep water from their homes. Water from swollen Mount Scott Creek, a tributary of Kellogg Creek, had spilled over its

CLACKAMAS HIGHLIGHTS

CANBY

Canby fire officials were watching the Molalla River south of the city and advised eight to 10 families along Alder Creek Lane to evacuate, fearing the river's rising waters would overflow a dike.

Firefighter Bob Satterwhite said the river was near the top of the dike. Should the evacuees need temporary housing, Fire Chief Jack Stark said an emergency shelter would be set up overnight at the Canby Adult Center, 1250 S. Ivy, with food, bedding and other supplies to be provided by the Oregon Trail Chapter of the American Red Cross. Call the fire department at 266-5851, the adult center at 266-2970 or the Red Cross at 284-1234.

MOLALLA

The Molalla River crept perilously close to homes, knocked power from the city's water intake plant and burst a dike in the city's sewage treatment plant, causing raw sewage to flow into Bear Creek.

By Tuesday evening, rescue workers were evacuating 30 to 40 elderly people from the South Shady Dell Road residential area. The water was close enough by 5 p.m. to pose a threat to elderly people, said Joe Misso, the Molalla Fire Department's deputy chief.

Water already had seeped into garages and made lakes of the fields around the homes.

Harold Osterud, health officer for the Clackamas County Public Health Division, said the sewage probably was too diluted to cause harm, but he warned residents to take these precautions to avoid contamination:

- Residents who drink from wells near the river should boil all their water until they can be sure it is not contaminated.
- Do not eat food supplies contaminated by river water.
- Avoid getting wet in river water.

After a first look around Molalla Tuesday morning, Molalla Fire Department volunteers placed about 700 sandbags to keep water away from at least five homes by the river and in cul-de-sacs. Water stood deep on many roads around town, and about five cars became waterlogged on South Molalla Avenue.

Power was restored to the city's water intake plant by midday, and operators were drawing as much water as they could in case the power shut off again.

ESTACADA

Estacada fire officials were watching the Clackamas River northwest of the city, worried that it could flood riverside homes in Paradise Park, a development of about three dozen homes on the east bank of the river. Firefighters helped those residents sandbag the riverbank, said Fire Chief Daniel D. Burke, "but if it gets really high, it's going to overwhelm the individual efforts." If a large shelter is needed, one would be set up by the city in a school or church. Call the fire depart-

Monday, March 11, 1996 - Oregonian

Molalla water supply problem is worse than it first appeared

By KATE TAYLOR
of The Oregonian staff

MOLALLA — Flooding last month left one problem in Molalla that time hasn't healed.

In fact, the more city officials look at their water system pump station, the worse it looks.

At first, they thought it would cost $1 million to repair the station, which transformed from a state-of-the-art pump into a mangle of metal and debris.

Days later, they noticed the river's shape had changed permanently, eroding above and under the pump and leaving the structure's foundation dangling several feet above the water.

They raised the cost to $4 million.

Now, they're throwing up their hands.

"It's just a mess," said City Administrator Harvey Barnes, who has clambered through mud and debris to tour the station several times. "It's totaled."

It will be much cheaper to build a new pump, which could cost as little as $600,000, Barnes said. City engineers and outside river experts are trying to decide where to place a new station.

Happily, the city's insurance will pay for rebuilding the new station, as well as the $85,000 it cost to install emergency pumps. The emergency pumps, which pump 2 million gallons of water a day — half the capacity of the old station — will serve the city until at least October.

In the meantime, the city "will have to watch it" with water consumption, although no rationing has been put into place, Barnes said. The city uses 1.8 million gallons a day.

The city also has applied for funding to the Federal Emergency Management Agency.

Besides insurance, the city has lots of friends.

The Army Corps of Engineers, which arrived to help restore the city water supply after the flooding, will help in the rebuilding. And volunteers who have toiled all along will continue to help with the new pump station.

Profile: Town turning into bedroom community

Continued from Page H1

Community Profile: MOLALLA

LOCATION: About 35 miles south of Portland, roughly bounded by the intersections of Oregon 213 and Oregon 211 to the west and Oregon 211 and South Mathias Road to the east, Vick Road to the north and Molalla Forest Road to the south.

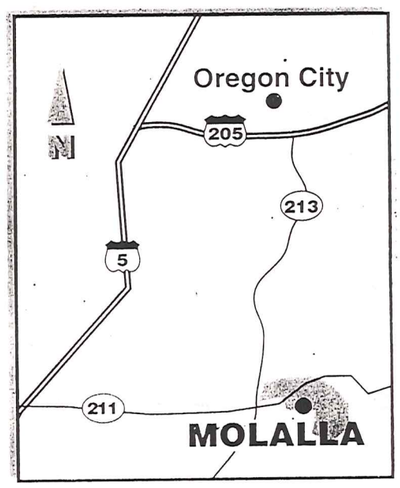
HOUSING: Very diverse, from single-family residences to apartment complexes and duplexes. Farm houses with acreage located slightly out of town. Two new subdivisions are under construction: 90-lot Shel-Mar Acres at the north end of town and 346-lot Big Meadows to the west.

PRICE RANGE: $80,000 to $200,000.

RECENT SALE: In November, $122,000 for a three-bedroom, two-bathroom 1,423-square-foot ranch-style home built in 1980.

SCHOOLS: Molalla River School District, which has one high school and seven elementary schools.

FOCAL POINTS: In town, the Dibble House, built in 1856, and the Buckeroo grounds, which come alive on July 4 for an annual rodeo, parade and carnival. Three parks offer picnic areas, playgrounds and other recreation. Four miles east of the city is the Molalla River and Feyrer Park. The river is a destination for fishing, whitewater rafting and swimming; Feyrer Park is a camping spot with RV hookups and campsites. Molalla Train Park, at Shady Dell east of town, features rides on miniature train cars and steam locomotives from May to October.



Wide-open spaces

Molalla is perhaps best known for its annual "Buckeroo," one of the Northwest largest rodeos, which brings more than 10,000 visitors to town over the July 4 weekend. Crowds line the downtown streets to watch parades, and gather for a chicken barbecue, carnival, dances and rodeo shows sanctioned by the Professional Rodeo Cowboys Association.

Wide-open spaces are bringing some of the visitors back to look for homes in the country.

"Probably the main reason we moved out here was to get out of the sprawl of the city," says Ann Hansen. She and her husband, Keith, moved to Molalla in August from Bremerton, Wash. "We were hoping to get away from violence."

The couple has two small children, and Ann says, "We wanted them to be out in a country type of area." Keith Hansen is from Oregon City and knew the Molalla area. It's still affordable, and they were able to buy a new house in Big Meadow, Ann explains. They purchased an 1,100 square-foot three-bedroom, one bathroom house for $111,000.

Neither Ann nor Keith work in Molalla. Keith Hansen works in drywall construction and travels the entire metropolitan area. Ann Hansen commutes to West Linn where she is employed as a bank teller.

"Molalla is rapidly turning into a bedroom community," says Allegra Gengler, sales associate with ERA Town & Country Estates. She says people started moving into the area a few years ago and, unlike some Oregon hot spots for house hunters, most people moving in are not from out of state.

They're usually young families wanting to move from Portland into the country, Gengler explains. Most new homeowners commute to jobs in either Portland or Salem.

Molalla is still rural, however, and that's the appeal, says Molly James, sales associate with Coldwell Banker Professional Group. "The demand (for homes) is going that way, to get out of the city."

But finding a house can be tough, because apart from new construction, not many are available. "For Sale" signs are scarce among existing houses in the downtown area, where prices start at about $80,000 for a fixer-upper. Add a few acres of land, and you'll pay considerably more.

"It never ceases to amaze me that people want to come out here from Portland and buy 2 to 3 acres and only want to spend $80,000," Mann says. "There isn't anything like that here."

A more realistic price for 2 to 3 acres with a fixer-upper house is about $120,000, Mann added.

New homes are selling nearly as fast as they can be built.

Burghardt & Co. began developing Big Meadow about a year ago, and sold 50 percent more homes than anticipated, with 24 homes completed and 52 sold.

Owner and developer Dale Burghardt says it was an optimal time for a subdivision on his grandfather's former cattle farm, with available land in the urban growth boundary dwindling. "We waited until the time was right to do a development."

Realtor Joe Mann says 1,000 new stick-built homes will go up in the Molalla city limits in the next two to five years, according to growth projections.

The families that are moving into the area are changing the demographics of the town.

"I've seen this community transition . . . from a timber community to a community of a real cross section of people," explains Mann, who has lived in Molalla for about 20 years.

Mann remembers four working sawmills within the city limits when he moved to Molalla, but now only two exist. Although some residents continue to work in the woods or in wood-related jobs, local employment is shifting toward light industry and local services. Newcomers tend to commute to work outside of Molalla.

A Molalla School Board survey indicated that families moved to the area because it's a small town with a small school district, says Mann, a school board member. Seventy percent of the people who answered the survey said they own their own computers, he adds.

"I'm sure we have a lot of people working out of their homes with their own computers."

Wild West past

Finney and Ruth Bohlander moved to Molalla from Beaver Creek about 50 years ago when Finney got a job with a logging company. They lived on the north fork of the Molalla River, says Ruth Bohlander. "The houses were as hard to get then as they are now."

The couple bought 3 acres in town for $500 in 1951 and have 7 acres now, says Ruth Bohlander, 76. Everyone knows where the Bohlanders live, because they're the only ones in town with a herd of sheep. Finney Bohlander, 79, still logs, and the couple has always enjoyed spending their free time in the woods.

The Bohlanders donated land to the city for parking at the Buckeroo grounds and, Ruth says, they plan to donate more for a swimming pool.

Another old timer, Alfred "Al" Shaver, 94, grows Christmas trees on 25 acres 3 miles south of town. The Molalla of his boyhood "was a typical western town," Shaver says.

The first settlers came to Molalla in the 1800s because of fertile soil and abundant water, according to the city history published by the Molalla Area Chamber of Commerce. The main industry was lumber, and grain and hay also were big agricultural crops.

The town grew around the current intersection of Molalla Avenue and Main Street and received its name from the Indian tribe that occupied the area. By 1856, Molalla was a thriving agricultural and trade center with many houses and schools. A general store soon opened and various sawmills started lumber manufacturing, which became the town's main industry. Molalla incorporated in 1913.

During the '20s and '30s, the town doubled in size. It grew again during the '40s and in the '70s, and also became more diverse, real estate agent Gengler says. Many Russian "Old Believers" came to Molalla about 30 years ago, and Hispanics have moved into the area to work the farms, she explains.

"It's an ideal place. It's got a nice river and trees. But we don't know our neighbors like we used to," says longtime resident and former Buckeroo queen Ellen Thronson, 73. "Many people moving here come here because they want to be left alone."

But most of Molalla's old timers really don't object to the current rapid increase in population. In fact, many people see it as a way to bring more business to the downtown merchants.

"It's inevitable. The population of the country is increasing and people are moving out of the city," says longtime resident Shaver. "I don't object to it. It's my thought that as the town grows, businesses will grow too."

"You're always going to get people who want it to stay a small-town community," adds real estate agent James, whose parents have owned a western store in Molalla for about 14 years. "But also there's those who know growth is going to happen and want to plan for it so it's done well.

"I don't hear people moving because Molalla is getting too big."

Looking forward

Through the changes, the community has remained compatible, Mann adds. "Crime out here is practically nil. There are a few auto infractions, some illicit drugs, some acting up, but not much, and so far no gang problems."

Molalla saw its first homicide in six years in 1994, and nobody can remember when the last bank robbery occurred, says Molalla Police Chief Rob Elkins, who has been there eight years. "What's kind of surprising is in 1988, we had one of the highest crime rates per capita in the area, but since then crime has steadily decreased."

Molalla has taken its first steps toward planning for the future. Molalla City Administrator Harvey Barnes came to town Aug. 1, moving to Molalla from Burns. One of his first steps was to hire a city planner. Seana Perkins, 22, of Banks, started Nov. 20.

With the increase of people and houses, Molalla needs to expand its water and sewer systems, Barnes explains. The city is working on plans for new facilities. The city is working on a new water, sewer, storm drain and street facilities plan, and Barnes hopes they will have expanded water and sewer systems in about two years.

Looking to the future, Barnes has other goals. "We'd like to see more jobs here locally," Barnes says. "We'd like to see some more industrial development occur." Some land is available for industrial development, he adds.

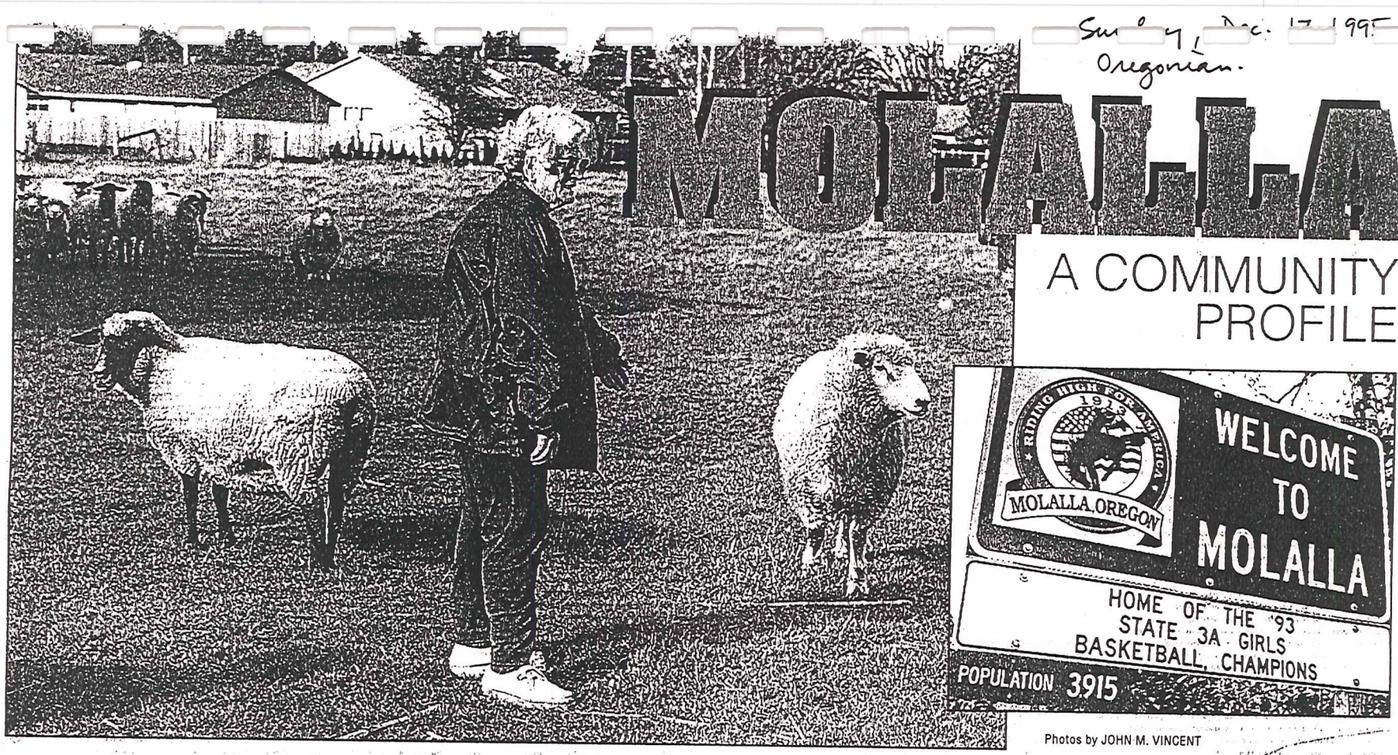
Agriculture doesn't promise the opportunities it once did, says Thronson. "A lot of the old timers got to where they couldn't farm and sold their land." Now many people work out of town. But that's OK, she says.

"Molalla will always be Molalla to me," Thronson says. "There's just lots more people, but a smile to the new people makes them feel like they're a part of the district."

Sun. Dec. 17, 1995
Oregonian.

MOLALLA

A COMMUNITY PROFILE



Photos by JOHN M. VINCENT

Ruth Bohlander, above, and her husband, Finney, moved to Molalla from Beaver Creek about 50 years ago. Molalla residents know where the Bohlanders live, because they're the only ones in town with a herd of sheep.

By LINDA CAMPILLO
Special Writer

It's a little bit country. It's a little bit Western. The place is Molalla, and the tiny town of 4,000 seems to have what many home buyers are looking for right now.

"We're seeing a large influx of people moving in," says Shirley Pierce, Molalla Visitor Center coordinator. "We had 26 families move (here) in September."

Nine more came in October, she says, and another 10 arrived in November, along with four new businesses.

Located about 17 miles south of Oregon City, the once sleepy lumber town is awakening as new families move into the area.

The town of Molalla (pronounced by old timers as MO-la-la) conjures visions of the old west, with facade-fronted buildings lining several small streets. All the basic services are downtown: grocery stores, banks, pharmacies, restaurants, a Western store, thift store and a few boutiques. The Molalla River skirts the town about 4 miles to the east.

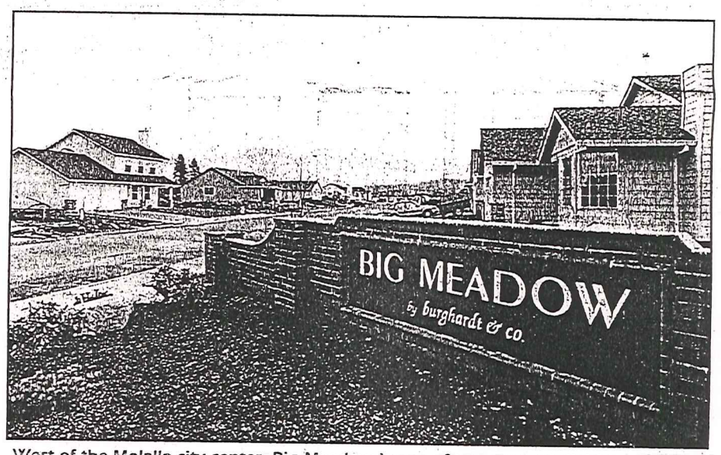
Homes in the downtown area are mainly single-story ranch style with some two-story farm houses, all sitting on flat lots. Trees dot the area, but the landscape is basically open.

Two new subdivisions are under construction: Shel-Mar Acres to the north has 90 lots, and Big Meadow to the west will include 346 lots. Developers say they're selling houses faster than projected, with price tags in the $109,000 to $155,000 range for 1,400 to 1,500 square feet. A few custom homes in Shel-Mar will sell for around $200,000, says Joe Mann, real estate agent with Heritage Real Estate Inc.

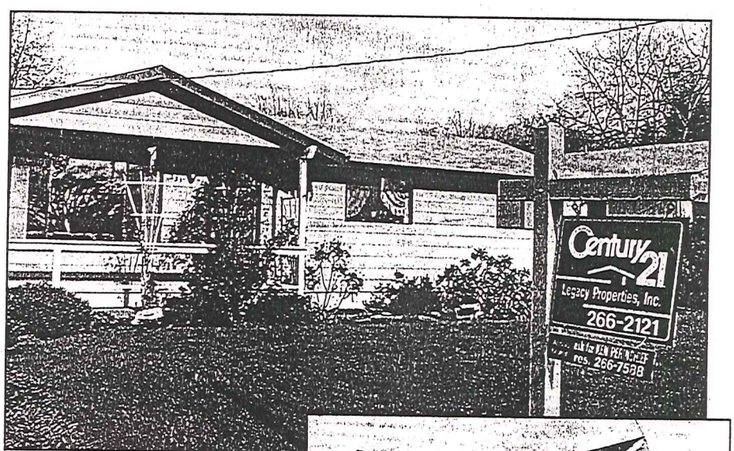
Both subdivisions offer large lots, starting at more than 6,000 square feet. Some sites capture views of Mount Hood.

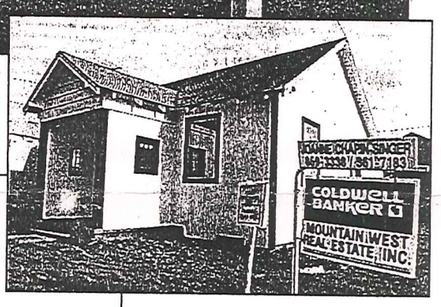
A new shopping center also is being proposed at the west end of town near Big Meadow, which would bring a major grocery store and several other businesses to the area.

Please turn to Profile, Page H2

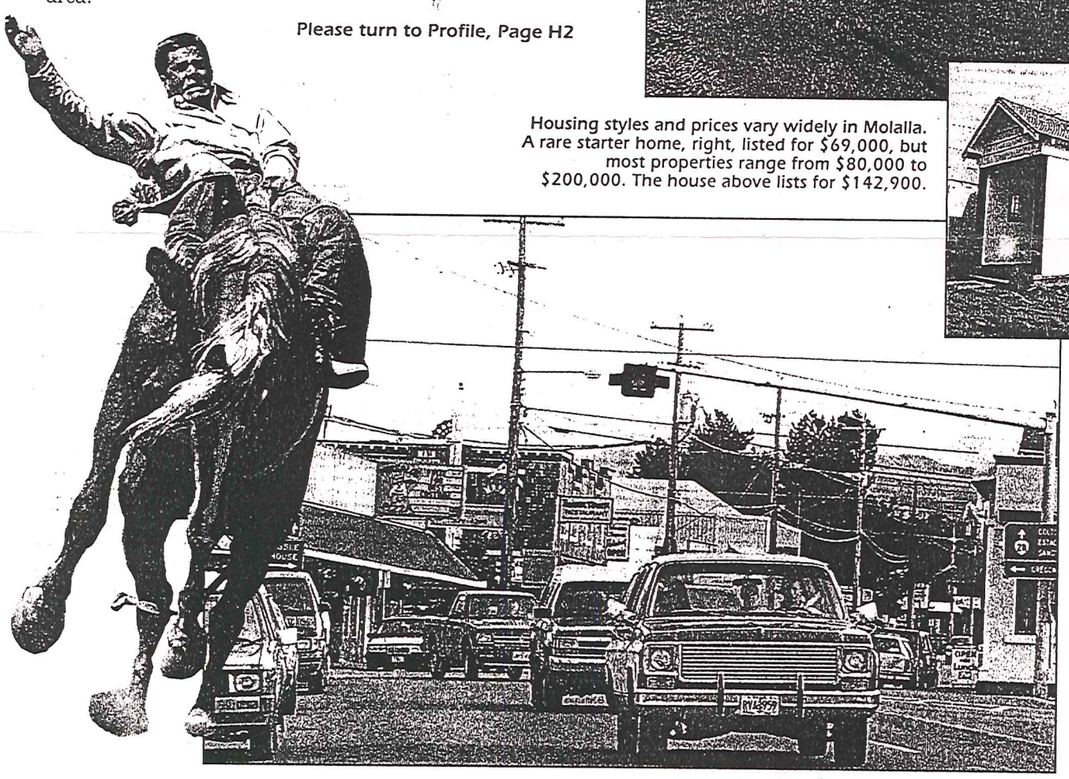


West of the Molalla city center, Big Meadow is one of two new subdivisions in town. When complete it will have 346 houses on lots starting at 6,000 square feet.





Housing styles and prices vary widely in Molalla. A rare starter home, right, listed for $69,000, but most properties range from $80,000 to $200,000. The house above lists for $142,900.



Molalla still has an Old West feel, but the once sleepy town is awakening with the steady influx of new families.

APPENDIX E

MINIMUM RAW WATER SAMPLING REQUIREMENTS AND RECENT ANALYTICALS

Oregon Health Division
Drinking Water Section
731-4381

Community Water System
Routine Chemical Monitoring*

For Jan. 1996 to Dec. 1998 Compliance Period

Chemicals	Surface Water	Ground Water
Inorganics	Yearly	One
Nitrate	Quarterly[1]	Yearly
Asbestos — AC Pipe	None[2]	
Asbestos — Source	None[2]	
Synthetic Organics	One in 3 yr. period	
Unregulated SOC	One "	
Volatile Organic	One "	
Unregulated VOC	One "	
Trihalomethane	Quarterly	
Radiological	Every 4 years	
Lead and Copper Rule	Yearly	

*This table describes the routine monitoring you must do. Waivers, reductions, wellhead protection programs, or detections will affect the sampling requirements. You will find details on number, location and timing of samples in the rule book.

Inorganics: testing may be reduced to one sample every 9 years if three rounds of sampling are completed and there are no MCL violations.

Nitrate: goes to quarterly sampling whenever a sample exceeds 5.0 mg/l.

SOC, VOC and unregulated SOC, VOC: testing may be reduced to one sample every 9 years if the system has a state approved wellhead protection program or a waiver.

Trihalomethanes: Trihalomethanes are monitored only by systems with a population of 10,000 or more.

Unregulated Chemicals: Systems with fewer than 150 connections are not required to test for unregulated synthetic or unregulated volatile organics if a waiver is requested in writing.

[1] Nitrate: testing for surface systems can be reduced to annually after 4 quarters of sampling and a reduction is requested in writing.
[2]Asbestos: routine monitoring is one sample every nine years. Monitoring will go to one sample every 3 years if the system exceeds Lead or Copper action levels.

This table supersedes previous editions. Rev 3/22/05

Contaminants and Maximum Levels

Inorganic

	mg/l
Antimony Total	0.006
Arsenic	0.05
Asbestos	7 MFL[1]
Barium	2
Beryllium Total	0.004
Cadmium	0.005
Chromium	0.1
Copper	1.3*
Cyanide	0.2
Fluoride	4.0
Lead	0.015*
Mercury	0.002
Nickel	0.1
Nitrate	10
Nitrate-Nitrite	10
Nitrite	1
Selenium	0.05
Sodium	20[2]
Sulfate	
Thallium Total	0.002

Volatile Organics

1,1-Dichloroethane‡	
1,1-Dichloroethylene	0.007
1,1-Dichloropropene‡	
1,1,1-Trichloroethane	0.2
1,1,1,2-Tetrachloroethane‡	
1,1,2-Trichloroethane	0.005
1,1,2,2-Tetrachloroethane‡	
1,2-Dichloropropane	0.005
1,2-Dichloroethane	0.005
1,2,3-Trichloropropane‡	
1,2,4-Trichlorobenzene	0.07
1,3-Dichloropropane‡	
1,3-Dichloropropene‡	
2,2-Dichloropropane‡	
Benzene	0.005
Bromobenzene‡	
Bromodichloromethane‡	
Bromoform‡	
Bromomethane‡	
Carbon Tetrachloride	0.005
Chlorodibromomethane ‡	
Chloroethane‡	
Chloroform‡	
Chloromethane‡	
o-Chlorotoluene‡	
p-Chlorotoluene‡	
Cis-1,2-Dichloroethylene	0.07
Dibromomethane‡	
m-Dichlorobenzene‡	
Dichloromethane	0.005
Ethylbenzene	0.7
Monochlorobenzene	0.1
O-Dichlorobenzene	0.6
P-Dichlorobenzene	0.075
Styrene	0.1
Tetrachloroethylene	0.005
Toluene	1.0
Total Xylenes	10.0
Trans-1,2-Dichloroethylene	0.1
Trichloroethylene	0.005
Vinyl Chloride	0.002

Synthetic Organics

	mg/l
2,4-D	0.07
2,4,5-TP Silvex	0.05
3-Hydroxycarbofuran‡	
Adipates	0.4
Alachlor (Lasso)	0.002
Aldicarb	
Aldicarb Sulfoxide	
Aldicarb Sulfone	
Aldrin‡	
Atrazine	0.003
Benzo(A)Pyrene	0.0002
BHC-gamma (Lindane)	0.0002
Butachlor‡	
Carbofuran	0.04
Carbaryl‡	
Chlordane	0.002
Dalapon	0.2
Dibromochloropropane	0.0002
Dicamba‡	
Dieldrin‡	
Dinoseb	0.007
Dioxin	$3x10^{-8}$
Diquat	0.02
Endothall	0.1
Endrin	0.002
Ethylene Dibromide (EDB)	0.00005
Glyphosate	0.7
Heptachlor Epoxide	0.0002
Heptachlor	0.0004
Hexachlorobenzene (HCB)	0.001
Hexachlorocyclopentadiene	0.05
Methomyl‡	
Methoxychlor	0.04
Metolachlor‡	
Metribuzin‡	
Pentachlorophenol	0.001
Phthalates	0.006
Picloram	0.5
Polychlorinated Biphenyls (PCB)	0.0005
Propachlor‡	
Simazine	0.004
Toxaphene	0.003
Vydate	0.2

‡ Unregulated organics.
[1] Million Fibers per Liter
[2] Advisory only
* Action Level

APPENDIX F
WELL LOGS

The original and first copy of this report are to be filed with the STATE ENGINEER, SALEM, OREGON 97310 within 30 days from the date of well completion.

WATER WELL REPORT

STATE OF OREGON (Please type or print) (Do not write above this line)

MAY 1 1975 STATE ENGINEER SALEM, OREGON

State Well No. 5S/2E-5

State Permit No.

CLAC 009944

(1) OWNER:

Name Richard D. Moorhouse

Address Rt. 3, Box 180 Molalla, Oregon 97038

(2) TYPE OF WORK (check):

New Well ☒ Deepening ☐ Reconditioning ☐ Abandon ☐

If abandonment, describe material and procedure in Item 12.

(3) TYPE OF WELL:

Rotary ☐ Driven ☐
Cable ☒ Jetted ☐
Dug ☐ Bored ☐

(4) PROPOSED USE (check):

Domestic ☐ Industrial ☐ Municipal ☐
Irrigation ☒ Test Well ☐ Other ☐

CASING INSTALLED:

Threaded ☐ Welded ☐

" Diam. from ft. to ft. Gage

" Diam. from ft. to ft. Gage

" Diam. from ft. to ft. Gage

PERFORATIONS:

Perforated? ☒ Yes ☐ No.

Type of perforator used Mills knife

Size of perforations 3/8 in. by 4 in.

72 perforations from 128 ft. to 132 ft.

88 perforations from 148 ft. to 152 ft.

56 perforations from 216 ft. to 220 ft.

(7) SCREENS:

Well screen installed? ☐ Yes ☐ No

Manufacturer's Name

Type Model No.

Diam. Slot size Set from ft. to ft.

Diam. Slot size Set from ft. to ft.

(8) WELL TESTS:

Drawdown is amount water level is lowered below static level Stettler 2nd day

Was a pump test made? ☒ Yes ☐ No If yes, by whom? Supply

Yield: 810 gal./min. with 96 ft. drawdown after 3/4 hrs.

810 " 104 " 21/2 "

" " "

Bailer test gal./min. with ft. drawdown after hrs.

Artesian flow g.p.m.

Temperature of water Depth artesian flow encountered ft.

(9) CONSTRUCTION:

Well seal--Material used

Well sealed from land surface to ft.

Diameter of well bore to bottom of seal in.

Diameter of well bore below seal in.

Number of sacks of cement used in well seal sacks

Number of sacks of bentonite used in well seal sacks

Brand name of bentonite

Number of pounds of bentonite per 100 gallons of water lbs./100 gals.

Was a drive shoe used? ☐ Yes ☐ No Plugs Size: location ft.

Did any strata contain unusable water? ☐ Yes ☐ No

Type of water? depth of strata

Method of sealing strata off

Was well gravel packed? ☐ Yes ☐ No Size of gravel:

Gravel placed from ft. to ft.

(10) LOCATION OF WELL:

County Clackamas Driller's well number

NE ¼ ¼ Section 5 T. 5S R. 2E W.M.

Bearing and distance from section or subdivision corner

(11) WATER LEVEL: Completed well.

Depth at which water was first found ft.

Static level ft. below land surface. Date

Artesian pressure lbs. per square inch. Date

(12) WELL LOG:

Diameter of well below casing

Depth drilled ft. Depth of completed well ft.

Formation: Describe color, texture, grain size and structure of materials; and show thickness and nature of each stratum and aquifer penetrated, with at least one entry for each change of formation. *Report each change in position of Static Water Level and indicate principal water-bearing strata.*

Cont. MATERIAL	From	To	SWL
Clay, grey, soft	189	210	
Clay, blue to grey	210	218	
Sand, grey, coarse	218	222	23
Clay, grey	222	256	
Clay, blue	256	270	
Clay, grey	270	305	
Clay dark grey to black	305	308	
Sand, black, med. with gravel from pea to med.	308	313	27
Clay, wood & gravel	313	315	
Sand, black, med. wood	315	321	27

Work started 2/10 1975 Completed 4/4 1975

Date well drilling machine moved off of well 4/5 1975

Drilling Machine Operator's Certification:

This well was constructed under my direct supervision. Materials used and information reported above are true to my best knowledge and belief.

[Signed] C. G. Westerberg (Drilling Machine Operator) Date 4/25, 19 75

Drilling Machine Operator's License No. 86

Water Well Contractor's Certification:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

Name C. G. Westerberg (Person, firm or corporation) (Type or print)

Address Rt. 1, Box 151, Mulino, Oregon

[Signed] C. G. Westerberg (Water Well Contractor)

Contractor's License No. 86 Date 4/25, 19 75

(USE ADDITIONAL SHEETS IF NECESSARY)

SP-45656-119

55/2E/5ac

STATE OF OREGON
WATER WELL REPORT
(as required by ORS 537.765)

clac 17723

(START CARD) # 37298

(1) OWNER: Well Number
Name Richard Moorhouse
Address 12775 S. Barnards Rd.
City Molalla, Or. 97038 State Zip

(2) TYPE OF WORK:
[X] New Well [ ] Deepen [ ] Recondition [ ] Abandon

(3) DRILL METHOD:
[ ] Rotary Air [ ] Rotary Mud [X] Cable
[ ] Other

(4) PROPOSED USE:
[ ] Domestic [ ] Community [ ] Industrial [X] Irrigation
[ ] Thermal [ ] Injection [ ] Other

(5) BORE HOLE CONSTRUCTION:
Special Construction approval [ ] Yes [X] No Depth of Completed Well 350 ft.
Explosives used [ ] Yes [X] No Type Amount

HOLE Diameter	From	To	SEAL Material	From	To	Amount sacks or pounds
16"	0	33	Cement w/5%	0	24	56 sacks
			bentonite.			
12"	33	350				
8"	350	380				

How was seal placed: Method [ ] A [ ] B [X] C [ ] D [ ] E
[ ] Other
Backfill placed from ft. to ft. Material
Gravel placed from ft. to ft. Size of gravel

(6) CASING/LINER:

	Diameter	From	To	Gauge	Steel	Plastic	Welded	Threaded
Casing:	12"	+1	300	.250	X		X	
	12"	300	320	.375	X		X	
Liner:								

Final location of shoe(s) 320'

(7) PERFORATIONS/SCREENS:
[X] Perforations Method Millsknife
[ ] Screens Type Material

From	To	Slot Size	Number	Diameter	Tele/pipe size	Casing	Liner
100	133	3/8x3	544			X	
140	144	3/8x3	83			X	
173	180	3/8x3	115			X	
185	193	3/8x3	132			X	
208	224	3/8x3	264	(Con't on pg. 2		X	

(8) WELL TESTS: Minimum testing time is 1 hour
[X] Pump [ ] Bailer [ ] Air [ ] Flowing Artesian

Yield gal/min	Drawdown	Drill stem at	Time
500	78		1 hr.
900	164		6 hr.
750	146		8 hr.

Temperature of Water 56° Depth Artesian Flow Found
Was a water analysis done? [ ] Yes By whom No
Did any strata contain water not suitable for intended use? [ ] Too little
[ ] Salty [ ] Muddy [ ] Odor [ ] Colored [ ] Other No
Depth of strata

(9) LOCATION OF WELL by legal description:
County Clackamas Latitude Longitude
Township 5S N or S. Range 2E E or W. WM
Section 5 SW ¼ NE ¼
Tax Lot 301 Lot Block Subdivision
Street Address of Well (or nearest address) Vick Rd. Molalla.
North of Vick Rd. and West of R.R. tracks

(10) STATIC WATER LEVEL:
20' ft. below land surface. Date 2/7/92
Artesian pressure lb. per square inch. Date

(11) WATER BEARING ZONES:
Depth at which water was first found 54'

From	To	Estimated Flow Rate	SW
100	133	--	
140	144	--	
173	180	--	
185	193 (Con't.)	--	

(12) WELL LOG:
Ground elevation

Material	From	To	SW
Topsoil	0	2	
Clay tan	2	9	
Cobbles med. to large with			
clay and gravel.	9	31	
Cemented gravel w/some clay	31	86	
Clay brn. gritty	86	88	
Cemented gravel brn.	88	118	
Clay brn.	118	119	
Gravel and clay brn.	119	132	
Clay tan	132	140	
Sand brn. med. course	140	143	
Clay brn.	143	150	
Sandstone grey.	150	155	
Clay grey sticky	155	166	
Clay green sandy	166	174	
Sand grey-black course w/clay	174	179	
Clay brn. w/wood	179	186	
Clay brn. w/sand	186	192	
Sand grey med. fine	192	194	
Clay grey	194	202	
Clay blue-green	202	209	
Sand and clay green course	209	214	

Date started 1-8-92 Completed 2-7-92

(unbonded) Water Well Constructor Certification:
I certify that the work I performed on the construction, alteration, or aba
ment of this well is in compliance with Oregon well construction standards. Ma
used and information reported above are true to my best knowledge and belie
WESTERBERG DRILLING INC.
31850 S. Hwy. 213 WWC Number 68
Signed P.O. Box 562 Date
Molalla, OR 97038
(bonded) Water Well Constructor Certification: 829-8526
I accept responsibility for the construction, alteration, or abandonment wor
formed on this well during the construction dates reported above. All work perf
during this time is in compliance with Oregon well construction standards. This
is true to the best of my knowledge and belief WWC Number 68
Signed Steven N. Strahl Date 2-23-92

STATE OF OREGON WATER WELL REPORT
(as required by ORS 537.765)

CLAC 2001A

Instructions for completing this report are on the last page of this form.

Westerberg Drilling, Inc.
36728 S. Kropf Rd.
Molalla, OR 97038
503-829-2526

RECEIVED
MAR - 6 1995
WATER RESOURCES DEPT.
SALEM, OREGON

5S/2E/4K

(START CARD) # 73186

(1) OWNER: Well Number

Name ROY MOORHOUSE
Address 13963 S. VICK RD.
City MOLALLA State OR Zip 97038

(2) TYPE OF WORK

[X] New Well [ ] Deepening [ ] Alteration (repair/recondition) [ ] Abandonment

(3) DRILL METHOD:

[ ] Rotary Air [ ] Rotary Mud [X] Cable [ ] Auger
[ ] Other

(4) PROPOSED USE:

[ ] Domestic [ ] Community [ ] Industrial [X] Irrigation
[ ] Thermal [ ] Injection [ ] Livestock [ ] Other

(5) BORE HOLE CONSTRUCTION:

Special Construction approval [ ] Yes [X] No Depth of Completed Well 340 ft.
Explosives used [ ] Yes [X] No Type Amount

HOLE Diameter	From	To	SEAL Material	From	To	Sacks or pounds
16	0	38	CEMENT	0	15	23 SACKS
			BENTONITE	15	38	22 SACKS
12	38	400				
			8' CEMENT PLUG	338	346	

How was seal placed: Method [ ] A [ ] B [X] C [ ] D [ ] E
[ ] Other
Backfill placed from 346 ft. to 400 ft. Material HOLE CAVED
Gravel placed from ft. to ft. Size of gravel

(6) CASING/LINER:

	Diameter	From	To	Gauge	Steel	Plastic	Welded	Threaded
Casing:	12	+2	340	.250	[X]	[ ]	[X]	[ ]
					[ ]	[ ]	[ ]	[ ]
					[ ]	[ ]	[ ]	[ ]
					[ ]	[ ]	[ ]	[ ]
Liner:					[ ]	[ ]	[ ]	[ ]
					[ ]	[ ]	[ ]	[ ]

Final location of shoe(s) 340

(7) PERFORATIONS/SCREENS:

[X] Perforations Method MILLS KNIFE
[ ] Screens Type Material

From	To	Slot size	Number	Diameter	Tele/pipe size	Casing	Liner
100	122	3/8x3	363			[X]	[ ]
148	218	3/8x3	1155			[X]	[ ]
276	304	3/8x3	462			[X]	[ ]
						[ ]	[ ]
						[ ]	[ ]

(8) WELL TESTS: Minimum testing time is 1 hour

[ ] Pump [X] Bailer [ ] Air [ ] Flowing Artesian

Yield gal/min	Drawdown	Drill stem at	Time
105	21		1 hr.
PUMP TEST NOT YET PERFORMED			

Temperature of water 54 Depth Artesian Flow Found
Was a water analysis done? [ ] Yes By whom
Did any strata contain water not suitable for intended use? [ ] Too little
[ ] Salty [ ] Muddy [ ] Odor [ ] Colored [ ] Other
Depth of strata:

(9) LOCATION OF WELL by legal description:

County CLACKAMAS Latitude Longitude
Township 5S N or S Range 2E E or W. WM.
Section 4 SW 1/4 NW 1/4
Tax Lot 300 Lot Block Subdivision
Street Address of Well (or nearest address)
13963 S. VICK RD.

(10) STATIC WATER LEVEL:

13 ft. below land surface. Date 2-16-95
Artesian pressure lb. per square inch. Date

(11) WATER BEARING ZONES:

Depth at which water was first found 36

From	To	Estimated Flow Rate	SWL
100	304	~100+	13

(12) WELL LOG:

Ground Elevation

IN Material	From	To	SWL
TOPSOIL	0	1	
CLAY BROWN	1	5	
COBBLES WITH CLAY	5	28	
CEMENTED GRAVEL & CLAY BRN	28	83	
CLAY BROWN	83	84	
CEMENTED GRAVEL & CLAY	84	109	
CLAY GREY W/some GRAVEL	109	122	
CLAY GREY	122	134	
CLAY BLUE/GREEN	134	148	
CLAY GREEN W/STREAKS OF SAND	148	157	
SAND BLK CEMENTED W/SMALL GRAVEL	157	174	
CLAY GREY W/STREAKS OF SAND	174	201	
GRAVEL & SAND LOOSELY CMTD	201	207	
CLAY GREY W/SOME GRAVEL	207	218	
CLAY BLUE GREEN	218	261	
CLAY GREY	261	276	
SAND FINE GREY & GRAVEL CMTD	276	282	
CLAY GREY STICKY W/SOME GRAVEL	282	304	

Date started 1-7-95 Completed 2-16-95

(unbonded) Water Well Constructor Certification:

I certify that the work I performed on the construction, alteration, or abandonment of this well is in compliance with Oregon water supply well construction standards. Materials used and information reported above are true to the best of my knowledge and belief.

WWC Number
Signed Date

(bonded) Water Well Constructor Certification:

I accept responsibility for the construction, alteration, or abandonment work performed on this well during the construction dates reported above. All work performed during this time is in compliance with Oregon water supply well construction standards. This report is true to the best of my knowledge and belief.

WWC Number 688
Signed Steven N. Stabile Date 2-28-95

ORIGINAL & FIRST COPY-WATER RESOURCES DEPARTMENT SECOND COPY-CONSTRUCTOR THIRD COPY-CUSTOMER

16

CLAC 20304

RECEIVED
JUN - 7 1995
WATER RESOURCES DEPT.
SALEM, OREGON

5S/2E/4bc

STATE OF OREGON WATER WELL REPORT
(as required by ORS 537.765)

(START CARD) # 73194

Instructions for completing this report are on the last page of this form.

(1) OWNER: Well Number

Name ROY MOORHOUSE

Address 13963 S. VICK RD.

City MOLALLA State OR Zip 97038

(2) TYPE OF WORK

☐ New Well ☐ Deepening ☒ Alteration (repair/recondition) ☐ Abandonment

(3) DRILL METHOD:

☐ Rotary Air ☐ Rotary Mud ☒ Cable ☐ Auger

☐ Other

(4) PROPOSED USE:

☐ Domestic ☐ Community ☐ Industrial ☒ Irrigation

☐ Thermal ☐ Injection ☐ Livestock ☐ Other

(5) BORE HOLE CONSTRUCTION:

Special Construction approval ☐ Yes ☒ No Depth of Completed Well 338 ft.

Explosives used ☐ Yes ☒ No Type Amount

HOLE Diameter	From	To	SEAL Material	From	To	Sacks or pounds
NO DRILLING OR SEALING PERFORMED						

How was seal placed: Method ☐ A ☐ B ☐ C ☐ D ☐ E

☐ Other

Backfill placed from ft. to ft. Material

Gravel placed from 48 ft. to 338 ft. Size of gravel 8/12 CSS

(6) CASING/LINER:

	Diameter	From	To	Gauge	Steel	Plastic	Welded	Threaded
Casing:	8	+2	101	250	☒	☐	☒	☐
	8	111	148	250	☒	☐	☒	☐
	8	174	198	250	☒	☐	☒	☐
	8	210	276	250	☒	☐	☒	☐
Liner:	8	304	338	250	☒	☐	☒	☐
					☐	☐	☐	☐

Final location of shoe(s)

(7) PERFORATIONS/SCREENS:

☐ Perforations Method

☒ Screens Type V-WIRE Material STAINLESS

From	To	Slot size	Number	Diameter	Tele/pipe size	Casing	Liner
101	111	.028		8	P/S	☒	☐
148	174	.028		8	P/S	☐	☐
198	210	.028		8	P/S	☐	☐
276	304	.028		8	P/S	☐	☐
BOTTOM PLATE WELDED ON AT 338						☐	☐

(8) WELL TESTS: Minimum testing time is 1 hour

☒ Pump ☐ Bailer ☐ Air ☐ Flowing Artesian

Yield gal/min	Drawdown	Drill stem at	Time
300	103		1 hr.
350	183		5
325	180		7.75

Temperature of water 54 Depth Artesian Flow Found

Was a water analysis done? ☐ Yes By whom

Did any strata contain water not suitable for intended use? ☐ Too little

☐ Salty ☐ Muddy ☐ Odor ☐ Colored ☐ Other

Depth of strata:

(9) LOCATION OF WELL by legal description:

County CLACKAMAS Latitude Longitude

Township 5S N or S Range 2E E or W. WM.

Section 4 SW 1/4 NW 1/4

Tax Lot 300 Lot Block Subdivision

Street Address of Well (or nearest address)

13963 S. VICK RD.

(10) STATIC WATER LEVEL:

13 ft. below land surface. Date 4-29-95

Artesian pressure lb. per square inch. Date

(11) WATER BEARING ZONES:

Depth at which water was first found

From	To	Estimated Flow Rate	SWL
NO DRILLING			

(12) WELL LOG:

Ground Elevation

Material	From	To	SWL

Westerberg Drilling, Inc.
36728 S. Kropf Rd.
Molalla, OR 97038
829-2526

Date started 4-26-95 Completed 4-29-95

(unbonded) Water Well Constructor Certification:

I certify that the work I performed on the construction, alteration, or abandonment of this well is in compliance with Oregon water supply well construction standards. Materials used and information reported above are true to the best of my knowledge and belief.

WWC Number

Signed Date

(bonded) Water Well Constructor Certification:

I accept responsibility for the construction, alteration, or abandonment work performed on this well during the construction dates reported above. All work performed during this time is in compliance with Oregon water supply well construction standards. This report is true to the best of my knowledge and belief.

WWC Number 688

Signed Steven N. Stadeli Date 5-2-95

ORIGINAL & FIRST COPY-WATER RESOURCES DEPARTMENT SECOND COPY-CONSTRUCTOR THIRD COPY-CUSTOMER

010027

P9

NOTICE TO WATER WELL CONTRACTOR
The original and first copy of this report are to be filed with the STATE ENGINEER, SALEM, OREGON 97310 within 30 days from the date of well completion.

RECEIVED
JUN 3 1965
STATE ENGINEER
SALEM, OREGON

WATER WELL REPORT
STATE OF OREGON
(Please type or print)

CLAC

State Well No. 5/2-7L

State Permit No.

(1) OWNER: Stettler Supply Co.

Name George Kyllo

Address Rt. 3, Box 235
Molalla, Oregon

(2) LOCATION OF WELL:

County Clackamas Driller's well number

NE ¼ SW ¼ Section 7 T. 5S R. 2E W.M.

Bearing and distance from section or subdivision corner

(3) TYPE OF WORK (check):

New Well [X] Deepening [ ] Reconditioning [ ] Abandon [ ]

If abandonment, describe material and procedure in Item 12.

(4) PROPOSED USE (check):

Domestic [ ] Industrial [ ] Municipal [ ]
Irrigation [X] Test Well [ ] Other [ ]

(5) TYPE OF WELL:

Rotary [ ] Driven [ ]
Cable [X] Jetted [ ]
Dug [ ] Bored [ ]

(6) CASING INSTALLED: Threaded [ ] Welded [X]

10 " Diam. from plus 1 ft. to 302 ft. Gage .279
8 " Diam. from 298 ft. to 347 ft. Gage .250
" Diam. from ft. to ft. Gage

(7) PERFORATIONS: Perforated? [X] Yes [ ] No

Type of perforator used Cut by torch

Size of perforations 1/4 in. by 9 in.

190 perforations from 321 ft. to 346 ft.
perforations from ft. to ft.
perforations from ft. to ft.
perforations from ft. to ft.
perforations from ft. to ft.

(8) SCREENS: Well screen installed? [ ] Yes [X] No

Manufacturer's Name
Model No.
Slot size Set from ft. to ft.
Diam. Slot size Set from ft. to ft.

(9) CONSTRUCTION:

Well seal—Material used in seal Clay & cuttings
Depth of seal 24 ft. Was a packer used? No
Diameter of well bore to bottom of seal 12 in.
Were any loose strata cemented off? [ ] Yes [X] No Depth
Was a drive shoe used? [X] Yes [ ] No
Was well gravel packed? [ ] Yes [X] No Size of gravel:
Gravel placed from ft. to ft.
Did any strata contain unusable water? [ ] Yes [X] No
Type of water? depth of strata
Method of sealing strata off

(10) WATER LEVELS:

Static level 112 ft. below land surface Date 5/22/65
Artesian pressure lbs. per square inch Date

(11) WELL TESTS: Drawdown is amount water level is lowered below static level

Was a pump test made? [X] Yes [ ] No If yes, by whom? Stettler Supply Co.
Yield: 575 gal./min. with 80 ft. drawdown after 8 hrs.
" " " "
" " " "
Bailer test gal./min. with ft. drawdown after hrs.
Artesian flow g.p.m. Date
Temperature of water 58 Was a chemical analysis made? [ ] Yes [X] No

(12) WELL LOG: Diameter of well below casing

Depth drilled 347 ft. Depth of completed well 339 ft.

Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of formation.

MATERIAL	FROM	TO
Top soil	0	1
Clay, tan	1	4
River rock to boulder size	4	30
Coarse gravel to small boulders	30	43
Clay, tan	43	48
Clay, fine sand in clay	48	58
Clay, brown, coarse sand and fine gravel (dry)	58	63
Sand, brown	63	70
Sandy brown clay	70	80
Sand, brown (26 gal. m. depth of 82 ft.)	80	85
Sandy tan clay	85	98
Sandy formation fine (sandstone)	98	105
Coarse brown sand (sandstone) (tested at 100 gal. m.)	105	110
Sandy clay	110	113
Clay, tan	113	117
Clay, blue	117	138
Gritty blue formation	138	141
Clay, blue toa grey color	141	165
Clay, blue	165	195

Work started 4/27 1965 Completed 5/24 1965

Date well drilling machine moved off of well 5/24 1965

(13) PUMP:

Manufacturer's Name
Type: H.P.

Water Well Contractor's Certification:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

NAME C. G. Westerberg (Person, firm or corporation) (Type or print)

Address Rt. 1, Box 151, Mulino, Oregon

Drilling Machine Operator's License No. 86

[Signed] C. G. Westerberg (Water Well Contractor)

Contractor's License No. 86 Date 5/28, 1965

(USE ADDITIONAL SHEETS IF NECESSARY)

are to be filed with the
WATER RESOURCES DEPARTMENT
SALEM, OREGON 97310
within 30 days from the date
of well completion.

WATER WELL REPORT
STATE OF OREGON
(Please type or print)

RECEIVED
APR 12 1977
WATER RESOURCES DEPT.
SALEM, OREGON

State Well No. 5S/2E-4bd

(Do not write above this line) State Permit No. 09924

(1) OWNER:
Name Joseph H. Brinkman
Address Rt. 4, Box 436
Molalla, Oregon 97038

(2) TYPE OF WORK (check):
New Well ☑ Deepening ☐ Reconditioning ☐ Abandon ☐
If abandonment, describe material and procedure in Item 12.

(3) TYPE OF WELL:
Rotary ☐ Driven ☐
Cable ☒ Jetted ☐
Dug ☐ Bored ☐

(4) PROPOSED USE (check):
Domestic ☒ Industrial ☐ Municipal ☐
Irrigation ☒ Test Well ☐ Other ☐

CASING INSTALLED:
Threaded ☐ Welded ☒
" Diam. from 1 ft. to 98 ft. Gage .250
6 " Diam. from 96 ft. to 137 ft. Gage .250
" Diam. from ft. to ft. Gage

PERFORATIONS:
Perforated? ☒ Yes ☐ No
Type of perforator used Torch
Size of perforations 3/16 in. by 9 in.
104 perforations from 98 ft. to 138 ft.
perforations from ft. to ft.
perforations from ft. to ft.

(7) SCREENS:
Well screen installed? ☐ Yes ☒ No
Manufacturer's Name
Type Model No.
Diam. Slot size Set from ft. to ft.
Diam. Slot size Set from ft. to ft.

(8) WELL TESTS:
Drawdown is amount water level is lowered below static level
Was a pump test made? ☒ Yes ☐ No If yes, by whom? Driller
Yield: 110 gal./min. with 70 ft. drawdown after 3 hrs.
" " "
" " "
Bailer test gal./min. with ft. drawdown after hrs.
Artesian flow g.p.m.
Temperature of water 54 Depth artesian flow encountered ft.

(9) CONSTRUCTION:
Well seal—Material used Bentonite
Well sealed from land surface to 27 ft.
Diameter of well bore to bottom of seal 12 in.
Diameter of well bore below seal 8 in.
Number of sacks of cement used in well seal sacks
How was cement grout placed? 300 lbs of International Jel bentonite
Was a drive shoe used? ☒ Yes ☐ No Plugs Size: location ft.
Did any strata contain unusable water? ☐ Yes ☒ No
Type of water? depth of strata
Method of sealing strata off
Was well gravel packed? ☐ Yes ☒ No Size of gravel:
Gravel placed from ft. to ft.

(10) LOCATION OF WELL:
County Clackamas Driller's well number
SE ¼ NW ¼ Section 4 T. 5S R. 2E W.M.
Bearing and distance from section or subdivision corner

(11) WATER LEVEL: Completed well.
Depth at which water was first found 95 ft.
Static level 10 ft. below land surface. Date 3/3/77
Artesian pressure lbs. per square inch. Date

(12) WELL LOG:
Diameter of well below casing
Depth drilled 139 ft. Depth of completed well 139 ft.

Formation: Describe color, texture, grain size and structure of materials; and show thickness and nature of each stratum and aquifer penetrated, with at least one entry for each change of formation. Report each change in position of Static Water Level and indicate principal water-bearing strata.

MATERIAL	From	To	SWL
Top soil	0	2	
Clay, gravel, brown	2	10	
Gravel, small boulders & clay	10	18	
Gravel, med to coarse	18	45	
Gravel, clay, brown	45	76	
Gravel, med., brown	76	82	
Gravel & clay, grey	82	87	
Clay, brown	87	93	
Gravel, brown, med,	93	98	10
Clay, blue	98	110	
Clay, grey	110	125	
Clay, blue, gritty	125	130	
Sandstone, black	130	137	10
Clay, grey	137	139	

Work started 3/21 19 77 Completed 4/4 19 77
Date well drilling machine moved off of well 4/4 19 77

Drilling Machine Operator's Certification:
This well was constructed under my direct supervision. Materials used and information reported above are true to my best knowledge and belief.
[Signed] (Drilling Machine Operator) Date 4/8, 1977
Drilling Machine Operator's License No. 942

Water Well Contractor's Certification:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.
Name C. G. Westerberg (Person, firm or corporation) (Type or print)
Address Rt. 1, Box 151, Mulino, Oregon
[Signed] C. G. Westerberg (Water Well Contractor)
Contractor's License No. 86 Date 4/8, 1977

(USE ADDITIONAL SHEETS IF NECESSARY)

SP*45656-119

OBSERVATION WELL

CLAC

NOTICE TO WATER WELL CONTRACTOR
The original and first copy of this report are to be filed with the STATE ENGINEER, SALEM, OREGON 97310 within 30 days from the date of well completion.

RECEIVED JUN 3 1964 STATE ENGINEER

WATER WELL REPORT 009966

STATE OF OREGON
(Please type or print)

State Well No. 5/2-5M

A. G. 2490

State Permit No. G-2671

(1) OWNER:

Name Norman Simmons

Address Rt8. #3, Box 122, Molalla, Ore.

(2) LOCATION OF WELL:

County Clackamas Driller's well number 23-64

NW ¼ SW ¼ Section 5 T. 5S R. 2E W.M.

Bearing and distance from section or subdivision corner

(3) TYPE OF WORK (check):

New Well [X] Deepening [ ] Reconditioning [ ] Abandon [ ]

If abandonment, describe material and procedure in Item 12.

(4) PROPOSED USE (check):

Domestic [ ] Industrial [ ] Municipal [ ]
Irrigation [X] Test Well [ ] Other [ ]

(5) TYPE OF WELL:

Rotary [ ] Driven [ ]
Cable [X] Jetted [ ]
Dug [ ] Bored [ ]

(6) CASING INSTALLED:

Threaded [ ] Welded [X]

10 " Diam. from 0 ft. to 329 ft. Gage .279

" Diam. from ft. to ft. Gage

" Diam. from ft. to ft. Gage

(7) PERFORATIONS:

Perforated? [X] Yes [ ] No

Type of perforator used Mills knife

Size of perforations ¼ in. by 1½ in.

120 perforations from 60 ft. to 90 ft.
464 perforations from 90 ft. to 148 ft.
48 perforations from 148 ft. to 160 ft.
perforations from ft. to ft.
perforations from ft. to ft.

(8) SCREENS:

Well screen installed? [ ] Yes [X] No

Manufacturer's Name

Model No.

Diam. Slot size Set from ft. to ft.

Diam. Slot size Set from ft. to ft.

(9) CONSTRUCTION:

Well seal—Material used in seal Bentonite and clay

Depth of seal 55 ft. Was a packer used? no

Diameter of well bore to bottom of seal 12 in.

Were any loose strata cemented off? [ ] Yes [X] No Depth

Was a drive shoe used? [X] Yes [ ] No

Was well gravel packed? [ ] Yes [X] No Size of gravel:

Gravel placed from ft. to ft.

Did any strata contain unusable water? [ ] Yes [X] No

Type of water? depth of strata

Method of sealing strata off

(10) WATER LEVELS:

Static level 36 ft. below land surface Date 6/2/64

Artesian pressure lbs. per square inch Date

(11) WELL TESTS:

Drawdown is amount water level is lowered below static level

Was a pump test made? [X] Yes [ ] No If yes, by whom? Steinman Bros.

Yield:	300	gal./min. with	109	ft. drawdown after	6 hrs.
"	250	"	102	"	7 "
"	200	"	93	"	8 "

Bailer test gal./min. with ft. drawdown after hrs.

Artesian flow g.p.m. Date

Temperature of water 55° Was a chemical analysis made? [ ] Yes [X] No

(12) WELL LOG:

Diameter of well below casing

Depth drilled 327 ft. Depth of completed well 327 ft.

Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of formation.

MATERIAL	FROM	TO
Yellow clay	0	6
Cement gravel, yellow clay seams	6	85
Gravel and yellow clay	85	96
Loosely cemented gravel	96	106
Sandy clay, dark blue	106	114
Granular clay, tan	114	121
Granular clay, brown with some rock	121	134
Water bearing		
Clay, sticky tan	134	142
Clay, yellow silty	142	167
Clay, blue and grey	167	184
Clay, brown sandy	184	186
Clay, grey	186	214
Clay, alternate blue and grey	214	270
Shale, soft grey	270	290
Clay, brown sticky	290	301
Grey shale	301	319
Clay, brown	319	322
Shale, blue sticky	322	327

Work started May 8 19 64 Completed June 2 19 64

Date well drilling machine moved off of well June 3 19 64

(13) PUMP:

Manufacturer's Name

Type: H.P.

Water Well Contractor's Certification:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

NAME Steinman Bros. (Person, firm or corporation) (Type or print)

Address 15112 S.E. McLoughlin, Milwaukie, Ore.

Drilling Machine Operator's License No. 68

[Signed] Steinman Bros. (Water Well Contractor)

Contractor's License No. 1 Date June 3, 1964

STATE OF OREGON WATER WELL REPORT
(as required by ORS 537.765)

CLAC 18102

5S/2E/6C4

(START CARD) # 32023

(1) OWNER: Well Number
Name Dennis K. & Douglas L. Hopper
Address 33285 S. Barlow Rd.
City Woodburn State OR Zip 97071

(2) TYPE OF WORK:
☒ New Well ☐ Deepen ☐ Recondition ☐ Abandon

(3) DRILL METHOD:
☐ Rotary Air ☐ Rotary Mud ☒ Cable
☐ Other

(4) PROPOSED USE:
☐ Domestic ☐ Community ☐ Industrial ☒ Irrigation
☐ Thermal ☐ Injection ☐ Other

(5) BORE HOLE CONSTRUCTION:
Special Construction approval ☐ Yes ☒ No Depth of Completed Well 323 ft.
Explosives used ☐ Yes ☒ No Type Amount

HOLE Diameter	From	To	SEAL Material	From	To	Amount sacks or pounds
16	0	50	Gran Bent	0	25	29 sks
12	50	365	annular backfill:			
			Gran Bent	25	41	as needed
			Cuttings	41	50	as needed

How was seal placed: Method ☐ A ☐ B ☐ C ☐ D ☐ E
☒ Other poured & probed
Backfill placed from 323 ft. to 365 ft. Material sand/slough
Gravel placed from ft. to ft. Size of gravel

(6) CASING/LINER:

	Diameter	From	To	Gauge	Steel	Plastic	Welded	Threaded
Casing:	12	+1	336	.375	☒	☐	☒	☐
bell red:					☐	☐	☐	☐
	16x12	+2	+1	std	☒	☐	☒	☐
					☐	☐	☐	☐
Liner:					☐	☐	☐	☐
					☐	☐	☐	☐

Final location of shoe(s) 336

(7) PERFORATIONS/SCREENS:
☒ Perforations Method air rotary
☐ Screens Type Material

From	To	Slot size	Number	Diameter	Tele/pipe size	Casing	Liner
173	191	.1x1	820			☒	☐
198	213	.1x1	600			☒	☐
231	240	.1x1	480			☒	☐
246	259	.1x1	620			☒	☐
277	286	.1x1	420			☒	☐

(8) WELL TESTS: Minimum testing time is 1 hour
☒ Pump ☐ Bailer ☐ Air ☐ Flowing Artesian

Yield gal/min	Drawdown	Drill stem at	Time
575	104		1 hr.
575	105		2 hr.
485	100		4 hr.
485	102		6 hr.

Temperature of Water 51 °F Depth Artesian Flow Found
Was a water analysis done? ☐ Yes By whom
Did any strata contain water not suitable for intended use? ☐ Too little
☐ Salty ☐ Muddy ☐ Odor ☐ Colored ☐ Other
Depth of strata: SEP 9229

(9) LOCATION OF WELL by legal description:
County Clackamas Latitude Longitude
Township 5S N or S. Range 2E E or W. WM.
Section 6 NW ¼ of SW ¼
Tax Lot 1900 Lot Block Subdivision
Street Address of Well (or nearest address) Cramer Rd. Molalla, OR

(10) STATIC WATER LEVEL:
40 ft. below land surface. Date 6/8/92
Artesian pressure lb. per square inch. Date

(11) WATER BEARING ZONES:
Depth at which water was first found approx. 41

From	To	Estimated Flow Rate	SWL
most all sand/gravel			
zones below 41'		see (8)	see (10)

(12) WELL LOG:
Ground elevation approx. 280

Material	From	To	SWL
see attached log			

RECEIVED
SEP 29 1992
WATER RESOURCES DEPT.
SALEM, OREGON

Additional Perforations with mills knife in casing:

From	To	Slot	No.
138	147	.3x3	162
157	163	.3x3	108
166	170	.3x3	72
174	177	.3x3	36

(some air rotary perforations may exist in the above intervals also, as tool was not functioning properly

Date started 2/17/92 Completed 7/8/92

(unbonded) Water Well Constructor Certification:
I certify that the work I performed on the construction, alteration, or abandonment of this well is in compliance with Oregon well construction standards. Material used and information reported above are true to my best knowledge and belief.
Signed Donald A Davis WWC Number 1085 Date 9/22/92

(bonded) Water Well Constructor Certification:
I accept responsibility for the construction, alteration, or abandonment work performed on this well during the construction dates reported above. All work performed during this time is in compliance with Oregon well construction standards. This report is true to the best of my knowledge and belief.
Signed Stephen J Schneider WWC Number 649 Date 9/22/92

5S/2E/6C

Hopper Brothers Well Log
by Schneider Equipment, Inc.
Start Card #32023

From	To	
0	3	Top soil, brown
3	11	Clay, brown, w/some gravel
11	15	Clay, brown & gravel
15	25	Clay, brown & gravel 4" minus
25	36	Gravel w/clay, brown
36	41	Gravel 4" minus, w/some clay, brown
41	54	Gravel 4" minus & sand, med
54	64	Gravel 4" minus w/clay, brown
64	68	Clay, brown, w/some gravel & sand, coarse
68	102	Gravel 8" minus & clay, brown
102	118	Gravel 6" minus & clay, brown, med, sandy
118	126	Gravel 2" minus & clay, brown, fine-med, sandy
126	133	Gravel 2" minus & clay, brown
133	138	Clay, brown
138	147	Gravel 2" minus w/some clay, brown, sandy
147	157	Gravel 4" minus & clay, brown
157	161	Gravel 1-1/2" minus & sand, med-coarse
161	163	Grvl 1-1/2" minus & sand, med-crse w/some clay, brown
163	165	Clay, brown, med-soft, sandy
165	166	Clay, brown, fine, sandy, & gravel 2" minus
166	170	Grvl 1-1/2"- & sand, med-crse, cem, w/some clay, brn
170	174	Clay, brown & rusty red, fine, sandy, cemented
174	177	Sand, brown, med-coarse & gravel 3/4" minus
177	179	Clay; coarse, sand; & pea gravel; cemented
179	184	Sand, med-coarse, brown & pea gravel
184	190	Sand, med-fine, brown
190	199	Clay, drk gray & black, some hard, dry
199	205	Sand, brown, med-fine, cemented, some loose
205	209	Clay, black, fine, sandy, w/some cemented
209	212	Sand, coarse, brown & pea gravel
212	220	Clay, blk & brown streaked, gritty, w/wood
220	225	Clay, dark gray/blk
225	232	Clay, gray, blk & brown streaked, firm
232	238	Sand, blue/grn, med-crse, w/clay, blue/grn, sandy
238	241	Clay, gray, sandy, fine, some cemented
241	247	Clay, gray, fine, sandy
247	258	Sand, blk, med-fine, compacted
258	275	Clay, blue-gray, sticky
275	278	Clay, blue, sandy
278	285	Sand, black, med, loose
285	288	Clay, blue, firm
288	306	Clay, blue/gray, soft, gritty
306	310	Clay, gray & brown streaked, soft
310	316	Clay, blue, med-soft, hard, dry
316	318	Clay, blue w/gray streaks, hard, dry
318	347	Clay, gray, med
347	351	Clay, gray w/brown streaks, sticky & gritty, firm
351	354	Claystone, gray
354	365	Clay, gray/blue, very sticky, firm

W32029.DDH

NOTICE TO WATER WELL CONTRACTOR
The original and first copy of this report are to be filed with the STATE ENGINEER, SALEM, OREGON 97310 within 30 days from the date of well completion

WATER WELL REPORT

STATE OF OREGON (Please type or print) Do not write above this line

RECEIVED MAR - 2 1973 STATE ENGINEER SALEM, OREGON

State Well No. 5S/2E-5 cb

State Permit No. 063955 CLAC

(1) OWNER:

Name N. J. Simons

Address Rt. 3, Box 122 Molalla, Oregon 97038

(2) TYPE OF WORK (check):

New Well ☒ Deepening ☐ Reconditioning ☐ Abandon ☐

If abandonment, describe material and procedure in Item 12.

(3) TYPE OF WELL:

Rotary ☐ Driven ☐
Cable ☒ Jetted ☐
Dug ☐ Bored ☐

(4) PROPOSED USE (check):

Domestic ☒ Industrial ☐ Municipal ☐
Irrigation ☐ Test Well ☐ Other ☐

CASING INSTALLED:

Threaded ☐ Welded ☒

6 " Diam. from 0 ft. to 117 ft. Gage .250

" Diam. from ft. to ft. Gage

" Diam. from ft. to ft. Gage

PERFORATIONS:

Perforated? ☐ Yes ☒ No

Type of perforator used

Size of perforations in. by in.

perforations from ft. to ft.

perforations from ft. to ft.

perforations from ft. to ft.

(7) SCREENS:

Well screen installed? ☐ Yes ☒ No

Manufacturer's Name

Type Model No.

Diam. Slot size Set from ft. to ft.

Diam. Slot size Set from ft. to ft.

(8) WELL TESTS:

Drawdown is amount water level is lowered below static level

Was a pump test made? ☒ Yes ☐ No If yes, by whom? Driller

Yield: 35 gal./min. with 30 ft. drawdown after 3 hrs.

" " "

" " "

Bailer test gal./min. with ft. drawdown after hrs.

Artesian flow g.p.m.

Temperature of water 53 Depth artesian flow encountered ft.

(9) CONSTRUCTION:

Well seal—Material used Bentonite

Well sealed from land surface to 26 ft.

Diameter of well bore to bottom of seal 10 in.

Diameter of well bore below seal 6 in.

Number of sacks of cement used in well seal sacks

Number of sacks of bentonite used in well seal 3 sacks

Brand name of bentonite National

Number of pounds of bentonite per 100 gallons of water 150 lbs./100 gals.

Was a drive shoe used? ☒ Yes ☐ No Plugs Size: location ft.

Did any strata contain unusable water? ☐ Yes ☒ No

Type of water? depth of strata

Method of sealing strata off

Was well gravel packed? ☐ Yes ☒ No Size of gravel:

Gravel placed from ft. to ft.

(10) LOCATION OF WELL:

County Clackamas Driller's well number

NW ¼ SW ¼ Section 5 T. 5S R. 2E W.M.

Bearing and distance from section or subdivision corner

(11) WATER LEVEL: Completed well.

Depth at which water was first found 127 ft.

Static level 35 ft. below land surface. Date 2/24/73

Artesian pressure lbs. per square inch. Date

(12) WELL LOG:

Diameter of well below casing 6

Depth drilled 137 ft. Depth of completed well 135 ft.

Formation: Describe color, texture, grain size and structure of materials; and show thickness and nature of each stratum and aquifer penetrated, with at least one entry for each change of formation. *Report each change in position of Static Water Level and indicate principal water-bearing strata.*

MATERIAL	From	To	SWL
Soil, brown	0	2	
Clay, brown	2	9	
Gravel, cemented	9	66	
Sand, clay and gravel brown	66	71	
Gravel, strips of clay brown	71	127	
Sandstone, brown	127	135	35
Clay, brown	135	137	

Work started 2/17 19 73 Completed 2/25 19 73

Date well drilling machine moved off of well 2/25 19 73

Drilling Machine Operator's Certification:

This well was constructed under my direct supervision. Materials used and information reported above are true to my best knowledge and belief.

[Signed] (Drilling Machine Operator) Date 2/27, 19 73

Drilling Machine Operator's License No. 527

Water Well Contractor's Certification:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

Name C. G. Westerberg (Person, firm or corporation) (Type or print)

Address Rt. 1, Box 151, Mulino, Oregon

[Signed] C. G. Westerberg (Water Well Contractor)

Contractor's License No. 86 Date 2/27, 19 73

(USE ADDITIONAL SHEETS IF NECESSARY)

SP-4MW-110

NOTICE TO WATER WELL CONTRACTOR
The original and first copy of this report are to be filed with the STATE ENGINEER, SALEM, OREGON 97310 within 30 days from the date of well completion.

WATER WELL REPORT

STATE OF OREGON (Please type or print) (Do not write above this line)

CLAC 010060 6-4341

State Well No. 5/2-8N

State Permit No.

(1) OWNER:

Name Albert Minerva

Address Rt. 3, Box 420
Molalla, Oregon 97038

(2) TYPE OF WORK (check):

New Well ☐ Deepening ☒ Reconditioning ☒ Abandon ☐

If abandonment, describe material and procedure in Item 12.

(3) TYPE OF WELL:

Rotary ☐ Driven ☐
Cable ☒ Jetted ☐
Dug ☐ Bored ☐

(4) PROPOSED USE (check):

Domestic ☐ Industrial ☐ Municipal ☐
Irrigation ☒ Test Well ☐ Other ☐

CASING INSTALLED:

Threaded ☐ Welded ☒

Final casing: installed to 143 ft.

5 9/16 " Diam. from 140 ft. to 233 ft. Gage 10 Ga.

" Diam. from ft. to ft. Gage

" Diam. from ft. to ft. Gage

PERFORATIONS:

Perforated? ☒ Yes ☐ No.

Type of perforator used cut by torch

Size of perforations 1/8 in. by 7 in.

22 perforations from 143 ft. to 152 ft.
38 perforations from 172 ft. to 182 ft.
50 perforations from 220 ft. to 229 ft.
perforations from ft. to ft.
perforations from ft. to ft.
perforations from ft. to ft.

(7) SCREENS:

Well screen installed? ☐ Yes ☒ No

Manufacturer's Name

Type Model No.

Diam. Slot size Set from ft. to ft.

Diam. Slot size Set from ft. to ft.

(8) WATER LEVEL: Completed well.

Static level 85 ft. below land surface Date 3/7/68

Artesian pressure lbs. per square inch Date

(9) WELL TESTS:

Drawdown is amount water level is lowered below static level

Was a pump test made? ☒ Yes ☐ No If yes, by whom? Driller

30 gal./min. with 75 ft. drawdown after 8 hrs.

" " " "

" " " "

Bailer test gal./min. with ft. drawdown after hrs.

Artesian flow g.p.m. Date

Temperature of water 54 Was a chemical analysis made? ☐ Yes ☒ No

(10) CONSTRUCTION:

Well seal—Material used Bentonite

Depth of seal 18 ft.

Diameter of well bore to bottom of seal 10 in.

Were any loose strata cemented off? ☐ Yes ☒ No Depth

Was a drive shoe used? ☐ Yes ☐ No

Did any strata contain unusable water? ☐ Yes ☒ No

Type of water? depth of strata

Method of sealing strata off

Was well gravel packed? ☐ Yes ☒ No Size of gravel:

Gravel placed from ft. to ft.

(11) LOCATION OF WELL:

County Clackamas Driller's well number

SW ¼ SW ¼ Section 8 T. 5S R. 2E W.M.

Bearing and distance from section or subdivision corner

(12) WELL LOG:

Diameter of well below casing

Depth drilled 233 ft. Depth of completed well 233 ft.

Formation: Describe color, texture, grain size and structure of materials; and show thickness and nature of each stratum and aquifer penetrated, with at least one entry for each change of formation. Report each change in position of Static Water Level as drilling proceeds. Note drilling rates.

MATERIAL	From	To	SWL
~~Set over well. Pulled pump. Well was supposed to be 152 ft. deep. well had filled to 128 ft. with brown sand. Cleaned well to 152 ft. Had to pull up 77 ft. Of casing and weld 81/2 inch dia. ring on casing to stop sand. Drove ring to 77 ft. depth~~			
~~52~~ depth to start			35
Clay, blue	152	168	
Clay, blue, sandy	168	172	
Clay, blue	172	176	
Sand, med. black	176	182	85
Clay, blue	182	220	
Sand, Med, grey	220	225	85
Clay, grey	225	233	

Work started 2/29 19 68 Completed 3/7 19 68

Date well drilling machine moved off of well 3/8 19

Drilling Machine Operator's Certification:

This well was constructed under my direct supervision. Materials used and information reported above are true to my best knowledge and belief.

[Signed] C. G. Westerberg (Drilling Machine Operator) Date 3/19 19 68

Drilling Machine Operator's License No. 86

Water Well Contractor's Certification:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

NAME C. G. Westerberg (Person, firm or corporation) (Type or print)

Address Rt. 1, Box 151, Mulino, Oregon

[Signed] C. G. Westerberg (Water Well Contractor)

Contractor's License No. 86 Date 3/19 19 68

NOTICE TO WATER WELL CONTRACTOR
The original and first copy of this report are to be filed with the STATE ENGINEER, SALEM, OREGON 97310 within 30 days from the date of well completion.

WATER WELL REPORT

STATE OF OREGON (Please type or print) (Do not write above this line) 010030

State Well No. 5/2-7 R

State Permit No. .....

(1) OWNER:

Name Albert Minerva

Address Rt. 3, Box 420

Molalla, Oregon 97038

(2) TYPE OF WORK (check):

New Well [X] Deepening [ ] Reconditioning [ ] Abandon [ ]

If abandonment, describe material and procedure in Item 12.

(3) TYPE OF WELL:

Rotary [ ] Driven [ ]
Cable [X] Jetted [ ]
Dug [ ] Bored [ ]

(4) PROPOSED USE (check):

Domestic [X] Industrial [ ] Municipal [ ]
Irrigation [ ] Test Well [ ] Other [ ]

CASING INSTALLED:

Threaded [ ] Welded [X]

..... " Diam. from 0 ft. to 53 ft. Gage .250

5 9/16 " Diam. from 51 ft. to 138 ft. Gage 10 Ga

..... " Diam. from ..... ft. to ..... ft. Gage .....

PERFORATIONS:

Perforated? [X] Yes [ ] No.

Type of perforator used Cut by torch

Size of perforations 1/8 in. by 5 in.

66 perforations from 55 ft. to 90 ft.

16 perforations from 114 ft. to 120 ft.

..... perforations from ..... ft. to ..... ft.

..... perforations from ..... ft. to ..... ft.

..... perforations from ..... ft. to ..... ft.

SCREENS:

Well screen installed? [ ] Yes [X] No

Manufacturer's Name .....

Type ..... Model No. .....

Diam. ..... Slot size ..... Set from ..... ft. to ..... ft.

Diam. ..... Slot size ..... Set from ..... ft. to ..... ft.

(8) WATER LEVEL: Completed well.

Static level 32 ft. below land surface Date 3/13/68

Artesian pressure ..... lbs. per square inch Date .....

(9) WELL TESTS:

Drawdown is amount water level is lowered below static level

Was a pump test made? [ ] Yes [ ] No If yes, by whom?

..... gal./min. with ..... ft. drawdown after ..... hrs.

" " " "

" " " "

Bailer test 28 gal./min. with 60 ft. drawdown after 1 hrs.

Artesian flow ..... g.p.m. Date .....

Temperature of water 54 Was a chemical analysis made? [ ] Yes [X] No

(10) CONSTRUCTION:

Well seal—Material used Bentonite

Depth of seal 34 ft.

Diameter of well bore to bottom of seal 10 in.

Were any loose strata cemented off? [ ] Yes [X] No Depth .....

Was a drive shoe used? [X] Yes [ ] No

Did any strata contain unusable water? [ ] Yes [X] No

Type of water? ..... depth of strata .....

Method of sealing strata off .....

Was well gravel packed? [ ] Yes [X] No Size of gravel: .....

Gravel placed from ..... ft. to ..... ft.

(11) LOCATION OF WELL:

County Clackamas Driller's well number .....

SE ¼ SE ¼ Section 7 T. 5S R. 2E W.M.

Bearing and distance from section or subdivision corner .....

(12) WELL LOG:

Diameter of well below casing .....

Depth drilled 138 ft. Depth of completed well 138 ft.

Formation: Describe color, texture, grain size and structure of materials; and show thickness and nature of each stratum and aquifer penetrated, with at least one entry for each change of formation. Report each change in position of Static Water Level as drilling proceeds. Note drilling rates.

MATERIAL	From	To	SWL
Top soil, brown	0	2	
Clay, brown	2	4	
Coarse gravel to small boulder size	4	12	
Clay, tan	12	26	
Clay, brown, [redacted]	26	35	
Clay, brown sandy	35	46	
Clay, brown	46	51	
Clay, brown sandy	51	56	
Sand, med., brown	56	63	32
Clay, blue	63	70	
Sandy, formation, black	70	73	32
Clay, blue	73	84	
Clay, blue, sandy	84	86	
Clay, blue	86	112	
Clay, blue, sandy	112	116	
Sand, fine, black	116	118	
Clay, grey	118	138	

Work started 3/8 1968 Completed 3/13 1968

Date well drilling machine moved off of well 3/13 1968

Drilling Machine Operator's Certification:

This well was constructed under my direct supervision. Materials used and information reported above are true to my best knowledge and belief.

[Signed] C. G. Westerberg (Drilling Machine Operator) Date 3/19 1968

Drilling Machine Operator's License No. 86

Water Well Contractor's Certification:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

NAME C. G. Westerberg (Person, firm or corporation) (Type or print)

Address Rt. 1, Box 151, Mulino, Oregon

[Signed] C. G. Westerberg (Water Well Contractor)

Contractor's License No. 86 Date 3/19 1968

APPENDIX G
WATER RIGHTS

COUNTY OF CLACKAMAS

CERTIFICATE OF WATER RIGHT

This is to Certify, *That* CITY OF MOLALLA *of* Molalla, *State of* Oregon, *has made proof to the satisfaction of the STATE ENGINEER of Oregon, of a right to the use of the waters of* Trout Creek *a tributary of* Molalla River *for the purpose of* Municipal *under Permit No.* 4980 *of the State Engineer, and that said right to the use of said waters has been perfected in accordance with the laws of Oregon; that the priority of the right hereby confirmed dates from* March 11, 1921;

that the amount of water to which such right is entitled and hereby confirmed, for the purposes aforesaid, is limited to an amount actually beneficially used for said purposes, and shall not exceed 4.0 cubic feet per second;

The use hereunder for irrigation shall conform to such reasonable rotation system as may be ordered by the proper state officer.

The amount of water used for irrigation, together with the amount secured under any other right existing for the same lands, shall be limited to one-eightieth of one cubic foot per second per acre, or its equivalent in case of rotation.

A description of the lands irrigated under the right hereby confirmed, and to which such right is appurtenant (or, if for other purposes, the place where the water is put to beneficial use), is as follows: Within the corporate limits of the City of Molalla, Oregon, and along the pipe lines in T. 5 S. R. 2 E. W. M., in Clackamas County, Oregon.

The right to the use of the water for irrigation purposes is restricted to the lands or place of use herein described.

Rights to the use of water for power purposes are limited to a period of forty years from the date of priority of the right, as herein set forth, subject to a preference right of renewal under the laws existing at the date of the expiration of the right for power purposes, as hereby confirmed and limited.

WITNESS the signature of the State Engineer, affixed this 23rd *day of* June, 1927.

RHEA LUPER
State Engineer.

Recorded in State Record of Water Right Certificates, Volume 7, *page* 7202.

PERMIT

STATE OF OREGON, }
County of Marion. } ss.

This is to certify that I have examined the foregoing application and do hereby grant the same, SUBJECT TO EXISTING RIGHTS and the following limitations and conditions:

The right herein granted is limited to the amount of water which can be applied to beneficial use and shall not exceed 3.0 cubic feet per second measured at the point of diversion from the stream, or its equivalent in case of rotation with other water users, from Molalla River

The use to which this water is to be applied is municipal

If for irrigation, this appropriation shall be limited to - - - - - of one cubic foot per second

and shall be subject to such reasonable rotation system as may be ordered by the proper state officer.

The priority date of this permit is August 17, 1954

Actual construction work shall begin on or before February 21, 1956 and shall thereafter be prosecuted with reasonable diligence and be completed on or before October 1, 1956

Complete application of the water to the proposed use shall be made on or before October 1, 1957

WITNESS my hand this 21st day of February 1955

Lewis A. Stanley
STATE ENGINEER

Permits for power development are subject to the payment of annual fees as provided in sections 1 and 2, chapter 74, Oregon Laws 1935.

Application No. 29401

Permit No. 23158

PERMIT

TO APPROPRIATE THE PUBLIC WATERS OF THE STATE OF OREGON

Division No. ______ District No. ______

This instrument was first received in the office of the State Engineer at Salem, Oregon, on the 17th day of August 1954, at 8:00 o'clock A. M.

Returned to applicant:

Corrected application received:

Approved:

February 21, 1955

Recorded in book No. 60 of Permits on page 23158

LEWIS A. STANLEY
STATE ENGINEER

Drainage Basin No. 2 Page 30

Fees Paid $24.00

Permit

Permit No. 23158

*APPLICATION FOR PERMIT

To Appropriate the Public Waters of the State of Oregon

I, The City of Molalla, Oregon
(Name of applicant)

of City Hall, Molalla, Oregon, care of City Recorder
(Mailing address)

State of Oregon, do hereby make application for a permit to appropriate the following described public waters of the State of Oregon, SUBJECT TO EXISTING RIGHTS:

If the applicant is a corporation, give date and place of incorporation City of Molalla, State of Oregon

1. The source of the proposed appropriation is Molalla River
(Name of stream)
, a tributary of Willamette

2. The amount of water which the applicant intends to apply to beneficial use is 3 cubic feet per second.
(If water is to be used from more than one source, give quantity from each)

**3. The use to which the water is to be applied is municipal water supply
(Irrigation, power, mining, manufacturing, domestic supplies, etc.)

4. The point of diversion is located 40 ft. N. (N. or S.) and 600 ft. W. (E. or W.) from the Section corner common to Section 14-15-22-23, Township 4 South, Range 2 East of the Willamette Meridian, Clackamas County, Oregon
(Section or subdivision)

(If preferable, give distance and bearing to section corner)

(If there is more than one point of diversion, each must be described. Use separate sheet if necessary)

being within the S.E. ¼ of S.E. ¼ (Give smallest legal subdivision) of Sec. 15, Tp. 4 South (N. or S.), R. 2 E. (E. or W.), W. M., in the county of Clackamas

5. The ~~pipeline~~ (Main ditch, canal or pipe line) 18" dia. 2 miles (Miles or feet) in length, terminating in the Southeast 8-9-17 and 16 (Smallest legal subdivision) of Sec. ~~of Sec.~~, Tp. 5 So. (N. or S.), R. 2 E. (E. or W.), W. M., the ~~proposed~~ location being shown throughout on the accompanying map.

DESCRIPTION OF WORKS

Diversion Works—

6. (a) Height of dam ..... feet, length on top ..... feet, length at bottom ..... feet; material to be used and character of construction ..... (Loose rock, concrete, masonry, rock and brush, timber crib, etc.; wasteway over or around dam)

(b) Description of headgate ..... (Timber, concrete, etc., number and size of openings)

(c) If water is to be pumped give general description 330 rpm - 3 pumps of 25 hp each (Size and type of pump)
total head is 160 (Size and type of engine or motor to be used, total head water is to be lifted, etc.)

*A different form of application is provided where storage works are contemplated.

**Application for permits to appropriate water for the generation of electricity, with the exception of municipalities, must be made to the Hydroelectric Commission. Either of the above forms may be secured, without cost, together with instructions by addressing the State Engineer, Salem, Oregon.

STATE OF OREGON
Water Resources Department

APPLICATION FOR TRANSFER OF WATER RIGHT

Applicant: City of Molalla

Mailing address: P.O. Box 248

Molalla,	Oregon	Clackamas	97038	829-8655
City or town	State	County	Zip	Phone

Type of change: Point of Diversion
(In point of diversion; place of use; use heretofore made of the water)

1. WATER RIGHT

A) Is the water right in your name? Yes (yes, no). If not, list name below:

B) Was the water right determined by a court decree? No (yes, no).

1. If yes, list the title of the proceedings: .
2. Certificate No.: .

C) Was the water right acquired by a water permit? Yes (yes, no).

1. If yes, list the Permit No.: 4980.
2. Certificate No.: 7202.

D) Date of priority right: March 11, 19 21.

E) To your knowledge, has any portion of the water right undergone a period of five or more consecutive years of nonuse? Yes (yes, no).

F) What are your reasons for the proposed changes? The City desires to provide for its long-range water supply needs by transfer of its existing right on Trout Creek to its existing water intake facilities on the Molalla River.

G) The water will be completely applied to the proposed use on or before: Immediately upon transfer, 19 .

2. LOCATION:

A) What is the source of water (river, stream, well)?: Trout Creek

B) Describe the authorized point of diversion:

Location in Reference to Survey Corner	¼, ¼ of Section	Section	Township	Range
N35° 30'W 810 feet from SE corner of Section 6, T6S, R3E	SE/SE	6	6S	3E

C) What is the name of the ditch used?: .

NOTE: Answer question D only if the application is for a change in the point of diversion.

D) Describe the proposed point of diversion:

Location in Reference to Survey Corner	¼, ¼ of Section	Section	Township	Range
40 ft. North and 600 ft. West from the section corner common to Sections 14-15-22-23, T5S, R2E	SE¼ of SE¼	15	5S	2E

E) Is the land within an irrigation district? Yes ___ No X

If Yes, which district? .

F) What is the use to which the water is applied?: Municipal water supply

T. 5S., R. 2E., W.M.

N

SCALE: 1" = 400'

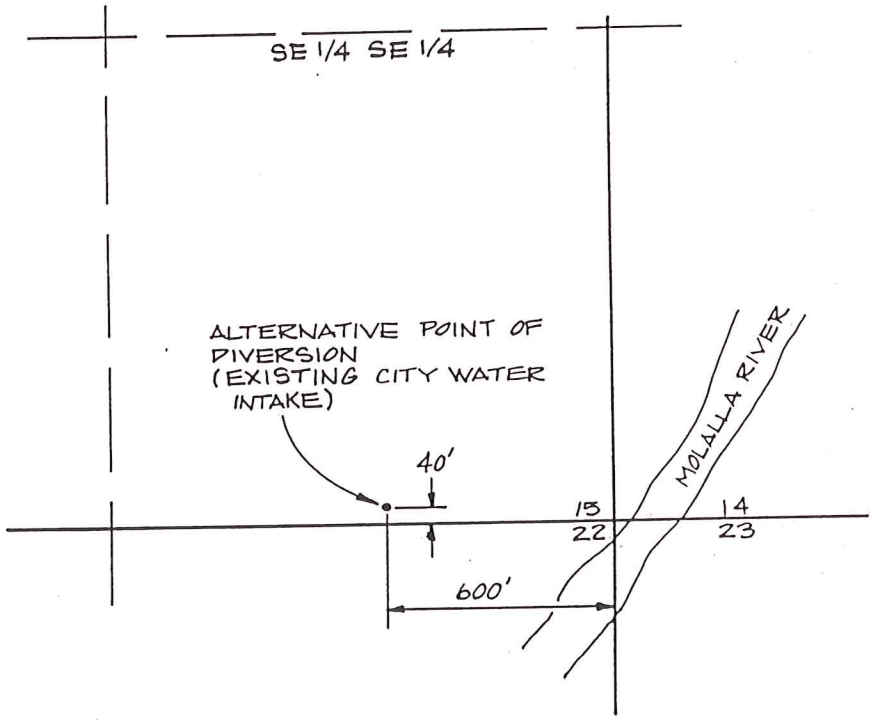


Figure 2

Certified Water Right Examiner
#121
Philip H. Smith
Nov 9, 1987
STATE OF OREGON

Application for Transfer of Water Right No. 7202

by

City of Molalla, Oregon
December, 1989

89-0191.40

G) Give the location of the area irrigated or place of use

Twp.	Range	Section	¼, ¼ of Section	No. of acres irrigated
5S	2E	8,9,17&16	(City of Molalla Water System)	

NOTE: Answer questions H, I, J, and K only if the application is for a change in use or place of use.

H) Are the lands from which you propose to transfer your water right free of all encumbrances? ______ (yes, no)

I) If no, give the description below of existing encumbrances:

	Amount

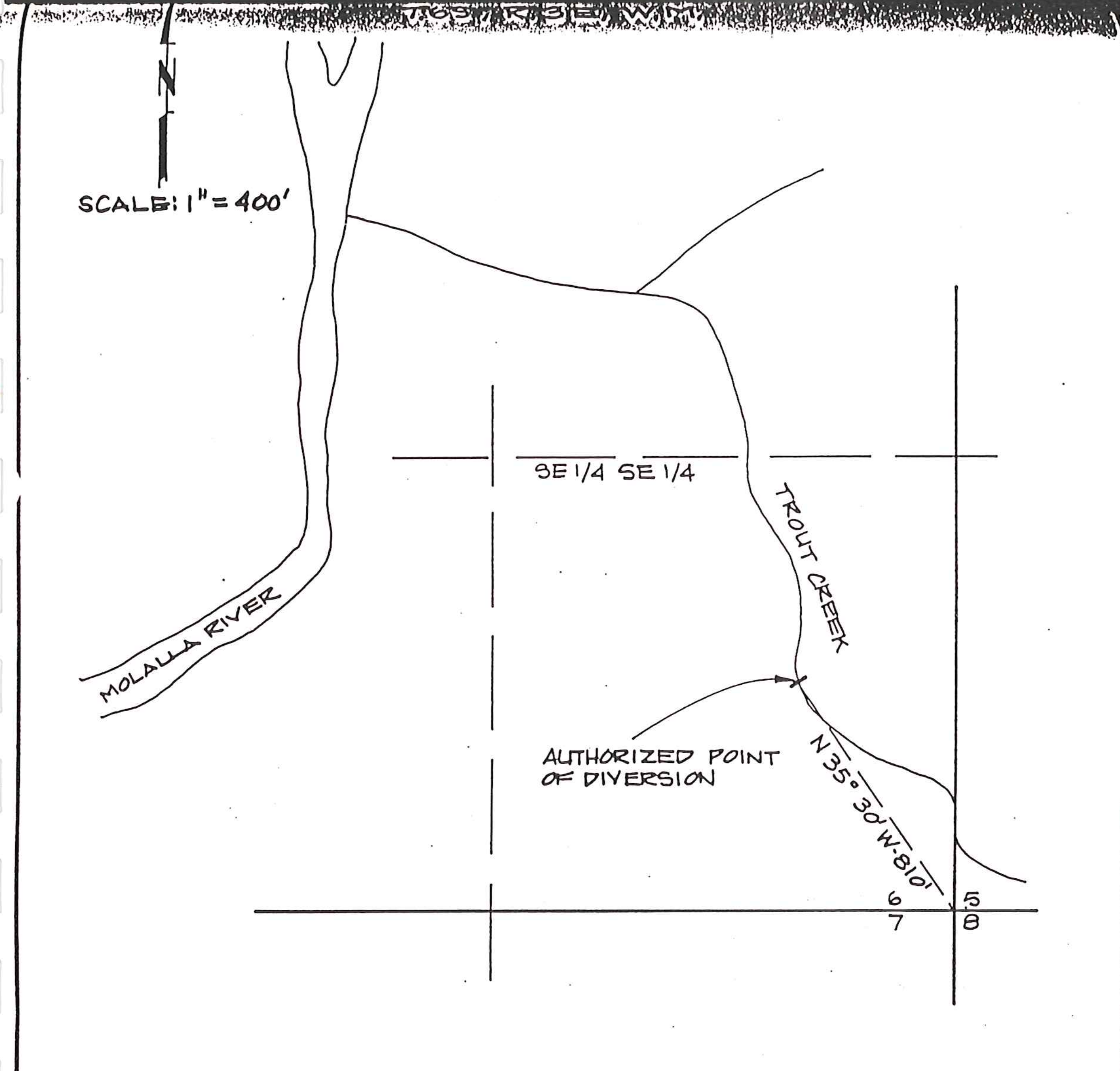


Figure 1

Application for Transfer
of Water Right No. 7202

by

City of Molalla, Oregon
December, 1989

Certified Water Right Examiner
#121
Philip H. Smith
Nov 9, 1987
STATE OF OREGON

89-0191.40

APPENDIX H

TROUT CREEK FLOW RECORDS

Discharge measurements for
02009001 Trout Cr nr Molalla

MMT	DATE	GH	Meas Q	
1	6/9/92	0.76	5.02	
2	7/2/92	0.66	3.88	
3	7/16/92	0.57	3.36	
4	8/12/92	0.54	1.99	
5	7/9/93	1.04	9.44	
6	8/5/93	1.01	9.83	
7	9/7/93	0.78	4.84	
8	06/10/94	1.09	26.10	not used 35% of flow in 3 sections, GH looks low
9	07/15/94	0.73	5.06	
10	08/09/94	0.60	3.51	
11	08/29/94	0.55	2.99	
12	09/22/94	0.51	2.17	
13	10/10/94	0.54	2.12	
14	06/01/95	0.90	11.20	
15	07/28/95	0.65	4.91	
16	08/18/95	0.71	6.33	
17	09/08/95	0.65	5.12	

02009001 TROUT CREEK NEAR MOLALLA, OR

LAT LONG S DA DATUM CO CLAC

DAILY DISCHARGE IN CUBIC FEET PER SECOND WATER YEAR Oct 1991 TO Sep 1992

Day	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1										X	X	X
2										3.9A	X	X
3										X	X	X
4										X	X	X
5										X	X	X
6										X	X	X
7										X	X	X
8										X	X	X
9									5.0A	X	X	X
10									4.9	X	X	X
11									4.9	X	X	X
12									5.0	X	2.0A	X
13									5.5	X	X	X
14									8.7	X	X	X
15									6.2	X	X	X
16									6.0	3.4A	X	X
17									5.9	X	X	X
18									5.3	X	X	X
19									4.7	X	X	X
20									4.3	X	X	X
21									4.1	X	X	X
22									3.8	X	X	X
23									3.4	X	X	X
24									3.3	X	X	X
25									3.2	X	X	X
26									3.3	X	X	X
27									3.2	X	X	X
28									3.3	X	X	X
29									X	X	X	X
30					------				X	X	X	X
31		------			------		------		------	X	X	------
TOTAL									94.0	7.3	2.0	
MEAN									4.70	3.65	2.00	
MAX									8.7	3.9	2.0	
MIN									3.2	3.4	2.0	
AC-FT									186	14	4.0	

	*	*	*	*	*	*	*	*	*	*	*	*
CAL YEAR 1991	TOTAL*	0.0										
WTR YEAR 1992	TOTAL*	103.3	MEAN	4.49	MAX	8.7	MIN	2.0	AC-FT	205		

* Incomplete Record */*/ prov **
A- no GH, estimated
X- no attempt to estimate

02009001 TROUT CREEK NEAR MOLALLA, OR

LAT LONG S DA DATUM CO CLAC

DAILY DISCHARGE IN CUBIC FEET PER SECOND WATER YEAR OCT 1994 TO SEP 1995

Day	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1									11	10	D	D
2									11	9.9	D	D
3									10	10	D	D
4									11	9.8	D	5.1
5									15	9.2	D	D
6								X	15	9.7	D	D
7								X	19	9.8	6.5	6.5
8								X	14	9.7	5.1	5.2
9								X	12	14	D	D
10								X	11	13	D	D
11								X	11	10	6.2	D
12								X	10	9.1	D	D
13								X	11	8.3	D	D
14								X	14	7.9	5.0	D
15								X	18	7.6	5.5	D
16								X	15	7.1	5.7	D
17								27	16	6.4	8.6	D
18								24	21	6.1	6.5	D
19								22	20	5.9	5.2	D
20								21	21	5.7	5.0	D
21								20	22	5.7	D	D
22								18	21	5.5	D	D
23								17	19	5.6	D	D
24								16	18	5.6	D	D
25								15	16	5.5	D	D
26								15	15	5.1	D	D
27								14	13	5.1	D	7.6
28								13	12	5.0	D	9.6
29					------			13	11	D	D	8.9
30					------			12	10	D	D	8.5
31		------			------		------	11	------	D	D	------
TOTAL								258	443	222.3	59.3	51.4
MEAN								17.2	14.8	7.94	5.93	7.34
MAX								27	22	14	8.6	9.6
MIN								11	10	5.0	5.0	5.1
AC-FT								512	879	441	118	102
	*	*	*	*	*	*	*	*		*	*	*

* Incomplete Record */*/ ud1 ***

D- doubtful GH

X- undefined stage-discharge relation

APPENDIX I

RECENT OHD COMPREHENSIVE PERFORMANCE EVALUATION

(503) 731-4317
FAX (503) 731-4077
Nonvoice (503) 731-4031

Oregon

DEPARTMENT OF HUMAN RESOURCES

HEALTH DIVISION

RECEIVED
11/3/95

May 28, 1993

Mr. Jack Dunn; Public Works Director
Mr. Keith Stiglbauer; Plant Supervisor
City of Molalla
P.O. Box 248
Molalla, Oregon 97038

Dear Mr. Dunn & Mr. Stiglbauer:

On April 23, 1993, Michael Whiteley and I conducted a **Comprehensive Performance Evaluation (CPE)** of the water treatment plant which provides drinking water for the **City of Molalla.** I wish to thank you both for all your help and assistance during the review.

I have enclosed a copy of the report for the City's records. Please review the report carefully and notify me of any errors or changes that should be made. As you know, this evaluation serves two main purposes for the City at this time. The Health Division will begin enforcement of new regulations for water supplies using filtered surface water sources (adopted by the Health Division from the federal Surface Water Treatment Rule) on June 30, 1993. First, the CPE evaluation gives the District an overview of how well the treatment plant is able to meet these new regulations. Second, the evaluation will allow the Health Division to determine how effectively (or to what degree) the treatment plant is able to remove particulate matter (including *Giardia lamblia* cysts) in the water according to the rules.

The treatment plant was evaluated for each of the four unit processes that comprise the total treatment train (coagulation/flocculation, sedimentation, filtration, and disinfection) and for the filter's ability to produce treated water following a backwash of the filter media. The major unit process evaluation was done by comparing calculated theoretical operating flows that would provide optimized treatment (the ability of the treatment process to produce 0.1 NTU treated water on a consistent basis) against actual peak operating flows measured and recorded at the treatment plant. The filtered water turbidity profile was made by collecting finished water turbidity values (via grab samples) from the filter effluent line for each filter immediately after the filters were returned to service following a backwash cycle.

Barbara Roberts
Governor

800 NE Oregon Stre
Portland, OR 972
(503) 731-4030 Er
(503) 252-7978 T
Emergency

A summary of the CPE findings is as follows:

1. The flocculation basins, sedimentation basins, and filters are all operated at flow rates which will provide optimum treatment at peak plant flows. The flocculation basin is theoretically able to provide up to 2000 GPM without compromising optimum treatment, and the sedimentation basin is able to provide 1924 GPM before optimum treatment is compromised, both of which are well above the peak flow rate of 1400 GPM.

2. The filtration stage was evaluated against a filtration rate of 5.0 GPM/FT^2 (typical of relatively shallow bed depth multi-media filters) and was found to be capable of providing optimized treatment at treatment plant flow rates up to 1440 GPM. That observation plus the previous observation can be interpreted that all three of the major unit processes (not including disinfection) participate in the optimization of treatment through particulate and pathogenic organism removal.

3. Data generated by the filtered water turbidity profile after backwashing the filter shows that the filter is able to meet the minimum treatment levels (0.5 NTU) for filtered water after a few minutes following the conclusion of the backwash cycle. However, the filters were not able to meet the health goal of 0.1 NTU until 45 minutes or more into the filter run. Turbidity grab samples were collected and recorded for at least 45 minutes after the backwash cycle concluded, and the effluent turbidity values reached a peak at the outset and decreased sharply at first before leveling out.

4. The amount of disinfection contact time available between the filter effluent and the first user on the transmission line is just barely enough to meet at least a 0.5-log reduction of *Giardia lamblia* through disinfection at all times. In this case, the first user was assumed <u>not</u> to be the rock quarry. More contact time could be made available to the City if the reservoirs at the treatment plant were piped to be used in series with each other and the transmission line.

As a result of the CPE findings, the Health Division has the following comments and recommendations:

1. The reservoir piping configuration should be modified to provide the greatest amount of available disinfection contact time. Once done, a tracer study should be done to determine the amount of actual contact time available. The study could include the transmission line as well. From this information, actual "CT" values can be calculated and then compared to required "CT" values.

2. After surveying the results of the major unit process evaluations, the Division concludes that the treatment plant operates as a conventional treatment plant. That is, the flocculation and sedimentation basins as well as the filters contribute to the optimization of the treatment process.

3. The turbidity profile data indicates that the treatment plant is capable of providing turbidity removal that would meet the minimum treatment standards (0.5 NTU) but may have some occasional difficulty meeting the health goals for optimum treatment standards (0.1 NTU). Even so, the level of operator expertise and the amount of time devoted to the treatment plant are two reasons why the plant produces such high quality drinking water.

4. As a result of this report, the treatment plant is credited with a 2.5-log reduction of particulate matter. The disinfection process is estimated to be capable of 0.53-log reduction. Overall, a 3.0-log reduction is required for the entire process (treatment plus disinfection). As a result, the treatment plant can currently achieve a 3.03-log reduction. Therefore, the City should meet both the turbidity standard and the "CT" requirements at all times and thus be in compliance with the surface water treatment technique requirements.

Again, I wish to thank you for assisting us in the evaluation. If you have any questions or would request that our office respond to questions about the evaluation from either the City Council or the public at large in a future meeting, please contact me to arrange a date.

Sincerely,

Michael W. Grimm

Michael W. Grimm, P.E.
Regional Manager
Drinking Water Section

enc.

cc: Jim Buckley, R.S.; Clackamas County Health Dept.

COMPREHENSIVE PERFORMANCE EVALUATION (CPE)

Name of Water System: CITY OF MOLALLA PWS#: 4100534
Date Conducted: APRIL 23, 1993
Persons Conducting CPE: MICHAEL W. GRIMM
MICHAEL WHITELEY
Operating Flow: 2.02 mgd (1400 GPM)
Maximum Hydraulic Capacity 2.02 mgd (1400 GPM)

Narrative:

- A COMPREHENSIVE PERFORMANCE EVALUATION (CPE) WAS CONDUCTED ON THE MOLALLA WATER TREATMENT PLANT. THE MAJOR UNIT PROCESSES WERE EVALUATED INDEPENDENTLY AND COMPARED TO TYPICAL ENGINEERING DESIGN STANDARDS (EPA OPTIMIZED TREATMENT GUIDANCE MANUAL, AWWA/ASCE WATER TREATMENT PLANT DESIGN). IN ADDITION, A PERFORMANCE POTENTIAL GRAPH WAS COMPILED FROM THE EVALUATION RESULTS (SEE FOLLOWING PAGE). A FILTERED WATER TURBIDITY PROFILE WAS ALSO CONDUCTED FOLLOWING A BACKWASH CYCLE. OPERATING FLOW WAS BASED ON PLANT DESIGN.

- THE RESULTS OF THE MAJOR UNIT PROCESS EVALUATION ARE AS FOLLOWS:

  1.) THE FLOCCULATION BASIN WAS FOUND TO BE OPERATING AT FLOWS FAR BELOW THE OPTIMIZED TREATMENT CAPACITY BASED ON THE SIZE OF THE UNIT. AS A TYPE I UNIT, THE FLOCCULATION BASIN SHOULD BE CAPABLE OF OPTIMIZED TREATMENT ABOVE THE PEAK DEMAND FLOW.

  2.) THE SEDIMENTATION BASIN WAS ALSO FOUND TO BE CAPABLE OF OPTIMIZED TREATMENT AT FLOWS EXCEEDING THE PEAK DEMAND.

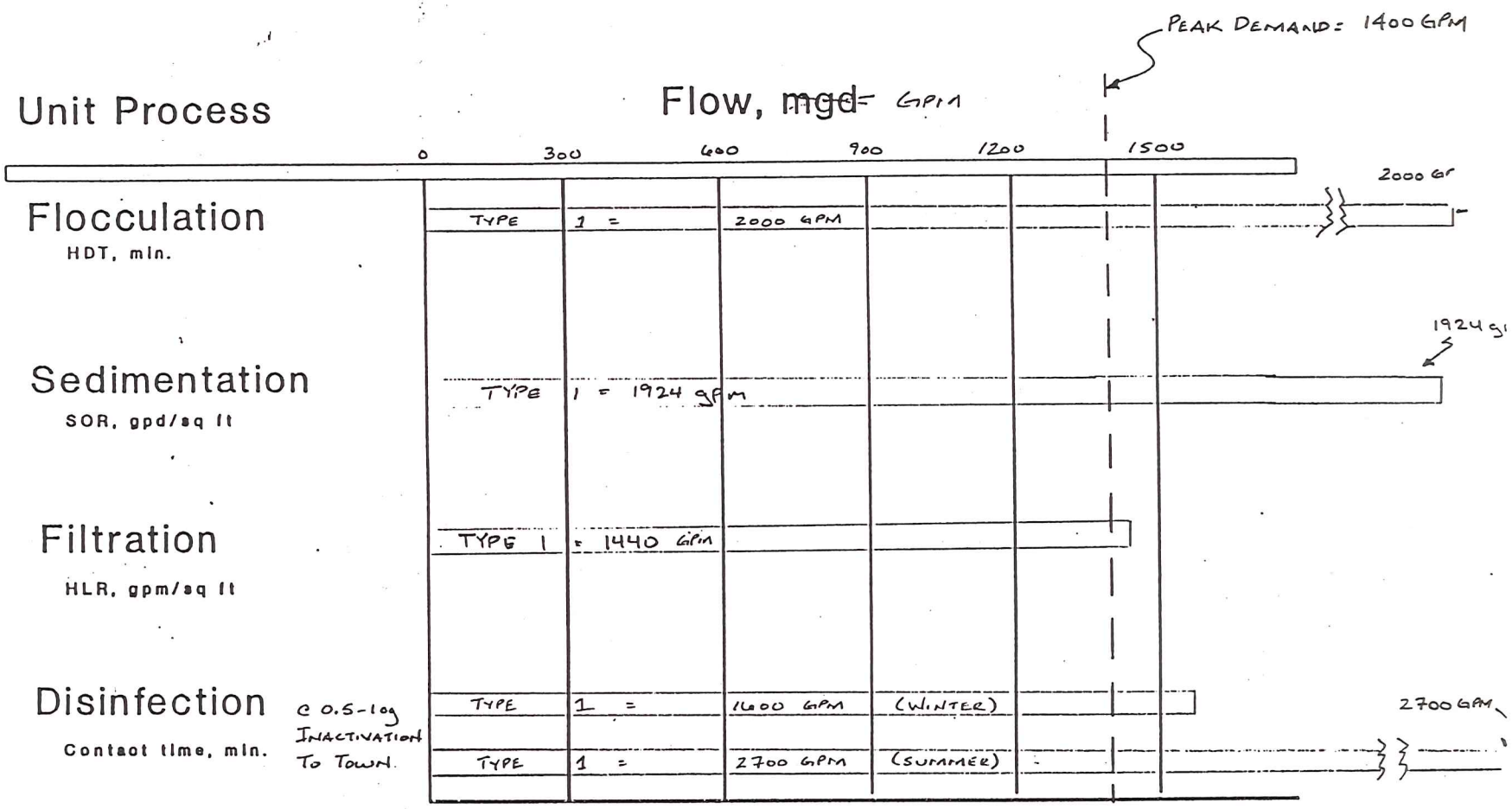
  3.) THE FILTRATION PROCESS AGAIN WAS EVALUATED AS A TYPE 1 UNIT.

  4.) THE DISINFECTION UNIT WAS RATED ASSUMING THE RESERVOIR IS USED FOR CONTACT TIME. IF THE RESERVOIR IS USED FOR CONTACT TIME, THE PROCESS COULD BE RATED AS A TYPE 2 UNIT.

- OVERALL, THE CITY MUST BE ABLE TO PROVIDE 3.0-log (99.9%) REDUCTION OF GIARDIA CYSTS BY JUNE 29, 1993 FROM THE FILTRATION SYSTEM AND DISINFECTION (CHLORINATION). THE PLANT IN ITS CURRENT OPERATING CONDITION SEEM CAPABLE OF MEETING THE FULL 3.0-log REDUCTION.

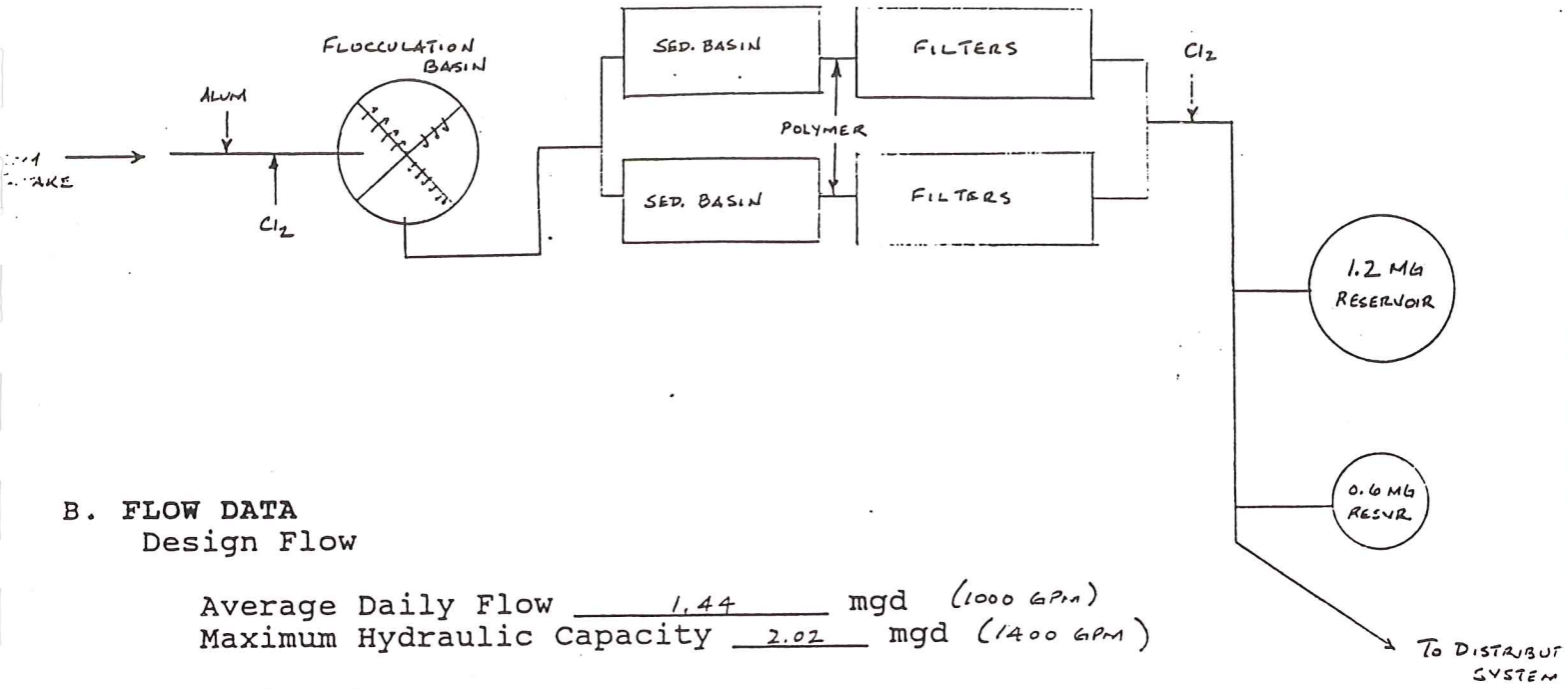
RESULTS = 2.5 - log CREDIT FOR THE TREATMENT PLANT.
0.57 - log CREDIT FOR DISINFECTION
3.07 - log TOTAL CREDIT (> 3.0-log REQUIRED LEVEL)

Performance Potential Graph



DESIGN DATA

A. PLANT FLOW DIAGRAM



B. FLOW DATA

Design Flow

Average Daily Flow 1.44 mgd (1000 GPM)
Maximum Hydraulic Capacity 2.02 mgd (1400 GPM)

Operating Flow

Peak Instantaneous Operating Flow 2.02 mgd (1400 GPM)

C. UNIT PROCESSES

Flow Stream Measured	Meter Type	Calibration Frequency	Comments
Raw Water:	McCROMETER	NONE	
Finished Water:	McCROMETER	NONE	
Backwash:	McCROMETER	NONE	
Backwash Recycle:			
Other (designate):			

DESIGN DATA

UNIT PROCESSES (cont.)

RAPID MIX

Rapid Mix:

Type
(mechanical, inline mechanical, (inline static))

Number of Mixers 1 Water Depth —
Number of Basins — Surface Dimensions —
Horsepower — Total Volume — gallons

Flow:

Theoretical — mgd Operating 2.02 mgd (1400 GPM)

Detention Time:

Theoretical — ~~mgd~~ Operating — ~~mgd~~

G Value

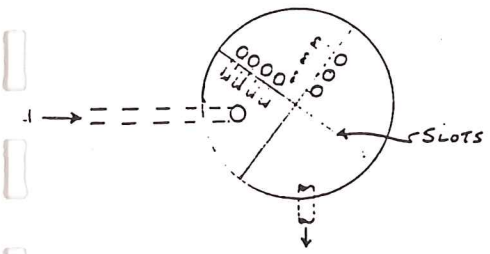
Theoretical — mgd Operating — mgd

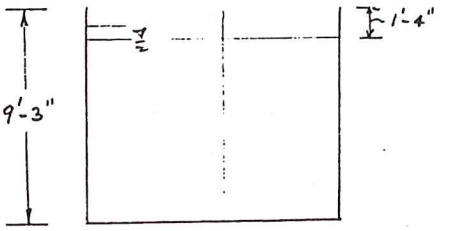
Operating Problems: NONE

COAGULATION / FLOCCULATION

Flocculation:

Type (e.g., paddle wheel, turbine, hydraulic) HYDRAULIC (BAFFLED CHAMBERS)
Control (e.g. constant speed or variable speed) —
High Temp. 20°C Low Temp. 4° C High pH 7.3 Low pH 6.7
Stages (sketch below)





$V = \frac{\pi}{4} D^2 \cdot H$
$= \frac{\pi}{4}(2 \times 11'-9")^2 \cdot (9'-3")$
$= 4000\ FT^3$
$= 30{,}000\ GALLONS$

STAGE/BASIN	SURFACE DIMENSIONS	DEPTH	VOLUME	HORSEPOWER	G VALUE
1	QUARTERED SECTIONS WITH AN 11'9" RADIUS	9'-3" - 1'-4" TO WATER	= 4000 FT³	= 30,000 GAL.	—
2					
3					
Total				30,000 GALLONS	

Flow: (2000 GPM)
Theoretical 2.88 MGD Operating 2.02 MGD (1400 GPM)
Detention Time:
Theoretical 15 ~~MGD~~ MIN. Operating 21 ~~MGD~~ MIN.

Calculations/Assumptions: THE THEORETICAL DETENTION TIME WAS DETERMINED WITH FACTORS SUCH AS LOW RAW WATER TURBIDITY, LOW T.D.S, AND FAIRLY NEUTRAL pH DICTATING A LOWER DETENTION TIME AND RELATIVELY COOL WATER DICTATING A SLIGHTLY HIGHER DETENTION TIME FROM

DESIGN DATA

C. UNIT PROCESSES (cont.)

SEDIMENTATION

Sedimentation Basins:
Type: ___ Conventional ✓ Tube Settlers ___ Upflow Clarifiers 284.8 #

Number of Basins 2 Surface Dimensions 11'2" x 25'6" / per sed. basin
Water Depth (shallowest) 5'6" ft. (deepest) 8' ft.
Weir Location ON THE SIDES AND IN THE MIDDLE
Weir Length 24' ft. (both filters together)
Total Surface Area 1285 ft2 Total Volume 4,349.28 ft3
Total Volume 32,618 ~~mg~~ gallons
569.7 #

Flow:

Theoretical 2.77 mgd (1924 gpm) Operating 2.016 mgd (1400 gpm)

Detention Time:

Theoretical 17.0 ~~hr~~ min. Operating 23.3 ~~hr~~ min.

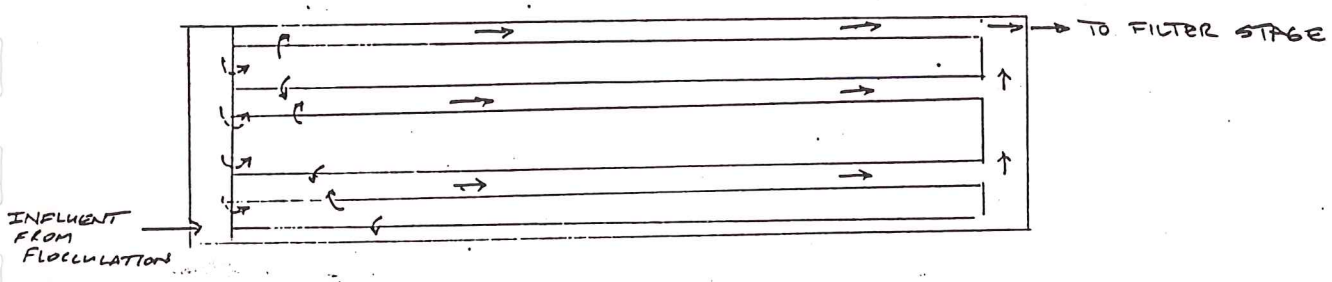
Weir Overflow Rate:

Theoretical 6.7 gpm/ft Operating 4.86 gpm/ft

Surface Settling Rate: 2.46

Theoretical 1.5 gpm/ft2 Operating ~~1,09~~ gpm/ft2

Inlet Conditions (Describe and/or sketch)



ONE OF TWO SEDIMENTATION BASINS

COMMENTS:
~~Operating Problems~~:

SURFACE SETTLING RATE WAS ASSESED AT 1.5 gpm/ft.^{2}. SHALLOW BASIN (< 10 FT.)

DESIGN DATA

C. UNIT PROCESSES (cont.)

SEDIMENTATION

Sedimentation Basins:
Type: ___ Conventional ✓ Tube Settlers ___ Upflow Clarifiers 284.8 #

Number of Basins 2 Surface Dimensions 11'2" x 25'6" / per sed. basin
Water Depth (shallowest) 5'6" ft. (deepest) 8' ft.
Weir Location ON THE SIDES AND IN THE MIDDLE
Weir Length 24' ft. (both filters together)
Total Surface Area ~~1285~~ 569.7 # ft2 Total Volume 4,349.28 ft3
Total Volume 32,618 ~~mg~~ gallons

Flow:

Theoretical 2.77 mgd (1924 gpm) Operating 2.016 mgd (1400 gpm)

Detention Time:

Theoretical 17.0 ~~hr~~ min. Operating 23.3 ~~hr~~ min.

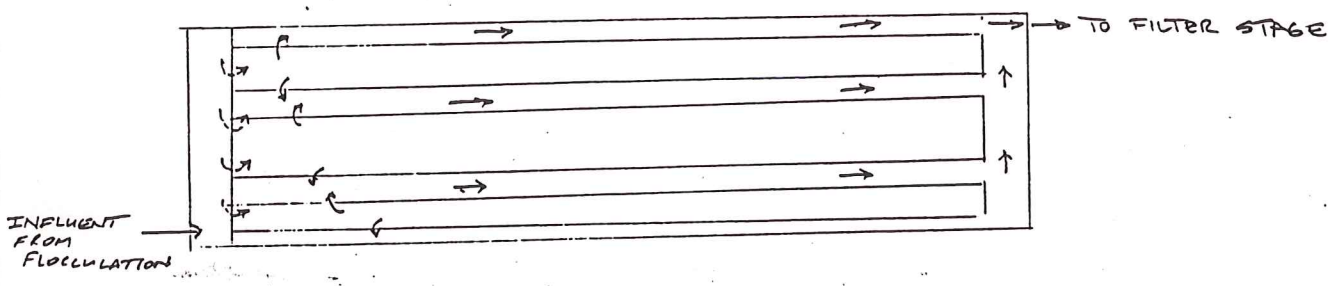
Weir Overflow Rate:

Theoretical 6.7 gpm/ft Operating 4.86 gpm/ft

Surface Settling Rate:

Theoretical 1.5 gpm/ft2 Operating ~~1.09~~ 2.46 gpm/ft2

Inlet Conditions (Describe and/or sketch)



ONE OF TWO SEDIMENTATION BASINS

COMMENTS:
~~Operating Problems~~:

SURFACE SETTLING RATE WAS ASSESED AT 1.5 gpm/ft.^{2}. SHALLOW BASIN (< 10 FT.)

DESIGN DATA

C. UNIT PROCESSES (cont.)

FILTRATION

Type of Filters (sand, ~~mixed media~~, dual media, pressure gravity, etc.)

Number of Filters 2 Surface Dimensions 9' x 16' each

Media Charachteristics:

MEDIA TYPE	DEPTH	EFFECTIVE SIZE	SPECIFIC GRAVITY
ANTHRACITE	18"		
SILICA SAND	10"		
GARNET	6"		
GRAVEL	20"		

Total Surface Area 288 ft2 (both filters combined)

Filtration Rate:

Theoretical 5.0 (1440 gpm/ft²) gpm/ft2 Operating 4.86 (1400 gpm/ft²) gpm/ft2

Filter Control (e.g., constant rate, declining rate, constant level)

Avaliable Headloss _____ ft.

Surface Wash:

Type (e.g., rotary, fixed, manual)
Water Flow Rate _____ gpm Surface Wash Rate _____ gpm
Duration (Operating) 6 1/2 min

Backwash:

Water Wash Rate:
Theoretical 15-20 gpm/ft2 Operating 6.17 gpm/ft2

Duration:
Theoretical 10-15 ~~gpm/ft2~~ min. Operating 9 ~~gpm/ft2~~ min.

Air Wash Rate:
Theoretical _____ scfm/ft2 Operating scfm?ft2

Control/Operating Problems:

	Yes	No		Yes	No
Mud Balls		✓	Hydraulic Loading		✓
Dirty Media			Air Bubbles		
Uneven Media		✓	Surface Wash Control		
Backwash Rate Gradual	✓		Filter Rate Control		

Comments:

16,000 gallons used to do the backwash in 9 minutes = 1778 gpm

Total surface area = 288 ft² ∴ Water wash rate = 6.17 gpm/ft².

DESIGN DATA

C. UNIT PROCESSES (cont.)

DISINFECTION

Contact Basin(s) (e.g. clearwell):

BASIN NO.	SURFACE DIMENSIONS	~~DEPTH~~	VOLUME	CHANNEL LENGTH TO WIDTH	THEORETICAL AVAILABLE EFFECTIVE CONTACT VOLUME
LINE TO RESERVOIRS	200 FT OF 14" LINE	214 FT^3 =	1600 GAL.		
LINE TO ROCK QUARRY	500 FT. OF 18" LINE	884 FT^3 =	6600 GAL.		
FROM QUARRY TO TOWN	5000 FT OF 14" LINE	5300 FT^3 =	40,000 GAL		
	Total Volume		48,200 GAL		48,200 GAL *
					8,200 GAL **

Chlorinator(s):
No. of Chlorinators 2 Capacity 50 lbs/day (POST)
Flow Proportioned ? YES 10 lbs/day (PRE)

Feed Rate:
Design _____ Operating _____

Flow:
Design _____ Operating _____

Dosage:
Design _____ Operating _____

Operating Problems:
* CONTACT TIME TO TOWN ; ** CONTACT TIME TO ROCK QUARRY

Calculating approximate CT:

maximum pH WINTER = 7.5 / SUMMER = 7.0 minimum temp. WINTER = 5°C / SUMMER = 10°C

maximum free Cl2 residual W = 1.0 / S = 0.7 expected log removal of plant 2.5

Required CT using above assumptions WINTER = 30 / SUMMER = 12

Has a tracer study been done ? No

If yes, what was the T10 ? — (min.)

If no, what is the estimated theoretical contact time ? * 34 MIN. / ** 5 MIN (min.)

Contact time required = $\frac{\text{Required CT}}{\text{Maximum Chlorine Residual}} = \frac{30}{1.0} = 30$ MIN. (WINTER)
$= \frac{12}{0.7} = 18$ MIN. (SUMMER)

Contact time required = WINTER = 30 / SUMMER = 18 minutes

Theoretical flow = $\frac{\text{Theoretical volume}}{\text{Contact time required}} = \frac{48,200 \text{ GAL}}{30 \text{ MIN.}} = 1600$ GPM (WINTER)
$= \frac{48,200 \text{ GAL}}{18 \text{ MIN.}} = 2700$ GPM (SUMMER)

Theoretical flow = 1600 gpm 2.31 mgd
2700 GPM = 3.86 MGD

INACTIVATION RATE = $\frac{\text{ACTUAL CT}}{CT_{99.9}} \times 3$ (ASSUME WINTER CONDITIONS)

Comments:
1) I.R. = (1.0 mg/l)(5 MIN) ÷ (179) x 3 = 0.08 -log TO ROCK QUARRY W/OUT RESVRS.
2) I.R. = (1.0 mg/l)(34 MIN) ÷ (179) x 3 = 0.57 -log TO "1ST USER" IN TOWN W/OUT RESVRS.
3) I.R. = (1.0 mg/l)(5 + 128 MIN) ÷ (179) x 3 = 2.23 -log TO ROCK QUARRY W/ UNBAFFLED RESVRS
4) I.R. = (1.0 mg/l)(34 + 128 MIN.) ÷ (179) x 3 = 2.72 -log TO "1ST USER IN TOWN W/ UNBAFFLED ".

DESIGN DATA

CHEMICAL FEED CAPABILITY

Coagulant Aids:

TYPE	DESIGN FEED RANGE	OPERATING FLOW (mgd) min.	OPERATING FLOW (mgd) max.	DESIGN DOSAGE (mg/l) min.	DESIGN DOSAGE (mg/l) max.
ALUM	30-50 lbs/day				

Polymers:

TYPE	PURPOSE	DESIGN FEED RANGE (GPH)	OPERATING FLOW (mgd)	DESIGN DOSAGE
8102 (POLYMER)	FILTER AID			

Dosage Control (describe):
VARIABLE SPEED & STROKE PUMPS

Operating Problems:

Conc./Pump Calibration Test:

Stabilization Chemicals:
Chemicals Used: NONE
Dosage Control (describe):

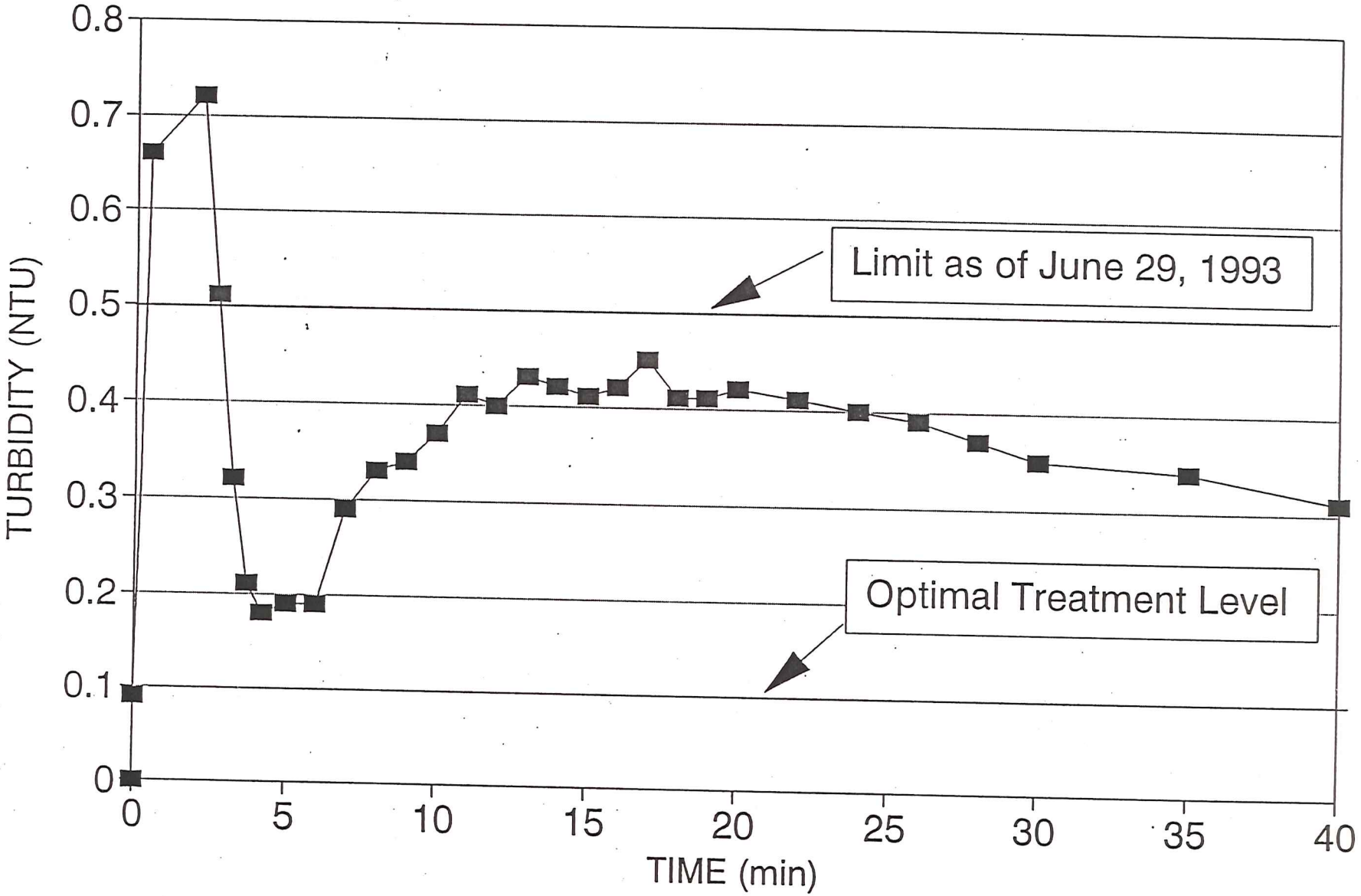
Operating Problems:

Fluoride:
Fluoride Compound Used: NONE
Dosage (Operating) _____ mg/l
Comments:

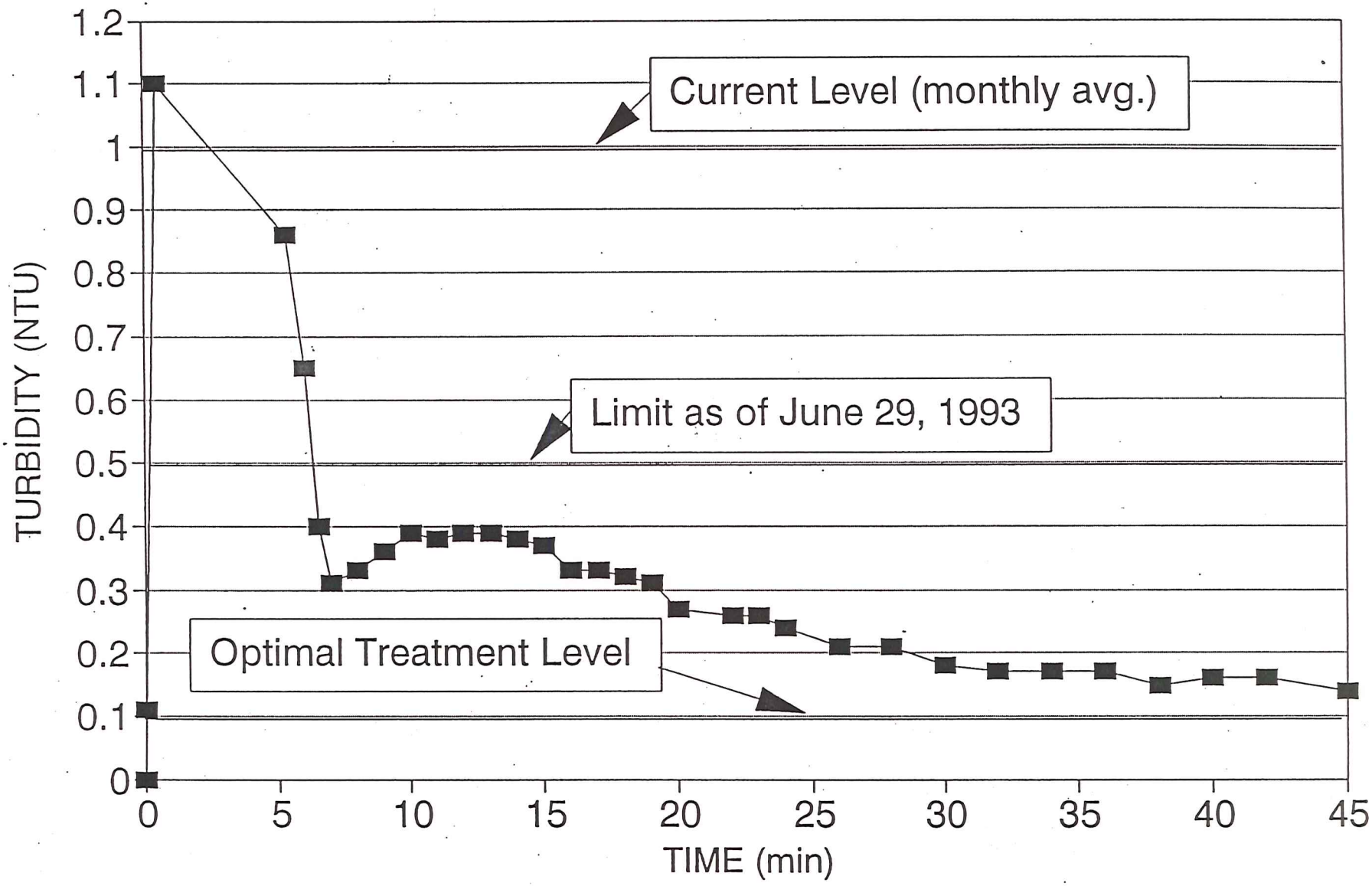
Softening:
Chemicals Used: NONE
Dosage Control (describe): _____

Operating Problems:

FILTER EFFLUENT TURBIDITY
MOLALLA FILTER #1



FILTER EFFLUENT TURBIDITY
MOLALLA FILTER #2



TEST DATA

A. TURBIDITY CHECKS AFTER BACKWASH:

Run # FILTER #1

Elapsed Time Before Backwash	Reading (NTU)
0:00	0.04
0:30	0.09
2:15	0.66
2:45	0.72
3:15	0.51
3:45	0.32
4:15	0.21
5:00	0.18
6:00	0.19
7:00	0.19
8:00	0.29
9:00	0.33
10:00	0.34
11:00	0.37
12:00	0.41
13:00	0.40
14:00	0.43
15:00	0.42
16:00	0.41
17:00	0.42
18:00	0.45
19:00	0.41
20:00	0.41
22:00	0.42
24:00	0.41
26:00	0.40
28:00	0.39
30:00	0.37
35:00	0.35
40:00	0.34
	0.31

Run # FILTER #2

Elapsed Time Before Backwash	Reading (NTU)
0:00	0.05
0:30	0.11
5:30	1.1
6:00	0.86
6:30	0.65
7:00	0.40
8:00	0.31
9:00	0.33
10:00	0.36
11:00	0.39
12:00	0.38
13:00	0.39
14:00	0.39
15:00	0.38
16:00	0.37
17:00	0.33
18:00	0.33
19:00	0.32
20:00	0.31
22:00	0.27
23:00	0.26
24:00	0.26
26:00	0.24
28:00	0.21
30:00	0.21
32:00	0.18
34:00	0.17
36:00	0.17
38:00	0.17
40:00	0.15
42:00	0.16
45:00	0.16
	0.14

Comments:

- COMBINED FILTER EFFLUENT BEFORE BACKWASH CYCLE = 0.064 NTU (FROM IN-LINE TURBIDIMETER) AND 0.06 NTU